Testbed Name	*NRL Cognitive Radio Test Laboratory*	*NRL Tactical Edge Network Testbed*	*Calit2 Wireless System Lab*	*ORBIT*	*Spectrum Sharing Innovation Test-bed and Public Safety Communications Research (PSCR) Lab demo network*	*ORNL Communications Test Bed*	*INL Wireless Testbed*	*US Army Test Ranges*	*Army C4ISR and Radio Analysis and Experimentation Facilities*	*Global Environment for Network Innovation (GENI)*	*AFRL Aerial Layer Networking Experimentation Facilities*	**Cognitive Radio Network (CoRNet)**
Agency	U.S. Naval Research Laboratory	U.S. Naval Research Laboratory	Calit2/UCSD	NSF	Department of Commerce	Department of Energy	Idaho National Laboratory (INL) Department of Energy (DOE) Federally Funded Research and Department Center (FFRDC)	US Army	US Army	NSF	US Air Force Research Laboratory	Virginia Tech
Location	Washington, DC	Washington, DC	La Jolla, CA	671 Rt. 1 South, North Brunswick, NJ	Boulder, CO	Oak Ridge, Tennessee	Idaho Falls, ID 83415	Fort Huachuca, AZ; White Sands Missile Range, NM; Yuma Proving Ground, AZ; Aberdeen Proving Ground, MD; Redstone Arsenal, AL;	Aberdeen Proving Ground, MD; and Fort Dix/Lakehurst, NJ	Approximately 46 university and industry sites across the continental U.S. and Alaska	Rome, New York with facilities in Stockbridge and Newport, NY	Blacksburg, VA
Name of facility	NRL Cognitive Radio Test Laboratory	NRL Tactical Edge Network Testbed	Calit2 Wireless System Lab	ORBIT	Institute for Telecommunication Sciences	Oak Ridge National Laboratory	INL Wireless Testbed	US Army Test Ranges including Electronic Proving Ground, White Sands Missile Range, Aberdeen Test Center, Yuma Test Center, and Redstone Test Center	Various C4ISR and Radio Analysis and Experimentation facilities including Radio Evaluation and Analysis Lab (REAL), 64 Channel GNU Radio Experimentation Platform, C4ISR & Network Modernization environment/venue	Global Environment for Network Innovation (GENI)	Newport Research Facility; Stockbridge Research Facility; Rome Research Site	CoRNet
Operator of facility	U.S. Naval Research Laboratory	U.S. Naval Research Laboratory	Calit2	WINLAB, Rutgers University	National Telecommunications and Information Administration and NIST	UT-Battelle, LLC	Battelle Energy Alliance (BEA)	US Army Developmental Test Command (DTC), which reports to the United States Army Test and Evaluation Command (ATEC).	US Army Communications-Electronics Research, Development and Engineering Center (CERDEC)	Raytheon BBN Technologies/GENI Project Office	US Air Force Research Laboratory	Virginia Tech
Available to industry	Yes, with cooperative research agreements	Yes, with cooperative research agreements	Yes	Yes	Yes, via Cooperative Research and Development Agreement (CRADA) under the Technology Transfer Act of 1986	Yes; through user agreements (providing access to experimental user facilities), work for others (WFO) agreements, and cooperative research and development agreements (CRADAs)	Yes. Note: Currently available for industry on government agency request or directly for industry with an FCC STA request. FCC licensing (pending new rule making on	Yes	Yes	Yes	Yes, with Commercial Test Agreement	Yes

