Wireless Spectrum R & D Project Inventory
(As of 2/1/2013)

Disclaimer: The work of the Wireless Spectrum R&D subgroup is ongoing. While the content of this document is suitable for public dissemination, all material is preliminary in nature and subject to revision. Nothing in the text should be construed as a commitment by the Federal government or any specific Federal agency to participate in or fund any particular line of research or development.

							Category	**Testing**			**Modeling and simulation**			**Methods and processes that engender efficient spectrum use**					**Technological development that enables efficient spectrum use**						**Education and Outreach**	**Policy and regulation**		**Security**	**Integration w/Internet or other infrastructure**	**Integrations across multiple warfighting functions**						**Funding**		
AGENCY	DEPARTMENT/ DIVISION /LAB/ PROGRAM/ AWARD	Project #	PROJECT TITLE/DESCRIPTION	EXAMPLES	INTENDED APPLICATION ENVIRONMENT (See Attachment C for examples)	EXPECTED FREQUENCY RANGE	**Topic Area**	Topic # 3	Topic # 23	Topic # 19	Topic # 6	Topic # 15	Topic # 7	Topic # 1	Topic # 14	Topic # 11	Topic # 4	Topic # 13	Topic # 16	Topic # 2	Topic # 21	Topic # 22	Topic # 12	Topic # 8	Topic # 5	Topic # 9	Topic # 18	Topic # 17	Topic # 10	Topic # 20	**Maturity**	Basic Research	Applied Research	Advanced Technology Development	Advanced Component Development	Demonstration & Validation		Funded in Past (2006-2010)	Presently Funded (FY11)
DHS	DHS S&T	3.004	Vidio Quality in Public Safety					1																													
DHS	DHS S&T	3.005	Wireless Broadband Technology					1																									X				X	X
DHS	DHS S&T	16.001	Multiband Radio Pilots																1														X				X	X
DOC	NIST	1.005	Coexistence in the unlicensed bands	Development and evaluation of coexistence mechanisms including collaborative and non-collaborative schemes										1																		X						
DOC	NIST	1.007	Seamless and secure mobility	Development of cross-layer techniques for using and sharing measured radio signal quality to adapting the network behavior										1																		X						
DOC	NIST	6.004	Seamless and secure mobility	Development of an evaluation platform to accurately assess and manage the performance and security characteristics of network mobility protocols and the use of multiple technologies							1																					X						
DOC	NIST	6.005	Performance analysis of communication technologies for public safety communications	Development of modeling and performance analysis tools and assessments for characterizing the performance of network technologies used for public safety applications							1																					X			X			
DOC	NIST	6.006	Performance analysis of wireless communications for Smart Grid applications	Development of guidelines for assessing the performance of wireless communications							1																					X						
DOC	NIST	6.007	Coexistence in the unlicensed bands	Development of methods and tools for quantifying the effects of interference on network performance and characterizing the performance of interference mitigation techniques							1																					X						
DOC	NIST	11.002	Performance analysis of communication technologies for public safety communications	Investigation of frequency allocation reuse and interference mitigation techniques to increase coverage and capacity												1																X						
DOC	NIST	11.003	Performance analysis of wireless communications for Smart Grid applications	Investigation of frequency allocation reuse and interference mitigation techniques to increase coverage and capacity												1																X						
DOC	NIST	15.013	Implant communications in Body Area Networks	Development of channel propagation models for implant communications. Assessment of interference and interference mitigation techniques								1																				X						
DOC	NIST	15.014	700MHz band channel propagation model	Development of propagation models based on measurement campaigns in different urban and suburban environments								1																							X				
DOC	NIST	15.015	RFID Interference Measurement	Quantifying the effects of interference on RFID device performance								1																								X			
DOC	NIST	15.016	Performance analysis of wireless communications for Smart Grid applications	Development of signal propagation models for Smart Grid operation environments								1																				X						
DOC	NIST	15.017	Mine mesh networks	Performance evaluation of network technologies for emergency mine communications; development of signal propagation models in mine communications								1																				X						
DOC	NIST	14.005	Laboratory-Based Test Methods for System-Level Tests of Wireless Devices.	Free-field, lab-based test methods that allow characterization of digitally modulated wireless devices in terms of spectrum efficiency, antenna performance, and interference. Includes methods for multiple antenna and frequency agile systems	Terrestrial	1 GHz - 140 GHz									1																		X	X			X		X	X
DOC	NIST	15.020	Measurement Methods for Digitally Modulated Signals at Millimeter-wave Frequencies.	Develop measurement science for digitally modulated signals at frequencies in the newly allocated 70, 80, and 90 GHz frequency bands. Work includes generation of modulated signals, traceability for received signal measurements.	Terrestrial	60 GHz - 140 GHz						1																				X	X			X			X

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DOC	NIST	15.021	Radio Propagation Measurements to Support Improved Public-Safety Radio Communication.	Collect measured field-test data on relevant channel characteristics in representative emergency responder radio environments, with a particular focus on challenging radio frequency propagation environments such as high-rises, convention centers, factories, and refineries. These data are used to develop and validate radio propagation and signal-strength models for frequency ranges for 50 MHz to 5 GHz.	Terrestrial	400 MHz - 5 GHz						1																				x	x			x		x	x
DOC	NIST	19.004	Laboratory-Based Test Methods for System-Level Tests of Wireless Devices.	Free-field, lab-based test beds that allow measurement of digitally modulated wireless devices in terms of spectrum efficiency, antenna performance, and interference. Includes methods for multiple antenna systems (e.g., diversity, beam forming, and MIMO technology) and frequency agile systems, Includes the design of scientifically sound measurement techniques specific to laboratory test environments that include dynamic combinations of electromagnetic reverberation chambers, wireless channel emulators, and anechoic chambers.	Terrestrial	1 GHz - 140 GHz				1																							x	x			x		x	x
DOC	NIST	22.001	RFID Interference Measurement	Development of measurements methods for quantifying the effects of interference																		1														x			
DOC	NIST	22.006	Test Methods for Software-defined and Cognitive Radio Technology	Develop lab-based test methods to assess next-generation developments in smart radio hardware.	Terrestrial	900 MHz - 5 GHz																1										x	x			x		x	x
DOC	NIST	22.007	Laboratory-Based Test Methods for System-Level Tests of Wireless Devices.	Free-field, lab-based test beds that allow measurement of digitally modulated wireless devices in terms of spectrum efficiency, antenna performance, and interference. Includes methods for multiple antenna systems (e.g., diversity, beam forming, and MIMO technology) and frequency agile systems, Includes the design of scientifically sound measurement techniques specific to laboratory test environments that include dynamic combinations of electromagnetic reverberation chambers, wireless channel emulators, and anechoic chambers.	Terrestrial	1 GHz - 140 GHz																		1										x	x			x		x	x
DOC	NIST	3.034	Laboratory-Based Test Methods for System-Level Tests of Wireless Devices.	Free-field, lab-based test beds that allow measurement of digitally modulated wireless devices in terms of spectrum efficiency, antenna performance, and interference. Includes methods for multiple antenna systems (e.g., diversity, beam forming, and MIMO technology) and frequency agile systems, Includes the design of scientifically sound measurement techniques specific to laboratory test environments that include dynamic combinations of electromagnetic reverberation chambers, wireless channel emulators, and anechoic chambers.	Terrestrial	400 MHz - 140 GHz		1																									x	x			x		x	x
DOC	NTIA	1.003	Dynamic Frequency Selection (DFS) Development and Support.	Provided scientific basis for DFS rules that allow DFS U-NII wireless networks to share radar bands on an interference sufferance basis. Continue to support the FCC and other Federal agencies with ongoing conformity assessment and troubleshooting of interference to radars from DFS devices.	Terrestrial, Maritime	5250-5350 5470-5725 MHz								1																				x			x		x	x
DOC	NTIA	1.009	Ultrawideband (UWB) Research, Development, and Support	Provided scientific basis for UWB rules that allow underlay (low power density) wireless devices to share spectrum across a number of frequency bands (e.g., GPS, sat TV, Amateur, PCS, DARS)	Terrestrial	3.1 - 10 GHz								1																			x	x			x		x	
DOC	NTIA	3.001	Dynamic Spectrum Access (DSA) Test Bed	Examining the ability of DSA devices (employing spectrum sensing and geo-location) to share with land mobile radio systems	Terrestrial	410-420 470-512 MHz		1																								x			x		x	x
DOC	NTIA	3.002	Interference Test-Bed. Computer-controlled system to perform conducted interference tests.	System is comprised of the following modular components: desired signal source, undesired signal source, victim reciever, and signal measurement. Has been used to measure UWB interference effects on GPS, C-band satellite television, and LMR receivers, DFS effects on radar, and DSA effects on LMR.	All	All		1																								x	x			x		x	x
DOC	NTIA	6.003	Simulation/modeling of aggregate DFS interference to radar	See NTIA Tech. Memo. 09-461	Terrestrial, Maritime	5 GHz					1																					x						x	x

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DOC	NTIA	6.008	Effects of the Channel on Radio Systems	Measurements and statistical models to describe intentional desired/undesired signals, man-made noise, propagation effects, etc. and utilization of those models in analytic, quasi-analytic, and simulation to predict error performance of digital radio systems	All	All					1																				X	X					X	X
DOC	NTIA	14.002	Spectrum measurement/survey/visualization techniques and standards	NTIA's spectrum survey system that was used for surveys back in the 1990s has been updated using modern spectrum analyzers. System will be operational by Summer 2011. See NTIA Report 97-336 for sample of past work products.	Aeronautical, Maritime, Terrestrial	100 MHz - 10 GHz									1																				X			X
DOC	NTIA	14.003	Radar EMC studies for FAA, USCG, DoD	Quantitative definition of harmful interference (Interference to Noise ratio) for a variety of radar systems. See NTIA Technical Report TR-06-444	Aeronautical, Maritime, Terrestrial	1200 MHz to 5 GHz									1																		X				X	X
DOC	NTIA	14.004	Receiver - Interference Protection Criteria	NTIA Report 05-432 - Interference Protection Criteria	Various	Various									1																X					X	
DOC	NTIA	15.012	Models to evaluate interference to incumbents	Development of short-range propagation model	Terrestrial, Aeronautical, Maritime	Various						1																				X					X	X
DOC	NTIA	4.001	Development and storage of statistical data on spectrum use	Spectrum survey system is going through final validation. Post-processed data can be made available for electronic distribution.	Aeronautical, Maritime, Terrestrial	100 MHz - 10 GHz											1																X					
DOC	NTIA	5.003	International Symposium for Advanced Radio Technologies (ISART)	The topic of ISART 2010 was spectrum sharing technologies. Leading minds from academia, government, and industry converged to discuss and debate overarching topics such as spectrum occupancy measurements, interference protection criteria, sharing government bands (e.g., radar, LMR), business models, context awareness, and research.	All	All																		1								X	X	X	X	X		X	X
DOC	NTIA/ITS and NTIA/OSM	1.001	Dynamic Spectrum Access (DSA)	Spectrum Sharing Innovation Test-bed which is investigating DSA sharing with LMRs.	Terrestrial	410-420 MHz								1																							X	X
DoD	AF/AFRL	1.023	Cognitve Nodes & Cognitve Networking	Define the requirements and interfaces amongst the major software components of a standardized cognitive radio architecture, enabling HW & SW vendors to develop to common interfaces, architecture and performance expectations										1																		X	X					X	X
DoD	AF/AFRL	3.006	Wireless networking protocols and communications technologies for small UAS	Wireless networking protocols and communications technologies for small UAS will develop accurate characterization of live airborne and mobile communication links, while establishing an enhanced emulation environment and UAS network protocols.				1																								X	X					X	X
DoD	AF/AFRL	10.001	Assured Access Anti jam Communications	Create a dynamically reconfigurable network communications fabric that allocates and manages system resources so as to satisfy multiple, often conflicting, mission-dependent design optimization constraints.																									1			X	X					X	X
DoD	AF/AFRL	11.001	Cognitve Nodes & Cognitve Networking	Define the requirements and interfaces amongst the major software components of a standardized cognitive radio architecture, enabling HW & SW vendors to develop to common interfaces, architecture and performance expectations												1																X	X					X	X
DoD	AF/AFRL	12.001	Advanced MIMO	Conformal antenna Design, Fabrication, and Testing on Aerial Layer Platforms																				1								X	X					X	X
DoD	AF/AFRL	13.001	V/W band power amplifier development															1																				X
DoD	AF/AFRL	15.001	Conducting Dynamic Spectrum Access experiments using small UAS and DARPA XG sensors	Conducting Dynamic Spectrum Access experiments using small UAS (UAS) and DARPA XG sensors to collect position-stamped spectral data in order to gain an understanding of the 3-D nature of the spectral environment								1																						X	X				X
DoD	AF/AFRL	16.002	Cognitve Nodes & Cognitve Networking	Define the requirements and interfaces amongst the major software components of a standardized cognitive radio architecture, enabling HW & SW vendors to develop to common interfaces, architecture and performance expectations															1													X	X					X	X
DoD	AF/AFRL	16.003	Assured Access Anti jam Communications	Create a dynamically reconfigurable network communications fabric that allocates and manages system resources so as to satisfy multiple, often conflicting, mission-dependent design optimization constraints.															1													X	X					X	X

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DoD	AF/AFRL	16.004	Wireless networking protocols and communications technologies for small UAS	Wireless networking protocols and communications technologies for small UAS while establishing an enhanced emulation environment and UAS network protocols- develop accurate characterization of live airborne and mobile communication links,															1														X	X					X	X
DoD	AF/AFRL	20.001	Joint Cognitve Routing & Spectrum Allocation																										1		X	X						
DoD	AF/AFRL	20.002	Wireless networking protocols and communications technologies for small UAS	Wireless networking protocols and communications technologies for small UAS - develop accurate characterization of live airborne and mobile communication links, while establishing an enhanced emulation environment and UAS network protocols.																										1			X	X				X	X
DoD	AF/AFRL	4.003	Understanding the 3D nature of the spectral environment	Conducting Dynamic Spectrum Access experiments using small UAS (UAS) and DARPA XG sensors to collect position-stamped spectral data in order to gain an understanding of the 3-D nature of the spectral environment													1																	X	X				X
DoD	AF/AFRL	5.001	Joint Cognitve Routing & Spectrum Allocation																					1							X	X						
DoD	Army/ CERDEC S&TCD	1.109	Enhancement of porting of Dynamic Spectrum Access (DSA) capability into current tactical waveforms	Port core DSA software to tactical Army systems to enable DSA and policy control capabilities in Army tactical communications systems.	Ground, Air									1																					X	X				X
DoD	Army/ CERDEC S&TCD	1.11	DSA Policy Generation Tool	Tool used to manage, generate and validate DSA policies. Includes capabilites to suppor many DSA-enabled radios and technologies such as WNaN, JTRS and other efforts.	Terrestrial									1																					X	X				X	X
DoD	Army/ CERDEC S&TCD	1.111	DSA Coexistence Policy Spectrum Sharing Analysis	Software and algorithms for determination of DSA policy parameters for protection of incumbent receivers. Policy parameters include excluded frequencies, spatial protection contours, temporal policies, sensing parameters (thresholds, sensing period and bandwidths) power limits detection schedules, etc.	Terrestrial									1																					X	X				X	X
DoD	Army/ CERDEC S&TCD	3.025	Cognitive Networking Radio Platform (CNRP)	Cognitive Radio Networking Platform (CNRP) provides the software and hardware to perform over-the-air evaluation of cognitive radio algorithms and technologies. CNRP comprises 64 node GNU Radio / USRP2 radio nodes with a GUI control interface and networking ready	Mostly terrestrial			1																											X		X			X	X
DoD	Army/ CERDEC S&TCD	6.009	Coalition Joint Spectrum Management and Planning Tool (CJSMPT)	CJSMPT provides a means of predicting and deconflicting interference between Counter IED jamming systems and Blue Force communications networks and among Blue Force networks. It supports all phases of the spectrum management process, transforming an ad-hoc, reactive, labor intensive, error-prone process into a coordinated, proactive, automated, accurately computed procedure.	Ground, Air								1																								X	X					
DoD	Army/ CERDEC S&TCD	10.006	Cognitive Networking Technologies Potato	To create, investigate and evaluate a set of advanced Cognitive Networking Technologies to be used in a scalable multi-radio network providing enhanced performance and requiring limited Soldier intervention	All																									1				X					X	X
DoD	Army/ CERDEC S&TCD	12.006	Chaotic Modulation for SATCOM and ground communications SBIRs	Develop and adapt chaotic modulation techniques for satellite communications (SATCOM) systems and tactical communications. Multiple access with potential improvement over code-division multiple access is being investigated.	Satellite and ground																			1											X					
DoD	Army/ CERDEC S&TCD	12.007	MIMO Technology with application to military tactical networks	Provide the Warfighter with the means to significantly increase communication throughput, reliability, and range and improve the anti-jamming and low-probability-of-detection (LPD) capabilities in multipath-rich environments	Terrestrial																			1											X				X	

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DoD	Army/ CERDEC S&TCD	15.018	3-D Urban and Rural Propagation Models	Algorithm for efficient model to predict propagation loss and channel characteristics (e.g. delay spread, Rician k factor) for mountainous/hilly rural environment and urban environment taking into account 3-D lateral scattering and reflections. The objective is more accurate loss prediction as well as prediction of channel characteristics for modeling MIMO and DSA.	Terrestrial								1																									X	X
DoD	Army/ CERDEC S&TCD	15.019	Simulation of Waveform Interactions for Interference Analysis of Military Networks	Develops algorithms and software to determine receiver performance in the presence of interference taking into account the effects of the modulation schemes, power levels, and frequencies of the victim and interferer. This is in contrast to current spectrum management methods that often treat interference as Gaussian noise.	All								1																									X	X
DoD	Army/ CERDEC S&TCD	16.086	Cognitive Aantennas	Develops policy-based aproach to control smart antenna parameters.	All														1																		X	X
DoD	Army/Navy/JSC CERDEC S&TCD/JSC/JTRS	2.039	Measurement-based Spectrum Planning and Management Capability SBIR	Define a measurement-based spectrum management system that monitors and characterizes the Radio Frequency (RF) spectrum that is in use in an Area of Interest. Uses available and emerging infrastructure (e.g. spectrum analyzer, DSA radio) as spectrum sensors. Identifies available spectrum by comparing RF measurements and SXXI database	All															1																			X	
DoD	DARPA	1.025	DARPA Next Generation (XG) program	XG was the first government program to investigate the issues and feasibility of Dynamic Spectrum Access. In th absence of spectrum survey, XG provides a capability for automatic, dynamic and opportunistic access to unused spectrum based upon local RF environments and operational needs; sensing and adapting are not enough - radios must act according to rules. The DARPA WNaN, EPLRS-XF and MAINGATE hardware, as well as PRC-148 and PRC-152 radios, have been upgraded with XG for further evaluation and testing.	Ground	0.2 - 6 GHz								1																									X	X	X		X	
DoD	DARPA	1.027	Behavioral Learning for Adaptive Electronic Warfare (BLADE)	The BLADE program will develop a highly adaptive Electronic Attack system that can rapidly detect and characterize new radio threats, synthesize new countermeasures, and provide accurate EW battle damage assessment in near real time. The goal is to provide enhanced spectrum situational awareness and produce highly efficient and targeted jam waveforms that allow US forces to strategically control the use of the electromagnetic spectrum within an area of interest.	Ground, Air	General								1																									X	X	X	X		X
DoD	DARPA	7.001	Enhanced Position Location Reporting System - eXtended Frequency (EPLRS-XF) Program	Upgrade of Enhanced Position Location Reporting System (EPLRS) with MAINGATE MANET protocol / algorithms and XG Dynamic Spectrum Access.	Ground	225 - 450 MHz.							1																												
DoD	DARPA	7.002	Mobile Ad hoc Information Network GATEway (MAINGATE) Program	MAINGATE is an integrated network radio system that combines a highly mobile, high capacity Internet-like wireless network with a gateway that permits integration of dissimilar US, Coalition and First Responder radios to seamlessly communicate among each other. MAINGATE is capable of disseminating voice, chat, situational awareness,a nd ISR and C2 data dissemination among those forces.	Ground, Air	Gateway: .2-6 GHz; C, X, Ku, Ka-bands --- MANET Radio: 300-450 MHz; 170-216 MHz 470-698 MHz, L,C, X, Ku, Ka-bands								1																									X	X	X		X	X
DoD	DARPA	12.002	DARPA Inteference Multiple Access (DIMA) Program	DIMA program uses Multi-User Detection (MUD) techniques to enable multiple users to simultaneously occupy the same channel, while requiring no power or timing control, for highly efficient communications. This program determined whether multiple user equipment (UE) transmissions could be simultaneously made on the same channel; DIMA demonstrated this by program completions, showing 3-6 times capacity increasee over WCDMA networking.	Ground	.7-6 GHz																			1													X	X			X	

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DoD	DARPA	12.003	Mobile Network MIMO (MNM) Program	MNM investigated MIMO techniques that used multi-path to create independent (parallel) communications channels in the same frequency band, rather than just mitigating the effects of multi-path interference (e.g., rake filtering). This program extended previous commercial work to a mobile, dynamic environment.	Ground	0.8 - 6 GHz																	1																		
DoD	DARPA	12.004	Advanced Wireless Networks for the Soldier (AWNS) Program	This program integrates multiple activities associated with the WNaN radio resulting in a Soldier Information System (SIS). AWNS includes: 1) completion of the WNAN radio hardware, firmware, and networking software, 2) integration of the Soldier Radio Waveform (SRW) for backward interoperability to legacy communication systems; 3) hardware and software interfaces to commercial communication devices; 4) network communication and infrastructure support for the Transformative Applications program, including Wireless Distributed Computing, and Content Based Access, and 5) enhancements to the radio physical layer communications capabilities from the distributed the MNM and DIMA programs into the WNaN radio, as well as the integration of Smart Antenna capabilities.	Ground	0.9 - 6 GHz																			1																		x
DoD	DARPA	13.002	Dyanmic Optica Tag Systems (DOTS)	The DOTs program developed modulating optical tags that are small, thin, and retro-reflecting. The tags will operate for long periods of time (greater than two months) in real-world environmental conditions (-40º to +70ºC) and allow for a wide interrogation angle (±60º). The tags will be passive (in the sleep mode) for most of the time and they will only activate when interrogated by a laser of the correct code. Once correctly interrogated, the tags will begin to modulate and retro-reflect the incoming beam.	Ground, Air	1.94×10^{14} Hz (1.55 µm)												1																								x
DoD	DARPA	13.003	NETEX Program	NETEX investigated military ultra wideband sensors and communications systems. In the area of communications, the program investigated the use of large instanteous bandwidths (> 500 MHz), very little energy per Hz and signal processing to create increased capacity (e.g., more users and more data rate per user) and minimize cosite interference with existing and future RF systems.	Ground, Air	0.3 - 3.5 GHz												1																								x
DoD	DARPA	13.004	Free space Optical Experimental Network Experiment (FOENEX)	FOENEX will develop the requisite technologies and demonstrate 10 Gigabit per second air-to-air & air-to-ground communications networking among 4 air / ground platform separated by ranges ≥ 200 kilometers and > 100 km, respectively, and under high turbulence atmospheric conditions	Ground, Air	1.94×10^{14} Hz (1.55 µm)												1																								x
DoD	DARPA	16.005	DARPA/MTO Adaptive RF Technology (ART) Program	The ART program will advance the development of reconfigurable and tunable RF/microwave filter arrays for high jammer to signal environments (900MHz - 6 GHz), analog spectrum sensor arrays, and waveform-agile reconfigurable RF front-end components.		0.9 - 6 GHz													1																								x
DoD	DARPA	16.006	Wireless Network after Next (WNaN) Program	The goals of WNaN represent a vast leap forward in ground tactical communications with respect to capability, functionality, network reliability, and affordability. WNaN: (1) Employs Dynamic Spectrum Access (DSA) capability; (2) Enhances mobile network connectivity by using Disruption Tolerant Networking (DTN) technology; (3) Implements many novel front-end filtering designs; and (4) Implements Mobile MIMO	Ground	0.9 - 6 GHz													1																								x

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DoD	DARPA	7.009	Mobile Ad hoc Information Network GATEway (MAINGATE) Program	MAINGATE is an integrated network radio system that combines a highly mobile, high capacity Internet-like wireless network with a gateway that permits integration of dissimilar US, Coalition and First Responder radios to seamlessly communicate among each other. MAINGATE is capable of disseminating voice, chat, situational awareness,a nd ISR and C2 data dissemination among those forces.	Ground, Air	Gateway: .2-6 GHz; C, X, Ku, Ka-bands --- MANET Radio: 300-450 MHz; 170-216 MHz 470-698 MHz, L,C, X, Ku, Ka-bands							1																				X	X	X		X	X
DoD	Navy/ ONR	1.035	Collaborative Networked Spectrum Awareness	Networked spectrum awareness and management across multiple systems and/or platforms	Military	N/A								1																		X					X	X
DoD	Navy/ ONR	1.037	Networking for Spectrum-Aware Cognitive Radios	Develop theory and metrics for network formation, stability and capacity	Military/Commercial	N/A								1																								
DoD	Navy/ ONR	3.028	Cognitive Radio and Dynamic Spectrum Awareness Test Bed	Establish Test methodologies, develop platform for testing algorithms and technology	Military/Commercial			1																											X			
DoD	Navy/ ONR	3.029	Cognitive Radio Test Bed	Testbed for development of new cognitive radio concepts	Military/Commercial	Wi-Fi		1																											X		X	
DoD	Navy/ ONR	3.03	Cognitive Radio Institute	Testbed for development of new cognitive radio concepts	Military/Commercial	Wi-Fi		1																											X			X
DoD	Navy/ ONR	3.031	A Wireless Network testbed for Stochastic Network Optimization	Testbed for development of new cognitive radio concepts	Military/Commerci	Wi-Fi		1																											X		X	
DoD	Navy/ ONR	3.032	Testbed and experiments om wireless mesh networks	Testbed for development of new cognitive radio concepts	Military/Commerci	Wi-Fi		1																											X		X	
DoD	Navy/ ONR	8.012	Crosslayer Cooperation for Energy Efficiency in Wireless Sensor Networks: Game Theoretic Solutions	Develop theory and approaches for reducing energy consumption using cross-layer techniques	Military/Commerci	N/A																		1							X					X	
DoD	Navy/ ONR	8.013	Energy Efficient Crosslayer Design Wireless Networks: Dynamic Sensor Management, Channel-Aware Data Transport and Survivability	Minimize energy consumption using cross-layer techniques	Military/Commerci	N/A																		1							X					X	
DoD	Navy/ ONR	8.014	Robust Extemely Energy Efficient Sensor Networks	Optimize MAC, time synchronization and network access protocols to reduce energy consumption	Military/Commerci	UHF																		1								X					X	
DoD	Navy/ ONR	17.031	Blind Spectrum Separation Approach for Jam-Resistant Communications	Novel techniques for improving the anti-jam performance of communications and sensing	Military/Commercial	N/A																					1					X					X	X
DoD	Navy/ ONR	17.032	Interference Alignment and the Promise of Unlimited, Secure Spectrum Access	Novel techniques for improving the anti-jam performance of communications and sensing	Military/Commercial	N/A																					1				X						X	X
DoD	Navy/ ONR	17.033	Distributed and Structured Interference Alignment for Mobile Ad Hoc Networks	Novel techniques for improving the anti-jam performance of communications and sensing	Military/Commercial	N/A																					1					X					X	X
DoD	Navy/ ONR	17.034	Coordinated Statistical Modeling and Reconfiguration for Data Integrity in Cognitive Radio Networks	Cognitive radio anti-tamper and data integrity	Military/Commerci	N/A																					1				X						X	X
DoD	Navy/ ONR	17.035	Cognitive Radio 2.0	Novel techniques for improving the anti-jam performance of communications and sensing	Military	N/A																					1				X						X	X
DoD	Navy/ ONR	17.036	Cognitive radio for ad-hoc tactical networks	Develop theory and metrics for cognitive radio jamming and anti-jam strategies	Military/Commerci	N/A																					1				X						X	
DoD	Navy/ ONR	17.037	Strategic cross-layer for delay-critical cognitive networks		Military/Commerci	N/A																					1				X						X	
DoD	Navy/ ONR	17.038	Cosite Mitigation with Forward Error Correction	Using forward error correction to co-exist with radars and other known interferers	Military/Commerci	N/A																					1					X					X	
DoD	Navy/ ONR	18.028	Bandwidth Exchange - A Framework for Improving the Performance of Cognitive Radio Networks	Models and techniques for assignment and re-assignment of spectrum	Military/Commercial	N/A																				1					X						X

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DoD	Navy/ ONR	20.003	Future JCREW	Robust components and apertures for multi-functional systems capable of support different requirements [e.g., high power and low power functions, different response times, etc.] at reasonable cost. Emphasis on supporting communications while jamming to counter Radio Controlled Improvised Explosive Devices (RCIEDs).	Military	Classified																								1				X				X	X
DoD	Navy/ ONR	21.001	Throughput rates and ultimate capacity of wireless networks with bursty traffic	Throughput and stability with bursty traffic and random access	Military/Commercial	N/A															1											X					X	X
DoD	Navy/ ONR	21.002	Receiver Statistics for Cognitive Radios in Dynamic Spectrum Access Networks	Dynamic Spectrum Access	Military/Commercial	N/A															1											X					X	X
DoD	Navy/ ONR	21.003	Ultra-Wide Band (UWB) Groundwave Comms for a distributed sensor network	HF groundwave comms usng ultrawideband radios	Military/Commercia	HF															1												X					X	
DoD	Navy/ ONR	21.004	JTRS Maritime spectrum awareness and spectrum adaptive polyphase waveform	Polyphase spectrum sensing, adaptation and Non-contiguous LPI/LPD waveform on Navy DMR	Military/Commercia	UHF															1												X					X	
DoD	Navy/ ONR	20.004	Cooperative Networked Radar	Networked spectrum awareness and management across multiple systems and/or platforms	Military	N/A																								1			X					X	X
DoD	Navy/ ONR	20.005	Integrated Topside Innovative Naval Prototype	Robust components and apertures for multi-functional systems capable of support different requirements [e.g., high power and low power functions, different response times, etc.] at reasonable cost. Dynamic resource management and allocation based on threat/mission across multiple functions.	Military	Classified																								1				X	X	X		X	X
DoD	Navy/ ONR	23.001	Risley Prism Directional Antenna and DVB-S2 SDR	Using millimeter wave signals (frequencies above 30 GHz) for mobile communications	Military	Ka-Band			1																								X	X				X	X
DoD	Navy/ ONR	23.002	Lightweight Switched Beam Antennas For Small UAVs Using Composite Structures	Using millimeter wave signals (frequencies above 30 GHz) for mobile communications	Military	Ka-Band			1																								X					X	
DoD	Navy/ ONR	23.003	Multiband Concentric Ring Metamaterial Reflector Feed	Development of robust smart radio hardware components, such as agile and wide band transmitters/receivers/antennas.	Military/Commercial	X- and Ka-Band			1																								X					X	
DoD	Navy/ ONR	23.004	Rotman Lens based lighweight narrowbeam antennas	Development of robust smart radio hardware components, such as agile and wide band transmitters/receivers/antennas.	Military/Commercial	C- band			1																								X					X	
DoD	Navy/ ONR	23.005	High Bandwidth Free Space Lasercomm	TALON FNC for Navy and USMC	Military/Commercia	IR			1																								X	X	X	X		X	X
DoD	OSD DDR&E/ NRL	21.005	DSA Enhancements and Network Scalability Analysis	Dynamic Spectrum Access	Military/Commercial	N/A															1												X						
DOE	INL	1.031	INL: Cognitive Intelligent Wireless baseband algorithms and spectrum R&D. Verification of development platform.	The INL is researching on new baseband algorithms, than OFDMA, for spectrum sensing signaling and control communication.	Aeronautical, maritime, space, terrestrial, high density or low density, subsurface, water or ground	10 MHz to 6 GHz								1																				X					X	X
DOE	INL	1.033	Cognitive Wireless Communication Technologies R &D	INL proposes to research, develop and validate new scientific technologies for Spectrum Sharing. This R&D is focused on developing methods and algorithms for advancing dynamic spectrum white-space sensing via under-lay control channel utilizing Spread Spectrum technologies for cooperative and non-cooperative networks.	Aeronautical, maritime, space, terrestrial, high density or low density, subsurface, water or ground	10 MHz to 6 GHz								1																				X						
DOE	INL	2.029	Cognitive Situational Awareness	INL proposes to research an innovative approach to keeping track of multiple cross-layers of radio communications and networks to optimize Cognitive Radio performance. INL will create and simulate cognitive algorithms for effective learning, maintaining and sharing information that relates to hidden-nodes that potentially hampers the network performance.																1												X						

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DOE	INL	2.03	Near real time common operational picture of the electromagnetic spectrum (i.e., what frequencies are in use, identifying what is using these frequencies, etc.)	INL proposes to develop a prototypical Near Real Time (NRT) Common Operational Picture (COP) of the Electromagnetic Spectrum leveraging existing architectures and software previously developed at the INL for the Electronic Warfare Modeling & Simulation (EWM&S) program.																1													X						X	X
DOE	INL	2.031	Traffic engineering, topology control, context-aware discovery in DSA networks	INL proposes to develop a prototypical Traffic Flow Simulation of the Electromagnetic Spectrum leveraging existing architectures and software previously developed at the INL for the Electronic Warfare Modeling & Simulation (EWM&S) program.																1													X							X
DOE	INL	3.02	Creation of a robust information infrastructure (e.g., real-time spectrum sensing database, information repository) to distribute and share operational information and results of the test bed experiments	INL proposes to develop, install and maintain a database that will distribute and share experimental test results.				1																									X							
DOE	INL	3.021	Large scale demonstrations with FCC/NTIA collaboration to demonstrate compatibility of new techniques with legacy systems	INL proposes to conduct large scale demonstrations of new techniques co-existing with legacy systems. Demonstrations would include the following existing INL legacy systems: GSM, UMTS, Mobile WiMAX, Fixed WiMAX, CDMA, VSAT, and WiFi.				1																													X		X	X
DOE	INL	3.022	Large-scale test beds; for example, in expansive and relatively remote locations capable of facilitating tests with full system loads under realistic conditions	INL proposes to build new DSA research facilities with upto 75 DSA base station sites including 9 Cell on Wheels, upto 50 LTE/HSPA/CDMA sites (number of DSA and legacy base station sites to be decided), DSA and LTE/HSPA core, IMS capabilities, 3 Radars, physical city emulation infrastructure, EME environment with city emulation, site spectrum management and local spectrum collaboration, support for national standardization and rule making, technology workshops. INL proposes to integrate new wireless technologies (LTE, WiMAX & Cognitive) with the existing INL legacy Wireless Test Beds and UAV site. The current INL WTB systems with voice features include: GSM, GPRS, UMTS, Fixed WiMAX, Mobile WiMAX, VSAT, CDMA, and WiFi.				1																														X		X	X
DOE	INL	3.023	Proofs-of-concept demonstrations covering a variety of bands, applications, and geographical areas	INL proposes to conduct proofs-of-concept demonstrations with legacy systems as well as new wireless Telecom technologies. Demonstrations would include the following existing INL legacy systems: GSM, UMTS, Mobile WiMAX, Fixed WiMAX, CDMA, VSAT, and WiFi.				1																													X		X	X
DOE	INL	3.024	Standardization and collaboration of current and future test beds (logically or physically) to allow for remote access for many researchers and facilitate an easily used experimental infrastructure	INL proposes design, install and maintain a system that will allow researchers to remotely access the INL WTB to monitor and perform experiments.				1																									X							
DOE	INL	3.026	Advanced test beds facilitating testing of ground-aerial-satellite, under-water interworking environments	The INL"s existing Wireless Test Bed currently facilitates ground-ariel-satellite interworking environments, see Items 47 through 50. INL propoes the Operation & Maintenance (O&M) of legacy systems				1																													X		X	X
DOE	INL	3.027	Development of integrated cyber evaluation test beds for evaluating large scale spectrum-sharing architectures, as well as proof-of-security concepts, protocols, datasets and applications	INL proposes to perform Cyber evaluations of large scale spectrum-sharing architectures, as well as proof-of-security concepts, protocols, utilizing the INL's proven Cyber Security expertise.				1																													X		X	X

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DOE	INL	6.001	Development of simulation tools for situational awareness and resiliency , for critical infrastructure and commercial implementations in spectrum sharing environments	INL proposes to develop an inter-dependency model to support Spectrum Sharing R & D Inventory. The INL will use this funding to extend the pre-existing INL capabilities to integrate frequency management aspects of Spectrum Sharing into the inter-dependency model.							1																				X						X	X
DOE	INL	6.002	Large-scale network simulations for dynamic spectrum access	Large-scale network simulations for dynamic spectrum access with adaptability as new capabilities in hardware, software, and policy emerge							1																												
DOE	INL	7.008	Opportunistic & Rigid Spectrum Access	INL proposes to research end-point wireless device and infrastructure architectures for transitioning from legacy static spectrum to a future Dynamic Spectrum Access (DSA) network.									1																			X							
DOE	INL	8.005	Health ramifications of radiation from the new spectral access techniques	Human and animal health/well-being by understanding the possible health ramifications of radiation from the new spectral access techniques, millimeter wave and beyond																				1														
DOE	INL	12.005	Multidimensional Techniques for Spectrum Efficiency	INL Proposes to research and develop new dimensions for increasing spectrum efficiency at both lower and higher layers, e.g., RF and baseband techniques are integrated for spectrum efficiency.																			1								X							
DOE	INL	14.001	Identifying Metrics for Spectrum Efficiency	INL proposes to research determining specific parameters that affect the spectrum efficiency, such length of time for a successful spectrum access, effect of high or low frequency selection vs. limitations on data rates, effect on processor and battery life as number of sub-carries increase, effect of using higher symbol rate modulations schemes vs. BER/BLER and intermodulation and channel interference.											1																X							
DOE	INL	16.007	Adaptive SDR Architectures	INL proposes to research & develop innovative hardware and software architecture based on software defined radio. Investigates throughput for parallel vs. central core DSP architecture, internal bus control for multiple FPGA's, complexity of control bus vs. speed / latency of pipelined processes.															1												X							
DOE	INL	17.03	Cognitive Multi-layer Embedded Security	INL proposes to research & develop the integration of embedded cross-layer security beginning with OS throughout higher layers of protocol and application. Research spectrum sharing security issues, analysis of trust worthiness, reliability and quality of service, trusted cognitive radio architecture. This R&D will integrate Cognitive Communication Electronics novel techniques for anti-jamming performance while detecting and tracking jamming frequencies including low probability of interception (LPI) and detection (LPD).																									1			X							
DOE	INL	4.002	Adaptive Radio With An Underlay Control Channel	INL proposes to research & develop methods and algorithms for advancing dynamic spectrum white-space sensing via under-lay control channel utilizing Spread Spectrum technologies for cooperative and non-cooperative networks.													1														X							
DOE	INL	5.002	Training program on new radio technologies	Develop training program on new radio technologies for spectrum management workforce																				1														
DOJ	NIJ/ The University of Texas at Dallas: 2009-SQ-B9-K007	16.089	Realization of a Software-defined Emergency Radio:	A software-defined radio prototype board based on TI's DRP Technology, capable of operating at 700 MHz band as a P25 push-to-talk radio	Terrestrial - Crimminal Justice/Public Safety	UHF,SHF													1													X						X	
DOJ	NIJ/ L3 Communications GS&ES: 2010-IJ-CX-K023	16.09	Intergation of NIJ funded prototype SDR/Cognitive Radio technologies	Integration of NIJ funded prototype technologies into a single, common, development platform.	Terrestrial - Crimminal Justice/Public Safety	VHF/UHF/SHF													1													X							X
DOJ	NIJ/ Stevens Institute of Technology; 2007-IJ-CX-K020	1.029	Cognitive radio protocols and platform for dynamic spectrum access in public safety networks	Cognitive dynamic spectrum access network protocols for bonding different wireless networks in a multi-radio platform Dynamic load balancing and hand-off techniques to mitigate interference and traffic overload	Terrestrial - Crimminal Justice/Public Safety	UHF,SHF								1																		X						X	

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DOJ	NIJ/ Stevens Institute of Technology; 2007-IJ-CX-K020	12.009	Cognitive radio protocols and platform for dynamic spectrum access in public safety networks	Cognitive channel management & network bonding	Terrestrial - Crimminal Justice/Public Safety	UHF,SHF																	1									X					X	
DOJ	NIJ/ Stevens Institute of Technology; 2007-IJ-CX-K020	17.029	Cognitive radio protocols and platform for dynamic spectrum access in public safety networks	CR technology to find/use spectrumCR technology to find/use spectrum, security enabled via path/route diversity, on a per IP packet basis	Terrestrial - Crimminal Justice/Public Safety	UHF,SHF																					1					X					X	
DOJ	NIJ/ Univerisity of California, Irvine; : 2006-IJ-CX-K044	8.006	Agile, Multi-Antenna Capable SDR Platform for Advanced Public Safety Communications.	Cognitive engine and UCI SDR prototype that optimizes radio power consumption through power management tegniques applied to waveform processing memory, and use of forward error correction, in reaction to local adio frequency environment and path conditions.	Terrestrial - Crimminal Justice/Public Safety	VHF/UHF/SHF																		1									X						
DOJ	NIJ/ Univerisity of California, Irvine; : 2006-IJ-CX-K044	16.087	Agile, Multi-Antenna Capable SDR Platform for Advanced Public Safety Communications	Cognitive engine and UCI SDR prototype for multiband RF MEMS antenna (In collaboration with USU 2009-SQ-B9-K005)	Terrestrial - Crimminal Justice/Public Safety	VHF/UHF/SHF													1														X					X	
DOJ	NIJ/ Utah State University, 2007-IJ-CX-K025 and 2009-SQ-B9-K005	12.008	The design, microfabrication, and test/characterization of MEMS integrated reconfigurable antennas operating over 150 MHz – 4900 MHz frequency bands with beam-tilt and polarization agility at a chosen band of operation:	Mulit-band electrically steerable, RF mems based antenna for operaions on VHF/UHF & SHF frequecies (in collaboration with UCI 2006-IJ-CX-K044)	Terrestrial - Crimminal Justice/Public Safety	VHF/UHF/SHF																	1										X					X	
DOJ	NIJ/ Virginia Tech: 2009-SQ-B9-K011	16.088	A Public Safety Cognitive Radio on a Digital Signal Processor Platform for Affordable Interoperability	Congnitive engine for waveform classification, recognition and channel bridging	Terrestrial - Crimminal Justice/Public Safety	VHF/UHF													1														X					X	
DOT	FAA/ Unmanned Aircraft Systems /National Airspace System (NAS)	11	Role of Cognitive Radio in Remote Operation of UAS	This project will first investigate and report on the current state of CR technology and UAS communications. It will then investigate the possible operational models and infrastructure required to support CR-based spectrum allocation at different levels of granularity; and the security and policy models needed to support CR-based spectrum allocation. The results will be delivered in an interim and final report. Information from this research will be relevant for the development of future requirements and standards for UAS and the NAS in general.	Aviation	138MHz to 3GHz										1																		X					X	
DOT	FAA/NextGen Solution Set Integration Group/NAS Enterprise Architecture Group/New ATM Requirements - FCI	11.012	Aeronautical Air-Ground Future Communications Infrastructure (FCI) for Next Generation air traffic management (ATM)	Aeronautical Mobile Airport Communications System (AeroMACS)in C-Band; L-Band Digitial Aeronautical Comm System (L-DACS) for terrestrial airspace; SatCom for oceanic and remote airspaces	Aviation	C-Band, L-Band, SatCom-Bands										1				1																X	X		X	X
FCC	FCC	9.001	Enforcement of Rules for DSA Technologies	-	-	-																			1												
FCC	FCC	9.002	Develop processes to streamline conformity assessment of radios	-	-	-																			1												
FCC	FCC	9.003	Regulatory reform	-	-	-																			1												
NASA	HQ/Aeronautics Research Mission Directorate (ARMD)/Integrated Systems Reseearch Program (ISRP)	11.008	Unmanned Aircraft Systems Integration in the National Airspace System (NAS)	UAS command and control	Aviation	C-Band, SatCom-Bands										1																	X	X		X	X
NASA	HQ/Space Communications and Navigation (SCaN)	11.006	Disruption Tolerant Networking	Interplanetary Overlay Network (ION) software development, Licklider Transmission Protocol (LTP) development, Deep Space flight demonstrations, International Space Station demonstrations	Space	Any										1																	X	X		X	X
NASA	HQ/Space Communications and Navigation (SCaN)	11.007	Data Compression	High Speed Image Compression, Lossless Data Compression	Space	Any										1																	X			X	X

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NASA	HQ/Space Communications and Navigation (SCaN)	15.008	Ka-band Propagation	Global propagation measurements	Space	Ka-Band						1																									x		x	x
NASA	HQ/Space Communications and Navigation (SCaN)	15.009	Ka-band Propagation		Space	Ka-Band						1																									x		x	x
NASA	HQ/Space Communications and Navigation (SCaN)	15.01	Ionospheric Products		Space	L-Band						1																									x		x	x
NASA	HQ/Space Communications and Navigation (SCaN)	15.011	Ionospheric Products		Space	L-Band						1																									x		x	x
NASA	HQ/Space Communications and Navigation (SCaN)	16.055	Software Defined Radio	Space Telecommunications Radio Standards (STRS) development, Flight hardware development	Space	S-Band, Ka-Band													1																			x		x	x
NASA	HQ/Space Communications and Navigation (SCaN)	16.056	Software Defined Radio		Space	S-Band, Ka-Band													1																			x		x	x
NASA	HQ/Space Communications and Navigation (SCaN)	16.057	CoNNeCT Payload, Operations, and Experiments	Communications, Navigation, and Networking reConfigurable Terminal (CoNNeCT) experiment for ISS (HTV3 Launch)	Space	S-Band, Ka-Band													1																			x		x	x
NASA	HQ/Space Communications and Navigation (SCaN)	16.058	CoNNeCT Payload, Operations, and Experiments		Space	S-Band, Ka-Band													1																			x		x	x
NASA	HQ/Space Communications and Navigation (SCaN)	16.059	Cognitive Radio Study (including cognitive networks)	Cognitive communications for NASA applications studies	Space	S-Band, X-Band, Ka-Band													1																	x				x	x
NASA	HQ/Space Communications and Navigation (SCaN)	16.06	Cognitive Radio Study (including cognitive networks)		Space	S-Band, X-Band, Ka-Band													1																	x				x	x
NASA	HQ/Space Communications and Navigation (SCaN)	19.002	Adv Antenna & Power Amplifier Technology		Space	Ka-Band				1																													x				x	x
NASA	HQ/Space Communications and Navigation (SCaN)	19.003	Adv Antenna & Power Amplifier Technology		Space	Ka-Band				1																													x				x	x
NASA	HQ/Space Communications and Navigation (SCaN)	13.031	Lunar Laser Communications Demonstration (LLCD)	Flight demonstration on Lunar Atmospheric and Dust Environment Explorer (LADEE) mission	Space	Optical												1																					x		x	x
NASA	HQ/Space Communications and Navigation (SCaN)	13.032	Spaceflight Optical Communications Component Development	Optical Comm Detector, Stabilization, and Laser Amplifier Technology	Space	Optical												1																					x		x	x
NASA	HQ/Space Communications and Navigation (SCaN)	13.033	Deep Space Optical Communications	Deep Space Optical Terminal (DOT)	Space	Optical												1																					x		x	x
NASA	HQ/Space Communications and Navigation (SCaN)	13.034	Ka-band Modulator	Ka-Band space flight modulator for >1 Gbps	Space	Ka-Band												1																					x		x	x
NASA	SOMD/SBIR Phase I	16.061	Reconfigurable Computing for Dynamically Reprogrammable Communications		Space Communications														1																			x	x			x	
NASA	SOMD/SBIR Phase I	16.062	Reconfigurable/Reprogrammable Communication Systems		Space Communications														1																			x	x			x	
NASA	SOMD/SBIR Phase I	16.065	Reprogrammable Radiation Tolerant Secure Network Access Module		Space Communications														1																			x	x			x	
NASA	SOMD/SBIR Phase I	16.072	Low Phase Noise Universal Microwave Oscillator for Analog and Digital Devices		Space Communications														1																			x	x			x	
NASA	SOMD/SBIR Phase I	16.074	Multi-Cluster Network on a Chip Reconfigurable Radiation Hardened Radio		Space Communications														1																			x	x				x
NASA	SOMD/SBIR Phase I	16.075	Reconfigurable RF Filters		Space Communications														1																			x	x				x
NASA	SOMD/SBIR Phase I	16.076	Architectures/Algorithms/Tools for Ultra-Low Power, Compact EVA Digital Radio		Space Communications														1																			x	x				x

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NASA	SOMD/SBIR Phase I	16.077	Reconfigurable EVA Radio with Built-In Navigation Capability		Space Communications														1													x	x					x
NASA	SOMD/SBIR Phase I	16.078	Reconfigurable Ultra-Low Power Miniaturized EVA Radio		Space Communications														1													x	x					x
NASA	SOMD/SBIR Phase I	16.081	Miniaturized Digital EVA Radio		Space Communications														1													x	x					x
NASA	SOMD/SBIR Phase I	16.083	Development of a Novel, Ultra-Low SWAP, RAD-Tolerant, Multi-Channel, Reprogrammable Photonic Integrated Circuit Optical Transceiver Module		Space Communications														1													x	x					x
NASA	SOMD/SBIR Phase I	16.084	Radiation Hard Electronics for Advanced Communication Systems		Space Communications														1													x	x					x
NASA	SOMD/SBIR Phase I	16.085	High Performance Ka Band Power Amplifiers for Future EVA Radio Applications		Space Communications														1													x	x					x
NASA	SOMD/SBIR Phase I & II	16.063	A Hardware/Software Design Environment for Reconfigurable Communication Systems		Space Communications														1													x	x				x	
NASA	SOMD/SBIR Phase I & II	16.064	Reconfigurable, Digital EVA Radio		Space Communications														1													x	x				x	
NASA	SOMD/SBIR Phase I & II	16.066	Multi-Mission microSDR		Space Communications														1													x	x				x	
NASA	SOMD/SBIR Phase I & II	16.067	Stackable Radiation Hardened FRAM		Space Communications														1													x	x				x	
NASA	SOMD/SBIR Phase I & II	16.068	Low Power, Small Form Factor, High Performance EVA Radio Employing Micromachined Contour Mode Piezoelectric Resonators and Filters		Space Communications														1													x	x				x	
NASA	SOMD/SBIR Phase I & II	16.069	Low Power Universal Direct Conversion Transmit and Receive (UTR) RF Module for Software Defined Radios		Space Communications														1													x	x				x	
NASA	SOMD/SBIR Phase I & II	16.07	Software Defined Common Processing System (SDCPS)		Space Communications														1													x	x				x	
NASA	SOMD/SBIR Phase I & II	16.071	Software Defined Multiband EVA Radio		Space Communications														1													x	x				x	
NASA	SOMD/SBIR Phase I & II	16.073	Reconfigurable, Cognitive Software Defined Radio		Space Communications														1													x	x					x
NASA	SOMD/SBIR Phase I & II	16.079	Fault Tolerant Software-Defined Radio on Manycore		Space Communications														1													x	x					x
NASA	SOMD/SBIR Phase I & II	16.08	Reconfigurable VLIW Processor for Software Defined Radio		Space Communications														1													x	x					x
NASA	SOMD/SBIR Phase I & II	16.082	RF Front End Based on MEMS Components for Miniaturized Digital EVA Radio		Space Communications														1													x	x					x

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NSF	CISE 0614773 / University of Virginia Main Campus	7.005	CSR---EHS: Multi-Frequency in Wireless Sensor Networks	A wireless sensor network (WSN) is an exciting new technology with application to environmental monitoring, agriculture, medical care, smart buildings, factory monitoring and automation, and military applications. A WSN can also be viewed as the underlying infrastructure that will be an integral to future ubiquitous and embedded computing applications. In 5-10 years, (i) many individual WSN will be very sophisticated and operating at high levels of utilization, and (ii) there will exist many thousands if not millions of sensor networks. When the latter situation materializes, WSNs can be expected to overlap and co-exist, especially in urban and other highly populated areas. Mobile networks will pass through other static and mobile networks. To deal with these scenarios will require efficient multi-frequency WSN systems. This project develops new suites of protocols for multi-frequency WSN along two complementary dimensions: (1) to achieve high performance for both broadcast and uni-cast communications within a single WSN, and (2) to handle noise and the crowded spectrum caused by any reason such as by random transmitting devices or by other nearby sensor networks. The intellectual									1																			X						########	
NSF	CISE 0619693 / Florida International University	3.013	MRI: Acquisition of a Testbed for Optical/Wireless Integration	This project, building a testbed for optical/wireless integration, aims at meeting the need of next generation communication systems, providing high data rates with ubiquitous access anytime anywhere. The integration of existing heterogeneous networks (including optical high-speed SONET, 3G cellular, Wireless LAN (WiFi), the forthcoming WiMAX, etc.), demands new solutions to issues such as architecture design for efficient integration, mobility management, network management, resource management, billing models, etc. This work, involving three kinds of access networks (the WiMAX over Sonet/WDM to WiFi access network, a 3G emulation network, and WiMAX over optical extension network), develops a prototype test bed, namely an emulation environment to evaluate practicality. The testbed supports research not only in the Optical/Wireless integration, but also in each stand-alone network. Specifically, the instrumentation aims at supporting the following research. System design for next-generation communication networks by integrating WiMAX, 3G and SONET, Novel wireless network planning strategy based on optical/wireless integration, Bandwidth management in wireless/wireline networks,				1																							X						########	
NSF	CISE 0626439 / Rutgers University New Brunswick	17.016	NeTS-ProWIN: Fingerprints in the Ether: Exploiting the Radio Channel to Enhance Wireless Security	The securing of wireless systems has traditionally employed cryptographic protocols that are modifications of conventional wired security mechanisms. However, the wireless environment enables new forms of intrusion that render such techniques inadequate. At the same time, the properties of the wireless medium comprise a unique source of domain-specific information. This project exploits that information to complement and enhance traditional security mechanisms. The project utilizes the unique space, time and frequency characteristics of the physical (PHY) layer, in combination with traditional higher layer techniques, to significantly enhance authentication and confidentiality. This cross-layer research is investigating fundamentally new approaches that utilize the statistical correlation properties associated with multipath propagation in designing new protocols. The project work relies on an integration of analysis, simulation and experiment by an interdisciplinary team whose expertise includes RF propagation, PHY-layer communications, statistical analysis, and wireless security and cryptographic protocols. The growing use of wireless communications by consumers, businesses,																											1			X						########	

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NSF	CISE 0626636 / University of Maryland College Park	1.089	Collaborative Research: NeTS-NBD: An Integrated Approach to Computing Capacity and Developing Efficient Cross-Layer Protocols for Wireless Networks	The research develops a unified mathematical framework for estimating the capacity and designing efficient cross-layer protocols in wireless ad hoc and mesh networks. In contrast to earlier efforts to derive analytical bounds on the capacity of random instances, the focus here is an algorithmic theory of network capacity. The mathematical programming framework guides the development of novel cross-layer protocols, and the theoretical effort is complemented by careful implementation and evaluation of protocols within existing simulation tools, such as ns-2, as well as on real rooftop wireless networks. The research consists of three basic components: (1) mathematical programming-based formulations of network capacity and efficient algorithms for computing capacity under multiple constraints, such as latency, energy, interference, etc; (2) the design and development of protocols and associated metrics that are motivated by the mathematical programming framework, and (3) prototype implementation and rigorous statistical analysis of protocols in a simulation environment, as well as on real roof-top wireless networks. The algorithmic theory of network capacity is											1																			X						########	
NSF	CISE 0626676 / University of Kansas Center for Research Inc	16.02	Collaborative Research: NeTS-FIND: CogNet - An Experimental Protocol Stack for Cognitive Radio Networks and Its Integration with the Future Internet	Proposal Number: 0626740 PI: Dipankar Raychaudhuri Institution: Rutgers University (collaborative with Kansas U and CMU) Proposal Number: 0626676 PI: Joe Evans Institution: Kansas University (collaborative with Kansas U and CMU) Proposal Number: 0626827 PI: Srini Seshan Institution: CMU Title: Collaborative NeTS-FIND: CogNet An Experimental Protocol Stack for Cognitive Radio Networks and Its Integration with the Future Internet Project Abstract This project has two major thrusts: the first is to identify broad architecture and protocol design approaches for cognitive radio networks at both local network and the global internetwork level. This architectural study is intended to lead to the design of control/management and data interfaces between cognitive radio nodes in a local network, and also between cognitive radio subnetworks and the global Internet. The second thrust is to apply these architectural and protocol design results to prototype an open-source cognitive radio protocol (the CogNet stack) and use it for experimental evaluations on emerging cognitive radio platforms. A number of architectural issues are examined as we try to identify an efficient and complete solution these																		1													X						########	
NSF	CISE 0626695 / University of Miami	7.006	NeTS-NBD: Cooperative Multi-Hop Wireless Communications and Networking: Joint Design of Error Control Coding, Medium Access, and Routing	Cooperative Multi-Hop Wireless Communications and Networking: Joint Design of Error Control Coding, Medium Access, and Routing Award 0626695 Xiaodong Cai Multi-hop communication is instrumental in many emerging wireless networks such as ad hoc networks, sensor networks, mesh networks, etc. However, current multi-hop communication methods cannot provide satisfactory network performance in terms of throughput, latency, energy efficiency, and robustness, when the network operates in typical environments with complicated channel fading and shadowing. This is due to several major problems: 1) At the network layer, current routing algorithms do not have any mechanisms to cope with the detrimental effects of fading and shadowing inherent in wireless channels, since these routing algorithms are based upon a disk model for wireless channels that takes into account path loss, but not fading and shadowing. 2) At the data link and physical layers, current transmission schemes do not properly explore the broadcasting nature of wireless transmissions to improve link reliability. 3) The lack of a joint design across the network, medium access control (MAC), and physical layers renders it difficult to											1																			X						########	

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NSF	CISE 0626740 / Rutgers University New Brunswick	16.021	Collaborative Research: NeTS-FIND: CogNet - An Experimental Protocol Stack for Cognitive Radio Networks and Its Integration with the Future Internet	Proposal Number: 0626740 PI: Dipankar Raychaudhuri Institution: Rutgers University (collaborative with Kansas U and CMU) Proposal Number: 0626676 PI: Joe Evans Institution: Kansas University (collaborative with Kansas U and CMU) Proposal Number: 0626827 PI: Srini Seshan Institution: CMU Title: Collaborative NeTS-FIND: CogNet An Experimental Protocol Stack for Cognitive Radio Networks and Its Integration with the Future Internet Project Abstract This project has two major thrusts: the first is to identify broad architecture and protocol design approaches for cognitive radio networks at both local network and the global internetwork level. This architectural study is intended to lead to the design of control/management and data interfaces between cognitive radio nodes in a local network, and also between cognitive radio subnetworks and the global Internet. The second thrust is to apply these architectural and protocol design results to prototype an open-source cognitive radio protocol (the CogNet stack) and use it for experimental evaluations on emerging cognitive radio platforms. A number of architectural issues are examined as we try to identify an efficient and complete solution these																		1												X						########	
NSF	CISE 0626827 / Carnegie-Mellon University	16.022	Collaborative Research: NeTS-FIND: CogNet - An Experimental Protocol Stack for Cognitive Radio Networks and Its Integration with the Future Internet	Proposal Number: 0626740 PI: Dipankar Raychaudhuri Institution: Rutgers University (collaborative with Kansas U and CMU) Proposal Number: 0626676 PI: Joe Evans Institution: Kansas University (collaborative with Kansas U and CMU) Proposal Number: 0626827 PI: Srini Seshan Institution: CMU Title: Collaborative NeTS-FIND: CogNet An Experimental Protocol Stack for Cognitive Radio Networks and Its Integration with the Future Internet Project Abstract This project has two major thrusts: the first is to identify broad architecture and protocol design approaches for cognitive radio networks at both local network and the global internetwork level. This architectural study is intended to lead to the design of control/management and data interfaces between cognitive radio nodes in a local network, and also between cognitive radio subnetworks and the global Internet. The second thrust is to apply these architectural and protocol design results to prototype an open-source cognitive radio protocol (the CogNet stack) and use it for experimental evaluations on emerging cognitive radio platforms. A number of architectural issues are examined as we try to identify an efficient and complete solution these																		1												X						########	
NSF	CISE 0626863 / University of Florida	12.127	NeTS-NBD: Simulcast Enhanced Wireless Networks	NeTS-NBD Simulcast Enhanced Wireless Networks Award 0626863 Tan F. Wong and John M. Shea Information theory predicts that it is more efficient to simultaneously transmit (simulcast) signals carrying independent information to multiple users on a wireless channel than it is to time-, frequency- or code-share the channel among the users. In current wireless networks, this simulcasting capability of the wireless medium is not utilized. This research aims to develop practical simulcasting transmission techniques that exploit such hidden resources in both infrastructure and ad hoc networks. The application of simulcasting at the physical layer has many impacts on the higher-layer protocols. Under a cross-layer framework, the use of simulcasting in wireless networks is investigated through analysis, simulation, and experimentation. The expected analytical results will be used to investigate the performance limits of simulcasting. Simulation results will be used to test protocol designs and evaluate performance under more realistic models for channel, traffic, mobility, etc. A heterogeneous ad hoc network (HANET) testbed will be developed to emulate simulcasting in real networks. The																						1								X						########	

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NSF	CISE 0626964 / Virginia Polytechnic Institute and State University	1.01	Collaborative Research: NeTS-NBD: An Integrated Approach to Computing Capacity and Developing Efficient Cross-Layer Protocols for Wireless Networks	The research develops a unified mathematical framework for estimating the capacity and designing efficient cross-layer protocols in wireless ad hoc and mesh networks. In contrast to earlier efforts to derive analytical bounds on the capacity of random instances, the focus here is an algorithmic theory of network capacity. The mathematical programming framework guides the development of novel cross-layer protocols, and the theoretical effort is complemented by careful implementation and evaluation of protocols within existing simulation tools, such as ns-2, as well as on real rooftop wireless networks. The research consists of three basic components: (1) mathematical programming-based formulations of network capacity and efficient algorithms for computing capacity under multiple constraints, such as latency, energy, interference, etc; (2) the design and development of protocols and associated metrics that are motivated by the mathematical programming framework, and (3) prototype implementation and rigorous statistical analysis of protocols in a simulation environment, as well as on real roof-top wireless networks. The algorithmic theory of network capacity is											1																			X						########	
NSF	CISE 0626980 / University of North Carolina at Charlotte	1.084	NeTS-NBD: WLAN Resource Management Using Multi-Agent Systems	This research investigates cooperative resource management among multiple WLANs (wireless local area networks) in WLAN/WPAN (wireless personal area networks) interference environments. The proliferation of WLAN deployments causes frequent geographical coverage overlap among multiple networks. When this occurs, the lack of cooperative resource management results in significant performance degradation due to inter-WLAN interference. Moreover, unbalanced loads among multiple networks can incur congestion in a few WLANs while there are unused resources in others. The objective of this research is to manage shared system resources fairly among multiple WLANs to optimize the overall performance. This research emphasizes the underlying predictability of network conditions and promotes management solutions tailored to different interference environments. A multi-agent system-based approach is proposed to achieve information sharing and decision distribution among multiple WLANs in a distributed manner. This research addresses the distributed constraint optimization problem (DCOP) in WLANs and studies the effectiveness of DCOP algorithms to find the optimal resource assignment through											1																			X						########	
NSF	CISE 0627074 / University of Illinois at Urbana-Champaign	1.082	NeTS-NBD: Multi-Channel Wireless Mesh Networks: Capacity, Protocols, and Experimental Evaluation	The density of wireless devices in homes, offices, and public spaces is expected to continue to increase with time, making it important to develop strategies to fully utilize the available wireless spectrum. Towards this goal, this project investigates protocol mechanisms that can exploit the availability of multiple wireless channels within a single wireless mesh network, while requiring each host or router to use only a small number of wireless interfaces. With a small number of interfaces, although a single host may not be able to use all the channels simultaneously, a group of hosts in a given neighborhood may be collectively able to use all the channels. This project strives to develop suitable protocols to translate this intuition into reality. The project is expected to have an impact on theory and practice of wireless mesh networking, by improving performance achievable in such networks. The anticipated results of the project include: Fundamental capacity analysis that establishes fundamental limits on performance of multi-channel wireless mesh networks, Network layer and link layer mechanisms that exploit availability of multiple wireless channels, while using a small number of interfaces at the hosts, and											1																			X						########	

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NSF	CISE 0627090 / University of California-Davis	16.035	NeTS-NBD: An Integrated Approach to Opportunistic Spectrum Access	NeTS-NBD: An Integrated Approach to Opportunistic Spectrum Access Award 0627090 Qing Zhao Built upon a hierarchical access structure with primary and secondary users, opportunistic spectrum access resolves the inefficiency of the current command-and-control model of spectrum regulation while maintaining compatibility with legacy wireless systems. The basic idea is to allow secondary users to exploit instantaneous spectrum availability and communicate non-intrusively to primary users. While conceptually simple, opportunistic spectrum access presents challenges not encountered in conventional networks. Cognitive medium access control coupled with signal processing for identifying and exploiting instantaneous spectrum opportunities is one of the central technological underpinnings. This research develops algorithms and protocols for opportunistic spectrum access under energy and hardware constraints. The main scientific ideas being developed include (i) cognitive sensing and access strategies that learn from observations and offer improved performance over time, (ii) distributed protocol implementations in ad hoc networks without central controllers or dedicated communication/control channels,														1															X						#######	
NSF	CISE 0627106 / University of Texas at Dallas	11.009	ProWiN: Methods and Algorithms for Resilient Packet Header Compression	Any unneeded bit transmitted from a wireless node harms the network in two ways: it wastes the power and bandwidth of the node itself, and it creates interference for other nodes. Since TCP/IP packets are on average short, existing packet headers of 40-60 bytes can create huge inefficiencies, motivating an ongoing effort in packet header compression. Unfortunately compression and error resilience are at odds: compressing the headers creates dependencies, so the compressed headers are fragile and susceptible to error propagation. This has been the central problem in packet header compression for over a decade. This research applies powerful tools from the statistical theory of communication to the problem of packet header compression/communication. These tools have had a truly amazing track record in various problems in wireless, wireline, and optical communications, audio, image and video compression, as well as mass storage devices. This effort concentrates on the design of systems involving block codes, convolutional codes, and turbo codes and applying them to packet header compression and communication, with a direct impact on the design of better and more efficient wireless networks of the															1															X						#######	
NSF	CISE 0627118 / University of Arizona	1.088	NeTS-ProWin: Resource Management and Distributed Protocols for Heterogeneous Cognitive-Radio Networks	The focus of this project is on optimal resource management and control of distributed cognitive radio (CR) networks, with the goal of harvesting the benefits of dynamic spectrum sharing that include improved spatial reuse (i.e., higher network throughput), programmable connectivity, and increased network availability. The research agenda includes centralized analytical formulations that aim at optimizing the operation of the bottom three layers as well as distributed routing and medium access protocols that implement the outcomes of such optimization. Depending on the channel dynamics (e.g., magnitude of the channel coherence time relative to the optimization window), optimizations based on deterministic-control formulations (for slowly varying channels) as well as stochastic-control formulations (for fast varying channels) are considered. In both cases, the underlying setup allows for multi-channel, multi-path routing at either the packet or the session levels. Distributed optimizations are also considered for peer-to-peer (ad hoc) hybrid networks, consisting of cognitive and "legacy" nodes. For this scenario, game-theoretic pricing policies are used to manage the interactions between												1																	X						#######	

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NSF	CISE 0627172 / University of Colorado at Boulder	12.125	NeTS-FIND: Radio Wormholes for Wireless Label Switched Mesh Networks	Proposal Number: 0627172 PI: Dirk Grunwald Institution: University of Colorado, Boulder Title: NeTS-FIND: Radio Wormholes for Wireless Label Switched Mesh Networks Abstract This proposal addresses two related problems in mesh networking, quality of service and traffic engineering, by advocating a new wireless network technology that builds on existing technologies applied to optical and wired networks. Mesh networks, which share properties of fixed multipoint wireless and ad hoc wireless networks, typically have lower throughput than fixed multipoint wireless networks because the same spectrum is used to deliver service to stations and relay traffic. This proposal seeks to extend and integrate three technologies to make mesh networks more useful. Overall, the proposal involves building "radio circuits" that use "cut through" switching similar to optical lambda switching. Orthogonal frequency multiple access (OFDMA) serves as the underlying PHY layer. Individual mesh nodes are implemented using a software-based radio switch, which allows transiting packets to be rapidly forwarded. Lastly, the Generalized Multi-Protocol Label-Switching (GMPLS) protocol provides a management																				1										X						########	
NSF	CISE 0628093 / SUNY at Stony Brook	12.022	CAREER: Coordinated Resource Management in IP-based Cellular Radio Access Systems	Flexible and efficient management of resources is imperative in the air interface and backhaul network, given the many challenges including the limited radio spectrum, high cost of radio access networks, volatile wireless channel conditions, and diverse and demanding QoS requirements. This research develops a comprehensive resource management framework for supporting both circuit-switched and packet-switched traffic seamlessly over an (initially CDMA-based) radio access system. Specific goals include studying the fundamental resource-allocation problems in the air interface and IP-RAN, understanding and incorporating the many interactions while implementing resource management, and trading-off optimality with control and management overhead. This work is part of a broad and ambitious effort to fundamentally advance the understanding of the inter-dependency between different network layers and systems. Specific research results will include the development of new cross layer design and optimization techniques, and the enhancement of QoS and energy efficiency at various layers. The growth of powerful multimedia services over wireless terminals is having a profound impact on societies																				1										X						########	
NSF	CISE 0631289 / Dartmouth College	7.007	NeTS-ProWiN - Collaborative Research: Dynamic Spectrum MAC with Multiparty Support in Adhoc Networks	NeTS-ProWiN: Collaborative Research - Dynamic Spectrum MAC with Multiparty Support in Adhoc Networks Award 0435306 Saswati Sarkar, University of Pennsylvania Abstract Major advances in dynamic spectrum management and the inevitable deregulation of large portions of the radio spectrum will revolutionize future wireless networks, services, and applications. This will lead to an era of spectrum efficient cognitive radios that will enable the deployment of radically different radio architectures, algorithms, and protocols over the next decade. This project is studying the design of a new programmable media access control (MAC) layer for this new environment. The MAC must regulate how future programmable radio devices can efficiently interact with each other using spectrum-aware communication algorithms. In our study, we model the MAC design as decision problems using tools from decision sciences such as stochastic control, optimization, graph theory and estimation theory. We validate the design of the MAC through an experimental implementation consisting of programmable radios. The expected results from the research include the design of a programmable MAC system that can enable												1																		X						########	

