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Despite Calls for Spectrum Sharing, Technological, Regulatory Questions Linger

A just-completed report from a presidential advisory committee urging President Obama to open up as much as 1,000 megahertz of government-controlled spectrum to the wireless industry on a shared basis has reignited debate about how the airwaves could, and should, be allocated in the United States.

The report, by the President's Council of Advisors on Science and Technology, or PCAST, is the latest indication of a growing awareness within the federal government that, while there is no new spectrum available, newer technologies like software-enabled radios may be able to greatly increase efficiencies and allow—for the first time—federal, nonfederal, and commercial entities to share the same bands of spectrum.

In two high-profile speeches in May, Federal Communications Commission Chairman Julius Genachowski appealed for acceptance of spectrum sharing as one way for wireless carriers to accommodate the ever-increasing consumer demand for smartphones and tablets, which require more spectrum to carry their data transmissions—significantly more than what is needed to carry cellular calls.

In March, the Commerce Department's National Telecommunications and Information Administration (NTIA) concluded in a much-anticipated report that, while it is possible to reallocate 95 MHz of government-held spectrum in the 1755-1850 MHz band for commercial mobile broadband and similar applications, some federal licensees, such as the Department of Defense, "could remain in the band indefinitely."

Hence, sharing must be embraced as a new reality.

Is Technology Ready? Taken together, these developments have changed the narrative in Washington from one about prying loose the spectrum from so-called "inefficient" users—TV broadcasters, federal government agencies—to one about *sharing* the spectrum.

While the concept has been embraced by the FCC, NTIA, and PCAST, the chief concern of the wireless industry is that spectrum-sharing technologies might not be ready for commercial application until 2020 at the earliest.

"If you come out and start saying, 'let's share spectrum,' and there's not a means for doing spectrum sharing, you've compounded the problem," Randall Stephenson, chairman, chief executive, and president of AT&T Inc., told reporters following remarks at a Washington event in June.

Since May, Stephenson has publicly suggested twice that spectrum-sharing technology is not ready for "prime time," while giving his general support for the idea pending the resolution of many "what ifs."

So far, neither the FCC nor the NTIA have begun to address the many questions that are now beginning to emerge: Who will share with whom? If wireless carriers must share spectrum that is licensed to federal government agencies, who retains priority access? What are the rules for the wireless carriers when they are using spectrum licensed to the federal government? And, perhaps most critically, what "type" of sharing ultimately will be promoted?

Currently, there are three sharing models under consideration: Geographic-based sharing, in which a wireless carrier may use a federal agency's frequencies only in certain geographic areas; "temporal"-based sharing, in which a wireless carrier may use a federal agency's frequencies only during certain times of the day or year; and technology-based sharing, in which wireless carriers and a federal agency would each use a cognitive, or "smart," radio device that can search wide swaths of a spectrum band for "quiet," or unused, frequencies over which to transmit and receive data. As for the latter, another important question looms: What will the new software required for each mobile device mean for the size, weight, battery life, and, ultimately, the cost of the handset?

"I haven't had anyone tell me that cognitive radio is ready for 'prime time,'" Chris Guttman-McCabe, vice president of regulatory affairs for CTIA-The Wireless Association, told BNA in an interview.

One of CTIA's member companies, T-Mobile USA, recently won a special temporary authority from the FCC to test "the ability of federal and commercial uses to share spectrum" in the 1755-1780 MHz bands and 2155-2180 MHz bands during "an interval where federal use for certain systems may continue. . ."

As part of the test, T-Mobile, together with CTIA, will be collecting data on the effects to commercial operations from existing federal licensees such as the DOD.

Ultimately, the focus will be on whether geographic- and temporal-based sharing—not technological-based

sharing—can be achieved in these federally controlled spectrum bands.

Most within the wireless industry hope the tests will show that the spectrum should be reallocated and auctioned—and not just shared.

Most of the 3,300 federal assignments within the 1755-1850 MHz band, for example, are licensed for point-to-point fixed microwave use by the departments of Energy and Homeland Security, and the Federal Aviation Administration. The Department of Defense also makes use of the spectrum for military satellites, precision-guided munitions training, and unmanned aerial vehicles. It is believed that much of this spectrum is not being utilized to its full capacity. According to people with knowledge of the matter, in some instances, the spectrum may be in use only for several minutes of each day.

The 1755-1780 MHz spectrum band in particular is among the most coveted by the wireless industry because it is immediately adjacent to 25 MHz of spectrum already allocated for mobile broadband uses and ready for auction—what is known as AWS-3, or Advanced Wireless Services-3, spectrum at 2155-2180 MHz. The thought is to ''pair'' the blocks of spectrum (25 MHz + 25 MHz) to create an internationally harmonized allocation. Under recently enacted legislation, the AWS-3 spectrum must be auctioned by the FCC within three years.

So, for the industry, time is of the essence to coax these federal agencies to move off of the band.