							experimentation) will be requested for wider industry availability.					
Available to fed agencies	Yes, with cooperative research agreements	Yes, with cooperative research agreements	Yes	Yes	Yes, via Interagency Agreement under the Economy Act	Yes; through government interagency agreements	Yes. Note: Has been serving more than 50 different government offices under NTIA authorities.	Yes	Yes	Yes	Yes	
Available to academia	Yes, with cooperative research agreements	Yes, with cooperative research agreements	Yes	Yes	Yes, via Cooperative Research and Development Agreement (CRADA) under Technology Transfer Act of 1986	Yes; through ORNL's University Partnerships Program that offers opportunities for sponsored R&D for undergraduates, recent college graduates, post docs, faculty, and distinguished fellowships	Yes. Note: Pilot demonstration for remotely enabled outdoor academic research experimentation also conducted.	Yes	Yes	Yes	Yes; via Information Institute. Currently conducting aerial experimentation with academia using remotely piloted vehicles.	Yes
Indoor	Yes	Yes	Yes	Yes	Yes, includes the following fully equipped facilities: anechoic chamber rated from 200 MHz to 40 GHZ, 4 RF shielded enclosures, audio/video quality labs, LTE and LMR test labs, 2 DSA radio test labs, and 4 general purpose RF test labs.	Yes; R&D labs and test facilities	Yes	Yes	Yes	Yes; multiple and varied wireless networking testbed capabilities, including Wi-Fi and WiMAX	Yes, includes: 32'x32'x50' anechoic chamber rated from **50 MHz** to 18 GHZ; general purpose RF Technology Center; Command and Control Concept & Technology Centers; SATCOM Facility; Network-Centric Integration and Interoperability Facility; Quantum Communications Lab; Secure Embedded High Performance Computing Lab	Yes, 48 nodes distributed in a building

Outdoor	No	No	Yes. Can be moved from indoor to outdoor	Yes	Yes, 1800 acre protected radio quiet zone approximately 12 miles from the laboratory. The Table Mtn Field Site has multiple buildings to house equipment and towers to support antennas for fixed station testing.	Yes; test ranges	Yes	Yes	Yes	Yes; multiple and varied wireless networking testbed capabilities, including Wi-Fi and WiMAX	Yes. Two individual auxiliary sites located approximately 20 miles from the Rome site. The three sites are networked with a variety of communications technology - both off-the-shelf and some with a military R&D purpose - to facilitate over-the-air wide area network & spectrum experimentation. Currently executing tri-site (geographically separated) wireless network spectrum assessment with airborne and ground nodes.	In development
Virtual	Yes	Yes	No	Yes	No	Yes; modeling, simulation, and design tools	In Planning. Note: Infrastructure and organizational structure exist to build this capability.	Yes	Yes	Yes; extensive networking simulation capabilities	Yes; High Performance Computing Facility supports real-time C4ISR applications through high performance computing hardware and software including Emulab.	Yes, via the internet
Hardware	Yes	Yes	Yes	Yes	Yes	Yes; chambers and test equipment	Yes	Yes	Yes	Yes; Wi-Fi, WiMAX, and other wireless networking interfaces	Yes	Yes, SDR heads with cluster processing

Spectrum authority	N/A	N/A	License free	FCC Experimental License for 2.6 Ghz WiMAX BS; also uses 2.4 & 5 Ghz unlicensed bands	Table Mtn is an authorized experimental test station under NTIA Redbook Section 7.11; otherwise STAs are used	NTIA with telecommunications proposals submitted to NTIA through IRAC by way of the DOE Spectrum Management Office	NTIA 7.11, 7.14;FCC Test Range Authority under development. Note: Spectrum management done at the INL, under the NTIA experimental test authority 7.11 and DOE guidance for government testing. INL Spectrum Manager on site. 7.14 testing coordinated through US Military Spectrum Management at Nellis AFB, NV. Working with the FCC to obtain FCC commercial test range status.	NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management and the provisions of Dept. of Defense Directive (DoDD) 4650.1	NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management and the provisions of Dept. of Defense Directive (DoDD) 4650.1	Part 15 (unlicensed) and some WiMAX FCC licenses	NTIA 7.11	Several band with FCC experimental license
Frequency Range (low, MHz)	< 1 MHz	N/A		100	30	10 kHz	Extremely Low Frequency (ELF)			Approximately 2400 MHz (Wi-Fi)	30MHz	100 MHz
Frequency Range (high, MHz)	currently used to 20 GHz	N/A		6500	18000	100 GHz	To 60 GHz and beyond			Approximately 3650 MHz WiMAX	18GHz (extended ranges as needed)	6 GHz
Contiguous frequency coverage	Yes	N/A	Our radio platforms cover 2.4GHz and 5GHz ISM band. However, we have NI PXI 5610 upconvertor and 5600 down convertor that cover from 9kHz to 2.7GHz	Yes (for subset of available radios)	Yes, for conducted testing, i.e. a wired test-bed. For radiated testing, operation is limited by frequencies and uses excluded in NTIA Section 7.11. LTE test bed uses 763-768 MHz, and 793-798 MHz	Yes	No (as per NTIA 7.11), restricted frequencies not permitted (very small bandwidths); harmful interference to transmitters and receivers outside the INL wireless range must be avoided.			No	Excluded bands per NTIA 7.11	No, antennas need to be swapped