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NSF	CISE 0634763 / University of Minnesota-Twin Cities	7.004	Collaborative Research: Cognitive Ad Hoc Networks: Capacity Optimization Through Local Adaptation	Title: Collaborative Research: Cognitive Ad Hoc Networks: Capacity Optimization Through Local Adaptation 0635003, Weber 0634979, Andrews 0634763, Jindal Due to the unpredictability of the environment in which unplanned (ad hoc) wireless networks will operate, an appealing approach is to allow the network to dynamically adapt to the perceived conditions. We define such ad hoc networks as cognitive. A framework is developed for understanding the benefits of local adaptation, by breaking adaptive techniques into the four major degrees of freedom available to the designer: time, frequency, code, and space. The aim is to address the following two questions. First, what are the fundamental limits on information flow through unplanned networks; in particular, how valuable is localized information and coordination in seeking to achieve this limit? Second, what are the relative values of adaptation in time, space, frequency, and code in terms of information flow; in particular, how does the network designer identify which degree of freedom is most valuable in a variety of networking scenarios? In this research, information theory and stochastic geometry are connected through a novel metric for ad hoc										1																			X						########	
NSF	CISE 0634952 / GA Tech Research Corporation - GA Institute of Technology	17.018	Physical Layer Security: Error Control Coding for Information Theoretic Security in Wireless and Beyond	The research. The research topics in this proposal are: 1) Fundamentals for the wiretap channel: error control codes for reliability and security, 2) Opportunistic wireless physical-layer security, 3) Highly reliable and secure distributed data storage. In all areas the focus is not only on theory but on practical algorithms to achieve the very high levels of security and reliability promised by information theory. The PI and collaborations: About half of the work in this proposal will be done with collaborators in Europe connected to the Georgia Tech Lorraine (GTL) campus in Metz, France where the PI was formerly Director of Research and currently Deputy Director. In March 2006, the PI and his colleagues, in partnership with the French Centre National de Recherche Scientifique (CNRS), established a joint research center dedicated to international collaborations in secure networks and advanced materials, the first such center of its kind in France. This center hosts fifteen people and ten projects from four institutions. The wireless portion of this proposal will be done in collaboration with colleagues at the University of Porto (J. Barros) and Cambridge University (M. Rodrigues). The international component of our project																											1			X						########	
NSF	CISE 0634973 / Rutgers University New Brunswick	18.012	Cooperation and Conflict: Coalitional Games in Spectrum Sharing	Mandayam, Narayan Rutgers Univ New Brunswick Cooperation and Conflict: Coalitional Games in Spectrum Sharing Cooperative communication techniques hold the promise of promoting efficient spectrum sharing and a good deal of important research has studied approaches such as collaborative signal processing, cooperative coding, relaying and forwarding. What is perhaps less generally considered in research studies is that cooperation may involve significant costs, and that the greatest immediate benefits will not necessarily go to the users that bear the greatest immediate cost. For example, cooperation may require that a terminal delay its own transmissions and use its limited energy budget to relay messages for other terminals. Moreover, even if there were no added cost in terms of energy or delay, the rules by which the benefit is distributed may create yet another type of disincentive to cooperation. Thus, even in the absence of any transaction costs for cooperation, the aggregate benefits of user cooperation can only be realized through techniques that provide adequate incentives to each user, and for each transaction. This project is using coalitional game theory as a framework to provide significant insight into																									1					X						########	

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NSF	CISE 0634979 / University of Texas at Austin	1.091	Collaborative Research: Cognitive Ad Hoc Networks: Capacity Optimization Through Local Adaptation	Title: Collaborative Research: Cognitive Ad Hoc Networks: Capacity Optimization Through Local Adaptation 0635003, Weber 0634979, Andrews 0634763, Jindal Due to the unpredictability of the environment in which unplanned (ad hoc) wireless networks will operate, an appealing approach is to allow the network to dynamically adapt to the perceived conditions. We define such ad hoc networks as cognitive. A framework is developed for understanding the benefits of local adaptation, by breaking adaptive techniques into the four major degrees of freedom available to the designer: time, frequency, code, and space. The aim is to address the following two questions. First, what are the fundamental limits on information flow through unplanned networks; in particular, how valuable is localized information and coordination in seeking to achieve this limit? Second, what are the relative values of adaptation in time, space, frequency, and code in terms of information flow; in particular, how does the network designer identify which degree of freedom is most valuable in a variety of networking scenarios? In this research, information theory and stochastic geometry are connected through a novel metric for ad hoc											1																			X						#######	
NSF	CISE 0635003 / Drexel University	12.053	Collaborative Research: Cognitive Ad Hoc Networks: Capacity Optimization Through Local Adaptation	Title: Collaborative Research: Cognitive Ad Hoc Networks: Capacity Optimization Through Local Adaptation 0635003, Weber 0634979, Andrews 0634763, Jindal Due to the unpredictability of the environment in which unplanned (ad hoc) wireless networks will operate, an appealing approach is to allow the network to dynamically adapt to the perceived conditions. We define such ad hoc networks as cognitive. A framework is developed for understanding the benefits of local adaptation, by breaking adaptive techniques into the four major degrees of freedom available to the designer: time, frequency, code, and space. The aim is to address the following two questions. First, what are the fundamental limits on information flow through unplanned networks; in particular, how valuable is localized information and coordination in seeking to achieve this limit? Second, what are the relative values of adaptation in time, space, frequency, and code in terms of information flow; in particular, how does the network designer identify which degree of freedom is most valuable in a variety of networking scenarios? In this research, information theory and stochastic geometry are connected through a novel metric for ad hoc																					1									X						#######	
NSF	CISE 0635048 / University of California-San Diego	12.169	Wave diversity in wireless communication	Methods to exploit the diversity of propagating waves are crucial to the efficient operation of wireless communication systems. Such diversity occurs along two different dimensions: space and time. Both of them pose fundamental limits on the amount of information that can be carried by electromagnetic radiation. This project attempts to present a unified view of these separate axes, based on the physical notion of space frequency spectrum of the propagating field, and to draw connections between the fields of information theory and electromagnetic theory. More specifically, the project defines the concept of information transmission in a multiple antenna channel from physical principles, and investigates how the amount of information transported over the channel to the receiver depends on both the spatial and the frequency bandwidth of the radiating system composed by the transmitting antennas and the scattering objects present in the environment. The spatial information content is quantified in a similar fashion than its temporal counterpart, by reducing the inverse problem of field reconstruction to a communication problem in space, and determining the relevant communication																					1									X						#######	

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NSF	CISE 0635165 / University of California-San Diego	1.021	Video Coding for Cognitive Radio	To achieve more efficient spectrum utilization, the FCC has been revisiting traditional license-based policies and moving toward the increased use of unlicensed, rule-based, strategies. In this scenario, attention is being given to cognitive radio, which uses spectrum on an opportunistic basis. The investigators study the design and performance evaluation of algorithms for the transmission of real-time video over cognitive radio channels. Since this technology involves sharing common spectrum, one key question is how much interference its deployment will impose upon the primary users' signals occupying the band. The investigation involves designing specific compression algorithms for video transmission over an opportunistically-used channel, and determining end-to-end performance in terms of video quality. The goal of a cognitive radio is to increase the spectral efficiency of allocated spectral bands by opportunistically making use of spectrum that is temporarily free of traffic. This is accomplished by sensing the channel, and adapting parameters of the transmit waveform such as modulation format, power, bandwidth, frequency location, and code rate. This research takes a cross layer												1																		X						########	
NSF	CISE 0635177 / Polytechnic University of New York	12.088	Joint Source and Channel Coding for Wireless Networks	Wireless network design poses several challenges that do not exist in wired networks. The wireless medium suffers from random time variations, the broadcast nature of wireless signals causes interference, the wireless spectrum is limited and mobile terminals have small batteries. These features become especially limiting for applications such as multimedia over wireless and low power sensor networks, where maintaining the end-to-end signal quality given the specific system resources is difficult. This research outlines a cross-layer approach between the application layer and the physical layer to address these problems. The objective is to design joint source and channel coding techniques to minimize the end-to-end source distortion. A general source and channel separation theorem for wireless networks does not exist; optimality of Shannon's separate source and channel code design fails for non-ergodic fading channels or for multiuser communication systems. On the other hand, even when source and channel separation is not optimal, it is desirable to have only a loose coupling between the source and channel coders to simplify the designs. The research addresses joint source and channel																					1										X						########	
NSF	CISE 0635191 / Massachusetts Institute of Technology	1.006	Collaborative Research: MIMO Networking: From Principles to Protocols	Recent years have seen the advent of sophisticated multiple-input, multiple-output (MIMO) technology for communication networks. Achieving the substantial performance gains promised by such technology requires not only the development of suitable network protocols, but also rethinking aspects of the associated network architecture based on careful consideration of issues that transcend individual layers in the hierarchy. To date, most effort has focused on the physical and medium-access layers, emphasizing coding and multiplexing issues. However, there is an emerging appreciation that the issues at the higher networking layers are at least as important and equally rich, and that the associated broader view of MIMO network design challenge is critical to realizing the performance potential of this technology. The proposed research is aimed at precisely these challenges, and will start from fundamental principles to the develop key insights from which efficient and robust networking protocols and resource management algorithms will follow. With the strong interest in the development of standards such as 802.16 and 802.11n, among many others, such research is especially timely and the potential for												1																		X						########	

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NSF	CISE 0635242 / Ohio State University Research Foundation -DO NOT USE	1.008	Collaborative Research: MIMO Networking: From Principles to Protocols	Recent years have seen the advent of sophisticated multiple-input, multiple-output (MIMO) technology for communication networks. Achieving the substantial performance gains promised by such technology requires not only the development of suitable network protocols, but also rethinking aspects of the associated network architecture based on careful consideration of issues that transcend individual layers in the hierarchy. To date, most effort has focused on the physical and medium-access layers, emphasizing coding and multiplexing issues. However, there is an emerging appreciation that the issues at the higher networking layers are at least as important and equally rich, and that the associated broader view of MIMO network design challenge is critical to realizing the performance potential of this technology. The proposed research is aimed at precisely these challenges, and will start from fundamental principles to the develop key insights from which efficient and robust networking protocols and resource management algorithms will follow. With the strong interest in the development of standards such as 802.16 and 802.11n, among many others, such research is especially timely and the potential for											1																			X						########	
NSF	CISE 0643954 / University of Illinois at Chicago	12.027	CAREER: Etiquette for Collaborative Communication and Networking	CAREER: Etiquette for Collaborative Communications and Networking NSF 0643954, PI: Daniela Tuninetti Abstract Wireless networks have traditionally been deployed with interference avoidance as the primary objective to ensure high throughput. Recently, a new and exciting paradigm has emerged in which interfering communications from different users are viewed as a way to spread "common information" across the network, thereby allowing for cooperation among otherwise uncoordinated transmitters. Cooperative communications holds the potential to enhance the communication capabilities of all users in the network simultaneously if users share their resources with their neighbors. This research aims at establish a theoretical foundation for collaborative communications by identifying the optimal resource sharing conduct, here referred to as etiquette, among users in peer-to-peer wireless networks. It is centered on the interference channel with generalized feedback, a novel information-theoretic network model that incorporates the knowledge a communicating pair of users can infer about other concurrent communications from information overheard. This research has two main																						1									X						########	
NSF	CISE 0644056 / Michigan Technological University	2.037	CAREER: Research on Real-time Robust and Secure Communications for Vehicular Ad Hoc Networks	CAREER: Research on Real-time Robust and Secure Communications for Vehicular Ad Hoc Networks This CAREER project is motivated by the belief that Vehicular Ad Hoc Networks (VANETs) based inter-vehicle communications could enhance traffic safety and traffic operation. VANET networks differ from general mobile ad hoc networks (MANET) because of the stringent requirements on real-time, robust, and secure communications and coordination in a critical highly dynamic environment. Building on research concerning run-time static relative-position relation among neighboring vehicles, this project addresses the major challenges in access technology, dynamic power control, robust multi-hop communication, and security and privacy provisioning. In particular, this project will develop new approaches to access technology enabling high channel availability over dynamic multi-path wireless channels, delay-bounded dynamic power control augmenting real-time communications over high mobility, robust multi-hop message disseminations in the presence of frequent fragmentations, and security implementation promoting cooperative communication and balancing privacy and security. It is envisioned that																			1											X						########	

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NSF	CISE 0644192 / Drexel University	12.025	CAREER: Coordinating Autonomous Agents via Distributed Constraint Reasoning	This CAREER project will develop representations and reasoning algorithms for Distributed Constraint Reasoning (DCR) to support the coordination of autonomous agents operating in real-time, open and large-scale real-world environments. The extension to existing DCR algorithms is the use of intelligent clustering of autonomous agents to reduce the time to find a solution. The research plan will result in a publicly available toolkit of DCR algorithm implementations, a common DCR algorithm evaluation environment, and a library of benchmark DCR models and datasets of real-world applications that will greatly facilitate the design and use of DCR algorithms. The critical need addressed in this research project is for representations, domain modeling techniques, and efficient algorithms for allowing loosely-coupled agents to coordinate effectively through distributed reasoning about interactions between individual agent decisions. The specific issues addressed are: time limitations, and privacy and security. This project investigates how to design algorithms that allow agents to tradeoff solution quality for computation time in domains where time is limited. This project investigates bottom-up clustering as a key																		1											X						$ -	
NSF	CISE 0644247 / Old Dominion University Research Foundation	12.026	CAREER: Distributed Broadcasting Protocols for Multi-Radio Multi-Channel and Multi-Rate Ad Hoc Mesh Networks	A vast array of broadcasting protocols has been developed to alleviate the Broadcast Storm Problem for single-radio single-channel and single-rate wireless networks. The emergence of Multi-radio Multi-channel and Multi-rate Mesh (M4) networks, however, brings a lot of new challenges, such as channel assignment, adjacent-channel interference, and network capacity. This project focuses on the design, analysis, and implementation of distributed broadcasting protocols for M4 networks. Challenges such as channel assessment and assignment, interference-aware metric design, transmission rate control, broadcasting tree construction, etc., are to be considered. In-depth theoretical analysis, simulations, and real-world network experiments are also conducted to evaluate the broadcasting protocols. This project also explores several educational innovations. These include the development of a novel three-layer teaching structure, efficient pedagogical approaches, and effective means of incorporating research into learning and education. As one important component of this project, outreach activities are developed for underrepresented minorities from local high schools with the aim of improving their																		1											X						########	
NSF	CISE 0650048 / University of California-San Diego	1.116	SGER: The CogNet (Cognitive Complete Knowledge Network) System	SGER: CogNet (Cognitive Complete Knowledge Network) System Award 0650048 Ramesh Rao The Cognitive Complete Knowledge Network (CogNet) system combines advances in storage, network connectivity, and device capability, with advances in analytical approaches to make next generation wireless systems refine their performance throughout the lifetime of their deployment. The CogNet architecture exploits the availability of low cost "some time some where" communications to asynchronously and automatically gather large amounts of user data by enlisting users, devices, and even the whole network as probes. The information gathered is derived from the radio state, network state, environment state, and user profiles, and is spatio-temporally tagged and archived in a distributed repository and made available to the community of participants. A user in a particular spatio-temporal region could learn about typical usage, others' experiences, network conditions, and protocol parameters by querying this repository and tune or adapt itself to achieve the desired quality of service. We use stochastic analysis, algorithm development, performance analysis and														1															X						########	

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NSF	CISE 0708469 / Wright State University	3.008	CRI: IAD Instrumentation of a Measurement and Test System for Open Spectrum Wireless Communication and Networking	Proposal #: CNS 07-08469 PI(s): Wang, Bin Bei, Yong; Wu, Zhiqiang Institution: Wright State University Dayton, OH 45435-0001 Title: IAD: Instr. of Measurement and Test System for Open Spectrum Wireless Communication and Networking Project Proposed: This project, instrumenting a complete measurement and test system for open spectrum wireless communication and networking research, addresses 1.Intelligent soft-decision cognitive sensing paradigm, 2.Spectrum mobility and routing schemes via proactive spectrum access, and 3.Cross-layer design approaches for providing differential quality-of-service (QoS) and quality assured multimedia services over next generation wireless networks. Providing hands-on experience, the instrument will serve as a tool for education and training students for their capstone design projects and for independent research projects. Enhancing curricula, the project facilitates research and education in wireless communication, cross-layer design, dynamic spectrum access, cognitive radio, sensor networks, and multimedia services over wireless. The project also facilitates development and demonstration of a software defined radio-				1																									X							#######	
NSF	CISE 0708989 / Polytechnic University of New York	3.007	CRI: IAD Cooperative Networking Testbed	Proposal #: CNS 07-08989 PI(s): Erkip, Elza Bertoni, Henry L.; Panwar, Shivendra S.; Wang, Yao Institution: Polytechnic University of New York Brooklyn, NY 11201-3840 Title: IAD: Cooperative Networking Testbed Amount Rec: $ 300,000 Project Proposed: This project, building two complementary testbeds for cooperative networking, responds to the fading and multipath distortion, as well as interference caused by multiple users operating over a limited bandwidth, often suffered by wireless communication systems. Respectively, each testbeds will 1.Use open source drivers for backward compatibility with the current WiFi technology based on the IEEE 802.11 standard. This approach uses a standard, non-cooperative physical layer since it is not possible to access the physical layer in commercial products. 2.Be based on software defined radio, allowing maximum flexibility in the implementation of a cooperative physical layer, a cooperative medium access control (MAC) layer as well as cross-layer design. Cooperative networking, where two or more active users in the network share their resources to jointly transmit their messages, provides resistance to fading, high				1																									X							#######	
NSF	CISE 0709001 / University of Massachusetts Lowell	12.065	CRI: IAD: Programmable Network Infrastructure with Emerging Technologies	The proposed project aims to build a programmable network infrastructure for advancing research and education in areas of computer network and wireless communication technologies at the University of Massachusetts Lowell. This infrastructure provides an extensible network test bed that is highly desirable in network research and education, but not yet available from conventional off-the-shelf network devices. The objective of the project is to build a programmable network platform for collaborative research and education. In particular, this research will (1) construct a network infrastructure with programmable components for experimenting new network designs; (2) study the programmability of the infrastructure and evaluate its performance on network processing; (3) apply the infrastructure in a broad range of research topics, including network security, network processor design, and dynamic spectrum sharing; (4) integrate experiment, theory and computational research in networks and communications into educational modules. The proposed programmable network infrastructure is a customized network infrastructure equipped with high-speed wired switches, wireless routers with																					1								X							#######	

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NSF	CISE 0709044 / Northeastern University	2.005	CRI: IAD Equipment for Cross-Layer Wireless Protocols Design and Prototyping	Proposal #: CNS 07-09044 PI(s): Guevara Noubir Institution: Northeastern University Boston, Ma 02115-5005 Title: IAD Equipment for Cross-Layer Wireless Protocols Design and Prototyping Project Proposed: This project, developing and implementing a networking technology leading to "ambient intelligence," requests test and measurement equipment to develop further a current project on heterogeneous wireless networks. The work aims to empower people through an appropriately designed robust and secure digital environment that is aware of their location, context, and needs. In order to enable ubiquitous computing in practice, it is essential to build robust, scalable, and secure wireless networks that can accommodate a wide variety of mobile devices. Prototyping and experimentation serve to validate the developed protocols. A set of radio-frequency instruments enables the following research endeavors: . Better and faster testing, debugging, and troubleshooting of RF boards; . Digitizing and generating signals at arbitrary frequencies; and . Accurate signal measurement and signal generation Broader Impacts: The work impacts society															1														X						#######	
NSF	CISE 0709264 / University of California-Davis	3.033	CRI: CRD -- QuRiNet: A Wide-Area Outdoor Wireless Mesh Test-Bed	Proposal #: CNS 07-09264 PI(s): Mohapatra, Prasant Boucher, Virginia; Liu, Xin Institution: University of California - Davis Davis, Ca 95618-0000 Title: CRD: QuRiNet: A Wide-Area Outdoor Wireless Mesh Test-Bed Project Proposed: This project, building an outdoor mesh Network so that the testbed is an interference free environment, facilitates access, provides measurement data and evaluation results. The testbed complements other testbeds deployed in environments susceptible to external interference. Wireless mesh networks (WMNs) have seen increased deployments in the areas of broadband home networking and enterprise networking. In addition, they are also being deployed at the community and municipal level, for extended service provider coverage to end users, and in areas lacking wired infrastructure. This project supports expanding the size, scope, performance, and robustness of current network, and facilitating the access and usability as a community resource. Quail Ridge, used for environmental research by the ecologists at UC Davis, is part of the University of California Natural Reserve System (NRS). The project continues ongoing efforts in the deployment of the				1																									X						#######	
NSF	CISE 0711094 / Illinois Institute of Technology	4.004	NeTS - SGER - Chicago Spectrum Observatory Proposal	This research: (1) creates and deploys a spectrum observatory platform to collect spectral occupancy data (30 MHz to 3 GHz) for Chicago for one year; (2) analyzes the data on a weekly basis to identify anomalies (occupancy and vacancy); (3) projects future spectrum occupancy, including seasonal trends; and (4) results in a wide distribution of the findings to the wireless R&D and regulatory communities via the Web, workshops, conference and journal papers. This research provides a quantum enhancement in the raw quantity and quality of the spectrum occupancy information available to wireless researchers and regulators. This grant supports collaborative research across and between academia, industry, and government entities enabling the rapid development of new wireless devices and networking concepts. In turn, the availability of this information and the techniques used provide a useful education platform, initially supporting graduate education at IIT. Minority students and women are engaged in the research, thereby deriving the ongoing benefit from this new knowledge. The US government communications policy-makers derive the greatest early benefit from this research.													1																X						#######	

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NSF	CISE 0716208 / Virginia Polytechnic Institute and State University	1.112	Collaborative Research: CT-T: TRIESTE: A Trusted Radio Infrastructure for Enforcing Spectrum Etiquettes	Most commercial wireless devices do not make lower-layer properties (e.g., raw waveform-level samples from an analog-to-digital converter) accessible to users. Recently, however, the research community has directed its attention towards the development of cognitive radios that will expose the lower-layers of the protocol stack to researchers and developers. Although the promise of such a flexible platform is great, there are also some serious potential security drawbacks. It is easily conceivable that cognitive radios could become an ideal platform for abuse since the lowest layers of the protocol stack will be accessible to programmers in an open-source manner. The proposed project addresses these concerns by focusing on two important building blocks needed in constructing a holistic solution to ensuring the trustworthy operation of software radios: first, the investigating team plans to develop tools to quantify the degree to which spectrum etiquette policies are abused in a network of cognitive radios and, second, the team plans to investigate methods for identifying such spectrum abuse, which is necessary in order to drive anomaly detection and response mechanisms. Overall, the broader impact of										1																			X						########	
NSF	CISE 0716311 / University of Maryland College Park	17.007	Collaborative Research: CT-ISG: Secure Capacity of Wireless Networks	Collaborative Research: CT-ISG: Secure Capacity of Wireless Networks The last decade has witnessed an amazing growth in wireless communications and networking applications. More and more subscribers are relying solely on their wireless communication and computing devices for communicating sensitive information. Preserving the security of wirelessly transmitted information is becoming ever more challenging, yet essential. This important issue is currently dealt with at the higher layers of the protocol hierarchies, yet the need to deal with it in physical layer is imminent as the security of many cryptographic algorithms is hard to evaluate and has caused disappointment in the past. In addition, there is rising interest in large networks of low-complexity transmitters including sensor nodes and RF-ID tags that may not have room for complicated and computationally intensive cryptographic algorithms. The main design goal up to date, for wireless communications and networking at the lower protocol layers, has been to provide high data rate, reliable communication to as many users as possible, by efficiently dealing with the challenges of the radio channel and sharing limited wireless resources. Capacity																											1			X						########	
NSF	CISE 0716325 / Pennsylvania State Univ University Park	17.008	Collaborative Research: CT-ISG: Secure Capacity of Wireless Networks	Collaborative Research: CT-ISG: Secure Capacity of Wireless Networks The last decade has witnessed an amazing growth in wireless communications and networking applications. More and more subscribers are relying solely on their wireless communication and computing devices for communicating sensitive information. Preserving the security of wirelessly transmitted information is becoming ever more challenging, yet essential. This important issue is currently dealt with at the higher layers of the protocol hierarchies, yet the need to deal with it in physical layer is imminent as the security of many cryptographic algorithms is hard to evaluate and has caused disappointment in the past. In addition, there is rising interest in large networks of low-complexity transmitters including sensor nodes and RF-ID tags that may not have room for complicated and computationally intensive cryptographic algorithms. The main design goal up to date, for wireless communications and networking at the lower protocol layers, has been to provide high data rate, reliable communication to as many users as possible, by efficiently dealing with the challenges of the radio channel and sharing limited wireless resources. Capacity																											1			X						########	

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NSF	CISE 0716400 / Rutgers University New Brunswick	1.002	Collaborative Research: CT-T: TRIESTE: A Trusted Radio Infrastructure for Enforcing Spectrum Etiquettes	Most commercial wireless devices do not make lower-layer properties (e.g., raw waveform-level samples from an analog-to-digital converter) accessible to users. Recently, however, the research community has directed its attention towards the development of cognitive radios that will expose the lower-layers of the protocol stack to researchers and developers. Although the promise of such a flexible platform is great, there are also some serious potential security drawbacks. It is easily conceivable that cognitive radios could become an ideal platform for abuse since the lowest layers of the protocol stack will be accessible to programmers in an open-source manner. The proposed project addresses these concerns by focusing on two important building blocks needed in constructing a holistic solution to ensuring the trustworthy operation of software radios: first, the investigating team plans to develop tools to quantify the degree to which spectrum etiquette policies are abused in a network of cognitive radios and, second, the team plans to investigate methods for identifying such spectrum abuse, which is necessary in order to drive anomaly detection and response mechanisms. Overall, the broader impact of										1																			X						########	
NSF	CISE 0721230 / Argon ST Network Systems	12.138	NeTS-WN: Collaborative Research: Toward High-Performance Mesh Networks	This project studies three fundamental problems to improve the performance of wireless mesh networks. (1) Managing delay and jitter. One fundamental problem affecting the performance of current mesh networks is the hop-by-hop relaying of data, resulting in significant per-hop and per-packet delay and/or jitter. This project designs a new MAC paradigm and a distributed method of scheduling data transmissions in a path-aware manner, to eliminate per-packet delay and jitter while minimizing per-hop delays. (2) Capacity analysis and utility optimization. As an augmentation to the large amount of simulation studies on multi-channel multi-radio mesh networks, this project develops a general theoretical model to analyze both unicast and broadcast capacities of mesh networks, and applies the model to optimally assign channels to maximize capacity, as well as optimizing application-specific utility functions relevant to user-perceived network performance. (3) Channel assignment for dynamic spectrum access mesh networks. Recent advancement in cognitive radio technology and regulatory reform in spectrum policy offer dynamic spectrum access (DSA) capability to mesh networks via providing dynamically																						1								X						########	
NSF	CISE 0721308 / University of Pennsylvania	18.01	Collaborative Research: WN: Management of Secondary Markets in Deregulated Wireless Networks	A global regulatory effort is underway to allow secondary spectrum trading by license holders and flexible access by end-users. Preliminary evidence in early incarnations of secondary spectrum markets indicates a sophisticated market structure and suggests that realizing full potential of deregulated spectrum entails overcoming fundamental technical and economic challenges. This project has the following research objectives: (i) Development of pricing strategies that capture network-wide effects of interference and that render secondary spectrum markets profitable for license holders; (ii) Design of market rules that facilitate new entrants and improve end-user perception in economic and performance terms; (iii) Development of resource discovery and monitoring algorithms that allow market participants to efficiently and securely utilize network services. These objectives are pursued in an integrated analytical framework that includes techniques of dynamic stochastic optimization, game theory, incentive engineering and tractable teletraffic modeling of large wireless networks. This project promotes healthy deregulation of the wireless communication sector and shows promise for societal impact in view of																									1					X						########	

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NSF	CISE 0721313 / Norfolk State University	12.139	NeTS-WN: Collaborative Research: Toward High-Performance Mesh Networks	This project studies three fundamental problems to improve the performance of wireless mesh networks. (1) Managing delay and jitter. One fundamental problem affecting the performance of current mesh networks is the hop-by-hop relaying of data, resulting in significant per-hop and per-packet delay and/or jitter. This project designs a new MAC paradigm and a distributed method of scheduling data transmissions in a path-aware manner, to eliminate per-packet delay and jitter while minimizing per-hop delays. (2) Capacity analysis and utility optimization. As an augmentation to the large amount of simulation studies on multi-channel multi-radio mesh networks, this project develops a general theoretical model to analyze both unicast and broadcast capacities of mesh networks, and applies the model to optimally assign channels to maximize capacity, as well as optimizing application-specific utility functions relevant to user-perceived network performance. (3) Channel assignment for dynamic spectrum access mesh networks. Recent advancement in cognitive radio technology and regulatory reform in spectrum policy offer dynamic spectrum access (DSA) capability to mesh networks via providing dynamically																		1											X						########	
NSF	CISE 0721361 / University of Delaware	12.14	NeTS-WN: Collaborative Research: Toward High-Performance Mesh Networks	This project studies three fundamental problems to improve the performance of wireless mesh networks. (1) Managing delay and jitter. One fundamental problem affecting the performance of current mesh networks is the hop-by-hop relaying of data, resulting in significant per-hop and per-packet delay and/or jitter. This project designs a new MAC paradigm and a distributed method of scheduling data transmissions in a path-aware manner, to eliminate per-packet delay and jitter while minimizing per-hop delays. (2) Capacity analysis and utility optimization. As an augmentation to the large amount of simulation studies on multi-channel multi-radio mesh networks, this project develops a general theoretical model to analyze both unicast and broadcast capacities of mesh networks, and applies the model to optimally assign channels to maximize capacity, as well as optimizing application-specific utility functions relevant to user-perceived network performance. (3) Channel assignment for dynamic spectrum access mesh networks. Recent advancement in cognitive radio technology and regulatory reform in spectrum policy offer dynamic spectrum access (DSA) capability to mesh networks via providing dynamically																		1											X						########	
NSF	CISE 0721421 / Virginia Polytechnic Institute and State University	1.092	NeTS-WN: Capacity Problems for MIMO-Enabled Wireless Mesh Networks	Recent advances in multiple-input-multiple-output (MIMO) technology show that much higher spectrum efficiency and capacity gain can be achieved by the use of multiple antennas at a node. The benefits of substantial improvement in capacity at no cost to additional spectrums have positioned MIMO as a breakthrough technology in wireless communications. Although MIMO is an active research area in the wireless communications community, there is very limited knowledge on how to apply MIMO technologies to improve network capacity in a multi-hop wireless network environment, perhaps because unlike existing wireless mesh networks, which are conceptually simple and relatively easy to characterize, the mathematical characterization of a MIMO-based mesh network involves space domain and requires complex matrix operations. Specifically, the unique MIMO channel matrix and potential spatial multiplexing introduce new research problems at multiple layers. This project aims to systematically address fundamental theories and algorithms for future MIMO-enabled mesh networks. Specifically, there are three main thrusts in this project: (1) developing tractable cross-layer matrix representation and theoretical models from													1																X						########	

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NSF	CISE 0721433 / Lehigh University	12.134	NeTS-WN: Collaborative Research: Cognition, Collaboration, and Competition in Hybrid Wireless Networks	The wireless network of the future is envisioned to be a seamless integration of several existing and emerging wireless networks. A key enabler for this network of the future is the cognitive software defined radio (SDR) which takes advantage of programmable hardware modules to dynamically and adaptively modify the functionality of various radio subsystems. The goal of this research is to facilitate seamless integration of wireless networks where information sent from a source to a destination can traverse multiple links that belong to heterogeneous underlying networks. The design and operation of the resulting hybrid wireless network is determined by three characteristics of future software defined radios: Cognition, Collaboration, and Competition. Research results will demonstrate how inherently competitive SDRs (i) work together to learn about current local network conditions; and (ii) use this information to construct adaptive links and routes across these local networks (and "non-networks") so that end-to end quality of service requirements are met. Specific research outcomes will include distributed, collaborative algorithms that aid cognitive SDRs in spectrum sensing and hybrid wireless network formation.																		1											X						########	
NSF	CISE 0721445 / Pennsylvania State Univ University Park	12.135	NeTS-WN: Collaborative Research: Cognition, Collaboration, and Competition in Hybrid Wireless Networks	The wireless network of the future is envisioned to be a seamless integration of several existing and emerging wireless networks. A key enabler for this network of the future is the cognitive software defined radio (SDR) which takes advantage of programmable hardware modules to dynamically and adaptively modify the functionality of various radio subsystems. The goal of this research is to facilitate seamless integration of wireless networks where information sent from a source to a destination can traverse multiple links that belong to heterogeneous underlying networks. The design and operation of the resulting hybrid wireless network is determined by three characteristics of future software defined radios: Cognition, Collaboration, and Competition. Research results will demonstrate how inherently competitive SDRs (i) work together to learn about current local network conditions; and (ii) use this information to construct adaptive links and routes across these local networks (and "non-networks") so that end-to end quality of service requirements are met. Specific research outcomes will include distributed, collaborative algorithms that aid cognitive SDRs in spectrum sensing and hybrid wireless network formation.																		1											X						########	
NSF	CISE 0721529 / University of Michigan Ann Arbor	1.098	NeTS-WN: Opportunistic Bandwidth Sharing Using MIMO: Beyond Time and Frequency	There is an expected shortage in bandwidth resources due to the recent success of, and hence the explosive demand for, wireless services and networks. This expected shortage is not so much due to the scarcity of bandwidth, but due to its inefficient use. There exist plenty of ``opportunities'' available along time and frequency dimensions that wireless networks can potentially exploit. It is therefore important to develop a new way of exploiting these opportunities effectively and efficiently. Recent technological advances make it possible to realize SDRs (Software-Defined Radios) or smart radios that, unlike traditional radios, can switch from one frequency to another at minimum cost, thereby enabling "opportunistic" spectrum access along time and frequency dimensions. SDRs empower next-generation wireless networks with adaptive and dynamic multi-band access, but introduce several unique cross-layer challenges. On the other hand, the newly-emerging MIMO (Multiple-Input Multiple-Output) technology has great potential for significant throughput enhancements, better interference suppression, and substantial energy savings. SDRs and MIMOs together form a complete means of													1																	X						########	

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NSF	CISE 0721545 / Pennsylvania State Univ University Park	18.026	WN: Collaborative Research: Management of Secondary Markets in Deregulated Wireless Networks	A global regulatory effort is underway to allow secondary spectrum trading by license holders and flexible access by end-users. Preliminary evidence in early incarnations of secondary spectrum markets indicates a sophisticated market structure and suggests that realizing full potential of deregulated spectrum entails overcoming fundamental technical and economic challenges. This project has the following research objectives: (i) Development of pricing strategies that capture network-wide effects of interference and that render secondary spectrum markets profitable for license holders; (ii) Design of market rules that facilitate new entrants and improve end-user perception in economic and performance terms; (iii) Development of resource discovery and monitoring algorithms that allow market participants to efficiently and securely utilize network services. These objectives are pursued in an integrated analytical framework that includes techniques of dynamic stochastic optimization, game theory, incentive engineering and tractable teletraffic modeling of large wireless networks. This project promotes healthy deregulation of the wireless communication sector and shows promise for societal impact in view of																							1						X							########	
NSF	CISE 0721570 / Virginia Polytechnic Institute and State University	1.097	NeTS-WN: Network Performance Limits for Future Cognitive Radio Networks	As cognitive radio (CR) technology becomes more mature in the near future, it is not hard to foresee that CR will eventually play a pivotal role in wireless networking, such as mesh and ad hoc networks. However, due to its unique characteristics in spectrum usage, a CR network differs significantly from the existing multi-channel multi-radio (MCMR) network. As a result, networking problems for CR networks are much more challenging and interesting. A major objective of this project is to develop network theoretical bounds and performance limits for future cognitive radio networks. Such efforts are not only of theoretical interest, but also offer fundamental understanding of the potential and limits of such networks, as well as provide performance benchmarks for the design and evaluation of distributed algorithms and protocols. New performance metrics such as Bandwidth-Footprint Product (BFP), which is unique to CR, will be employed, along with traditional performance metrics (e.g., network capacity). Special consideration will be given to interference modeling, power control, scheduling, and routing. An analytical framework will be developed that allows one to unify the multi-dimensional cross-												1																		X							########	
NSF	CISE 0721580 / GA Tech Research Corporation - GA Institute of Technology	16.036	NeTS-WN: COGNET: Cognitive Radio Networks based on OFDM	Cognitive radio networks enable the sharing of the wireless spectrum with licensed users, but impose challenges due to the fluctuating nature of the spectrum as well as the diverse quality-of-service (QoS) requirements. To address these challenges, a spectrum-aware COGnitive radio NETwork (COGNET) based on orthogonal frequency division multiplexing (OFDM) is proposed. In COGNET, five major research directions are investigated: (1) First, a frequency agile, wideband analog/RF front-end technology is developed, which is robust to non-linearity (RF/analog IC design). (2) To detect the presence of licensed users, a fast detection scheme is developed by exploiting the spatial diversity inherent to multi-user networks (spectrum sensing), (3) To select the best channel, novel decision methods are proposed that consider channel information, licensed user activities, and application requirements (spectrum decision). (4) A dual-mode spectrum sharing framework is proposed, which enables access to existing networks as well as coordination between cognitive radio users (spectrum sharing). (5) A spectrum mobility management framework is proposed to achieve efficient operations as cognitive users switch between the channels when a																		1												X							########	

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NSF	CISE 0721604 / Vanderbilt University	2.04	Radio Interferometric Tracking of Wireless Nodes Indoors	The project aims at developing the foundations and the technology required for fine-grain indoor localization of wireless nodes using radio interferometry. Specifically, the project will develop a propagation model for radio interference signals in severe Multipath environments and an allocation strategy of frequency bands and channels to minimize RF multipath effects, maximize accuracy, and minimize measurement time. The project will also investigate how localization algorithms could work with linear combinations of distances of four nodes provided by the interferometric measurements as opposed to traditional pair-wise range estimates. The expected results of the research are a set of ranging, localization, and tracking services that achieve high precision localization even indoors and a corresponding reference implementation on an existing hardware platform. The implementation will enable extensive experimentation to gain additional insight into different reverberant environments as well as to validate the theoretical results under a range of different real-world conditions. The results can potentially enable many location-aware applications, such as accurate asset tracking																1													X						#######	
NSF	CISE 0721652 / University of Illinois at Urbana-Champaign	12.136	NeTS-WN: Collaborative Research: Interference Management and Cooperation in Wireless Networks: A Modern View	Two important features distinguish wireless communication from wireline communication: the time-variations of the wireless links and the broadcast property of wireless transmissions. In the past decade, a new fundamental understanding of time-variations from an information theoretic point of view has developed. This understanding has led to radical shifts in points of view regarding wireless system design, not only at the physical layer but also at higher layers. In contrast, the progress in a fundamental understanding of the broadcast nature of wireless links has been far slower. Most of the techniques that exist as implemented in current wireless networks to deal with interference and cooperation are ad hoc. In this project we focus on the broadcast nature of the wireless link by taking a cue from the success in dealing with the time varying nature of the wireless link: true progress in wireless communication comes from a synthesis of a fundamental and information theoretic understanding into networking ideas. We propose to (a) obtain a fundamental understanding of how to optimally manage interference and achieve cooperation, (b) build an abstraction of the physical layer that captures the																					1								X						#######	
NSF	CISE 0721744 / University of Florida	12.13	NeTS-WN: A Novel Cross-layer Design Approach for Wireless Ad Hoc Networks	Increasing demand for high data rate applications, such as multimedia services and mobile TV over wireless ad hoc networks, urges researchers to develop more flexible network protocols in order to meet various Quality of Service (QoS) requirements. Unfortunately, the traditional strict layering design approach is no longer effective in wireless ad hoc networks, particularly in the mobile ad hoc networks, and fails to achieve the desired flexibility. Thus, cross-layer network design becomes much more important than ever and should be investigated thoroughly. In this project, the PI carefully selects three research tasks ? joint design of flow/congestion control and medium access control, active collaborative relaying, and opportunistic medium access control and auto rate control ? to demonstrate how cross-layer design should be done and how this design could improve the performance. In all these problems, the medium access control (MAC) layer acts as the anchor point to extract the needed information about the wireless environment to be used for other layers. In so doing, network protocols can be made more adaptive and responsive. It is expected that cross-layer design methodology can be significantly advanced																					1								X						#######	

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NSF	CISE 0721803 / Arizona State University	1.094	NeTS-WN: Collaborative Research: Cross-layer Optimization for Dynamic Spectrum Access Wireless Mesh Networks	In this project, the PIs will focus on the emerging Dynamic Spectrum Access (DSA) Wireless Mesh Networks (WMNs). Cross-layer design is strongly needed for such a network due to its two special features; dynamic spectrum availability and spectrum heterogeneity. Quite different from other well-studied wireless networks, such as mobile ad hoc networks and wireless sensor networks, the major concerns of WMNs are throughput, fairness, and QoS support, instead of mobility support and power efficiency. The PIs plan to conduct a comprehensive study on cross-layer optimization in DSA WMNs, and design protocols under the guidance of this cross-layer optimization. They will concentrate on the bottom four layers of the network stack and seek joint congestion control, routing, spectrum sharing, and power control solutions with the objective of maximizing throughput, achieving certain fairness, and providing QoS support. Furthermore, the research will be conducted under various network models including different interference models, different traffic models, and different fairness models. The INTELLECTUAL MERIT of the project includes (1) a unified mathematical model which precisely characterizes all important											1																			X						#######	
NSF	CISE 0721820 / Arizona State University	12.132	NeTS-WN: Collaborative Research: Channel-Aware Distributed Scheduling for Optimal Throughput and Latency: A Unified PHY/MAC Approach	The design of wireless ad-hoc networks faces a number of unique challenges in wireless communications including 1) co-channel interference among active links in a neighborhood, and 2) time-varying channel conditions over fading channels. Experimental data reveals that, in many realistic scenarios, fading effects can often adversely affect the MAC layer, and the coupling between the timescales of fading and MAC calls for a unified PHY/MAC design. Due to the distributed nature of ad hoc communications, little work has been done to develop channel-aware, distributed scheduling for throughput maximization. There are virtually no systematic studies on channel-aware scheduling for real-time traffic under latency constraints. A principal goal of this project is to fill this void and build a theoretic foundation for channel-aware, distributed scheduling in wireless ad-hoc networks, for both elastic traffic and inelastic traffic. With the goal of developing a framework for unified PHY/MAC optimization, the proposed research consists of three thrusts. The first two thrusts investigate distributed opportunistic scheduling for elastic traffic and focus on throughput maximization from network-centric and user-centric																					1									X						#######	
NSF	CISE 0721826 / Rutgers University New Brunswick	18.021	NeTS-WN: A Joule for your Byte: Barter-Exchange Incentive Mechanisms for Wireless Networks	This project will explore the role of barter-exchange incentives for cooperation in wireless networks. While cooperative wireless techniques show great promise, they also assume a degree of trust and a form of "selfless" behavior that may not be realistic. Cooperating terminals will accrue benefits, but they will also incur costs (wasted battery energy being an obvious example). Over time, benefits might logically be expected to exceed costs for most participants, but in the short term there will be winners and losers, and we cannot realistically assume that enlightened self-interest will prevail. The sizable literature on incentive mechanisms for wireless networks has emphasized abstract mechanisms in which nodes receive some form of credit for helping other nodes. These prior efforts often mimic the operation of a complex economy. In doing so, they illustrate the difficulties inherent in this approach. The efficient operation of a complex economy requires such enablers as a stable currency, a system of credit and credit-worthiness, a shared understanding of what things are worth, and a good deal of record keeping. It may be that this complexity is not warranted here, and that a simpler approach, based on the mechanisms																									1					X						#######	

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NSF	CISE 0721860 / Trustees of Boston University	18.027	WN: Collaborative Research: Management of Secondary Markets in Deregulated Wireless Networks	A global regulatory effort is underway to allow secondary spectrum trading by license holders and flexible access by end-users. Preliminary evidence in early incarnations of secondary spectrum markets indicates a sophisticated market structure and suggests that realizing full potential of deregulated spectrum entails overcoming fundamental technical and economic challenges. This project has the following research objectives: (i) Development of pricing strategies that capture network-wide effects of interference and that render secondary spectrum markets profitable for license holders; (ii) Design of market rules that facilitate new entrants and improve end-user perception in economic and performance terms; (iii) Development of resource discovery and monitoring algorithms that allow market participants to efficiently and securely utilize network services. These objectives are pursued in an integrated analytical framework that includes techniques of dynamic stochastic optimization, game theory, incentive engineering and tractable teletraffic modeling of large wireless networks. This project promotes healthy deregulation of the wireless communication sector and shows promise for societal impact in view of																							1						X							########	
NSF	CISE 0721875 / Johns Hopkins University	12.131	NeTS-WN: Agile Wireless Ad Hoc Networks	The goal of this proposal is developing advanced algorithmic theory that will lead to real-life implementation in wireless networks. In particular, we will experiment with some advanced and algorithmic ideas inspired by the past algorithmic work of the PI. We are going to leverage the practical solutions that we used in the Wave Relay system at Johns Hopkins, which combines two new components: the Pulse Protocol for scalability of routing and topology update, and the Medium Time Metric, which is a routing metric tailored for wireless networks. The Pulse protocol has optimized for large scale and mobility and is better scalability properties than AODV, DSR in simulations. In fact, simulations show Pulse protocol to scale for up to 5,000 mobile nodes. It uses a proactively-constructed tree with on-demand shortcuts on that tree. It can be viewed as combination of proactive and reactive methods. The Medium Time Metric exploits the multi-rate capability of modern wireless devices to minimize consumption of the shared wireless medium. This cross layer approach incorporates per-packet feedback from the physical and medium access control layers to dramatically increase efficiency and elasticity of both																					1								X							########	
NSF	CISE 0721880 / Montana State University	1.096	NeTS-WN: Collaborative Research: Cross-layer Optimization for Dynamic Spectrum Access Wireless Mesh Networks	In this project, the PIs will focus on the emerging Dynamic Spectrum Access (DSA) Wireless Mesh Networks (WMNs). Cross-layer design is strongly needed for such a network due to its two special features; dynamic spectrum availability and spectrum heterogeneity. Quite different from other well-studied wireless networks, such as mobile ad hoc networks and wireless sensor networks, the major concerns of WMNs are throughput, fairness, and QoS support, instead of mobility support and power efficiency. The PIs plan to conduct a comprehensive study on cross-layer optimization in DSA WMNs, and design protocols under the guidance of this cross-layer optimization. They will concentrate on the bottom four layers of the network stack and seek joint congestion control, routing, spectrum sharing, and power control solutions with the objective of maximizing throughput, achieving certain fairness, and providing QoS support. Furthermore, the research will be conducted under various network models including different interference models, different traffic models, and different fairness models. The INTELLECTUAL MERIT of the project includes (1) a unified mathematical model which precisely characterizes all important													1																X							########	

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AGENCY	DEPARTMENT/ DIVISION /LAB/ PROGRAM/ AWARD	Project #	PROJECT TITLE/DESCRIPTION	EXAMPLES	INTENDED APPLICATION ENVIRONMENT (See Attachment C for examples)	EXPECTED FREQUENCY RANGE	**Topic Area**	Topic # 3	Topic # 23	Topic # 19	Topic # 6	Topic # 15	Topic # 7	Topic # 1	Topic # 14	Topic # 11	Topic # 4	Topic # 13	Topic # 16	Topic # 2	Topic # 21	Topic # 22	Topic # 12	Topic # 8	Topic # 5	Topic # 9	Topic # 18	Topic # 17	Topic # 10	Topic # 20	**Maturity**	Basic Research	Applied Research	Advanced Technology Development	Advanced Component Development	Demonstration & Validation	**Funding**	Funded in Past (2006-2010)	Presently Funded (FY11)
NSF	CISE 0721914 / University of Kansas Center for Research Inc	1.099	NeTS-WN: Quantification of Spectrum Availability for Wireless Network Access	To resolve the apparent scarcity of available prime radio spectrum (300 MHz - 3 GHz), the dynamic spectrum access paradigm was proposed to improve spectrum utilization. By enabling temporary, unlicensed wireless access to the unoccupied licensed spectrum, called "spectrum holes", a larger number of wireless transmissions can be supported by the same spectrum while simultaneously respecting the rights of the incumbent license holders. However, this paradigm heavily depends on the location and size of these spectrum holes, which can vary randomly with respect to time, frequency, and geography. The objective of this project is: (i) to accurately characterize the availability of prime spectrum in mid-size US cities, i.e. the average and most common case, for secondary access via theoretical and experimental techniques, (ii) to quantitatively determine the long-term behavior and trends of spectrum occupancy and spectrum hole availability, and (iii) to understand and obtain insight into the electrospace characteristics (time, frequency, spatial) over a large urban area. The quantitative assessment and characterization of available prime spectrum is important for providing access to new and growing wireless services.										1																				X						########	
NSF	CISE 0721935 / University of Arizona	1.09	NeTS-WN: Cross-Layer Optimizations and Adaptive Protocols for Opportunistic and Collaborative Cognitive Radio Networks	The focus of this project is on optimal resource allocation and control in collaborative cognitive radio networks (CRNs). Through opportunistic access to the available spectrum, CRNs aim at improving the utilization of network resources by achieving higher spatial reuse, programmable connectivity, and increased network availability. The research agenda includes centralized analytical formulations that aim at optimizing the operation of the bottom three layers as well as distributed routing and medium access protocols that implement the outcomes of such optimization. Joint optimization of spectrum, transmission powers, and rates for CR communications will be considered in the presence of several primary (spectrum-licensed) radio networks (PRNs). No feedback from the PRNs will be assumed. Several formulations will be studied, which differ in the assumptions made on the channel dynamics (indirectly, user mobility), optimization window (packet vs. flow time scale), and availability or otherwise of power masks. Besides one-hop optimizations, the project will also consider multi-channel, multi-path optimizations at the packet and the flow time scales. The optimization results will then be integrated										1																				X						########	
NSF	CISE 0721961 / University of California-Santa Barbara	18.025	WN: Real-Time Spectrum Auctioning Through Distributed Coordination	Proliferation of wireless networks has dramatically changed the way we live and work. However, wireless innovation and deployment has been blocked by the spectrum shortage problem as a result of today's static spectrum assignment. While most spectrum bands have been allocated to existing wireless networks and technologies, they are severely under-utilized. This research will seek to improve spectrum utilization using dynamic spectrum access. In this new system, components of future wireless networks no longer have statically assigned spectrum. Instead, they request spectrum on-demand matching their time-varying demand and pay for what they use. To exploit the full potential of dynamic spectrum access, this research will focus on developing an efficient spectrum auction system which auctions spectrum periodically to wireless nodes and dynamically assign spectrum to minimize interference. Moving away from traditional centralized solutions, this project focuses on distributed auction system to manage large volume of spectrum requests across large geographic areas. The success of this project will advance understanding in dynamic spectrum access systems, and impact development of cognitive radios and																										1					X						########	

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NSF	CISE 0721992 / University of Illinois at Urbana-Champaign	12.133	NeTS-WN: Collaborative Research: Channel-Aware Distributed Scheduling for Optimal Throughput and Latency: A Unified PHY/MAC Approach	The design of wireless ad-hoc networks faces a number of unique challenges in wireless communications including 1) co-channel interference among active links in a neighborhood, and 2) time-varying channel conditions over fading channels. Experimental data reveals that, in many realistic scenarios, fading effects can often adversely affect the MAC layer, and the coupling between the timescales of fading and MAC calls for a unified PHY/MAC design. Due to the distributed nature of ad hoc communications, little work has been done to develop channel-aware, distributed scheduling for throughput maximization. There are virtually no systematic studies on channel-aware scheduling for real-time traffic under latency constraints. A principal goal of this project is to fill this void and build a theoretic foundation for channel-aware, distributed scheduling in wireless ad-hoc networks, for both elastic traffic and inelastic traffic. With the goal of developing a framework for unified PHY/MAC optimization, the proposed research consists of three thrusts. The first two thrusts investigate distributed opportunistic scheduling for elastic traffic and focus on throughput maximization from network-centric and user-centric																				1										X						########	
NSF	CISE 0722003 / Illinois Institute of Technology	4.005	NeTS - WN - Spectrum Observatory System	This research project establishes a permanent Spectrum Observatory in Chicago to monitor and support the analysis of spectrum usage for a three-year period. This observatory is supplemented by a mobile spectrum occupancy platform to nomadically examine various target cities to both explore "unused spectrum" and in Chicago to validate the fixed observatory readings as representative measurements for the city. Selected suburban and rural measurements are performed to expand the understanding of the differences in spectrum usage in these environments. The research focuses on: 1) obtaining the occupancy data, 2) analyzing the anomalies and trends in the data, and 3) examining the opportunities for improved spectral utilization suggested by the observed usage patterns. This grant supports collaborative research across and between academia, industry, and government entities. The research impacts: 1) transceiver designers, 2) cognitive radio researchers, 3) spectrum owners and stakeholders, 4) engineering students and faculty, and 5) regulators. The greatest impact of this information may be to U.S. government communications policy. Currently, information on spectrum																														X						########	
NSF	CISE 0722008 / Portland State University	13.017	NeTS-WN: Gigabits/Sec/User	This research project examines the problem of providing high data-rate wireless connectivity to users in indoor environments. The goal is to be able to reach gbps/user rates even when there are multiple users present. The technology that we are researching is to use is the 60 GHz ISM spectrum whose special propagation properties make it ideally suited to this task. The approach taken is to use multiple, spatially-distributed smart antennas in a room to provide coverage where needed and when needed. All the antennas are connected to a single access point which allows us to dynamically change spectrum and link allocation among the users (as they move or as their needs change). Indeed, the design of the access point is also novel since it needs to support a gross throughput of several gbps. The innovations in this work include the exploitation of the special properties of 60 GHz, design of algorithms for efficient spectrum reuse, support for multiple MAC protocols within a room to better adapt to user needs, a novel access point architecture, and a tight correlation between design of the system and user access patterns. The methodology being followed is primarily theoretical and simulation-based. Providing high data-rate																	1													X						########	

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NSF	CISE 0722032 / University of California-Berkeley	12.137	NeTS-WN: Collaborative Research: Interference Management and Cooperation in Wireless Networks: A Modern View	Two important features distinguish wireless communication from wireline communication: the time-variations of the wireless links and the broadcast property of wireless transmissions. In the past decade, a new fundamental understanding of time-variations from an information theoretic point of view has developed. This understanding has led to radical shifts in points of view regarding wireless system design, not only at the physical layer but also at higher layers. In contrast, the progress in a fundamental understanding of the broadcast nature of wireless links has been far slower. Most of the techniques that exist as implemented in current wireless networks to deal with interference and cooperation are ad hoc. In this project we focus on the broadcast nature of the wireless link by taking a cue from the success in dealing with the time varying nature of the wireless link: true progress in wireless communication comes from a synthesis of a fundamental and information theoretic understanding into networking ideas. We propose to (a) obtain a fundamental understanding of how to optimally manage interference and achieve cooperation, (b) build an abstraction of the physical layer that captures the																				1										X							########	
NSF	CISE 0722868 / Polytechnic University of New York	3.014	MRI: Acquisition of an Experimental Platform for Wireless Multimedia Networking	Proposal #: CNS 07-22868 PI(s): Erkip, Elza Erkanwar, Shivendra S.; Wang, Yao Institution: Polytechnic University of New York Brooklyn, NY 11201-3840 Title: MRI/Acq.: Experimental Platform for Wireless Multimedia Networking Project Proposed: This project, acquiring an experimental platform to support integrated research and educational activities on wireless multimedia networking, examines problems of limited bandwidth of the wireless channel, of interference caused from multiple users operating in the same band, of rapid variations due to signal fading, of limited battery life of wireless devices, and of speed and reliability of wireless networking. The instrumentation consists of multiple radios based on software defined radio platforms, wireless nodes and open source drivers based on the IEEE 802.11 Wireless Local Area Network (WLAN) standard, DSP platforms enabling real time video encoding and wireless transmission, dynamic power scaling, and power measurement, and test equipment. The instrument supports research on: Cooperative wireless networking, Wireless video transmission, Energy efficient networking, and Integration of research and education through the				1																									X							########	
NSF	CISE 0723263 / San Diego State University Foundation	16.034	MRI: Acquisition of a Test-bed for Next Generation Cognitive Radio Wireless Networks	Proposal #: CNS 07-23263 PI(s): Kumar, Sunil Nagaraj, Santosh V.; Sarkar, Mahasweta Institution: San Diego State University San Diego, CA 92115-1338 Title: MRI/Acq.: Test-bed for Next Generation Cognitive radio Wireless Networks Project Proposed: This project, acquiring a state-of-the-art cognitive radio test bed on which the protocols that exploit the merits of cognitive radios at the physical, MAC, transport, and routing layers can be tested, includes verification on a practical testbed or prototype to validate the theoretical and simulations work needed for the development of wireless networks, especially cross layer architectures. The work involves Addressing the needs of commercial platforms that often do not allow any changes in the underlying framework and seldom provide researchers full control of the RF, PHY, and lower MAC functionalities. Obtaining new and realistic models for spectrum hole detection and spectrum usage pattern providing real data depicting trend and patterns of spectrum usage which will contribute significantly in building prototypes (Simulation results are only as good as the models that use them.) Recreating concepts from a model of																			1										X							########	

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NSF	CISE 0728445 / Princeton University	12.056	Collaborative Research: TF: Information Theory of Channels with Missing Observations	NSF Division of Computer and Communications Foundations: Theoretical Foundations Program Solicitation NSF 07-525: Information Theory of Channels with Missing Observations Principal Investigators: Giuseppe Caire and Sergio Verd'u University of Southern California Princeton University Summary This project takes a unified information theoretic approach to problems in transmission, compression, estimation and sensing in which observations may be missing from the available data. In many applications of current practical interest, data is subject to random erasures because of fading and/or jamming (in wireless), packet dropping due to finite buffer sizes (in networks), impulse noise (in power and subscriber looplines), defective media (in magnetic recoding), faulty transducers (in sensor networks), reduced complexity (in compressed sensing), link failure (in wired infrastructure of a cellular system), opportunistic signaling(in nonstationary channels), etc. It is of great theoretical and practical interest to assess the impact of the missing data on the fundamental Shannon theoretic limits for reliable compression and transmission, as well as the estimation theoretic limits. Furthermore, new practical questions arise																			1											X						########	
NSF	CISE 0728484 / Trustees of Boston University	12.054	Collaborative Research: Low Peak to Average Power Multicarrier Signals via Coding: Fundamental Limits and Algorithms	One of the most important obstacles in deployment of high data rate, low cost, and power efficient multicarrier communication systems is the cost of front-end RF amplifiers. Multicarrier modulations offer the promise of low complexity equalization, adaptability to frequency selectivity of the channel, and efficient use of available bandwidth in cognitive networks. However, multicarrier signals consist of linear superposition of many subcarriers leading to large peak to average power ratio (PAPR) and implying the need for highly linear power amplifier. In particular, RF power amplifier becomes substantially power inefficient and expensive when its linearity region increases to accommodate signals with large PAPR. Any nonlinearity introduced by the power amplifier can cause large out-of-band leakage and reduce the transmit range of the link. While the worst case PAPR is quite large, it has been established by the investigators that the likelihood of having large peaks is small and there exist codes of almost full rate with PAPR bounded by a constant. Existing coding schemes, however, provide low PAPR and large minimum distance at the cost of substantially reducing the transmission rate. This research involves addressing both																			1											X						########	
NSF	CISE 0728572 / Harvard University	12.055	Collaborative Research: Low Peak to Average Power Multicarrier Signals via Coding: Fundamental Limits and Algorithms	One of the most important obstacles in deployment of high data rate, low cost, and power efficient multicarrier communication systems is the cost of front-end RF amplifiers. Multicarrier modulations offer the promise of low complexity equalization, adaptability to frequency selectivity of the channel, and efficient use of available bandwidth in cognitive networks. However, multicarrier signals consist of linear superposition of many subcarriers leading to large peak to average power ratio (PAPR) and implying the need for highly linear power amplifier. In particular, RF power amplifier becomes substantially power inefficient and expensive when its linearity region increases to accommodate signals with large PAPR. Any nonlinearity introduced by the power amplifier can cause large out-of-band leakage and reduce the transmit range of the link. While the worst case PAPR is quite large, it has been established by the investigators that the likelihood of having large peaks is small and there exist codes of almost full rate with PAPR bounded by a constant. Existing coding schemes, however, provide low PAPR and large minimum distance at the cost of substantially reducing the transmission rate. This research involves addressing both																			1											X						########	

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NSF	CISE 0728762 / Ohio State University Research Foundation -DO NOT USE	17.017	Opportunism, Cooperation and Feedback for Wireless Secrecy	The design of efficient wireless networks presents exciting challenges which are markedly different from their counterparts in wire-line networks. Of particular interest is the perceived vulnerability of wireless networks to security attacks. Ensuring network robustness against various types of security threats is, therefore, one of the important design objectives. This project adopts a new optimistic perspective in which the wireless medium is viewed as a resource instead of a liability. In particular, we identify three principles, namely opportunism, cooperation and feedback by which the wireless channel can be efficiently exploited to counter passive eavesdropping attacks. The first research thrust is dedicated to developing an opportunistic secrecy framework in which the multi-path fading fluctuations are used to create an advantage for the legitimate destination(s) over the eavesdropper(s). Our investigations seek to characterize the fundamental limits of opportunistic secrecy and develop low complexity protocols capable of leveraging the corresponding performance gain. The second research thrust aims to: 1) develop novel cooperation strategies inspired by the secrecy constraint, 2) derive sharp secrecy capacity																								1				X							########	
NSF	CISE 0728763 / University of Notre Dame	12.077	Geometric Analysis of Large Wireless Networks: Interference, Outage, and Delay	Geometric Analysis of Large Wireless Networks: Interference, Outage, and Delay Martin Haenggi, University of Notre Dame Abstract: Large wireless systems, in particular ad hoc and sensor networks, have great potential for numerous applications. They have been the subject of intense investigation over the last decade. Despite these efforts, many of their fundamental properties are still not well understood, and it is unknown how to design network protocols in an optimum fashion. Important progress has been made in determining the capacity scaling behavior of these systems, but the asymptotic nature of these results severely restricts their applicability to practical networks. This project complements such scaling studies by aiming at a precise characterization of certain performance metrics, including reliability and delay. Further, some of the standard modeling assumptions, such as the uniformly random node distribution are questioned, and existing results are extended to other node distributions that better reflect real networks with interacting nodes. The investigators use a rigorous analytic approach that combines tools from stochastic geometry, point process theory, branching processes, and information																						1							X							########	
NSF	CISE 0728803 / North Carolina State University	12.062	Communications Theory Perspectives on the Design of Compact Multi-Antenna Wireless Transceivers	Recent research on multiple-input multiple-output (MIMO) communications has shown that deploying arrays at the transmitter and receiver can dramatically improve the capacity of wireless multipath channels. Since the physical size of a transceiver is often limited, increasing the number of array elements often requires closer inter-element spacing and leads to signal correlation and mutual coupling. Coupling can profoundly impact the received power, diversity and system capacity. Moreover, this impact depends essentially on aspects of the transceiver design, such as antenna matching and the dominant sources of noise. Intellectual Merit: This project seeks to develop a systems-level perspective on the design of compact array transceivers for wireless communications. The aim is to understand how antennas, matching networks, amplifiers and communications algorithms interact to determine overall performance, and to jointly optimize the design of these interacting subsystems. Three issues are addressed: (1) channel models which incorporate diverse noise sources, transceiver design and interference from other users for both narrowband and broadband channels; (2) the impact of different noise sources and propagation																						1							X							########	

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NSF	CISE 0728826 / Colorado State University	12.05	Collaborative Research: Systematic Optimization in Wireless Multicasting	Research Abstract Multicasting, where common information is transmitted from a source to multiple destinations,is the core component of many network applications such as multimedia distribution, information update, group conferencing, etc. Creative encoding of network trac at the intermediate terminals can signicantly improve the throughput of a multicast over conventional replicate-and-forward approaches. Due to the open nature of the wireless medium, communication throughput of a wireless link depends on its transmission power and on the interference generated by nearby network terminals. The goal of this research is to develop a systematic framework for maximizing a general multicast utility function via the joint optimization of transmission power, rate, and schedule,within the framework of network coding. The investigators model a wireless ad hoc network by means of a topology graph, which contains point-to-point links and point-to-multipoint hyperarc links with coupled link throughput capacities. Under the assumption of optimal network coding, the research first develops an iterative gradient-steering" optimization framework. A network utility maximization problem is converted to a transmission																				1										X						########	
NSF	CISE 0728955 / University of Colorado at Boulder	12.097	Multi-antenna Communications with Finite-Rate Feedback	The next generation of wireless standards are aimed at providing high speed communication to mobile users. Two of the most promising technologies that can dramatically increase the information rate without the increase of power or spectrum are those that exploit multiple antennas and finite-rate feedback from the receiver to the transmitter. The benefit of side information at the transmitter is significant in regimes that happen to fit the requirements of high speed downlink communication by mobile devices, where there are more transmit than receive antennas. Among the post Third Generation wireless technologies, most of them, such as WiMax, Super3G/LTE (Long Term Evolution), 802.11n, employ MIMO-OFDM technology. It is anticipated that this research will lead to methods for significantly increased spectral efficiencies in these technologies. The proposed research is on wireless communications ranging from its fundamental underpinnings in information theory to the analysis and optimization of novel and practicable communication architectures that exploit a few bits of feedback per channel realization. Mechanisms exist for providing finite-rate feedback and methods by which the wireless channel fluctuations can be																				1										X						########	
NSF	CISE 0728966 / University of Maryland College Park	12.051	Collaborative Research: Systematic Optimization in Wireless Multicasting	Research Abstract Multicasting, where common information is transmitted from a source to multiple destinations, is the core component of many network applications such as multimedia distribution, information update, group conferencing, etc. Creative encoding of network trac at the intermediate terminals can significantly improve the throughput of a multicast over conventional replicate-and-forward approaches. Due to the open nature of the wireless medium, communication throughput of a wireless link depends on its transmission power and on the interference generated by nearby network terminals. The goal of this research is to develop a systematic framework for maximizing a general multicast utility function via the joint optimization of transmission power, rate, and schedule, within the framework of network coding. The investigators model a wireless ad hoc network by means of a topology graph, which contains point-to-point links and point-to-multipoint hyperarc links with coupled link throughput capacities. Under the assumption of optimal network coding, the research first develops an iterative gradient-steering" optimization framework. A network utility maximization problem is converted to a transmission																				1										X						########	

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NSF	CISE 0729119 / Stanford University	12.052	Collaborative Research: The Role of Feedback in Two-Way Communication Networks	Many common communication situations are over inherently two-way channels, such as telephone systems, digital subscriber lines (DSL), cellular networks, and the Internet. In fact, even `point-to-point' systems, where the end goal is to transfer information in one direction, often give rise to two-way communication scenarios due to the presence of feedback. In such systems, one can receive feedback from the other end of the channel, which can be used to improve the quality of communication. Although feedback is present in many communication systems, and is being used in certain primitive forms as in channel estimation and automatic repeat request, the theory behind its use is far from complete. This research investigates the role of feedback in two-way communication networks and provides architecture-level guidance for designing robust and efficient communication systems. While positive results lead to novel approaches to communication systems design, negative results prevent over-engineering and allow more confidence in simple and modular implementations. At the same time, feedback is a pivotal concept in biological and artificial control systems, learning machines, and communication networks. A																		1										X						#######	
NSF	CISE 0729122 / University of California-Berkeley	12.068	Delay, Feedback, and Interaction	Information theory is the strategic theory of communication: providing architectural guidance and fundamental bounds. For communication, there are three core quality of service parameters: probability of error, rate, and end-to-end delay. Shannon's seminal capacity theorems establish bounds on rate as the tolerated probability of error goes to zero while the acceptable end-to-end delay goes to infinity. However, for many applications like telemedicine, remote control (e.g. fly-by-wireless in UAVs), and even video-conferencing, short delays are also critical. Unfortunately, it turns out that the classical block-code oriented approaches to information theory are misleading regarding the tradeoffs involving end-to-end delay, especially when feedback is involved. This research aims to remedy that situation and thereby get a deeper understanding of the nature of information flows and their communication requirements. Having these fundamental architectural results will help guide not only the design of next generation communication systems, but is also critical for the setting of regulatory policy governing wireless spectrum since both interactive and non-interactive applications must coexist efficiently in the wireless																		1										X						#######	
NSF	CISE 0729129 / University of Maryland College Park	12.085	Information Flow Theory in Dense Wireless Networks	Abstract: Future wireless networks are composed of a massive number of nodes densely distributed in large geographical areas. Such networks are used in applications such as wide area environmental protection, transportation, automated agriculture, or wireless micro-sensing in civil infrastructure systems. Information generated by distributed sources is transported to the destinations by collaborative efforts of nodes that forward the traffic of each other; therefore, the information is diffused over routes composed of many hops, each contributing to a short range transmission. Careful analysis of the networks with such large number of wireless nodes involves a prohibitive level of complexity. This complexity is due to the uncoordinated interactions between each pair of nodes in the network (e.g., due to interference of simultaneous transmissions); as a result, little is known about the behavior of massively dense wireless networks. The introduced methodology models a dense wireless network by a continuum of nodes. The spatially continuous model of information flow is a very promising methodology to overcome the prohibitive complexity of conventional discrete space																		1										X						#######	

