Wireless Spectrum Research and Development (WSRD) Workshop IV

Promoting Economic Efficiency in Spectrum Use: the economic and policy R&D Agenda

When: April 23-24, 2013
Where: MIT (32-G449 Patil Conference Room/Kiva, 32 Vassar Street, Cambridge, MA 02139)

The goal of this 2-part/2-day invitation-only workshop is to identify economic and policy R&D that, if addressed, would have the biggest likely impact in promoting progress toward more efficient spectrum utilization and sharing.

During the first day, we will hear from key value-chain and customer constituencies engaged in commercializing the necessary technologies and business models to highlight the progress to date and key business, market, and policy challenges that need to be addressed in order to secure timely progress. Building on these insights, during the second day, a group of researchers from industry, government, and academia will focus on the current status of economic and policy research relevant to addressing those commercialization challenges, gaps in the research, and the data, tools and methods which are best suited to address those gaps.

Organizers and Sponsors

This workshop is being organized under the direction of the Wireless Spectrum R&D Senior Steering Group (WSRD) in the Networking and Information Technology Research and Development (NITRD), with support from the National Science Foundation (NSF). The workshop organizing committee includes:

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Background

The growth of wireless in all of its forms – from sensors to mobile broadband, from satellites to ad hoc mesh networks – is putting increased strain on our scarce RF spectrum resources, motivating both commercial and government users to look toward new spectrum management models that will support increased utilization, including spectrum sharing. The Presidential Memorandum *Unleashing the Wireless Broadband Revolution* (June 28, 2010) directed

> Sec. 3. The Secretary of Commerce, working through NTIA, in consultation with the National Institute of Standards and Technology, National Science Foundation (NSF), the Department of Defense, the Department of Justice, NASA, and other agencies as appropriate, shall create and implement a plan to facilitate research, development, experimentation, and testing by researchers to explore innovative spectrum-sharing technologies, including those that are secure and resilient.

In response to this mandate, the *Wireless Spectrum Research and Development* (WSRD) Senior Steering Group (SSG) was created in the White House Office of Science & Technology Policy (OSTP) to "coordinate spectrum-related research and development activities across the Federal government. The purpose is two-fold: to help coordinate and inform ongoing activities across Federal agencies; and to facilitate the identification of shortcomings in the Government's R&D portfolio with respect to technologies that allow a more efficient use of spectrum."

Thus far, and in three earlier workshops during 2011-2013, the principal focus of R&D efforts addressed by WSRD has been technical; however there is growing recognition that for this work to bear fruit, a broader R&D perspective is required. New wireless and spectrum sharing technologies call forth a need for new policy frameworks and business models, and confront users and markets with new wireless economics that need to be better understood in order to realize the full potential of wireless innovation. Gaining user and network operator acceptance and trust in new spectrum sharing models and designing such systems to be secure and resilient is *not* just a technical challenge; it simultaneously calls for changes in spectrum management procedures and practices by network operators, users, and regulatory authorities and the evolution of new types of economic relationships among spectrum rights holders. The non-(engineering)-technical R&D agenda includes theoretical and empirical work on wireless technology markets, regulatory reform, and radio system design – where one takes seriously the perspective that the "system" includes the larger ecosystem of users, network operators, and regulatory authorities.

Examples of open R&D questions in the spectrum-related research with a significant non-engineering component include:

1. What are the most important new wireless technologies that are not being commercialized sufficiently quickly? What economic (incentive, business model, or market factors) and policy challenges explain this?
2. What is the value of spectrum? How does it vary by band, by use, over time, or by regulatory regime? What metrics are needed to facilitate valuing spectrum and usage rights?
3. What is the optimal institutional framework for managing spectrum interference? How might existing regulatory institutions best take advantage of the smart radio technologies like cognitive radio, spectrum access databases, and sensing? How should property rights for primary and secondary users be modified to align incentives for efficient spectrum use?
4. How will use of DSA-enabled radios affect the operations of public safety professionals? What will be the operational and financial impact of transitioning to new public safety radio systems?
5. How much activity might we expect to see in active spectrum sharing markets? Over what time-scale? How might it vary by band? By spectrum-management framework?
6. What will the economic impact be from increased sharing of spectrum resources? Among government users? Among commercial users? Among government and commercial users?
7. What is the optimal economic design for small-cell mobile broadband last-mile architectures for municipalities? What are the implications for sharing spectrum and RAN infrastructure?
8. What are viable business models for using secondary access or pre-emptible spectrum resources?
9. How will DSA impact competition in wireless infrastructure and services?