Size	2-6 ft tall, 19in racks	220 host computers	Small scale (~50m)	20 x 20 m indoor and 2 x 2 km outdoor	7.3 square km at Table Mtn, 20 km x 20 km for LTE test-bed covered under STA	58 sq miles	890 square miles outdoor wireless range plus Idaho Falls INL Campus areas. Note: There is also indoor (upgradable) Anechoic Chamber of size 17 ft (Length)x 10 ft (Width) x 8 ft (Height) and an additional RF isolation screen room with the same dimensions.	Multiple sites covering thousands of square miles of terrain and restricted airspace	N/A	Distributed across ~46 campuses	Rome Research Site (campus: 65 acres; lab: 883,716 sq ft); Stockbridge (300 acres; 13,983 sq ft lab); Newport (78 acres; 25,236 sq ft lab) situated approximately 1.5 miles apart with 400' deep valley for several "far field" outdoor ranges spanning the two hilltops.	48 nodes
Number of supportable users?	Dedicated to single application/experiment per use.	No fundamental limit on users; practical limit is we can support about 5 separate experiments at a time	One experiment at a time as of now. More hardware platforms are needed in order to support multiple users at a time.	No limit on number of users. Main radio grid and 9 smaller sandboxes operate as scheduled time-shared facilities. Outdoor node shared by <10 experiments using software virtualization.	No fundamental limit on users; practical limit is we can support about 4 separate experiments at a time	No fundamental limit on users, but will need to schedule planned activities	No fundamental limit on users. The wireless testbed can serve different sets of wireless eco-system stakeholders and different vertical applications simultaneously.	Many test facilities are available	Capability to perform concurrent tests on different radios / configurations	Approximately 46 participating organizations	Concurrent experiments with multiple sites, labs, links, and radios via air, ground, and SATCOM.	one user at a time
Wired testbed capability	Yes	Yes	Yes	Yes; large-scale reproducible experiments with up to 400 radio nodes	Yes	Yes	170 mile underground main fiber loop using DWDM/CWDM for optical isolation between production and test traffic, plus a 65 mile aerial fiber loop across the main INL power loop (two loops are isolated from each other). Seven independent LAN configurations dedicated to test range.	Yes	Yes	Yes (actually, more extensive wired facilities are availalble compared to wireless)	Yes	no

Propagation environment(s)	Limited RF propagation attenuation	Modeled, emulated RF propagation with terrain and other effects	Indoor and Urban	Indoor and industrial/residential for radio grid; suburban for outdoor network	Table Mtn Field Site: open area rural. Other radiated tests can be conducted via STA in rural, light suburban and urban environments in the Boulder/Denver area.	Mostly ridge and valley terrain; rural and suburban (main ORNL site) settings; humid subtropical climate	Rural and light suburban Note: 1. Suburban and city environments can be created through a combination of physical and emulated outdoor environments. 2. Possible nearby city collaboration for experimentation on specific frequency ranges.	Diverse terrain ranges from high desert valley to wooded mountains at various elevations	RF matrices connected to RF ports on radios, Outdoor facilities with foilage and open environments	Varied LAN and WAN environments, indoor and outdoor	Rome (light suburban); Newport and Stockbridge (rural) with hills, valleys, foliage, and weather.	Indoor multi floor
Permanent or temporary setup	Permanent	Permanent	Flexible setup	Permanent	Permanent sites are located at Table Mtn Field Site and the Green Mtn tower site immediately west of the lab.	Permanent development and test facilities; willing to arrange temporary setup for special projects	1. Permanent Tier-1 commercial grade cellular and LMR network infrastructures 2. Mobile Cell-on-Wheels for creating varied test environments 3. Network-in-a-box equipment also available for localized connectivity or waveform generation and basic functional testing Note: Combination of indoor and outdoor environments can also be used with remote connectivity.	Permanent	Permanent	Permanent	Permanent	Permanent