''The 'gold standard' should be clearing the spectrum,'' said Guttman-McCabe. ''If that can't happen in a reasonable amount of time, the fallback is 'well, let's get spectrum to market by sharing.' But the first effort, like in Japan, Mexico, Canada, Germany, South Korea, Spain—countries that are freeing up hundreds of megahertz for mobile broadband—has to be to clear spectrum for an auction.''

Cognitive Radio Seen Changing Spectrum Policy. Under a presidential executive order issued in June 2010, the NTIA and FCC must make available for auction some 500 MHz of spectrum for mobile broadband applications by 2020.

The NTIA, which manages the government's use of spectrum, has already identified 115 MHz—in the 3550-3650 MHz and the 1695-1710 MHz bands.

For the FCC's part, an additional 120 MHz of spectrum being sought from television broadcasters through ''voluntary incentive auctions'' would increase the amount available for mobile devices capable of browsing the internet at high speeds by about 22 percent, to 667 megahertz. The NTIA, however, still must free an additional 380 MHz by 2020.

With broadcasters and federal government agencies appearing resistant to turning over spectrum, most people who follow the FCC and NTIA expect the administration to fall short of the 500-MHz goal—unless, of course, regulators impose radical new rules for sharing spectrum.

''I think everyone is realizing that dedicating spectrum and dividing it up in all these little pieces, which are reserved for people who may or may not be using it at any one time, doesn't make sense any more,'' said Rick Rotondo, vice president of marketing at Florida-based xG Technology Inc., which has developed a cognitive radio-based mobile VoIP and data system for the military.

Today, much of the spectrum is licensed to commercial users and government agencies in swaths of frequency of varying widths. Aside from build-out requirements imposed by the FCC on commercial users, which amounts to a ''use it or lose it'' policy and is ''loosely enforced,'' as one industry source noted, there is little to no incentive to use the spectrum efficiently. But, as technology makes it easier to communicate over the airwaves without interfering, many, including PCAST, believe that such ownership rights will become unnecessary.

In the nearer term, though, it is Rotondo's hope that his company's technology will help alleviate what has been termed ''spectrum exhaust,'' created by smartphones like Apple's iPhone.

With xG's ''xMax,'' for example, a mobile device could soon be able to scan spectrum bands—bands controlled by a federal government agency—for a clear, ''unused'' channel, select it, and then immediately begin transmitting and receiving data over it. As of now, xMax operates in the ''license-free'' ISM 900 MHz band at 902-928 MHz.

''When there is [federal government] spectrum available to use, you use it; if there's no spectrum available, you fall back to your [the carriers'] own spectrum,'' Rotondo told BNA in an interview, explaining his company's technology.

''Spectrum sharing should be seen not as an 'either-or' but 'in addition to,' just as Wi-Fi [wireless fidelity] networks are 'in addition to' the carriers' core networks,'' he added. ''The [carriers'] statements about spectrum sharing sound very similar to what they said about Wi-Fi. They were once against Wi-Fi. When they needed Wi-Fi to offload data traffic, their attitude changed. Theirs is more a statement of attitude than a fact about the technology.''

LTE and Sharing May Be Complex Proposition. At the moment, however, most within the wireless industry are remaining cautious.

One reason is that 4G LTE—short for Fourth Generation, Long Term Evolution, the new wireless networking standard—was designed for use in licensed spectrum bands, while most cognitive radio systems were built for use in ''unlicensed'' spectrum bands.

Carriers are investing heavily in 4G LTE networks, which can download data at speeds between 5 and 12 megabits per second, enough for easy streaming of video, which is most desired by consumers.

''Cognitive radio systems were developed recognizing that there will be other users of the spectrum and occasionally people will transmit at the same time and

'collide,' '' noted Peter Rysavy, a wireless engineer who works as a consultant to the carriers. "That's fine, but if you take a technology such as LTE: How many thousands of man-years of engineering are in that technology at this point to simply say, 'well, we can just use it in some cognitive way.' You cannot. LTE is based on the basic assumption of a clear, licensed band. It absolutely cannot coexist with anything else—any other user or transmission—without some massive redesign.''

Rysavy agreed that a large number of questions must be answered before the carriers fully embrace spectrum sharing.

"While we still don't know in what way, and how much, and how predictably we can actually share the spectrum, we also don't even know if it's going to be useful, even if we had the technology ready,'' Rysavy told BNA in an interview.

One company pushing for a technology-based approach to spectrum sharing is Vienna, Va.-based Shared Spectrum Company (SSC), which was just awarded two patents (U.S. Patent No. 8184678: *Method and system for transmitting signals with reduced spurious emissions* and U.S. Patent No. 8184653: *Systems and methods for a cognitive radio having adaptable characteristics*).

A pioneer of cognitive radio technology, the company recently has developed a technology for the commercial market called the "Spectrum Sensing Toolbox,'' which essentially "senses" which frequencies are being used in a spectrum band.

According to CEO Tom Stroup, Shared Spectrum Company was founded on the premise that while "virtually all of the spectrum is assigned, most of it is not being used.''

As the company found in its own studies, only between 15 and 20 percent of the spectrum is used all of the time.