For questions contact: Bill Lehr (MIT, 617-258-0630, wlehr@mit.edu)

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Day 1: Tuesday, April 23

Time	Description
8:30-9:00	Coffee & Registration
9:00-9:30	Greeting, Logistics, Introductions (Bill Lehr, MIT; Byron Barker, NTIA; Andy Clegg, NSF; John Chapin, DARPA)
9:30-10:00	Keynote: Tom Power (OSTP)
10:00-10:15	Break
10:15-11:30	*Panel 1.1 Recent Experiences with Spectrum Sharing* Moderator: Byron Barker (NTIA) 1. Mark Gibson - ComSearch (on 1755-1850 band) 2. Steve Sharkey - T-Mobile (on 1695-1710 and 1755-1850 bands) 3. Peter Ecclesine - Cisco (on 5 GHz bands) 4. Jeff Schmidt - SpectrumBridge (TV White Space)
11:30-12:15	Panel 1.2 Public Safety and New Spectrum Use Models Moderator: Fred Frantz (Engility) 1. Fred Frantz, Director, National Law Enforcement and Corrections Technology Center (NLECTC) Communications Technology Center of Excellence (moderator) 2. Don Denning, Chief Information Officer for Public Safety, City of Boston 3. P. A. (Al) Sadowski, IT Manager, North Carolina Department of Public Safety, North Carolina State Highway Patrol 4. Scott Wilder, Director of Technology, Brookline Police Department
12:15-13:15	Lunch w/ Peter Rysavy (Rysavy Research) (speaker, 12:40-1:05)
13:15-14:45	Panel 1.3 Impediments to Commercialization of Sharing Moderator: John Chapin (DARPA). 5 min each, max 2 slides 1. Dean Brenner - Qualcomm (Small cell in 3.5 GHz) 2. Steve Sharkey - T-Mobile 3. Chris Guttman-McCabe - CTIA 4. Stacey Black, AT&T 5. Brett Kilbourne, Utilities Telecom Council 6. Jake MacLeod, TIA 7. Mark Cooper, CFA
14:45-15:00	Break
15:00-16:00	Panel 1.4 Jumpstarting investment - Investor and Legal Perspectives Moderator: Peter Tenhula (NTIA) 1. Barlow Keener/Armand Musey 2. Mark Lowenstein (Mobile Ecosystem) 3. Mitchell Lazarus (FHH)
16:00-16:45	Small group breakouts to prioritize list of barriers/problems/issues and identify list of research questions (10-12 per group)
16:45-17:20	Group discussion to coalesce break-out group discussion – John Chapin (DARPA)
17:20-17:30	Closing remarks Tom Power (OSTP)
17:30-18:30	Free time/return to hotel/etc.
18:30-21:00	No-Host Dinner (Royal East Restaurant, 782 Main St.)