Can support classified research	Yes; hardware and data facilities can be protected at the Secret level.	Yes; hardware and data facilities can be protected at the Secret level.	No	No	No	Yes; hardware and data facilities can be protected at the SCI level	Yes. Hardware, software, networks, applications, data and people can be protected at all the appropriate classified levels. Note: Different levels of classified facilities and access to corresponding networks available.	Yes;	Yes;	No	Yes.	no
Max RF power levels	~10 W	N/A	1 W	10 W for WiMAX, 100 mW for most SDR platforms, up to 500 mW for ISM/UNII platforms	Most cabling and antennas can support up to 50 W; LTE system up to 1000 W ERP	Most amplifiers, cabling, and antennas can support up to 100 W	Max RF Power approved on a case by case basis. No Max RF Power limit except to avoid harmful interference to local spectrum owners.				Subject to experiment and approvals.	100 mW but can be increased with modifications
Road testing capability	Not Currently	N/A	No	On public roads around the facility (Rutgers campus area, New Brunswick, NJ)	Yes, 10 km of road within facility. Safe speeds as posted.	Yes; road testing capabilities are available at nearby National Transportation Research Center (NTRC)	Yes. 14 miles of rail lines in addition to the 200 miles of roads for transportation testing diversity. Safe speeds up to 65MPH. Note: Special transportation roads that can support higher speeds for public safety and government use can be built within the range on a needed basis.	Yes	No	Could be incorporated	Yes	no

Aeronautical testing capability	Not Currently	N/A	No	No	No	No	Small UAV runway (1,000 ft) available. Maximum UAV altitude 1200 AGL. Overflights OK. Not near crowded airspace, civilian airports or military ranges. Note: Aeronautical testing over the range with terrestrial ground support possible. Nearest Idaho Falls city airport is about ~45 miles away. Nearest military bases are about 200 miles away.	Yes	Yes	Could be incorporated	Stockbridge: A Small Unmanned Aerial System (SUAS) airfield is operational within the facility for development and evaluation of advanced RF/optical communications systems, radar imaging systems, foliage penetration studies and for communications link experiments with small unmanned aircraft systems. Griffiss International Airport with a 1-mile-length runway is available and adjacent to the Rome Research Site.	no
Ship/maritime testing capability	Not Currently	N/A	No	No	No	No	No			Possibly could be incorporated(?)	Availability of Seneca Lake and Lake Ontario nearby for underwater testing.	no
Device-level testing	Yes, with capabilities to the application layer	Yes, layer 3 and above network devices	Yes, in particular the transmitter PA	Yes	Yes	Yes	Yes. Note: Both the outdoor facilities, as well as indoor anechoic chamber and RF isolation screen room facilities can be used.	Yes	Yes	Limited	Yes	no
System-level testing	Yes	Yes	Yes	Yes	Yes	Yes	Yes. Note: Large systems and interoperability between systems can be tested in real outdoor environments.	Yes	Yes	Yes	Yes. In particular, the three distinct site arrangement is uniquely suited to the evaluation of fractionated survivable remote-piloted systems and technologies to enable freedom of operations in	

												contested environments.	
Distance to closest population center	N/A	N/A	Inside population center	In town/campus (total population ~100,000)	Lab is in Boulder, population 100,000. Table Mtn Field Site is 9 miles north of Boulder.	Located in Oak Ridge city limits and approximately 5 miles from Oak Ridge retail and residential hubs	Approximately 45 Miles on the East (Mid-size town, population 70,000), 40 Miles over the mountain on the west (Population 500), 45 Miles on the North (Village with population 10), 60 Miles on the West (Population 500). The closest city to the south s 240 Miles.	Varies		Embedded within population centers	Sites embedded within rural towns and a light suburban city.	
Channel simulators available	Not Currently	Yes	No	Yes	Yes, particularly LTE and Project 25 LMR simulators. Lab has experience generating radar waveforms.	Yes	No. Note: Can lease or procure.		Yes		Yes; for available IEEE standards and arbitrary waveforms over various propagation models.	no
Basic testing	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mission testing	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