In the coming months, while Stroup and SSC will highlight the benefits of their spectrum-sharing technology, some people in the telecommunications industry who keep close tabs on the FCC and NTIA believe that regulators will look first to the recently created TV "white spaces" database for guidance.

Put simply, that database will identify when and where the unlicensed spectrum in between TV channels—known as white spaces—is being used, so that those wanting to transmit their signal can select the right frequencies without creating interference with others.

Stroup said he believes that the database approach for sharing licensed spectrum ultimately may not work effectively, however. The sensitivity of not only *how* the Defense Department is using the spectrum, but *when*, will pose administrative challenges, he said.

"The military is not necessarily going to divulge if they conduct telemetry testing. . .,'' Stroup told BNA in an interview.

Stroup also warned about the potential for "greedy'' spectrum users. In the lead-up to the creation of a TV white spaces database, theater owners, sports arenas, and churches—which make use of the spectrum for wireless microphones—had raised concerns about being subjected to interference from new users. A database resolves that issue, at least in theory, but Stroup noted that some federal government agencies may register for round-the-clock use, whether or not they need their spectrum 24 hours, seven days a week.

"There is the potential for them saying, 'look, we're using all of our spectrum all the time,' '' Stroup said. "At 3 a.m., if a frequency is not being used, can someone else use it? It depends if they registered it in the database that way.''

Certainly, Shared Spectrum Company has a vested interest in seeing spectrum-sharing technology develop for commercial application.

The company demonstrated its Spectrum Sensing Toolbox at the Mobile World Congress in Barcelona, Spain, in February, and currently the technology is undergoing testing by the wireless carriers.

Though the technology—and technologies like it—have the potential of revolutionizing spectrum policy, most predict that policymakers will take a multifaceted approach to spectrum sharing, and proceed carefully.

"This is going to be a 10 to 15 year process, by conservative estimates,'' said Jonathan Spalter, chairman of Mobile Future, an industry group that counts Alcatel-Lucent, AT&T, T-Mobile, Cisco, Ericsson, and Qualcomm as members.

He noted that it took more than 10 years to finalize the standard for Wi-Fi, 802.11, and just about as long for the FCC to open up TV white spaces to new, unlicensed uses.

"Spectrum sharing, while it may be part of an overall policy solution in the long term, is not going solve the immediate problem, and that is the very real need for more spectrum for mobile broadband,'' Spalter told BNA in an interview.

Problem of Interference Looms Large. A primary concern for the FCC and NTIA, at least at this stage, may be how to prevent interference.

"The number one thing that has to be addressed is that any technology that is introduced cannot impact the availability of spectrum for the primary user or the quality of service,'' said Doug Smith, CEO of Oceus Networks, a solutions developer for voice, video, and data communications, using LTE technology, for federal agencies.

As envisioned by PCAST, in a future, theoretical sharing regime, federal government licensees, such as the DOD, would be granted the highest priority of access in their own bands of spectrum, while commercial companies, such as Verizon Wireless and AT&T Inc., would be given secondary access. A third group of "tertiary" users would be afforded "general authorized access," similar to Wi-Fi network operators, which make use of unlicensed spectrum.

Smith, an engineer by training, noted that it is always "dangerous" to employ different technologies in the same spectrum band.

"With the time, money, and the complexity of finding adequate new spectrum, I think [the NTIA and FCC] are going to have to boil it down to geographic exclusion zones," Smith told BNA in an interview.

Geographic sharing, to Smith, would be the safest and easiest option. A wireless carrier could transmit on government-controlled frequencies only in a tightly defined geographic area, in the Los Angeles metro area, but not in San Francisco, for instance.

"It's as hard a policy problem as it is a technology problem," said Smith, adding that the spectrum needs of the DOD are just as critical.

Earlier this year, the Defense Department successfully lobbied lawmakers to remove from the Senate con-

ferees' version of the Middle Class Tax Relief and Job Creation Act of 2012 language requiring the FCC to auction the 1755-1780 MHz band for mobile broadband uses within three years.

According to one wireless industry source who spoke to BNA on the condition of anonymity, the problem for policymakers right now is finding the right package of incentives to convince federal government agencies to give up, or share, spectrum.

"Either way, it's an inconvenience for them," the source said. "And that has to be overcome."

The PCAST report, among other things, calls on the president to create a "synthetic" currency system that would reward those agencies willing to cooperate in the form of increases in their annual budgets.

"People don't always need to be forced; it's a lot better if they are incentivized," said Roger Entner, an analyst at Recon Analytics who follows the wireless industry. "The carrot is a lot more useful than the stick."

The problem, according to Entner, is not just that federal government agencies have no incentive to change the status quo, but that there has been too much "regulatory inertia."

"What's holding all this up on the commercial side is the lack of a regulatory framework," Entner told BNA in an interview. "I think we're there, it's just that people don't realize it. They continue to look around and say, 'Are we there yet?' We're there. For policymakers, it's about making the realization of the world we live in, not the world we want to live in."

By Paul Barbagallo

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