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NSF	CISE 0729162 / University of Southern California	12.049	Collaborative Research TF: Information Theory of Channels with Missing Observations	NSF Division of Computer and Communications Foundations: Theoretical Foundations Program Solicitation NSF 07-525: Information Theory of Channels with Missing Observations Principal Investigators: Giuseppe Caire and Sergio Verd'u University of Southern California Princeton University Summary This project takes a unified information theoretic approach to problems in transmission, compression, estimation and sensing in which observations may be missing from the available data. In many applications of current practical interest, data is subject to random erasures because of fading and/or jamming (in wireless), packet dropping due to finite buffer sizes (in networks), impulse noise (in power and subscriber looplines), defective media (in magnetic recoding), faulty transducers (in sensor networks), reduced complexity (in compressed sensing), link failure (in wired infrastructure of a cellular system), opportunistic signaling(in nonstationary channels), etc. It is of great theoretical and practical interest to assess the impact of the missing data on the fundamental Shannon theoretic limits for reliable compression and transmission, as well as the estimation theoretic limits. Furthermore, new practical questions arise																				1										X						########	
NSF	CISE 0729195 / University of California-San Diego	12.057	Collaborative Research: The Role of Feedback in Two-Way Communication Networks	Many common communication situations are over inherently two-way channels, such as telephone systems, digital subscriber lines (DSL), cellular networks, and the Internet. In fact, even `point-to-point' systems, where the end goal is to transfer information in one direction, often give rise to two-way communication scenarios due to the presence of feedback. In such systems, one can receive feedback from the other end of the channel, which can be used to improve the quality of communication. Although feedback is present in many communication systems, and is being used in certain primitive forms as in channel estimation and automatic repeat request, the theory behind its use is far from complete. This research investigates the role of feedback in two-way communication networks and provides architecture-level guidance for designing robust and efficient communication systems. While positive results lead to novel approaches to communication systems design, negative results prevent over-engineering and allow more confidence in simple and modular implementations. At the same time, feedback is a pivotal concept in biological and artificial control systems, learning machines, and communication networks. A																				1										X						########	
NSF	CISE 0729210 / Texas Engineering Experiment Station	12.089	Joint Source-Channel Coding for Wireless Networks	0729210 - Joint Source-Channel Coding for Wireless Networks Currently, there is a significant demand for reliable, high-quality access to multimedia content over wireless networks. This demand stems from society's growing desire for ubiquitous access to multimedia, whether it be critical medical information (x-rays, real-time patient video), news, or entertainment. Providing such services over wireless networks is challenging because wireless channels are subject to a phenomenon known as fading, due to which the instantaneous link quality from the transmitter to the receiver varies with time, frequency and location. The link quality is often not known at the transmitter, necessitating the use of transmission schemes that are robust to changes in the link quality. This research involves the design and analysis of efficient encoding schemes for transmission of analog signals such as multimedia signals over fading wireless channels, when the instantaneous link quality is not known at the transmitter. Particular emphasis is placed on techniques which are efficient for broadcasting signals to many users with different link qualities and techniques that allow the reconstruction quality at the receiver to scale gracefully with the link																				1										X						########	

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NSF	CISE 0729222 / University of California-Santa Barbara	16.054	Towards A Theory of Communication With Sloppy Analog-to-Digital Conversion: A Framework for Low-Cost Gigabit wireless	The economies of scale of cellular and WiFi networks are enabled by low-cost integrated circuit implementations of sophisticated digital signal processing (DSP) algorithms in wireless communication transceivers. An implicit assumption in this approach is that analog received signals can be converted to a reasonably faithful digital representation, an assumption that breaks down as link speeds increase to the point that high-precision analog-to-digital conversion (ADC) becomes too costly and power-hungry. This project involves the design of wireless networks in the latter regime: the goal is to design low-cost links operating at multiGigabit speeds (i.e., more than an order of magnitude faster than WiFi), exploiting large swaths of unlicensed spectrum in the 3-10 GHz band and the 60 GHz band. The research rethinks communication transceiver design, with the starting assumption that high-speed ADCs are ``sloppy.'' The research involves obtaining fundamental performance benchmarks using information theory, and devising DSP algorithms that achieve these performance benchmarks. The ultimate objective is to enable a quantum leap in the speed of wireless networks for the home and enterprise, while preserving the																		1												X						########	
NSF	CISE 0738372 / Illinois Institute of Technology	5.004	NeTS - Wireless Network PI Meeting	Illinois Institute of Technology (IIT) will serve as the host for the annual NSF Wireless Networking Principle Investigator (PI) meeting for 2007. Specifically, IIT and in particular the Wireless Network and Communications Research Center (WiNCom) will assist the National Science Foundation in the organization and successful operation of this PI Meeting involving the leading technologists and researchers contributing to the NSF wireless networking programs from across the nation. Special guest speakers from industry, government and the regulatory community will serve to enhance the dialog at the session. This year's meeting promises to be rich in new, exciting results in several areas of the wireless networks field. Significant contributions are anticipated from the projects directed to both better understand our spectrum limited world and to enhance the efficiency in its utilization. In the past few years the wireless research community, the regulatory agencies (FCC and NTIA), the defense community (and in particular DARPA) and the various industry players (service providers and equipment providers) have become acutely aware of the spectrum limitations that have bounded																								1							X						########	
NSF	CISE 0746925 / Virginia Polytechnic Institute and State University	17.003	CAREER: Non-Conventional Solutions for Ensuring Security in Cognitive Radio Networks	Proposal #: 0746925 Title: CAREER: Non-Conventional Solutions for Ensuring Security in Cognitive Radio Networks The PHY and MAC layers of cognitive radio networks are very different from those of conventional wireless networks. The distinguishing attributes of cognitive radio networks such as cooperative spectrum sensing, on-demand spectrum contention, incumbent- and self-coexistence mechanisms, and spectrum etiquette mechanisms raise new security implications that have not been studied previously. The overarching goal of this research is to contribute to the ongoing research and standardization efforts of cognitive radio technology by investigating crucial security issues that hold the key to the success and wide deployment of cognitive radio networks. We are currently focusing on problems that cannot be addressed using conventional security solutions. To solve these challenging problems, research is needed in areas that are considered "non-conventional" within the context of network security. These areas include RF signal identification, data smoothing, cyclic spectrum analysis, distributed detection and data fusion, etc. This research involves conducting high risk and high impact research in the																											1				X						########	

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NSF	CISE 0746977 / Worcester Polytechnic Institute	12.021	CAREER: Opportunistic Routing in Multihop and Multirate Wireless Networks	Abstract: Opportunistic routing (OR) is a powerful new concept that exploits broadcast nature of wireless medium and spatial diversity of network topology to cope with time-varying wireless links in multihop wireless networks. Its potential to improve the network performance, such as network capacity, has not been well understood and there is also a lack of efficient and distributed routing protocols that fully exploit its advantage to achieve performance optimality at the end-to-end path level. This project focuses on the theory and protocol design of OR in multihop wireless networks. The results will also be extended to incorporate other emerging wireless technologies, such as multi-rate, multi-channel, etc. There are two main thrusts in this project. The first thrust focuses on a theoretic study on the network capacity and performance bounds achievable by OR. A novel theoretical framework will be established to characterize the wireless interference, multirate capability, time-varying channel fading, and their impact on the performance of OR. A method to compute the throughput bounds between a source and destination pair in a given OR network will be devised. The second thrust is to develop distributed																				1										X						########	
NSF	CISE 0747332 / University of Minnesota-Twin Cities	12.172	CAREER: Exploring the Design and Fundamental Limits of Wireless Spatial Networks	Wireless networks now constitute a critical component of the national communications infrastructure, and information theory has served as the guiding light for the growth of wireless. However, the critical role that space, i.e., the physical locations of devices, plays in wireless networks has been largely downplayed in wireless research. Indeed, the wireless revolution would not have been possible without spatial reuse (i.e., reuse of spectrum at physically separated locations). If a link or system is studied while ignoring reuse, design conclusions can be vastly different than when reuse is considered. As wireless usage continues to grow, it is becoming increasingly important that a fundamental understanding of the limits and optimal design of networks be developed. This research introduces a framework for modeling spatial interactions in wireless networks and develops methodologies for analyzing such networks. Spectrum sharing is perhaps the most basic wireless network: transmit-receive pairs wish to communicate with each other but not with other pairs, but are forced into a shared environment because they must use common spectrum. A canonical model that explicitly models node locations, dubbed the spatial interference channel, is introduced.																				1										X						########	
NSF	CISE 0751127 / University of Wisconsin-Madison	3.009	CRI-Planning: A Virtualized Vehilcular Wireless Testbed with Spectrum Agility	The focus of this project is to plan for and then assemble an initial outdoor vehicular testbed, called MadBed (for its location in Madison, Wisconsin) equipped with unique capabilities of spectrum agility. The testbed has been designed: (i) to enable a research plan that involves experimental support for ongoing projects of multiple research groups, initially at UW-Madison, and after the planning phase, for open access. (ii) to initiate an educational plan that focuses on a laboratory-oriented curriculum and facilitates distance learning programs with other educational institutions; and introduces an undergraduate wireless experimentation laboratory that supplements courses with hands-on experience; and (iii) to realize an outreach plan that includes public release of developed platforms and software, open availability of the testbed to the broader wireless research community, and demonstration of wireless substrate that may be of great value for research in the GENI vision. The testbed is being deployed in the downtown area of Madison, WI. The pilot deployment for planning consists of 5 roadside (static) nodes and 4 vehicular mobile nodes, each equipped with a combination of software defined radio (SDR)					1																								X						########	

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NSF	CISE 0754315 / Worcester Polytechnic Institute	1.1	NeTS-WN: Quantification of Spectrum Availability for Wireless Network Access	To resolve the apparent scarcity of available prime radio spectrum (300 MHz - 3 GHz), the dynamic spectrum access paradigm was proposed to improve spectrum utilization. By enabling temporary, unlicensed wireless access to the unoccupied licensed spectrum, called "spectrum holes", a larger number of wireless transmissions can be supported by the same spectrum while simultaneously respecting the rights of the incumbent license holders. However, this paradigm heavily depends on the location and size of these spectrum holes, which can vary randomly with respect to time, frequency, and geography. The objective of this project is: (i) to accurately characterize the availability of prime spectrum in mid-size US cities, i.e. the average and most common case, for secondary access via theoretical and experimental techniques, (ii) to quantitatively determine the long-term behavior and trends of spectrum occupancy and spectrum hole availability, and (iii) to understand and obtain insight into the electrospace characteristics (time, frequency, spatial) over a large urban area. The quantitative assessment and characterization of available prime spectrum is important for providing access to new and growing wireless services.											1																			X						########	
NSF	CISE 0755026 / Stevens Institute of Technology	16.042	REU Site: Integrated Software Radio and RF Test Bed for Wireless Research in Cognitive Networks	This project renews a Research Experience for Undergraduates site focused on wireless research in cognitive networks. The research aims to increase spectrum utilization significantly for both military and commercial applications. Students develop software defined radio frequency transmitters and receivers, develop an integrated test bed, and conduct research using the test bed. The project involves collaboration between the host institution and Jackson State University, with half the students and one mentor coming from Jackson State. Undergraduate students participate in a ten-week summer research program at the host institution. The project includes mentorship by experienced computer science faculty members, weekly presentations and seminars, laboratory visits and other professional development opportunities. The intellectual merit of this project lies in strong research basis and the expertise of the faculty. The projects are in major current research areas that are of interest to the community at large and that have clear practical applications. The research related to dynamic spectrum access techniques may significantly improve the spectrum utilization for future wireless networks. The broader impacts of the																		1													X						########	
NSF	CISE 0821319 / Cleveland State University	17.01	MRI: Acquisition of Equipment to Establish a Secure and Dependable Computing Infrastructure for Research and Education at Cleveland State University	Proposal #: CNS 08-21319 PI(s): Zhao, Wenbing ; Lu, Yongjijian; Sridhar, Nigamanth; Yu, Chansu Institution: Cleveland State University Cleveland, OH 4415-2214 Title: MRI/Acq.: Acq. of Equipment to Establish a Secure and Dependable Computing Infrastructure for Research and Education at Cleveland State University Project Proposed: This project, acquiring server and networking equipment for activities in the area of secure and dependable computing, supports research in enterprise distributed systems, wireless mobile networks, and sensor networks. Projects include - Byzantine fault tolerance for long-running, nondeterministic systems, - Performability in wireless mobile networks, and - Hybrid emulation of wireless sensor networks. Novel methods are sought for providing Byzantine fault tolerance to long-running, nondeterministic distributed systems. Performance in highly stressed mobile wireless network is investigated in terms of high node mobility and strong interference, as is understanding of nodes? boundary behavior under extreme conditions seeking novel methods to survive the stress via cooperation. Lastly, a novel framework for hybrid emulation of wireless sensor																											1			X						########	

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NSF	CISE 0829867 / University of Florida	12.075	EMT/BSSE: Biological networks as a communication model for entities with complex interactions	Biological networks show the complex interactions between bio-chemical entities that are often vital for the survival of organisms. The entities communicate with each other to collaborate and perform complex functions that they can not do individually. Numerous applications follow an interaction pattern that resembles biological networks. Wireless networks, sensor networks and homeland security are just a few examples to these applications. Employing biological networks to model the communication patterns in these applications is very promising as the biological networks are robust and flexible. The biological networks efficiently adapt to the alterations in genes or proteins to minimize the damage done to the network by finding alternative ways to keep the network stable whenever it is possible. One of the critical problems in analysis of biological networks as well as many other applications with complex communication networks is finding similarities between them. To solve this problem, it is necessary to find an alignment of the interacting entities of the input pathways. An alignment of two networks is a one-to-one mapping between a subset of their nodes (i.e., entities). This research develops a generic																		1											X						#######	
NSF	CISE 0830451 / University of Tennessee Knoxville	1.093	Collaborative Research: Collaborative Quickest Detection in Ad hoc Networks with Application in Cognitive Radio	Quickest detection is an important technique to detect the change of probability distribution in a random process being monitored. It is widely used in problems like financial decision making, environmental monitoring and industrial quality control. With the rapid development of networking techniques, there exist pressing demands to carry out quickest detection based on observations from many nodes and make decision at more than one node. Motivated by this demand, this research studies collaborative quickest detection in ad hoc networks, in which nodes exchange observation statistics and make local decisions about distribution change. In contrast to existing theory of decentralized quickest detection, the collaborative quickest detection does not need a data processing center, thus avoiding the round-trip time overhead and possible data congestion. Moreover, collaboration can enhance the agility and robustness of the detection of change. The research involves aspects of statistical signal processing (e.g. detection rule), information theory (e.g. source coding) and networking (e.g. scheduling or broadcast). An important application of collaborative quickest detection is spectrum sensing in cognitive											1																		X						#######	
NSF	CISE 0830462 / North Carolina State University	1.095	Collaborative Research: Collaborative Quickest Detection in Ad hoc Networks with Application in Cognitive Radio	Quickest detection is an important technique to detect the change of probability distribution in a random process being monitored. It is widely used in problems like financial decision making, environmental monitoring and industrial quality control. With the rapid development of networking techniques, there exist pressing demands to carry out quickest detection based on observations from many nodes and make decision at more than one node. Motivated by this demand, this research studies collaborative quickest detection in ad hoc networks, in which nodes exchange observation statistics and make local decisions about distribution change. In contrast to existing theory of decentralized quickest detection, the collaborative quickest detection does not need a data processing center, thus avoiding the round-trip time overhead and possible data congestion. Moreover, collaboration can enhance the agility and robustness of the detection of change. The research involves aspects of statistical signal processing (e.g. detection rule), information theory (e.g. source coding) and networking (e.g. scheduling or broadcast). An important application of collaborative quickest detection is spectrum sensing in cognitive											1																		X						#######	

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NSF	CISE 0830480 / University of Minnesota-Twin Cities	12.164	Theoretical Foundations for Wireless Communication Networks	Abstract In lieu of a formal theory, designing wireless networks often relies on suboptimum rules that under-utilize the available resources. The objective of this research is to build on theoretical foundations of wireless networks by formulating generic optimization problems in a variety of settings. Questions about these problems are posed and answers are subsequently translated to fundamental properties. Among possible questions, this project focuses on the following ones: q1) How difficult are these optimization problems to solve? q2) What structural properties they possess? and q3)What solver(s) should be employed ? Answers to q1) determine whether optimal wireless networking is feasible; addressing q2) translates to architectural principles, e.g., optimal layered architectures; and responses to q3) lend themselves to working wireless network protocols. This project builds on a preliminary result which asserts that separating wireless networks into layers is optimal in the presence of random fading. The approach leverages this principle and related structural properties introduced by fading to develop a formal theory encompassing algorithmic, performance analysis and development																	1											X						########	
NSF	CISE 0830556 / University of California-Los Angeles	12.09	Knowledge and Strategic Learning in Multi-user Communications	Multi-user wireless communications systems form competitive environments, where heterogeneous and self-interested users compete for the limited spectrum resources. However, the techniques that have recently dominated multi-user communication research are not well suited for heterogeneous environments, because they usually assume transceivers that have similar standards and passively select their actions based on either complete or no knowledge about the competitors? protocols, utilities etc. Such passive system designs do not take advantage of the users? ?smartness? and may lead to inefficient spectrum usage. In contrast, this research characterizes and constructs multi-user communications systems, where users engage in proactive interactions for dividing the spectrum. A new multi-user communication paradigm is proposed, where the interaction between users and their resulting performance is driven not only by their ability to adapt their communication strategies, but also by their ability to make optimal decisions about information exchanges based on their knowledge about their competitors and the environment. The research has two main research thrusts. First, the investigators																	1											X						########	
NSF	CISE 0830651 / University of Notre Dame	12.058	Collaborative Research: Distributed Error Correction Strategies in Wireless Networks	Networked wireless communications over multiple hops is rapidly emerging as the main architecture of future wireles systems, including multihop extensions of cellular and WiFi networks, mesh networks, and sensor networks. Common among these types of networks is that they are not completely unstructured (or ad hoc) networks, but traffic is routed and accumulated towards a common destination. Due to this characteristic property, these networks will be referred to as Networks with Traffic Accumulation, or NETAs. Traffic accumulation creates hot sposts or bottlenecks around the common destination because of the increased traffic load and interference. Despite the severity of the hot spot problem, there is a lack of efficient methods to cope with it. This research addresses the hot spot issue in NETAs by developing new distributed error correction strategies tailored to two important subclasses- line networks and tree networks. In line networks, the investigators study fundamental properties and the design of distributed channel coding protocals using serially concatenated and protograph-based constructions to strengthen the error correction capability near the destination without sacrificing																	1											X						########	

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NSF	CISE 0830666 / New Mexico State University	12.059	Collaborative Research: Distributed Error Correction Strategies in Wireless Networks	Networked wireless communications over multiple hops is rapidly emerging as the main architecture of future wireles systems, including multihop extensions of cellular and WiFi networks, mesh networks, and sensor networks. Common among these types of networks is that they are not completely unstructured (or ad hoc) networks, but traffic is routed and accumulated towards a common destination. Due to this characteristic property, these networks will be referred to as Networks with Traffic Accumulation, or NETAs. Traffic accumulation creates hot spots or bottlenecks around the common destination because of the increased traffic load and interference. Despite the severity of the hot spot problem, there is a lack of efficient methods to cope with it. This research addresses the hot spot issue in NETAs by developing new distributed error correction strategies tailored to two important subclasses- line networks and tree networks. In line networks, the investigators study fundamental properties and the design of distributed channel coding protocals using serially concatenated and protograph-based constructions to strengthen the error correction capability near the destination without sacrificing																		1											X						########	
NSF	CISE 0830685 / University of California-Davis	1.03	Feedback and Learning in Cognitive Radio Systems	Cognitive radio is the key enabling technology for future generations of wireless systems that address critical challenges in spectrum efficiency, interference management, and coexistence of heterogeneous networks. This research aims to develop fundamental theories and practical algorithms for cognitive radio systems. It focuses on three key areas: (i) spectrum opportunity sensing and cognition; (ii) spectrum opportunity tracking and exploitation; and (iii) cognitive opportunistic networking. These three areas represent a logical progression that expands in scope and complexity. Key innovations of this research include exploiting the heavy tail and self similar nature of primary traffic processes in the design of cognitive radio systems. The inevitability of sensing errors, which has mainly been studied in isolation at the physical layer, is explicitly taken into account in all aspects of this research, from the investigation of fundamental performance limits to the design of algorithms and protocols at all network layers. The overall objective of this research is to gain a rigorous understanding of the role of feedback and learning in cognitive radio systems, to characterize fundamental structures and performance limits of												1																	X						########	
NSF	CISE 0830702 / University of Maryland College Park	12.166	Towards Modeling Mobile Wireless Networks -- When Connectivity Meets Mobility!	Towards modeling wireless networks -- When connectivity meets mobility! The search for appropriate wireless network models that capture the effects of node locations and user interferences has led to the introduction of several classes of random graphs with increasingly complex notions of adjacency (i.e., one-hop connectivity). In such one-hop connectivity graph models, the presence of an edge between two nodes captures their ability to communicate directly and reliably with each other. However, viewed as systems, networks are "greater than the sum of their parts" -- One-hop connectivity gives rise to "network connectivity" as network resources collectively enable end-to-end data transfer between participating nodes. When the graph determined by the one-hop connectivities is static (or slowly changing at the time scales of interest), network connectivity is readily identified with the usual notion of graph connectivity in the one-hop connectivity graph. In the presence of mobility, the one-hop connectivity structure of the network changes over time, graph connectivity may no longer be suitable to capture network connectivity and other, more appropriate, notions need to be considered. With this in mind, we introduce																					1									X						########	

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NSF	CISE 0830796 / University of California-Berkeley	12.086	Information Theory of Networks: A Deterministic Approach	Claude Shannon's point-to-point information theory is a basis for the design of all modern day communication systems, ranging from cellular communications, cable and DSL modems, statellite communications, compact disks, etc. Extending the theory from point-to-point communication to an entire network of communicating nodes is a holy grail of the communication field. It is expected that such an information theory of networks would have a significant impact for applications such as wireless and sensor networks. Yet, despite significant effort in the past 40 years, only isolated cases have been solved and there is still limited understanding of central issues such as interference, cooperation, broadcast and distributed compression of correlated information. This research advocates a new general approach to attack network information theory problems. The new approach involves three steps: 1) approximate the noisy network with an appropriately chosen deterministic model which focuses on the interaction between the various signals rather than the noise; 2) analyze the analytically simpler deterministic model; 3) translate the insight into finding approximately optimal strategy for the																		1										X							########	
NSF	CISE 0830809 / University of California-Irvine	12.087	Interference Management and the Capacity of Wireless Networks	Project Summary: Interference Management and the Capacity of Wireless Networks Interference is believed to be the principal barrier to achieving higher data rates in wireless networks. The recent emergence of the idea of interference alignment has shown that the capacity of wireless networks can be significantly higher than prior estimates. The key idea is to design signals cleverly to occupy half the bandwidth in such a manner that they cast overlapping shadows at each receiver where they constitute interference, while they remain distinct at the receivers where they are desired. The surprising conclusion is that "everyone gets half the cake", i.e., regardless of the number of users competing for the same wireless spectrum, potentially every user is able to access half the bandwidth with no interference from other users. This research integrates the interference alignment perspective into the existing array of wireless network capacity results and uses the collective insights, tools and techniques to develop optimal interference management algorithms. The integrated view of interference management resulting from this research is a significant contribution to both the theory and practice of wireless network design. It																		1										X							########	
NSF	CISE 0831490 / University of Utah	17.009	CT-ISG: Opportunistic Secret Key Exchange Using Wireless Link Characteristics and Device Mobility	The objective of this research is to build new measurement-based methods for secure secret key establishment between two wireless devices, without ever communicating the secret key, using diverse physical characteristics of the wireless medium, notably an innovative measurement called temporal link signatures, and using device mobility. The intellectual merits of this research include (i) collection of extensive measurements and characterization of spatial and temporal behavior of wireless link signatures in a variety of indoor and outdoor settings, (ii) determination of the shared secret space in different settings through the use of analytical methods and the measurement data, (iii) novel methods for enhancing the length of the shared secrets to make them robust against brute force attacks, (iv) novel methods for dealing with asymmetric measurements of link signatures, and (v) a complete, implementable methodology, with specific configuration recommendations, for secure secret key establishment in real scenarios. This research will have a significant broad impacts. It generates a large amount of measurement data useful for various future wireless communications and security																											1			X						########	

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NSF	CISE 0831549 / University of California-Los Angeles	12.1	NEDG: A New Systematic Framework for Cross-layer Optimization	Cross-layer design problems in wireless networks are usually very complex, since they require simultaneously optimizing a large amount of algorithms and parameters. Most existing solutions for cross-layer optimization rely on heuristic procedures to solve this problem. However, to obtain an optimal utility for the wireless user, cross-layer optimization should be formulated rigorously as a sequential decision problem that takes into account the capability of the various layers to autonomously make forecasts about their experienced dynamics, and perform foresighted adaptation, while adhering to the existing layered network architecture. To address this challenge, the investigators study a new, systematic framework for cross-layer optimization that allows each layer to make autonomous and foresighted decisions on the selected transmission strategies (e.g. protocol parameters and algorithms), while cooperatively maximizing the utility of the wireless user by optimally determining what necessary information should be exchanged among layers. This research involves two main thrusts: (a) Develop a novel cross-layer optimization framework with message exchange among layers in which each layer																				1									X						########	
NSF	CISE 0831633 / Virginia Polytechnic Institute and State University	18.005	Collaborative Research: NECO: A Market-Driven Approach to Dynamic Spectrum Sharing	To counter the inefficiencies of the current spectrum usage, regulatory bodies, all over the world, are exploring ways to deregulate the spectrum market by allowing flexible dynamic spectrum access (DSA) in a broad range of spatio-temporal scale. Recent advances in radio technology have given an impetus to this trend. For DSA to fulfill its promise of economic and societal impact, wireless services based on DSA must be commercially successful, and a tangible spectrum market must evolve that can be supported by technology. This research project will build a realistic DSA architecture for cellular networks supported by appropriate market mechanisms in an integrated fashion that is both technically and economically viable and efficient. This is a truly trans-disciplinary approach spanning the fields of wireless networking and systems, algorithmics, economics, simulation and modeling, which leads to a deeper understanding of the dynamics of the spectrum market by (i) realistic modeling of various market entities (i.e., buyers, sellers, and the market mechanisms), (ii) dynamic spectrum demands and bids based on innovative and realistic population dynamics models, and (iii) new and robust market clearing																									1					X						########	
NSF	CISE 0831660 / Massachusetts Institute of Technology	12.128	NeTS-NEDG: Adaptive Wideband Networks for the Multimedia Home	Users' desires to share high definition audio and video around the home are driving the need for ever-increasing wireless bandwidth. Wideband radios, whose bandwidth spans hundreds of MHz to many GHz, can provide the solution. Recent years have shown significant work on the design and implementation of wideband radio transceivers that function for a single link. However, this is not enough; for wideband technologies to become practical, we need a wideband link to coexist with narrowband technologies with which it shares the spectrum (e.g., 802.11 a/b/g and WiMax), as well as operate efficiently in the presence of other wideband links producing successful wideband networks. This project presents FAWN, a Frequency Adaptive Wideband Network designed for wideband radios operating in the unlicensed spectrum. FAWN allows wideband transceivers to coexist with narrowband devices operating in the same frequencies, while forming a network of their own. FAWN also exploits frequency diversity, introducing novel autorate algorithms and MAC protocols that are frequency-aware. We will implement FAWN in wideband radio hardware and evaluate our design in a testbed of wideband nodes and narrowband																				1									X						########	

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NSF	CISE 0831670 / University of Illinois at Urbana-Champaign	1.038	NEDG: MIMO Links in Wireless Edge Networks: Cross-Layer Protocol Design	NEDG: MIMO Links in Wireless Edge Networks: Cross-Layer Protocol Design Abstract: Wireless networking has gained significant acceptance in recent years. In particular, wireless local area networks (LANs) and mesh networks are increasingly being deployed in the unlicensed bands of the spectrum. While the density of wireless devices is likely to increase, the spectrum available for the devices remains limited. Therefore, techniques to improve performance of wireless networks are of great interest. Intellectual Merit: This project will explore the use of multi-antenna technology in wireless networks. A particular focus will be on the design and evaluation of cross-layer protocols for multi-input multi-output (MIMO) channel access. This project will address the fundamental challenges of managing interference and intelligent use of MIMO technology in wireless edge networks. The topics to be covered include design of cross-layer protocols for MIMO-based wireless networks, development of accurate simulation models for MIMO channels, and experimental evaluation of a selected subset of protocols. Through these research activities, the project will contribute to enhancing the performance of wireless											1																			X						########	
NSF	CISE 0831762 / Lucent Technologies Bell Laboratories	18.006	Collaborative Research: NECO: A Market-Driven Approach to Dynamic Spectrum Sharing	To counter the inefficiencies of the current spectrum usage, regulatory bodies, all over the world, are exploring ways to deregulate the spectrum market by allowing flexible dynamic spectrum access (DSA) in a broad range of spatio-temporal scale. Recent advances in radio technology have given an impetus to this trend. For DSA to fulfill its promise of economic and societal impact, wireless services based on DSA must be commercially successful, and a tangible spectrum market must evolve that can be supported by technology. This research project will build a realistic DSA architecture for cellular networks supported by appropriate market mechanisms in an integrated fashion that is both technically and economically viable and efficient. This is a truly trans-disciplinary approach spanning the fields of wireless networking and systems, algorithmics, economics, simulation and modeling, which leads to a deeper understanding of the dynamics of the spectrum market by (i) realistic modeling of various market entities (i.e., buyers, sellers, and the market mechanisms), (ii) dynamic spectrum demands and bids based on innovative and realistic population dynamics models, and (iii) new and robust market clearing																									1					X						########	
NSF	CISE 0831791 / SUNY at Stony Brook	18.007	Collaborative Research: NECO: A Market-Driven Approach to Dynamic Spectrum Sharing	To counter the inefficiencies of the current spectrum usage, regulatory bodies, all over the world, are exploring ways to deregulate the spectrum market by allowing flexible dynamic spectrum access (DSA) in a broad range of spatio-temporal scale. Recent advances in radio technology have given an impetus to this trend. For DSA to fulfill its promise of economic and societal impact, wireless services based on DSA must be commercially successful, and a tangible spectrum market must evolve that can be supported by technology. This research project will build a realistic DSA architecture for cellular networks supported by appropriate market mechanisms in an integrated fashion that is both technically and economically viable and efficient. This is a truly trans-disciplinary approach spanning the fields of wireless networking and systems, algorithmics, economics, simulation and modeling, which leads to a deeper understanding of the dynamics of the spectrum market by (i) realistic modeling of various market entities (i.e., buyers, sellers, and the market mechanisms), (ii) dynamic spectrum demands and bids based on innovative and realistic population dynamics models, and (iii) new and robust market clearing																									1					X						########	

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NSF	CISE 0832025 / William Marsh Rice University	12.101	NEDG: Cooperative Wireless Networks: From Theory to Urban-Scale Trials	This project studies a paradigm in which nodes cooperate by pooling power and bandwidth resources and where flows interact opportunistically to avoid interference and increase network utilization. The PIs will leverage their existing expertise in cooperative and opportunistic communications to analyze the implications for broader networks of communication nodes. In particular, they will instantiate their design philosophy in three ways: Node Information Management: While previous network analyses considered only isolated aspects of a node (e.g., channel gain), the project studies a comprehensive network state information, which captures not only physical-layer conditions but also higher-layer information such as queue state, processing power, and availability of forwarding routes. Novel Network Representations: Instead of regarding the network as a simple connectivity graph, the PIs will introduce and develop a network representation which incorporates both temporal and spatial relationships between nodes. The PIs refer to this as the trellis representation of the network, and it will enable us to describe cooperative and opportunistic communication in a wide area																				1										X						########	
NSF	CISE 0832084 / University of Houston	12.129	NeTS-NEDG: Toward Service Predictability under Uncertain Resource Availability in 802.11 Like Networks	Explosion of wireless products and innovative use of the ISM bands lead to a very crowded spectrum space. When densely deployed, significant performance degradation may be experienced ranging from higher latency and lower data rate to starvation and service disruption. To tackle the co-existence problems, two key challenges need to be addressed. First, there exists innate uncertainty in channel quality, user location and population as well as coexisting devices and networks. Second, many emerging applications using radio technologies in the ISM bands require high availability and predictable services instead of large access bandwidth. The focus of this project is thus to develop theoretical models and algorithms for robust resource management that target at minimizing the outage and/or disruption of desired service level under varying resource availability in 802.11 like networks. This work will result in i) new methods and measurement procedures for inferring internal and external conditions of broadband wireless networks; ii) novel concept of effective margin as a quantifiable metrics for the robustness of resource management decisions; and iii) design of an optimization framework for robust resource																				1										X						########	
NSF	CISE 0832090 / University of California-Santa Barbara	1.039	NeTS NEDG: Dynamic Spectrum Access for Availability and Reliability	Historical static spectrum allocation has led to an artificial spectrum scarcity, leaving no usable spectrum for future wireless networks. Dynamic spectrum access is the ideal solution to break such scarcity and make spectrum available to new wireless networks. However, without providing proper reliability guarantees, dynamic spectrum access is unacceptable to many networks and services. Thus, instead of focusing solely on improving spectrum utilization, dynamic spectrum access should provide reliable spectrum usage that meets network's individual needs. This research develops SAFIRE, a robust architecture for dynamic spectrum access that provides reliable and efficient spectrum usage to large wireless networks. This research holds great practical values for wireless network designers and service providers who rely on available and reliable spectrum access to deploy and advance their networks. Recognizing the fundamental tradeoffs between spectrum utilization and reliability, this research focuses on efficient algorithms to meet individual networks? reliability requirements while improving spectrum utilization. The investigators will develop statistical mechanisms to proactively regulate spectrum demands											1																			X						########	

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NSF	CISE 0832120 / Illinois Institute of Technology	1.086	NeTS-NECO: Some Fundamental Problems for Performance Study of Opportunistic Spectrum Utilization	NeTS-NECO: Some Fundamental Problems for Performance Study of Opportunistic Spectrum Utilization Summary of Proposed Research Activities: This work will develop, design, and implement efficient wireless network protocols for better spectrum utilization and study some fundamental performance bounds for networks with opportunistic spectrum utilization. This work will study the Nash Equilibrium points of the spectrum sensing game and spectrum access game when secondary users are selfish. This work will design stable distributed link scheduling and routing methods to maximize throughput, and derive some necessary and/or sufficient conditions on attainable flows. This work will also develop tractable and insightful metrics and models for wireless networks using SOPs; obtain upper and lower performance bounds for these metrics for a given set of models; define the negotiation between application and network for picking the operating point. Intellectual Merit: This work not only identifies unexplored important problems (i.e., finding equilibriums of spectrum sensing and access games, studying the capacity limits of networks with SOPs) and offers methods to solve them, but also proposes novel												1																	X						########	
NSF	CISE 0832154 / University of California-Santa Barbara	13.03	XPLR: MultiGigabit millimeter wave mesh networks: Cross-layer design and experimental validation	The large amount of unlicensed and semi-unlicensed bandwidth available for millimeter (mm) wave communication enable multi-Gigabit wireless networking that can potentially transform the telecommunications landscape. Intellectual Merit: This research investigates the use of the unlicensed 60 GHz ''oxygen absorption'' band for providing a quickly deployable broadband infrastructure based on multi-Gigabit outdoor mesh networking. Millimeter wave links are inherently directional: the directionality is required to overcome the increased path loss at higher frequencies, and is feasible for nodes with compact form factors using antenna arrays realized as patterns of metal on circuit board. This project addresses the cross-layer design of mesh networks with such highly directional links, in which implicit coordination using carrier sense mechanisms cannot be relied on, and there is no omni-directional mode for explicit coordination. In addition, the research will investigate new design principles for directional medium access control, with the challenge being to coordinate nodes despite the deafness induced by directionality, while taking advantage of the drastically reduced spatial interference. The project will also																	1													X						########	
NSF	CISE 0832161 / University of Southern California	12.099	NEDG: Contention-Awareness in Mesh Transport: Theory and Practice	Contention-Awareness in Mesh Transport: Theory and Practice Multi-hop wireless mesh networks are becoming increasingly important elements of edge networks in the Internet. These networks of static nodes provide community networking, distributed sensing, and Internet access. In each case, the primary advantage of a mesh is its easy deployability and upgradability. Despite these advantages, mesh networks have not seen widespread adoption. The primary reason for this is a lack of attention to the transport performance of such networks, which leads to poor end-user experience. The central challenge to improving transport performance in mesh networks is to make the transport protocol aware of the complex interference that exists in multi-hop wireless networks. Intellectual Merit. This work will explore the design space of transport protocols for mesh networks. It will focus on two classes of designs: a) easy to implement, fair and efficient schemes that ensure that competing traffic is correctly throttled when congestion is detected inside the network, and b) near-optimal schemes estimate available network capacity and apportion it to flows in a fair and efficient manner. Broad Impact. The proposed work can spur the																						1								X						########	

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NSF	CISE 0832833 / Missouri University of Science and Technology	12.154	Signal Processing for Wireless Communications over Triply Selective Fading Channels	Multiuser multiple input multiple output (MIMO) communication is likely to become instrumental for future wireless communication networks due to limited frequency spectrum and increasing demand for high data rate and high quality services. Research on MIMO wireless communication has been going on for about a decade. Various MIMO signal processing methods and information theoretical results have been developed using simplified or idealized fading channel models. Relatively less work has been done for the transceiver design of MIMO communications over realistic fading channels, which usually undergo space-selective, time-selective, and frequency-selective fading. This realistic fading is referred to as triply selective fading. The triply selective fading contains doubly selective as a special case but it is not a trivial extension, especially in terms of capacity-based transceiver design. The project investigates several key problems in multiuser MIMO communications over triply selective fading channels. First, it analyzes the effects of triply selective fading and its correlation matrices on the ergodic capacity, outage capacity, network throughput, and error performance of multiuser MIMO multiple access channels																		1										X							########	
NSF	CISE 0837995 / Columbia University	10.004	Small Grant for Exploratory Research: Creating a Future Internet Network Architecture with a Programmable Optical Layer	Intellectual Merit: The project explores a transformative networking architecture for the future Internet that truly exploits the physical optical layer in a cohesively integrated fashion. We specifically seek to explore an architectural design that encompasses the capabilities of a fully programmable optical layer. Within this unified architectural platform the optical layer becomes a directly accessible component of the network capable of dynamically morphing to meet the increasingly diverse demands of emerging applications. To realize these capabilities will require breaking the barriers currently separating the underlying optical transport technologies from the networking layers by introducing programmable cross-layer access deeply into the physical layer. The effort will include a design exploration and simulation validation for the uniquely integrated architectural platform evaluated across varied networking applications and traffic scenarios envisioned for the future Internet. Broader Impact: If successful, our exploratory effort could provide a new framework for concretely bridging the gap between the future Internet networking research efforts and the underlying heterogeneous substrate by creating an																											1		X							########	
NSF	CISE 0844111 / University of Arizona	12.034	CAREER: Securing Channel Access in Multi-Channel Ad Hoc Networks	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). CAREER: Securing Channel Access in Multi-Channel Ad Hoc Networks Proposal ID: 0844111 PI?s Name: Loukas Lazos University of Arizona Award Abstract An increasing number of mobile users rely on wireless technologies to gain secure and uninterrupted access to network services. As the volume of data disseminated via the wireless medium rapidly expands, provision of performance, reliability, and security become challenging problems. These problems can be alleviated by the use of multiple orthogonal frequency bands (channels) that has been demonstrated to substantially reduce contention and interference. However, for systems with poor physical security and lack of centralized resource allocation such as ad hoc, sensor, and cognitive radio networks, a multitude of internal and external attacks against the medium channel access mechanisms can negate any gains due to channelization. Most previous adversary models and protection methods are limited to single-channel networks thus ignoring the additional vulnerabilities and complexities of channelization. This project aims to advance our understanding regarding the																					1								X							########	

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NSF	CISE 0844850 / University of Texas at Austin	12.033	CAREER: Opportunistic Middleware for Delay-Tolerant Networks	0844850 Christine Julien University of Texas at Austin CAREER: Opportunistic Middleware for Delay-Tolerant Networks Delay-tolerant networks are characterized by extreme unpredictability of connectivity due to disconnections between senders and receivers that often persist for long periods of time. This style of network has become increasingly important, largely due to emerging applications, such as enabling access to the Internet in remote areas, social networking, and mobile search and rescue. Existing solutions are generally tailored to very specific applications, instead of focusing on application properties in general. Intellectual Merit. This project uses applications' common characteristics to drive the development of coordination support for delay-tolerant networks by simplifying application development and providing an expressiveness that enables new classes of fluid and responsive applications. The project begins by developing an understanding of coordination in delay-tolerant networks by developing a theory of temporally extended conversations among communicating parties. To support these conversations, the research also examines the creation of new communication protocols that adapt their																				1										X						########	
NSF	CISE 0845671 / University South Carolina Research Foundation	12.036	CAREER:THAWS--Towards Highly Available Wireless Services	With the continuing proliferation of wireless technology, a wide spectrum of emerging applications using this technology will be tightly interwoven into the fabric of our everyday lives: wireless sensor networks can monitor personal health or critical infrastructures. The viability and success of many of these applications critically hinges on the availability of the underlying wireless communication. As wireless networks become increasingly pervasive, the problem of radio interference and jamming will be inevitable, raising a serious threat to the availability of wireless services. To enable the continuous and highly-available data delivery services over the entire lifetime of wireless networks in support of wireless applications, it is crucial that the wireless networks have built-in strong defense mechanisms against interference and jamming. This project aims to develop a suite of holistic solutions that monitor the radio environment and provide quick recovery to interrupted services in case of jamming or radio interference. In contrast to traditional techniques, such as spread spectrum which requires costly new hardware, the proposed techniques involve networks to manage their resources collaboratively across all layers to assure																				1										X						########	
NSF	CISE 0845700 / Virginia Polytechnic Institute and State University	1.049	CAREER: Cross-layer optimization in Cognitive Radio Networks in the Physical interference model based on SINR constraints: Algorithmic Foundations	One of the most significant recent advances in wireless networks is the Cognitive Radio Network (CRN), which can allow unlicensed (or secondary) users to access spectrum bands allocated to licensed (primary) users, without disrupting their performance. Since many licensed spectrum bands have been found to be greatly underutilized, CRNs can potentially enhance the spectrum usage significantly. The basic principle underlying CRNs is to first sense the spectrum usage by primary users, and then allocate power levels and channels opportunistically to the secondary users, so that the interference levels at primary users are within an acceptable threshold. Most theoretical analyses of protocols in such networks use disk/graph based approximations (in which "close-by" links cannot transmit simultaneously) to model wireless interference; however, these are inadequate and can lead to infeasible solutions with unacceptable interference levels at the primary users. The goal of this proposal is to examine the theoretical foundations of cross-layer optimization in Cognitive Radio Networks in the Physical interference model, which is considered a much better approximation of interference than disk based models. The results of this												1																		X						########	

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NSF	CISE 0845776 / Montana State University	12.028	CAREER: Leveraging Smart Antennas for WiMAX-based Mesh Networking	The WiMAX technology (IEEE 802.16) can provide high-speed and long-range wireless communications for a large variety of applications. Smart antennas, such as Digital Adaptive Array (DAA) and Multiple Input and Multiple Output (MIMO) antennas, can offer a long transmission range and improve network capacity via interference suppression and spatial multiplexing. The objective of this project is to provide a comprehensive networking solution for a WiMAX mesh network with smart antennas by investigating the fundamental problems, including scheduling, routing and relay station placement. Specifically, their computational complexities will be investigated, and efficient and standard-compliant algorithms and protocols will be proposed to solve them. The PI will also develop a relay station model in the OPNET Modeler, and a DAA antenna based testbed to evaluate and validate the proposed solutions. The algorithms and protocols proposed in this project can be applied in the WiMAX product development and are expected to impact the standardization activities in IEEE and IETF. The relay station model and the testbed can be used by other researchers for evaluation and validation. Moreover, the proposed research activities																1													X						########	
NSF	CISE 0845812 / Michigan State University	16.017	CAREER: Towards Cognitive Communications in Wireless Networks	Today's cognitive radio is characterized by its capability to perceive the existence of spectrum holes through spectrum sensing, and then transmitting on these unutilized frequencies. While each individual cognitive radio is very capable and can make independent decisions, lack of user coordination and network control raises serious issues in efficiency, security and resource waste in wireless environments. These problems call for fundamental changes in cognitive communication network design. In this research, we introduce and develop the concept of cognitive network, which is defined as an intelligent wireless system that can collect and analyze the current network conditions, and then make real-time corresponding changes in network operating parameters, such as modulation scheme, transmission power, carrier frequencies, data frame structure, coding schemes, resource allocation and security management. We provide a comprehensive framework for the development of cognitive networks from a network-centric perspective. More specifically, we plan to: (i) Introduce a novel architecture for cognitive network; (ii) Design efficient and secure resource management protocols; (iii) Develop highly																1													X						########	
NSF	CISE 0845842 / New York University	1.045	CAREER: A Low-Cost Efficient Wireless Architecture for Rural Network Connectivity	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This project develops WiFi-based Rural Extensions (WiRE), a new wireless architecture that can provide high bandwidth connectivity to rural regions at extremely low costs. WiRE is a comprehensive rural connectivity solution that can support a wide range of applications with performance, robustness and functionality guarantees. The design of WiRE addresses several research challenges across different protocol layers including: (1) an adaptive, high-performance unified Medium Access Control layer that seamlessly works across different network environments; (2) a secure and scalable naming and addressing solution to enable cellular access using mobile devices; (3) robust solutions for fault-tolerant network design, failure recovery, network management and unreliable power; (4) Quality of Service mechanisms to provide predictable end-to-end performance. The project enhances the understanding of networking and systems challenges in the developing world and can have enormous societal benefits to billions in rural regions. It makes fundamental advances in wireless networks including understanding complex												1																	X						########	

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NSF	CISE 0845968 / Purdue University	12.031	CAREER: Next Generation Network Coding: Distributed Design Via Coded Feedback	The exponentially increasing demands for heterogenous services over Internet and wireless networks have imposed new urgency and great challenges for designing next-generation networks that achieve higher throughput, better resiliency to adversary attacks, and stronger security for sensitive information. Recently, a new network coding paradigm has emerged, which potentially achieves the above goals simultaneously in an optimal fashion. Nonetheless, to realize fully its promised benefits requires a clean-slate methodology of network code design that achieves optimal performance and maintains low complexity while reacting quickly to the ever changing network environment. To that end, the investigators study coded feedback, which generalizes the conventional feedback mechanism that acknowledges non-coded traffic by incorporating the unique algebraic structure of network-coding. This research first explores the joint algebraic properties between coded forward and feedback packets, which are the basis for the subsequent development of new, efficient network protocols for next generation network codes. In particular, the investigators are interested in the roles of																				1										X							########	
NSF	CISE 0846044 / Oregon State University	1.057	CAREER: Optimization and Design of Next-Generation Cognitive Mesh Networks: From Theory to Practice	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Cognitive radios and multi-antenna systems are two recent components that each offers a great potential for improving spectrum efficiency. The former enables opportunistic spectrum access (OSA), while the latter enables multiple-input, multiple-output (MIMO) capability. This project develops theoretical and practical frameworks for wireless mesh networks when they are both MIMO-enabled and OSA-capable. The objective of this research is three-fold. First, it takes a bottom-up, cross-layer approach to understand, model, and characterize the optimal end-to-end network throughput while accounting for physical-layer limitations and link-layer contention constraints. Second, the project develops efficient networking algorithms by investigating new paradigms that shift away from traditional ones to suit these OSA-capable, MIMO-enabled networks. Third, this project implements the thus-developed techniques in a real, experimental wireless mesh network that is built from off-the-shelf commercial components. This demonstrates both the feasibility and the effectiveness of the developed concepts. This project													1																	X							########	
NSF	CISE 0847211 / Stevens Institute of Technology	1.108	SGER: Securing Spectrum Usage in Future Radio Systems	SGER: Securing Spectrum Usage in Future Radio Systems Project Summary The future wireless devices will be highly-programmable with the exposure of the protocol stacks to the public. Adversaries can easily purchase low-cost wireless devices to launch a variety of attacks with little effort. These attacks will compromise the advantage of dynamic spectrum access for the greater good. Therefore, there is an urgent need to regulate and monitor future radio operations to ensure the spectrum is properly used. This work will explore new paradigms of securing future radio systems that take advantage of domain-specific information. Particularly, this work will utilize location information to assist in detecting anomalous behaviors when enforcing spectrum etiquettes because location has unique characteristics of describing the current physical status of a wireless device, hard to falsify, and not reliant on cryptography. Intellectual Merit: The key contribution of this work is to design efficient mechanisms and develop effective frameworks that can both detect anomalous activities in spectrum usage as well as localize adversaries without requiring overhead on wireless devices. This work represents a significant contribution to													1																	X							########	

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NSF	CISE 0851400 / Virginia Polytechnic Institute and State University	1.104	REU Site: Cognitive Communications	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This REU site is focused on cognitive communications at Virginia Polytechnic Institute, and hosts 10 undergraduate students for 10 weeks for 3 years. The site recruits, trains, and retains undergraduate students to research by supporting them in the following ways: ? Prepares them to think creatively and independently; ? Motivates them to pursue graduate studies; ? Helps them to develop general research skills in an interdisciplinary context; ? Allows them to gain hands-on experience in cognitive radios, wireless networking, and their applications; ? Promotes a sense of confidence, team spirit, and an appreciation of the potential of interdisciplinary collaboration in creating new knowledge; ? Exposes them to the intellectual excitement involved in research activities; and ? Teaches them to effectively assimilate latest research, assess their own knowledge, present experimental results, effectively prepare reports and publications, and understand the methods for translating ?research to practice (R2P).? Intellectual Merit: Cognitive communications is an area of high interest to researchers in wireless communications. The mentors in the project									1																		X						########	
NSF	CISE 0855200 / University of North Carolina at Charlotte	6.01	II-NEW: Versatile Hardware Emulator for ISM-band Network Management	Experimental investigations are important in the development of wireless network protocols. While the widely used simulation approach for experimental investigations is good for studying large-scale network-level performance, simulators cannot represent the real physical environment and hardware implementation precisely. On the other hand, the testbed approach can address the realism drawback of the simulation approach, but faces serious repeatability and control issues. A recent trend on evaluating wireless network protocols is to use wireless emulators. Emulators can achieve both a high degree of realism and fine-grained repeatability. This project develops a versatile hardware-based emulator supporting controllable, repeatable, and scalable experiments over a wide range of ISM-band wireless networks (2-6GHz), including IEEE 802.11 a/b/g/n, IEEE 802.15.4, and Bluetooth networks. The hardware emulator is a particularly convenient research tool for investigating the unique interference issue in ISM bands by providing a controllable interference environment. It enables experimental investigations in a number of research projects, including wireless network protocol development, interference									1																		X						########	
NSF	CISE 0855201 / University of Wisconsin-Madison	3.01	II-EN: A Metro-Scale Vehicular Wireless Testbed with Spectrum Awareness and Spectrum Agility	This project builds a unique metro-scale, vehicular wireless testbed, called MadBed, with capabilities for wide-area wireless connectivity, with specially designed nodes mounted on Madison area city buses. The testbed is also being leveraged to provide Internet services to the passengers of these city buses. Further the testbed is also providing various vehicular communication services to the bus network, e.g., tracking of city buses, and some specialized law enforcement capabilities. The infrastructure is enabling a large number of specialized wireless and mobile networking research projects in the UW-Madison campus. A few examples include exploration of new wireless network management techniques for wide-area wireless networks, exploration in design of new cooperative MAC protocols, exploration in wide-area spectrum sensing and their utilization, and in vehicular delay tolerant networking. As part of its educational component, MadBed is allowing a greater hands-on experience to students in the classroom on design and performance of wide-area wireless environments. In its outreach component, the PIs of MadBed are partnering with a local governmental organization called Educational Communications Board of							1																				X						########	

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NSF	CISE 0855261 / University of Utah	2.013	II-NEW: An Infrastructure for Researching Wireless Link Signatures	The objective of this project is to acquire and set up a wireless measurement infrastructure and use it to research new wireless link signatures and their applications. The signature of a wireless link between a wireless transmitter and a receiver represents the wireless link's unique physical characteristics. Wireless link signature applications include secret key establishment between a wireless transmitter and a receiver without ever communicating the secret key, and location distinction which is the ability to detect at one or more receivers when a transmitter changes its location. The intellectual merit of this research includes (i) extensive measurements of wireless link characteristics under (a) heterogeneous indoor and outdoor settings, (b) a variety of wireless standards with different types of transmitters, and (c) different frequency bands with the help of highly capable spectrum analyzers, (ii) development of novel methodologies for different wireless link signature applications including location distinction, and secret key establishment, using these measurements, and (iii) evaluation of the methodologies through implementation. This research impacts the development and deployment of wireless																1													X						########	
NSF	CISE 0904305 / Massachusetts Institute of Technology	12.047	CIF:Medium:Collaborative Research:Understanding and Managing Interference in Communications Networks	The ubiquity of wireless devices and services and the ever increasing bandwidth demand make it imperative to improve spectrum utilization. Key to improving spectrum efficiency in a multi-user networks is understanding and managing interference. This collaborative project studies the phenomenon of interference in communication networks and develops a theoretical foundation on how to deal with interference under realistic operating conditions. The study addresses several long-standing open problems; solutions to those problems should collectively advance our understanding on interference and provide guidance on the design of future wireless networks. This project pursues a broad range of topics that are of great theoretical and practical significance. Conventional wisdom suggests that, since interference has structure that is not present in thermal noise, this structure should be exploited by transceivers. On the other hand, there are situations where interference can be essentially ignored without compromising system throughput, as evidenced by recent breakthroughs in the study of the sum-rate capacity of Gaussian interference channels. This project demonstrates that there are different regimes for interference																				1										X						########	
NSF	CISE 0904619 / University of Illinois at Urbana-Champaign	12.045	CIF:Medium:Collaborative Research: Understanding and Managing Interference in Communication Networks	The ubiquity of wireless devices and services and the ever increasing bandwidth demand make it imperative to improve spectrum utilization. Key to improving spectrum efficiency in a multi-user networks is understanding and managing interference. This collaborative project studies the phenomenon of interference in communication networks and develops a theoretical foundation on how to deal with interference under realistic operating conditions. The study addresses several long-standing open problems; solutions to those problems should collectively advance our understanding on interference and provide guidance on the design of future wireless networks. This project pursues a broad range of topics that are of great theoretical and practical significance. Conventional wisdom suggests that, since interference has structure that is not present in thermal noise, this structure should be exploited by transceivers. On the other hand, there are situations where interference can be essentially ignored without compromising system throughput, as evidenced by recent breakthroughs in the study of the sum-rate capacity of Gaussian interference channels. This project demonstrates that there are different regimes for interference																				1										X						########	

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NSF	CISE 0905235 / University of Southern California	12.038	CIF: Medium: Collaborative Research: Understanding and Managing Interference in Communications Networks	The ubiquity of wireless devices and services and the ever increasing bandwidth demand make it imperative to improve spectrum utilization. Key to improving spectrum efficiency in a multi-user networks is understanding and managing interference. This collaborative project studies the phenomenon of interference in communication networks and develops a theoretical foundation on how to deal with interference under realistic operating conditions. The study addresses several long-standing open problems; solutions to those problems should collectively advance our understanding on interference and provide guidance on the design of future wireless networks. This project pursues a broad range of topics that are of great theoretical and practical significance. Conventional wisdom suggests that, since interference has structure that is not present in thermal noise, this structure should be exploited by transceivers. On the other hand, there are situations where interference can be essentially ignored without compromising system throughput, as evidenced by recent breakthroughs in the study of the sum-rate capacity of Gaussian interference channels. This project demonstrates that there are different regimes for interference																			1										X						########	
NSF	CISE 0905267 / University of California-Davis	12.107	NeTS: Medium: Collaborative Research: Unlocking Capacity for Wireless Access Networks through Robust Cooperative Cross-Layer Design	Cooperative networking exploits the broadcast nature of the wireless channel by effectively pooling the overheard information, which is traditionally treated as harmful interference. While there is a mature suite of tools at the physical (PHY) layer to harvest cooperative gains, it is still unclear how these tools can be employed to deliver significant network capacity gains. The goal of this project is to design and implement cross-layer mechanisms for cooperative networking. By integrating PHY layer cooperation with Medium Access Control (MAC) and application layers, the project will provide higher network capacity and improved multimedia quality. The project has two interrelated components investigating basic architectures for next generation cooperative networks: (i) Cooperative data transmission, which focuses on a robust cooperative MAC-PHY incorporating multiple relays under mobility and loose requirements on synchronization and network topology. (ii) Cooperative video transmission, which exploits the synergy between cooperation and layered compression in providing unequal error protection, as well as differential quality in multicast. Apart from potential impacts on the theory and practice of new wireless																			1										X						########	
NSF	CISE 0905320 / Syracuse University	12.046	CIF:Medium:Collaborative Research: Understanding and Managing Interference in Communication Networks	The ubiquity of wireless devices and services and the ever increasing bandwidth demand make it imperative to improve spectrum utilization. Key to improving spectrum efficiency in a multi-user networks is understanding and managing interference. This collaborative project studies the phenomenon of interference in communication networks and develops a theoretical foundation on how to deal with interference under realistic operating conditions. The study addresses several long-standing open problems; solutions to those problems should collectively advance our understanding on interference and provide guidance on the design of future wireless networks. This project pursues a broad range of topics that are of great theoretical and practical significance. Conventional wisdom suggests that, since interference has structure that is not present in thermal noise, this structure should be exploited by transceivers. On the other hand, there are situations where interference can be essentially ignored without compromising system throughput, as evidenced by recent breakthroughs in the study of the sum-rate capacity of Gaussian interference channels. This project demonstrates that there are different regimes for interference																			1										X						########	

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NSF	CISE 0905331 / Purdue University	12.105	NeTS: Medium: Collaborative Research: Unifying Network Coding and Cross-Layer Optimization for Wireless Mesh Networks: From Theory to Distributed Algorithms to Implementation	Wireless mesh networks promise a flexible and cost-effective solution for bringing high-bandwidth low-latency applications to the home. Two orthogonal but immensely attractive approaches for designing high-performance mesh networks are network coding and cross-layer optimization. The former exploits the interfering wireless media as a broadcast channel by ingenious information processing, while the latter intelligently allocates and shares network resources across the layers. This project investigates the long-overdue and highly challenging synergistic union of network coding and cross-layer optimization. The characterization of intersession network coding (INC), coding across different network flows, is NP-hard. Nonetheless, the problem can be made tractable under important practical settings. Based on new path-based characterizations, this project rigorously quantifies the network capacity in presence of different practical INC schemes. A new network-coding based cross-layer paradigm is developed for controlling mesh networks that takes into account practical considerations such as robustness, scalability, and time-varying wireless broadcast environment. New distributed, low-overhead protocols are constructed and																		1										X						########	
NSF	CISE 0905397 / University of Illinois at Urbana-Champaign	1.048	NeTS: Medium: Collaborative Research: MIMO-Pipe Modeling, Scheduling and Delay Analysis in Multi-hop MIMO Networks	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). The fundamental differences between multi-hop networks and point-to-point settings indicate that leveraging MIMO gains in multi-hop networks requires a paradigm shift from high SNR regimes to interference-limited regimes. This project undertakes a broad research agenda centered around developing fundamental theory towards achieving optimal throughput and delay performance in wireless networks. The first key step is to take a bottom-up approach for solid model abstraction of MIMO links while taking into account interference, and to extract a set of feasible rate/reliability requirements, corresponding to meaningful MIMO stream configurations. Under a common thread of MIMO-pipe scheduling, this project focuses on tackling the following challenges: 1) Developing rate/reliability models for ``MIMO-pipes'' in multi-hop networks; 2) MIMO-pipe scheduling for throughput maximization and delay minimization; and 3) Real-time scheduling of MIMO-pipes with delay constraints (for time-critical traffic). This project contributes to the formulation of new fundamental theories for multi-hop MIMO											1																		X						########	
NSF	CISE 0905398 / Princeton University	17.014	NeTS: Medium:Collaborative Research: Cooperative beamforming for efficient and secure wireless communication	"This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5)." There is a growing need for wireless networks that can sustain high data rates, are robust to interference, make efficient use of battery resources, and offer secure communications. This project introduces cooperative beamforming (CB), a novel technique that enables high throughput and power efficient communications in a secure manner. CB consists of two stages. In the first stage, the sources share their data with neighboring nodes via low-power communications. Various approaches for such information sharing are considered, with a goal to minimize queuing delays, conserve energy, and achieve high throughput. In the second stage, the cooperative nodes apply a weight to the signal received during first stage, and transmit. The weights are such that a specific objective criterion (e.g., signal to interference at the destination) is maximized. In CB, although each node uses low power, all nodes together can deliver high power to a faraway destination. This increase in power offsets power reduction due to propagation attenuation. CB can be viewed as an alternative to multihop transmission and, unlike multihop																											1			X						########	

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NSF	CISE 0905407 / Northwestern University	18.018	NeTS:medium: Design of Dynamic Spectrum Markets for Wireless Networks	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). It is widely recognized that current wireless spectrum policy has been an impediment to the continued growth of high-capacity wireless networks. This project is investigating the consequences of lifting current restrictions on spectrum allocation and ownership, and allowing for extensive spectrum markets for allocating spectrum across locations, times and diverse applications. Various market structures that may emerge in such a setting are being studied using multi-disciplinary techniques including ideas from micro-economics, optimization theory and wireless networking. A key issue being explored is how to define the spectrum assets that will be traded in such a market taking into account both the interference among different users of wireless spectrum and the performance of the resulting market mechanisms. This results in a characterization of the trade-offs, in terms of efficiency and complexity of different asset definitions and market mechanisms. These results provide new insights into market-based allocation for wireless spectrum. Results disseminated via publications could help facilitate a transition																							1						X						########	
NSF	CISE 0905408 / Ohio State University Research Foundation -DO NOT USE	12.126	NeTS-Medium: Collaborative Research: Unifying Network Coding and Cross-Layer Optimization for Wireless Mesh Networks: From Theory to Distributed Algorithms to Implementation	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Wireless mesh networks promise a flexible and cost-effective solution for bringing high-bandwidth low-latency applications to the home. Two orthogonal but immensely attractive approaches for designing high-performance mesh networks are network coding and cross-layer optimization. The former exploits the interfering wireless media as a broadcast channel by ingenious information processing, while the latter intelligently allocates and shares network resources across the layers. This project investigates the long-overdue and highly challenging synergistic union of network coding and cross-layer optimization. The characterization of intersession network coding (INC), coding across different network flows, is NP-hard. Nonetheless, the problem can be made tractable under important practical settings. Based on new path-based characterizations, this project rigorously quantifies the network capacity in presence of different practical INC schemes. A new network-coding based cross-layer paradigm is developed for controlling mesh networks that takes into account practical considerations such as robustness,																					1								X						########	
NSF	CISE 0905425 / Drexel University	17.011	NeTS: Medium: Collaborative Research: Cooperative beamforming for efficient and secure wireless communication	"This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5)." There is a growing need for wireless networks that can sustain high data rates, are robust to interference, make efficient use of battery resources, and offer secure communications. This project introduces cooperative beamforming (CB), a novel technique that enables high throughput and power efficient communications in a secure manner. CB consists of two stages. In the first stage, the sources share their data with neighboring nodes via low-power communications. Various approaches for such information sharing are considered, with a goal to minimize queuing delays, conserve energy, and achieve high throughput. In the second stage, the cooperative nodes apply a weight to the signal received during first stage, and transmit. The weights are such that a specific objective criterion (e.g., signal to interference at the destination) is maximized. In CB, although each node uses low power, all nodes together can deliver high power to a faraway destination. This increase in power offsets power reduction due to propagation attenuation. CB can be viewed as an alternative to multihop transmission and, unlike multihop																										1			X						########	

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NSF	CISE 0905446 / Polytechnic University of New York	12.106	NeTS: Medium: Collaborative Research: Unlocking Capacity for Wireless Access Networks through Robust Cooperative Cross-Layer Design	Cooperative networking exploits the broadcast nature of the wireless channel by effectively pooling the overheard information, which is traditionally treated as harmful interference. While there is a mature suite of tools at the physical (PHY) layer to harvest cooperative gains, it is still unclear how these tools can be employed to deliver significant network capacity gains. The goal of this project is to design and implement cross-layer mechanisms for cooperative networking. By integrating PHY layer cooperation with Medium Access Control (MAC) and application layers, the project will provide higher network capacity and improved multimedia quality. The project has two interrelated components investigating basic architectures for next generation cooperative networks: (i) Cooperative data transmission, which focuses on a robust cooperative MAC-PHY incorporating multiple relays under mobility and loose requirements on synchronization and network topology. (ii) Cooperative video transmission, which exploits the synergy between cooperation and layered compression in providing unequal error protection, as well as differential quality in multicast. Apart from potential impacts on the theory and practice of new wireless																		1										X							########	
NSF	CISE 0905513 / Colorado School of Mines	17.013	NeTS: Medium: Collaborative Research: Cooperative Beamforming for Efficient and Secure Wireless Communication	"This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5)." There is a growing need for wireless networks that can sustain high data rates, are robust to interference, make efficient use of battery resources, and offer secure communications. This project introduces cooperative beamforming (CB), a novel technique that enables high throughput and power efficient communications in a secure manner. CB consists of two stages. In the first stage, the sources share their data with neighboring nodes via low-power communications. Various approaches for such information sharing are considered, with a goal to minimize queuing delays, conserve energy, and achieve high throughput. In the second stage, the cooperative nodes apply a weight to the signal received during first stage, and transmit. The weights are such that a specific objective criterion (e.g., signal to interference at the destination) is maximized. In CB, although each node uses low power, all nodes together can deliver high power to a faraway destination. This increase in power offsets power reduction due to propagation attenuation. CB can be viewed as an alternative to multihop transmission and, unlike multihop																											1			X						########	
NSF	CISE 0905556 / University of Houston	17.012	NeTS: Medium: Collaborative Research: Cooperative Beamforming for Efficient and Secure Wireless Communication	"This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5)." There is a growing need for wireless networks that can sustain high data rates, are robust to interference, make efficient use of battery resources, and offer secure communications. This project introduces cooperative beamforming (CB), a novel technique that enables high throughput and power efficient communications in a secure manner. CB consists of two stages. In the first stage, the sources share their data with neighboring nodes via low-power communications. Various approaches for such information sharing are considered, with a goal to minimize queuing delays, conserve energy, and achieve high throughput. In the second stage, the cooperative nodes apply a weight to the signal received during first stage, and transmit. The weights are such that a specific objective criterion (e.g., signal to interference at the destination) is maximized. In CB, although each node uses low power, all nodes together can deliver high power to a faraway destination. This increase in power offsets power reduction due to propagation attenuation. CB can be viewed as an alternative to multihop transmission and, unlike multihop																											1			X						########	

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NSF	CISE 0905603 / Arizona State University	1.05	NeTS: Medium: Collaborative Research: MIMO-Pipe Modeling, Scheduling and Delay Analysis in Multi-hop MIMO Networks	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111- 5). The fundamental differences between multi-hop networks and point-to-point settings indicate that leveraging MIMO gains in multi-hop networks requires a paradigm shift from high SNR regimes to interference-limited regimes. This project undertakes a broad research agenda centered around developing fundamental theory towards achieving optimal throughput and delay performance in wireless networks. The first key step is to take a bottom-up approach for solid model abstraction of MIMO links while taking into account interference, and to extract a set of feasible rate/reliability requirements, corresponding to meaningful MIMO stream configurations. Under a common thread of MIMO-pipe scheduling, this project focuses on tackling the following challenges: 1) Developing rate/reliability models for ``MIMO-pipes'' in multi-hop networks; 2) MIMO-pipe scheduling for throughput maximization and delay minimization; and 3) Real-time scheduling of MIMO-pipes with delay constraints (for time-critical traffic). This project contributes to the formulation of new fundamental theories for multi-hop											1																			X						#######	
NSF	CISE 0908506 / Arizona State University	5.005	NSF Workshop Sponsorship for the Second International Workshop on Social Computing, Behavioral Modeling, and Prediction	The Workshop on Social Computing, Behavioral Modeling, and Prediction provides an interdisciplinary platform to encourage researchers of traditionally disjoint fields such as sociology, psychology, behavioral science, cognitive science, mathematics, computer science, religious studies, and engineering to exchange ideas and findings, enhance mutual understanding of state‐of‐the art development in individual fields, develop cross‐discipline awareness, promote collaborative research opportunities, and offer a conducive environment for graduate students. In the last few years, the emergence of the social web has had a profound influence on computing and on society. A pertinent example stems from social networks where individuals from various cultural and social backgrounds interact and exchange information. In such a scenario, it will be useful to understand the development of such social networks and the behavior of individuals who are part of such networks to gain insight into different cultures and patterns of social behavior that can form the basis for predictive models. The focus of this workshop is not only on applications pf social computing but also on the encompassing research from varied																						1								X						#######	
NSF	CISE 0910531 / Virginia Polytechnic Institute and State University	17.021	TC: Large: Collaborative Research: AUSTIN - An Initiative to Assure Software Radios have Trusted Interactions	TC:Large: Collaborative Research: AUSTIN?An Initiative to Assure Software Radios have Trusted Interactions Software and cognitive radios will greatly improve the capabilities of wireless devices to adapt their protocols and improve communication. Unfortunately, the benefits that such technology will bring are coupled with the ability to easily reprogram the protocol stack. Thus it is possible to bypass protections that have generally been locked within firmware. If security mechanisms are not developed to prevent the abuse of software radios, adversaries may exploit these programmable radios at the expense of the greater good. Regulating software radios requires a holistic approach, as addressing threats separately will be ineffective against adversaries that can acquire, and reprogram these devices. The AUSTIN project involves a multidisciplinary team from the Wireless Information Network Laboratory (WINLAB) at Rutgers University, the Wireless@Virginia Tech University group, and the University of Massachusetts. AUSTIN will identify the threats facing software radios, and will address these threats across the various interacting elements related to cognitive radio networks. Specifically, AUSTIN will																											1			X						#######	