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Day 2: Wednesday, April 24

Time	Description
9:00-9:15	Greeting, Introductions -- Bill Lehr (MIT)
9:15-9:35	John Leibovitz (FCC) Research a policymaker would like to see
9:35-10:45	Panel 2.1 Lightning Talks I Moderator: Andrew Clegg (Moderator) 5-7 minute talks "here's valuable research that needs to be done " 1. Martin Weiss (UPitt) Enforcement in cooperative sharing 2. Anant Sahai (UC, Berkeley) Building trust against political risk 3. Michael Marcus (Marcus) FCC delays and impact on investment & innovation 4. Barlow Keener (Keener) Economic loss from fallow spectrum 5. Mark Cooper (CFA) Evolving regulatory rules for innovation and social benefit 6. Michael Honig et al. (Northwestern) Spectrum valuation & regulatory regime
10:45-11:00	Break
11:00-12:15	*Panel 2.2 Economics Research Challenges & Opportunities* Moderator: Tom Hazlett (George Mason) 1. Gerry Faulhaber (UPenn) 2. Michael Katz (UC, Berkeley) 3. Scott Wallsten (TPI) 4. Guilia McHenry (Brattle Group)
12:15-13:15	Lunch w/ International Research Perspectives from Vanu Bose (Vanu) & Xavier Fernando (Ryerson) (12:30-13:00)
13:15-14:15	Panel 2.3 Spectrum Management Reform Moderator: Yochai Benkler (Harvard) 1. Pierre de Vries (UColo, Boulder) Receiver management 2. John Quinlan (OMB) Spectrum Incentives in the Federal Budgetary Framework 3. Preston Marshall (ISI) Implementing new spectrum utilization metrics
14:15-15:25	Panel 2.4 Lightning Talks II Moderator: Andrew Clegg (Moderator) 1. Tom Hazlett (George Mason) Overlays and Efficient Spectrum Relocation 2. Michael Marcus (Marcus) Efficient Co-design of military radar and comm systems 3. Martin Weiss (UPitt) Moving spectrum markets up the stack 4. Doug Sicker (UColo) Policy-based v. technical solutions for interference mgmt. 5. Dina Katabi (MIT) GHz-wide sensing and decoding using cheap radios 6. Allan Sadowski (NC Pub Safety) Spectrum Efficient Antenna Revolution
15:25-15:40	Break
15:40-16:30	Small group breakouts to prioritize list of barriers/problems/issues and identify list of research questions (6-8 per group)
16:30-17:15	Moderator: Doug Sicker (UColo, Boulder) Group discussion to coalesce break-out group discussions
17:15-17:30	Wrap-up and Closing – Bill Lehr (MIT)

BREAKOUT SESSIONS – Goals and Instructions

Time: Day 1 (April 23 -- 16:00-17:20), Day 2 (April 24 -- 15:40-17:15)

Following the workshop, we will be producing a report that summarizes key findings and includes a list of *multidisciplinary* research topics that can promote more efficient spectrum use (in the economic sense).

Toward this end, at the end of each day, we will have a 90 minute session during which we will organize into smaller breakout groups, which will be followed by a plenary session to coalesce results. These sessions are intended to foster focused discussion and contributions from all workshop participants.

We will finalize the topics for the breakout sessions and participation in real-time based on what we hear and learn over the course of the workshop and will need all participants to actively contribute.

At the start of each day's breakout session, participants will vote on which areas should be discussed in the groups. Participants will self-select which group to join based on research interests, but should avoid being with the same people both days.

We will be collecting topic areas for the breakout groups based on what we hear throughout the workshop proceedings, but are offering these candidates to seed the list.

Type I: "Greater adoption/use of X would promote more (economically) efficient spectrum use"

- more/better enforcement
- small cell architectures (potentially shared)
- evidence based policy making
- commercial/federal shared spectrum
- dynamic spectrum access
- private commons / band managers
- secondary markets
- spectrum usage rights / receiver standards
- expansion of unlicensed spectrum

If your group focuses on a Type I area, please answer the following questions:

1. What are the key sticking points preventing or slowing forward progress in this area?
2. What are worthwhile projects for interdisciplinary research that would help get past those sticking points? Identify specific research projects, ideally with reference to methods/approach, data sources, and desired research outcomes.
3. What are tangible next steps that should be taken to launch those projects - by federal agencies, by academia, by industry? Who would be the right collaborators to pursue the work?

Type II: "Appropriate research on Y would promote more (economically) efficient spectrum use"

- policy/rules/business cases for spectrum sharing
- cost/incentives for adopting more efficient approaches
- process/drivers/economic policy tools for evolution
- measuring the value/use of spectrum
- techniques to improve technical efficiency
- new standards that facilitate sharing

If your group focuses on a Type II area, please answer the following questions:

1. What are the most likely pathways for research results in this area to promote more efficient spectrum use? Try and identify with as much specificity as possible what entities (audience) would exploit research results in this area, and how would they exploit them.
2. What are worthwhile projects for interdisciplinary research within this area? Again, identify specific research projects, ideally with reference to methods/approach, data sources, and desired research outcomes.
3. What are tangible next steps that should be taken to launch those projects - by federal agencies, by academia, by industry? Who would be the right collaborators to pursue the work?

To repeat: We will be adjusting/expanding the above lists of areas throughout the workshop proceedings.

After 45 minutes of breakout discussion, we will reconvene in plenary session and each group will report on their discussions and we will have an opportunity for feedback between the groups.

Group results and discussion notes will feed into the workshop report preparation process. And, we request that participants with further thoughts and notes share those with the organizing committee in real-time or after the workshop to supplement those discussions.