Operational testing	Yes	Yes	No	Yes	Yes	Yes	No: Certified Military/ Government Operational Test and Evaluation. Yes: Range regularly executes large-scale operational scenario testing for emergency first responders, nuclear detection and counter proliferation exercises. Note: Support functional, operational, overload testing environments, besides mobility, roaming, technology inter-working, inter-operability, spectrum repurposing and sharing technologies.	Yes	No	Yes	Yes	
Technology Interoperability Testing	Yes	No	No	Yes	Yes	Yes	Yes. Note: Multiple technologies are currently available. New technologies can be added to the range on a needed basis.	Yes	Yes	Yes	Yes	
Protocol Compliance Testing	Yes	Yes	No	Yes	Yes	Yes	No. Protocol testers available for 2G/3G network technologies		No	Yes	Yes	

Available technologies (e.g., HSPA, LTE, Wi-Fi, WiMax, etc.)	N/A	Virtual modeled WiFi, tactical radio, SATCOM, etc. connectivity	Wi-Fi and simplified Cellular TDMA system	WiMAX, UMTS, ZigBee, Bluetooth, WiFi, SDR	LTE, Project 25 LMR, U-NII Dynamic Frequency Selection radio, point-to-point microwave, wired MPLS	GSM/EDGE (cell phone); Wi-Fi; WiMax; Zigbee; Bluetooth; ultra wideband (UWB); satellite communications (SATCOM)	1. Extensive set of isolated, commercial-grade, Tier-1 cellular equipment's. 2. Supported testing networks include GSM, UMTS, CDMA, WiFi, WiMax (mobile & fixed), HF/VHF/UHF, WiFi, LMR, P25 and Satellite communications systems. 3. Backbone networks include SONET, 60 Miles of optical fiber, microwave and satellite networks. 4. Additional UAV and UGV test facilities. Note: In planning 1) LTE and 802.22 WRAN networks. 2) Wireless security testing infrastructure. 3) Wireless IPv6 test and integration infrastructure.	Extensive capabilities, see http://www.dtc.army.mil/default.aspx and linked web sites for individual test facilities	Various military systems, DSA radios, USRP2 radios, Traffic generators, Battle Command Applications, etc.	Wi-Fi; WiMAX	SATCOM; DAMA; mini-CDL; TTNT; QNT; legacy HF, VHF, UHF; 117G handheld radios; WNaN radios; WiMAX; microwave; optical (live 15 nmi link); WiFi; GNU radios (USRP2) and more.	N/A

Types of basic test equipment available	Signal Generation, Arbitrary Waverform generation, real time spectrum analysis, Network traffic generation, visualization, and data capture and analysis tools	Network traffic generation, visualization, and data capture and analysis tools	Spectrum analyzers, signal generators, National Instruments upconvertor and downconvertor . WARP radio platform, USRP, etc.	Vector Signal Analyzer (to 6 GHz, Spectrum Analyzer (to 13 GHz), Vector Signal Generator (to 6 GHz), Digital Scopes, Digital Signal Analyzer	Spectrum analyzers (to 26 GHz); vector signal generators (to 20 GHz) with fading simulators; vector signal analyzers (36 MHz bandwidth), real time spectrum analyzers (up to 6 GHz), vector network analyzers (up to 20 GHz), digital storage scopes (up to 12 GHz), Multiple LTE-specific network and Spectrum analyzers, and protocol conformance equipment	Spectrum analyzers; network analyzers; logic analyzers; waveform generators; digital storage scopes; protocol analyzers	Spectrum analyzers (to 26.5 GHz); real time spectrum analyzers (to 14 GHz); vector signal analyzers (to 26.5 GHz); vector signal generators (to 6 GHz); analog signal generators (to 40 GHz); vector network analyzers (to 40 GHz); vector impedance analyzer (to 100 MHz); 1 GS/S & 500 MHz digital storage scopes; Time Domain Reflectometer, RF power meters (to 40 GHz); waveform generators; cellular engineering handsets; protocol analyzers.	Extensive capabilities, see http://www.dtc.army.mil/default.aspx and linked web sites for individual test facilities	State of the art instrumentation, data collection & reduction	Extensive	State-of-the-art spectrum analyzers; vector signal generators; network analyzers; digital storage scopes; and power meters; and instrumentation to include aircraft pedestals, towers, and SATCOM DAMA simulator.	Arbitary Waveform Generators and Signal Analyzers