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AGENCY	DEPARTMENT/ DIVISION /LAB/ PROGRAM/ AWARD	Project #	PROJECT TITLE/DESCRIPTION	EXAMPLES	INTENDED APPLICATION ENVIRONMENT (See Attachment C for examples)	EXPECTED FREQUENCY RANGE	**Topic Area**	Topic # 3	Topic # 23	Topic # 19	Topic # 6	Topic # 15	Topic # 7	Topic # 1	Topic # 14	Topic # 11	Topic # 4	Topic # 13	Topic # 16	Topic # 2	Topic # 21	Topic # 22	Topic # 12	Topic # 8	Topic # 5	Topic # 9	Topic # 18	Topic # 17	Topic # 10	Topic # 20	**Maturity**	Basic Research	Applied Research	Advanced Technology Development	Advanced Component Development	Demonstration & Validation	**Funding**	Funded in Past (2006-2010)	Presently Funded (FY11)
NSF	CISE 0910557 / Rutgers University New Brunswick	17.027	TC:Large: Collaborative Research: AUSTIN-- An Initiative to Assure Software Radios have Trusted Interactions	TC:Large: Collaborative Research: AUSTIN?An Initiative to Assure Software Radios have Trusted Interactions (CNS-0910557) Software and cognitive radios will greatly improve the capabilities of wireless devices to adapt their protocols and improve communication. Unfortunately, the benefits that such technology will bring are coupled with the ability to easily reprogram the protocol stack. Thus it is possible to bypass protections that have generally been locked within firmware. If security mechanisms are not developed to prevent the abuse of software radios, adversaries may exploit these programmable radios at the expense of the greater good. Regulating software radios requires a holistic approach, as addressing threats separately will be ineffective against adversaries that can acquire, and reprogram these devices. The AUSTIN project involves a multidisciplinary team from the Wireless Information Network Laboratory (WINLAB) at Rutgers University, the Wireless@Virginia Tech University group, and the University of Massachusetts. AUSTIN will identify the threats facing software radios, and will address these threats across the various interacting elements related to cognitive radio																								1				X							########	
NSF	CISE 0910671 / University of Massachusetts Amherst	17.022	TC: Large:Collaborative Research: AUSTIN-- An Initiative to Assure Software Radios have Trusted Interactions	TC:Large: Collaborative Research: AUSTIN An Initiative to Assure Software Radios have Trusted Interactions Software and cognitive radios will greatly improve the capabilities of wireless devices to adapt their protocols and improve communication. Unfortunately, the benefits that such technology will bring are coupled with the ability to easily reprogram the protocol stack. Thus it is possible to bypass protections that have generally been locked within firmware. If security mechanisms are not developed to prevent the abuse of software radios, adversaries may exploit these programmable radios at the expense of the greater good. Regulating software radios requires a holistic approach, as addressing threats separately will be ineffective against adversaries that can acquire, and reprogram these devices. The AUSTIN project involves a multidisciplinary team from the Wireless Information Network Laboratory (WINLAB) at Rutgers University, the Wireless@Virginia Tech University group, and the University of Massachusetts. AUSTIN will identify the threats facing software radios, and will address these threats across the various interacting elements related to cognitive radio networks. Specifically, AUSTIN will																								1				X							########	
NSF	CISE 0914371 / Washington State University	2.018	NetSE: Small: Activity-Aware Sensor Network for Smart Environments	A smart environment contains many highly interactive and embedded devices as well as the ability to control these devices automatically in order to meet the demands of the environment. While smart environments offer many societal benefits, they also introduce new and complex challenges for wireless network design. A typical home may be equipped with hundreds or thousands of wireless sensors that aid in ensuring the health, safety, and productivity of its residents. If these sensors are continuously operating in full-alert mode, they will expend a great deal of energy and bandwidth. The result is an expensive infrastructure that requires constant maintenance to replace batteries and ensure quality-of-service. The goal of this project is to imbue such wireless sensor networks with cognitive capabilities and context awareness that will allow them to act in a more intelligent manner. The principal investigators (PIs) will use machine learning techniques to recognize activities that are being performed in the smart environment. This context information will then be conveyed to the network to allow sensor nodes to intelligently decide when to sleep, when to wake up, and how to route information. By transforming sensor																			1										X							########	

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NSF	CISE 0914899 / New Jersey Institute of Technology	1.079	CIF: NeTS:Small:Collaborative Research:Distributed Spectrum Leasing via Cross-Layer Cooperation	CIF: NeTS: Small: Collaborative research: Distributed Spectrum Leasing via Cross-Layer Cooperation ?Cognitive radio? networks, in which primary (licensed) and secondary (unlicensed) terminals coexist over the same bandwidth, are regarded as a promising solution to address spectral shortage and overcrowding. The main conventional approaches to enable such coexistence are: (i) Underlay/ overlay/ interweave strategies, which enforce strict constraints on the secondary behavior in order to avoid interference to the primary; and (ii) System-wide dynamic spectrum allocation. Both frameworks have significant drawbacks for implementation of large-scale distributed cognitive radio networks due to technological and theoretical limits on secondary spectrum sensing for (i) and on the stringent constraints on protocols and architectures for (ii). To address the problems highlighted above, this research introduces and studies the novel framework of Distributed Spectrum Leasing via Cross-Layer Cooperation (DiSC) as a basic mechanism to guide the design of Medium Access Control/ Data Link (MAC/DL) - Physical (PHY) layer protocols in decentralized cognitive radio networks. According to this framework, dynamic												1																		X						########	
NSF	CISE 0914912 / Ohio State University Research Foundation -DO NOT USE	1.115	CIF: NeTs Small: Collaborative Research: Distributed Spectrum Leasing via Cross-Layer Cooperation	CIF: NeTS: Small: Collaborative research: Distributed Spectrum Leasing via Cross-Layer Cooperation ?Cognitive radio? networks, in which primary (licensed) and secondary (unlicensed) terminals coexist over the same bandwidth, are regarded as a promising solution to address spectral shortage and overcrowding. The main conventional approaches to enable such coexistence are: (i) Underlay/ overlay/ interweave strategies, which enforce strict constraints on the secondary behavior in order to avoid interference to the primary; and (ii) System-wide dynamic spectrum allocation. Both frameworks have significant drawbacks for implementation of large-scale distributed cognitive radio networks due to technological and theoretical limits on secondary spectrum sensing for (i) and on the stringent constraints on protocols and architectures for (ii). To address the problems highlighted above, this research introduces and studies the novel framework of Distributed Spectrum Leasing via Cross-Layer Cooperation (DiSC) as a basic mechanism to guide the design of Medium Access Control/ Data Link (MAC/DL) - Physical (PHY) layer protocols in decentralized cognitive radio networks. According to this framework, dynamic												1																		X						########	
NSF	CISE 0915203 / University of Pennsylvania	18.016	NetS: SMALL: Collaborative Research: Financial Dynamics of Spectrum Trading	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Presence of a well-structured market is necessary for efficient and flexible use of licensed spectrum bands, and for fair pricing of spectrum usage. The goal of this project is to design radio spectrum markets that allow trading of spectral resources - not only of the raw spectrum, but also of a variety of service contracts derived from the use of spectrum. Specific sub-problems that will be addressed in this context include: 1) spectrum-portfolio construction that optimizes risk-versus-return trade-offs, 2) strategy design for optimal cooperation among providers, 3) price-driven dynamic scheduling of subscribers, 4) optimal pricing of spectral contracts, and 5) regulatory mechanisms for effective functioning of the spectrum markets. The solutions to the above problems take advantage of similar formulations in financial engineering, and use tools from optimization, stochastic calculus, and control and game theory. The project is expected to revolutionize spectrum trading by facilitating the design of secondary spectrum markets and spectrum regulation policies. Towards this end, This project aims at establishing a new																										1				X						########	

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NSF	CISE 0915318 / Texas State University - San Marcos	1.044	NeTS: Small: Collaborative Research:Secure and Resilient Channel Allocation in Multi-Radio Wireless Networks	Computing devices equipped with multiple radio interfaces and working on multiple channels are becoming predominant in wireless networks. These networks are usually Multi-Interface Multi-Channel Mobile Networks (MIMC-MANETs). However, the study of security vulnerabilities and the research of fundamental security mechanisms in channel management of MIMC-MANETs have been seriously lagging behind the rapid progress of other research. This project studies the security of MIMC-MANETs in three aspects. 1. Investigating the unique (unknown) security vulnerabilities associated with channel management in MIMC-MANETs. 2. Developing MIMC-enabled security mechanisms. This project redefines channel conflict, reveals the fundamental causes and consequences of channel attacks, and develops novel and attack-resilient security mechanisms to secure channel management (and routing) in MIMC-MANETs. New security mechanisms utilize the capability of MIMC, and include collaborative channel monitoring, channel-utilization based channel conflict detection and resolution, logic-based attack investigation, and cross-layer security design. 3. Building MIMC										1																			X							########	
NSF	CISE 0915331 / University of North Carolina at Charlotte	12.12	NeTS:Small:Collaborative Research: An Integrated Environment-Independent Approach to Topology Control in Wireless Ad Hoc Networks	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Each node in a wireless ad hoc network can choose the power at which it makes its transmissions and thus control the topology of the network. Though well-studied in the research literature, the problem of topology control has been largely considered only in idealized wireless environments and in isolation as a graph-theoretic abstraction. This project focuses on the design of topology control algorithms for reduced energy consumption, reduced interference and higher capacity in real wireless environments in the presence of multipath fading, link failures, high error rates and many other radio irregularities. The methodology follows two key philosophical goals: (i) an environment-independent approach which makes no constraining assumptions about the wireless environment (as opposed to trying to achieve approximations of reality in the assumptions), and (ii) an integrated approach which does not merely abstract out the problem of topology control separated from routing and link scheduling but embraces these into the design at the outset. This research also explores the																					1									X							########	
NSF	CISE 0915335 / Lehigh University	12.121	NeTS:Small:Collaborative Research: An Integrated Environment-Independent Approach to Topology Control in Wireless Ad Hoc Networks	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Each node in a wireless ad hoc network can choose the power at which it makes its transmissions and thus control the topology of the network. Though well-studied in the research literature, the problem of topology control has been largely considered only in idealized wireless environments and in isolation as a graph-theoretic abstraction. This project focuses on the design of topology control algorithms for reduced energy consumption, reduced interference and higher capacity in real wireless environments in the presence of multipath fading, link failures, high error rates and many other radio irregularities. The methodology follows two key philosophical goals: (i) an environment-independent approach which makes no constraining assumptions about the wireless environment (as opposed to trying to achieve approximations of reality in the assumptions), and (ii) an integrated approach which does not merely abstract out the problem of topology control separated from routing and link scheduling but embraces these into the design at the outset. This research also explores the																					1									X							########	

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NSF	CISE 0915393 / Drexel University	12.122	NeTS:Small:Collaborative Research: An Integrated Environment-Independent Approach to Topology Control in Wireless Ad Hoc Networks	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Each node in a wireless ad hoc network can choose the power at which it makes its transmissions and thus control the topology of the network. Though well-studied in the research literature, the problem of topology control has been largely considered only in idealized wireless environments and in isolation as a graph-theoretic abstraction. This project focuses on the design of topology control algorithms for reduced energy consumption, reduced interference and higher capacity in real wireless environments in the presence of multipath fading, link failures, high error rates and many other radio irregularities. The methodology follows two key philosophical goals: (i) an environment-independent approach which makes no constraining assumptions about the wireless environment (as opposed to trying to achieve approximations of reality in the assumptions), and (ii) an integrated approach which does not merely abstract out the problem of topology control separated from routing and link scheduling but embraces these into the design at the outset. This research also explores the																					1									X						########	
NSF	CISE 0915599 / University of North Carolina at Charlotte	12.115	NeTS: Small: Cross-layer Design for Seamless Mobility Support in Hybrid Wireless Mesh Networks	The wireless mesh network technology has recently emerged as a promising solution to building large-scale wireless Internet with quick and easy deployment. It has numerous applications, such as broadband Internet access, building automation, and intelligent transportation systems. The indispensable technology enabling large-area roaming in wireless mesh networks is mobility management. Mobility management has been extensively studied in infrastructure-based single-hop wireless access networks. However, Internet-based hybrid wireless mesh networks involve multihop wireless access from users to the Internet. In such an environment, routing and wireless channel access over multihop wireless links can produce detrimental effects on the performance of mobility management in wireless mesh networks. This research develops scalable and cost-effective mobility management mechanisms for Internet-based hybrid wireless mesh networks. It emphasizes the integrated design of mobility management with efficient medium access control and wireless multihop routing, which was not considered in traditional mobility management design. This research will provide innovative techniques to numerous																					1									X						########	
NSF	CISE 0915655 / Purdue University	17.023	TC: Small: Collaborative Research: Mathematics of Infection Diffusion in Wireless Networks	Abstract The spread of malware has the potential to slow down or cripple wireless services. It poses a particularly inimical threat to a multitude of activities ranging across an entire spectrum from social interaction and gaming, to the flow of commerce and informational services, and, at the largest scale, to national security. Current countermeasures are mostly ad hoc and reactive in that they are used to fend off threats as they arrive or are preemptively discovered. This project aims to develop theoretical foundations for malware control and counter-measure design in wireless networks by drawing from epidemiological analogues in containment or quarantining strategies for limiting the spread of infectious diseases in human society, and game-theoretic models for interactions among opponents. Optimal power control quarantining strategies that curtail and regulate the spread of contagion by exploiting the broadcast property of the wireless medium will be designed, validated analytically and experimentally, and incorporated in networking protocols. This work will facilitate the development of new wireless paradigms where a plethora of devices need to securely communicate with each other and with other entities on the																											1			X						########	

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NSF	CISE 0915697 / University of Pennsylvania	17.024	TC: SMALL: COLLABORATIVE RESEARCH: Mathematics of Infection Diffusion in Wireless Networks	Abstract The spread of malware has the potential to slow down or cripple wireless services. It poses a particularly inimical threat to a multitude of activities ranging across an entire spectrum from social interaction and gaming, to the flow of commerce and informational services, and, at the largest scale, to national security. Current countermeasures are mostly ad hoc and reactive in that they are used to fend off threats as they arrive or are preemptively discovered. This project aims to develop theoretical foundations for malware control and counter-measure design in wireless networks by drawing from epidemiological analogues in containment or quarantining strategies for limiting the spread of infectious diseases in human society, and game-theoretic models for interactions among opponents. Optimal power control quarantining strategies that curtail and regulate the spread of contagion by exploiting the broadcast property of the wireless medium will be designed, validated analytically and experimentally, and incorporated in networking protocols. This work will facilitate the development of new wireless paradigms where a plethora of devices need to securely communicate with each other and with other entities on the																								1			X							########	
NSF	CISE 0915699 / University of California-Santa Barbara	18.015	NeTS: Small: A Practical and Efficient Trading Platform for Dynamic Spectrum Distribution	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Historical static spectrum assignment has led to a critical spectrum shortage. While new prominent wireless technologies starve for spectrum, large chunks of spectrum remain idle most of the time under their current owners. With proper economic incentives, spectrum redistribution based on an open market can eliminate the artificial shortage. This project develops S-TRADE, an auction-driven spectrum trading platform to implement the spectrum marketplace. S-TRADE differs significantly from conventional FCC-style spectrum auctions that target only a few large corporate players and take months or years to conclude. Instead, S-TRADE serves many small players and enables on-the-fly spectrum transactions. In essence, S-TRADE selectively buys idle spectrum pieces from providers and sells them to a large number of buyers matching their individual demands. By effectively multiplexing spectrum supply and demand in time and space, the proposed marketplace also significantly improve spectrum utilization. The design of S-TRADE focuses on achieving spectrum multiplexing/reuse to improve spectrum utilization while guaranteeing																									1			X							########	
NSF	CISE 0915772 / University of Hawaii	12.039	CIF: Small: Collaborative Research: Wireless Networks: Fundamental Limits via Extremal Entropy Properties	CIF: Small: Collaborative Research: Wireless Networks: Fundamental Limits via Extremal Entropy Properties Using extremal entropy properties to characterize the fundamental performance limits of network communication is a tradition of information theory. Most historical successes, however, relied on one particular extremal entropy inequality: the entropy-power inequality of Shannon and Stam, which, though powerful, applies mainly to networks with certain degradedness structure. Moreover, wireless features such as multiple-input multiple-output (MIMO) communications, channel uncertainty incurred by fading, and secrecy constraints due to the broadcast nature of radio communication bring new challenges that cannot be overcome by the entropy-power inequality of Shannon and Stam alone. This situation calls for in-depth investigations of the interaction between converse problems in network information theory and extremal entropy properties in statistics, resorting to powerful statistical tools to solve important communication engineering problems. The specific goals of this research are: 1) to examine systematic ways of establishing extremal entropy properties through links between information theory and statistics; 2) to																						1						X							########	

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NSF	CISE 0915969 / University of Rochester	1.083	CIF: Small: Collaborative Research: Cooperative Sensing and Communications for Cognitive Radio Networks	The emerging cognitive radio network (CRN) paradigm has a great potential to solve what seems to be a spectrum crisis, by allowing the unlicensed or secondary users (SUs) to opportunistically and dynamically utilize the white spaces within the licensed bands, without causing harmful interference to the licensed or primary users (PUs). This research investigates two essential components of CRNs: spectrum sensing and spectrum access and sharing. More specifically, the PIs study: 1) novel integrated signal processing and communication designs for data fusion in cooperative spectrum sensing, and 2) novel cooperative spectrum sharing and communication schemes that benefit both PUs and SUs. In contrast to the existing data fusion rules that assume error-free communication channels with capacity constraints, this research involves novel integrated designs that consider the deteriorating effects of communication channels between the radios and the fusion point and therefore are robust against channel errors and provide higher detection reliability. The robustness can further be improved by employing distributed space-time coding and harvesting diversity gain. Novel cooperative communication schemes										1																			X						#######	
NSF	CISE 0915988 / Massachusetts Institute of Technology	12.123	NeTS:Small:Collaborative Research: Effective control of wireless networks via topology adaptation and randomization	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Wireless Mesh Networks have emerged as a solution for providing last-mile Internet access. By exploiting advanced communication technologies, they can achieve very high rates. However, effectively controlling these networks, especially in the context of advanced physical layer technologies, realistic models for channel interference, and distributed operation, remains a major challenge. Hence, the project focuses on developing effective and practical network control algorithms that make efficient use of wireless resources through joint topology adaptation, network layer routing, MAC layer scheduling, and physical layer power, channel, and rate control. The design of the algorithms leverages recent developments in the control of dynamical systems and randomized algorithms, and takes into account realistic channel models. This includes: (i) topology adaptation algorithms that take advantage of channel allocation, power control, and the controlled mobility capabilities of some of the nodes to dynamically decompose the network into sub-networks in which low-complexity distributed scheduling and routing																					1									X						#######	
NSF	CISE 0915994 / Oklahoma State University	1.085	CIF: Small: Collaborative Research: Cooperative Sensing and Communications for Cognitive Radio Networks	NSF Proposal Number: 0915969 PI: Vosoughi Title: CIF: Small: Collaborative Research: Cooperative Sensing and Communications for Cognitive Networks Project Abstract: The emerging cognitive radio network (CRN) paradigm has a great potential to solve what seems to be a spectrum crisis, by allowing the unlicensed or secondary users (SUs) to opportunistically and dynamically utilize the white spaces within the licensed bands, without causing harmful interference to the licensed or primary users (PUs). This research investigates two essential components of CRNs: spectrum sensing and spectrum access and sharing. More specifically, the PIs study: 1) novel integrated signal processing and communication designs for data fusion in cooperative spectrum sensing, and 2) novel cooperative spectrum sharing and communication schemes that benefit both PUs and SUs. In contrast to the existing data fusion rules that assume error-free communication channels with capacity constraints, this research involves novel integrated designs that consider the deteriorating effects of communication channels between the radios and the fusion point and therefore are robust against										1																			X						#######	

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NSF	CISE 0916000 / Western Illinois University	1.04	NeTS: Small: Collaborative Research: Secure and Resilient Channel Allocation in Multi-Radio Wireless Networks	Computing devices equipped with multiple radio interfaces and working on multiple channels are becoming predominant in wireless networks. These networks are usually Multi-Interface Multi-Channel Mobile Networks (MIMC-MANETs). However, the study of security vulnerabilities and the research of fundamental security mechanisms in channel management of MIMC-MANETs have been seriously lagging behind the rapid progress of other research. This project studies the security of MIMC-MANETs in three aspects. 1. Investigating the unique (unknown) security vulnerabilities associated with channel management in MIMC-MANETs. 2. Developing MIMC-enabled security mechanisms. This project redefines channel conflict, reveals the fundamental causes and consequences of channel attacks, and develops novel and attack-resilient security mechanisms to secure channel management (and routing) in MIMC-MANETs. New security mechanisms utilize the capability of MIMC, and include collaborative channel monitoring, channel-utilization based channel conflict detection and resolution, logic-based attack investigation, and cross-layer security design. 3. Building MIMC									1																				X						########	
NSF	CISE 0916073 / University of California-Irvine	1.087	CIF:Small:Physical Layer Optimization for Cognitive Sensor Networks	Physical Layer Optimization for Cognitive Sensor Networks The cognitive radio concept has been a revolutionary development in wireless communications systems. Cognitive, software-defined radios are able to adjust link and network resources in order to optimize communications performance. However, high rate, robust communications is often just one of many possible network objectives. For example, in sensing applications, the goal is to maximize coverage, detect important events with high probability, and track objects of interest with high accuracy. These goals are often at odds with those for optimum communications; improved coverage requires more widely dispersed sensors, complicating network connectivity. High resolution sensing requires more bits of information, which in turn place a strain on network throughput. Power devoted to routing or packet forwarding reduces a sensors lifetime. Clearly, a different paradigm is needed when sensing performance is the critical factor, or perhaps most interestingly, when both communications and sensing performance must be considered in tandem. This research effort introduces Cognitive Sensing									1																				X						########	
NSF	CISE 0916106 / University of Texas at Austin	1.067	NeTS: Small: Predictable Optimization of Opportunistic Communication	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Opportunistic communication leverages communication opportunities arising by chance to provide significant performance benefit or even enable communication where it would be impossible otherwise. This project develops algorithms, techniques, and protocols that optimize opportunistic communication to achieve good, predictable performance in wireless mesh networks and vehicular networks. A key challenge involved is how to systematically optimize opportunistic communication to achieve good predictable wireless performance. The research addresses the challenge by making three major contributions. First, the PIs develop novel robust optimization techniques that systematically optimize opportunistic communication even in the presence of high uncertainty. Second, they design efficient models, measurement and inference techniques, and prediction algorithms to obtain the required inputs to the optimization algorithms. Third, they exploit inter-flow coding opportunities arising from multi-flow diversity to further enhance the efficiency of opportunistic communication. To demonstrate the effectiveness of the									1																				X						########	

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NSF	CISE 0916180 / Stevens Institute of Technology	1.08	NetSE:Small: Human Behavior Inspired Cognitive Radio Network Design	Cognitive radios enabling dynamic spectrum access are envisioned to sense the environment and self-learn to maximize an individual or group utility function. This results in cheating, irrational behavior, inequality aversion, altruism, learning from past memory, etc. These traits are strikingly similar to human behavior and social interactions. Therefore, this project explores this parallelism going beyond traditional game theoretic analysis. What are the implications if communication protocols in a cognitive radio network resemble human behavioral and psychological interactions? Will the network develop its own psychology with random perturbations, similar to human evolution? These are the fundamental questions addressed in this project using tools from social science and behavioral games. Some of the main theoretical ideas will be implemented in SpiderRadio, a cognitive radio network prototype developed in the PIs? laboratory at Stevens. Intellectual Merit: The intellectual merit of this project is an inter-disciplinary effort that overlaps human behavioral models, cognitive psychology, economic models, decision theory and dynamic spectrum access. Emerging social science concepts such as evolutionary and							1																					X						########	
NSF	CISE 0916263 / Columbia University	12.111	NeTS: Small: Collaborative Research: Effective Control of Wireless Networks via Topology Adaptation and Randomization	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Wireless Mesh Networks have emerged as a solution for providing last-mile Internet access. By exploiting advanced communication technologies, they can achieve very high rates. However, effectively controlling these networks, especially in the context of advanced physical layer technologies, realistic models for channel interference, and distributed operation, remains a major challenge. Hence, the project focuses on developing effective and practical network control algorithms that make efficient use of wireless resources through joint topology adaptation, network layer routing, MAC layer scheduling, and physical layer power, channel, and rate control. The design of the algorithms leverages recent developments in the control of dynamical systems and randomized algorithms, and takes into account realistic channel models. This includes: (i) topology adaptation algorithms that take advantage of channel allocation, power control, and the controlled mobility capabilities of some of the nodes to dynamically decompose the network into sub-networks in which low-complexity distributed scheduling and routing																					1									X						########	
NSF	CISE 0916283 / Bucknell University	12.112	NeTS: Small: Collaborative Research: The Flexible Internetwork Stack (FINS) Framework	Modern networks invalidate many of the assumptions of traditional networking. For example, mobile ad hoc networks (MANETs) invalidate the assumption that there will be stable routes in the network, throwing traditional routing techniques into disarray. Handheld computing devices further challenge assumptions about platform mobility. While the need for cross-layer design to meet these new challenges has become well known, no replacement for the traditional network stack has emerged yet. Implementing experimental cross-layer approaches on commodity hardware and software remains challenging. In this project we are building a framework for modular, extensible, experimental, network stack implementation, called the FINS (Flexible Internetwork Stack) Framework. The framework allows users to leverage existing protocols (such as TCP and IP) where needed, providing implementations that provide more real-time control and transparency than is available in existing implementations, while allowing users to replace or modify components as desired. Thus, the FINS Framework allows researchers ready access to the network stack in a manner previously possible only in simulation or by making painstaking																					1									X						########	

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NSF	CISE 0916300 / Virginia Polytechnic Institute and State University	12.113	NeTS: Small: Collaborative Research: The Flexible Internetwork Stack (FINS) Framework	Modern networks invalidate many of the assumptions of traditional networking. For example, mobile ad hoc networks (MANETs) invalidate the assumption that there will be stable routes in the network, throwing traditional routing techniques into disarray. Handheld computing devices further challenge assumptions about platform mobility. While the need for cross-layer design to meet these new challenges has become well known, no replacement for the traditional network stack has emerged yet. Implementing experimental cross-layer approaches on commodity hardware and software remains challenging. In this project we are building a framework for modular, extensible, experimental, network stack implementation, called the FINS (Flexible Internetwork Stack) Framework. The framework allows users to leverage existing protocols (such as TCP and IP) where needed, providing implementations that provide more real-time control and transparency than is available in existing implementations, while allowing users to replace or modify components as desired. Thus, the FINS Framework allows researchers ready access to the network stack in a manner previously possible only in simulation or by making painstaking																			1											X						########	
NSF	CISE 0916469 / Pennsylvania State Univ University Park	1.061	NeTS: Small: Collaborative Research:Secure and Resilient Channel Allocation in Multi-Radio Wireless Networks	Computing devices equipped with multiple radio interfaces and working on multiple channels are becoming predominant in wireless networks. These networks are usually Multi-Interface Multi-Channel Mobile Networks (MIMC-MANETs). However, the study of security vulnerabilities and the research of fundamental security mechanisms in channel management of MIMC-MANETs have been seriously lagging behind the rapid progress of other research. This project studies the security of MIMC-MANETs in three aspects. 1. Investigating the unique (unknown) security vulnerabilities associated with channel management in MIMC-MANETs. 2. Developing MIMC-enabled security mechanisms. This project redefines channel conflict, reveals the fundamental causes and consequences of channel attacks, and develops novel and attack-resilient security mechanisms to secure channel management (and routing) in MIMC-MANETs. New security mechanisms utilize the capability of MIMC, and include collaborative channel monitoring, channel-utilization based channel conflict detection and resolution, logic-based attack investigation, and cross-layer security design. 3. Building MIMC														1																X						########	
NSF	CISE 0916480 / Drexel University	12.102	NeTS: Small: Cognitive Antennas for Wireless Ad Hoc Networks	Cognitive radios, which have the ability to adjust bandwidth, modulation scheme, transmit power, error coding, and other parameters, provide tremendous flexibility for adaptation to network conditions. While cognitive radios predominantly change spectral allocation or modulation characteristics, this project considers networks of cognitive radios in which the antennas at each node can be electronically reconfigured. Coupling cognitive radios with reconfigurable antennas gives network nodes an additional degree of freedom to increase link robustness, enhance interference suppression, and increase spectral capacity. This project demonstrates how the flexibility in radiation patterns provided by electrically reconfigurable antennas, or ?cognitive antennas?, can enable a greater density of co-channel communication links and thus increase network capacity. Multi-sensor data fusion is being used to incorporate antenna and radio configuration with cognitive radio scene assessment and adaptation techniques, using multiple data sources. Distributed control techniques are being developed to adapt cognitive radio settings with minimum interaction between nodes, and and the stability and																					1									X						########	

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NSF	CISE 0916576 / Michigan State University	1.071	NeTS:Small:Collaborative Research:Holistic Transparent Performance Assurance within the Crowded Spectrum	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Cheap commercial off-the-shelf wireless devices are being increasingly deployed for performance-sensitive applications such as patient monitoring with body sensors and home networking for multimedia and gaming. However, wireless communications may interfere with each other when they use the same or adjacent radio frequencies. This becomes a growing issue as the public 2.4GHz spectrum is being populated by a variety of devices, including 802.11b/g routers, ZigBee sensors, Bluetooth headsets, and cordless phones. Existing interference mitigation schemes are tightly tied with the physical/MAC layers of particular platforms, and hence often cannot co-exist in the same network without sacrificing the system performance. This project develops a Holistic Transparent Performance Assurance (HTPA) framework to support performance-sensitive applications in the crowded spectrum. HTPA consists of 1) a spectrum profiler that models the spectrum usage and dynamic external, intra- and inter-platform interferences in heterogeneous wireless environments; 2) a virtualized medium access control layer that provides unified											1																			X						########	
NSF	CISE 0916713 / University of Texas at Austin	12.173	CIF: Small: Structured Transmission Strategies for Wireless Networks	Abstract 0916713 - CIF: Small: Structured Transmission Strategies for Wireless Networks In this project, we use lattice and other structured coding techniques to induce alignment in wireless networks. This effort uses these codes on three different fronts: a.) Interference networks, where we use structured codes to align the interference seen at each receiver. The objective is to determine the capacity of this channel to within a constant gap using these codes. b.) Cognitive networks - where we use lattice codes to mitigate the interference seen by both the licensed and the cognitive radios. We exploit code structure to both (partially) learn the interfering signal at the cognitive radio and then use this knowledge to precode/align our interference signal. c.) Secure wireless networks: again, we utilize the structure of the codebook to determine simple transformations at the source in order to keep eavesdroppers in the network at bay. We employ these codes to detect, and depending on code structure, correct for modification attacks on the codebook.																						1									X						########	
NSF	CISE 0916802 / Purdue University	12.117	NeTS: Small: Toward High-Performance WLANs: Bridging the Physical Layer Divide	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This project architects high-performance wireless local area networks (WLANs) by understanding the impact of physical layer attributes on performance and incorporating them in the design and control of next generation WLANs. The research is comprised of three parts. The first part develops models of spatial diversity, the dominant physical layer feature, that help understand and predict the performance of infrastructure mode WLANs. The second part integrates spatial diversity with cross-layer protocol analysis that allows evaluation of the influence of physical layer attributes on both lower- and higher-layer protocols. The third part investigates new network controls that harness opportunities provided by spatial diversity that help mitigate, and in some cases, transcend their detrimental performance effect including unfairness and throughput degradation. The control dimension extends to large-scale WLANs covering city blocks and campuses that inject complex spatial coupling. The project employs a combination of simulation, experimentation, and analysis to achieve its goals. The broader impact of this project lies																						1									X						########	

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NSF	CISE 0916867 / Texas Engineering Experiment Station	12.04	CIF: Small: Collaborative Research: Wireless Networks: Fundamental Limits via Extremal Entropy Properties	CIF: Small: Collaborative Research: Wireless Networks: Fundamental Limits via Extremal Entropy Properties Using extremal entropy properties to characterize the fundamental performance limits of network communication is a tradition of information theory. Most historical successes, however, relied on one particular extremal entropy inequality: the entropy-power inequality of Shannon and Stam, which, though powerful, applies mainly to networks with certain degradedness structure. Moreover, wireless features such as multiple-input multiple-output (MIMO) communications, channel uncertainty incurred by fading, and secrecy constraints due to the broadcast nature of radio communication bring new challenges that cannot be overcome by the entropy-power inequality of Shannon and Stam alone. This situation calls for in-depth investigations of the interaction between converse problems in network information theory and extremal entropy properties in statistics, resorting to powerful statistical tools to solve important communication engineering problems. The specific goals of this research are: 1) to examine systematic ways of establishing extremal entropy properties through links between information theory and statistics; 2) to																				1										X						########	
NSF	CISE 0916958 / Rensselaer Polytechnic Institute	18.017	NeTS: Small: Collaborative Research: Financial Dynamics of Spectrum Trading	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Presence of a well-structured market is necessary for efficient and flexible use of licensed spectrum bands, and for fair pricing of spectrum usage. The goal of this project is to design radio spectrum markets that allow trading of spectral resources - not only of the raw spectrum, but also of a variety of service contracts derived from the use of spectrum. Specific sub-problems that will be addressed in this context include: 1) spectrum-portfolio construction that optimizes risk-versus-return trade-offs, 2) strategy design for optimal cooperation among providers, 3) price-driven dynamic scheduling of subscribers, 4) optimal pricing of spectral contracts, and 5) regulatory mechanisms for effective functioning of the spectrum markets. The solutions to the above problems take advantage of similar formulations in financial engineering, and use tools from optimization, stochastic calculus, and control and game theory. The project is expected to revolutionize spectrum trading by facilitating the design of secondary spectrum markets and spectrum regulation policies. Towards this end, This project aims at establishing a new																										1					X						########	
NSF	CISE 0916994 / College of William and Mary	1.073	NeTS:Small:Collaborative Research:Holistic Transparent Performance Assurance within the Crowded Spectrum	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Cheap commercial off-the-shelf wireless devices are being increasingly deployed for performance-sensitive applications such as patient monitoring with body sensors and home networking for multimedia and gaming. However, wireless communications may interfere with each other when they use the same or adjacent radio frequencies. This becomes a growing issue as the public 2.4GHz spectrum is being populated by a variety of devices, including 802.11b/g routers, ZigBee sensors, Bluetooth headsets, and cordless phones. Existing interference mitigation schemes are tightly tied with the physical/MAC layers of particular platforms, and hence often cannot co-exist in the same network without sacrificing the system performance. This project develops a Holistic Transparent Performance Assurance (HTPA) framework to support performance-sensitive applications in the crowded spectrum. HTPA consists of 1) a spectrum profiler that models the spectrum usage and dynamic external, intra- and inter-platform interferences in heterogeneous wireless environments; 2) a virtualized medium access control layer that provides unified													1																		X						########	

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NSF	CISE 0917008 / Stevens Institute of Technology	1.019	TC: Small: Denial-of-Service Attacks and Counter Measures in Dynamic Sepctrum Access Networks	Abstract: 0917008: TC: Small: Denial-of-Service Attacks and Counter Measures in Dynamic Spectrum Access Networks This project studies denial-of-service (DoS) attacks that are unique to dynamic spectrum access (DSA) networks: (a) DoS attacks by incumbent user emulation; (b) DoS attacks by protocol manipulation. In the first case, one or more malicious nodes pretend to be the primary by mimicking the power and/or signal characteristics to deceive legitimate secondary nodes into vacating the white space unnecessarily. In the second case, the malicious users either modify spectrum sensing related information or falsify their own sensing data thereby affecting the final decision. A number of mathematical models for the DoS attacks and several counter measures based on game theory, decision theory, stochastic learning, cryptography and Byzantine fault tolerance are developed in this project. Some defense mechanisms and protocols developed through this project will be tested on SpiderRadio (a cognitive radio test-bed being developed in the PIs? laboratory). Broader Impact: Since DSA networks are expected to play an important role in first responder networks, the solutions proposed here are expected to impact design of such											1																			X						########	
NSF	CISE 0917067 / University of Texas at Austin	1.075	NeTS:Small:Dynamic Coupling and Flow-Level Performance in Data Networks: From Theory to Practice	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). The performance of network users' best effort flows, e.g., file transfer delays and web browsing responsiveness, depends on the resources they are allocated over time. When varying traffic loads share these resources and/or wireless nodes' transmission capacities depend on each other through interference, the allocated resources and thus flows' performance are coupled through the traffic and interference dynamics. This project investigates such performance coupling in data networks and, in turn, how it affects protocol and network design. This is a significant problem, as most data networks share these characteristics, and we currently have no robust tools to effectively predict and thus optimize performance. Expected results include new theory, approximations and performance bounds enabling the analysis of such systems which are also applicable to other domains. Expected results also include using these tools to investigate: (1) the benefits of, and capacity allocation, in networks supporting multipath transport and/or shared wireless access networks; and (2), the development of improved protocols and algorithms that											1																			X						########	
NSF	CISE 0917097 / University of Minnesota-Twin Cities	12.11	NeTS: Small: Addressing Research Challenges in Low-Duty-Cycle Wireless Sensor Networks	Energy-efficient wireless communication is critical for long-term sensor network applications, such as military surveillance, habitat monitoring and infrastructure protection. To reduce the energy costs of RF listening, a node has to reduce its duty-cycle by sampling wireless channels very briefly and shutting down for long periods. Consequently, the connectivity of low-duty-cycle networks becomes time-dependent. Previous research in this type of networks predominately focused on physical and link-layer designs. This project is positioned to provide significantly added value to these earlier successful research by conducting the first systematic research at the network layer for low-duty-cycle communication under a wide spectrum of network configurations covering a large design space. The key research challenge addressed by this project is to optimize networking performance (e.g., delay, reliability, and cost) in the presence of sleep latency and other practical considerations including (i) unreliable links, (ii) dynamic energy availability, and (iii) mobility. With a successful outcome from this project, long-term sensor applications can be supported by low-duty-cycle networking technologies, leading to significantly reduced costs in																						1								X						########	

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NSF	CISE 0917251 / University of California-Davis	1.058	NeTS: Small: Beyond Listen-Before-Talk: Advanced Cognitive Radio Access Control in Distributed Multiuser Networks	The award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Cognitive radio (CR) has the potential to improve spectrum utilization and expand wireless communication services by opportunistically utilizing underutilized spectrum bands. This project designs advanced cognitive radio access and power control algorithms that can achieve better spectrum efficiency while limiting interference to primary communications. Moving beyond the more traditional access strategies that rely only on secondary user (SU) spectral sensing to avoid collision with primary users (PUs), this research exploits various levels of primary network?s data link control (DLC) signaling and feedback information. Such DLC information is available in many practical wireless systems, such as transmission profile, receiver ACK/NACK, channel quality indicator, and power control information. Utilizing such information elevates the level of SU cognition. It provides more efficient spectrum sharing, better PU protection (especially in the presence of multiple distributed SUs), and multiple levels of SU and PU interaction. The major outcomes include: 1) Distributed multi-SU cognitive access and power control based on PU										1																			X						#######	
NSF	CISE 0917343 / University of Southern California	7.003	CIF: Small: Cognitive Femtocells: Breaking the Spatial Reuse Limits of Cellular Systems	Cognitive femtocells: Breaking the spatial reuse limits of cellular systems Abstract: The next generation of wireless cellular systems will be data traffic driven, providing seamless connectivity to the Internet and its services. In the areas of information and communication technologies, cellular systems and the Internet have proven to be the most transformative technologies for society. This research endeavors to optimally marry these two technologies with the goal of dramatically increasing achievable data rates and coverage. The proposed solution is to deploy very small cellular access points in residential homes and offices. These ``femtocells" are connected to the network via existing DSL/Cable and do not require additional deployment of costly wired infrastructure. Several theoretical challenges are posed by the femtocell concept. In particular, due to lack of coordination with the rest of the network, femtocells interfere with the network itself. This research develops novel solutions for femtocell technology by exploiting ideas from cognitive radio, based on intelligent opportunistic usage of the shared radio resource. Femtocell base stations will be deployed without careful frequency planning and will react to the												1																		X						#######	
NSF	CISE 0917410 / University of Southern California	1.078	NetSE: Small: Cooperation and Incentives in Communication and Social Networks	A vision of the next-generation wireless networks includes deployment of highly capable intelligent devices that connect to form high-quality high-speed wide-area wireless networks. This necessitates advances on several fronts: more efficient spectrum use by sharing among cognitive devices, more sophisticated communication schemes and new "socially-aware" network architectures. In this project, we seek to increase wireless network capacity and capabilities by a factor of 10 or more by developing mechanisms and algorithms for enhancing cooperation among users in networks by using ideas from mathematical game theory and taking advantage of social aspects of networks. This project will solve well-known hard problems in communication networks from a novel perspective, combining ideas from mathematical economics, game theory and information theory to propose incentive-informed schemes that will enable user cooperation in networks thereby paving the way for ubiquitous wireless connectivity. The project will solve long-standing unsolved problems in information theory and develop a mathematical theory of social communication networks. The project will potentially transform existing wireless and													1																	X						#######	

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NSF	CISE 0923003 / Drexel University	3.016	MRI: Development of Software Defined Communications Testbed for Radio and Optical Wireless Networking	Proposal #: CNS 09-23003 PI(s): Bandekar, Kapil R. Fontecchio, Adam K.; Johnson, Jeremy R.; Kim, Youngmoo E.; Kurzweg, Timothy P. Institution: Drexel University Title: MRI/Dev.: Software Defined Communications Testbed for Radio and Optical Wireless Networking This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Project Proposed: This project, developing a multi-purpose Software Defined Communications (SDC) testbed to be used for rapid design and prototyping of the next generation wireless communication networks making use of radio, optical, or ultrasonic modalities, responds to the impending need for new high-bandwidth, inexpensive, flexible, and upgradable wireless communication technologies to meet the growing demands of future applications. Among others, the SDC testbed aims to enable many projects including high-speed secure data transmission, thru-metal relay and control networks, localization and tracking, real-time wireless video transmission, and enhanced home entertainment systems. The integrated plan challenges the existing radio frequency centric view of software defined radio by					1																								X						########	
NSF	CISE 0923479 / William Marsh Rice University	16.024	Collaborative Research: MRI: Development of mobileWARP - A Platform for Next-Generation Wireless Networks and Mobile Applications	Proposal #: CNS 09-23479 PI(s): Sabharwal, Ashutosh; Aazhang, Behnaam; Cavallaro, Joseph R.; Knightly, Edward W.; Zhong, Lin Institution: Rice University Collaborative with Proposal #: CNS 09-23484 PI(s): Bacso, Clifford Institution: Methodist Hospital Rsrch Inst. Title: MRI/Dev.: Mobile WARP: Platform for Next Generation Wireless Networks & Mobile Applications This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Project Proposed: This collaborative project, developing a mobile, open, and all-layers programmable platform for wireless communication systems research, supports the design, development, and dissemination of a community platform instrument, for collaborative architecting next-generation wireless networks and mobile applications, including medical applications. Wireless Open-Access Research Platform (mobileWARP), targets fundamental new research for next generation mobile network clients. The work involves the following thrusts: - Programmable and Context-Aware Mobile Platform, - True Cross-Layer Design Flows, and - Open-Access for Research and Education. Mobile														1														X						########	
NSF	CISE 0923484 / The Methodist Hospital Research Institute	16.025	Collaborative Research: MRI: Development of mobileWARP - A Platform for Next-Generation Wireless Networks and Mobile Applications	Proposal #: CNS 09-23479 PI(s): Sabharwal, Ashutosh; Aazhang, Behnaam; Cavallaro, Joseph R.; Knightly, Edward W.; Zhong, Lin Institution: Rice University Collaborative with Proposal #: CNS 09-23484 PI(s): Bacso, Clifford Institution: Methodist Hospital Rsrch Inst. Title: MRI/Dev.: Mobile WARP: Platform for Next Generation Wireless Networks & Mobile Applications This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Project Proposed: This collaborative project, developing a mobile, open, and all-layers programmable platform for wireless communication systems research, supports the design, development, and dissemination of a community platform instrument, for collaborative architecting next-generation wireless networks and mobile applications, including medical applications. Wireless Open-Access Research Platform (mobileWARP), targets fundamental new research for next generation mobile network clients. The work involves the following thrusts: - Programmable and Context-Aware Mobile Platform, - True Cross-Layer Design Flows, and - Open-Access for Research and Education. Mobile														1														X						########	

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NSF	CISE 0932114 / Trustees of Boston University	12.064	CPS: Medium: Collaborative Research: The Foundations of Implicit and Explicit Communication in Cyberphysical Systems	Proposal Title: CPS:Medium:Collaborative Research: The Foundations of Implicit and Explicit Communication in Cyberphysical Systems Institution: University of California-Berkeley Abstract Date: 07/30/09 The objective of this research is to develop the theoretical foundations for understanding implicit and explicit communication within cyber-physical systems. The approach is two-fold: (a) developing new information-theoretic tools to reveal the essential nature of implicit communication in a manner analogous to (and compatible with) classical network information theory; (b) viewing the wireless ecosystem itself as a cyber-physical system in which spectrum is the physical substrate that is manipulated by heterogeneous interacting cyber-systems that must be certified to meet safety and performance objectives. The intellectual merit of this project comes from the transformative technical approaches being developed. The key to understanding implicit communication is a conceptual breakthrough in attacking the unsolved 40-year-old Witsenhausen counterexample by using an approximate-optimality paradigm combined with new ideas from sphere-packing and cognitive radio channels. These techniques open up radically new																			1										X						########	
NSF	CISE 0932410 / University of California-Berkeley	12.063	CPS: Medium: Collaborative Research: The Foundations of Implicit and Explicit Communication in Cyberphysical Systems	The objective of this research is to develop the theoretical foundations for understanding implicit and explicit communication within cyber-physical systems. The approach is two-fold: (a) developing new information-theoretic tools to reveal the essential nature of implicit communication in a manner analogous to (and compatible with) classical network information theory; (b) viewing the wireless ecosystem itself as a cyber-physical system in which spectrum is the physical substrate that is manipulated by heterogeneous interacting cyber-systems that must be certified to meet safety and performance objectives. The intellectual merit of this project comes from the transformative technical approaches being developed. The key to understanding implicit communication is a conceptual breakthrough in attacking the unsolved 40-year-old Witsenhausen counterexample by using an approximate-optimality paradigm combined with new ideas from sphere-packing and cognitive radio channels. These techniques open up radically new mathematical avenues to attack distributed-control problems that have long been considered fundamentally intractable. They guide the development of nonlinear control																			1										X						########	
NSF	CISE 0933717 / University of Kansas Center for Research Inc	1.117	Workshop on Future Research in Cognitive Radios	This workshop of about 15 experts explores future research directions in cognitive radio networks. The team members have all been involved with early projects aimed at demonstrating the potential of cognitive radio platforms. Based on the results of several projects conducted over the past few years, the PIs believe that the time is right for a large-scale testbed project aimed at conclusively demonstrating the benefits of this technology, at scale, with applications, and in real-world deployment scenarios. The PIs: (a) Develop a scientific perspective that clearly articulates research questions and challenges that need to be addressed that need to be solved to build Cognitive Radio systems, (b) define the required infrastructure to carry out the science, (c) develop and present a coherent road-map agenda, (d) define educational outreach activities that will engage teachers/students in this effort. The availability of a general-purpose platform that can serve as a microprocessor-like universal platform for wireless system development and deployment is potentially transformative. Such a platform and one or more test-bed facilities available to the broader community of computer scientists and engineers could unleash a wave of												1																		X						########	

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AGENCY	DEPARTMENT/ DIVISION /LAB/ PROGRAM/ AWARD	Project #	PROJECT TITLE/DESCRIPTION	EXAMPLES	INTENDED APPLICATION ENVIRONMENT (See Attachment C for examples)	EXPECTED FREQUENCY RANGE	**Topic Area**	Topic # 3	Topic # 23	Topic # 19	Topic # 6	Topic # 15	Topic # 7	Topic # 1	Topic # 14	Topic # 11	Topic # 4	Topic # 13	Topic # 16	Topic # 2	Topic # 21	Topic # 22	Topic # 12	Topic # 8	Topic # 5	Topic # 9	Topic # 18	Topic # 17	Topic # 10	Topic # 20	**Maturity**	Basic Research	Applied Research	Advanced Technology Development	Advanced Component Development	Demonstration & Validation	**Funding**	Funded in Past (2006-2010)	Presently Funded (FY11)
NSF	CISE 0948907 / University of Minnesota-Twin Cities	1.102	ProTOMAC: Proactive Transmit Opportunity Detection at the MAC Layer for Cognitive Radio Networks	The wide proliferation of wireless services and applications with increasing bandwidth needs is rapidly creating a spectrum shortage. However, the problem is caused primarily by inefficient legacy spectrum allocation and utilization policies, so that even when some applications suffer from lack of bandwidth, there is idle capacity in the band they are using or other bands. This project develops and demonstrates a revolutionary approach for addressing spectrum scarcity and unlocking hidden communication capacity thereby increasing the reach and utility of wireless connectivity. The non-traditional communication technique studied in this research effort detects transmission opportunities that occur when incumbent primary users enjoy signal to noise ratio values that are higher than the minimum value required to maintain their quality of service. It then judicially exploits these opportunities while preserving the current quality of service of the primary users. The project develops novel change detection methods that fuse goodness of fit tests and density estimation and similarity assessment using information theoretic methods to study network traffic and designs innovative distributed goodness of											1																		X						########	
NSF	CISE 0950342 / University of Central Florida	1.026	EAGER: Tackling Vulnerabilities in Cognitive Radio Networks: A Game Theoretic Approach	Cognitive radio networks (CRNs) operate on secondary spectrum bands, where they opportunistically access and use under-utilized spectrum bands. Though research on CRNs is gaining momentum, there is still little or no understanding of how these networks will fair in the face of attacks. Moreover, the addition of new architectures and protocols bring more vulnerabilities that have not been seen before. This project will make use of game theoretic techniques to develop pragmatic design methodologies that will lead to more efficient algorithms and protocols for tackling vulnerabilities in cognitive radio networks while maintaining high spectrum usage. The intellectual merit of this project lies in the execution of four tasks. These are 1) devising and solving malicious node detection games where malicious nodes(s) will be detected and isolated by regular nodes, 2) devising mechanisms that will enforce cooperation among cognitive radio nodes such that they use the commonly available spectrum in a co-operative manner, 3) developing rules and policies such that nodes belonging to different networks can co-exist, and 4) studying the performance trade-offs on service guarantees when policies are set in a											1																		X						########	
NSF	CISE 0953071 / University of California-Irvine	2.009	EAGER: Usable Location Privacy in Geo-Social Networks	This project is focused on a potentially transformational research study involving the simultaneous investigation of usability and security/privacy technologies for location-based geo-social applications, with the objective of studying the usability, feasibility, and scalability of privacy-preserving and secure location-aware geo-social networking platforms for mobile devices. The approach is based on a belief that usability and security/privacy are addressed properly and most effectively from the start. In particular, the project will study the usability of privacy-agile secure location-based communication and associated supporting protocols that scale to large numbers of users and accommodate various privacy levels suitable for different application domains. By studying the usability of location-aware protocols, the investigators propose methods that provide seamless connectivity and functionality over different networking technologies, without sacrificing the user experience. The investigators also plan to address other security issues in privacy-preserving operation, including authentication, access control and accountability. This project envisions a wide range of future applications with three unifying factors: (1)																			1										X						########	

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NSF	CISE 0953117 / Cornell University	12.024	CAREER: Breaking the Barriers in Wireless Network Information Theory: A Deterministic Approach	Shannon's masterpiece, A Mathematical Theory of Communication (1948), is one of the most influential works in the history of communications. In this seminal work, Shannon characterized the fundamental limit for reliable communication over point-to-point channels and provided the architectural system design for achieving it. Extending this theory to network setting has been one of the greatest challenges in information theory over the past few decades. Progress in this area is expected to produce significant breakthrough in the design of distributed wireless networks of the future, such as ad-hoc networks. So far, most research efforts have approached this problem using the same generality and accuracy used by Shannon for point-to-point channels. However, meeting such a standard has proven to be extremely difficult, to the extent that the capacity of most basic networks is still unknown. This research overcomes the limitations of prior work by presenting a new approach, which is based on changing the focus to seek approximate solutions accompanied by guarantees on the gap to optimality. At the heart of this approach is the development of simple, deterministic channel models that capture the main features of the wireless																				1										X						########	
NSF	CISE 0953165 / Iowa State University	12.029	CAREER: Meeting Deadlines: Theories and Algorithms to Support Delay Constrained Communication in Wireless Networks	Wireless technology has emerged as a low-cost and infrastructure-free method to deploy communication networks and has inspired a wide range of applications such as wireless mesh networks for public safety, wireless sensor networks for unmanned surveillance, and vehicular networks for accident warnings. Many of these applications require effective delay control for desired performance, which, however, is one of the most difficult problems in wireless network design due to the inherent weaknesses of wireless communication such as limited bandwidth, channel fading, and interference. In the past few years, a major breakthrough in wireless network research has been to harness the power of optimization theory and stochastic network theory for network design. These advances, however, shed little light on communication latency (or delay) because the focus is almost exclusively on the long-term throughput. This project takes a bold step to break away from today's throughput-first mentality, and embraces a delay-oriented approach where delay is a primary design objective, not a byproduct of throughput-oriented designs. The expected results of this project include: (i) new network theories that quantify fundamental delay																				1										X						########	
NSF	CISE 0953377 / University of Houston	1.055	CAREER: Mutual Benefit in Cognitive Radio Networks: A Coalitional Game Framework	Cognitive radio (CR) is a revolutionary wireless communication paradigm in which cognitive (secondary) users are able to observe, learn, optimize, and intelligently adapt for spectrum utilization without interfering with traditionally licensed (primary) users. Yet, the major technical challenges remain: First, to avoid interfering with primary users, the cognitive users must explore and sense the spectrum opportunities to determine whether there are ongoing activities before data transmission. Second, a critical issue is dynamic and opportunistic resource allocation over time-varying heterogeneous interfering environments. Third, due to hardware limitation, each cognitive user should distributively choose the candidate channels to either sense or access (i.e., exploration and exploitation). To overcome these challenges, the novel cooperative game theory methods are employed that emphasizes mutual benefit management with simple distributed solutions. For different problems and scenarios, this research project investigates three categories of cooperative games: Canonical Coalition Game, Coalition Formation Game, and Coalition Graph Game. The schemes and frameworks are implemented using the													1																	X						########	

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NSF	CISE 0953513 / Auburn University	1.114	CAREER: Towards Rich Multimedia Experience in Emerging Cognitive Radio Networks	A cognitive radio (CR) is a frequency-agile wireless communication device with intelligent control and a monitoring interface that enables dynamic spectrum access. The CR concept represents a paradigm change in spectrum regulation and utilization. As basic understandings gained, there is a compelling need to fully capitalize CR's high potential for supporting new applications. This CAREER project investigates the problem of enabling rich multimedia services in emerging CR networks. Although highly rewarding, the new dimension of dynamics on channel availability, sensing, and access brings about a whole level of technical challenges. To address these challenges, a novel cross-layer optimization and control approach is employed, complemented with distributed algorithm design and development of an open source CR video testbed. The manifold design trade-offs, multifarious dynamics, scarce resources and, on the other hand, video's tight QoS constraints make the optimization and control approach highly suited for "squeezing" the most out of CR video networks. The three research thrusts include: cross-layer optimization of CR video networks, classical and modern control theory based analysis and design of CR											1																		X						########	
NSF	CISE 0953644 / University of North Carolina at Charlotte	1.06	CAREER: Towards Seamless Mobility in Cognitive Radio Wireless Networks	The cognitive radio technology is a promising technology to overcome the imbalance between the increase in the spectrum access demand and the inefficiency in the spectrum usage by allowing dynamic spectrum access. Seamless mobility is considered as a critical component to ensure the success of cognitive radio network (CRN) deployment, but unfortunately, is under-explored in the literature. The research objective of this project is to develop new policies and algorithms for providing seamless mobility support in cognitive radio wireless networks (CRNs). The approach involves identifying the new issues in the mobility support caused by the changing spectrum environment in CRNs, exploiting the varying spectrum opportunities in time and space domains, proactively utilizing the spectrum opportunities for mobility preparations, and optimizing the performance via spectrum-adaptive mobility management schemes. This project will provide innovative mobility support techniques to numerous applications of the CRN technology. It will also have significant impacts on research in emerging technologies with high mobility scenarios, such as vehicular networks, and opportunistic interconnections of											1																		X						########	
NSF	CISE 0954116 / University of Southern California	18.003	CAREER: Network Economics: Theory and Architectures for Incentive-engineered Networks	The next generation networks are envisaged to be very large-scale, highly complex systems that handle heterogeneous traffic in diverse environments, are truly distributed and have even greater capacity, reliability and capability. These attributes can be achieved by deploying sophisticated mathematical techniques that require cooperative behavior among the various independent entities that often have economic interests. Such cooperation however, can be hard to achieve in practice leading to suboptimal performance. In this project, we are developing a systematic and foundational theory of network incentives and cooperation that aids in methodical network architecture design for vastly greater capacity, more efficient operation and improved reliability. The theory, mechanisms and architectures for incentive engineered networks that we are developing combine ideas from mathematical economics, game theory, information and queueing theories. The project will have substantial broader impact on the development of science, technology and education by leading to development of the emerging field of network economics, and has broad relevance in improving the efficiency and reliability of networks for																										1				X						########	

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NSF	CISE 0956382 / University of California-Los Angeles	1.101	NSF Workshop on Distributed Processing over Cognitive Networks	NSF Workshop on Distributed Processing over Cognitive Networks The emerging interest in cognitive networks, smart grids, and self-organizing networks is motivating heightened research on distributed and collaborative signal processing strategies that enable networks to adapt and respond to information in real-time. Cognitive networks consist of spatially distributed nodes that are linked together through a connection topology. The nodes are generally isotropic without any particular node taking a central control role. The nodes cooperate with each other and adapt their states in response to both local data collected at the nodes and data received from their immediate neighbors. Information arriving at any particular node creates a ripple effect that propagates throughout the network by means of a diffusive process. The diffusion of information results in a form of collective intelligence as evidenced by improved adaptation, learning, tracking, and convergence behavior relative to non-cooperative networks. The purpose of the workshop is to bring together research experts from various modalities to brainstorm on the challenges and opportunities of cognitive networks. The											1																			X						########	
NSF	CISE 0956780 / University of Iowa	12.072	EAGER: Autonomic Computing Systems and Wireless Networking	EAGER: Autonomic Computing Systems and Wireless Networking This exploratory proposal addresses some of the algorithmic issues of autonomic distributed systems, and explores its applicability to the self-management of large-scale wireless networks. An autonomic system mimics the human body's autonomic nervous system that regulates homeostatic functions without conscious intelligent control, and provides facilities for self-management in large-scale complex heterogeneous systems. The proposal argues that with the rapid growth of wireless networking and cognitive radios, combined with the demand for seamless ubiquitous services, autonomic computing faces interesting challenges and opportunities. It examines various algorithms for self-management, and illustrates their applicability in the large wireless networks providing ubiquitous services. These include methods of stabilizing streaming applications in a wireless network, stabilization of distributed applications containing selfish agents, and designing gracefully degradable systems. It also studies the new paradigm of population protocols that has the potential to generate ambient knowledge in a transparent way in a system of passively																						1									X						########	
NSF	CISE 0958477 / University of Massachusetts Lowell	2.012	II-New: A Network Forensics Lab for Integrated Research and Education at University of Massachusetts Lowell	This proposal aims to establish a network forensics lab at University of Massachusetts Lowell. This proposed research and education infrastructure consists of network devices, such as network analyzers, Cisco routers, spectrum analyzer, and software for collecting and analyzing wired and wireless data. The requested infrastructure will support three projects focusing on network forensics: (1) Tracing Anonymous Criminals on the Internet (2) Localizing and Locking Anonymous Malicious Wireless Mobiles (3) Fingerprinting Wireless Mobiles for Forensics Purpose These projects will address issues that are critical to the nation?s security and will train students who will be sought out by industrial companies and research laboratories. The proposed research will also position UMass Lowell among the leaders in network forensics research and education. The three projects in this proposal have the following broader impact: (i) The proposed infrastructure will enhance the research and education of network forensics, and will create an opportunity for developing new courses on network forensics and data recovery and analysis in UMass Lowell. (ii) The proposed infrastructure will also																			1											X						########	

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NSF	CISE 0958483 / Rutgers University New Brunswick	3.003	CI-ADDO-EN: Major Equipment Upgrade and Improved Operations Support for the ORBIT Open Access Wireless Networking Testbed	The ORBIT open access testbed for next-generation wireless networking at Rutgers was developed to address the challenge of supporting realistic and reproducible wireless networking experiments at scale. The 400-node ORBIT radio grid was released as a community resource in 2005, and can be accessed by researchers via an Internet portal (www.orbit-lab.org) which provides a variety of services to assist users with experiment setup, control and measurement. This project is aimed at a major hardware upgrade of the computing equipment and measurement instruments which make up the ORBIT testbed. Specific equipment items being upgraded are: - All 400 ORBIT radio nodes which serve as the primary computing platform for experimenters. - Computing/storage servers and switching equipment in the ORBIT backend cluster. - RF measurement instruments for spectrum monitoring on the radio grid. This project also includes resources for ongoing maintenance and software support necessary for continued 24/7 operation of the ORBIT facility as a community resource. The proposed equipment upgrade will prepare ORBIT for anticipated higher performance experiments on emerging wireless					1																								X						########	
NSF	CISE 0958891 / Ohio State University Research Foundation -DO NOT USE	5.007	Workshop on Future Wireless Communication Networks	The wireless industry has had a transformative impact on our society and has revolutionized almost all aspects of human interaction. These networks are intertwined with the fabric of both civilian and military societies, and their continued growth and well-being is critical to the success and health of our nation. Nonetheless, the technology is still very much in its infancy of the development, with the potential to grow and becoming orders-of-magnitude more sophisticated. To chart a broad vision for the future of wireless research, we have assembled a group of expert researchers from the wireless and applications community for a two-day workshop. At the workshop, attendees discuss and debate the critical challenges in wireless networking, and articulate a vision for conducting fundamental and inter-disciplinary research in the area. Workshop attendees are invited from a broad spectrum of the community (theorists, practitioners, junior, mid-level, and senior researchers, core and application-oriented researchers). Expected Results: A report that identifies major issues affecting future wireless research; exposure of the research community to new and exciting inter-disciplinary problems; and generating																						1							X						########	
NSF	CISE 0963925 / University of California-Irvine	12.037	CIF: Medium: Interference Alignment and the Rate-Reliability Tradeoff of Wireless Networks	Modern society is increasingly relying on wireless networks. Spectrum is the most valuable resource in a wireless network. How to share this limited resource among different users is one of the main challenges. When different users share the same spectrum, their signals cause interference to each other. Therefore, the most distinctive feature of wireless networks is the phenomenon of interference. In this research, we place special emphasis on practical considerations to ultimately find new ? realistic ? methods to deal with interference. A recent development is the idea of interference alignment which has shown that the capacity of wireless networks may be significantly higher than previously believed. Since higher rates invariably come at the cost of lower reliability, the emerging capacity results present only half the picture. This research is motivated by the need to complete this picture by evaluating the benefits of interference alignment schemes on the performance of wireless networks when both rate and reliability are of concern. The research follows three main thrusts. First, we examine the rate-reliability tradeoff of interference alignment schemes from the traditional coding perspective																						1							X						########	

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NSF	CISE 0963957 / George Washington University	1.052	NeTS: Medium: Collaborative Research: Opportunistic and Compressive Sensing in Wireless Sensor Networks	This collaborative project investigates Opportunistic Sensing (OS) and Compressive Sensing (CS) in Wireless Sensor Networks (WSNs). OS refers to a paradigm in which a WSN can automatically discover and select sensor modalities and sensors based on an operational scenario, resulting in an adaptive network that automatically finds scenario-dependent, objective-driven opportunities with optimized performance. CS is a novel sensing/sampling paradigm that goes against the common wisdom in data acquisition. Both OS and CS help improve efficient operations and performance of WSNs significantly. In particular, OS aims at reduction from space by selecting a subset of sensors and modalities for efficient data fusion, whereas CS targets reduction in sampling by selecting a subset of samples non-uniformly. Therefore, theoretical foundations and algorithms for opportunistic and compressive sensing are essential for advancing the state of the art in WSNs that not only ensure effective utilization of sensing assets but also provide robust optimal performance. This project addresses fundamental research issues from information theoretic viewpoint to evaluate joint OS and CS distortions, develop OS and										1																			X						########	
NSF	CISE 0964018 / University of California-Berkeley	17.004	CIF: Medium: Collaborative Research: Interactive Security	The wide use of wireless data services leads to sensitive and confidential information delivered over wireless links. With e-crimes resulting from such information being compromised to unauthorized parties at an all time high, the ?all wireless? vision can truly materialize only if the security of wireless information transfer can be guaranteed. Conventional approaches to information security are designed for wired networks with assumptions that lead to a disassociation from the physical medium in which communication takes place, and provide guarantees against adversaries that are computationally limited. This project provides a new approach for wireless networks to deliver provable and unconditional security. This research designs wireless networks with a secure foundation guaranteeing reliable and secure delivery of information. In doing so, the investigators account for untapped and rich resources provided by wireless systems naturally, including sources with correlated observations or application content, channels that provide spatial and temporal diversity, network nodes that are helpers or relays providing interaction, and broadcast and bi-directional nature of the medium enabling communication with feedback. The																											1			X						########	
NSF	CISE 0964060 / Henry M Jackson Fdn for Advmt of Military Medicine	1.054	NeTS: Medium: Collaborative Research: Opportunistic and Compressive Sensing in Wireless Sensor Networks	This collaborative project investigates Opportunistic Sensing (OS) and Compressive Sensing (CS) in Wireless Sensor Networks (WSNs). OS refers to a paradigm in which a WSN can automatically discover and select sensor modalities and sensors based on an operational scenario, resulting in an adaptive network that automatically finds scenario-dependent, objective-driven opportunities with optimized performance. CS is a novel sensing/sampling paradigm that goes against the common wisdom in data acquisition. Both OS and CS help improve efficient operations and performance of WSNs significantly. In particular, OS aims at reduction from space by selecting a subset of sensors and modalities for efficient data fusion, whereas CS targets reduction in sampling by selecting a subset of samples non-uniformly. Therefore, theoretical foundations and algorithms for opportunistic and compressive sensing are essential for advancing the state of the art in WSNs that not only ensure effective utilization of sensing assets but also provide robust optimal performance. This project addresses fundamental research issues from information theoretic viewpoint to evaluate joint OS and CS distortions, develop OS and										1																			X						########	