Data collection capabilities	Currently limited to a few TBs storage	Approximately 250 TB storage in machine cluster	Yes	16 TB	Basic laptop and server network storage	Data capture/replay equipment; lab-based data collection/storage systems; mobile data collection trailer; extensive signal processing experience; real-time signal characterization	Limited storage capacity dedicated to the testbed available. Note: Large data collection servers with nation-wide controlled remote access can be setup for use by regulators, other government agencies, industry and academia	Extensive capabilities, see http://www.dtc.army.mil/default.aspx and linked web sites for individual test facilities	State of the art instrumentation, data collection & reduction	Extensive	Newport Research Facility: full scale aircraft antenna evaluation; mounted on top of heavy duty pedestals to evaluate far-field and effects of the fuselage/materials, external fuel tanks and armaments, and any other externally mounted equipment. Isolation measurements are also performed to determine antenna-to-antenna coupling. Full 360 degree pedestal testing and at various angles. State-of-the-art instrumentation permits thousands of antenna patterns to be measured in one rotation of the aircraft. Ranges interconnected via fiber optic network.	
Hardware repair/test bench facilities	Yes	N/A	Yes	SMT reworking bench and other test/workshop facilities are available on-site	Basic repair and test facilities are available onsite	Basic fabrication, repair, test, and calibration facilities, including semiconductor chip probe station and surface mount equipment	Basic repair and test facilities, including surface mount equipment, are available onsite Note: In house hardware prototyping and staging facilities saves time for rapid experimentation when needed	Extensive capabilities, see http://www.dtc.army.mil/default.aspx and linked web sites for individual test facilities		Limited	Custom fabrication & prototyping; Surface mount & fabrication	limited

Remote connectivity	Yes	Yes	Yes. Testbed can be accessed over Internet with security credentials.	Yes	Yes; unclassified monitoring and data collection systems can be remote. No remote capability for classified testing.	Yes; unclassified monitoring and data collection systems can be remote; no remote capability for classified testing	Yes Unclassified monitoring and data collection systems can be remote Interconnectivity with classified networks available. Note: Connectivity to specialized national experimental intranets available through Energynet connectivity		Connectivity to other Army, Joint, industry and academic facilities	Yes	Yes; IP connectivity between sites, defense intranets, industry, and academia.	
Intellectual Property Rights protection	Yes	Yes	RF can be separated in theory. But it is not as of now. Data collection can be separated with controlled access and encrypted data transfer.	No	Yes. RF and data collection facilities can be physically separated with controlled access.	Yes; nondisclosure agreements (NDAs) for sharing proprietary information, material transfer agreements (MTAs) for receiving and providing materials, and licensing agreements for obtaining rights to ORNL patents and copyrights	Yes. 1. RF and data collection facilities can be physically separated with controlled access. 2. Physical and logical separation of stakeholders available as needed. 3. Dedicated legal teams available for support Note: Technology Deployment team support available for technology commercializatio n	In accordance with Federal, DoD and Army regulations	In accordance with Federal, DoD and Army regulations		Yes, in accordance with Federal, DoD and Air Force regulations	
Safety, Physical security	Onsite fire protection; physical security force on duty 24/7. Controlled access to facility.	Onsite fire protection; physical security force on duty 24/7. Controlled access to facility.	Controlled access to facility, fire protection onsite, etc.	Card-key controlled access to facility; sprinker system for fire-proofing	Lab: onsite fire protection; physical security force on duty 24/7. Controlled access to facility. Table Mtn Field Site: unmanned, controlled access facility	Onsite fire protection; available emergency services: physical security force on duty 24/7; controlled access	Yes Medical clinic, fire station, physical security forces available on site.			Yes	Yes	yes

Medical Facility	Nearest medical facility is 10 miles away	Nearest medical facility is 10 miles away	More than one hospital on campus	Major medical center is within 5 km	Nearest medical facility is 3 miles from the lab and 9 miles from the Table Mtn Field Site	On-site medical facility; on-site first responders; several comprehensive medical facilities available within 20-mile radius	Yes 1. There is a medical clinic within the range for 24x7 emergency needs. 2. Nearest medical hospital is 45 miles away, provides life flight service.			In general vicinity	Yes, 2-5 miles from each site.	
Application space (radar, mobile networks, etc.)	Communications focus HF-20GHz, interference emitters can be replayed from captured data.	Mobile and fixed wireless networks in various environments.	Primarily edge wireless access network	Next-generation mobile networks including WPAN, ad-hoc, WiFi, cellular, vehicular and future Internet architecture	Primarily mobile and fixed wireless networks. Can also support radar testing.	Software defined radio; mobile and fixed wireless networks; radar; tagging and tracking; intelligent systems	1. Mobile and fixed wireless networks. 2. Smart grid and energy industry 3. UAV (Up to 1200AGL, 200 pounds), UGV testing 4. Limited aerial testing Note: Can create test environments for: 1. Intelligent transportation systems. 2. Medical devices. 3. Sensors and Mobile Adhoc NETworks (MANETs).	Various applications, see http://www.dtc.army.mil/default.aspx and linked web sites for individual test facilities	US Army Networks. Joint capability is enables through collaboration between laboratories and connectivity to other facilities.	Fixed and mobile networks	Aerial layer networking (remotely piloted aircraft, mobile terrestrial radios, SATCOM), antenna measurement, radar	Indoor spectrum management
Big machine shops, heavy equipment & skilled support staff							Yes			Potential access available within local university/industry campuses	Yes.	
Generators & Fueling							Yes			Limited	Subject to experiment and approvals.	
Processes & Procedures							Resource (assets, personnel & spectrum) Management, Configuration Management & well established maintenance procedures.				Subject to experiment and approvals.	

Executive summary					ITS conducts research and engineering that fosters the development of new spectrum sharing strategies, supports spectrum related policy decisions and rulemakings by NTIA and the FCC, and assists ongoing regulation and management of the radio spectrum. The lab performs comprehensive and band-specific spectrum surveys that help identify candidate bands for sharing and characterize Federal incumbent spectrum usage. Spectrum surveys also facilitate feasibility studies of proposed sharing schemes. Select schemes are subjected to detailed electromagnetic compatibility studies including system and propagation modeling. These models are validated using laboratory and field measurements. The analyses culminate in the development of interference protection criteria (IPC). IPC quantify the threshold of harmful interference from new systems' emissions from the incumbent Federal					GENI, a virtual laboratory for exploring future internets at scale, creates major opportunities to understand, innovate and transform global networks and their interactions with society. Dynamic and adaptive, GENI opens up new areas of research at the frontiers of network science and engineering, and increases the opportunity for significant socio-economic impact. GENI will: (1) support at-scale experimentation on shared, heterogeneous, highly instrumented infrastructure; (2) enable deep programmability throughout the network, promoting innovations in network science, security, technologies, services and applications; and provide collaborative and exploratory environments for academia, industry and the public to catalyze groundbreaking discoveries and innovation.		CoRNet is available to the research community for a variety of experiments. Open source software availability

					user's operational perspective and provide the technical underpinning for rulemakings. When new rules are adopted, ITS supports the regulatory process by developing and promulgating conformity assessment test procedures and test systems. As needed, ITS conducts surveillance tests on new systems to ensure ongoing compliance with the rules.							
Spectrum sharing related research					Electromagnetic Compatibility Testing, Emissions Measurements, Propagation Modeling and Measurement, Development of Interference Protection Criteria, Development of Conformity Assessment Systems, Noise Measurements, Spectrum Survey and Occupancy Measurements					Varied		available