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NSF	CISE 0964170 / Columbia University	18.019	NetSE: Medium: Collaborative Research: Promoting Secondary Spectrum Markets via Profitability-Driven Methods and Algorithms	Wireless telecommunications are undergoing substantial policy reforms in pursuit of better spectral efficiency. A key element in these reforms entails granting full property rights to spectrum license holders, thereby paving the way to secondary spectrum markets. Spectrum markets hold a remarkable potential to increase spectrum utilization by making it available to a larger fraction of public at lower cost. Yet, although a favorable regulatory framework has been in effect in the last few years, liquidity of spectrum markets is inhibited due to uncertainties perceived by spectrum license holders. These uncertainties stem from complex relationships between effects of electromagnetic interference and economic considerations. This research involves a constructive study of viability of spectrum markets by establishing methods and algorithms that render such markets profitable for their participants. The investigators focus on analytical study of profitability of spectrum markets, and its empirical verification. Main thrusts of the research program are: (i) fundamental elements of pricing and interference externalities for efficient and economically viable use of spectrum; (ii) algorithms for																									1				X							#######	
NSF	CISE 0964362 / Pennsylvania State Univ University Park	17.005	CIF: Medium: Collaborative Research: Interactive Security	The wide use of wireless data services leads to sensitive and confidential information delivered over wireless links. With e-crimes resulting from such information being compromised to unauthorized parties at an all time high, the ?all wireless? vision can truly materialize only if the security of wireless information transfer can be guaranteed. Conventional approaches to information security are designed for wired networks with assumptions that lead to a disassociation from the physical medium in which communication takes place, and provide guarantees against adversaries that are computationally limited. This project provides a new approach for wireless networks to deliver provable and unconditional security. This research designs wireless networks with a secure foundation guaranteeing reliable and secure delivery of information. In doing so, the investigators account for untapped and rich resources provided by wireless systems naturally, including sources with correlated observations or application content, channels that provide spatial and temporal diversity, network nodes that are helpers or relays providing interaction, and broadcast and bi-directional nature of the medium enabling communication with feedback. The																										1				X							#######	
NSF	CISE 0964495 / Johns Hopkins University	1.074	CIF: Medium: Collaborative Research: Explicit Codes for Efficient Operation of Wireless Networks	This project deals with models of wireless multi-terminal networks incorporating practical constraints such as individual links that experience fading, applications that are delay-sensitive, network communication that is subject to broadcast and interference constraints and nodes that are constrained to operate in half-duplex mode. The network is assumed to be static for the duration of the message, but can change from one message to the next and channel-state information is assumed to be present only at the receiver. In such settings, cooperative communication in which intermediate nodes facilitate communication between a particular source-sink pair, is key to efficient operation of the network. A key goal of any communication system, is one of achieving an optimal rate-reliability tradeoff. The diversity-multiplexing gain tradeoff (DMT) determines the tradeoff between relevant first-order approximations to the rate and reliability of communication. The DMT of point-to-point communication links has been extensively studied and signal sets are available that are optimal under any statistical distribution of the fading channel. There now exist protocols and codes for two-hop relay networks that come close to												1																		X							#######	

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NSF	CISE 0964500 / University of Delaware	1.076	CIF: Medium:Collaborative Research: Explicit Codes for Efficient Operation of	This project deals with models of wireless multi-terminal networks incorporating practical constraints such as individual links that experience fading, applications that are delay-sensitive, network communication that is subject to broadcast and interference constraints and nodes that are constrained to operate in half-duplex mode. The network is assumed to be static for the duration of the message, but can change from one message to the next and channel-state information is assumed to be present only at the receiver. In such settings, cooperative communication in which intermediate nodes facilitate communication between a particular source-sink pair, is key to efficient operation of the network. A key goal of any communication system, is one of achieving an optimal rate-reliability tradeoff. The diversity-multiplexing gain tradeoff (DMT) determines the tradeoff between relevant first-order approximations to the rate and reliability of communication. The DMT of point-to-point communication links has been extensively studied and signal sets are available that are optimal under any statistical distribution of the fading channel. There now exist protocols and codes for two-hop relay networks that come close to										1																			X						#######	
NSF	CISE 0964507 / University of Southern California	1.072	CIF: Medium: Collaborative Research: Explicit Codes for Efficient Operation of Wireless Networks	This project deals with models of wireless multi-terminal networks incorporating practical constraints such as individual links that experience fading, applications that are delay-sensitive, network communication that is subject to broadcast and interference constraints and nodes that are constrained to operate in half-duplex mode. The network is assumed to be static for the duration of the message, but can change from one message to the next and channel-state information is assumed to be present only at the receiver. In such settings, cooperative communication in which intermediate nodes facilitate communication between a particular source-sink pair, is key to efficient operation of the network. A key goal of any communication system, is one of achieving an optimal rate-reliability tradeoff. The diversity-multiplexing gain tradeoff (DMT) determines the tradeoff between relevant first-order approximations to the rate and reliability of communication. The DMT of point-to-point communication links has been extensively studied and signal sets are available that are optimal under any statistical distribution of the fading channel. There now exist protocols and codes for two-hop relay networks that come close to										1																			X						#######	
NSF	CISE 0964645 / University of Maryland College Park	17.006	CIF: Medium: Collaborative Research: Interactive Security	The wide use of wireless data services leads to sensitive and confidential information delivered over wireless links. With e-crimes resulting from such information being compromised to unauthorized parties at an all time high, the ?all wireless? vision can truly materialize only if the security of wireless information transfer can be guaranteed. Conventional approaches to information security are designed for wired networks with assumptions that lead to a disassociation from the physical medium in which communication takes place, and provide guarantees against adversaries that are computationally limited. This project provides a new approach for wireless networks to deliver provable and unconditional security. This research designs wireless networks with a secure foundation guaranteeing reliable and secure delivery of information. In doing so, the investigators account for untapped and rich resources provided by wireless systems naturally, including sources with correlated observations or application content, channels that provide spatial and temporal diversity, network nodes that are helpers or relays providing interaction, and broadcast and bi-directional nature of the medium enabling communication with feedback. The																											1			X						#######	

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AGENCY	DEPARTMENT/ DIVISION /LAB/ PROGRAM/ AWARD	Project #	PROJECT TITLE/DESCRIPTION	EXAMPLES	INTENDED APPLICATION ENVIRONMENT (See Attachment C for examples)	EXPECTED FREQUENCY RANGE	**Topic Area**	Topic # 3	Topic # 23	Topic # 19	Topic # 6	Topic # 15	Topic # 7	Topic # 1	Topic # 14	Topic # 11	Topic # 4	Topic # 13	Topic # 16	Topic # 2	Topic # 21	Topic # 22	Topic # 12	Topic # 8	Topic # 5	Topic # 9	Topic # 18	Topic # 17	Topic # 10	Topic # 20	**Maturity**	Basic Research	Applied Research	Advanced Technology Development	Advanced Component Development	Demonstration & Validation	**Funding**	Funded in Past (2006-2010)	Presently Funded (FY11)
NSF	CISE 0964652 / Trustees of Boston University	18.02	NetSE: Medium: Collaborative Research: Promoting Secondary Spectrum Markets via Profitability-Driven Methods and Algorithms	Wireless telecommunications are undergoing substantial policy reforms in pursuit of better spectral efficiency. A key element in these reforms entails granting full property rights to spectrum license holders, thereby paving the way to secondary spectrum markets. Spectrum markets hold a remarkable potential to increase spectrum utilization by making it available to a larger fraction of public at lower cost. Yet, although a favorable regulatory framework has been in effect in the last few years, liquidity of spectrum markets is inhibited due to uncertainties perceived by spectrum license holders. These uncertainties stem from complex relationships between effects of electromagnetic interference and economic considerations. This research involves a constructive study of viability of spectrum markets by establishing methods and algorithms that render such markets profitable for their participants. The investigators focus on analytical study of profitability of spectrum markets, and its empirical verification. Main thrusts of the research program are: (i) fundamental elements of pricing and interference externalities for efficient and economically viable use of spectrum; (ii) algorithms for																								1					X						########	
NSF	CISE 0964713 / University of Texas at Arlington	1.056	NeTS: Medium: Collaborative Research: Opportunistic and Compressive Sensing in Wireless Sensor Networks	This collaborative project investigates Opportunistic Sensing (OS) and Compressive Sensing (CS) in Wireless Sensor Networks (WSNs). OS refers to a paradigm in which a WSN can automatically discover and select sensor modalities and sensors based on an operational scenario, resulting in an adaptive network that automatically finds scenario-dependent, objective-driven opportunities with optimized performance. CS is a novel sensing/sampling paradigm that goes against the common wisdom in data acquisition. Both OS and CS help improve efficient operations and performance of WSNs significantly. In particular, OS aims at reduction from space by selecting a subset of sensors and modalities for efficient data fusion, whereas CS targets reduction in sampling by selecting a subset of samples non-uniformly. Therefore, theoretical foundations and algorithms for opportunistic and compressive sensing are essential for advancing the state of the art in WSNs that not only ensure effective utilization of sensing assets but also provide robust optimal performance. This project addresses fundamental research issues from information theoretic viewpoint to evaluate joint OS and CS distortions, develop OS and										1																			X						########	
NSF	CISE 1011811 / University of California-Davis	1.062	CIF: Large: Collaborative Research: Cooperation and Learning Over Cognitive Networks	Cooperation and Learning over Cognitive Networks Studies on herding and self-organization in economics and the social and biological sciences have observed that coordination among multiple agents leads to regular patterns of behavior and swarm intelligence, even when each group member shows limited behavioral complexity. In ant colonies, for example, individual ants cannot capture rich spatial information from their environment because of their limited sensing ability. Nevertheless, when the ants coordinate their activities within a colony, the group ends up exhibiting better sensing abilities. Using signal processing and communications techniques, the research studies how and why such manifestations of rational and organized behavior arise at the group level from local interactions among agents with limited abilities, what communication topologies enable such behavior, and what type of signal processing enables such formations. This research seeks to understand and reverse-engineer the distributed intelligence encountered in socio-economic-biological networks, by investigating relations with learning and rationality over cognitive networks. The latter are adaptive networks that avoid centralized information processing and										1																			X						########	

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NSF	CISE 1011903 / Carnegie-Mellon University	1.064	CIF: Large: Collaborative Research: Cooperation and Learning over Cognitive Networks	Cooperation and Learning over Cognitive Networks Studies on herding and self-organization in economics and the social and biological sciences have observed that coordination among multiple agents leads to regular patterns of behavior and swarm intelligence, even when each group member shows limited behavioral complexity. In ant colonies, for example, individual ants cannot capture rich spatial information from their environment because of their limited sensing ability. Nevertheless, when the ants coordinate their activities within a colony, the group ends up exhibiting better sensing abilities. Using signal processing and communications techniques, the research studies how and why such manifestations of rational and organized behavior arise at the group level from local interactions among agents with limited abilities, what communication topologies enable such behavior, and what type of signal processing enables such formations. This research seeks to understand and reverse-engineer the distributed intelligence encountered in socio-economic-biological networks, by investigating relations with learning and rationality over cognitive networks. The latter are adaptive networks that avoid centralized information processing and										1																			X						#######	
NSF	CISE 1011918 / University of California-Los Angeles	1.066	CIF: Large: Collaborative Research: Cooperation and Learning Over Cognitive Networks	Cooperation and Learning over Cognitive Networks Studies on herding and self-organization in economics and the social and biological sciences have observed that coordination among multiple agents leads to regular patterns of behavior and swarm intelligence, even when each group member shows limited behavioral complexity. In ant colonies, for example, individual ants cannot capture rich spatial information from their environment because of their limited sensing ability. Nevertheless, when the ants coordinate their activities within a colony, the group ends up exhibiting better sensing abilities. Using signal processing and communications techniques, the research studies how and why such manifestations of rational and organized behavior arise at the group level from local interactions among agents with limited abilities, what communication topologies enable such behavior, and what type of signal processing enables such formations. This research seeks to understand and reverse-engineer the distributed intelligence encountered in socio-economic-biological networks, by investigating relations with learning and rationality over cognitive networks. The latter are adaptive networks that avoid centralized information processing and										1																			X						#######	
NSF	CISE 1011956 / Trustees of Boston University	1.068	CIF: Large: Collaborative Research: Cooperation and Learning Over Cognitive Networks	Cooperation and Learning over Cognitive Networks Studies on herding and self-organization in economics and the social and biological sciences have observed that coordination among multiple agents leads to regular patterns of behavior and swarm intelligence, even when each group member shows limited behavioral complexity. In ant colonies, for example, individual ants cannot capture rich spatial information from their environment because of their limited sensing ability. Nevertheless, when the ants coordinate their activities within a colony, the group ends up exhibiting better sensing abilities. Using signal processing and communications techniques, the research studies how and why such manifestations of rational and organized behavior arise at the group level from local interactions among agents with limited abilities, what communication topologies enable such behavior, and what type of signal processing enables such formations. This research seeks to understand and reverse-engineer the distributed intelligence encountered in socio-economic-biological networks, by investigating relations with learning and rationality over cognitive networks. The latter are adaptive networks that avoid centralized information processing and										1																			X						#######	

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NSF	CISE 1011962 / Princeton University	12.118	NeTS:Large:Collaborative Research: Architecting Manageable Interference for Next-Generation Wireless Networks	Current wireless network architectures are based on interference avoidance, which advocates eliminating simultaneous transmissions to avoid collisions at the receivers. However, this design principle is largely an artifact of design simplification. In contrast, if neighboring nodes pool their resources, and cooperate in their signal transmissions, the network could turn interference to its advantage for potentially many-fold increase in network capacity. This cooperative viewpoint necessitates revisiting networking research?s foundations, which are being addressed with a two-part strategy: 1. Network-centric Cooperative Signal Design: Cooperative signaling injects ?network? into signal design, thereby breaking conventional boundaries. Nodes have to understand how their transmissions will be perceived, decoded, suppressed, cancelled, enhanced or forwarded by other nodes. This fundamental shift in signal design (from conventional point-to-point PHYsical layer) is being addressed by developing capacity bounds, distributed codes and messaging protocols for scalable cooperation. 2. Signal-centric Cooperative Network Design: The converse to network-inspired signal design is ?signal-centric? network design.																1													X						#######	
NSF	CISE 1012029 / Arizona State University	1.07	CIF: Large: Collaborative Research: Cooperation and Learning Over Cognitive Networks	Cooperation and Learning over Cognitive Networks Studies on herding and self-organization in economics and the social and biological sciences have observed that coordination among multiple agents leads to regular patterns of behavior and swarm intelligence, even when each group member shows limited behavioral complexity. In ant colonies, for example, individual ants cannot capture rich spatial information from their environment because of their limited sensing ability. Nevertheless, when the ants coordinate their activities within a colony, the group ends up exhibiting better sensing abilities. Using signal processing and communications techniques, the research studies how and why such manifestations of rational and organized behavior arise at the group level from local interactions among agents with limited abilities, what communication topologies enable such behavior, and what type of signal processing enables such formations. This research seeks to understand and reverse-engineer the distributed intelligence encountered in socio-economic-biological networks, by investigating relations with learning and rationality over cognitive networks. The latter are adaptive networks that avoid centralized information processing and													1																	X						#######	
NSF	CISE 1012700 / Ohio State University	12.103	NeTS: Large: Collaborative Research: Foundations for Network Cooperation at Signal Scale	Current wireless network architectures are based on interference avoidance, which advocates eliminating simultaneous transmissions to avoid collisions at the receivers. However, this design principle is largely an artifact of design simplification. In contrast, if neighboring nodes pool their resources, and cooperate in their signal transmissions, the network could turn interference to its advantage for potentially many-fold increase in network capacity. This cooperative viewpoint necessitates revisiting networking research?s foundations, which are being addressed with a two-part strategy: 1. Network-centric Cooperative Signal Design: Cooperative signaling injects ?network? into signal design, thereby breaking conventional boundaries. Nodes have to understand how their transmissions will be perceived, decoded, suppressed, cancelled, enhanced or forwarded by other nodes. This fundamental shift in signal design (from conventional point-to-point PHYsical layer) is being addressed by developing capacity bounds, distributed codes and messaging protocols for scalable cooperation. 2. Signal-centric Cooperative Network Design: The converse to network-inspired signal design is ?signal-centric? network design.																					1									X						#######	

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NSF	CISE 1012831 / William Marsh Rice University	1.077	NetSE: Large: Urban-Scale Polymorphic Wireless Networks: Community-Driven Assessment, Design, and Access	Intellectual Merit. This project will develop the world?s first urban polymorphic wireless access network, a network that can radically transform its basic properties on-the-fly. A key step is deployment of infrastructure and client nodes that can access diverse spectral ranges spanning from MHz to GHz. This unique capability in spectrum access enables revisiting the foundations of network assessment, design, and access. This experimental approach capitalizes on an unprecedented opportunity in an urban community within Houston: In Pecan Park, an underserved community, the project team will serve as researchers, the wireless network service provider, the network equipment and protocol designers, and community-technology educators and advocates. In a coordinated effort using this urban testbed, the project addresses the following three inter-related research thrusts: CACTUS: cross sectional assessment of community and technology usage: development of a first-of-its-kind network assessment tool that integrates three new methods with existing network trace collection capabilities: (i) sociological assessment of community-technology wireless access objectives from perspectives of both usage											1																			X						#######	
NSF	CISE 1012921 / William Marsh Rice University	12.104	NeTS: Large: Collaborative Research: Foundations for Network Cooperation at Signal-scale	Current wireless network architectures are based on interference avoidance, which advocates eliminating simultaneous transmissions to avoid collisions at the receivers. However, this design principle is largely an artifact of design simplification. In contrast, if neighboring nodes pool their resources, and cooperate in their signal transmissions, the network could turn interference to its advantage for potentially many-fold increase in network capacity. This cooperative viewpoint necessitates revisiting networking research?s foundations, which are being addressed with a two-part strategy: 1. Network-centric Cooperative Signal Design: Cooperative signaling injects "network" into signal design, thereby breaking conventional boundaries. Nodes have to understand how their transmissions will be perceived, decoded, suppressed, cancelled, enhanced or forwarded by other nodes. This fundamental shift in signal design (from conventional point-to-point PHYsical layer) is being addressed by developing capacity bounds, distributed codes and messaging protocols for scalable cooperation. 2. Signal-centric Cooperative Network Design: The converse to network-inspired signal design is ?signal-centric? network design.																					1									X						#######	
NSF	CISE 1016260 / North Carolina State University	17.025	TC: Small: Defending against Insider Jammers in DSSS- and FH-Based Wireless Communication Systems	Jamming resistance is crucial for applications where reliable wireless communication is required, such as rescue missions and military operations. Spread spectrum technologies such as Frequency Hopping (FH) and Direct Sequence Spread Spectrum (DSSS) have been used as countermeasures against jamming attacks. However, these anti-jamming techniques require that senders and receivers share a secret key in order to communicate with each other. In situations where the adversary can compromise a legitimate communication device and learn the secret key, she can effectively defeat FH or DSSS wireless communication and thus disrupt normal network operations. In general, traditional anti-jamming techniques such as FH and DSSS are vulnerable to insider attacks where the adversary has access to the secret key used for anti-jamming wireless communication. This project develops novel and efficient insider-jamming-resistant techniques for both DSSS and FH-based wireless communication systems. This research consists of two thrusts: The first thrust develops novel spreading/despreading techniques to enhance DSSS-based wireless communication to defend against insider																											1			X						#######	

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NSF	CISE 1016649 / University of Texas at Austin	12.08	Heterogeneous Network Connectivity and Capacity	A common characteristic of the emerging generation of wireless networks is their heterogeneity: these networks consist of devices with very different capabilities and requirements sharing overlapping spectrum. Intelligent home networks consisting of HD streaming, gaming consoles, wireless routers, and energy monitoring devices is one example; cognitive networks (utilizing white spaces), and femtocell networks being two more. Somewhat surprisingly, nearly all engineering design, analysis, and knowledge is based entirely on the assumption of node homogeneity Our research involves obtaining fundamental new laws and limits for the connectivity and capacity of heterogeneous wireless networks. The nature of such limits is expected to provide a roadmap for better design principles. The novelty of this research is based on a new application of marked point processes, where the points model the node locations and marks characterize essential traits of the node, like their bandwidth and power. To calculate the desired statistical properties of the network, we introduce and advance new mathematical tools such as Tauberian theory, series of random functions, Stein approximation theory, and sub-ergodic																		1											X						########	
NSF	CISE 1016742 / University of Notre Dame	12.116	NeTS: Small: Theory and Practice of Coooperative Wireless Networks	Although theoretical results predict that significant gains can be achieved from node cooperation, current wireless systems are exclusively built on point-to-point communication, where transmissions are separated in time, frequency, or space. Before cooperative techniques can be implemented, two key questions need to be addressed: How do they perform in the context of a larger network, and how do they perform in actual experiments? This project aims at providing answers to both these questions by combining theory and experimental work. On the theory side, the investigators use a rigorous analytic approach that combines tools from stochastic geometry and information theory. The stochastic geometry approach permits statements about ensembles of networks, rather than just a single fixed network geometry, which is often more tractable and leads to more general results. On the experimental side, performance measurements are taken on small cooperative networks of software radio devices. They are used to derive analytical models that can be used at higher layers in the protocol stack and to determine the overhead and control traffic required to set up the cooperation. Based on the insight																		1											X						########	
NSF	CISE 1016748 / Pennsylvania State Univ University Park	12.109	NeTS: Small: Collaborative Research: Harnessing Network Coding Gains in Multi-Rate Wireless Networks	Network coding brings the promise of increased wireless network capacity by decreasing the overall number of transmissions. In practice however, many challenges remain in realizing the gains from network coding. In particular the interactions between network coding and transmission rate control have not been carefully studied to date. While transmission at higher rates favor a capacity increase, they can diminish overhearing possibilities, a key requirement of network coding. This proposal considers the problem of transmission rate control and network coding in a holistic way. A framework that examines the interdependencies between the use of network coding and multiple transmission rates with respect to various functions spanning the link and routing layers, is developed. The following tasks are being undertaken: (i) Design a network-coding aware transmission rate control module that allows nodes to transmit at the high bit rates while at the same time facilitating network coding. (ii) Design a set of functions at the link and routing layers that provide the best trade-offs between applying network coding and controlling interference and network congestion (iii) Implement and extensively evaluate a																		1											X						########	

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NSF	CISE 1016841 / University of Delaware	1.059	NeTS: Small: Collaborative Research: Learning to help: Trading spectrum ownership for performance	In contrast with most existing dynamic spectrum access (DSA) paradigms which impose a `foe' relationship between primary users (PUs) and secondary users (SUs), this project investigates a new DSA paradigm which encourages PUs and SUs to help each other by trading spectrum ownership for improved overall performance. Specifically, this project designs two different schemes: (1) Give-And-Take (GAT) and (2) Network Coding + Secondary User Relay (NC+SR). The former does not need to change the radio or the protocol stack of PUs, while the latter assumes that PUs and SUs are capable of performing network coding. In GAT, SUs help deliver the traffic of PUs and in return are allowed to access licensed spectrum in a manner disruptive to PUs. The help constitutes the `give' part, and the disruptive spectrum accesses constitute the `take' part. In NC+SR, SUs help relay PU traffic between PUs. When relaying PU packets, SU relay nodes may encode SU packets onto PU packets via network coding, so that SU packets get a `free ride' on PU packets. Both GAT and NC+SR promise the improved performance of PUs as well as SUs. The project studies the issues of protocol design and performance optimization of the two schemes. Results								1																				X						#######	
NSF	CISE 1016943 / University of Arizona	17.02	TC: Small: Enemies from Within: Thwarting Sophisticated Insider Attacks in Wireless Networks	Wireless networks are inherently vulnerable to external and internal network attacks, due to the open nature of the wireless medium and the poor physical security of wireless devices. While external attacks can be neutralized through a combination of cryptography-based measures and robustness mechanisms, internal attacks, which are launched from compromised nodes, are much more sophisticated in nature. Insider adversaries exploit knowledge of network secrets (e.g., cryptographic keys and pseudo-random spreading codes) and protocol semantics to maximize their detrimental impact by selectively and adaptively targeting critical network functionalities. This project focuses on designing and evaluating secure protocols for thwarting sophisticated insider attacks of selective, adaptive, and cross-layer nature. A unified adversarial model is considered in which selective jamming and/or dropping of high-value packets (e.g., control information) is used as the primary vehicle for denying network service. Defending wireless networks under this model is particularly challenging, because the adversary remains active for short periods of time and may adapt/modify his strategies on the fly. The impact of insider																										1			X						#######	
NSF	CISE 1017012 / University of California-Riverside	12.108	NeTS: Small : Collaborative Research: Harnessing Network Coding Gains in Multi-Rate Wireless Networks	Network coding brings the promise of increased wireless network capacity by decreasing the overall number of transmissions. In practice however, many challenges remain in realizing the gains from network coding. In particular the interactions between network coding and transmission rate control have not been carefully studied to date. While transmission at higher rates favor a capacity increase, they can diminish overhearing possibilities, a key requirement of network coding. This proposal considers the problem of transmission rate control and network coding in a holistic way. A framework that examines the interdependencies between the use of network coding and multiple transmission rates with respect to various functions spanning the link and routing layers, is developed. The following tasks are being undertaken: (i) Design a network-coding aware transmission rate control module that allows nodes to transmit at the high bit rates while at the same time facilitating network coding. (ii) Design a set of functions at the link and routing layers that provide the best trade-offs between applying network coding and controlling interference and network congestion (iii) Implement and extensively evaluate a																					1								X						#######	

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NSF	CISE 1017053 / University of Delaware	8.003	CIF:Small: Collaborative Research: Distributed PHY/MAC Optimization for Energy and Spectral Efficient Wireless Networks	The widespread demand for high rate multimedia wireless communications has drastically increased the power consumption of wireless networks. However, the advances in battery technology have not kept pace, resulting in a severe mismatch between the energy thirst and battery capacity of mobile units. The major objective of this research is to develop energy-efficient techniques for robust and secure wireless networks through distributed optimization of cross-layer network design. This research performs a comprehensive investigation into energy-efficient wireless communications. In wireless networks, the channel conditions of users, at different locations, times, and frequencies are different. The quality of service and network efficiency can be significantly improved if these differences can be exploited. Since all protocol layers impact energy consumption, the investigators will develop cross-layer energy-efficient techniques to reduce redundant message transfers and the associated energy consumption. This research will focus on energy-efficient transmission and resource allocation strategies that are amenable to applications in wireless OFDM and MIMO systems, and																				1									X						########	
NSF	CISE 1017172 / Norfolk State University	1.046	NeTS: Small: Collaborative Research: Learning to help: Trading spectrum ownership for performance	In contrast with most existing dynamic spectrum access (DSA) paradigms which impose a `foe' relationship between primary users (PUs) and secondary users (SUs), this project investigates a new DSA paradigm which encourages PUs and SUs to help each other by trading spectrum ownership for improved overall performance. Specifically, this project designs two different schemes: (1) Give-And-Take (GAT) and (2) Network Coding + Secondary User Relay (NC+SR). The former does not need to change the radio or the protocol stack of PUs, while the latter assumes that PUs and SUs are capable of performing network coding. In GAT, SUs help deliver the traffic of PUs and in return are allowed to access licensed spectrum in a manner disruptive to PUs. The help constitutes the `give' part, and the disruptive spectrum accesses constitute the `take' part. In NC+SR, SUs help relay PU traffic between PUs. When relaying PU packets, SU relay nodes may encode SU packets onto PU packets via network coding, so that SU packets get a `free ride' on PU packets. Both GAT and NC+SR promise the improved performance of PUs as well as SUs. The project studies the issues of protocol design and performance optimization of the two schemes. Results																													X						########	
NSF	CISE 1017192 / GA Tech Research Corporation - GA Institute of Technology	8.004	CIF:Small: Collaborative Research: Distributed PHY/MAC Optimization for Energy and Spectral Efficient Wireless Networks	The widespread demand for high rate multimedia wireless communications has drastically increased the power consumption of wireless networks. However, the advances in battery technology have not kept pace, resulting in a severe mismatch between the energy thirst and battery capacity of mobile units. The major objective of this research is to develop energy-efficient techniques for robust and secure wireless networks through distributed optimization of cross-layer network design. This research performs a comprehensive investigation into energy-efficient wireless communications. In wireless networks, the channel conditions of users, at different locations, times, and frequencies are different. The quality of service and network efficiency can be significantly improved if these differences can be exploited. Since all protocol layers impact energy consumption, the investigators will develop cross-layer energy-efficient techniques to reduce redundant message transfers and the associated energy consumption. This research will focus on energy-efficient transmission and resource allocation strategies that are amenable to applications in wireless OFDM and MIMO systems, and																				1									X						########	

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NSF	CISE 1017248 / GA Tech Research Corporation - GA Institute of Technology	1.069	NeTS: Small: Wireless Multihop Networking with MIMO	Wireless networks have had a profound impact on the way people work and live. With the advent of mesh networks and WiMax, wireless multihop networks could have a similar impact by providing the last piece of a ubiquitous networking infrastructure. However, wireless multihop networks are subject to a capacity limit, as set forth in the classic work by Gupta and Kumar. Of different technologies proposed for throughput enhancement, the use of MIMO links is especially promising. This project considers how to use MIMO resources optimally to achieve network-wide performance goals. MIMO resources can be used to increase single-link performance through array and diversity gains and spatial multiplexing of streams, or to activate otherwise conflicting links simultaneously through interference suppression. The proposed research characterizes the inherent tradeoffs among these capabilities. The PIs are addressing the problem through both formal optimization techniques and algorithm design and analysis. Algorithms for evaluating feasibility of a set of MIMO links, for scheduling streams across a MIMO network, and for routing of flows are being developed. Our problem formulations										1																			X						########	
NSF	CISE 1017430 / University of Illinois at Urbana-Champaign	12.042	CIF: Small: Cooperative Interference Management-A Fundamental Study	Interference is a fundamental feature of the wireless medium and a major performance bottleneck in the engineering of wireless networks. However, the broadcast nature of the wireless medium which manifests itself in the form of interference can also be a benefit in disguise. It allows multiple nodes to receive a common signal and generates the potential for cooperation. Much of the fundamental research effort on the broadcast aspect so far has addressed these two aspects (interference and cooperation) separately. This project studies interference management and cooperation in a common context and a holistic manner. The research conducted in this effort (a) looks for novel communication strategies that harness the broadcast advantage while minimizing its interfering nature; (b) looks to identify engineering contexts where the novel communication strategies provide the most gain over traditional approaches; and (c) looks to characterize novel fundamental outer bounds (beyond the cut-set ones) to rates of reliable network communication where cooperation and interference coexist. These goals are addressed by starting out with simple (but canonical) models of wireless networks featuring two unicast traffic under three formulations that cover a																					1									X						########	
NSF	CISE 1017436 / University of Illinois at Chicago	12.043	CIF: Small: Fundamental Limits of Layered Wireless Networks	The goal of the research is to determine the fundamental, information theoretic limits of when and how to layer multiple wireless networks on shared and/or unlicensed bands in a seamless and spectrally efficient manner. Wireless networks are everywhere: WiFi, Bluetooth, cordless phones populate increasingly dense unlicensed frequency bands. Cellular, satellite, military and first-responder networks occupy exclusively licensed bands that are gradually giving way to dynamic, secondary spectrum sharing forms of licensing. For both types of licensing, it is crucial that multiple wireless networks co-exist in the same finite spectral resources in an intelligent, efficient and scalable manner. The time is ripe for a fresh look at how to optimally layer wireless networks, reaching far-beyond today's ``interference-limited'' solutions which combine orthogonal access and the treatment of interference as noise. The research moves away from classical information theoretic single-layer, homogeneous networks to include realistic oblivion constraints on how different layers should interact in a hierarchical fashion. Understanding how to best layer networks constitutes a major step towards eliminating current spectral inefficiencies.																					1									X						########	

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AGENCY	DEPARTMENT/ DIVISION /LAB/ PROGRAM/ AWARD	Project #	PROJECT TITLE/DESCRIPTION	EXAMPLES	INTENDED APPLICATION ENVIRONMENT (See Attachment C for examples)	EXPECTED FREQUENCY RANGE	**Topic Area**	Topic # 3	Topic # 23	Topic # 19	Topic # 6	Topic # 15	Topic # 7	Topic # 1	Topic # 14	Topic # 11	Topic # 4	Topic # 13	Topic # 16	Topic # 2	Topic # 21	Topic # 22	Topic # 12	Topic # 8	Topic # 5	Topic # 9	Topic # 18	Topic # 17	Topic # 10	Topic # 20	**Maturity**	Basic Research	Applied Research	Advanced Technology Development	Advanced Component Development	Demonstration & Validation	**Funding**	Funded in Past (2006-2010)	Presently Funded (FY11)
NSF	CISE 1017549 / University of Texas at Austin	1.065	NeTS: Small: From Sensing To Sharing Across Networks In White Space	The anticipated opening up of white space by the FCC for unlicensed use has created exciting new opportunities. It also presents unique challenges: (i) it requires accurate wide-band spectrum sensing technique to avoid interfering with primary users, and (ii) it needs dynamic spectrum sharing in heterogeneous setting both within networks and across networks. This project develops a holistic approach for spectrum sensing to address spatio-temporal variability and spectrum sharing among multiple secondary users and networks in white space. In particular, it first develops efficient and accurate spectrum sensing techniques that simultaneously exploit time- and frequency-domain features, sparsity in active transmitters, and temporal and spatial locality in the transmissions. Second, it studies the cost and benefits of sharing network state in a heterogeneous network where different nodes have different information views. Third, it studies spectrum sharing across networks (e.g., CSMA/MaxWeight, TDMA/CSMA co-located networks). It develops algorithms and studies performance and fairness both with implicit sharing (i.e., no state-exchange) and with explicit sharing of information across networks. Fourth, it proposes a ground-up											1																			X						#######	
NSF	CISE 1017722 / Duke University	2.017	NeTS: Small: Collaborative Research: Analytic Modeling and Enhancement of Vehicular Ad Hoc Networks for Safety Related Applications	The vehicular ad hoc network is one of the key enabling components in Intelligent Transportation Systems that has been developed for safe and smooth driving without excessive delays. A major hurdle in the development of the networks for time-dependent safety-critical services is the lack of established models and metrics. These enable one to determine the effectiveness of the network design mechanisms for predictable quality of service, and allow the evaluation of the tradeoff between network parameters. This collaborative research project between Oral Roberts University and Duke University analyzes and suggests enhancements of safety-critical services in vehicular ad hoc networks. Several key issues are investigated in the project. First, the project develops stochastic modeling techniques to address some open problems, such as hidden terminal issues and rebroadcast coverage problems in two-dimensional broadcast vehicular networks under typical traffic scenarios. Second, new analytical models are developed for time-dependent analysis of time-critical safety services. Consequently, performance, reliability, and survivability metrics for the safety services are defined and analyzed. Third, new solutions to assure reliable																			1											X						#######	
NSF	CISE 1017887 / Michigan Technological University	17.026	TC: Small: Security Provisioning for Cognitive Radio Networks	The emerging wireless paradigm of dynamic spectrum access via cognitive radio technology has been increasingly recognized for its great potential in drastically enhancing spectrum utilization efficiency. The basic requirements of cognitive radio networks (CRNs) are to protect licensed primary users and provide reliable dynamic spectrum access to secondary cognitive users, which give rise to a new fundamental issue in spectrum access related security. This project develops a comprehensive security system that lays down a secure backbone for CRNs that coexist with primary networks under various network architectures and spectrum coexistence paradigms. The developed security measures are coherently embedded into the entire CRN, from the very beginning of the spectrum sensing stage to the dynamic spectrum access process until the data communication stage. Targeting three main sources of CRN security vulnerability, our research objectives and thrusts include: 1) systematically identify the unique primary user related attacks in CRNs and develop a suite of attack detection and defense mechanisms; 2) develop secure and robust strategies of dynamic spectrum access for benign cognitive users; 3) design																											1			X						#######	

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NSF	CISE 1017982 / University of Virginia Main Campus	18.004	CIF: Small: Dynamic Pricing of Interference in Cognitive Radio Networks	The telecommunications industry is on the verge of major structural change. Historically, the industry's regulator has allocated licenses for the utilization of well-defined bands within the available spectrum. Unlike other commodities, no secondary market for the spectrum has ever developed. Technological limitations as well as legal and regulatory constraints may have contributed to this fact. Today the evidence clearly points to a situation of relative under-utilization of the spectrum. A "cognitive radio network" (CRN) is a new paradigm for wireless communications aimed at enabling a more efficient use of the spectrum. This research project focuses on two significant technical and regulatory issues which must be resolved to ensure successful deployment of cognitive radio networks. The first issue relates to the network?s ability to manage interference in a distributed fashion without cooperation from the primary users. Here, the research tasks include the analysis, from a signal processing and algorithmic point of view, of various price-based schemes for dynamic spectrum allocation in a broad range of CRN scenarios under a variety of regulatory restrictions. The second relevant issue pertains to the design of a secondary market																												X							########	
NSF	CISE 1018115 / Cornell University	1.081	CIF: Small: Cognitive Spectrum Access: Fundamental Limits, Protocols, and Performance Analysis	Wireless access through unlicensed spectrum is a major component for future broadband initiatives. Unfortunately, unlicensed frequency bands are congested, and existing technologies do not provide quality assurance for users with different access priorities and needs. The lack of quality of service guarantee is a key roadblock to providing multimedia content and facilitating broadband communications. There is a cogent need for technologies that provide distributed hierarchical access of unlicensed spectrum through dynamic spectrum sensing, learning, and cognitive sharing of spectrum opportunities. This research develops mathematical theory and practical methodologies for the cognitive access of wireless spectrum shared by multiple classes of users. The technical approaches of this research are based on the structural optimality of certain carrier sensing policies. The optimality and simplicity of these policies result in new practical yet optimal solutions to cognitive spectrum sharing among users from different priority classes. The overall objective is twofold. First, it aims at gaining a foundational understanding of the limits of cognitive spectrum access in hierarchical networks. In particular, it characterizes the											1																		X							########	
NSF	CISE 1018154 / Trustees of Boston University	8.011	NeTS: Small: Periodic schedules for energy-efficient wireless coexistence	This project is motivated by the following challenges that arise due to the growth of services and applications that rely on radio technologies: (i) As spatial density of spectrum usage increases more wireless systems need to coexist on common spectrum bands, (ii) The energy footprint of wireless information technologies grows at a remarkable pace that is exacerbated by the increasing density, and (iii) An increasing fraction of applications require tight delay guarantees that are incompatible with classical random access techniques. The objective of the program is to develop a scalable framework for providing delay guarantees in dense spectrum usage scenarios, while eliminating energy consumption in medium access arbitration. Towards this goal the project studies fundamental properties and implementations of periodic medium access schemes under which conflicting transmissions are separated in time. Inherent properties of periodic spatial systems are studied from both descriptive and prescriptive viewpoints. The scope of the program includes development of decentralized algorithms that are provably robust to propagation delays, hidden nodes, and clock drifts. An energy-efficient																						1							X							########	

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NSF	CISE 1018185 / University of Maryland College Park	12.124	NetSE: Small: Delay Minimization in Wireless Networks	Traditional information theory investigates transmission problems from a physical layer perspective. Information theory aims to determine largest achievable communication rates between transmitters and receivers for a given physical communication channel. In the simplified source-channel-destination model, information-theoretic approaches assume the availability of an infinite number of bits at the transmitters before the transmission starts. The burstiness of the arrivals and the associated issue of delay are mostly ignored. In contrast, network theory gives sophisticated analysis of network layer issues, such as random arrivals and network delay. However, in network-theoretic approaches, the underlying physical layer model is usually very simplified, e.g., in most approaches simultaneous transmissions are not allowed, and even when they are allowed, a collision channel model is used, which is far too simplistic to capture what can be achieved in the physical layer from an information-theoretic perspective. This project aims to develop a fundamental understanding for the issue of delay in networks, and design transmission methods and scheduling algorithms to minimize delay in network communications. Towards this																				1									X						########	
NSF	CISE 1018346 / University of Maryland College Park	12.114	NeTS: Small: Component Based Routing and Clique Based Scheduling for Modular Cross-layer Design of Mobile Ad-hoc Networks	Systematic methodologies for the design of distributed and implementable routing and scheduling algorithms that enable one to design, provision and manage mobile wireless networks with predictable and controllable performance are lacking. The research project provides a new framework for modular cross-layer design of scheduling and routing algorithms for ad-hoc networks. Clique based methods are used for scheduling, where cliques are defined in the interference graph. Clique based policies are developed to achieve optimal throughput and as basis for distributed implementable algorithms for scheduling. Clique based scheduling is easier and more flexible and provides a pathway to extend Network Calculus results, to provide deterministic performance bounds for wireless networks. For the routing, a component based design model is used that divides the routing protocol into components with separate design concerns. Stability, agility and flexibility are better achieved through a component based architecture. These solutions are still cross-layer, but they have well defined interfaces for signaling, control and information exchange between components and layers. Performance models provide a systematic methodology																				1									X						########	
NSF	CISE 1018464 / University of Massachusetts Amherst	17.015	NeTS: Small: Design and Initialization of Secure Wireless Networks: Foundations and Practice	Wireless ad hoc networking has become a critical technology for nodes to communicate with each other in the absence of infrastructures such as base stations. It will be used in a variety of applications including wireless sensor networks, disaster recovery, and military on-the-field communications. Significant advances have been made in the area of wireless ad hoc networking at all levels of the protocol stack, MAC, routing, congestion control, etc., with an eye toward configuring networks so as to optimize metrics such as capacity, connectivity, delay, etc. However, there remain numerous issues that have not been satisfactorily dealt with, ranging from identifying network configurations to optimize emerging security metrics, to how to effect various desirable network configurations: namely, how does an ad hoc network bootstrap itself to realize the promised performance and security? We address this question in our research. Specifically we focus on the following: ? Wireless network security: Characterize the tradeoff between performance and security in opportunistic wireless networks where eavesdroppers and/or jammers are present, and develop algorithms for providing secure communication in such environments. ?																											1			X						########	

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NSF	CISE 1018578 / Northwestern University	12.044	CIF: Small: Limited Feedback and Information Exchange for Wireless Systems	Commercial cellular networks have recently experienced a dramatic increase in demand for data services. Satisfying this demand will require substantial (order-of-magnitude) increases in the spectral efficiency that can be achieved by such networks. This will require much more extensive information exchange and cooperation among nodes in the network than in current systems. This research investigates possible approaches for cooperation among nodes in a cellular network based on practical methods for feedback and information exchange. The main theme of this research is on techniques for exchanging and exploiting limited state information about channels, interference, and quality of service in a wireless network. The focus is on two scenarios: feedback for point-to-point fading links, and information exchange between two cooperative base stations. The first scenario is meant to address limits imposed by fading for mobiles well within a cell, whereas the second scenario addresses limits imposed by interference at a cell boundary. One of the goals is to gain fundamental understanding into the trade-off between channel state feedback and receiver state feedback for fading channels. For the two-cell scenario, cooperative																		1											X						#######	
NSF	CISE 1018605 / Oral Roberts University	2.016	NeTS: Small: Collaborative Research: Analytic Modeling and Enhancement of Vehicular Ad Hoc Networks for Safety Critical Applications	The vehicular ad hoc network is one of the key enabling components in Intelligent Transportation Systems that has been developed for safe and smooth driving without excessive delays. A major hurdle in the development of the networks for time-dependent safety-critical services is the lack of established models and metrics. These enable one to determine the effectiveness of the network design mechanisms for predictable quality of service, and allow the evaluation of the tradeoff between network parameters. This collaborative research project between Oral Roberts University and Duke University analyzes and suggests enhancements of safety-critical services in vehicular ad hoc networks. Several key issues are investigated in the project. First, the project develops stochastic modeling techniques to address some open problems, such as hidden terminal issues and rebroadcast coverage problems in two-dimensional broadcast vehicular networks under typical traffic scenarios. Second, new analytical models are developed for time-dependent analysis of time-critical safety services. Consequently, performance, reliability, and survivability metrics for the safety services are defined and analyzed. Third, new solutions to assure reliable																			1											X						#######	
NSF	CISE 1018741 / California Institute of Technology	12.041	CIF: Small: Computational Tools for Bounding Network Capacities	Wireless access through unlicensed spectrum is a major component for future broadband initiatives. Unfortunately, unlicensed frequency bands are congested, and existing technologies do not provide quality assurance for users with different access priorities and needs. The lack of quality of service guarantee is a key roadblock to providing multimedia content and facilitating broadband communications. There is a cogent need for technologies that provide distributed hierarchical access of unlicensed spectrum through dynamic spectrum sensing, learning, and cognitive sharing of spectrum opportunities. This research develops mathematical theory and practical methodologies for the cognitive access of wireless spectrum shared by multiple classes of users. The technical approaches of this research are based on the structural optimality of certain carrier sensing policies. The optimality and simplicity of these policies result in new practical yet optimal solutions to cognitive spectrum sharing among users from different priority classes. The overall objective is twofold. First, it aims at gaining a foundational understanding of the limits of cognitive spectrum access in hierarchical networks. In particular, it characterizes the																						1								X						#######	

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NSF	CISE 1018786 / Illinois Institute of Technology	1.063	NeTS: Small: Dynamic Spectrum Access for Mission Critical Wireless Networks	Public safety first responders have a need for increased access to radio spectrum to improve interoperability between agencies in natural and human-caused emergencies, and to accommodate bandwidth intensive applications such as mission critical video surveillance. Dynamic Spectrum Access, a new paradigm that promises improved RF spectrum access and efficiency, has been hindered in its application to mission critical networks by a lack of the detailed understanding of the spectrum utilization characteristics necessary to drive system development. This project is generating the fundamental long-term and high-resolution spectrum measurements needed to characterize the time, frequency, energy, and spatial dynamics of mission critical wireless networks in a dense urban environment (Chicago). Empirical and analytical models that characterize public safety spectrum utilization are being created from these measurements. The empirical and analytical models are being used in turn as inputs to discrete-event simulations of candidate mission critical Dynamic Spectrum Access approaches in order to assess the ability of these approaches to improve capacity, while maintaining the necessary performance as											1																			X						########	
NSF	CISE 1040207 / Prairie View A&M Research Foundation	3.017	MRI:Acquisition: A Software-Defined Radio Based Testbed for Next Generation Wireless Networks Research	Proposal #: 10-40207 PI(s): Bian, Lijun; Annamalai, Annamalai Institution: Prairie View A&M University Title: MRI/Acq.: A Software-Defined Radio-Based Testbed for Next Generation Wireless Network Research Project Proposed: This project from an MSI, principally undergraduate university, acquiring/building software-defined radio (SDR) platforms for wireless monitoring and surveillance, aims to test and verify theoretical results for synthetic Multiple-Input-Multiple-Output (MIMO) systems. The work will - Enhance PHY and MAC visibility of operational wireless networks by distributed acquisition of RF signals and decodable frames and - Facilitate evaluation and repeatable experimentations in ongoing research projects in the area of wireless communications and networking, The project involves - Development of software tools for trace collection and replay for repeatable experimentation; - Collection of extensive wireless traces in campus environments to understand propagation characteristics, device types, and co-existence issues; - Construction of device fingerprint database for commonly used wired devices; and - Performance of synthetic MIMO experiments in a fully controlled environment. Broader Impacts:											1																			X						########	
NSF	CISE 1040422 / University of Texas at Dallas	3.011	MRI Consortium: Development of Wireless Networking Testbed and Emulator (WiNeTestEr)	Proposal #: 10-40422 Collaborative with Proposal #: 10-40429 PI(s): Prakash, Ravi & Rajan, Dinesh Banerjee, Bhaskar; Mittal, Neeraj, Venkatesan,S. & Camp, Joseph, Chen, Jinghong, Gui, Ping Institution(s): University of Texas-Dallas & Southern Methodist University Title: MRI/Dev Consortium: Dev. of Wireless Networking Testbed and Emulator (WiNeTestEr) Project Proposed: This project proposes to build a versatile wireless networking testbed called Wireless Networking Testbed and Emulator (WiNeTestEr). The main objectives and the novelty of this testbed is in its capability to - Emulate the large-scale wireless networks in multiple licensed and unlicensed bands, - Allow access to local and remote users to configure and control the same emulator, and provide repeatability, - Support experiments related to node mobility, multi-antenna (MIMO) operation, and cognitive radios, and - Provide an easy-to-use interface for remotely running wireless experiments over The main intellectual challenge is in fundamental difficulties to emulate the analog nature of wireless channels and the related effects, such as attenuation, multipath fading and multi-user interference. To this end the proposal											1																			X						########	

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NSF	CISE 1040429 / Southern Methodist University	3.012	MRI Consortium: Development of Wireless Networking Testbed and Emulator (WiNeTestEr)	Proposal #: 10-40422 Collaborative with Proposal #: 10-40429 PI(s): Prakash, Ravi & Rajan, Dinesh Banerjee, Bhaskar; Mittal, Neeraj, Venkatesan,S. & Camp, Joseph, Chen, Jinghong, Gui, Ping Institution(s): University of Texas-Dallas & Southern Methodist University Title: MRI/Dev Consortium: Dev. of Wireless Networking Testbed and Emulator (WiNeTestEr) Project Proposed: This project proposes to build a versatile wireless networking testbed called Wireless Networking Testbed and Emulator (WiNeTestEr). The main objectives and the novelty of this testbed is in its capability to - Emulate the large-scale wireless networks in multiple licensed and unlicensed bands, - Allow access to local and remote users to configure and control the same emulator, and provide repeatability, - Support experiments related to node mobility, multi-antenna (MIMO) operation, and cognitive radios, and - Provide an easy-to-use interface for remotely running wireless experiments over The main intellectual challenge is in fundamental difficulties to emulate the analog nature of wireless channels and the related effects, such as attenuation, multipath fading and multi-user interference. To this end the proposal addresses methods to emulate the					1																								X						########	
NSF	CISE 1048339 / Virginia Commonwealth University	1.042	NeTS: Small: Collaborative Research: Secure and Resilient Channel Allocation in Multi-Radio Wireless Networks	Computing devices equipped with multiple radio interfaces and working on multiple channels are becoming predominant in wireless networks. These networks are usually Multi-Interface Multi-Channel Mobile Networks (MIMC-MANETs). However, the study of security vulnerabilities and the research of fundamental security mechanisms in channel management of MIMC-MANETs have been seriously lagging behind the rapid progress of other research. This project studies the security of MIMC-MANETs in three aspects. 1. Investigating the unique (unknown) security vulnerabilities associated with channel management in MIMC-MANETs. 2. Developing MIMC-enabled security mechanisms. This project redefines channel conflict, reveals the fundamental causes and consequences of channel attacks, and develops novel and attack-resilient security mechanisms to secure channel management (and routing) in MIMC-MANETs. New security mechanisms utilize the capability of MIMC, and include collaborative channel monitoring, channel-utilization based channel conflict detection and resolution, logic-based attack investigation, and cross-layer security design. 3. Building MIMC									1																				X						########	
NSF	CISE 1049541 / University of Southern California	12.073	EAGER: Towards an Open Source Backpressure Protocol Stack for Wireless Networks	While it has been shown theoretically that stochastic network optimization techniques utilizing queue backpressure can result in high performance cross-layer protocols, there has been limited prior work on translating them into practice. In this exploratory research project, we develop and demonstrate a novel cross-layer backpressure protocol stack for wireless sensor networks, building on our implementation of the backpressure collection protocol (BCP). The possible gains of this highly agile approach to cross-layer wireless networking are substantial and include increased throughput even in the presence of mobility, handling of bursty external interference events with reduced losses, and reduced protocol implementation complexity. We incorporate techniques for MAC-layer backoff prioritization, transport layer utility optimization, mechanisms to handle various kinds of network dynamics, and interoperability with asynchronous low power sleep schedules. Protocol implementation code developed in the project will be released publicly as open-source. It is expected that the successful completion of this project will provide an important proof-of-concept that stochastic																					1								X						########	

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NSF	ENG 0601394 / University of Washington	2.028	Wireless Communications and Detection Through Obscuring Environments	This proposal is directed to the development of new technologies making use of our recent study of time-reversal techniques, correlation imaging techniques, and array coherence tomographic imaging. We propose to develop an array network system of multiple sensors which transmit spatially and temporally modulated signals. The received signals are correlated and adapted in space and time in order to obtain high-resolution images. Signals are distorted due to the intervening medium, but we make use of our recent studies on correlation imaging through multiple scattering random media and array tomographic imaging technique to obtain improved image resolution, together with our recent studies on time-reversal, imaging, communication, and super-resolution in random media. This study is aimed at the development of generalized theories of space-time-polarization wave interactions with complex media, both deterministic and stochastic. Intellectual Merit Intellectual Merit of the Proposed Activity: This proposal addresses the development of theories of the interaction of waves with a complex environment, the use of distributed sensors, and the unified treatment of all information including		1-20 GHz													1														X						########	
NSF	ENG 0601692 / Purdue University	13.019	Spectral Line-by-Line Pulse Shaping	Intellectual Merit: Mode-locked lasers generate periodic trains of ultrashort pulses that are characterized in the frequency domain by an evenly spaced series of discrete spectral lines. Recently, the stabilization of such optical frequency combs has led to a direct and precise connection between frequencies spanning radio-frequency to optical and to enormous progress in precision optical frequency synthesis and metrology. In parallel, pulse shaping techniques that exploit frequency domain manipulation of optical spectral components for synthesis of user-specified ultrashort pulsed fields have been developed and widely adopted. Until now frequency stabilization of mode-locked lasers and frequency domain manipulation and shaping of such lasers have been considered separately. Therefore, a new research program is planned in which high resolution pulse shapers resolve and control individual spectral lines. The envisioned research includes investigation of pulse shaping in the line-by-line regime, with an emphasis on new phenomena arising from line-by-line manipulation; demonstration of waveform characterization methods appropriate for line-by-line pulse shaping; development of novel pulse shaper													1														X						########	
NSF	ENG 0602621 / University of Texas at Austin	16.019	Collaborative Research: Architecture and Implementation of Intelligent Transceivers for Ultra-Wideband Communications	In February 2002, the Federal Communications Commission (FCC) revised its Part 15 emission rules and allowed the use of a large section of the radio-frequency (RF) spectrum by commercial ultra-wideband (UWB) transmission devices. The restrictions imposed on these devices include a limit on the transmitted power spectral density of -41 dBm/MHz from 3.1 to 10.6 GHz and a minimum signal bandwidth of 500 MHz. The availability of such a wide bandwidth has enabled several new short-distance, low-power, high bit-rate applications for communication, ranging and location-finding. Industrial standards proposals for the use of the above bandwidth allow for very impressive throughput performance. However, since time-to-market is a major constraint, many of these standards use variants of well-known carrier-based communication methods. This new FCC policy allows the public use of such a large spectrum for the first time. Thus it opens opportunities for fundamentally new research in wireless communications in topics such as radically new signaling methods and architectures, and their integrated circuit realization, in contrast with the traditional narrow-band approach of carrier-based modulation		3-11 GHz													1														X						########	

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NSF	ENG 0611017 / Pirouette Software Consulting	1.015	STTR Phase I: Feasibility of Mobile Peer-to-Peer Search on Hand-held Devices	This Small Business Technology Transfer (STTR) Phase I research project will design MOBI-DIK, a system for local search in mobile peer-to-peer networks. A mobile peer-to-peer network is a set of portable devices such as laptops, PDA's and cellular phones, that communicate via short-range, unregulated wireless technologies, e.g., IEEE 802.11 (namely, Wi-fi) or Bluetooth. With such communication mechanisms, a mobile device carried by a pedestrian or mounted in a vehicle receives information from its neighbors, or from remote mobile devices by multi-hop transmission relayed by intermediate portable devices and stationary hotspots. MOBI-DIK is a set of software services, application program and user interfaces (i.e. a software platform)that facilitates the development of matchmaking and resource-discovery applications in mobile peer-to-peer networks. The set of services includes a data model to describe resources and requests, power, bandwidth, and memory management parameters, and a distributed algorithm for information discovery in mobile peer-to-peer environments. MOBI-DIK is based on the ideas of opportunistic resource dissemination (a mobile device propagates the resource-information to encountered											1																			X						########	
NSF	ENG 0619315 / Jackson State University	12.092	MRI: Acquistion of Equipment for RF Communication and Antenna Design Research Laboratory	Abstract This MRI proposal will acquire equipment to establish an RF communication and antenna design research laboratory at Jackson State University (JSU). The laboratory will advance the knowledge and development of future generation state of the art RF communication systems. The establishment of the laboratory will support research projects in RF communications and antenna design that are ongoing in the Department of Computer of Engineering at JSU. The first research project involves the design of microstrip antennas for ultra wideband phased arrays, spatial power combiners and wireless communication applications. The second research project focuses on measurement and characterization of communication channels which is critical for the design of efficient receivers. The third research project deals with the design of high efficiency RF power amplifiers, which dominate the power consumption of many today's transceivers because of the necessity to deliver a large amount of power to the antenna. Intellectual merit: The research projects enumerated will advance promising techniques for the development of efficient phased array antennas for ultra wide band applications and the design of																					1									X						########	
NSF	ENG 0620588 / SILVUS COMMUNICATION SYSTEMS INC	1.107	SBIR Phase II: Adaptive/Cognitive Software Radio Architecture for Gbps+ Wireless Networking	This Small Business Innovation Research Phase II project will develop interference-mitigating technology for wireless networks. The traditional 802.11 WLAN systems that have been used for data communications are becoming ubiquitous. The next generation of these systems will be relied upon for video distribution, metropolitan networking, as well as a host of other applications that are as yet undefined. They must achieve aggregate network throughput rates in excess of one Gbps while operating in the unlicensed ISM bands. This, however, must be done in the face of ever increasing interference in the bands that in turn pose a serious threat to continued market growth. The current effort will address the interference problem by successfully combining novel spectrum sensing and cognitive approaches (observe, learn, react) with a host of powerful PHY, MAC, and combined PHY-MAC protocols. This effort will look to heavily leverage a new tool in the arsenal, namely that of multiple antennae enabled nodes that are included in the major Wi-Fi and WiMax standards. The FCC revolutionized the wireless industry by opening up the unlicensed ISM bands. These bands reduce the barrier to entry for companies to											1																			X						########	

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NSF	ENG 0621416 / University of Illinois at Urbana-Champaign	18.013	Distributed Scheduling Mechanisms	0621416 - Hajek Distributed Scheduling Mechanisms The main goal of the project is to explore the design and analysis of distributed market based scheduling algorithms, which enable agents to reserve resources online. Methods for gaining computational feasibility in the face of the difficult combinatorial problems will be investigated, including: (1) trading off optimality in a controlled way, while retaining important properties, (2) focusing on average case, or worst case, performance, and (3) leveraging the fact that future uncertainty often makes online algorithms simpler than their offline counterparts. An intriguing sideline of the study is to identify mechanisms under which distributed intelligent agents can make online choices as effectively as a centralized algorithm. Intellectual Merit: The project will bring together tools from disparate areas of recent research, including those from the theory of auctions and mechanism design from microeconomics, competitive analysis of online algorithms, deterministic and stochastic optimization methods, and both local and global stability analysis. Broader Impact: The work could have broad applications in many social and economic settings. For example, the methods could																							1						X							########	
NSF	ENG 0621874 / University of Southern California	12.155	Silicon Based Ultra Wideband (UWB) Integrated Antenna Arrays for High-Resolution Imaging	Abstract ECS-0621874 H. Hashemi, University of Southern California Silicon based integrated multi-antenna systems have generated great research interest due to their advantages in improving the wireless communication system capacity and radio frequency (RF) imaging resolution at a lower cost. Phased arrays, special case of multi-antenna systems, form a narrow beam that can be steered towards intended directions. Higher bandwidth results in better range resolution for imaging systems. Ultra wideband (UWB) antenna arrays achieve both high scanning (azimuth) resolution and range (depth) resolution. Integration of a complete UWB antenna array transceiver in silicon results in substantial improvements in cost, size, functionality, and reliability. The intellectual merit is in the integration of multiple engineering fields such as integrated circuit design, electromagnetic theory, semiconductor devices, communications, and control systems to implement a high resolution integrated imaging antenna array. During the course of the proposed work, we will analyze, design, fabricate, and measure fully integrated UWB antenna array transceivers for high resolution imaging applications using																					1									X							########	
NSF	ENG 0622082 / Southern Illinois University at Carbondale	16.037	Network Analyzer on Chip: An Integrated Frequency Domain Sensor	Abstract ECS-0622082 P. Wang, Southern Illinois University of Carbondale The objective of this research is to develop network analyzer on chip (NAoC) for biological and chemical sensing in frequency domain through microwave dielectric spectroscopy. Integrated tunable radio frequency (RF) signal sources and broadband six-port networks will be developed and characterized from ~ 1 GHz to ~ 10 GHz. The performance of the integrated NAoC system will be characterized and demonstrated through on-chip sensing and analysis of water, DNA and other chemical agents. Self-calibration capabilities will also be developed. Approaches to balance the trade-offs among NAoC performance, costs, complexity, and convenience to use will be established for the targeted sensing applications. Intellectual Merit: This is the first effort to systematically develop tunable, broadband and miniaturized integrated microwave circuits and components in complementary-metal-oxide-semiconductor (CMOS) technology for NAoC applications; this is the first effort to develop an integrated broadband vector NAoC for on-chip scattering parameter measurements; this is the first effort to incorporate self-																		1												X							########	

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NSF	ENG 0622125 / Tennessee Technological University	16.053	Time-Reversed Ultrawideband MIMO (UWB-MIMO) for Low Cost, High Data Rate Communications	Abstract ECS-0622125 R. Qiu, Tennessee Technological University This proposal focuses on a novel theory and testbed for high-data-rate ultrawideband (UWB) wireless multiple-input multiple-output (MIMO) transceivers. The proposed system paradigm uses time-reversal with noncoherent detection as an alternative to coherent reception. It exploits the hostile, rich-multipath channel as part of the receiver chain. Intellectual Merit: This research will be the first to investigate the time-reversal UWBMIMO from a unified, coherent view. The combination of statistical communication theory, time-domain transient electromagnetics and real-life prototyping will lead us to better understand the limits of nature. If the proposed project is successful, a new theoretical framework will be created and be systematically applied to various systems, including wireless, optical, acoustic, and seismic fields. This new theory has many resemblances to the corresponding narrowband MIMO theory, but in its peculiarly transient electromagnetic parts is incomparably richer, and more difficult than the narrowband MIMO that offers no analogies to the time-reversal based UWB MIMO.															1														X						########	
NSF	ENG 0622133 / Yale University	2.035	A Lightweight Event-Driven Network of Biomimetic Image Sensors	This proposal focuses on the use of biomimetic image sensors for an image sensor network. Custom image sensors will provide a reduced visual representation and enable the sensor network to interpret behavior and activity in an indoor setting. The research emphasis is to 1) parse out sensor observations into a set of distinguishable actions that can be understood by machines, 2) preserve privacy by extracting data from a scene without acquiring images and by making image reconstruction difficult for perpetrators, 3) provide ultra-low power components and a lightweight sensor network of images that operates using symbolic information over low bandwidth wireless links. Intellectual Merit: The research enables image parsing and interpretation on sensor networks. A new generation of probabilistic detection algorithms that operate on prioritized data to produce fast detections with limited information will be developed. The algorithms will be able to execute on the low-end microcontrollers used on sensor nodes. Using modular and biomimetic approaches, the PIs will design low-power image sensors that will perform efficient data extraction at the sensor level. Their																1													X						########	
NSF	ENG 0622200 / University of California-Davis	1.024	CyberSystem: A Decision-Theoretical Approach to Resource-Constrained Cyberinfrastructure	This proposal focuses on spectrum- and energy-efficient medium access and routing in resource-constrained cyberinfrastructure. It develops the enabling technology that allows the seamless integration of ubiquitous sensing, wireless communications, and heterogeneous networking. Intellectual Merit: The joint exploitation of spectrum, channel, and traffic dynamics forms the unifying theme of this research. The proposed research aims to put on firm theoretic ground the methodology of cross-layer design by pursuing a decision-theoretic approach. This approach integrates spectrum sensing with spectrum access, signal processing for traffic estimation and change detection with opportunistic routing, energy and power constraints with channel fading and traffic statistics. The ultimate goal is a cyberinfrastructure that is traffic adaptive, spectrum agile, and resource efficient. Broader Impacts: As a multidisciplinary project intersecting signal processing and wireless networking, this research promotes interaction and collaboration across different research communities and facilitates compilation of research efforts made by independent societies for the advance of Cyberinfrastructure. Specific												1																	X						########	

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NSF	ENG 0631286 / Ohio State University Research Foundation -DO NOT USE	3.019	The Ohio State University ConnectionOne Center for Radio Frequency Systems	The Ohio State University will become a research site partner in the multi-university Industry/University Cooperative Research Center for Telecommunications, Integrated Circuits and Systems. The research site will provide the capabilities, expertise, and research facilities for conducting collaborative research in the multi-university research program. The collaborative research will enhance the research/education activities within the group and advance the state-of-the-art of the wireless communications technology, and establish stronger ties with industry.				1																								X						########	
NSF	ENG 0636463 / GA Tech Research Corporation - GA Institute of Technology	13.023	TCHCS: Collaborative Research: Optimal Hybrid RF-Wireless Optical Communication for Maximum Efficiency and Reliability	ECS-0636569 H. Pishro-Nik, University of Massachusetts Amherst ECS-0636463 A. Adibi, GA Institute of Technology Intellectual Merit: The University of Massachusetts Amherst and the Georgia Institute of Technology propose an optimal hybrid free space optical/radio frequency point-to-point communication system that simultaneously achieves maximum availability and maximum efficiency. The concept behind the proposed communication algorithms and architectures is cooperation between the two heterogeneous channels. At the heart of the proposed hybrid system is a hybrid-channel coding scheme that makes it possible to maintain a high data throughput, even under extreme atmospheric conditions. The code nearly achieves the highest theoretically possible rates and obviates the need for switching between two different links or networks (i.e., wireless and optical). Such communication system provides a unique solution when a high throughput with an extremely low outage probability is crucial. The research includes three strongly coupled components: 1. Analysis, design, and implementation of a new rate-adaptive coding mechanism to optimally use the parallel channels; 2.														1														X						########	
NSF	ENG 0636569 / University of Massachusetts Amherst	13.027	TCHCS: Collaborative Research: Optimal Hybrid RF-Wireless Optical Communication for Maximum Efficiency and Reliability	ECS-0636569 H. Pishro-Nik, University of Massachusetts Amherst ECS-0636463 A. Adibi, GA Institute of Technology Intellectual Merit: The University of Massachusetts Amherst and the Georgia Institute of Technology propose an optimal hybrid free space optical/radio frequency point-to-point communication system that simultaneously achieves maximum availability and maximum efficiency. The concept behind the proposed communication algorithms and architectures is cooperation between the two heterogeneous channels. At the heart of the proposed hybrid system is a hybrid-channel coding scheme that makes it possible to maintain a high data throughput, even under extreme atmospheric conditions. The code nearly achieves the highest theoretically possible rates and obviates the need for switching between two different links or networks (i.e., wireless and optical). Such communication system provides a unique solution when a high throughput with an extremely low outage probability is crucial. The research includes three strongly coupled components: 1. Analysis, design, and implementation of a new rate-adaptive coding mechanism to optimally use the parallel channels; 2.														1														X						########	

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NSF	ENG 0636575 / University of Notre Dame	12.162	TCHCS: Novel Superconnects for Ultrahigh-Performance Hybrid Communications Systems	Abstract ECS-0636575 G. Bernstein, Univ. of Notre Dame Summary- The availability of high-performance systems is no longer limited by device performance, but rather by the cost of advanced technologies and the packaging performance. In particular, 50-to-75 GHz wireless links have been demonstrated linking fiber-based and wireless networks, but this is not available commercially due partly to the cost of integrating the various components into compact and cost-efficient systems. Here, novel interface technology to improve the performance of high-speed systems at lower cost is presented. Typically, signals flow from one IC through a wire or bump, into a lead and onto a substrate or board and then the reverse to another IC. The proposed novel technology creates a vastly improved electrical circuit path directly between ICs through the use of IC structures that allow chips to be edge-to-edge interconnected, resulting in the highest possible bandwidth and lowest possible losses. The PIs call this "Quilt Packaging" because the resulting mosaic of dice is reminiscent of a sewn cloth quilt. The PIs will build on their experience fabricating "quilts" of silicon ICs to include compound semiconductor microwave and optoelectronic circuits. Signals propagating																				1										X						########	
NSF	ENG 0636593 / Cornell University	12.163	TCHCS: Ultra-High Modulation Efficiency Semiconductor Lasers for RF(Wireless)-Optical(Fiber/Free-Space) Hybrid Links	ECS-0636593 F. Rana, Cornell University The goal of this project is to develop laser sources that will enable high gain hybrid wireless/optical links. The research proposed here aims to develop semiconductor lasers with ultra-high modulation efficiencies that can increase optical link gains by as much as 40 dB, without adding to the cost, power budget, noise budget, and without sacrificing the link bandwidth. The proposed laser sources could be used to realize amplifier-free hybrid RF/wireless-optical (fiber/free-space) links where the link itself would act as the amplifier. The proposed research plan also includes demonstrations of amplifier-free hybrid RF/wireless-optical (fiber/free-space) links with high link gains and with bandwidths in the 1-10 GHz range. The availability of such devices would enable cheap, cost-effective, and power efficient hybrid micro-cellular and pico-cellular network modules that would allow seamless flow of information between the RF (wireless) and the optical domains. The proposed project would involve interdisciplinary research from device design and fabrication to link design and development providing a rich set of areas for graduate student research. The																				1										X						########	
NSF	ENG 0636594 / Carnegie-Mellon University	13.024	TCHCS: COLLABORATIVE RESEARCH: Millimeter-wave MIMO: A New Architecture for Integrated 10-40 Gigabit Wireless/Optical Hybrid Networks	ECS-0636594 Chik Yue, Carnegie Mellon University ECS-0636621 Upamanyu Madhow, University of Santa Barbara Our objective is to develop the system architecture, signal processing algorithms and integrated circuit techniques for a robust, quick set-up, point-to-point wireless link which achieves speeds of 10-40 Gbps over a range of several kilometers, using millimeter (mm) wave spectrum. Since these speeds are comparable to those of optical fiber, the outcome of this project enables a fail-safe hybrid communication backbone infrastructure, which can be deployed or restored rapidly in the events of disaster and emergency. The system employs a novel hierarchical architecture which meshes beamforming (to provide link margins sufficient to overcome the limitations of mm-wave propagation in harsh weather) and spatial multiplexing (to provide large spectral efficiency, of the order of tens of bits per second per Hertz, required to realize optical link speeds using channel bandwidths of only several GHz). Beamforming gains are obtained by electronically steerable monolithic arrays. Each such array is a subarray in a larger array, forming a spatially multiplexed virtual multiple-input, multiple-output (MIMO)																	1													X						########	

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NSF	ENG 0636598 / University of Virginia Main Campus	12.078	GOALI: TCHCS: Adaptive Modulation and Coding for Hybrid MIMO FSO/RF Communication System	ECS-0636598 M. Brandt-Pearce, University of Virginia Our society's demand for wireless bandwidth is clearly increasing at a rapid rate, yet our radio frequency resources are all but depleted. This seeming impasse can be resolved by communicating over the wireless optical domain with its nearly boundless bandwidth, using an RF link as a backup. The objective of the proposed research is to use channel modeling and adaptive modulation/coding to unleash the synergy between the two technologies, relying on multiple parallel links (multiple-input multiple-output, MIMO) to provide the needed throughput and diversity. This is a collaborative effort between UVa and L-3 Communications, Communications Systems-West. The work is approached as five overlapping tasks performed by the three PIs and two graduate students. The communication theory behind a hybrid FSO/RF system will be developed, including the acquisition of channel state information. Data showing the correlation between channels will be collected. Adaptive modulation and coding techniques for simultaneous MIMO RF and optical links will then be designed and tested on realistic implementations. Intellectual Merit: The results of the																			1										X						########	
NSF	ENG 0636603 / North Carolina State University	19.001	TCHCS: Defining the Boundaries of Free Space Underwater Communications	Abstract Approximately 70 percent of the world's surface is ocean, and the ocean remains one of the last frontiers for exploration. This exploration is hampered by the lack of high band width communications. Radio waves do not propagate in sea water, and acoustic communication systems operate at relatively low bandwidth. Recent developments in blue/green semiconductor light sources suggest an alternative technology path to high bandwidth underwater optical communications. Intellectual Merit: The technical challenge of this proposal is to understand how the propagation of light underwater impacts optical communication system design and to develop methodologies to compute accurate communication link budgets for different ocean water conditions. To accomplish this, underwater optical communication systems will be built and tested in different water conditions. Understanding the role of absorption and scattering on the attenuation and dispersion of the signal is especially important to quantify. The scattering of light underwater also places special requirements on the dynamic range of the receiver, as well as the collection optics and pointing requirements.						1																						X						########	
NSF	ENG 0636621 / University of California-Santa Barbara	13.025	TCHCS: COLLABORATIVE RESEARCH: Millimeter-wave MIMO: A New Architecture for Integrated 10-40 Gigabit Wireless/Optical Hybrid Networks	ECS-0636594 Chik Yue, Carnegie Mellon University ECS-0636621 Upamanyu Madhow, University of Santa Barbara Our objective is to develop the system architecture, signal processing algorithms and integrated circuit techniques for a robust, quick set-up, point-to-point wireless link which achieves speeds of 10-40 Gbps over a range of several kilometers, using millimeter (mm) wave spectrum. Since these speeds are comparable to those of optical fiber, the outcome of this project enables a fail-safe hybrid communication backbone infrastructure, which can be deployed or restored rapidly in the events of disaster and emergency. The system employs a novel hierarchical architecture which meshes beamforming (to provide link margins sufficient to overcome the limitations of mm-wave propagation in harsh weather) and spatial multiplexing (to provide large spectral efficiency, of the order of tens of bits per second per Hertz, required to realize optical link speeds using channel bandwidths of only several GHz). Beamforming gains are obtained by electronically steerable monolithic arrays. Each such array is a subarray in a larger array, forming a spatially multiplexed virtual multiple-input, multiple-output (MIMO)																	1												X						########	

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NSF	ENG 0636650 / University of Colorado at Boulder	13.028	TCHCS: Hybrid RF/Optical ICs for High-Bandwidth Spread-Spectrum Communications	ECS-0636650 R. McLeod, University of Colorado at Boulder This new architecture requires an equally novel integration platform for hybrid electro-optic systems. The proposed platform can be thought of as "optical wire-bonding" in which arbitrary discrete RF or optical components are interconnected in 3D to form complex, dense circuits. This process is made possible by advanced photopolymers that can simultaneously encapsulate the individual hybrid subcomponents and can be photo-patterned in 3D to develop micron-scale gradient index features. These index features in the form of optical waveguides are aligned to the encapsulated hybrids by a custom 3D lithography system, avoiding all active alignment. Intellectual Merit This proposal presents a revolutionary integration technology for RF/optical components in the context of a hybrid wireless/optical communication system. The architecture supports multi-channel, mobile GHz bandwidth without the limitations of traditional spread-spectrum codes or adaptive beam-steered antenna arrays. The cornerstone of the communication architecture is a smart electro-optic node (SEON) that adaptively tracks multiple broadband mobile transmitters. Reception													1																	X						########	
NSF	ENG 0636677 / University of Southern California	10.005	TCHCS: A Hybrid Integrated Bidirectional Transparent RF-Optical Interface for Heterogeneous Data Traffic	ECS-0636677 H. Hashemi, Univ of Southern California The proposed program is a collaborative and interdisciplinary effort to develop a seamless interface between wireless and optical networks irrespective of RF carrier frequency, channel bandwidth, and data modulation format. Intellectual Merit: The broad technical goals are to advance the fundamental understanding and produce dramatic performance increases at the interface between optical and microwave hybrid systems. We will develop technology that facilitates the integration of hybrid RF and photonic integrated circuits at the chip level with improved performance, reduced component size, and dramatic new functionality. To accomplish this, it will be necessary to facilitate bi-directional traffic between the two domains, seamlessly convert traffic from an RF carrier wave into an optical carrier wave, transparently accommodate various bit-rates and modulation formats, process data capacities that are well in excess of any previously reported RF-optical link, and demonstrate energy efficiency in this hybrid RF+optical interface. Technical challenges involving spectral efficiency, traffic granularity, transmission impairments, RF CMOS integration, and chip-																											1			X						########	
NSF	ENG 0637667 / Cardinal Peak, LLC	1.017	STTR Phase I: Video Streaming in a Robot MANET - Optimizing Throughput and Power Consumption via Adaptive Robot Re-positioning and Bandwidth Allocation	This Small Business Technology Transfer (STTR) Phase I Project investigates the streaming of video through a cluster of mobile ad hoc network (MANET) autonomous robots operating in a challenging multi-path propagation environment. This project will quantify the gains in video throughput and power consumption achievable by automatic robot re-positioning with respect to these initial positions. This research is motivated by the fact that, in multi-path and fading environments, small changes in a robot's location can lead to significant gains in the received signal strength. Automatic iterative optimization of the robot positions could therefore lead to robot constellations that achieve significantly higher throughput or require significantly less power. Classical approaches for addressing multi-path degradations include robust modulation techniques, such as orthogonal frequency-division multiplexing (OFDM), and spatial diversity. This project will determine if an OFDM-based 802.11g system, can achieve significant performance improvements when combined with an automatic robot re-positioning algorithm. Teams of robots are ideally suited for investigating environments intrinsically hostile to humans. Such												1																	X						########	

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NSF	ENG 0637863 / Untravel Media, Inc.	2.022	SBIR Phase I: Mobile Path Anchoring for Multimedia Travel Applications	This Small Business Innovation Research (SBIR) Phase I project will examine non-networked means of delivering location-based services for mobile narrative content. Mobile content is rapidly expanding within the booming global tourism market. Untravel has entered this market with locally-produced, high-end multimedia walking tours, Mobile Media Documentaries (MMDs), for a variety of handsets. The Company is proposing background research, software prototyping to determine the effectiveness and market potential of a set of location-based services. These services can potentially be delivered with more granularity and timeliness than other location-based services (GPS, cell phone tower triangulation, or wi-fi location) because users are walking along a known tour path. Specifically, the research will develop software for delivering path geosptatial coordinates to mobile devices at point of purchase. The effort will prototype a photo geotagging function and a push advertising system based on these known path coordinates. Finally, the research will develop a user profile system that allows adjustment of tour length and path. This research has broader commercial potential in developing general locative systems																	1												X						########	
NSF	ENG 0638531 / Purdue University	12.153	SGER: Ultra Wideband Time-Variant Matching Networks with Very High Impedance Ratios for Nanoscale Electronics	Objective: To explore novel RF circuit topologies designed in the time rather than in the frequency domain for achieving very high impedance transformations (>200:1) over ultra wide bandwidths (DC-9GHz). The proposed approach will result in circuits that will be instrumental in communication and characterization systems focused on high-impedance RF components including nanoscale FETs and nanomechanical resonators. Intellectual Merit: For over half a century the design of nearly all wireless commercial communication systems has been following two major design conventions: 1) the RF system impedance is set to 50 with a realizable impedance transformation ratio of less than 10:1 due to technological limitations; 2) the bandwidth of the transmitted data is limited to a small fraction of the center frequency, typically less than 10%. Although higher bandwidths are possible, they come at the expense of extra loss and real estate on the chip. Until recently, these limitations have not hindered the implementation of high-performance wireless communication systems because conventional RF devices and the developed predominantly frequency-domain design techniques are well suited for 50 narrowband systems. The advent of																					1								X						########	
NSF	ENG 0644764 / University of Maryland College Park	1.051	CAREER: Distributed control of dynamic systems using a wireless communcation medium: two new paradigms	ECCS-0644764 PI: Martins ABSTRACT The interplay between control and communications is pervasive in most of today's large scale engineering enterprises, including the industrial and transportation sectors. This proposal puts forward a program, with tightly coupled research and educational components, centered on the design of distributed control systems with wireless communication capabilities. In contrast to wire-line networks, wireless communications allows mobility, streamlines re-configuration and reduces deployment costs. However, most mobile wireless communication technologies feature interference, fading and power constraints. These attributes make the analysis and the design of such networked control systems significantly more difficult. This proposal's research plan introduces two new paradigms. The first paradigm, denoted as networked preview control, specifies a framework consisting of a wireless network of spatially-distributed sensors and one controller. Given a disturbance field, networked preview control aims at using the remote sensors to provide the controller with disturbance preview information. The second paradigm concerns the design of cooperative control strategies for a mix of													1																X						########	

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AGENCY	DEPARTMENT/ DIVISION /LAB/ PROGRAM/ AWARD	Project #	PROJECT TITLE/DESCRIPTION	EXAMPLES	INTENDED APPLICATION ENVIRONMENT (See Attachment C for examples)	EXPECTED FREQUENCY RANGE	**Topic Area**	Topic # 3	Topic # 23	Topic # 19	Topic # 6	Topic # 15	Topic # 7	Topic # 1	Topic # 14	Topic # 11	Topic # 4	Topic # 13	Topic # 16	Topic # 2	Topic # 21	Topic # 22	Topic # 12	Topic # 8	Topic # 5	Topic # 9	Topic # 18	Topic # 17	Topic # 10	Topic # 20	**Maturity**	Basic Research	Applied Research	Advanced Technology Development	Advanced Component Development	Demonstration & Validation	**Funding**	Funded in Past (2006-2010)	Presently Funded (FY11)
NSF	ENG 0646339 / Q-Track Corporation	2.023	SBIR Phase II: Location Aware Computing Using Near Field Electromagnetic Ranging	This Small Business Innovative Research (SBIR) Phase II research project seeks to transform the Real-Time Location Systems (RTLS) industry by bringing to fruition a simple, inexpensive, yet highly accurate approach to location awareness: Near-Field Electromagnetic Ranging (NFER) technology. RTLS is an important and rapidly growing segment within the Radio Frequency Identification (RFID) industry. In today's world of just-in-time commerce, Supply Chain Management (SCM) requires inexpensive real-time location data to improve efficiency and maintain competitiveness. Established technologies like the Global Positioning System (GPS), UltraWideBand (UWB), and traditional time-of-flight ranging have proven unable to perform satisfactorily within complicated, real-world, indoor propagation environments. The anticipated result of this research effort will be a pilot installation of a NFER tracking system in a warehouse. It is predicted that: "RTLS and wireless LAN technologies, combined with innovative applications, will fundamentally change the way businesses manage and track high-value assets." Accelerated development of a technology that can meet this market need will bolster the American																1													X							########	
NSF	ENG 0647380 / Colorado State University	12.081	Higher-Order Finite Element-Moment Method Modeling Techniques for Conformal Antenna Applications	0324345 Notaros The central goal of the proposed research is the development of a new, highly efficient and accurate, hybrid higher-order computational electromagnetics (CEM) method for modeling, analysis, and design of conformal antennas. Conformal antennas have many advantages over traditional protruding antennas because of their low weight, low drag, low cost, unobtrusive nature, and great flexibility. A new higher-order finite element method (FEM) and a new higher-order method of moments (MoM) will be developed, and the two methods will be hybridized into a higher-order FEM-MoM method of great capabilities. The modeling techniques will use generalized hexahedral finite elements and generalized quadrilateral boundary elements of higher geometrical orders in conjunction with higher-order hierarchical field/current basis functions. The new MoM will employ the surface integral equation formulation using Green's functions for free-space or unbounded homogeneous media, thus avoiding use of the dyadic Green's function (for canonical geometries). The new FEM-MoM method will enable modeling of cavity-backed conformal antennas with arbitrary material complexities that are conformal to																					1								X							########	
NSF	ENG 0648694 / Montana State University	11.01	REU Site: Wireless communications for rural and remote areas	EEC-0648694 Richard S. Wolff The proposed REU site will engage 8 undergraduate students each year for three years in a 10 week research experience at Montana State University. The objectives of the program are: 1) to expose undergraduate students to real-world, innovative and interdisciplinary research focused on wireless communications for rural and remote areas; 2) to encourage more undergraduates to continue their academic careers and seek graduate degrees in engineering, computer and information science; and 3) to develop research skills and improve communication and collaborative skills. This REU program will be tightly coupled to the highly successful MSU campus-wide and College of Engineering programs already in place to recruit and retain Native American students. This REU will address the nation's need for a diverse group of innovative engineering researchers and professionals capable of using a variety of technologies to address communications systems needs in an ever increasing number of diverse domains serving commercial, educational and national defense objectives. Also, the REU program will serve to attract high-quality undergraduate Native American students,																1													X							########	

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NSF	ENG 0700383 / University of California-Davis	2.008	Distributed Vehicular Traffic Management via DSRC-Enabled Vehicles	In this research, we exploit the ad hoc networks formed by vehicles equipped with robust wireless communication devices, storage, processing, and sensing capability to perform robust traffic state estimation and distributed traffic management. First, we will utilize the sensing and computation capabilities of vehicles and the self-organized grid computing engine to develop robust estimation and control algorithms to smooth vehicular traffic flow on freeways. Through simulation and analysis we will investigate the effectiveness of these schemes with the goal to reduce accidents, minimize congestion delays and maximize throughput. We will also investigate the required degree of penetration to make such a system effective. Second, as part of this research, we will develop the software architecture, the networking protocols, and the resource management algorithms to create the grid computing engine, VGrid, and integrate it with the roadside sensor infrastructure. New challenges arise due to the dynamic nature of the ad hoc grid computer as both the topology and the node membership change with time. Third, we will develop an integrated simulation tool that has both a realistic vehicular mobility model and communication/networking															1														X						########	
NSF	ENG 0701448 / Purdue University	16.04	Novel Hybrid Photonic-RF Ultrawideband Wireless Communications Technologies	ECCS-0701448 A.Weiner, Purdue University Intellectual Merit: Novel design and implementation techniques based on hybrid photonic-RF systems that will revolutionize the ultra wideband (UWB) communication technology are the major focus of this work. The backbone of the proposed UWB architecture includes relatively few sophisticated photonically-enabled access nodes that are capable of synthesizing, receiving and correcting arbitrary UWB waveforms in dispersive and multipath environments. The clients of this network will include a large number of inexpensive RF UWB nodes with integrated on-chip photonic circuits. The arbitrary photonically-generated UWB waveforms in conjunction with the diversity of RF and photonic circuits will enable complex coding schemes that effectively address many challenging issues including multipath, antenna dispersion and photonics volume. Broader Impact: The broader impacts of this research will be evident in three different areas: 1) Technology/Economic: The pioneering work of the principal investigator in femtosecond pulse shaping will lead for the first time to unique economically-feasible concepts such as chirped UWB radars and chip-level arbitrary waveform generators. 2)															1														X						########	
NSF	ENG 0701559 / GA Tech Research Corporation - GA Institute of Technology	12.066	Cross Layer Communication Module for Ultrawideband Wireless Sensor Networks	Integrative, Hybrid and Complex Systems Ian F. Akyildiz Georgia Institute of Technology Cross-layer Communication Module for Ultra Wide Band Based Wireless Multimedia Sensor Networks Intellectual Merit: The availability of inexpensive hardware, such as complementary metal oxide semiconductor (CMOS) cameras and microphones that are able to capture multimedia content from the environment, has fostered the development of wireless multimedia sensor networks (WMSNs). WMSNs consist of wirelessly-connected devices that allow retrieving video and audio streams, still images, and scalar sensor data. The realization of WMSNs requires the sensor network paradigm to be rethought in view of the need for mechanisms to deliver multimedia content with a predefined level of quality of service (QoS). In view of these challenges, the objective of this project is to develop a novel cross-layer module for multimedia traffic in WMSNs. Several key elements will be investigated to provide QoS and to exploit the correlation that is present in WMSNs. The architecture of WMSNs will be first developed. Then, a cross-layer controller unit, which enforces network layer QoS support, will be developed. To capture the																					1								X						########	

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NSF	ENG 0701695 / University of Illinois at Urbana-Champaign	13.016	Monolithic Integrated Terahertz Frequency Generator	Intellectual Merit: There are a number of potentially important applications that require electromagnetic energy in the terahertz region of the radio spectrum. These include very short range highly secure telecommunications and the subcutaneous imaging of skin cells. The terahertz region has been difficult to access it is well above the range of transistors and well below that of lasers. One method for obtaining terahertz emission is to mix (heterodyne) two laser beams together in a photomixer. While this has been demonstrated with discrete lasers and bulk optical components in a laboratory, practical applications require a simple, compact, and robust source. The objective of this program is a terahertz frequency generator chip. The investigators will implement on a single substrate two tunable diode lasers, a photomixer, and a THz radiating element. The intellectual merit of this program includes development of a particularly useful optoelectronic integrated circuit for terahertz generation. This program also provides for a new collaborative research effort involving a senior professor, with experience in photonic devices, and a new young professor and her students, with experience in novel epitaxial growth																	1													X						########	
NSF	ENG 0702234 / University of Hawaii	2.01	GOALI - Wireless Life Monitoring Transponders	Integrative, Hybrid and Complex Systems Victor M. Lubecke University of Hawaii GOALI: Radio Transponders for Life Monitoring Intellectual Merit: Both Doppler radar and radio frequency identification (RFID) involve modulated backscatter technology. This project combines these technologies to transcend the human life sign monitoring capabilities of both technologies. This will be achieved through two different Doppler radar applications of passive radio frequency (RF) backscatter tags. First, body worn "band-aid" transponder tags are proposed to modify Doppler radar return signals in time and frequency to isolate a subject's cardiopulmonary motion from other motion and subjects, while facilitating the sensing and telemetry of additional biomedical data. Combining these wireless tags with Doppler motion sensing allows detection and isolation of untagged subjects among tagged subjects. Second, backscatter tags as environmentally distributed "radar node" transponders are proposed, which would form a bi-static radar system to suppress transmitter phase and "shake" noise effects to enable cardiopulmonary motion sensing at large distances, while also allowing passive sensing by exploiting RF signals																		1												X						########	
NSF	ENG 0703042 / Clemson University	16.038	Network Analyzer on Chip: An Integrated Frequency Domain Sensor	Abstract ECS-0622082 P. Wang, Southern Illinois University of Carbondale The objective of this research is to develop network analyzer on chip (NAoC) for biological and chemical sensing in frequency domain through microwave dielectric spectroscopy. Integrated tunable radio frequency (RF) signal sources and broadband six-port networks will be developed and characterized from ~ 1 GHz to ~ 10 GHz. The performance of the integrated NAoC system will be characterized and demonstrated through on-chip sensing and analysis of water, DNA and other chemical agents. Self-calibration capabilities will also be developed. Approaches to balance the trade-offs among NAoC performance, costs, complexity, and convenience to use will be established for the targeted sensing applications. Intellectual Merit: This is the first effort to systematically develop tunable, broadband and miniaturized integrated microwave circuits and components in complementary-metal-oxide-semiconductor (CMOS) technology for NAoC applications; this is the first effort to develop an integrated broadband vector NAoC for on-chip scattering parameter measurements; this is the first effort to incorporate self-																		1												X						########	

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NSF	ENG 0703313 / University of California-Santa Barbara	13.026	TCHCS: COLLABORATIVE RESEARCH: Millimeter-wave MIMO: A New Architecture for Integrated 10-40 Gigabit Wireless/Optical Hybrid Networks	ECS-0636594 Chik Yue, Carnegie Mellon University ECS-0636621 Upamanyu Madhow, University of Santa Barbara Our objective is to develop the system architecture, signal processing algorithms and integrated circuit techniques for a robust, quick set-up, point-to-point wireless link which achieves speeds of 10-40 Gbps over a range of several kilometers, using millimeter (mm) wave spectrum. Since these speeds are comparable to those of optical fiber, the outcome of this project enables a fail-safe hybrid communication backbone infrastructure, which can be deployed or restored rapidly in the events of disaster and emergency. The system employs a novel hierarchical architecture which meshes beamforming (to provide link margins sufficient to overcome the limitations of mm-wave propagation in harsh weather) and spatial multiplexing (to provide large spectral efficiency, of the order of tens of bits per second per Hertz, required to realize optical link speeds using channel bandwidths of only several GHz). Beamforming gains are obtained by electronically steerable monolithic arrays. Each such array is a subarray in a larger array, forming a spatially multiplexed virtual multiple-input, multiple-output (MIMO)														1																X						########	
NSF	ENG 0707211 / University of Virginia Main Campus	5.006	Research Related to the National Reconnaissance Office (NRO) Membership in WICAT: First Year Plan and Possible Follow-on Activities	Funds provided by the Department of Air Force will be used to fund a project at the Industry/University Cooperative Research Center for Wireless Internet at the University of Virginia. The major objectives of the project are to improve wireless network performance capabilities and security for mobile users. The I/UCRC has been carrying out a variety of research efforts focused on serving mobile users operating in a large enterprise. This project will complement the existing effort at the University of Virginia that is exploring image processing techniques that separate foreground and background information for images so as to reduce bandwidth and processing requirements for mobile users. The research will be conducted under the standard I/UCRC terms as all of the other research efforts carried our under the Center memberships.																						1							X						########	
NSF	ENG 0711638 / Centar	12.145	SBIR Phase I: A New Class of Fast Fourier Transforms	This Small Business Innovation Research (SBIR) Phase I research project is directed at development of a high performance, parameterized fast Fourier transform (FFT) circuit that will be sold as an intellectual property product to be used in ASIC and FPGA embedded signal processing applications. For the past 40 years parallel FFT implementations have remained relatively unchanged, being based essentially on different permutations of the signal flow graph and mappings thereof. Consequently, the inherent irregularities of the signal flow graph are reflected in the complex commutators or permutation circuits, large butterfly units, global interconnections, and stage-to-stage differences seen in today's FFTs and result in an inherent inflexibility and lack of performance. A radically different approach to parallel FFT implementation is proposed here based on a new matrix formulation of the discreet Fourier transform (DFT) which decomposes it into structured sets of multiplication-free 4-point DFTs. As a result, (1) implementations are simple, locally connected and structured, thereby allowing lower power and higher performance mappings to modern FPGAs and ASICs; (2) significant added functionality and flexibility																					1								X						########	

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NSF	ENG 0711825 / Bridge Wave Electronics	12.157	STTR Phase I: Metamaterial-Based Antennas for Miniaturized Multi-Band Wireless Systems	This Small Business Technology Transfer (STTR) Phase I research project explores novel wireless antenna technologies based on one or two dimensional metamaterial structures. The basic approach is to compress, twist, and fragment (CTF) metal strips or discs in a multi-layer structure to form self-tuned, bandwidth optimized, and miniaturized antennas. A concept of dispersion band engineering is introduced in this project to facilitate the antenna design. By tailoring the transmission band characteristics through the use of three-dimensional (3D) substrate metallization, it is possible to reduce guide-wavelength dramatically while maintaining low dispersion. The metallized materials comprise possibly high-density localized vias and metal films within multiple dielectric layers in printed circuit structures. This project investigates new integrated antennas evolved from such structures. Wireless communications continue to demand compact power efficient multi-standard and multi-functional systems where the antenna has been a salient component and the bottleneck for miniaturization and broadband applications. The proposed concept of 3D volume integrated circuits to replace conventional																		1											X						########	
NSF	ENG 0712241 / Invertix Corporation	12.159	STTR Phase I: Phase-Modulated Antennas for Bandwidth-Efficiency and Cost Reduction	This Small Business Technology Transfer (STTR) Phase I research project aims to prove the feasibility of Direct Phase Antenna Modulation (DPAM), an innovative wireless communication signaling technology that promises to greatly enhance spectral efficiency and multi-user interference, while reducing hardware complexity and component cost. The proposed approach uses specific novel properties of an antenna structure to perform modulation and demodulation, bypassing the need for these blocks in transmitter or receiver electronics. A doubling of data rate for a fixed spectrum allocation and quality of service can be achieved through use of a novel orthogonal bit per symbol in conjunction with traditional Quadrature Phase Shift Keying (QPSK) signaling. This proposed DPAM technology promises to enhance the widely used QPSK format, improving bandwidth efficiency by 50% while reducing system complexity and costs. Such an increase in bandwidth can have a large impact on wireless communications as radio spectrum, a fixed resource, is becoming more and more congested. This technology can support future versions of 802.x wireless data, personal communications, and telemetry services for consumer,																		1											X						########	
NSF	ENG 0712593 / Harmonic Devices Inc.	16.047	SBIR Phase I: Miniaturized, Wide-Bandwidth, Low-Loss Contour and Thickness-Extensional Mode PZT-on-SOI Resonators and Filters	This Small Business Innovation Research Phase I project will investigate the feasibility of miniaturized, wide-bandwidth, low-loss bandpass filters for wireless communication and other signal processing applications enabled by novel high Q thin-film piezoelectric micromechanical resonators. The research team is proposing thin-film PZT-on-SOI micromechanical resonator topologies that can simultaneously enable filters with greater fractional bandwidth (up to 40%) and order-of-magnitude lower passband losses (less than 1 dB) than any competing technology by virtue of fundamentally superior electromechanical coupling and innovative resonator designs. Using contour and thickness extensional mode electromechanical resonators, the company can manufacture miniaturized banks of high-performance IF filters and discrete RF filters with frequencies ranging from 10 to 500 MHz and 500 MHz to 1 GHz, respectively. The resonators will be designed to maximize the kt 2Q product, which is regarded as an important figure of merit for filter design compared to current-state-of-the-art VHF to UHF filtering technologies, the proposed MEMS-based solution will permit system architectures with smaller form factors, reduced																		1											X						########	

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NSF	ENG 0723113 / University of Texas Brownsville	12.093	MRI: Acquisition of Microwave Measurement Facilities for RF/MMIC Research	ECCS-0723113 Yong Zhou, University of Texas Brownsville INTELLECTUAL MERIT: Competitive next-generation radar sensors in radio frequency range 2-50GHz should preferably be a large bandwidth, high performance, low power consumption, low cost, small-sized and a light-weight solution. The development of semiconductor technology in recent years has led to the microwave monolithic integrated circuit technique, which made it possible to design the microwave transmitter/receiver directly on a single chip with the advantages that the traditional discrete solution can not achieve. Another approach to fulfill the above performance requirements is the development and utilization of artificially-structured metamaterial, whose potential advantages include increased bandwidth and the physical size reduction. Research aiming at different applications can be carried out based on the two approaches. The investigators request a vector network analyzer, a signal generator, and the microwave design/simulation software to enhance and initialize the research in microwave sensor design and its three specific applications: 1) the development of low false-alert-rate radio frequency sensors for south border surveillance, 2) the ultra-																				1										X						########	
NSF	ENG 0725555 / Massachusetts Institute of Technology	8.015	Collaborative Research: Energy-efficient communication with optimized ECC decoders: Connecting Algorithms and Implementations	Integrative, Hybrid and Complex Systems Vladimir M. Stojanovic, Massachusetts Institute of Technology Aleksandar Kavcic, University of Hawaii Collaborative Research: Energy-efficient Communication with Optimized ECC Decoders: Connecting Algorithms and Implementations Intellectual Merit: In a classical unidirectional communication system, the transmitter and the receiver functions are optimized separately. Recently, bidirectional, power-constrained communication systems have emerged, such as for wireless mobile devices and high-speed interconnections within digital systems, where both the transmitter and the receiver draw power from the same supply and where their joint power consumption affects the data rate and the energy-efficiency of the whole system. Thus, the transmitter and the receiver need to be jointly optimized. This research pursues a strategy to jointly optimize severely power-constrained communication systems to achieve a balance between speed (data rate), performance (in terms of error rate), and power consumption. The strategy uses special families of decoders of error correction codes (ECCs) that allow tradeoffs in complexity and power																						1								X						########	
NSF	ENG 0725593 / University of Michigan Ann Arbor	13.014	Integrated Low Phase Noise Millimeter-Wave Oscillators Based on High-Order Resonance Circuits	Intellectual Merit: Oscillators are fundamental building blocks in communication systems, radars and many electronic circuits. Phase noise of the oscillators limits the performance of the RF and microwave transceivers. Phase noise of the local oscillator in a radio receiver down converts the adjacent channels into intermediate frequency thereby limiting receiver's immunity to nearby interference and jamming. Phase noise of local oscillator in a transmitter corrupts the information carried in the phase of the carrier. In a radio transmitter phase noise can also overwhelm the nearby weak channels. Since the number of wireless subscribers and thus, the amount of RF interference continue to increase, modern communication standards demand excellent phase noise performance from local oscillators in transceivers. Within this project several new circuit approaches for the design of integrated low phase noise microwave and millimeter wave oscillators are proposed. This project can also opens potential avenues for the design of other type circuits like high performance active filters. Broader Impacts: Any advancement in the design of simple and low phase noise oscillators will help to improve the overall communication systems performance and																	1													X						########	

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NSF	ENG 0725616 / University of Massachusetts Amherst	16.029	Frequency-Shifted Reference Ultra-Wideband (UWB) Communications	Abstract ECCS-0725616 D. Goeckel, University of Massachusetts Amherst The Intellectual Merit of this project is motivated by the desire for extremely wideband communication system architectures, which have the potential to achieve accurate positioning, material penetration, overlay with other wireless communication systems, and the support of many users in a given area. Thus, the research objective is to solve the challenges of low-power high-performance transceiver architectures that are scalable to extreme bandwidths. The project considers a novel framework that solves the difficult channel estimation problem in such architectures by sending a reference signal that is slightly shifted in frequency from the data signal. This allows for efficient data recovery with a simple low-power receiver. This project will address the key research challenges within this framework. In systems with extreme bandwidths, there is significant in-band interference, and thus the systems aspects of a multi-channel receiver for interference rejection will be developed. The efficient support of many users through varying frequency offset signatures and corresponding receiver architectures will also be developed. Next, the fundamental																	1													X						########	
NSF	ENG 0725649 / University of Hawaii	8.007	Collaborative Research: Energy-efficient communication with optimized ECC decoders: Connecting Algorithms and Implementations	Integrative, Hybrid and Complex Systems Vladimir M. Stojanovic, Massachusetts Institute of Technology Aleksandar Kavcic, University of Hawaii Collaborative Research: Energy-efficient Communication with Optimized ECC Decoders: Connecting Algorithms and Implementations Intellectual Merit: In a classical unidirectional communication system, the transmitter and the receiver functions are optimized separately. Recently, bidirectional, power-constrained communication systems have emerged, such as for wireless mobile devices and high-speed interconnections within digital systems, where both the transmitter and the receiver draw power from the same supply and where their joint power consumption affects the data rate and the energy-efficiency of the whole system. Thus, the transmitter and the receiver need to be jointly optimized. This research pursues a strategy to jointly optimize severely power-constrained communication systems to achieve a balance between speed (data rate), performance (in terms of error rate), and power consumption. The strategy uses special families of decoders of error correction codes (ECCs) that allow tradeoffs in complexity and power																						1								X						########	
NSF	ENG 0725785 / University of California-Los Angeles	8.01	Enabling Almost Digital, Power Efficient, Wireless Transmitters	Enabling Almost Digital, Power Efficient, Wireless Transmitters The objective of the research is to develop efficient, precise, and highly re-configurable wireless communication transmitter integrated circuits. The proposed approach replaces the most important component of a transmitter, namely the analog power amplifier (PA), with a new power digital-to-analog converter (PDAC) to generate high power, wide bandwidth modulated radio frequency signals with minimal power consumption. Unlike the traditional analog PA, the PDAC uses digital signal processing principles and digital logic to improve performance; it is therefore reliable, re-configurable, and appropriate for integration in deep sub-micron fabrication processes. A prototype transmitter integrated circuit suitable for broadband wireless and/or cel-lular communications will be designed, had fabricated, and tested as a proof of concept. The intellectual merit is that it presents a promising, radically different approach to im-prove wireless transmitter performance and reliability. It envisages a solution that treats digital-to-analog converter and power amplifier research together, and not in isolation; treating them in isolation has inexorably led																						1								X						########	

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NSF	ENG 0725801 / University of Oklahoma Norman Campus	2.007	Disaster Area Wireless Network	Integrative, Hybrid and Complex Systems Hazem H. Refai University of Oklahoma Disaster Area Wireless Network Intellectual Merit: The objective of this research is to design a quickly deployable, reliable communication infrastructure for reestablishing communication following a disaster. Such a disaster area wireless network (DAWN) would provide much needed communication for coordinating relief and recovery efforts until normal communication channels can be reestablished. The DAWN infrastructure is based on network nodes deployed on balloons that are tethered to the ground. Each node utilizes free-space optical (FSO) and radio frequency (RF) links to construct a hybrid network between balloons and between balloons and the ground. To realize such a system, this research investigates: (i) viable mechanisms for physical layer connectivity between balloons using FSO links that consider link acquisition and maintenance; (ii) receiver access control (RAC) protocols to allow sharing of receivers among multiple FSO nodes; (iii) routing algorithms and methods for topology design to realize a self-configuring FSO ring topology with an RF link for inter-nodal communications and															1													X						########	
NSF	ENG 0725914 / University of California-Irvine	12.074	ECCS-IHCS: Adaptive Network Assimilations Through System Reconfigurability	Intellectual Merit: Wireless communications, at present, relies on a multiplicity of wireless access technologies. However, the distinct communication capabilities of these technologies present significant barriers for interoperability and migration between different network infrastructures. Network assimilation is necessary to bridge the gap between the infrastructure networks and the diversity of end-user communication devices. This research investigates a software-defined radio (SDR) solution to support concurrent execution of multiple communication systems on a single SDR platform, which functions as the base station, through hardware and software reconfiguration. The research challenges to be addressed at the physical layer and the networking layer of the SDR platforms include: (i) reconfigurable and adaptive architectures based on field programmable gate array (FPGA) technology to change the communication capabilities of the SDR platform; (ii) concurrent and time-shared execution of multiple communication systems on a single SDR platform; and (iii) mobility context definition and transfer to support seamless mobility. The project contributes to the state-of-the-art of SDR																					1								X						########	
NSF	ENG 0725929 / University of California-Los Angeles	12.048	Closely Coupled Antenna Systems for Wireless Communications	ECCS-0725929 Yuanxun Wang, UCLA Intellectual merits A communication system with multiple antennas promises enhanced robustness and increased data capacity in comparison with single antenna systems. However, this benefit degrades when antennas are placed close to each other. The objective of the proposal is to first explore the behavior of closely coupled antennas using tools from the fundamental physics of electromagnetics, information theory and network theory, and secondly, to develop a new class of multi-antenna systems that are appropriate for compact wireless communication platforms. The proposed research is to fully exploit the multiple information channels that exist even in closely coupled antennas. It is proposed that the parallel information channels in the form of multiple modes can be utilized independently through a passive mode decomposition network. Consequentially, enhanced antenna gain beyond conventional limits and wireless link capacity can be obtained. Broader impacts A new class of multiple-antenna radio systems on compact wireless platforms will be developed. It fosters the interactions among different engineering research areas in antennas, circuit design and wireless																					1								X						########	

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NSF	ENG 0727960 / Purdue University	2.011	GOALI: Nanoparticle-Enabled Printing of Large-Area Electronic Hierarchical Systems	The research objective of this GOALI project is to create new low temperature, nanoparticle-based printing processes for inorganic semiconductor nanoparticle inks in order to enable fabrication of low cost, all-printed devices for wireless applications, such as WiFi and cellular communications. Although inorganic semiconductor nanoparticles may sinter at lower temperatures than their bulk counterparts, these temperatures are generally significantly higher than 150C, the maximum processing temperature allowable with low cost polyester or paper substrates. New low temperature sintering processes will be explored to improve the semiconducting performance of the printed nanoparticle films without increasing the maximum temperature during processing above this target temperature. The proposed approach includes preparation of nanoscale films from model semiconductor nanoparticle inks using non-proprietary benchmark printing platforms. The nanostructural characteristics of the starting powders and resulting films will be related quantitatively to device performance and film mobility. The processing conditions necessary to increase particle-particle contact area will be															1													X						########	
NSF	ENG 0728064 / Carnegie-Mellon University	12.019	Asymptotic Analysis and Control of Stochastic Networks	The objective of this proposed research is to develop mathematical tools for the analysis and design of complex stochastic networks arising in telecommunications, computer and service systems. These networks are typically too complex to lend themselves to an exact analysis. The primary goal of this research is to develop new techniques for obtaining a variety of asymptotic approximations for these systems. Specifically, these include so-called fluid or first-order approximations that describe the mean behavior of the system, diffusion approximations that capture fluctuations around the mean, and large deviations approximations that provide estimates for the probabilities of rare events that are critical to the working of the system. These techniques will be applied to gain insight into the behavior of several concrete classes of networks. In particular, new admission control algorithms will be developed for so-called ?real-time? systems that process tasks with deadlines such as, for example, telecom systems carrying digitized voice and tracking systems. In addition, estimates of performance measures will be obtained for multi-server systems that arise in call centers. We will also investigate the equilibrium properties of networks with																					1								X						########	
NSF	ENG 0732252 / University of Texas at Dallas	16.016	CAREER: High-Performance Ultra-Wideband Radio Design	0134629 Namgoong Ultra-wideband (UWB) radio systems are emerging as one of the key technologies for high bandwidth digital wireless communications. The rationale for deploying UWB radio systems lies in the benefits of exceptionally wide bandwidths: covertness (very low power density signal), very accurate ranging (down to a few centimeters), good material penetration (at low frequencies) and high performance in dense multipath (because of fine time resolution). A common concern among UWB proponents is that an integrated, high-performance radio may not be achievable, because of the extremely high bandwidth, dynamic range, and clock speeds required. Such concern appears to lead to two alternative development paths. In the first, the UWB radio system is scaled down to operate at a much reduced bandwidth, compromising much of the benefits of an UWB system. In the other, advanced process technology with numerous discrete components is employed, albeit at the expense of significantly higher cost and power consumption. In this proposal, the PI presents a promising approach to realizing an integrated high-performance UWB radio using today's low-cost standard CMOS															1													X						########	

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NSF	ENG 0738088 / Auburn University	12.084	I/UCRC: Wireless Research Center for Cross-Layer Optimization of Coexisting Systems	Auburn University plans to establish a research site of the Industry/University Cooperative Research Center for the Wireless Internet. The research at Auburn University will address several important areas in the next generation wireless Internet and will complement the research capabilities at the existing research sites. The theme of the research will be cross-layer optimization of coexisting wireless systems. As a research site of the I/UCRC, Auburn University will be able to expand the base of technologies that the faculty and graduate students have been addressing at the system level. The research will benefit the society by providing efficient and low cost wireless systems.																1												X						########	
NSF	ENG 0740154 / Nasfine Photonics, Inc.	13.018	SBIR Phase I: Ultra-Linear Optical Modulator (SFDR =130-145.1 dBHz)	This Small Business Innovation Research Phase 1 research project aims to investigate the feasibility of a super-linear optical modulator technology. This innovation involves a unique and complementary combination of Phase Modulator (PM) and weak Gires-Tournois Resonator (GTR) modulator inside a reflective-type modulator. This modulator has other superior features such as broadband operation, high tolerance characteristics, simple design structure, small footprint, and low-cost potential. This research will focus on the design, simulation, fabrication, and measurement on this ultra-linear waveguide-type optical modulator designed to operate below GHz ranges. The impact of this project has broad commercial, military and scientific significance and represents a major, on-going engineering challenge because of its fundamental role in the overall performance of analog fiber-optics transmission links. In the commercial arena, linearized modulators are key devices in ultra-dense cable television (CATV), Radio-over-Fiber (RoF) communications, broadband wireless access, cellular/personal communication and other mobile platform antenna systems. In the military arena, linearized modulators with																1												X						########	
NSF	ENG 0740453 / PRIME RESEARCH LC	13.021	STTR Phase I: Optowireless	This STTR Phase I research proposal will solve disparate requirements of all-optical networks and mobile wireless networks by reconciling, linking, and harmonizing the optical and wireless domains. It will enable a host of new network architectures and mechanisms for integrating optical and wireless domains. Subsequent development may focus on full duplex communications, further miniaturization, or network architectures that exploit the full range of benefits. This will lead to a myriad of enabling spin-off technologies in applications that require extreme miniaturization. The system will develop a method to harvest optical energy from fibers to generate electrical power. This technology will enable microsystems to be driven by purely optical means over many kilometers of optical fiber. This wireless technology promises a host of applications, particularly in harsh or extreme environments. Fiber optic sensor systems will benefit by having another degree of freedom for multiplexing and interrogation. Applications that require fiber optic sensor instrumentation but cannot provide access may use this to interrogate the systems over wireless links. This can be used to replace copper cables in ships, airplanes, hospitals,																1												X						########	

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NSF	ENG 0740461 / Pharad LLC	13.02	STTR PHASE I: High Performance Signal Generation and Data Encoding for Fiber Distributed 60 GHz WPANs	This STTR Phase I research project will develop new enabling technologies for the realization of an integrated fiberoptic wireless network architecture for future millimeter-wave (mm-wave) wireless personal area networks (WPANs). To fully enable the diversity of bandwidth-demanding services for a large number of users or terminals communicating over shorter distances, a mm-wave WPAN architecture that can accommodate multi-gigabit-per-second data rates and multiple radio coverage areas is essential. The integration of a mm-wave WPAN with a fiber-optic signal distribution scheme provides an efficient means to deliver the required high data rate signals to a large number of radio distribution access points and ensure optimized radio coverage. An optical technique for generating the mm-wave WPAN signals that results in a low phase noise RF carrier after conversion back into the RF domain is essential. Also, the transport of the 60 GHz WPAN signals over fiber must be tolerant to the potential impact of fiber chromatic dispersion on the signal to noise ratio of the recovered wireless signal. New photonic technologies and system architectures are needed that will satisfy the WPAN physical layer														1																X						########	
NSF	ENG 0740584 / Sand 9, Inc.	16.045	SBIR Phase I: Nanomechanical Resonator Technology for Passive and Active Devices in Wireless Applications	This Small Business Innovation Research Phase I research project seeks to develop novel radio-frequency components for wireless communication using an innovative nanomechanical resonator technology platform. The company has developed the world's highest-frequency mechanical resonator and will use this device to create programmable RF filters for wireless communications in the 100 MHz to 3 GHz ranges. The project will develop a 900MHz and 2GHz filter design, test and characterize the design, transfer the manufacturing process to a commercial CMOS fabrication, package the devices using standard commercially available methods, design and test a single pole double throw switch and integrate a switch and filter onto the same die. Each of these resonators can act as a high Q filter, and arrays of these resonators can be combined to create bandpass filters of arbitrary bandwidth with low insertion loss and excellent outside-band attenuation. This potentially disruptive technology incorporates novel mechanical amplification of rigid nanostructures to achieve GHz resonant frequencies and RF performance levels not possible with MEMS scale devices. These filters will offer significant performance improvement over existing RF														1																X						########	
NSF	ENG 0746310 / Northeastern University	1.047	CAREER: An Interdisciplinary Approach to the Study of Wave-Based Signal Processing: Compressive Sensing and Signal-Subspace-Based Imaging	Integrative, Hybrid and Complex Systems Edwin A. Marengo Northeastern University CAREER: An Interdisciplinary Approach to the Study of Wave-Based Signal Processing: Compressive Sensing and Signal-Subspace-Based Imaging Intellectual Merit: This research studies wave-based systems, their signals, and processing. The research is carried out within the particular and comparative framework provided by two signal processing approaches, compressive sensing and signal subspace methods. Compressive sensing is emerging as a promising new approach to simultaneously and non-adaptively sample and compress sparse signals. Signal subspace methods form a broad class of super-resolution approaches whose applicability to imaging of complex targets has been studied by the principal investigator. The goal of this project is to study the nascent compressive sensing approach and the better established signal subspace approach in a synergistic framework motivated by open problems in active detection and super-resolution imaging. Most past work in compressive sensing has focused on passive sensing and linear systems, while this project focuses on active sensing. Here the inverse problem is generally nonlinear. Thus, this project aims												1																		X						########	

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NSF	ENG 0746599 / Dartmouth College	12.03	CAREER: Multi-Agent Coordination and Distributed Estimation for Mobile Sensor Networks	Objective: Mobile sensor networks (MSNs) are complex wireless networks of mobile agents equipped with a variety of sensors including infrared, ultrasonic, cameras, sonar, and radar. MSNs have broad applications in scientific data gathering; performing search and rescue operations; real-time information processing for disaster response; and surveillance and security. The objective of the proposal is to develop innovative methods for multi-agent coordination and distributed estimation for mobile sensor networks operating in uncertain environments. Intellectual Merit: The research includes (1) detection and tracking of events using networked mobile robots with short-range directional sensors and (2) crowd control during disasters in complex infrastructures. Some key challenges distinguish mobile sensor networks from static ones: (1) the network topology of MSNs is "dynamic" due to motion of the sensors and this tremendously complicates design and analysis of the algorithms, (2) maintaining network connectivity is hard, (3) mobile sensors cannot simply roam at random; motion coordination algorithms are needed to achieve better tracking performance. The main "research objectives" of this project																		1											X						########	
NSF	ENG 0747501 / Massachusetts Institute of Technology	16.018	CAREER: Digitally-assisted Architectures for Next Generation RF Transceivers	Abstract ECCS-0747501 J. Dawson, MIT The objective of this research is to discover circuit architectures that enable the next generation of wireless transceivers for communications and biomedical applications. The approach is to focus on digitally assisted architectures, which exploit digital signal processing to enable transceiver performance. The wireless and biomedical fields are the most important, highest-impact applications in integrated circuit design because of exploding commercial and military demand. The difficulty is that transistors in modern processes do not permit the use of analog architectures that have, for decades, served so well. The intellectual merit of this program is a rigorous exploration of the optimal division of transceiver functionality between the analog and digital domains. This issue is pursued both through the application of mathematical optimization techniques, and also through design creativity to discover new circuit architectures. The projects to be pursued include new digitally assisted architectures for power amplifier linearizers, biomedical implants, and ultra high bandwidth polar transmitters. In addition, the PI will explore a new hierarchical optimization																		1											X						########	
NSF	ENG 0747623 / University of Michigan Ann Arbor	12.023	CAREER: Advances in Metamaterial Structures and Devices	Proposal Number: ECCS-0747623 Proposal Title: CAREER: Advances in Metamaterial Structures and Devices PI Name: Grbic, Anthony PI Institution: University of Michigan Ann Arbor The objective of this research is to address critical needs in the emerging field of electromagnetic metamaterials and to explore entirely new methods of manipulating electromagnetic waves. New approaches to designing volumetric metamaterials with increased bandwidth and reduced losses will be pursued and an entirely new class of metamaterial surfaces will be developed. Intellectual Merit: The proposed volumetric metamaterials rely on traveling-wave structures to achieve their low-loss and large bandwidth performance. This is in contrast to more conventional metamaterial designs that rely on weakly coupled resonators. Using this new approach, negative refractive index lenses capable of super-resolution and novel microwave devices will be devised. In addition, finely patterned metamaterial surfaces that can focus electromagnetic energy to extreme subwavelength resolutions will be explored. These surfaces present an entirely new perspective on electromagnetic field manipulation and																					1								X						########	

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NSF	ENG 0748206 / University of Utah	2.038	CAREER: RF-Sensing Networks for Radio Tomographic Environmental Imaging	Integrative, Hybrid and Complex Systems University of Utah Neal K. Patwari CAREER: RF-Sensing Networks for Radio Tomographic Environmental Imaging Intellectual Merit: This research focuses on the development of new technologies to ?see? through walls into buildings to show interior structures and the motion of people within the structure. Rather than relying on a single self-contained short-range radar, this method uses a large-scale network of low-cost sensors as multi-static radio frequency (RF) radars whose pair-wise and spectral measurements can be used to image the environment. This research lies at the intersection of statistical signal processing and radio propagation and addresses the necessary key advances related to dense networks of RF sensors and accurate statistical channel models. The proposed research (1) uses extensive measurements to develop valid statistical channel models that depend on the attenuation field, (2) develops and tests estimation algorithms for radio tomographic imaging, and (3) analyzes their estimation performance. Broader Impact: If successful in leading to new tomographic environmental imaging systems, the proposal has the potential to significantly benefit fire fighters, other first																		1											X						########	
NSF	ENG 0800619 / Pennsylvania State Univ University Park	12.098	Nanoengineering Electrodes for Reliable Microelectromechanical Ohmic Contact Switches	The objective of this award is to develop electrodes with enhanced reliability for microelectromechanical systems (MEMS) ohmic contact switches. Gold is commonly used as the electrode material because of its high ductility, low electrical resistivity, inertness to oxidation, high thermal conductivity, and relatively high melting point. However, the reliability of gold electrodes must be improved for many intended applications. Electrodes in this study will benefit from the high electrical and thermal conductivity of an underlying gold film, but their surfaces will be engineered through the deposition of nanoscale coatings or the creation of nanoscale morphological features. The influence of the length scale of these surface modifications on the performance of the electrodes will be studied to refine the electrode design. These surface modifications are expected to mitigate failures caused by electrodes sticking together, arcing and material transfer, and increasing contact resistance with use. This investigation is coupled with materials characterization of new, cycled, and failed switches provided by collaborators from industry and government laboratories, including switches that will incorporate the																						1								X						########	
NSF	ENG 0801128 / University of Notre Dame	12.171	A Practical Approach Multi-User Channels with Unknown Fading	Integrative, Hybrid and Complex Systems Oliver Collins, University of Notre Dame Practical Approach Multi-User Channels with Unknown Fading The objective of this research is to develop practical and useful communication schemes and receivers for channels with fading characteristics that are unknown to the transmitters and receivers. The fundamental approach pursued is iterative estimation and interference cancellation. Specifically, the research seeks to develop simplified receivers and estimators so that the techniques can be applied to real systems Intellectual Merit: This work considers practical schemes for achieving capacity approaching performance limits for multi-user channels with unknown fading. Essentially all channels in the physical world have unknown fading. However, because of analytical difficulties, most work assumes side information about the fading is available at the receivers and/or transmitters. Thus, the existing body of knowledge does not accurately account for the potential dramatic reduction in capacity produced by the fading process when it is unknown. This research attempts to address this deficiency. Broader Impacts: The broader impacts of the project include																						1								X						########	

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NSF	ENG 0801641 / University of Utah	16.039	Next Generation Communication Networks Using Multicarrier Filter Bank	Integrative, Hybrid and Complex Systems Behrouz Farhang-Boroujeny, University of Utah Next Generation Communication Networks Using Multicarrier Filter Bank The objective of this research is to develop an effective solution for next-generation wireless communications that comprehensively addresses the important issues of efficient use of the wireless spectrum, user mobility, and multi-access applications. The approach is to use multicarrier filter banks to minimize the side-lobes of the filters that constitute the subcarrier signals, thereby alleviating the need for subcarrier synchronization among different nodes in a network. Freedom from the subcarrier synchronization should alleviate problems due to Doppler shift under mobility and, also, enable cognitive radio communication and support communication among ad-hoc nodes without the need for centralized infrastructure nodes. Intellectual Merit: The intellectual merits of this research include a thorough analysis and development of the class of multicarrier systems that use filter banks for subcarrier channelization with emphasis on networks with high-mobility; development of novel equalization and synchronization algorithms																1													X						########	
NSF	ENG 0801798 / GA Tech Research Corporation - GA Institute of Technology	8.009	Development of Environmentally-Friendly Paper-Based Technology Platforms for RFID's and Sensors with	Objective The objective of this effort is to demonstrate the utilization of common-paper substrates for inkjet-printed increased-functionality cognitive and autonomous inexpensive radio frequency tags and wireless nodes. The approach will use a characterization of paper-based materials and different inkjet-metallization schemes to help integrate components (antennas, transmission lines, matching networks, batteries and energy scavengers), with for compatibility of IC-interconnects with paper. Intellectual Merit The intellectual merit of this proposal is the development of the first paper-based inkjet-printed technology platform to integrate RF, antenna, material and battery technologies and develop the first-generation of enhanced-range communication/sensor nodes able to operate in various environments. The scavenging-antenna approach will facilitate the research in autonomous rugged wireless modules and will allow for the first true mapping of potentially harvested energy in commercial bands. Broader Impact The broader impact of this effort would lead to the reconfigurable autonomous sensor networks of the future, addressing various societal challenges (chemical/explosive-																						1								X						########	
NSF	ENG 0801997 / University of Washington	12.069	Design and Prototyping for Network Convergence	Integrative, Hybrid and Complex Systems University of Washington Hui Liu Design and Prototyping for Network Convergence The objective of this research is to develop new network architectures for achieving convergence of digital broadcasting and (two-way) cellular data networks while delivering the quality-of-service necessary for multimedia distribution. The research approach is two-pronged. The first component is a joint design method for hybrid services to be natively supported in a collaborative cellular network. The second component of the research is a method for dynamic spectrum reuse within an extended cognitive radio (IEEE 802.22) framework. Intellectual Merit: This project addresses theoretical questions and associated system design issues underpinning the transition of next-generation digital broadcasting to broadband collaborative networks. The problems addressed are relevant to the recent availability of new radio frequency spectrum for broadcast and emerging industry standards, such as MediaFlo and Mobile WiMAX, that similarly seek an evolutionary path towards such a convergence. The project, while not specific to the above technologies and standards, is intended to result in cross-cutting																					1								X						########	

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NSF	ENG 0802113 / Auburn University	1.036	IHCS: Towards Efficient Medium Access Control for Wireless Networks	Proposal 0802113 -- Abstract: (248 words) The objective of this project is to improve the efficiency of random medium access control protocols. The approach is to employ efficient scheduling to amortize the high control overhead of medium access over a longer sequence of data frames. Fully distributed protocols will be developed to implement this approach. Intellectual Merit: This proposal outlines a research and education plan focusing on the theory and system design of efficient random access protocols. The theoretical and algorithmic thrust includes: (i) developing a general analytical framework, (ii) exploiting multi-user diversity under fading channels, and (iii) extension to multi-hop and multi-channel wireless networks. The experimental thrust includes (i) formalizing the protocols and prototyping open source device drivers, and (ii) testbed experiments. The proposed approach has the potential of solving the low throughput problem many wireless networks suffer, as demonstrated in our preliminary studies. The proposed theoretical study will provide underpinning for the proposed protocol as well as existing standard components. The proposed field experiments will yield useful experimental experience and insights under a realistic								1																				X						########	
NSF	ENG 0809036 / Virginia Polytechnic Institute and State University	12.083	I/UCRC: WICAT@VT	This award establishes Virginia Polytechnic (VT) as a research site of the Industry/University Collaborative Research Center (IUCRC) for the Wireless Internet Center for Advanced Technology (WICAT). Other sites of this collaborative research center include the New York Polytechnic (lead), Auburn University, Columbia University and the University of Virginia. The mission of this center is to focus on emerging technologies for wireless internet. Virginia Polytechnic will be a strong partner of WICAT and will perform research activities that will be complementary and synergistic with those of the other WICAT sites. The theme at the Virginia Polytechnic site will be cognitive radio based wireless networks, with the following thrust areas: Software Defined Radios, Cognitive Radios, Cognitive Network Test Bed Implementation, Theoretical Foundations of Wireless Communications, and Wireless Systems Modeling and Simulation. The test bed will enable researchers from WICAT and others to implement and test algorithms, protocols, applications and hardware technologies within a realistic environment. Virginia Polytechnic will make significant contributions to the mission of WICAT. The effort at Virginia Tech will be a subset of the																					1								X						########	
NSF	ENG 0809612 / North Carolina State University	12.152	SGER: Channel Modeling and Adaptive Transmitter/Receiver Design for Outdoor Ultrawideband Communication Systems	Integrative, Hybrid and Complex Systems Alexandra Duel-Hallen Channel Modeling and Adaptive Transmitter/Receiver Design for Outdoor Ultrawideband Communication Systems The objective of this research is to alleviate potential outages in outdoor ultrawideband communications systems due to shadowing and other challenging propagation environments by exploiting the frequency-dependent distortion of individual multipath components. The approach is to create a novel physical model and to use it in testing robust receiver algorithms and adaptive transmission methods for outdoor ultrawideband systems. Intellectual Merit: A novel outdoor ultrawideband channel model that provides typical and challenging data sets and insights required for designing and validating communications methods is developed. Robust low-complexity receivers and adaptive transmission methods for ultrawideband radio frequency channels with frequency dependent propagation gains are investigated. The transformative idea involves transmission of pulses either in the lower (up to 1 GHz) or upper (above 3 GHz) band of the ultrawideband spectrum (as specified by the Federal Communication Commission's mask), depending upon which																					1								X						########	

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NSF	ENG 0810792 / LHC2 Inc.	12.16	STTR Phase I: Smart Antenna Systems for Unlicensed ISM-band Public Safety and Remote Meter Reading Data Networks	This Small Business Technology Transfer (STTR) Phase I project will characterize the interference environment of outdoor unlicensed 900 and 2400 MHz wireless networks used for public safety and energy management. It will also develop a proof of concept and test innovative interference minimizing smart antenna prototypes to restore operations and improve performance of public safety networks. Private wireless broadband networks, deployed by municipalities and utilities are used for such functions as public safety, public Internet access, and energy and water management. These networks are experiencing dramatic growth in both size and number. This growth, along with expanding enterprise and consumer use of overlapping devices and Wireless Local Area Networks (WLANs), continue to exacerbate performance reducing interference problems. This interference has forced many municipalities to double their investments in infrastructure equipment or to increase transmitter power to overcome interference, thus producing more interference for overlapping systems. If successful the use of this antenna in the proposed band will help first responders save lives. For example, interactive live																	1											X						########	
NSF	ENG 0821503 / University of Michigan Ann Arbor	2.015	MRI: Acquisition of Instruments for the Research of Applying Ultra Wide Band Based Wireless Networks to Vehicles for Communications and Controls	Objective: In this project, we requested instrumentation to setup a UWB laboratory to support the research of intra-vehicle wireless networks and wireless networked control system (wireless NCS). Related topics include in-vehicle UWB channel measurement and modeling, an optimal high-speed UWB data transmission scheme using multiple band orthogonal frequency-division multiplexing (OFDM), a robust real-time control message delivery method using time-hopping UWB radio under various vehicle setting and interferences, an effective media access control protocol, and control system performance analysis and design under unreliable data transmission links. Intellectual Merit: The project intends to fully utilize an intelligent mechanism in the design of wireless NCS by sensing, analyzing, and predicting channel conditions and network configuration consequently adaptively adjusting network configurations and modifying schemes to optimize system objectives. The outcomes of this project will advance the state-of-the-art wireless communications, networks and control systems and the mechanisms applied are extremely applicable to various fields of science and engineering. Broader Impact: The application of intra-vehicle															1													X						########	
NSF	ENG 0821658 / Tennessee Technological University	3.015	MRI: Acquisition of Research and Education Equipment for Ultra-Wideband Wireless Sensor Network and Radar Sensing Integration	Objective: In this proposal, the acquisition of ultra-wideband (UWB) wireless sensor network and radar (Environmental) sensing integration equipment is proposed. The new lab equipment will form a UWB radar sensing system including an arbitrary waveform generator, real-time spectrum analyzer, and a digital phosphor oscilloscope. The new equipment will be integrated with the existing UWB sensor network at Tennessee Technological University (TTU). The equipment would provide a core facility for all academic departments and research centers at TTU. Primary users of the instruments, across different colleges, would be Center for Manufacturing Research, Department of Electrical and Computer Engineering, Department of Manufacturing and Industrial Technology, and Department of Earth Sciences. Intellectual Merit: Some projects are funded by NSF, ONR, or DoE. At this time, the PIs and the participating faculties are either waiting for the acquisition of the proposed facility or using off-campus equipment. The purchase of the dedicated state-of-the-art facilities at TTU would greatly enhance the participating faculties, productivity and ability in conducting the ongoing research and				1																								X						########	

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NSF	ENG 0822777 / Locomatix, LLC	2.024	SBIR Phase II: Scalable Location Data Management	This Small Business Innovation Research Phase II project aims to design, implement, and test scalable methods for providing location-based services, with a special emphasis on mobile cell phone applications. Examples of such applications include continuous monitoring of static and dynamic geo-fences, building dynamic mobile social networks, and mobile e-commerce. The Phase II effort will develop methods to push the efficiency of the location-based computation techniques, and develop methods for more sophisticated features such as privacy management and mobile power management, which will be crucial for the wider adoption of location-based applications. Location data is currently generated by continually moving physical objects equipped with location-based sensors, such as GPS and Wi-Fi based tags. Data management methods for these datasets require dealing with high update rates, large volumes of historical location data, and location-based triggers that raise an alert when the location of a moving object meets certain criteria (for example, if an object is beyond a well-defined boundary). Existing methods for supporting applications that have these requirements are not scalable. The broader merits of																1													X						########	
NSF	ENG 0823927 / University of Utah	1.028	Enabling MIMO Communication for Complex Channels	The objective of this research is to develop the critical analytical framework for Multiple Input Multiple Output (MIMO) communication in complex channels. Existing MIMO capacity calculation software will be enhanced by including complex channel models for vehicles, lossy biological channels, and highly noisy channels. We will also integrate detector models with the electromagnetic and communication MIMO models, and verify the models via measurement. Intellectual Merit: Today's MIMO models do not include an accurate representation of non-Gaussian, ultra-reflective, depolarizing, and highly lossy channels seen in many personal communication channels, body-worn or implanted medical communication channels, highly reflective and lossy ('Hyper-Raleigh') channels typical of intra-vehicular communication for sensor networks inside aircraft, cars, buses, trains, ships, etc., most wireless ad-hoc network environments, or the human body scattering channel for medical imaging. This research program will provide more advanced channel models for MIMO. This will enable specialized MIMO design for each application, providing a far greater probability of initial success for the deployed systems. Broader Impacts:										1																			X						########	
NSF	ENG 0823946 / Tufts University	16.023	Collaborative Research: 3D Integrated Imaging Receivers for 10-Gb/s Free Space Optical MIMO	The objective of this research is to create a new class of power-efficient imaging photoreceivers to reach an aggregated data rate of 50 gigabits per second and beyond for broadband wireless optical communication. The approach is to develop a large array of planar tessellated photodetectors with a rate of 10 gigabits per second per pixel. The array includes diversity selection circuits, which are implemented using an optical multi-input/multi-output configuration. With respect to intellectual merit, this project addresses two well-known challenges in optical wireless communication, channel scintillation and optical beam alignment. The research explores power-efficient InGaAs metal-semiconductor-metal photodetectors that are integrated with silicon integrated circuits for multifunctional operation (decision, amplification, and computing), and the implementation of multi-input/multi-output architectures for signal processing of massive amounts of data. This research is expected to augment the body of knowledge on carrier drift characteristics in the photodetectors at low voltage bias and the physics of complex three-dimensional optoelectronic device structures. This research also explores																1													X						########	

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NSF	ENG 0823971 / Rensselaer Polytechnic Institute	8.008	Design of Energy-Efficient Programmable Signal Processing Accelerators in 3D Integrated Heterogeneous Multi-Core Processor for Mobile Multimedia Communication	The objective of this research is to develop energy-efficient programmable signal processing accelerators for heterogeneous multi-core mobile multimedia communication processors utilizing three-dimensional (3D) integration technology. The approach is to use the massive storage capacity and extremely high logic-memory data bandwidth enabled by 3D logic-memory integration, realized by vertically stacking high-performance logic die and high-density memory dies together, to fully exploit the parallelism inherent in most signal processing functions. The intellectual merit lies in the research theme of jointly considering signal processing algorithm, programmable accelerator architecture, and memory modeling and optimization to most effectively exploit the unique features, i.e., storage capacity and bandwidth, provided by 3D logic-memory integration. Within the proposed scope, this research addresses video coding and forward error correction coding systems, which dominate the energy consumption of mobile multimedia communication signal processing. Because of the high storage density of dynamic random access memory (DRAM), this research will focus on 3D logic-DRAM integration and develop accurate 3D																				1									X							########	
NSF	ENG 0823987 / Auburn University	17.028	Using the Channel State Information for Wireless Security Enhancement	The objective of this research is to develop and analyze new approaches to enhancing security in wireless networks. The approach is to exploit physical layer attributes, in particular the properties of the wireless medium, to significantly enhance user authentication. Openness of wireless and sensor networks makes them vulnerable to spoofing attacks where an unauthorized user masquerades as another legitimate user/device. While conventional cryptographic security mechanisms can be used to foil such attacks, they do not offer a complete solution. This research exploits the distinct channel state information of a legitimate user to authenticate subsequent transmissions from this user. The intellectual merit of this research includes a thorough consideration of novel efficient approaches to channel estimation for time-varying frequency-selective fading channels under various interference and noise scenarios. The intellectual merit also includes a fairly complete statistical characterization of the estimated channels for use in robust statistical hypothesis testing to ascertain if the estimated physical layer attributes match the previous physical layer attributes from the legitimate user or if they are from a spoofer. Sequential																											1			X							########	
NSF	ENG 0824031 / Texas Engineering Experiment Station	16.03	High-Resolution RF to Digital Converter for Next Generation Broadband Communication Systems	Objective: The objective of this research is to demonstrate the feasibility and robustness of a new mixer-less high-performance receiver architecture for multi-standard wireless radio systems based on a programmable bandpass sigma-delta modulator. The approach uses a highly linear low-noise amplifier as the input stage to a programmable high resolution analog-to-digital converter and enables low-noise conditioning, filtering and high-resolution signal digitization at radio frequencies. Intellectual Merit: The research aims at eliminating the analog down-conversion that is traditionally used in existing receiver front-ends. The new architecture employs highly selective LC filters embedded in the control loop that rejects the out-of-band interferers. This further relaxes the requirements of the analog circuits employed in the digitizer. This approach lowers the complexity and power consumption of the receiver while providing high resolution. Additionally, a unique self-healing software based calibration scheme will be developed to optimize the analog-to-digital converter for performance. Broader Impacts: The new adaptive analog-to-digital interface has the potential to enable the efficient implementation of																			1											X							########	

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NSF	ENG 0824052 / Pennsylvania State Univ University Park	13.01	Broadband Sensors Optical Wireless Local Area Networks	The objective of this research is to design wireless optical communication techniques for integration into sensor networks. The approach is to employ low-cost, compact-sized, and power-efficient white LEDs and photolithographic optical transceivers, in conjunction with indoor environment channel modeling and spatially coded multiple access techniques, to realize secure broadband communications interfaces among sensors. The intellectual merit of this work lies in its potential to provide capacity and quality-of-service superior to conventional radio frequency techniques. This research directly addresses the challenges in obtaining parallel independent optical communications channels that will provide a means of spatial diversity, which, in turn, will result in improved power budget. Furthermore, use of photolithographic (thin film) beam splitters and combiners and white LEDs for transceiver optics pose a challenging, but promising, new area for sensor networks communications. The broader impacts of this research include more efficient and more reliable communication links for facilities that rely upon sensors for collecting/distributing vital information (hospitals, planes, ships, factory plants). Co-														1																X						########	
NSF	ENG 0824068 / Rensselaer Polytechnic Institute	16.026	Collaborative: 3D Integrated Imaging Receivers for 10-Gb/s Free Space Optical MIMO	The objective of this research is to create a new class of power-efficient imaging photoreceivers to reach an aggregated data rate of 50 gigabits per second and beyond for broadband wireless optical communication. The approach is to develop a large array of planar tessellated photodetectors with a rate of 10 gigabits per second per pixel. The array includes diversity selection circuits, which are implemented using an optical multi-input/multi-output configuration. With respect to intellectual merit, this project addresses two well-known challenges in optical wireless communication, channel scintillation and optical beam alignment. The research explores power-efficient InGaAs metal-semiconductor-metal photodetectors that are integrated with silicon integrated circuits for multifunctional operation (decision, amplification, and computing), and the implementation of multi-input/multi-output architectures for signal processing of massive amounts of data. This research is expected to augment the body of knowledge on carrier drift characteristics in the photodetectors at low voltage bias and the physics of complex three-dimensional optoelectronic device structures. This research also explores															1																X						########	
NSF	ENG 0824081 / University of Maryland College Park	17.002	Addressing Physical-Layer Challenges via CLAWS: Cross-Layer Approaches to Wireless Secure Communications	The objective of this research is to investigate new approaches to achieving security in wireless communications systems and other complex networks using physical layer properties. The Cross-Layer Approaches to Wireless Secure Communications (CLAWS) effort aims to address security in new communication paradigms where security is difficult to provide only through existing cryptographic and network security techniques. The CLAWS approach attempts to jointly optimize overall system performance and security. The scheme should be applicable to wireless sensor networks, wireless ad-hoc networks, and future-generation wireless and hybrid communication systems. The intellectual merit of the research is based on: (i) development of a new secure communication design methodology that jointly considers physical laws related to signal transmission and processing, security requirements, and other system performance requirements; (ii) application of the methodology to cooperative wireless communications to trace compromised or adversarial relays, which is a challenging form of insider attack that is not yet widely studied; and (iii) application of the methodology to sensor																											1				X						########	