Spectrum sharing related publications					Case Study: Investigation of Interference into 5 GHz Weather Radars from Unlicensed National Information Infrastructure Devices, Part II, July 2011, NTIA TR-11-479						Available upon request from NSF		available
Spectrum sharing related publications					Case Study: Investigation of Interference into 5 GHz Weather Radars from Unlicensed National Information Infrastructure Devices, Part I, November 2010, NTIA TR-11-473								
Spectrum sharing related publications					Effects of RF Interference on Radar Receivers , February 2006, NTIA TR-06-444								
Spectrum sharing related publications					Resolving Interference from an Airport Surveillance Radar to a Weather Radar, April 2006, NTIA TM-06-439								
Spectrum sharing related publications					Measurement procedures for the radar spectrum engineering criteria (RSEC), March 2005, NTIA TR-05-420								
Spectrum sharing related publications					Interference Protection Criteria Phase 1 - Compilation from Existing Sources, October 2005, NTIA TR-05-432								
Spectrum sharing related publications					Wideband Man-Made Radio Noise Measurements in the VHF and Low UHF Bands, July 2011, NTIA TR-11-								

					478							
Spectrum sharing related publications					Interference potential of ultra wideband signals: Part 1: Procedures to characterize ultra wideband emissions and measure interference susceptibility of C-band satellite digital television receivers, Feb. 2005, NTIA TR-05-419							
Spectrum sharing related publications					Interference Potential of Ultra wideband Signals Part 2: Measurement of Gated-Noise Interference to C-Band Satellite Digital Television Receivers, August 2005, NTIA TR-05-429							
Spectrum sharing related publications					Interference Potential of Ultra wideband Signals Part 3: Measurement of Ultra wideband Interference to C-Band Satellite Digital Television Receivers, February 2006, NTIA TR-06-437							
Spectrum sharing related publications					Measurements to determine potential interference to public safety radio receivers from ultra wideband transmission systems, June 2003, NTIA TR-03-402							

Spectrum sharing related publications					Addendum to NTIA Report 01-384: Measurements to Determine Potential Interference to GPS Receivers from Ultra wideband Transmission Systems, Sep. 2001, NTIA TR-01-389							
Spectrum sharing related publications					Measurements to Determine Potential Interference to GPS Receivers from Ultra wideband Transmission Systems, NTIA TR-01-384							
Spectrum sharing related publications					The Temporal and Spectral Characteristics of Ultra wideband Signals, NTIA TR-01-383							
Spectrum sharing related publications					Measurements of Pulsed Co-Channel Interference in a 4-GHz Digital Earth Station Receiver, May 2002, NTIA TR-02-393							
Spectrum sharing related publications					Potential interference from broadband over power line (BPL) systems to federal government radio communications at 1.7-80 MHz - Phase 1 Study, April 2004, NTIA TR-04-413							
Spectrum sharing related publications					Electromagnetic Compatibility Testing of a Dedicated Short-Range Communication (DSRC) System that Conforms to the Japanese Standard, Nov. 1998, NTIA TR-99-359							

Spectrum sharing related publications					Spectrum Usage for the Fixed Services, NTIA TR-00-378							
Spectrum sharing related publications					Measurements to Characterize Land Mobile Channel Occupancy for Federal Bands 162–174 MHz and 406–420 MHz in the Denver, CO Area, August 2008, NTIA TR-08-455							
Spectrum sharing related publications					Measurements to Characterize Land Mobile Channel Occupancy for Federal Bands 162-174 MHz and 406-420 MHz in the Washington, D.C., Area, NTIA TR-07-448							
Spectrum sharing related publications					Broadband Spectrum Survey at San Francisco, California May-June 1995, July 1999, NTIA TR-99-367							