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NSF	ENG 0824095 / University of Hawaii	15.007	Cyber-Enabled Radio Propagation Prediction for the Design of Advanced Wireless Communications Systems	The objective of this research is to exploit the geospatial resources available in cyberspace for the study of radio propagation in urban and mountain areas. The approach is interdisciplinary and includes research in the area of 3D reconstruction of buildings using 2D and projected images and examination of the effect of terrain and building materials on radio propagation coverage. It will result in the development of ray tracing models suitable for modeling complex building structures such as metal-framed structures and complex walls. Intellectual merits: This research is interdisciplinary involving areas of geospatial resources, computational intelligence, electromagnetic wave propagation, and wireless communications systems. The integrated research will lead to the development of potentially transformative propagation modeling algorithms and tools to provide computationally efficient and more accurate capabilities for radio propagation prediction and characterization for advanced wireless communications technology including cognitive radio systems. Broader impacts: This research addresses the need for accurate, fast, worldwide radio frequency signal coverage prediction for advanced										1																			X						########	
NSF	ENG 0824128 / University of Pennsylvania	16.033	Monolithically Integrated Aluminum Nitride Micromechanical Radio Front-End	Objective The objective of this research is to develop the first single-chip radio frequency platform formed by the integration of Aluminum Nitride contour-mode resonators and switches. The approach is based on understanding the fundamental issues for piezoelectrics at the system integration level by focusing on fabrication yield, reliability, and reproducibility of the proposed microdevices. The frequency of operation of the resonators will be increased up to 6 GHz and recently developed microswitches will be integrated in the same process and optimized for low voltage actuation. Intellectual Merit The large scale integration of piezoelectric micromechanical devices will have a transformational impact on future radio front-ends. New low power radio architectures that take advantage of frequency hopping and channel selection will be enabled by this integration. Fundamental challenges related to device design, impedance characterization and Q limits will be explored at unreported frequencies of operation. The fundamental issues of piezoelectrics concerning material orientation, electromechanical coupling, residual stresses and transducer modeling																1													X						########	
NSF	ENG 0824199 / GA Tech Research Corporation - GA Institute of Technology	2.041	WINeRS: A Multichannel Wireless Implantable Neural Recording and Stimulating System for Hippocampal Electrophysiology Research on Memory	Objective: The objective of this research is to develop a multichannel Wireless Implantable Neural Recording and Stimulating (WINeRS) system to be used as a bidirectional interface with the central nervous system for neurobiology research applications. The system will be evaluated in the context of hippocampal electrophysiology research on memory. Intellectual Merit: High power, large size, low efficiency, limited bandwidth, and susceptibility to noise and interference are some of the major existing challenges in development of such systems, which will be targeted by adopting a modular scalable system-on-a-chip architecture. The ultra low-noise recording unit will be clockless and tunable to the frequency band of interest within the neural signal. It will have stimulus artifact rejection capability and adaptive resolution to the bandwidth and number of active channels. Three individual radio-frequency carriers will be optimized for high-efficiency inductive powering, high-rate forward data transmission, and wideband back telemetry across the skin. State-of-the-art microassembly will be devised to combine the multichannel stimulation and recording units with multiple antennas, microwire bundles, and																	1												X						########	

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NSF	ENG 0824237 / Iowa State University	12.076	Fault-Tolerant Cooperative Communication in Large-Scale Wireless Networks	Abstract Sang Wu Kim Iowa State University Fault-Tolerant Cooperative Communication in Large-Scale Wireless Networks The objective of this research is to develop a fundamentally new cooperative communication architecture that is inherently self-scalable, robust in the presence of transmission errors and malicious attacks, and allows decentralized network operation with flexibility for topology changes in large-scale wireless networks with noisy channels. The approach is to concatenate the parities of previous hops with those of the next hop such that the error correction capability grows with the number of hops in a multiplicative manner, generate parities randomly independent of other relay nodes, and exploit node cooperation using cross-layer design to obtain mutual benefits beyond those of traditional cross-layer cooperation within individual nodes. With respect to intellectual merit, this work considers practical cooperative communication methodologies that promote efficient and secure data transmission in noisy, large-scale wireless networks. Because of analytical challenges, much of the prior research in this area has been limited to capacity bounds for small-																				1										X						########	
NSF	ENG 0824265 / University of Washington	1.103	Realizing the Internet of Things via RFID Sensor Nets	The objective of this research is to formulate design principles for and demonstrate, via prototyping, the feasibility of a new sensor network of everyday objects based on radio frequency identification (RFID) system components. The vision exploits the advantages of RFID while addressing two key challenges, namely the lack of sensor integration onto RFID tags and the need for careful redesign of the transceivers (i.e, down and up links as well as the multiple access protocol). Central to the success of the proposed research are two key advances already in place at University of Washington-Intel Research Labs. First, a new class of passive RFID tags, called wireless identification and sensing platforms (WISPs), integrated with appropriate sensors and designed for enhanced power harvesting are available. Second, a software-defined reader (SDR) that allows innovation of link and medium access control (MAC) protocols is available. With respect to intellectual merit, the research pursues an integrated systems solution to RFID network design at various interacting levels of abstraction. As an example, the research considers coupled circuit and electromagnetic simulation that characterizes the back-scattered uplink												1																			X						########	
NSF	ENG 0824322 / Northern Arizona University	8.001	BRIGE: Energy-Efficient Communication with Combined Decoding/Inference	0824922 Sheryl Howard, Northern Arizona University BRIGE: Energy-Efficient Communication with Combined Decoding/Inference ABSTRACT Intellectual Merit: This research project develops a network cross-layer inference framework that combines source/application-level modeling with channel coding and probabilistic decoding/inference. The goal is reduction of network energy consumption while maintaining good performance. Selective transmission censoring further reduces network energy consumption. The main research objectives include: developing source-channel decoding algorithms that incorporate a correlated source model, channel coding, probabilistic decoding and source inference; developing transmission censoring algorithms that predict via inference the result of censoring selected data, and censor to maximize overall network performance and energy reduction; examining unequal error protection of bits and/or messages; and comparing energy consumption and implementation feasibility of the best source-channel decoding/inference and censoring algorithms in an existing wireless environmental sensing network. The																						1									X						########	

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NSF	ENG 0824977 / Stanford University	2.006	Decentralized Structural Control Strategies with Wireless Sensing and Actuation	The objective of this research is to develop novel structural control methods that take advantage of advanced sensing and wireless communication technology. The key intellectual merit of this research is the development of structural control methods that are ideally suited for embedment in a wireless sensing and control system defined by a distributive computational architecture. Specifically, decentralized control strategies will be developed to address the issues of communication range, bandwidth and latency of a wireless sensing and control network. Deliverables include new and novel decentralized control schemes such as a market-based strategy that models the control problem as a commodity market, simulation results of the structural control methods, and experimental validation of combining decentralized controls and wireless sensing and actuation technologies. Large-scale experimental tests will be conducted with international collaborators to evaluate and validate this research and development effort. This research is expected to enhance the safety and performance of civil structures on one hand and expand the utilization of wireless communication technology to structural engineering															1														X						########	
NSF	ENG 0827153 / University of Virginia Main Campus	2.027	Technology Based Evaluation of Classroom Learning	This research will address the feasibility of enabling teachers at the high school and college levels to evaluate how well their students are learning via an automated analysis of data collected through technology-based instrumentation of their classrooms. The data will include audio/video collections on interactive class room behaviors, which are related to established performance markers. Results of data collections will be integrated into a DVD presentation that will produce feedback for the teacher for self-evaluation with the opportunity for self-improvement, or incorporation into guided coaching systems. The effort will build upon prior efforts from three different research communities: education, military intelligence, and Internet technology. This research will advance video processing that focuses on automated behavior pattern analysis related to a class room. It will also increase understanding of the relationship between previously developed manual class room observation metrics for helping teachers to improve and corresponding metrics gathered from an array of class room sensors. The conduct of this work will lead to identification of yet to be considered advances in the application of audio/video															1														X						########	
NSF	ENG 0830601 / University of California-San Diego	1.053	CAREER: Information-driven distributed coordination of mobile sensor networks in dynamic scenarios	Project Summary The emergence of low-cost, highly-autonomous vehicles equipped with control, communication, sensing and computing capabilities is paving the way for the deployment of mobile sensor networks in a wide range of applications. Examples include environmental monitoring, oceanographic research, high-stress, rapid de- ployment operations, and health monitoring of civil infrastructure. In these envisioned applications, many critical processes occur at temporal and spatial scales that cannot be effectively sampled with current ap- proaches. Mobile sensor networks hold the promise to provide the rich, in-situ spatio-temporal data needed to revolutionize the detection, estimation, and monitoring of dynamic natural phenomena. Controlled mobility integrated with distributed data fusion capabilities will enable sensor networks to provide broad spatial cov- erage, react to short-lived events in real time, and track key processes that occur away from fixed sites. The state of the art in distributed data fusion only considers static networks, and therefore is not directly applicable to ad-hoc, dynamically changing mobile networks. The state of the art in motion coordination of networked systems has only developed											1																		X						########	

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NSF	ENG 0832238 / University of Arizona	16.027	Connection One: Telecommunication Circuits and Systems (I/CURC)	The University of Arizona is renewing its participation in the Connection One (C1) center, an I/UCRC center that was created in 2002. The lead institution is Arizona State University, and the center at present includes five universities and more than twenty industry members. The main research mission of the C1 is to develop technologies and solutions for emerging wireless communication systems, ranging from circuit designs and smart antennas to wireless network architectures and protocols. The scope of C1 extends to the integration of wireless and broadband wire-line technologies (optical communications). The primary focus of the proposed site over the next five years will be to increase the scope of the present work focused on communication protocols for wireless systems as well as mixed analog/digital circuit designs. The extensions to areas of research in wireless technology such as security and RFID are very positive. The cognitive radio area is also an important area for contribution as well as the integrated sensor area. The activities proposed by the University of Arizona (UA) research site will impact many important technology needs in the commercial and public sectors. The use of industrial															1														X						########	
NSF	ENG 0832519 / University of New Mexico	10.003	Fiber Optic Communications and Ultrabroadband Systems (FOCUS): UNM's Connection One IUCRC Center	The University of New Mexico is proposing to join the Arizona State University (lead institution), University of Arizona, Rensselaer Polytechnic Institute, Ohio State University and the University of Hawaii existing Industry/University Cooperative Research Center for Communications Circuits and Systems Center (Connection One). The proposed research site would increase the research capabilities and activities of the Center by focusing on fiber-optics and wireless (ultra-wideband) communications and systems. Some key objectives of the proposed research site include defining an initial set of well-defined research projects in collaboration with the industry partners, to market a forward-looking research and development vision to potential industry partners, and to build a team of core industry members committed to establishing the proposed site. The proposed center will pursue research projects of importance to a broad range of companies including Air Force Research Lab, Sandia National Lab, Encore, Gridline and others. The activities at the proposed site will involve faculty researchers, graduate and undergraduate students working together with industrial representatives. The proposed research site will also have																											1		X						########	
NSF	ENG 0832735 / University of California-Los Angeles	16.051	SGER: Hybrid MIMO Sphere Decoder VLSI Architecture	The objective of this research is to advance multi-antenna wireless communication devices by providing signal processing hardware that can adapt to varying operating conditions. The approach is based on layered optimization that spans signal processing algorithms, hardware architectures, digital circuits, and the underlying semiconductor devices. The goal is to demonstrate improvements of several orders of magnitude in both deployed algorithm complexity and hardware cost. With respect to intellectual merit, this project provides a hardware solution that leverages the fundamental tradeoff between diversity and spatial-multiplexing in multi-antenna wireless channels. High algorithm complexity limits current practical systems to 4-by-4 antenna arrays and a single operating mode. This work supports adaptive antenna arrays (up to 16-by-16) and multiple operating modes, with reduced hardware cost. This flexibility is being realized in hardware, resulting in a 100 times improvement in energy efficiency compared to general-purpose processors. An objective is to use silicon area more effectively to provide higher data rates, improved services to mobile devices, and access to a variety of existing and new															1														X						########	

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AGENCY	DEPARTMENT/ DIVISION /LAB/ PROGRAM/ AWARD	Project #	PROJECT TITLE/DESCRIPTION	EXAMPLES	INTENDED APPLICATION ENVIRONMENT (See Attachment C for examples)	EXPECTED FREQUENCY RANGE	**Topic Area**	Topic # 3	Topic # 23	Topic # 19	Topic # 6	Topic # 15	Topic # 7	Topic # 1	Topic # 14	Topic # 11	Topic # 4	Topic # 13	Topic # 16	Topic # 2	Topic # 21	Topic # 22	Topic # 12	Topic # 8	Topic # 5	Topic # 9	Topic # 18	Topic # 17	Topic # 10	Topic # 20	**Maturity**	Basic Research	Applied Research	Advanced Technology Development	Advanced Component Development	Demonstration & Validation	**Funding**	Funded in Past (2006-2010)	Presently Funded (FY11)
NSF	ENG 0838893 / Beam Power Technology, Inc.	12.147	SBIR Phase I: High-efficiency Multi-carrier Ribbon-beam Amplifier for Wireless Communications	This SBIR Phase I research proposal will demonstrate an innovative Ribbon-Beam Amplifier (RBA) which significantly advances the state-of-the-art in solid-state and vacuum electronic Radio Frequency (RF) amplification. The goal is to determine the feasibility of a ribbon-beam amplifier that is highly efficient (56%), broadband (1930-1990 MHz), and high power (100 W in continuous-wave operation). As a next-generation RF amplifier, the RBA is expected to be applicable to third-generation (3G) wireless communications and future wireless communication platforms such as emerging fourth generation (4G) and ultra-wide-band (UWB) wireless communications. If successful, this project will lead to commercially deployable RBA products overcoming the limitations of existing solid-state multi-carrier power amplifiers (MPCAs) which have low efficiency, complex and expensive linearization circuits, and narrow instantaneous bandwidth (30 MHz). The proposed technology will significantly lower both the capital cost and operating cost of commercial wireless base station amplifiers. Using increases in efficiency of a factor of 2 to 3 over current solid state products provides for cost reduction in primary power usage by the amplifiers																		1											X						########	
NSF	ENG 0839225 / Cambridge Analog Technologies, Inc.	16.048	SBIR Phase I:High Performance Zero-Crossing Based A/D Converter Architectures	This SBIR Phase I research proposal will investigate new circuit architectures for high performance Analog-to-Digital (A/D) converters with potentially more than an order of magnitude lower power consumption and much smaller silicon area than conventional architectures. The new architectures are based on zero-crossing detectors. The zero-crossing based circuits utilize the virtual-ground based signal processing as in traditional op-amp based circuits. Therefore, they provide the same functionality and robustness and are compatible with most op-amp based circuit architectures. The zero-crossing detectors replace the virtual ground forcing function of the op-amp with virtual ground detection by a zero-crossing detector. The zero-crossing detector based circuits provide high speed operation at extremely low power consumption, are tiny in size, and are compatible with standard deep submicron Complementary Metal Oxide Semiconductors (CMOS) technologies. The proposed research, if successful, can have far reaching impact, because A/D converters are ubiquitous in electronics systems. The power consumption represents approximately thirty (30) fold reduction from the state-of-the art. It will provide high																		1											X						########	
NSF	ENG 0845822 / San Diego State University Foundation	12.035	CAREER:Novel Reconfigurable Aperture Antennas and Arrays for Compact Multifunctional Antenna Solutions	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). The objective of this research is to explore novel reconfigurable aperture antennas and arrays, which can provide compact multifunctional antenna solutions. The approach is to examine (i) reconfigurable radiation pattern aperture antennas with multiple phase centers by controlling the modal amplitudes and phases in multimode radiating elements, (ii) frequency reconfiguration of microstrip antennas by implementing radio frequency (RF) Micro-Electro-Mechanical-Systems (MEMS) switches and MEMS variable capacitors, and (iii) ground plane reconfiguration of microstrip antennas to reconfigure the impedance and radiation pattern properties. The research will lead to novel, compact and reconfigurable aperture antennas for wireless communications and radar systems providing multifunctionality. The proposed innovative approaches have the potential to allow hardware minimizations, simplify complex antenna implementations, and provide enhanced performance antenna solutions. The theory and analysis tools developed will help in conceptualizing future antennas and enhancing the quality																					1								X						########	

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NSF	ENG 0845849 / Washington State University	8.002	CAREER:Body-enabled Design Paradigm: A New Pathway for Next Generation Battery-free Wireless Sensor Nodes Powered by Sustainable Energy Sources	The objective of this research is to develop a transformative design paradigm for battery-free wireless sensors powered by renewable energy sources for biomedical applications, monitoring public infrastructures, environmental monitoring, and homeland security. This research focuses on creating energy-efficient wireless sensors and providing power to sensors from sustainable energy sources with maximum efficiency. The approach is to use the body terminal of scaled devices in innovative ways to enable a novel energy-efficient body-enabled design paradigm, forging a new pathway to battery-free wireless sensors powered by sustainable energy sources. With respect to intellectual merit, the research has the potential to develop a transformative design paradigm to significantly reduce power consumption of wireless sensors and forging reconfigurable energy-efficient power management systems based on the new design paradigm to maximally harvest energy from energy transducers and efficiently power the sensors. Combining digitally-assisted architectures and the design paradigm, new hardware architectures for battery-free energy-efficient wireless sensors will be developed. The broader impacts of this project include																				1										X						########	
NSF	ENG 0846298 / University of Utah	2.036	CAREER: High-Rate Wireless Data Links for Biomedical Implants	The objective of this research is to develop high-rate data links (>20 Mb/s) for implanted biomedical devices that can operate in the presence of narrowband interference from an inductive power link. The approach is to employ ultra-wideband signaling with transmitted reference synchronization to realize low-power, high-rate data transfer over the short distances required by biomedical implants. A comprehensive approach to system design is employed, with substantial effort focused on the design and modeling of the antenna and channel so that their effects can be accounted for in the circuit design. The novel ultra-wideband transceiver architectures being explored in this work will bring about an order of magnitude increase in data rates for biomedical implants, as compared to the narrowband transceivers that are currently prevalent. This research will advance the state of the art in low-power, short-range wireless communications, and is expected to prove beneficial for a range of applications beyond implantable devices. The high-rate data links being explored in this research have the potential to be of tremendous benefit to society, by enabling biomedical devices that can improve the quality of life for																			1										X						########	
NSF	ENG 0846628 / Massachusetts Institute of Technology	13.011	CAREER: Terahertz Electronics based on Nitride Nanowire Transistors	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). The objective of this research is to push the limits of electronics to THz frequencies and to increase society?s awareness to the new possibilities offered by the combination of electronics and nanotechnology. The approach is based on demonstrating the superior performance of nitride nanowire transistors and on identifying the best methods for circuit-level integration of these new devices. This research will enable the basic building blocks required for the development of ultra-broadband wireless communication, advanced imaging and radar, electronic THz spectroscopy and THz digital computation. The intellectual merit of the proposed program lies in maximally leveraging the flexibility and unique properties of nitride semiconductors, with advanced processing technologies and high frequency analysis and modeling. Through this interdisciplinary approach, which combines electrical engineering, materials science and semiconductor physics, this project will demonstrate new breakthroughs that will push the limits of high frequency electronic performance beyond the THz barrier. The broader impact of this work is to increase																	1												X						########	

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NSF	ENG 0846672 / University of Central Florida	12.032	CAREER: Next-Generation Ultra-Low-Cost Phased Arrays	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). The objective of this research is to develop next-generation ultra-low-cost phased arrays for various applications including radar, broadcasting, cellular communications, satellite communications, and weather forecasting. The approach is to investigate an innovative concept termed electronically steerable passive array radiator (ESPAR) and develop BST varactors on organic substrates. Intellectual Merit: The proposed research is expected to have a significant impact on the design of low-cost, simple yet efficient phased array systems. The proposed novel BST varactor integration technique will have a broad impact on a variety of applications which require high-density integrated capacitors and varactors. Conformal designs of the proposed ESPAR phased arrays help increase the function and reduce the power consumption of wireless sensor nodes, with a significantly reduced cost. Broader Impacts: The proposed research will enable next-generation ultra-low-cost phased arrays to be affordable in a variety of applications. One important application that can take advantage of this technology is automotive collision avoidance radar or																		1											X						########	
NSF	ENG 0848285 / Centar	12.151	SBIR Phase II: A New Class of Fast Fourier Transforms	This Small Business Innovation Research (SBIR) Phase II project is directed at development of a high performance, programmable fast Fourier transform (FFT) circuit for use in embedded signal processing integrated circuits. Over the last 40 years the technology for executing parallel FFT implementations has remained relatively unchanged, being based essentially on different permutations of the signal flow graph and mappings thereof. Performance improvements are now largely achieved by shrinking circuit geometries according to Moore's Law. Because of the limits imposed by physics of integrated circuit fabrication, it is expected that continued improvement in signal processing will only be achieved with more efficient algorithmic implementations in combination with advanced integrated circuit technologies. This proposal focusses on a radically different architecture for parallel FFT circuits based on a new matrix formulation of the discrete Fourier transform (DFT) to achieve exactly this goal. The specific advantages of this new formulation include: 1) logic and memory resource requirements are reduced; 2) less power is consumed; 3) significant added functionality is accrued; and 4) design, test,																		1											X						########	
NSF	ENG 0848716 / Sand 9, Inc.	16.05	SBIR Phase II: Nanomechanical Resonator Technology for Passive and Active Devices in Wireless Applications	This Small Business Innovation Research (SBIR) Phase II research project seeks to develop novel radio-frequency components for wireless communication using an innovative nanomechanical resonator technology platform. The team has developed the world's highest-frequency mechanical resonator and will use this device to create RF filters for wireless communications in the 100 MHz to 3 GHz range. Building on the simulation results and optimal device designs the team will fabricate, test and characterize nanomechanical filters for use in wireless communication devices. There is a significant problem that designers of cellular handsets and other wireless devices are facing when adding additional air interfaces such as WiFi, WiMax, Bluetooth and Global Position Service (GPS) into their products. Each additional air interface requires a new set of RF filters and as the number of air interfaces multiplies the number of conventional filters required increases dramatically. The goals of the Phase-II project are to (i) develop nanomechanical filters in the 100 MHz - 3 GHz range; (ii) test and characterize the device for optimal performance parameters; (iii) transfer the manufacturing process to a																		1											X						########	

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NSF	ENG 0900930 / GA Tech Research Corporation - GA Institute of Technology	1.013	Spectrum Management in Cognitive Radio Ad Hoc Networks	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). The objective of this research is to develop a spectrum management framework for cognitive radio ad hoc networks. The project investigates the challenges posed by the distributed multi-hop architecture, the dynamic network topology, and the frequently changing spectrum seen in these networks. Up to now, the research in this area has mainly focused on infrastructure-based networks. This research aims to highlight the major challenges in the distributed operation and provide protocol-level solutions for each of them. With respect to intellectual merit, this research has the potential to lead to a cooperation strategy that improves the sensing accuracy at an acceptable communication cost. To enable this interaction between nodes, an on-demand reliable common control channel is devised. For determining the best spectrum for transmission, a joint spectrum and route selection method is developed. Moreover, a cognitive radio medium access control protocol is proposed, with goals of providing interference avoidance as well as efficient spectrum utilization. Finally, a spectrum-aware route recovery framework is											1																			X						########	
NSF	ENG 0901066 / Stevens Institute of Technology	12.067	Data-Driven Adaptive Quantization for Distributed Inference	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). The objective of this research is to develop an integrated framework for rate-constrained adaptive quantization techniques with application to distributed inference in wireless sensor networks. The approach allows sensor nodes to sequentially transmit their quantized data and each individual node can adaptively change its local quantizer based on prior transmissions from other nodes. Specific goals include development of linear and nonlinear adaptive quantization schemes and distributed inference methods, such as distributed estimators and detectors, distributed consensus algorithms with quantized message passing, and distributed random field estimation methods, by exploiting adaptive quantization, graphical models and distributed optimization techniques. With respect to intellectual merit, the project addresses a fundamental challenge of quantization for distributed inference in a sensor network environment, where the optimum quantizer generally cannot be implemented due to its dependence on unknown parameters associated with the random event being monitored by the																					1									X						########	
NSF	ENG 0901088 / Texas Engineering Experiment Station	16.032	Miniaturized Waveguide RF MEMS Tunable Filters	"This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5)." The objective of this research is to develop a waveguide radio-frequency micro-electromechanical systems tunable filter as a unique three-dimensional microstructure in silicon. The approach is based on combining 1) bulk micromachining for miniaturized cavity implementation, 2) surface micromachining for radio-frequency micro-electromechanical systems planar circuit development, and 3) high-aspect-ratio-microstructure fabrication to bias the planar circuit embedded inside the cavity using vertical signal routing. With respect to intellectual merit, the proposed highly miniaturized three-dimensional filter enables vertical integration with front-end electronics to create a fully functional frequency-agile microstructure through the major paradigm shift of combining three aspects of microfabrication for the first time. The filter provides superior electrical performance including ultra-high selectivity, wideband tuning, low loss, high linearity and extremely low power consumption for tuning. A dielectric-filled, evanescent-mode, micromachined waveguide filter is proposed to provide low loss, and also to reduce the size of the filter relative to its bulky																		1												X						########	

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NSF	ENG 0901420 / Tennessee Technological University	1.018	Collaborative Research: Wideband Cognitive Radio Communication: Modeling, Algorithm and Testbed	The objective of this research is to address fundamental problems in wide band cognitive radio, namely statistical information of wideband spectrum and corresponding system design, from both theoretical and implementation perspectives. A hardware test bed will demonstrate the proposed statistical modeling and algorithms. The interdisciplinary nature of the research lends itself to cross-disciplinary collaboration and education that can involve researchers in electrical engineering, computer science, and math. The research provides the basis for course projects in areas including wireless communications and machine learning. The research has the potential to bring new results and outcomes to the cognitive radio research community. The research has the potential to contribute fundamental models, algorithms, and test beds for the study and realization of wideband cognitive radio. It also has the potential to provide new methodologies and techniques for fields like statistical modeling, signal processing, communication theory, and hardware implementation. With respect to broader impacts, the proposed research also encourages active participation from											1																			X						########	
NSF	ENG 0901425 / University of Tennessee Knoxville	1.02	Collaborative Research: Wideband Cognitive Radio: Modeling, Algorithm and Testbed	The objective of this research is to address fundamental problems in wide band cognitive radio, namely statistical information of wideband spectrum and corresponding system design, from both theoretical and implementation perspectives. A hardware test bed will demonstrate the proposed statistical modeling and algorithms. The interdisciplinary nature of the research lends itself to cross-disciplinary collaboration and education that can involve researchers in electrical engineering, computer science, and math. The research provides the basis for course projects in areas including wireless communications and machine learning. The research has the potential to bring new results and outcomes to the cognitive radio research community. The research has the potential to contribute fundamental models, algorithms, and test beds for the study and realization of wideband cognitive radio. It also has the potential to provide new methodologies and techniques for fields like statistical modeling, signal processing, communication theory, and hardware implementation. With respect to broader impacts, the proposed research also encourages active participation from											1																			X						########	
NSF	ENG 0901464 / University of Michigan Ann Arbor	16.041	Novel RF/Microwave Switchable Filters Based on Electrostrictive Resonance in Ferroelectric Thin Films	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). The objective of this research is to demonstrate novel intrinsically switchable filters for frequency-agile communication systems and cognitive radios. The basis of the proposed effort is the investigation of field-tunable electrostriction effect in ferroelectric thin films. The resonant behavior of the ferroelectric thin film can be switched on and off through application of a DC bias voltage, and can potentially be utilized for designing low cost, high performance and integrated intrinsically switchable radio frequency (RF) and microwave resonators and filters. Frequency-agile devices provide the ability to switch communication channels through switchable and tunable frontend filters. The realization of frequency-agile components with minimal complexity is further desired for miniature low-power wireless systems integrated into a single chip. In this work, a key building block for a frequency-agile transceiver is proposed, utilizing the acoustic wave and microwave interactions in ferroelectric thin films. This project will serve to educate graduate students through direct participation in the research. The proposed research is of																		1													X						########	

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NSF	ENG 0901563 / CUNY City College	12.018	A cost effective migration path to a fully packet based hybrid fixed/mobile backhaul infrastructure	The objective of this research is to develop and demonstrate critical elements necessary for the integration of passive optical network (PON) broadband access technologies with "Fourth Generation" (4G) mobile wireless broadband access technologies. The approach is to devise and analyze an Ethernet-based multiservice network architecture that spans and integrates fiber-based PON and 4G wireless access technologies. With respect to intellectual merit, the proposed architecture seeks to integrate both PON and 4G wireless access technologies in terms of unified control and management of both wired and wireless access networks. This adds a number of challenging dimensions to the integration problem. In contrast to mainstream centralized PON and radio access network (RAN) architectures, the proposed converged access networking scheme must support not only a fully distributed integrated PON-RAN architecture, but also a unified control plane that manages and controls both fixed optical and mobile radio network resources. This calls for new integrated wireline and wireless radio control algorithms and procedures that operate in a distributed manner. With respect to broader impact,																			1										X						########	
NSF	ENG 0901682 / University of Virginia Main Campus	13.029	Ultraviolet Communication: Increasing the Distance-Rate Product	"This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5)." The objective of the research is to improve the distance-throughput product of ultraviolet communication systems by several orders of magnitude so that they may be used as inexpensive short-distance non-directed links, such as for voice and data. The approach taken combines a mix of communication-theoretic methods (modulation, coding, multi-beam transmission) and improved UV technologies (fine-tuned optics, powerful electro-optic devices) to obtain this gain. The research culminates in the development of an experimental testbed demonstrating and validating the concepts. The novel contribution of this work is the blending of advanced communication techniques with clever optics to improve the link quality and make it suitable for a variety of applications. Previous research efforts have been one-dimensional, focusing on the devices, the physics, or the modulation, and exclusively for military applications. Commercial applications require significantly higher capacity and reliability, and multiple simultaneous users. This research provides a systematic plan for accomplishing this																	1												X						########	
NSF	ENG 0901883 / Oregon State University	12.079	GOALI: Short-Range, Wireless Communications for Next-Generation Computing Systems	The objective of this research is to advance the fundamental understanding of the benefits and limitations of using short-range, low-latency, wireless communications in a conventional, multichip computing environment. Traditional computing platforms, consisting of many integrated circuits on a single printed circuit board, incorporate several types of wireline interconnects with varying bandwidth and latency requirements. This research takes a holistic approach in exploring the implications of using short-range wireless communication on different levels of the computing system, from the circuits and communications to the networking and system architecture. These implications have the potential to pave the way to integrated designs and methodologies for incorporating wireless capability in the inter-chip communication infrastructure of next generation computing systems. The intellectual merit of the research is the insight that the replacement of conventional, lower bandwidth serial communications with a multi-point, low-latency, wireless system will enable a number of computing system improvements, such as low latency, fault tolerance, reconfigurable bandwidth																					1								X						########	

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NSF	ENG 0912539 / Kai Medical, Inc.	2.021	SBIR Phase I: Wireless Sleep Monitor	This SBIR Phase I research proposed is to develop a new technique for detecting Obstructive Sleep Apnea (OSA) without contact with the patient. The proposal will explore the use of Doppler radar technology to provide respiratory movement, heart rate, and activity level that could be used in a Type III Home Sleep Devise (HST) device. With the use of a commercially available wireless pulse oximeter and a wireless airflow sensor, there is potential to build a fully non-intrusive, portable, Type III HST device that could be easily deployed at home and in the field. This research effort involves developing and testing of a robust Doppler radar system for sleep monitoring. The two main objectives of the project are to develop 5.8 GHz Doppler radar hardware that will provide an accurate measure of physiological motion and to develop new methods for detecting OSA. Sleep is widely understood to play a key role in physical and mental health. Yet research indicates that 40 million Americans suffer from insomnia and chronic sleep disorders, with over 12 million Americans suffering from OSA. Serious consequences including increased mortality can result from untreated sleep disorders. The scarcity of sleep clinics and the expense associated with standard															1													X						########	
NSF	ENG 0912667 / Resensys, LLC	1.105	SBIR Phase I: An RF Radiation Empowered Sensing Method for Low Cost Structural State Monitoring	This Small Business Innovation Research Phase I research project addresses distributed structural integrity monitoring of infrastructure systems such as bridges and pipelines. The existing solutions for structural state sensing are expensive, labor intensive, non-scalable, and unreliable. The focus of this project is to determine the feasibility of an innovative, cost effective, non-intrusive, and scalable structural-state sensing technology known as Active RF Test (ART). The ART technology is based on the use of mechanically flexible patch-like wireless sensor devices that can be attached to distributed points of a structure. ART uses RF energy delivered from an in-network energy source to the sensors. Because the ART sensor patches will be battery-less, they will be durable and environment-friendly. The expected outcomes of this project are a novel battery-less power system for the ART patch sensors including a receive and rectifier antenna and a thin film super-capacitor as the energy storage medium, an energy-efficient wakeup scheduling scheme, in which the active duty cycles of the sensors are synchronized for correlated measurements, and a proof-of-concept prototype of a flexible ART patch sensor. According to the National Bridge Inventory												1																	X						########	
NSF	ENG 0912758 / MultiFlow Communications	16.046	SBIR Phase I: Virtual Flow Pipelining Based Radio Communication Chip Architecture	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This SBIR Phase I research proposal will develop architectural solutions for programmable radio devices. The emergence of multiple radio access technologies and their continued evolutionary development drive a need to support them in a programmable manner. The objective is to enable flexibility for future evolution while ensuring processing of high data bandwidths. Current practices are based on the Software Defined Radio (SDR) approach. This approach lacks performance, is difficult to program and silicon-on-chip (SoC) devices are complex. The Virtual Flow Pipelining architecture proposed here enables programmable SoC devices with low hardware complexity, simple programming model, and high performance. These characteristics are achieved using atomic architectural support for the function synchronization, scheduling, sequencing and communication with performance guarantees. The benefits of the programmable platform are longer lifetime of devices, faster time to market, and universal reach. It will simplify prototyping effort, and accelerate product and technology adoption. The market																		1											X						########	

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NSF	ENG 0915842 / SUNY at Buffalo	12.119	NeTS:Small: A Joint Layered Coding Scheme for Unified Reliable and Secure Media Transmission over Wireless Networks	The objective of this research is to develop a joint layered coding scheme to meet the needs of end-to-end simultaneous error protection and secure media transmission over wireless networks. The approach takes advantage of the hierarchical structure of digital media compressed by media coding standards, such as JPEG2000 and MPEG-4/H.264. Simultaneous error and authentication protection is a significant goal of this project. The intellectual merit of this research lies in the integrated investigations into authentication strategy and data unit selection; joint media error and authentication protection; and optimal rate allocation for all components of the media transmission system. The proposed joint layered coding scheme has the potential to enable the design of both error protection and authentication within the same framework and to achieve optimal resource and bandwidth allocation. With respect to broader impact, the integration principle investigated here has the potential to be applied to more general system designs where components are competing for limited resources. Also, the layered coding-based integrated media authentication scheme has the potential to be resilient to denial-of-service attacks, thus																				1									X						########	
NSF	ENG 0917973 / Syracuse University	3.018	PFI: Wireless Grid Innovation Testbed	This Partnerships for Innovation (PFI) project--a Type II (A:B) partnership between Syracuse University, an NSF PFI graduate (0227879, initiated at Tufts University), and Virginia Tech University, which is currently a research site of another NSF-supported partnership program: I/UCRC Wireless Internet Center for Advanced Technology (WICAT) (0809036)--is focused on the creation of the first national Wireless Grid Innovation Testbed (WGIT). The project integrates prior knowledge and technology. Scientists at universities will work with a consortium of private organizations in a laboratory with the resources to support open innovation and user-created innovations in a system that supports their capture, documentation, and improvement. The intellectual merit of this project lies in the innovative combination of grid networking and wireless networking. The ultimate vision of the wireless grid is that of an adaptive network with secure, inexpensive, and coordinated real-time access to dynamic, heterogeneous resources, across geographic, political and cultural boundaries without forsaking stability, transparency, scalability, control and flexibility. Better assessment of wireless grids technology, network performance, and					1																								X						########	
NSF	ENG 0922812 / Southern Methodist University	12.094	MRI-Consortium: Acquisition of Near-Field Antenna Test System	The objective of this project is to acquire, install, and maintain a near-field antenna test system at the University of Texas at Dallas (UTD) - Southern Methodist University (SMU) Antenna Characterization Lab for use by the UTD-SMU faculty and students for research, development, and class instruction in the area of antennas and wave propagation as well as by local industries in the Dallas-Fort Worth metroplex area. Intellectual Merit: The proposed 3-D scanner measurement system will facilitate the development of antennas for wireless communications, particularly cellular phone antennas, window-unit antennas for satellite-ground communication, and antennas for spatial and polarization diversities. The antennas of cellular phones will have improved efficiency and produce substantially reduced harmful radiation to the user's head, while the window-unit antenna will be conveniently mounted flat over a window pane for satellite reception such as cable viewing. The spatial and polarization diversity will increase the reliability of currently available wireless devices. Broader Impacts: The UTD-SMU Antenna Characterization Lab expects three broad impacts from the acquisition of the facility																				1									X						########	

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NSF	ENG 0924028 / Pharad LLC	13.022	STTR Phase II: Optical Fiber Distributed 60 GHz Wireless Personal Area Network	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer (STTR) Phase II research project will create novel technologies for the realization of a cost-effective, optical fiber distributed 60 Gigahertz (GHz) wireless personal area network (WPAN). The 60 GHz frequency region for wireless communications is attracting much interest worldwide because of the huge bandwidth it can provide. The integration of a 60 GHz WPAN with a fiber-optic signal distribution scheme will enable the required high data rate signals to be efficiently and cost-effectively delivered to a large number of radio access points ensuring optimized radio coverage. A cost-effective prototype wireless access point for a fiber distributed 60 GHz WPAN will be developed and multi-gigabit-per-second (Gb/s) bi-directional data transmission demonstrated. Consumers will directly benefit from the fiber distributed 60 GHz WPAN through the provision of new communication services and the increased affordability in gaining access to unprecedented multi-Gb/s data rate tetherless connectivity. The broader impacts of this research are the														1															X						########	
NSF	ENG 0925034 / University of Washington	2.014	Integrated Space-time Strategies for Imaging and Communication in Complex Environments	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). The objective of this research is the development of new generalized integrated imaging and communication technologies making use of recent studies on several techniques such as time-reversal imaging, correlation imaging, and array coherence tomographic imaging. These integrated techniques offer new areas of research with a potential for practical applications. The approach is the combined use of analytical, numerical and experimental studies for the specific topics of: (i) information fusion of multiple imaging sensors; (ii) coherent passive radars making use of angle-of-arrival estimation and ambiguity function; and (iii) research on communications through complex environments unifying propagation research and signal processing. Theories and computations are often based on assumptions and approximations and it is important to verify the results by experiments. This research includes experiments using the proposed methods to verify the theories and to point to new improvement of theories. The intellectual merit of this research is new theoretical foundations which unify propagation and															1														X						########	
NSF	ENG 0925469 / University of Rochester	16.031	Information Theoretical Approach to Data Converters Design: Turbo-code A/D Converters	The objective of this research is to develop a new class of high performance analog-to-digital converters. The approach is to treat an analog-to-digital converter as a communication channel and to employ concepts from information and communications theory in its analysis and design. Existing architectures fall far short of the theoretical "conversion capacity," the maximum bit resolution - bandwidth product achievable for a given device technology. However, by employing turbo-coding principles and other near-capacity achieving coding schemes, converter architectures that approach theoretical conversion capacity are possible. Intellectual Merit: This research synthesizes two previously disconnected fields, information theory and analog integrated circuit design, to give new insights into analog-to-digital converter performance limits and to lead to architectures that will enable the theoretical performance limits to be reached by employing advanced coding strategies to overcome practical limitations such as device switching speed and noise. Broader Impacts: Improved analog-to-digital converters will enable applications such as software-defined radio to improve the															1														X						########	

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NSF	ENG 0925670 / Cornell University	12.167	Ultra-Flexible Radios for Networks of Avian RF Tags	The objective of this research is to develop radios for multi-function bird tracking tags. Each radio tag will support geo-localization, in-flight telemetry and networking. The approach is to develop a passive-mixer-first radio architecture that connects highly flexible baseband circuitry to the antenna through a "transparent front-end." State-of-the-art radios provide programmable gain, bandwidth, and center frequency, but have fixed antenna interfaces, dramatically reducing their flexibility. The proposed ?transparent front-end? allows direct interaction between highly controllable baseband circuitry and variable, poorly controlled antennas. Thus, all important properties of the radio are made programmable, including previously fixed properties such as impedance matching, allowing on-the-fly reconfiguration. Furthermore, this flexibility comes with little or no cost in terms of power consumption or performance. By developing the theoretical and practical aspects of the design of transparent front-ends, this project will complete a multi-decade trend from fixed, single function radios to fully flexible multi-function transceivers. Because transparent front-end radios enhance performance while reducing cost and size, they are likely																		1											X						########	
NSF	ENG 0925797 / North Carolina State University	12.156	Stretchable, Tunable, Self-Healing Microfluidic Antennas	"This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5)." The objective of this research is to investigate microfluidic technology as a platform for highly flexible antennas and electronics. The approach is to fill flexible, elastomeric microchannels with a liquid metal that has unique rheological properties. These properties allow the liquid metal to maintain mechanical stability in the channels and to flow in response to deformation (stretching, flexing, wrapping) to ensure electrical continuity while providing significant tunability and conformability. The proposed devices represent a significant improvement from conventional copper antennas, which cannot be stretched beyond ~2% strain without inducing irreversible damage. This collaborative project will have an impact on applications ranging from wireless devices to biomedical electronics. The research will provide a better understanding of the characteristics and limitations of the proposed systems, and will allow this technology to be incorporated into complex antenna architectures. The proposed interdisciplinary research will benefit society by leading to advanced electronics																		1											X						########	
NSF	ENG 0925881 / Michigan Technological University	1.022	Compression and Cooperation for Wideband Spectrum Sensing and Cognition	The objective of this research is to increase the resolution and reduce the cost of wideband spectrum sensing and cognition, which are challenging core issues in spectrum-sharing cognitive networks. The approach seeks to leverage the benefits of compressive sampling and user cooperation to develop a collaborative compressed sensing framework for wideband networks. Research thrusts include compressed wideband sensing at affordable signal acquisition costs and reliable collaborative sensing with low network overhead. This research combines compression and collaboration techniques with the goal of innovation in wideband spectrum sensing. The project seeks to develop a suite of compressed sensing algorithms that exploit spectral sparsity to reduce the need for high-speed sampling in ultra-wideband and wideband radios. A decentralized approach for joint cooperation and compression, which exploits spatial diversity to alleviate the hidden terminal problem caused by wireless channel fading, is investigated for ad hoc cognitive networks. Further, the research examines fundamental tradeoffs in a cooperative sensing system including diversity gain, compression, sensing time and complexity. This project has the													1																	X						########	

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NSF	ENG 0926029 / Iowa State University	2.025	Soil Sensors and their Wireless Underground Network for Precision Farming and Environmental Management	The objectives of this program are to develop: (1) In-situ soil sensors for monitoring soil properties such as soil moisture and nitrates; (2) Underground wireless sensor network for autonomously gathering the spatio-temporally varying soil properties; (3) Information management and decision-making technology based on distributed monitoring for modeling and analysis of agricultural production systems. The intellectual merits are: (1) Development of a network based framework for researchers to better understand properties of soils and the environment over a large area; (2) Establishment of an underground sensor and communication network; (3) Development of tools for fertilization management in farming for minimizing their environmental impact while meeting crop demands. The broader impacts are: (1) The proposed program is a step toward precisely controlling fertilizer application that will help reduce their run-offs to the watersheds and minimizing the environmental impact; (2) The proposed underground sensor network will find its use in any application requiring remote underground distributed-sensing, safety against surface activities (human, fire, etc.), or covertness (e.g., border patrol); (3) The underground															1														X						########	
NSF	ENG 0926833 / Iowa State University	16.014	BRIGE: Architectures and Circuits for Simultaneous Spectrum Sensing and Data Reception in Cognitive Radio	In certain emergency situations the existing communication infrastructure may be damaged or simply overloaded. Through the use of cognitive radio networks, emergency personnel would maintain the ability to communicate, share data, and coordinate large numbers of people. The PI's long term research goals are to make significant contributions in the area of realizing a viable, fully integrated cognitive radio that is capable of operating over the frequency range of 1 - 10 GHz. A critical component of such a system is the spectrum sensing front. A major limitation in current spectrum sensing front ends is their limited range of operating frequencies (typically less than 1 GHz) and large sensing overhead. This proposal discusses research aimed at a spectrum sensing front end that is capable of performing simultaneous spectrum sensing and data reception while operating over the frequency range of 1 - 10 GHz. This project will be divided into the following four tasks: development of a simultaneous spectrum sensing and data reception algorithm, development of a wideband spectrum sensing architecture, development of narrowband, tunable circuits for the chosen architecture and validation and demonstration The															1														X						########	
NSF	ENG 0928092 / Lehigh University	12.141	New Model and Methodology for Signal Estimation and Decoding	This project aims to apply nonlinear dynamics to the study of (iterative) statistical inference, an important class of algorithms with well-proven applications in communications, signal processing and artificial intelligence. Existing models and methodologies for iterative analysis, coming largely from an information theoretical perspective, are inadequate in predicting and controlling the individual (rather than the ensemble-average) time-evolution behavior of a large-dimension and highly-dynamic signal sequence. On the other hand, estimating nonlinear dynamical systems, especially the challenging case of chaos, has not taken advantage of the powerful tool of statistical inference nearly as much as it could have. A wide spectrum of activities are planned to bring together the important ideas and tools from these two fields, to supply each other with new perspectives and new approaches, and to hopefully generate a whole new engineering methodology for unifying classical signals and chaotic signals. Specific focus will be set on understanding the cause and impact of chaotic behavior in statistical inference, developing ways to control chaos and transient chaos, and using statistical inference on appropriate models, such as																					1								X						########	

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NSF	ENG 0930676 / ADVANCED DIAMOND TECHNOLOGIES	12.158	STTR Phase I: Piezoelectric/diamond RF MEMS Filters for Mobile Wireless Applications	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer Phase I project will develop ultrananocrystalline diamond (UNCD®) as a high frequency structural layer for piezoelectrically-transduced micromachined RF resonators for MHz-GHz applications in wireless telecommunication systems. Diamond, in theory, is the ideal RF MEMS resonator material, having the extreme bulk properties of high acoustic velocity, hardness, thermal stability, and linearity, combined with the surface properties of low stiction and desirable surface chemistry. Diamond MEMS resonators can enable MEMS RF devices for civilian and military applications and allow for the direct integration of MEMS with microelectronics. With the potential for 100× reduction in size and power consumption relative to existing technologies while extending the performance of "radio on a chip" systems into the GHz, the RF MEMS market is forecasted at $1.1 billion by 2010.																		1											X						########	
NSF	ENG 0932542 / University of Texas at Dallas	2.026	Student Design Projects to Aid Hearing Impaired at The University of Texas at Dallas	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). 0932542 Torlak The aim of this proposal is to implement a highly focused program at The University of Texas at Dallas that enables seniors enrolled in senior design projects in the Department of Electrical Engineering (EE) to partner with clinical collaborators from The Callier Center for Communication Disorders and explore new ideas for improving access, integration and quality of life for persons with hearing disabilities. The Callier Center for Communication Disorders at the University of Texas at Dallas is a multifaceted, university based institution containing a large number of interdisciplinary programs. This effort will combine a unique blend of resources, personnel, and NIH-sponsored projects in The Department of Electrical Engineering and Callier Center for engineering seniors to understand the bases, treatments, and technology for persons with hearing impairments. Intellectual Merit The objective of the proposed design program is to encourage collaboration for senior engineering students with Audiology students, persons with impaired hearing, and research faculty to identify assistive															1													X						########	
NSF	ENG 0934091 / University of Hawaii	12.168	University of Hawaii Partnership with the NSF I/U CRC for Telecommunication Circuits and Systems at Arizona State University	Center for Telecommunication Circuits and Systems (Connection One) IIP-0934091 University of Hawaii Iskander This is a proposal to renew the University of Hawaii's participation in the Connection One (C1) center, an I/UCRC center that was created in 2002. The lead institution is Arizona State University, and at present includes five universities. The main research mission of the C1 is to develop technologies and solutions for emerging wireless communication systems, ranging from circuit designs and smart antennas to wireless network architectures and protocols. The scope of C1 extends to the integration of wireless and broadband wire-line technologies (optical communications). The primary focus of the proposed site over the next five years will be to continue providing the capabilities, expertise, and research facilities for conducting research that complements and supports the overall research focus in the Connection One Center. The University of Hawaii (UH) brings in significant research strength in areas such as channel modeling, advanced antenna system designs, and digital signal processing for smart antennas and effective detection and classification of buried objects. UH has been a member of C1 since																					1								X						########	

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NSF	ENG 0936200 / Institute of Electrical & Electronics Engineers, Inc.	5.008	Workshop: Student Travel Support to the 2009 IEEE MTT-S International Microwave Symposium. To be Held in Boston, MA on June 8-12, 2009.	The objective of this activity is to provide partial travel support for six students from U.S. universities to attend the 2009 IEEE MTT-S International Microwave Symposium (IMS). The IMS is the annual meeting of the Microwave Theory and Techniques Society (MTT-S) of the Institute of Electrical and Electronics Engineers, Inc. (IEEE). The IMS is also the major international symposium in the microwave field and a focus of research results in wireless telecommunications. The 2009 IMS will be held in Boston, MA, USA on June 8-12, 2009. Intellectual Merit: The main impact is primarily educational, as the travel support allow students' participation in IMS 2009. This participation is an important part of the education process. It provides students with the opportunity to interact with more experienced researchers, and to be exposed to new areas of research. Broader Impact: Student participation at the IMS not only promotes education but also fosters the next generation of microwave engineers.																				1								X							########	
NSF	ENG 0944654 / Leanics Corporation	2.019	SBIR Phase I: High-Rate Low-Power Wireless Telemetry System for Medical Applications	This Small Business Innovation Research (SBIR) Phase I project proposes to demonstrate the feasibility of an efficient high throughput video broadcast system over the Medical Implant Communication Service (MICS) band for camera pill and micro robot technologies while maintaining ultra low power consumption. Current camera pill designs have relatively low data rate and high power consumption. The proposed system is designed to significantly improve the specifications over the existing systems in use. The intellectual merit of the proposed research lies in the design of an integrated circuit for camera pill applications which combines advanced digital broadband technologies like orthogonal frequency division multiplexing (OFDM), low density parity check (LDPC) code, and diversity combining with the state of the art VLSI architecture designs. Major expected advantages of this technology include: ultra high throughput, super low power and compact transmitter, low cost transmitter, long distance spec, real-time transmission, accurate synchronization algorithms, frequency bandwidth efficiency, and interference avoidance. Furthermore, if this high throughput system is used with other low rate devices, the remaining																			1										X							########	
NSF	ENG 0944685 / Beam Power Technology, Inc.	12.148	SBIR Phase I: High-efficiency, high-power, lightweight elliptic-beam traveling-wave-tube amplifier for satellite communications	This Small Business Innovation Research (SBIR) Phase I project proposes to research and develop a novel, broadband, high-efficiency, high-power elliptic-beam helix traveling-wave-tube amplifier (TWTA). The proposed project addresses the problem and opportunity in satellite communication, i.e. the need of broadband amplifiers that are efficient, high-power, highly reliable, and above all small and lightweight. The Phase I research objective is to determine the scientific, mechanical and manufacturing feasibility of the proposed elliptic-beam helix TWTA. The Phase I research includes: 1. Optimization of the gain and efficiency of the proposed elliptic-beam helix TWTA; 2. Concept design of a suitable elliptic electron beam system; 3. Preliminary electrical design of an elliptic helix rf structure; and 4. Preliminary mechanical design of the proposed elliptic-beam helix TWTA. The proposed elliptic-beam helix TWTA is anticipated to significantly improve the efficiency, power output, reliability, size and weight over the conventional circular-beam helix traveling wave tube amplifiers (TWTAs) which are currently the technology of choice for satellite communications. The broader impact/commercial potential of this project																						1								X							########	

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NSF	ENG 0944995 / HYPRES, Inc.	16.044	SBIR Phase I: Modified Doherty Transmit Architecture Employing Digital Signal Synthesis for Wideband RF Communication	This Small Business Innovation Research (SBIR) Phase I project proposes to demonstrate a Radio Frequency (RF) transmitter capable of groundbreaking performance for wireless infrastructure applications. Significant performance gains are expected from three main innovations in this highly-digital transmitter. First, building on the Doherty Power Amplifier (PA), a unique method of optimal digital synthesis of the RF drive signals is proposed; no analog upconversion, power-split and phase adjustment are needed. Digital signals drive a Doherty PA with modified bias, achieving higher efficiency than conventional designs. Second, efficiency and linearity are further improved over wide bandwidth (BW) by predistorting the digitized RF waveform directly. Third, a modular PA implementation is introduced, which is adaptively reconfigured to optimize the overall power efficiency with varying load. The design goals of the proposed work are: wide BW (100MHz), widely programmable carrier frequency (2.3-2.8GHz), high linearity (better than -65dBc), high output power (200W) and excellent average efficiency (>60% at 10dB backoff). Analysis comparing the proposed PA to a conventional design shows average															1														X						########	
NSF	ENG 0945252 / FIDELITY COMTECH INC	1.106	SBIR Phase I: Dynamic Broadband Wireless Networks	This Small Business Innovation Research (SBIR) Phase I project will demonstrate the feasibility of building networks that can adaptively adjust their cell coverage (the geographic footprint of the radio signal) to optimize performance. These adjustments may be in response to changing environmental conditions, interference, changing traffic patterns, or failures in portions of the system. The intellectual merit of the proposed activity is to facilitate the deployment of large scale broadband networks by developing technology that can automatically adapt coverage and mitigate interference. As broadband wide-area wireless networks (e.g., WiMAX and fourth generation cellular) become more pervasive and cell sizes become smaller, it becomes increasingly difficult to set up such networks so they efficiently share the finite RF spectrum. The problem is exacerbated by the fact that these networks and the environment in which they exist is changing all the time. This project will demonstrate that cooperating phased array antennas can continuously adapt their coverage areas to optimize total network performance using a combination of RF propagation models, antenna pattern creation algorithms, and constrained optimization procedures based												1																	X						########	
NSF	ENG 0945428 / MetaTenna	12.149	SBIR Phase I: Inkjet Printed Antennas for Wireless Local Area Networks	This Small Business Innovation Research (SBIR) Phase 1 project will result in transparent, conductive organic polymer antennas that have the potential to revolutionize wireless communications. Recent advances in material science have allowed for conductive organic polymers that can enable transparent polymer structures on a variety of substrates. The principal technical activities of the project involve: i.) Developing chemical formulations and fabrication techniques to use commercial materials printers to inkjet print antennas out of flexible and transparent conductive organic polymers and ii.) Measuring the radiation efficiency, gain, and data transfer performance of the new antennas on a variety of conformal antenna structures. The broader impact/commercial potential of this project include the significant commercial potential of having antennas that are optically transparent and fabricated using additive inkjet processing techniques. Antennas can be printed on transparent stickers and adhered to different surfaces. Antennas that previously occupied valuable circuit board space on mobile devices, could be printed conformally on the surface of the device, allowing them to be miniaturized. The																						1								X						########	

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NSF	ENG 0945497 / XW, LLC	12.146	SBIR Phase I: Adaptive Filter Bank Modulation for Ubiquitous Landline-Based Broadband Access	This Small Business Innovation Research (SBIR) Phase I project targets significantly increased throughputs and distances for broadband access over landline infrastructure in both urban and suburban/rural environments. For many underserved areas, it will offer the only low-cost broadband access alternative to costly, inefficient satellite coverage. In the physical-layer communication system being developed, conventional Fourier Transform (FT) based Discrete-Multi-Tone (DMT) techniques are replaced with the more spectrally efficient Wavelet-based Adaptive Filter Bank Modulation (AFBM) patented technology. A key aspect of this innovation is in the adaptive nature of its modulation method, optimizing use of available channel capacity. The project will comprise both in-depth theoretical analysis, at the algorithmic level, as well as implementation challenges, where innovation at the architectural level is expected to minimize system cost and power consumption. The theoretical research will target spectrum utilization maximization in the constrained copper-wire channels, which is enabled by the adaptive features of the technology combined with a novel approach to the wavelet-basis selection and its use in the																		1											X						########	
NSF	ENG 0946111 / Nano Liquid Devices, Inc	16.043	SBIR Phase I: Low Cost, High Bandwidth RF Switch	This Small Business Innovation Research Phase I project is aimed at developing Micro Metal Sphere (MMS) fabrication technology for Radio-Frequency (RF) Micro-Electro-Mechanical-System (MEMS) switch. The target applications are high-bandwidth RF switches and digitally-tunable RF modules that can be used in wireless communication systems including cell phones. The MMS technology is distinguished from conventional cantilever or bridge type MEMS switches in that it does not have a suspended element and no restoring force is involved in the switch actuation. In conventional MEMS switches, the restoring force is often not able to overcome interfacial forces over time and causes the infamous stiction that leads to permanent failure. Since the MMS switch is designed to switch with free body, it does not suffer from mechanical wear and possibly free from stiction. In addition, the MMS technology can provide an extremely cost effective packaging solution replacing commonly used labor intensive and costly wafer level packaging technology. Since the MMS technology is integration-friendly with conventional silicon CMOS technology, it can be placed on top of any CMOS IC. Therefore, anticipated benefit with the																		1											X						########	
NSF	ENG 0946124 / Auctionomics	18.024	SBIR Phase I: Incorporating Bidder Budgets in Multi-Item Auctions	This Small Business Innovation Research (SBIR) Phase I project will develop auction software that allows bidders to specify budget constraints, and will assess the feasibility of this software for conducting large-scale multi-item auctions. Multi-item auction design has been at the frontier of research in economics and computer science over the past fifteen years. Yet no existing mechanism enables effective competition when bidders face serious budget constraints. New, sealed-bid designs that enable bidders to specify a budget encourage bidders to place more and higher bids, better reflecting values. Sellers will therefore receive higher prices and assignments of goods will be more economically efficient. In multi-item auctions, bidders often cannot risk outcomes where they may be required to pay more than their authorized budgets. Examples are widespread, ranging from online ad placement to auctions of mineral rights and radio spectrum licenses, and rudimentary technologies to account for Internet ad budgets have already been deployed. There is an immediate need for related budget-based technology physical world auctions where the absence of such technology is reducing the number and level																									1					X						########	

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NSF	ENG 0948132 / Clemson University	12.07	EAGAR: Collaborative Research: Towards A Unified Wireless Network Involving Reconfigurable Devices	This EArly-concept Grants for Exploratory Research (EAGER) project considers a vision of a future wireless network where all mobile devices in the network consist of one or more software-defined radios that support multiple communication modes and access schemes and where the network actively manages the access modes of the constituent terminals. The research seeks to realize this vision by combining expertise in network architectures, physical layer issues, and network layer issues and by considering cross-layer co-design. The project aims to: (i) improve understanding of the roles and impacts of next-generation software-defined radios on future wireless systems; (ii) produce a device model that accurately represents the capabilities and limits of next-generation software-defined radios; and (iii) develop new techniques for managing bandwidth in such a unified wireless network. With respect to intellectual merit, the research has the potential to produce a novel resource allocation scheme that provides a set of services over a heterogeneous wireless infrastructure considering the capabilities and limitations of software-defined radios. The project will develop preliminary results related to these approaches and preliminary																		1											X						########	
NSF	ENG 0948155 / University of California-Irvine	12.071	EAGER: Collaborative Research: Towards a Unified Wireless Network Involving Reconfigurable Devices	This EArly-concept Grants for Exploratory Research (EAGER) project considers a vision of a future wireless network where all mobile devices in the network consist of one or more software-defined radios that support multiple communication modes and access schemes and where the network actively manages the access modes of the constituent terminals. The research seeks to realize this vision by combining expertise in network architectures, physical layer issues, and network layer issues and by considering cross-layer co-design. The project aims to: (i) improve understanding of the roles and impacts of next-generation software-defined radios on future wireless systems; (ii) produce a device model that accurately represents the capabilities and limits of next-generation software-defined radios; and (iii) develop new techniques for managing bandwidth in such a unified wireless network. With respect to intellectual merit, the research has the potential to produce a novel resource allocation scheme that provides a set of services over a heterogeneous wireless infrastructure considering the capabilities and limitations of software-defined radios. The project will develop preliminary results related to these approaches and preliminary																		1											X						########	
NSF	ENG 0952581 / Rensselaer Polytechnic Institute	13.015	Modeling and Performance Optimization of mm-wave Frequency Synthesizers	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). The objective of this research is to investigate a new class of mm-wave phase-locked loops (PLLs) for ultra-wide bandwidth applications. Current mm-wave PLLs are based on injection-locked frequency dividers, which have many locking limitations that affect their operating range. These limitations translate to limited data rate communications, and low resolution in imaging and spectroscopy applications. This work proposes a fundamental change in the design of mm-wave phase locked loops, combining the functions of the oscillator and injection-locked frequency divider through the use of N-push operation. The intellectual merit of this proposal is manifested in its goal of developing new circuit techniques for mm-wave applications that efficiently utilize the wide bandwidth available and lends itself to operation at even higher frequency at the mm-wave/THz boundary. The proposed approach is expected to achieve an order of magnitude improvement in the phased-locked-loop operation range and simplify the design of the fundamental oscillator and the selection process of the frequency divider. A successful effort will provide the																	1												X						########	

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NSF	ENG 0956792 / Carley Technologies, Inc.	16.052	STTR Phase II: Tunable RF Front Ends for Wireless Devices	This Small Business Technology Transfer (STTR) Phase II project addresses the creation of tunable radio frequency filters for future wireless devices. The proposed approach combines research on advanced magnetic materials with research on nano-structuring of magnetic and non-magnetic materials with the goal of achieving an order of magnitude or more increase in quality factor (Q) and maximum value of inductors (Ls) used to implement tunable inductor capacitor (C) filters at frequencies up to 5GHz; specifically Ls > 50nH, Qs > 100, and self-resonance frequencies > 3 GHz. The approach is to economically deposit oriented high-moment magnetic materials in a non-magnetic matrix to achieve high permeability while avoiding eddy current losses at high frequencies through the use of nano-structuring. In addition, this research will explore novel circuit design techniques for radio front ends that will exploit inductors fabricated using the proposed structures to implement tunable radio frequency filters suitable for advanced wireless devices. Novel circuit design approaches must be developed because the LC filters built using the proposed technology will have significantly lower Q than existing surface acoustic wave filter														1															X						########	
NSF	ENG 0956880 / LHC2 Inc.	12.161	STTR Phase II: Smart Antenna Systems for Unlicensed ISM-band Public Safety and Remote Meter Reading Data Networks	This Small Business Technology Transfer Research (STTR) Phase II project will develop high performance, low-cost, interference filtering smart-antenna prototypes, anticipated to improve Signal to Interference Ratios (SIR) by up to 12dB. This results in improved wireless data rates by up to a factor of 4 or expands coverage by up to a factor of 16, dramatically reducing system costs. Private wireless broadband networks, deployed by municipalities and utilities are used for public safety, public Internet access, and energy and water management. These networks are experiencing dramatic growth in both size and number. This growth, along with expanding enterprise and consumer use of overlapping devices and Wireless Local Area Networks (WLANs), continue to exacerbate performance reducing interference problems. This interference has forced many municipalities to double their investments in infrastructure equipment or to increase transmitter power to overcome interference, thus producing even more interference. Phase II objectives are to demonstrate technology effectiveness and conduct customer trials. Tasks include; antenna structure refinement, transceiver design, smart antenna algorithm																			1										X						########	
NSF	ENG 0958317 / Montana State University	12.096	MRI-R2: Acquisition of Instrumentation for Development and Testing of Digital Beamforming Antennas	This proposal will be awarded using funds made available by the American Recovery and Reinvestment Act of 2009 (Public Law 111-5), and meets the requirements established in Section 2 of the White House Memorandum entitled, Ensuring Responsible Spending of Recovery Act Funds, dated March 20, 2009. I also affirm, as the cognizant Program Officer, that the proposal does not support projects described in Section 1604 of Division A of the Recovery Act. "See Section I.B. above for additional information on implementation of ARRA Section 1604 Intellectual Merit This instrumentation supports research and development of adaptive digital beam forming antennas and related digital signal processing techniques to enable reliable high-speed wireless communications in ad hoc and mesh networks. This project explores the use of smart, adaptive antennas in conjunction with a high bandwidth radio system to yield improved range and also to suppress potential interference from unwanted signals. The goal is to develop a compact, low cost, light weight, smart, adaptive antenna system using digital signal processing techniques that can readily inter-work with new chip-scale radio technologies. This technology																						1								X						########	

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NSF	ENG 0958908 / Villanova University	12.095	MRI-R2 Acquisition of Enhanced Antenna Measurement Facilities for Emerging RF and Millimeter-Wave Applications	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Objective The Antenna Research Laboratory at Villanova University is a unique regional and national facility existing in only a handful of US Universities. The existing facility is capable of automated antenna pattern, gain and radar measurements from 2 to 40 GHz, and has supported numerous projects in this frequency range. This 10-year-old facility, however, is rapidly becoming dated, and needs upgrading if it is to continue to be a useful means to conduct leading academic research and training. Our objective is to expand the capability of this facility to include measurements from 500MHz to 110GHz. Intellectual Merit The intellectual merit of the new instrumentation is in expanding the performance of the existing facility to enable future leading edge research dealing with scale model measurements of antennas on large platforms, millimeter-wave antennas and arrays, Global Positioning Systems, wireless communication and RFID Systems, and Imaging Systems, all areas of interest to federal and industry sponsors and potential users of the facility. Broader Impacts The broader impact of the new facility is																		1												X						########	
NSF	ENG 1000551 / University of Massachusetts Lowell	2.003	Collaborative Research: Multivariate Remote Process Sensing for Improved Observability in Injection Molding	The objective of this collaborative research project is to significantly improve observability in polymer processing and characterize its contribution to higher product quality and manufacturing productivity. Multivariate, wireless sensors will be designed and structurally integrated into an injection mold to monitor the dynamic variations in four critical polymer states: pressure, temperature, velocity, and viscosity. An embedded ASIC chip (Application-Specific Integrated Circuit) will be incorporated within the sensor package to coordinate the multi-modal sensing actions, enable adaptive sampling rates to capture the process dynamics in an energy-efficient manner, and control the acoustic-based wireless digital transmission of the four process parameters. If successful, the research will advance knowledge and understanding of energy harvesting means for remote sensing and the optimal interface of sensors with embedded microelectronics, in a harsh manufacturing environment. The design of the sensors represents the first system integration of piezoelectric and infrared transduction principles with mechanistic analysis, and has the potential to improve molding productivity, wherein each percentage point																		1												X						########	
NSF	ENG 1000816 / University of Connecticut	2.004	Collaborative Research: Multivariate Remote Process Sensing for Improved Observability in Injection Molding	The objective of this collaborative research project is to significantly improve observability in polymer processing and characterize its contribution to higher product quality and manufacturing productivity. Multivariate, wireless sensors will be designed and structurally integrated into an injection mold to monitor the dynamic variations in four critical polymer states: pressure, temperature, velocity, and viscosity. An embedded ASIC chip (Application-Specific Integrated Circuit) will be incorporated within the sensor package to coordinate the multi-modal sensing actions, enable adaptive sampling rates to capture the process dynamics in an energy-efficient manner, and control the acoustic-based wireless digital transmission of the four process parameters. If successful, the research will advance knowledge and understanding of energy harvesting means for remote sensing and the optimal interface of sensors with embedded microelectronics, in a harsh manufacturing environment. The design of the sensors represents the first system integration of piezoelectric and infrared transduction principles with mechanistic analysis, and has the potential to improve molding productivity, wherein each percentage point																		1												X						########	

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NSF	ENG 1001815 / Oakland University	12.06	Collaborative Research: Signal Processing Devices Based on Spin-Torque Nano-Oscillators	Collaborative Research: Signal Processing Devices Based on Spin-Torque Nano-Oscillators Recent breakthroughs in understanding of current-induced magnetization dynamics in nano-structures have led to the emergence of a new type of microwave spin-torque nano-oscillatorssources. The goal of this collaborative research program is to create experimental prototypes and develop a theory of operation of two novel microwave signal-processing devices that are based on spin-torque nano-oscillators : (i) ultra-fast broadband spectrum analyzer;(ii) on-chip microwave signal modulator. The proposed devices are based on a new oscillator geometry with two ?free? magnetic layers. In this geometry, the free layers precess in directions opposite to each other, thus doubling the frequency of the generated microwave signal. This novel geometry will pave the way towards the development of oscillator-based devices with operation frequency of up to 80 gigahertz. Another goal of this program is to research the possibilities for wireless on-chip and chip-to-chip communications between the developed nano-sized devices, that will allow them to exchange and process microwave signals without high-resistance																		1											X						########	
NSF	ENG 1002113 / University of Michigan Ann Arbor	2.001	Collaborative Research: Multi-band Differential Code-Shifted Reference Technology for Ultra Wide Band Radio Applied to Intra-Vehicle Wireless Control and Communications Systems	ECCS-1002150 (Lead) and 1002113 (Non-Lead) Hong Nie and Weidong Xiang University of Northern Iowa and University of Michigan-Dearborn Abstract Intellectual Merit: Modern automobiles increasingly rely on electronics and computing technologies to achieve enhanced vehicle control and intra-vehicle communications capabilities, resulting in large amounts of wiring and placing a considerable engineering burden on the designers of automobiles. Ultra Wide Band radio is a promising technology for intra-vehicle wireless control and communications applications since it is capable of achieving high-speed and robust transmissions within a short distance. However, in-vehicle channels introduce dense and extended multi-path components into received signals, and are sensitive to the movement of drivers and passengers. Hence existing Ultra Wide Band technologies need to be redesigned when applied to an in-vehicle environment. This collaborative project firstly addresses the differential code shifted reference technology to capture more signal energy without performing channel estimation leading to an enhanced bit-error rate performance in a low complexity. Secondly,																			1											X						########	
NSF	ENG 1002150 / University of Northern Iowa	2.002	Collaborative Research: Multi-band Differential Code-Shifted Reference Technology for Ultra Wide Band Radio Applied to Intra-Vehicle Wireless Control and Communications Systems	ECCS-1002150 (Lead) and 1002113 (Non-Lead) Hong Nie and Weidong Xiang University of Northern Iowa and University of Michigan-Dearborn Abstract Intellectual Merit: Modern automobiles increasingly rely on electronics and computing technologies to achieve enhanced vehicle control and intra-vehicle communications capabilities, resulting in large amounts of wiring and placing a considerable engineering burden on the designers of automobiles. Ultra Wide Band radio is a promising technology for intra-vehicle wireless control and communications applications since it is capable of achieving high-speed and robust transmissions within a short distance. However, in-vehicle channels introduce dense and extended multi-path components into received signals, and are sensitive to the movement of drivers and passengers. Hence existing Ultra Wide Band technologies need to be redesigned when applied to an in-vehicle environment. This collaborative project firstly addresses the differential code shifted reference technology to capture more signal energy without performing channel estimation leading to an enhanced bit-error rate performance in a low complexity. Secondly,																			1											X						########	

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NSF	ENG 1002152 / Tufts University	13.012	Collaborative Research: Active Metamaterial/pHEMT Hybrid Devices for Terahertz Modulation and Detection	The objective of the research is to design and develop a suite of electronic devices operating at terahertz frequencies. The approach is based on the active control of metamaterial structures using plasma wave resonant behavior of the gated two-dimensional electron gas in the channel of GaAs HEMT devices. Intellectual Merit: The research is focused on the creation of unique metamaterial/pHEMT hybrid devices to fill the "terahertz gap," where very few components exist today. The fundamental approach uniquely combines the emerging field of electromagnetic metamaterials with novel plasma wave electronic transport phenomena in transistors. The plasma wave behavior in sub-micron transistors offers the unique possibility to detect and modulate terahertz frequency signals. Modulator and demodulator device architectures will be developed to facilitate wireless communications in the terahertz regime with targeted data rates exceeding hundreds of gigabits per second. Broader Impacts: The research will help catalyze development in diverse areas such as high data rate wireless communications, terahertz spectroscopy for cancer detection and tools for homeland security. The project will establish research and teaching															1															X						########	
NSF	ENG 1002180 / University of Minnesota-Twin Cities	1.011	Sparsity-Aware RF Cartography for Cognitive Networks	ECCS-1002180 Georgios Giannakis University of Minnesota Sparsity-Aware RF Cartography for Cognitive Networks ABSTRACT Intellectual Merit: Wireless cognitive radio (CR) technology holds great promise to address fruitfully the perceived dilemma of bandwidth under-utilization versus spectrum scarcity, which has rendered fixed-access communication networks inefficient. Accordingly, the need arises for fundamental research in critical cognition infrastructure to sense, learn, and adapt to the environment CR networks operate. This proposal aims to develop this infrastructure for comprehensive situation awareness through the novel notion of RF cartography. Paralleling the success of routing tables, the vision is to jointly utilize interference and channel gains maps to identify opportunistically available bands for re-use, and handoff operation; localize and track user activities; as well control resource allocation and routing decisions. The approach draws from contemporary advances in sparsity-aware regression, compressive sampling, basis expansions, spline interpolation, and kriged Kalman filtering. The project leverages these tools to investigate: (a) distributed, online, and adaptive algorithms for map estimation and														1															X						########	
NSF	ENG 1002214 / University of Florida	12.142	Resource-Constrained Wireless Video Communication	The proposal aims to improve the quality of video communications, especially real-time video, over wireless networks for power limited devices. It is comprehensive in that it includes theoretical work, algorithm design, and testbed implementation. The objective of this research is to study resource-constrained wireless video communication; the resources under consideration include bandwidth, power, and delay. The proposed approach is a novel delay-Power-Rate-Distortion theory, which provides a means to quantify the relationship among delay, power consumption, bit-rate, and video distortion. In this project, the PI will apply the proposed delay-Power-Rate-Distortion theory to cross-layer design that jointly optimizes the video encoder and the wireless communication component under total resource constraints; and develop a general-purpose testbed with implementation of the proposed algorithms. The ideas and approaches outlined in this proposal are expected to fill a number of important gaps in fundamental understanding of resource-constrained wireless video communication and will provide the theoretical underpinning for system design and algorithm implementation. The delay-Power-Rate-																						1									X						########	

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NSF	ENG 1002288 / University of Oklahoma Norman Campus	12.165	Towards Hybrid Wireless Networking under Adverse Channels	ECCS-1002288 Hazem Refai University of Oklahoma Towards Hybrid Wireless Networking under Adverse Channels ABSTRACT Intellectual Merit: The potential advantages of optical wireless communication fall short of reasonable expectations if adverse effects caused by atmospheric turbulence are not accurately compensated for. Adverse weather conditions degrade the performance of the system, causing increased bit error rate (BER), packet loss and network delays, as well as decreased network throughput. The objective of this project is to design a hybrid optical/RF system that is resistive to degradations caused by poor optical channel condition due to atmospheric turbulence. Combinations of experimental research and theoretical modeling will be utilized to realize such a system. The research will include the design of an optical transceiver that will efficiently handle optical transmission using different wavelengths while maintaining a light-weight optical interface and consuming minimal power. The research will examine the use of proper wavelengths for data transmission to minimize the influence of weather and maximize range without increasing transmission power. Current																	1											X						########	
NSF	ENG 1002340 / Boston College	13.013	Collaborative Research: Active Metamaterial/pHEMT Hybrid Devices for Terahertz Modulation and Detection	The objective of the research is to design and develop a suite of electronic devices operating at terahertz frequencies. The approach is based on the active control of metamaterial structures using plasma wave resonant behavior of the gated two-dimensional electron gas in the channel of GaAs HEMT devices. Intellectual Merit: The research is focused on the creation of unique metamaterial/pHEMT hybrid devices to fill the "terahertz gap," where very few components exist today. The fundamental approach uniquely combines the emerging field of electromagnetic metamaterials with novel plasma wave electronic transport phenomena in transistors. The plasma wave behavior in sub-micron transistors offers the unique possibility to detect and modulate terahertz frequency signals. Modulator and demodulator device architectures will be developed to facilitate wireless communications in the terahertz regime with targeted data rates exceeding hundreds of gigabits per second. Broader Impacts: The research will help catalyze development in diverse areas such as high data rate wireless communications, terahertz spectroscopy for cancer detection and tools for homeland security. The project will establish research and teaching																1												X						########	
NSF	ENG 1002358 / University of California-Irvine	12.061	Collaborative Research: Signal Processing Devices Based on Spin-Torque Nano-Oscillators	Collaborative Research: Signal Processing Devices Based on Spin-Torque Nano-Oscillators Recent breakthroughs in understanding of current-induced magnetization dynamics in nano-structures have led to the emergence of a new type of microwave spin-torque nano-oscillatorssources. The goal of this collaborative research program is to create experimental prototypes and develop a theory of operation of two novel microwave signal-processing devices that are based on spin-torque nano-oscillators : (i) ultra-fast broadband spectrum analyzer;(ii) on-chip microwave signal modulator. The proposed devices are based on a new oscillator geometry with two ?free? magnetic layers. In this geometry, the free layers precess in directions opposite to each other, thus doubling the frequency of the generated microwave signal. This novel geometry will pave the way towards the development of oscillator-based devices with operation frequency of up to 80 gigahertz. Another goal of this program is to research the possibilities for wireless on-chip and chip-to-chip communications between the developed nano-sized devices, that will allow them to exchange and process microwave signals without high-resistance																					1								X						########	

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NSF	ENG 1002577 / Montana State University	11.011	REU Site: Wireless Communications for Rural and Remote Areas	This three year renewal REU site program at Montana State University (MSU)will provide research experiences for ten undergraduate students. The objectives of the ten week summer program are: 1) to expose undergraduate students to real-world, innovative and interdisciplinary research focused on wireless communications in rural and remote areas; 2) to encourage undergraduates to pursue graduate degrees and careers in engineering; and 3) to develop research skills and improve communication and collaborative skills. To assist in the growth of the undergraduate students each participant will be paired with both a faculty advisor and graduate student research mentor. During the ten week program, students will work on their individual research projects in conjunction with participation in the MATLAB mini-course, workshops and seminars. They will also have opportunities to explore the Bozeman region during scheduled field trips and to participate in social activities with MSU staff and students in the other campus summer undergraduate programs. At the end of the ten weeks, each REU student will be required to submit a written report on his/her research. Students will also present their project results at an on-campus joint												1																	X						########	
NSF	ENG 1002678 / MultiFlow Communications	16.049	SBIR Phase IB: Virtual Flow Pipelining Based Radio Communication Chip Architecture	This Small Business Innovation Research (SBIR) Phase I research proposal will develop architectural solutions for programmable radio devices. The emergence of multiple radio access technologies and their continued evolutionary development drive a need to support them in a programmable manner. The objective is to enable flexibility for future evolution while ensuring processing of high data bandwidths. Current practices are based on the Software Defined Radio (SDR) approach. This approach lacks performance, is difficult to program and silicon-on-chip (SoC) devices are complex. The Virtual Flow Pipelining architecture proposed here enables programmable SoC devices with low hardware complexity, simple programming model, and high performance. These characteristics are achieved using atomic architectural support for the function synchronization, scheduling, sequencing and communication with performance guarantees. The benefits of the programmable platform are longer lifetime of devices, faster time to market, and universal reach. It will simplify prototyping effort, and accelerate product and technology adoption. The market opportunities for commercialization are																		1												X						########	
NSF	ENG 1005106 / University of Arkansas	12.143	REU Site: Summer Research Experiences in Wireless Sensor Networks - Design and Applications	This REU Site program at the University of Arkansas will focus on applied research in the development of monitoring and detection Wireless Sensor Network (WSN) systems for a variety of multidisciplinary purposes, such as structural and environmental monitoring, radio frequency identification (RFID), telemetrics, smart home, biomedical sensing, etc. This three year REU site program will engage 10 undergraduate students each year in hands-on research in this important research area. The objectives of this program include the following: 1) introduce WSN concepts and applications to undergraduate students; 2) provide opportunities for collaborative project-based research with hands-on experience in a multidisciplinary atmosphere; 3) attract undergraduate students from traditionally underrepresented groups to conduct research in an emerging field; 4) provide students with the opportunities to apply the knowledge learned in the classroom to solve real-world problems; 5) provide a unique opportunity for participants to carryout research projects specifically designed for them in state-of-the-art laboratories; 6) provide opportunities for the REU students to serve as mentors to younger students; 7)																					1								X						########	

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NSF	ENG 1013233 / Bridge Wave Electronics	12.15	SBIR Phase I: Metamaterial Volumetric Folded Antennas for Wireless Systems	This small business innovation research Phase I project explores novel wireless antenna technologies based on metamaterial volumetric folded antennas structures. The approach is to compress, twist, and fragment metal strips or discs in a multi-layer structure to form self-tuned, bandwidth optimized, and miniaturized antennas. The design methodology of engineering the coupled-line common and differential modes simultaneously presents many opportunities for radio-frequency and microwave components in wireless technology. The new approach of reducing dramatically antenna resonant length and stored electric and magnetic energy, at the same time, while increasing many times the radiated power in an area-constrained multi-layer platform is unique and opens up many possibilities of useful integrated antenna structures. The research methodology is to fold metamaterial slow-wave wires. Those folded wires spread out into multiple layers use effectively the antenna volume in integrated circuits and enhance many times the radiation resistance. The proposed ideas combine the theory of metamaterial slow-wave coupled lines, folded integrated antennas, and volumetric wires, aiming for miniaturization as well as the bandwidth																		1											X						########	
NSF	ENG 1013303 / Q-Track Corporation	2.02	SBIR Phase I: Software-Defined Locator-Receiver for NFER Systems	This Small Business Innovation Research (SBIR) Phase I project seeks to implement a software-defined radio digital receiver design for use in Real-Time Locating Systems (RTLS) employing Near Field Electromagnetic Ranging (NFER) technology. NFER RTLS has demonstrated industry leading wireless location of individual tracking tags. The proposed effort will drastically increase the capacity of NFER RTLS from 20-50 tag reads per second to a thousand or more. RTLS's comprise an important and rapidly growing segment within the radio frequency identification (RFID) industry. Incumbent RTLS vendors use high frequency, microwave RF systems originally optimized for communications, not location. But communications and location are two different problems requiring fundamentally different answers. NFER technology was designed with location in mind. Using low frequency (~1MHz), long wavelength (~300m) signals, typically around 1MHz, NFER systems are more penetrating, longer range, more multipath resistant, and more robust than competing products. Already a relatively simple and low-cost method for RTLS in complicated indoor environments, the proposed research aims to dramatically increase the																			1											X						########	
NSF	ENG 1013589 / Whisper Communications LLC	17.019	SBIR Phase I: Physical Layer Security for Wireless Communications	This Small Business Innovation Research (SBIR) Phase I project will add security of the strongest type to the physical layer of wireless communication systems, a layer in the protocol stack where currently little or no security is implemented. Despite existing security mechanisms that operate at higher layers of the protocol stack, the lack of any security measure at the wireless physical layer poses a significant threat. Hence, the goal of this project is to provide reliable and secure broadband wireless connectivity against passive eavesdroppers, where data privacy is tied to proximity to the data source. In this physical layer security approach, privacy will be provided by powerful error correcting codes and pre-processing techniques to deliver high reliability to the intended parties and high security against remote eavesdroppers. The intellectual merit of this proposal is in new approaches to physical layer communications, from both theoretical and practical perspectives. This project will focus on: (1) Development of secure codes for 60GHz wireless communications, (2) Implementation of an uncompressed video platform with secure codes to demonstrate secure wireless video transmission, and (3) Validation, specification, and testing of the																											1			X						########	

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NSF	ENG 1013852 / GigaBeam Corporation	12.144	SBIR Phase I: 256 QAM Modem Supporting 10 Gb/s Radio	This Small Business Innovation Research (SBIR) Phase I project supports the development of a Quadrature Amplitude Modulation (QAM) Modulator-Demodulator (Modem) able to exploit existing emerging millimeter-Wave (mm-Wave) spectrum. Unlike lower frequency allocations, wide available bandwidths are capable of supporting data-rates in excess of 1Gb/s by using complex modulation schemes. Though such Modems exist for a multitude of standard products found in everyday use, none are capable of being scaled for use at data-rates approaching 10Gb/s and characteristics of mm-Wave channels have not been accommodated in their design. The objective of this project is to establish the feasibility and direct the future development of such a Modem while taking into full account the channel characteristics important in an mm-Wave communications link, by thoroughly modeling the system at a high level of abstraction, then instantiating the digital subsystem with existing Field Programmable Gate Array (FPGA) technology. This would result in a clear radio development path, with the ability to scale. The broader impact/commercial potential of this project center on the improved understanding and utilization of																				1									X						########	
NSF	ENG 1028464 / University of Illinois at Urbana-Champaign	18.014	Dynamic combinatorial auctions	The main goal of the project is to design and analyze distributed allocation strategies, which enable agents to effectively share resources through an interactive process. Applications include government auctions of assets such as licenses for wireless bandwidth, spot auctions of wireless bandwidth, online auctions, or online sharing of resources in a smart grid. The approach is to bridge the significant gap between theory and application in combinatorial auctions, using methods of decision and control systems. In addition, the PI shall formulate a theoretical basis for prediction markets. The proposed research is grouped into four areas. (1) Bridging the theory-practice gap in combinatorial auctions. (2) Auctions with profit sharing. (3) Auctions with dynamics? (4) A theoretical basis for prediction markets. Intellectual Merit: The project will bring together and develop tools from disparate areas of recent research, including those from the theory of auctions and mechanism design from microeconomics, competitive analysis of online algorithms, deterministic and stochastic optimization methods, and both local and global stability analysis. Broader Impact: The work could have broad applications in many social and economic																										1					X						########	
NSF	ENG 1028608 / Drexel University	17.001	A Framework for Wireless Network Security Based on Reconfigurable Antennas	The objective of this project is to demonstrate how electrically reconfigurable antennas can be coupled with physical layer based security algorithms to significantly augment wireless network security. The large scale proliferation of wireless technology brings with it a more serious concern for security since wireless data transmission introduces multiple avenues for attack and penetration into a network. Reconfigurable antennas are antennas that can be electrically modified to exhibit different radiation patterns. The approach is to develop a framework for wireless network security based on the capabilities of reconfigurable antennas and techniques adapted from wireless communications, signal processing, and information theory. The intellectual merit of this project is to address the technical challenges associated with wireless network security by using reconfigurable antennas. The ability of reconfigurable antennas to generate different channel realizations from a single physical antenna also has the potential to greatly augment physical layer based security algorithms and encryption-key generation techniques. Emphasis will be placed on the development of compact reconfigurable antenna structures,																										1					X						########	

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NSF	ENG 1028782 / University of Houston	1.032	IHCS: Collaborative Research: Compressive Spectrum Sensing in Cognitive Radio Networks	The objective of this research is to improve design of collaboratively discovering unused spectrum in a revolutionary wireless communication paradigm, the cognitive-radio network, in which cognitive-radio users can detect and share the unused spectrum. The proposed approach is to apply collaborative compressive sensing to increase spectrum sensing bandwidth, speed, and accuracy. Specifically, the cognitive radios, rather than sweeping a set of channels sequentially, will sense linear combinations of the powers of multiple channels and report them to the fusion center, where the occupied channels are recovered using compressive sensing algorithms. Missing and erroneous reports can be exactly recovered by matrix completion since the matrix of all reports has a low-rank. Prior knowledge of channel gains is not required. The system computes more but senses much less and faster, which will be validated by both numerical and USRP2-based simulations. The proposed research is potentially transformative as the novel framework and algorithms will broadly apply to signal sensing involving multiple sensors, modalities, and data sources. This research will have a broader impact on several audiences. The study of										1																				X						########	
NSF	ENG 1028790 / William Marsh Rice University	1.034	IHCS: Collaborative Research: Compressive Spectrum Sensing in Cognitive Radio Networks	The objective of this research is to improve design of collaboratively discovering unused spectrum in a revolutionary wireless communication paradigm, the cognitive-radio network, in which cognitive-radio users can detect and share the unused spectrum. The proposed approach is to apply collaborative compressive sensing to increase spectrum sensing bandwidth, speed, and accuracy. Specifically, the cognitive radios, rather than sweeping a set of channels sequentially, will sense linear combinations of the powers of multiple channels and report them to the fusion center, where the occupied channels are recovered using compressive sensing algorithms. Missing and erroneous reports can be exactly recovered by matrix completion since the matrix of all reports has a low-rank. Prior knowledge of channel gains is not required. The system computes more but senses much less and faster, which will be validated by both numerical and USRP2-based simulations. The proposed research is potentially transformative as the novel framework and algorithms will broadly apply to signal sensing involving multiple sensors, modalities, and data sources. This research will have a broader impact on several audiences. The study of										1																				X						########	
NSF	ENG 1032002 / Auburn University	1.012	Collaborative Research: Unlocking Capacity for Wireless Networks Using Cooperative and Cognitive Techniques	This proposal seeks funding for the Center for Wireless Internet Center for Advanced Technology (WICAT) studies conducted by the Polytechnic Institute of New York site (lead), the University of Virginia site and the site at Auburn University. Funding Requests for Fundamental Research are authorized by an NSF approved solicitation, NSF 10-507. The solicitation invites I/UCRCs to submit proposals for support of industry-defined fundamental research. ☒This proposal is a comprehensive research project for significantly improving the capacity of wireless networks. In past decades, there has been an exponential growth of wireless devices and wireless networks. While wireless networks have brought us the convenience of mobility and new applications, they are limited by bandwidth bottlenecks. The industry and spectrum regulators are trying to allocate more bandwidth, but they still fall behind the bandwidth increases in wireless networks. Thus it is critically important to use spectrum resources more efficiently. The proposed work aims to decrease interference, including cooperative and cognitive networking. This research will not only make significant contributions to the research community, but also be very										1																				X						########	

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NSF	ENG 1032035 / Polytechnic University of New York	1.014	Collaborative Research: Unlocking Capacity for Wireless Networks Using Cooperative and Cognitive Techniques	This proposal seeks funding for the Center for Wireless Internet Center for Advanced Technology (WICAT) studies conducted by the Polytechnic Institute of New York site (lead), the University of Virginia site and the site at Auburn University. Funding Requests for Fundamental Research are authorized by an NSF approved solicitation, NSF 10-507. The solicitation invites I/UCRCs to submit proposals for support of industry-defined fundamental research. ?This proposal is a comprehensive research project for significantly improving the capacity of wireless networks. In past decades, there has been an exponential growth of wireless devices and wireless networks. While wireless networks have brought us the convenience of mobility and new applications, they are limited by bandwidth bottlenecks. The industry and spectrum regulators are trying to allocate more bandwidth, but they still fall behind the bandwidth increases in wireless networks. Thus it is critically important to use spectrum resources more efficiently. The proposed work aims to decrease interference, including cooperative and cognitive networking. This research will not only make significant contributions to the research community, but also be very								1																				X							########	
NSF	ENG 1032060 / University of Virginia Main Campus	1.016	Collaborative Research: Unlocking Capacity for Wireless Networks Using Cooperative and Cognitive Techniques	This proposal seeks funding for the Center for Wireless Internet Center for Advanced Technology (WICAT) studies conducted by the Polytechnic Institute of New York site (lead), the University of Virginia site and the site at Auburn University. Funding Requests for Fundamental Research are authorized by an NSF approved solicitation, NSF 10-507. The solicitation invites I/UCRCs to submit proposals for support of industry-defined fundamental research. ?This proposal is a comprehensive research project for significantly improving the capacity of wireless networks. In past decades, there has been an exponential growth of wireless devices and wireless networks. While wireless networks have brought us the convenience of mobility and new applications, they are limited by bandwidth bottlenecks. The industry and spectrum regulators are trying to allocate more bandwidth, but they still fall behind the bandwidth increases in wireless networks. Thus it is critically important to use spectrum resources more efficiently. The proposed work aims to decrease interference, including cooperative and cognitive networking. This research will not only make significant contributions to the research community, but also be very								1																				X							########	
NSF	ENG 1032567 / North Dakota State University Fargo	12.02	BRIGE: Cross-layer Inter-network Cooperation for Broadcast, Cellular and Ad-hoc Hybrid System	Intellectual Merit: Cooperation is an effective strategy in nature to achieve individual or common goals by forming cooperative groups. While the wireless communications research community has shown that cooperation techniques can substantially increase the system performance, most of the existing work is limited to a single network. On the other hand, the ubiquitous wireless applications are bringing more and more new networks, making the co-existence of multi-networks inevitable. The objective of this BRIGE research is to develop a new network structure that integrates cellular, TV broadcast, and ad-hoc networks using cross-layer inter-network cooperation techniques. The research components of the project consist of two parts. The first part is a collaborative broadcast and cellular hybrid system, which is a joint design approach for broadcast and cellular services to be simultaneously supported in a single platform. In this project, focus is on the more practical hybrid model with joint coding, where information bits are coded across both time and frequency. The second part is a collaborative cellular and ad-hoc hybrid system, which achieves the benefits offered by both infrastructure networks																					1								X							########	

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NSF	ENG 1032604 / Ohio State University	16.015	BRIGE: UWB Digital to RF Transmitter Architecture and Circuits for Future Software Radio Systems	Intellectual Merit: This BRIGE research project aims to demonstrate a new class of ultra wideband software defined radio transmitters using a novel mixer-less direct digital-to-RF digital-to-analog converter. The linchpin of the proposed direct RF modulator is a multi-path and multi-phase digital-to-analog converter architecture, designed to cancel ? in the digital domain ? sampling image frequencies and non-linearity spurs, and yet operate at the Nyquist-rate of the RF signal. Specifically, the transmitter comprises a wholly-digital baseband to RF modulation scheme that will enable unparalleled degree of programmability and achieve very high dynamic range spurious free operation. Furthermore, in light of various mismatches in the parallel digital-to-analog converter paths, self-healing algorithms will be investigated to enable built-in test and tune of the circuit parameters. Broader Impacts: The proposed modulator will eliminate the need for heterodyne mixing following the digital-to-analog conversion, a technology deemed critical to meet the Software Defined Radio forum?s definition of the ?ideal software radio?. This technology could be transitioned to a wide range of rapidly evolving commercial and															1														X						########	
NSF	ENG 1035086 / Arizona State University	12.082	I/UCRC CGI : SenSIP - A Research Site of the Net-Centric Software and Systems Center	The Sensor Signal and Information Processing (SenSIP) consortium at the Arizona State University (ASU) is planning to join the Industry/University Cooperative Research Center (I/UCRC) entitled "Net-Centric Software and Systems" which currently is a multi- university Center comprised of the University of North Texas (lead institution), and the University of Texas at Dallas. The mission of SenSIP at ASU is to develop signal and information processing foundations for next-generation integrated multidisciplinary sensing applications in biomedicine, defense, energy, and other systems. ASU requests funding for becoming a third site of the NSF Center for Net-Centric Software and Systems under the leadership of Professor Andreas Spanias. ASU will bring to the existing Center much needed complementary capabilities in the areas of digital signal and image processing, multimedia systems, sensor networks, information theory and wireless communications. The proposed site will enable the creation of new capabilities in sensor signal processing and will bridge the gap between sensor development and large scale sensor deployment; and, is uniquely positioned to promote industry research,																					1								X						########	
NSF	ENG 1035221 / Virginia Polytechnic Institute and State University	1.004	Collaborative Research: Enhancing Access to the Radio Spectrum (EARS) Workshop to be Held July/August, 2010, in Arlington, VA.	Enhancing Access to the Radio Spectrum (EARS) is a multi-disciplinary activity whose goal is to improve the efficiency with which the radio spectrum is utilized and to improve access to the radio spectrum in support of current and new technologies. Achieving these goals will, among other impacts, improve the availability of wireless broadband to Americans presently without broadband access, as called for in the American Recovery and Reinvestment Act. Because the radio spectrum is a valuable but finite natural resource, improvements in spectrum efficiency will have significant economic impact to the nation and the world. This award funds the first step, which is an invitational workshop that will bring together some of the key researchers and policy makers involved in radio spectrum access. All relevant fields will be represented, including science, engineering, economics, and policy. The output of the workshop will include a vision for the future of radio spectrum access and use, and a prioritized list of research areas that can help achieve that vision.											1																		X						########	

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NSF	ENG 1038528 / University of Hawaii	16.01	2010 International Conference on Wireless Information Technology and Systems on August 28, 2010, Honolulu, HI.	The objective of this activity is to provide support for up to ten students from U.S. universities to attend the 2010 IEEE International Conference on Wireless Information Technology and Systems (ICWITS). The conference will be held August 28 - September 3, 2010 at the Hilton Hawaiian Village in Honolulu, Hawaii. Three IEEE societies, AP-S, MTT-S, and ComSoc, are co-sponsoring the conference. The conference agenda includes five plenary sessions and over 20 technical sessions. Intellectual Merit: The conference will provide a unique forum for leading researchers from different disciplines to meet and discuss a future vision for the wireless technology and define integrative approaches for addressing future research challenges. Topics covered by the conference include microwave devices, and components, antennas, propagation, and communications technologies such as digital signal processing, networking protocols, and networking infrastructure. Graduate student participation is very significant as they represent the future leadership in developing this technology. Broader Impacts: Support for conference participation is open to U.S. students who are currently enrolled in a Ph.D. degree																		1												X						########	
NSF	ENG 1040327 / Gonzaga University	12.091	MRI: Acquisition of Smart Antenna Laboratory Equipment	Research Objectives and Approaches: The objective of this research is to meet the ever-increasing demand for reliable, secure high-bandwidth wireless communications. Bandwidth demand is being met with innovative new technologies and standards; however, the success and proliferation of these systems causes increased wireless interference, which inadvertently reduces the reliability and bandwidth of these and adjacent systems. The approach is to provide Smart Antenna Laboratory equipment that enables innovators to address issues by facilitating the design, simulation, and testing of interference-reducing, high-performance communications radios, algorithms, and antenna systems. Intellectual Merit: As digital computational densities have followed Moore?s law, so has the complexity and performance of wireless digital communication systems. Nearly all new wireless standards use multi-antenna techniques to increase spectral efficiency and resulting system bandwidth. As the system complexity increases so does the barrier-to-entry for companies and educational institutions requiring access to the instrumentation, measurements and simulation environments required to																						1								X						########	
NSF	ENG 1052628 / University of Wisconsin-Madison	16.028	EAGER: A Novel Hybrid Analog-Digital Architecture for Optimum Agile Wireless Communication Using Discrete Lens Arrays	The objective of this research is to demonstrate proof-of-concept of a new multi-antenna wireless transceiver design that promises dramatic improvements in capacity and power/bandwidth efficiency compared to the state-of-the-art systems. The approach is based on a new hybrid analog-digital multiple-input-multiple-output architecture that enables a continuous-aperture phased-array operation and optimum beam agility. The new analog-digital interface is realized via a novel phased-array architecture - a high-resolution discrete lens array - that computes an analog spatial Fourier transform and enables optimum link adaptation through beam agility. The integrated theoretical-experimental research plan includes development of basic theory and prototype development to demonstrate the potential of the new transceiver design. Intellectual Merit: The compelling performance gains promised by the proposed agile transceiver rely on several innovations relative to the state-of-the-art, including: i) Integration of analog and digital processing for optimum adaptation; ii) Integration of coherent beam-forming and spatial multiplexing; iii) Source-channel matching for capacity																		1												X						########	

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NSF	MPS 0604513 / Stanford University	18.001	604513 Title Exchange Market Equilibrium and Auction Pricing	Complexity theory is the foundation of high-performance computing. The goal of the theory is to develop criteria for measuring effectiveness of various computational algorithms. The term "complexity" refers to the amount of resources required by a computation. In this project, running time or number of arithmetic operations is the major resource of interest. Linear programming (LP) has been an important computational problem in complexity analysis. Due to the relentless research effort in LP algorithms, a linear program can be solved today one million times faster than it was done twenty years ago. Businesses, large and small, now use LP models to control manufacture inventories, price commodities, design civil/communication networks, and plan investments. LP even becomes a popular subject taught in under/graduate and MBA curriculums, advancing human knowledge and promoting science education. Now many other important computational problems are emerging or reemerging. In particular, there has been a growing trend in models, theories, and algorithms on problems arisen in Internet economics, information network, auction/game pricing, as well as social organization issues enabled																							1						X						########	
NSF	MPS 0608634 / Iowa State University	11.004	608634 Title Collaborative ResearchHeavy Traffic Limit Models and Control Analysis for Wireless Queueing Systems--incorporating Long-Range Dependence and Heavy Tails	The investigators study the heavy traffic analysis in wireless systems under novel phenomena of long-range dependence and heavy tails. These phenomena are characteristic of current wireless systems driven by data-intensive applications such as multimedia, WWW, and real-time interactions. The heavy traffic approach is a powerful way to analyze queuing systems at near capacity, yielding complex, yet tractable limit models that retain the essential features of the actual queuing system. But most of the existing literature on heavy traffic analysis, including wireless systems, is based on short-range dependent (Markovian-like) models and light tails. In the case of heavy tails only, the focus is on extending the perturbed test function method, based on the martingale problem, for showing weak convergence to a queuing model expected to be driven by stable Levy motion. When long-range dependence characteristics are also present, the focus is on developing a powerful alternative approach based on the Poisson random measure representation of traffic processes. In this case, weak convergence to a queuing model driven by fractional Brownian motion is expected. The power control problem associated with wireless												1																	X						########	
NSF	MPS 0608663 / University of North Carolina at Chapel Hill	11.005	608663 Title Collaborative Research Heavy Traffic Limit Models and Control Analysis for Wireless Queuing Systems - incorporating Long-Range Dependence and Heavy Tails	The investigators study the heavy traffic analysis in wireless systems under novel phenomena of long-range dependence and heavy tails. These phenomena are characteristic of current wireless systems driven by data-intensive applications such as multimedia, WWW, and real-time interactions. The heavy traffic approach is a powerful way to analyze queuing systems at near capacity, yielding complex, yet tractable limit models that retain the essential features of the actual queuing system. But most of the existing literature on heavy traffic analysis, including wireless systems, is based on short-range dependent (Markovian-like) models and light tails. In the case of heavy tails only, the focus is on extending the perturbed test function method, based on the martingale problem, for showing weak convergence to a queuing model expected to be driven by stable Levy motion. When long-range dependence characteristics are also present, the focus is on developing a powerful alternative approach based on the Poisson random measure representation of traffic processes. In this case, weak convergence to a queuing model driven by fractional Brownian motion is expected. The power control problem associated with wireless												1																	X						########	

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NSF	MPS 0608669 / North Carolina State University	11.013	608669 Title Collaborative ResearchHeavy Trafffic Limit Models and Control Analysis for Wireless Queueing Systems--incorporating Long-Range Dependence and Heavy Tails	The investigators study the heavy traffic analysis in wireless systems under novel phenomena of long-range dependence and heavy tails. These phenomena are characteristic of current wireless systems driven by data-intensive applications such as multimedia, WWW, and real-time interactions. The heavy traffic approach is a powerful way to analyze queuing systems at near capacity, yielding complex, yet tractable limit models that retain the essential features of the actual queuing system. But most of the existing literature on heavy traffic analysis, including wireless systems, is based on short-range dependent (Markovian-like) models and light tails. In the case of heavy tails only, the focus is on extending the perturbed test function method, based on the martingale problem, for showing weak convergence to a queuing model expected to be driven by stable Levy motion. When long-range dependence characteristics are also present, the focus is on developing a powerful alternative approach based on the Poisson random measure representation of traffic processes. In this case, weak convergence to a queuing model driven by fractional Brownian motion is expected. The power control problem associated with wireless												1																	X						########	
NSF	MPS 0653533 / University of Washington	2.032	653533 Title Inverse Problems in Remote Sensing	Abstract The PI's goals are to develop new multi-dimensional mathematical tools for remote sensing applications. A primary emphasis of this project is to draw precise and useful conclusions from data that is both limited and noisy. The PI and collaborators have developed and continue to develop methods for finding the location and convex geometry of one or more objects based on multiple measurements that can be obtained with a single mobile antenna. At a fixed wave number, the phenomenon of evanescence limits the dimension of the linear space of propagating waves (far fields) in terms of the size of the (support of the) source. This project utilizes this dimensional marker as a tool for locating a source or scatterer, filtering the signal it radiates, estimating its size and possibly even the number of its (well-separated) components. The phenomenon of evanescence prevents us from obtaining highly detailed images using low frequency electro-magnetic waves. Evanescence refers to the fact that the components of the wave which carry the information necessary for high spatial resolution decay so rapidly with distance from an object, that they are effectively invisible from afar. In this project, we are developing methods to use																			1											X						########	
NSF	MPS 0705062 / Northeast Radio Observatory Corp	16.011	705062 Title Development of a Wideband Burst Mode Data Recorder for Radio Astronomy	AST-0705062/Whitney This project will develop a wideband burst-mode data recorder for Very Long Baseline Interferometry that will increase effective recorded burst bandwidths over present systems by factors exceeding 16. The Very Long Baseline Interferometry arrays enabled by this work will significantly enhance the ability of the astronomy community to carry out observations in several key science areas.																		1											X						########	

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NSF	MPS 0706928 / University of North Carolina at Charlotte	15.004	706928 Title Wave Propagation and Scattering in Networks of Thin Waveguides	The objective of this project is the analysis of wave propagation in networks of thin waveguides. Problems of this type cannot be solved explicitly and are poorly amenable to computational methods because of the complicated 3-dimensional geometrical structure of such a network. The goal of the project is to develop methods allowing the reduction of the problem to a much simpler one-dimensional problem on the quantum graph, which is the limit of the network as the diameter of the waveguides tends to zero. The study will include the asymptotic analysis of the scattering solutions, the spectrum, and the resolvent for the Helmholtz equation for all frequencies (at the bottom and in the bulk of the spectrum). The project also includes the analysis of possible mechanisms for slowing down of wave packages in optical networks and the study of stability and intermittency in the system in the presence of random noise. The project will provide mathematical background for the investigation of information flows in complex optical networks. In particular, it will provide an efficient tool to construct necklace type devices for synchronizing the work of very fast optical elements and much slower electronics. The results and the methods to										1																			X						########	
NSF	MPS 0722330 / California Institute of Technology	13.005	722330 Title Development of an Integrated Time and Frequency Domain THz Spectroscopy and Dynamics Facility	With support from the Chemistry Research Instrumentation and Facilities Instrument Development program, Geoffrey Blake of the Department of Chemistry and Scott Fraser of the Department of Biology at California Institute of Technology in conjunction with Peter H. Siegel of the Jet Propulsion laboratory will develop a compact integrated time domain and frequency domain Terahertz spectrometer. The novelty of this instrument development project is the generation of the two phase coherent THz pulses from two 20 fs Ti:Sapphire lasers, which has not been demonstrated. This system will operate as a user facility allowing for broad access of use. The system will be used in several applications including (1) biological imaging to characterize nano-materials and biological systems, (2) national security imaging applications and (3) optoelectronic applications which may lead to breakthroughs in telecommunications and optical computing. A wide range of additional students, postdoctoral fellows and senior researchers will benefit from the anticipated THz capabilities. Outreach activities through existent programs will encourage the participation of undergraduates and K-12 students.																	1													X						########	
NSF	MPS 0724073 / National Academy of Sciences	23.006	724073 Title Partial Support of the Committee on Radio Frequencies	The National Academy of Sciences' Committee on Radio Frequencies is comprised of prominent scientists and engineers who provide studies and advice to the Academy on issues involving scientific uses of the radio spectrum. Such uses often involve techniques and applications that are outside the realm of traditional radio spectrum applications, therefore the Committee is useful to help guide the FCC and other regulatory bodies toward the adoption of spectrum rules and policies that will not create unnecessary interference to radio astronomy, meteorology, remote sensing, oceanography, and other scientific uses of the spectrum. Because of the multi-disciplinary aspect of the Committee's goals, it is supported by both the National Science Foundation and the National Aeronautics and Space Administration. The full Committee, comprised of 15 members, meets approximately twice per year, and between meetings it works on crafting comments and other written documents in response to various regulatory proceedings. The Committee also sends representatives to appropriate meetings of scientific (e.g., the International Union of Radio Scientists) and policy-setting bodies (e.g., the International Telecommunication Union) to									1																				X						########	

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NSF	MPS 0735361 / University of Texas at Arlington	2.033	735361 Title NSF/CBMS Regional Conference in the Mathematical Sciences -- Inverse Scattering for Radar Imaging -- Spring 2008	This conference features Prof. Margaret Cheney of Rensselaer Polytechnic Institute as the distinguished lecturer who will deliver ten lectures in the field of inverse scattering for radar imaging. The basic idea behind radar imaging is to illuminate a target with pulses of electromagnetic waves; the reflected waves are recorded and analyzed in order to make an image of the target or to determine its properties. The field of radar imaging has been developed, during the last fifty years, entirely within the engineering community. Fifty years ago many of the challenges were engineering ones: It was difficult to design equipment to transmit microwaves at the high powers necessary and to detect the very faint returning signals. These hardware problems, however, have generally been overcome, and the remaining challenges in the field are mainly mathematical: What waveforms should we transmit? Where should we position the antennas to obtain the information we want? How should we process the data to make high-resolution images? How can we detect and remove artifacts? Can we form images of targets hidden by foliage? Can we determine the material properties of a target? Any significant future progress in the field is																	1													X						#######	
NSF	MPS 0753983 / Claremont McKenna College	16.012	753983 Title Collaborative Research Algorithms for Simulation and Design of Analog VLSI Lattices	New technologies in areas such as wireless communication, portable computing, and handheld electronics have increased the demand for signal processing at high frequencies. Part of the challenge in designing silicon integrated circuits that can meet this demand is to overcome limitations in the efficiency and frequency bandwidth of modern transistors. Here it is proposed to use two-dimensional networks of inductors and capacitors to overcome these limitations. These high-speed, high-efficiency networks have a cut-off frequency that is higher than that for silicon-based transistors. Moreover, such networks can be incorporated into standard silicon chips that can be fabricated at low cost. The proposed research has the potential to revolutionize high-frequency analog signal processing, leading to chips that operate up to 1000 times faster than current ones. There are a large number of possible designs for such networks, and only a small number of these possibilities have already been explored. The proposed research seeks to develop algorithms that greatly assist in the simulation and design of two-dimensional inductor-capacitor networks. Simulating a large network involves the solution of a large, coupled system of																		1													X						#######	
NSF	MPS 0757680 / Oklahoma State University	13.006	757680 Title THz Surface Waves, Waveguide THz-TDS and the 2D-TEM Plane	This experimental research program will explore fundamental optical physics and applications using far-infrared terahertz (THz) radiation. The PI has previously extended the concept and utility of parallel-plate waveguides to that of a much larger two-dimensional plane. Within this plane two-dimensional quasi-optical elements have demonstrated THz guiding and diffraction. This project will investigate optical physics with recently designed two-dimensional quasi-optical components with negative index of refraction. Researchers will measure the refractive properties and assess the utility of these extremely dispersive components. In addition, the program will experimentally measure and theoretically study the propagation of THz surface electromagnetic waves (plasmons) on planar subwavelength arrays of holes in thin metal films. The experiments are designed to resolve a discrepancy with the theoretically predicted very large transverse extent of the THz surface plasmons and previously observed transmission through hole arrays. The program will transform the previously developed technique of waveguide THz Time-Domain Spectroscopy into a new spectral analysis technique with high sensitivity and frequency resolution for																	1													X						#######	

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NSF	MPS 0806532 / GA Tech Research Corporation - GA Institute of Technology	12.01	806532 Title Time-Frequency and Applied Harmonic Analysis	Heil DMS-0806532 Four main directions are selected for advancement in this project: (a) Time-frequency independence conjectures and related topics; (b) Quantification of localization for nonabelian coherent state frames; (c) Applications to affine pseudodifferential operators (broadband time-varying filters); (d) Multiwavelet development of the shearlet transform and construction of compactly supported shearlets. Each of these interrelating topics contains deep mathematical questions directly related to fundamental issues in redundant representation and transformation of signals. Each topic reaches into a broad range of areas in mathematical analysis, and progress requires a synthesis of different ideas from both abstract analysis and applied harmonic analysis, including pseudodifferential operator theory, noncommutative Banach algebras, and new forms of multiresolution analysis suitable for two-dimensional and higher signal processing. The problems addressed in this project concern fundamental questions regarding the basic mathematical tools that underlie modern signal processing, including such applications as wireless communications, radar, seismic sensing, and																				1										X						#######	
NSF	MPS 0807896 / University of Maryland College Park	12.011	807896 Title Nonlinear Signal Processing and Wireless Communications using Frames and Operators Theory	Balan DMS-0807896 The investigator develops a new mathematical framework for nonlinear signal processing and wireless communication channels. The nonlinear signal processing problem addressed here is signal reconstruction from the magnitude of a redundant linear representation. When the linear redundant representation is associated to a group representation (such as the Weyl-Heisenberg grgoup), the relevant Hilbert-Schmidt operators inherit this invariance property. Thus a fast (nonlinear) reconstruction algorithm seems possible. A wireless communication channel is modeled as a linear operator that describes how transmitted signals propagate to a receiver. For ultrawide band (UWB) signals, the Doppler effect no longer can be modeled as a frequency shift. Instead it is captured as a time dilation operator. A continuous superposition of time-scale shifts is used to model a UWB communication channel, and consequences to pseudo-differential operator theory are analyzed. The investigator takes up two problems related to signal processing. In the first he considers how to represent signals in ways that allow more effective reconstructon of them from limited information. In the second he analyzes																				1										X						#######	
NSF	MPS 0811086 / Vanderbilt University	12.012	811086 Title Accurate digital representation and recovery for redundant frames	Redundant frame representations play a central role in signal processing applications. By using overcomplete systems to represent signals, frames offer increased design flexibility and are thereby able to provide robustness against noise and data loss in many settings. The investigator studies the mathematics of digitally representing redundant finite frame expansions, with an emphasis on two key steps: coefficient quantization and signal reconstruction. The work on quantization (the encoding step) focuses on the class of Sigma-Delta algorithms and studies rigorous approximation error bounds, dual frame methods for boosting performance, and the design of new algorithms for multiple description coding and orthogonal frequency division multiplexing. Sigma-Delta algorithms are well suited for utilizing the correlations inherent in redundant collections of frame coefficients, and are desirable in practice since they can be robustly implemented using very coarse, for example one bit, scalar quantizers. In the work on signal recovery (the decoding step), the investigator studies new nonlinear consistent reconstruction algorithms for analog-to-digital conversion in the settings of Pulse Code Modulation and Sigma-Delta																				1										X						#######	

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NSF	MPS 0811104 / University of Delaware	12.013	811104 Title Absolutely Stable Time Domain Integral Equation Methods in Computational Electromagnetism	Despite decades of advances in computational electromagnetics (CEM), some problems still elude efficient and accurate solutions. Problems occurring in the analysis of microelectromechanial systems, electromagnetic compatibility, and ultra wide band antenna design involve complex geometry, small structures, and large propagation distances across homogeneous regions. Solutions to problems with these characteristics are most efficiently computed (in principle) by time-domain integral equation (TDIE) techniques. Unfortunately, while TDIEs have been researched for more than thirty years, there is still no TDIE scheme for CEM that can efficiently model curvilinear geometry while ensuring stability. Thus, current techniques are either of low order of convergence or unreliable stability. Mathematical error analysis, work estimates and computer programs created under this proposal will demonstrate a new method, based on convolution quadrature, that promises to deliver both superlinear accuracy and unconditional stability. Electromagnetic theory governs the behavior of light, radio waves, and microwaves. Understanding the behavior of electromagnetic waves is of the utmost																		1											X						#######	
NSF	MPS 0811169 / University of California-Davis	12.014	811169 Title Computational Harmonic Analysis in Information Theory, Signal Processing, and Data Analysis	In this research effort the investigator creates mathematical concepts and numerical methods for information technology, communications engineering, and data analysis. The investigator uses tools from pseudodifferential operator theory, time-frequency analysis, random matrix theory, and Banach algebra theory, yielding efficient numerical algorithms with rigorously-established properties under carefully stated conditions. Some concrete topics of this research effort are: (i) Development of a theoretical framework for key problems in classical and quantum information theory. Specifically, the investigator considers the channel capacity problem in time-varying communications and quantum communications; (ii) Sparse representations and compressed sensing in X-ray crystallography, communications, and radar. Initial steps toward building a framework for nonlinear compressed sensing; (iii) Noncommutative harmonic analysis and pseudodifferential operators from the point of view of computational efficiency and the development of fast algorithms. Particular attention is paid to spectral factorization for operators in a noncommutative setting, and their application in signal processing and wireless																		1											X						#######	
NSF	MPS 0847405 / Syracuse University	13.007	847405 Title CAREER Terahertz Spectroscopy of Molecular Solids Experiment and Theory	In this award, Dr. Timothy Korter from Syracuse University, together with his graduate students, will employ time-domain terahertz (THz) vibrational spectroscopy to probe interactions between molecules in the solid state. The vibrations are strongly influenced by the molecular environment which provides information about the intermolecular potential energy surfaces which in turn are related to macroscopic chemical properties such as phase transitions. Dr. Korter plans to investigate two important classes of materials - crystalline pharmaceuticals and solid-state energetic materials. Due to their complicated structures influenced by hydrogen bonding, crystal packing and the presence of enantiomers, the THz vibrational spectra are exceedingly complex, and interpretation is only possible through integration of predictive methods. Density functional theory and ab initio modeling combined with careful experimentation will be instrumental in understanding the origins of the spectral features observed. Structural analysis will be complemented through techniques such as NMR spectroscopy, X-ray diffraction, and Raman spectroscopy. Collaboration with Dr. Brown from UCSB will provide access to spectral features															1														X						#######	

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NSF	MPS 0905288 / University of Arizona	13.008	905288 Title A Sideband-Separating Receiver at 385-500 GHz Advancing Spectroscopic Frontiers at Sub-Millimeter Wavelengths	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This project is for the design and construction of a sideband-separating Superconductor-Insulator-Superconductor mixer receiver for the 380 to 500 GHz band. The receiver, whose design will mimic that used for the Atacama Large Millimeter/submillimeter Array (ALMA) 210 to 275 GHz receiver developed by the National Radio Astronomy Observatory, would be deployed on the Arizona Radio Observatory's Sub-Millimeter Telescope on Mt. Graham, Arizona. The receiver would be used to study known molecular spectral lines in this region, as well as likely discover many new ones. The advantage of this design over the ALMA design is that the balanced system allows the use of much lower local oscillator power, which can be important in some instances (such as array feeds, for example) where sufficient local oscillator power is difficult to achieve.													1															X						#######	
NSF	MPS 0907236 / University of Virginia Main Campus	16.013	907236 Title Collaborative Research Characterization of Traps in GaInAs/GaAsSb Multiple Quantum Well Structures	Technical. This collaborative project addresses materials science growth/processing research of InGaAs/GaAsSb multiple quantum wells (MQW) with related investigations aimed toward mid-IR wavelength detector applications. The nature of the band alignment allows tuning of the en-ergy gap by varying layer thickness, strain, and composition. Emphasis is placed on gaining greater understanding of the trap formation in GaInAs/GaAsSb MQWs and correlation of their formation with prototype device performance. The approach involves the use of InP to provide advantages: these include the use of compressive and tensile strained materials for flexible device design options; mature wafer foundry capabilities for processing InP-based structures; the ability to leverage advances in InP-based epi-growth over the past decade; and the ability to leverage fu-ture advances driven by InP electronics. Currently, device performance apppears limited by mid-gap traps in the absorption region; hence this work is focused on providing a more complete un-derstanding of these traps and correlating them with device performance. While the MIR photo-diode test structure used in this work has its merit from device perspectives,														1															X						#######	
NSF	MPS 0908379 / University of Kentucky Research Foundation	12.015	908379 Title Weight Enumeration for Convolutional Codes	Gluesing-Luerssen DMS-0908379 The project aims at furthering the mathematical theory of convolutional codes. The error-correcting quality of these codes can be measured by a variety of distance parameters that have been introduced in the engineering-oriented literature. The main idea of the project is the investigation of convolutional codes based on the weight adjacency matrix, a single parameter that comprises, among other things, all those different distance measures. So far two major results have been established by the investigator: a MacWilliams Identity Theorem stating that the weight adjacency matrix of a code fully determines that of the dual code, and a theorem stating that codes without non-zero constant codewords and sharing the same weight adjacency matrix are monomially equivalent. These results open up new directions in convolutional coding theory. Firstly, self-dual codes can be studied theoretically. Besides the obvious fact that the weight adjacency matrix of a self-dual code is invariant under the MacWilliams transformation, the close link between self-dual convolutional codes and self-dual block codes obtained by tail-biting plays a crucial role. It can be expected that, conversely, positive results																					1									X						#######	

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NSF	MPS 0908507 / University of Chicago	12.016	908507 Title Collaborative Research Waves and Fronts in Heterogeneous Media	Numerical simulation of the microscopic details of wave propagation in random media is still beyond the reach of modern computers: a typical propagation distance may be on the order of hundreds of wavelengths and as many correlation lengths of random fluctuations. This necessitates the use of various approximate macroscopic models, of which kinetic equations constitute an important class. However, the passage from microscopic wave equations to large-scale kinetics is a complicated problem in itself. The goal of the first part of the project is to develop new tools and better understanding of kinetic limits, especially in the regime when random media have long range correlations that lead to multiple temporal and spatial scales for various wave phenomena. The second part of the project investigates the qualitative behavior of solutions of reaction-diffusion-advection equations, with the main focus on the effect of a fluid flow. The interaction of the mixing, dynamic, and geometric properties of the underlying flow and the effects of diffusion and reaction will be investigated. The problem becomes especially complex in the situations where the feedback from the reaction process on the fluid flow cannot be ignored. The project																				1										X						#######	
NSF	MPS 0908535 / University of California-Davis	15.005	908535 Title Propagation, Focusing and Imaging in Complex Media	This project covers three areas related to multiply scattered waves: coherence propagation, focusing, and imaging in cluttered media. Firstly, a comprehensive and rigorous framework is formulated to analyze the space-frequency coherence properties of waves in random media. Secondly, the multiply scattered evanescent waves will be taken into account to enhance the wave focusing in cluttered media. Thirdly, imaging methods based on the compressed sensing techniques will be developed to achieve stable, accurate imaging of multiple targets in clutter with nearly minimal sensing resources. Multiple scattering is a basic phenomenon in wave physics. It affects how signals and information are transferred in clutter prevalent in both natural and urban environments. In addition to fundamental research in wave physics, the main applications of the project are in remote sensing and near-field imaging. In particular, the project on detecting intruders hidden in clutter is important for homeland security and tissue imaging. The project on imaging in the background of rough surfaces will have impacts on aerial sensing of natural resources and targets in the terrestrial environment, as well as design of											1																			X						#######	
NSF	MPS 0922929 / Drexel University	13.009	922929 Title MRI Acquisition of an Ultrafast Laser System for Terahertz Spectroscopy and Sub -Picosecond Dynamics	0922929 Baxter Drexel U. Technical Summary: THz radiation (0.1?10 x1012 Hz, ë~30µm?3mm) bridges the gap between electronics and visible/infrared optics and is a frontier region of scientific inquiry in physics, chemistry, biology, medicine, materials science, and engineering. However, there is a significant barrier to entry into THz science because of the required expertise and capital equipment. Accessible user facilities would transform THz science by enabling all new investigators to quickly acquire data without the need for specialized collaborations or access to accelerators. Toward that end, the PIs propose to acquire an ultrafast laser system for research and education in terahertz spectroscopy and sub-picosecond dynamics. The laser system will be housed in Drexel University?s Centralized Research Facilities, and it will be operated as the first bench-scale THz user facility in the nation. This laser system provides a combination of (1) access to THz radiation, (2) spectroscopy with sub-picosecond time resolution, and (3) a continuously tunable pulsed light source from UV to mid-IR. The laser source will be combined with different detection systems to enable terahertz time domain spectroscopy (THz-TDS), time-																	1													X						#######	

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NSF	MPS 0926384 / University of Oklahoma Norman Campus	2.034	926384 Title One year in National Weather Center Mathematical theory in radar image	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). The PI will spend one academic year at the National Weather Center (NWC), on the campus of the University of Oklahoma. The PI will gain experience in the acquisition and interpretation of radar data, and enhance his collaborations with researchers at NWC. The proposed research builds upon the expertise of the PI in the study of geometric flows. Recently, the PI and his collaborators have successfully introduced conformal geometric flows for one dimensional simple curves, as well as other geometric flows, that are expected to have applications to problems at NWC. The nonlinear decomposition of images will also be studied, and this work may lead to more efficient representations of weather phenomena. The PI will use this experience at NWC to develop a new course on the mathematical theory of image analysis. There will also be new opportunities for interdisciplinary research for undergraduate and graduate students.																		1												X						########	
NSF	MPS 0929241 / Southern Methodist University	15.006	929241 Title Numerical Methods for Wave Propagation Problems Efficient Resolution of Multiple Scales	The focus of our research will be the detailed study of questions we deem crucial to the development of reliable, efficient, and general computational tools for wave propagation problems. These, in turn, can have long-term impacts on numerous fields in science and engineering. Precisely we will: (i) Further develop accurate methods for truncating the computational domain near regions where full approximations are required, extending the range of application of the successful methods we have previously constructed to inhomogeneous and anisotropic media as well as to multiscale computations; (ii) Construct and analyze novel high-resolution approximation schemes enabling accurate simulations with near-optimal degrees-of-freedom per wavelength, mild time-step stability restrictions, and easy coupling with grid grid generation software to efficiently treat problems in complex geometry; (iii) Apply our methods to difficult problems in aeroacoustics; (iv) Collaborate with other computational scientists who are building and maintaining high-quality software for simulating waves. Wave propagation phenomena are ubiquitous in nature. Although waves may be produced by physical processes ranging from electric											1																		X						########	
NSF	MPS 0954704 / GA Tech Research Corporation - GA Institute of Technology	12.017	954704 Title CAREER Streaming Data Analysis in Sensor Networks	This research aims to offer statistical foundation and a host of efficient scalable methodologies for streaming data analysis in sensor networks. In many applications, sensor networks are deployed to online monitoring of changing environments over time and space, with a goal of early detection of some particular trigger events that can cause significant damage. However, the nature of streaming data from distributed, diverse sources and the constrained network resources (on communication, computing, costs, privacy of raw data, etc.) pose significant challenges, which require the development of new statistical tools, methods and theories. In this project, the investigator proposes a novel general framework for monitoring sensor networks in which a trigger event may affect different sensors or data streams differently. Some specific research topics include pure (consensus or parallel) detection and inference after detection, under different scenarios, depending on the models for sensor observations and the design requirements of sensor protocols. In addition, the research will integrate research and education by infusing the research findings into the curriculum, by organizing seminars												1																		X						########	

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NSF	MPS 1005441 / University of North Carolina at Charlotte	16.008	1005441 Title Numerical Methods for Wave Propagations in Inhomogeneous Media	In this proposal, the PI will develop numerical methods and their mathematical analysis, ultimately their implementations in studying wave phenomena in nano-electronics, coupled arrays of quantum dots, and phase shift masks in lithography. Propagation of classical electromagnetic and quantum waves plays a key role in these physical and engineering systems. In order to gain a quantitative understanding of the wave phenomena in those systems, accurate and efficient numerical simulations are needed with appropriately designed numerical algorithms. The targeted applications motivate our research with the following three proposed numerical methods: [1] An adaptive conservative cell average spectral method for Wigner equations in electron transport of nano-electronics; [2] A fast integral solver for quantum wave scattering in 3-D quantum dots in layered media [3] A parallel spectral element method based on eigen-oscillations for complex Helmholtz equations. The potential technology impact of this research is to understand the physics involved and provide design guidelines for nano-electronics such as nano-MOSFETs, phase shift masks, and quantum dots. The numerical methods developed in this															1															X						########	
NSF	MPS 1008183 / University of Missouri-Columbia	1.113	1008183 Title Applications of frames to problems in mathematics and engineering	Casazza DMS-1008183 The investigator works on several fundamental questions concerning applications of Hilbert space frames. Much of the work concerns "fusion frames," which provide a natural framework for performing hierarchical data processing. Recent advances in hardware technology have enabled the economic production and deployment of a large number of low-cost components, which in combination enable reliable and efficient operation. Across many disciplines there is a fundamental shift from centralized information processing to distributed or network-wide information processing. Data communication is shifting from point-to-point communication to packet transport over wide area networks where network management is distributed and the reliability of individual links is less critical. Radar imaging is moving away from single platforms to multiple platforms that cooperate to achieve better performance. Wireless sensor networks are emerging as a new technology that potentially enables cost-effective and reliable surveillance. All these applications involve a large number of data streams, which need to be integrated at a central processor. Fusion frames are a recent development designed precisely for														1															X						########	
NSF	MPS 1009954 / University of California-San Diego	1.041	1009954 Title Mathematics of Network Coding	Zeger DMS-1009954 The project develops foundations for the recently booming applied mathematics field of network coding. Network coding offers the promise of improved performance over traditional network routing techniques used in practical engineering applications. Emphasis is placed on the fundamental theory of communication in networks that allow coding in addition to routing. Applications include improved throughput in packet networks and power savings in wireless ad hoc networks. The work exploits the diverse mathematical, engineering, and computer science background from the investigator's previous work and involves mathematical analysis, algorithm design, and computer simulation. The main topic areas investigated are: the role of alphabet size and error correcting codes in network coding, techniques for computing or bounding network capacities, determining the scalar or vector solvability of networks, theoretically achievable rates under a limitation of the number of network nodes that can perform coding, and bi-directional networks. This project has applications to practical engineering problems involving packet switched networks, such as sensor networks, military														1															X						########	

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NSF	MPS 1013766 / Cornell University	12.17	1013766 Title RFI Mitigation Workshop	This proposal solicits funds for 10 early career US scientists and/or engineers to attend the Workshop on Radiofrequency Interference Mitigation 2010 (RFI2010), to be held 29-31 March, 2010 in Groningen, the Netherlands, near Westerbork Observatory. RFI2010 is the third in a series of international workshops, held every 3-4 years; they provide the only forum where scientists can exchange ideas and share results on this important topic.																			1										X						#######	
NSF	MPS 1016405 / New Jersey Institute of Technology	15.002	1016405 Title Hybrid Algorithms for Wave Propagation	This project is focused on the development of innovative and efficient algorithms dedicated to solving problems of acoustic and electromagnetic wave propagation. The strategy consists of using domain decomposition to design advanced numerical techniques for obtaining high computational efficiency, and improved convergence and accuracy properties. The proposed approach also allows for suitable utilization of parallel computing. The investigator is concerned with two classes of problems. The first consists of using domain decomposition methods to suitably combine, (1) finite element methods with boundary element methods, and (2) finite element methods with asymptotic techniques. In the second class, the investigator proposes to couple domain decomposition methods with a specific integral equation method for problems concerning multiple scatterers in the high frequency regime. The resulting algorithm bypasses the need to resolve at the wavelength scale while retaining error-controllability. A new Krylov-subspace method that significantly improves convergence of the iterative procedure will be investigated. This approach will decrease the computational time required to obtain a											1																			X						#######	
NSF	MPS 1016577 / University of Texas at Austin	15.003	1016577 Title Multiscale Algorithms for Wave Propagation	Most scientific processes and their related mathematical models have important features in a wide range of time and length scales. Some typical examples related to the computation of waves are propagation and scattering of high frequency waves and interaction of the wave field with complex media. Discretizing these problems directly at the finest scale and solving the resulting systems with standard numerical algorithms inevitably leads to an enormous computational problem with unacceptable long computation times and large memory requirements. Building on our previous experience in multiscale algorithms, we plan to design, implement, and analyze novel algorithms for problems in high frequency wave propagation and related fields. Such problems are challenging since many well-known techniques, such as multigrid and standard fast multipole methods have limited efficiency. We will focus on the following three topics: (1) high frequency acoustic and electromagnetic scattering, (2) Gaussian beam methods for high frequency wave and Schrodinger equations, and (3) homogenization of complex media with multiple reiterated scales. The overarching theme of the research presented in this proposal is to exploit the geometric											1																			X						#######	

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NSF	MPS 1035474 / University of Illinois at Urbana-Champaign	1.043	1035474 Title Collaborative Research Enhancing Access to the Radio Spectrum (EARS) Workshop	Enhancing Access to the Radio Spectrum (EARS) is a multi-disciplinary activity whose goal is to improve the efficiency with which the radio spectrum is utilized and to improve access to the radio spectrum in support of current and new technologies. Achieving these goals will, among other impacts, improve the availability of wireless broadband to Americans presently without broadband access, as called for in the American Recovery and Reinvestment Act. Because the radio spectrum is a valuable but finite natural resource, improvements in spectrum efficiency will have significant economic impact to the nation and the world. This award funds the first step, which is an invitational workshop that will bring together some of the key researchers and policy makers involved in radio spectrum access. All relevant fields will be represented, including science, engineering, economics, and policy/regulatory. The output of the workshop will include a vision for the future of radio spectrum access and use, and a prioritized list of research areas that can help achieve that vision.										1																		X						########	
NSF	MPS 1048718 / Harvard University	16.009	1048718 Title CASPER2010 Workshop for New Paths in Heterogeneous Digital Signal Processing	This grant will partially fund a workshop titled "CASPER2010: Workshop for New Paths in Heterogeneous Digital Signal Processing". The base mission of CASPER (Collaboration for Astronomy Signal Processing and Electronics Research) is to enhance and streamline the development of astronomical instrumentation through the development of platform-independent, open-source hardware and software. The aims of this workshop are to: * Provide hands-on training in hardware and firmware development to students and experienced astronomers * Discuss and disseminate scientific accomplishments enabled by CASPER projects * To broaden the participation of the wider Digital Signal Processing community in the mission of CASPER The funding provided by NSF will be used exclusively to provide travel and participation support for students and junior faculty to attend the workshop. Additional outreach activities related to the workshop will enhance the experience for the student participants. These activities include participation in lectures at the Harvard Smithsonian Center for Astrophysics (CfA) and night time observing with optical telescopes at the CfA. In addition, the participants will have access to a 2-m radio																1													X						########	
NSF	SBE 0752931 / Pennsylvania State Univ University Park	18.008	Collaborative Research: Auctions and Resale Markets	Auctions have been widely used in recent years as a way to effectively privatize social assets. Some prominent examples of such assets are oil and gas rights, timber rights and rights to use the electromagnetic spectrum. The practical use of auctions has, in turn, led to substantial developments in the theoretical and empirical analysis of auctions. In most real-world auctions bidders anticipate the resale possibilities, either among themselves or to a larger market. The presence of resale markets affects both bidding behavior and the performance of auctions. With a few exceptions, however, the bulk of the theoretical and empirical work on auctions to date has neglected the issue of resale markets. This project explores two major questions. First, given that resale possibilities exist, how do different auction formats perform in terms of revenue and economic efficiency? In particular, is one format preferable to another in the presence of resale? Second, how do resale possibilities affect bidding behavior in auctions and how do these possibilities affect the performance of a given auction format, both in terms of efficiency and in terms of the revenue? For instance, is resale advantageous to a seller, say a																									1					X						########	

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NSF	SBE 0849349 / Duke University	18.002	Applied Mechanism Design	This award funds research using computational methods on a problem in mechanism design that is especially important in understanding the likely outcomes of complicated auctions. The research team use mechanism design theory and linear programming techniques to consider whether first-price auctions are more or less vulnerable to collusion than second-price or ascending bid auctions. They also determine how a tacit or explicit cartel might operate in a variety of different kinds of auctions. The research has substantial broader impacts because auction methods are widly used. The Federal government currently uses auctions to allocate telecommunications spectrum and rights to offshore drilling, timber, and mining. Proposals to use a 'cap and trade' system to reduce greenhouse gas emissions also rely on auction methods.																					1						X						#######	
NSF	SBE 0851200 / Yale University	18.009	Collaborative Research: Robust Predictions in Games With Private Information	In many economic environments the participants do not have the same information about the relevant aspects of their situation. For example, in a financial market each investor may have different pieces of information about the underlying value of an asset or a company. In product markets, each competiting firm may have private information about its cost structure. In auctions, such as the wireless spectrum auctions organized by the Federal Communications Commission or the offshore oil tracts auctioned off by the U.S. Department of the Interior, the bidders have private information about their valuations and also some, possibly noisy, information about the valuations of their competitors. The private information of an agent, whether it is about his/her own valuations or the valuations of the competing agents will determine the behavior and the strategy of the agent. But in practice, the theoretical and/or empirical analysts do not have a clear understanding of what the economic agents know and, in particular, what they do or do not know about each other. The missing and incomplete information si also highly relevant from a policy perspective as the supervising or regulatory authority in many markets face																					1						X						#######	
NSF	SBE 0851674 / Ohio State University Research Foundation -DO NOT USE	18.022	Package Auctions	This research project explores the performance of different package auction designs in different environments. Past research shows that package auction mechanisms can be effective in settings where market clearing prices do not exist and standard auctions are expected to perform poorly. This project extends the PI's research with his collaborator Paul Milgrom of Stanford University in several directions by conducting laboratory experiments combined with simulation methods to test the game theoretic models. The team explores whether different bidding languages lead to different and better results. They measure the impact of constraints, like budget constraints, that are faced by institutional bidders. This project has broader impact because the results will help auction designers to identify the pros and cons of different auction formats in different environments. Individuals, firms, or governments who seek to use auctions will have more comprhensive knowledge when choosing the specific methods used to conduct their auctions.																					1						X						#######	

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NSF	SBE 0922297 / Stanford University	18.023	Problems in Applied Market Design	Economic analysis has played an increasing role in shaping the design of market rules and institutions. In the field of auctions and market design, ideas now move rapidly from the research frontier into practice, informing government policy on the allocation of radio spectrum, being incorporated into proposals for cap and trade policy, troubled asset purchases, and broadband stimulus, and providing new methods and approaches for private sector firms such as Google that have been quick to capitalize on new ideas about auctions and market organization. This project uses a combination of economic theory and empirical methods to understand a series of applied problems in market design. The first problem relates to the design and implementation of radio spectrum auctions, now run regularly by many countries following the lead of the FCC. The research documents a variety of surprising bidding patterns in past auctions and explains the role of strategic bidding. A second project studies the college admissions market. The investigator documents a set of empirical facts about the use of early admissions programs and develops a game-theoretic model that matches the empirical patterns and explains the strategic choices facing																								1						X						#######	
NSF	SBE 0924773 / University of Maryland College Park	18.011	Common-Value Auctions with Liquidity Needs	This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This award funds research to conduct laboratory experiments that will compare the outcomes of different auction mechansims. One of the most fruitful areas of theoretical auction research has been the comparison of static auction mechanisms with dynamic auction mechansims and the development of new dynamic auction desgins for auctioning multiple items. This project provides new empirical evidence comparing the performance of static and dynamic auctions when bidders are financially constrained. This evidence is particularly noteworthy because it sheds new light on how auctions for multiple items with common values perform in practice. Specifically, the experiments compare sealed bid and dynamic auction formats in common value environments where bidders have liquidity needs (in reverse auctions) or budget constraints (in standard auctions). Recent research in economic theory predicts that the dynamic auctions result in both higher auction efficiency and higher auction revenue. The experiments test this prediction. Auctions of this type have been suggested as a method for solving several																								1						X						#######	