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Communications

No Silver Bullets for FCC, NTIA Spectrum Challenge

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Radio-based communication has always played a vital role in our communities, but new technologies have so amplified the power of radio waves that the demand for spectrum-based services and devices has exploded.

There are no silver bullets to address this escalating demand. Existing and future commercial mobile broadband service providers will only be able to address demand by employing every available technology enhancement they can afford, in combination with getting access to more spectrum.

Moving forward, there is the question of where to find more spectrum resources to support commercial services and how those resources will be made available. Given the size of the mobile computing industry, which includes networks, devices, applications and services, and given how much of the economy now depends on these technologies, timely and optimum government spectrum policy to nurture this transformational industry is imperative. Not only will such action produce significant benefits to the economy, it is critical for the United States to remain competitive on a global basis.

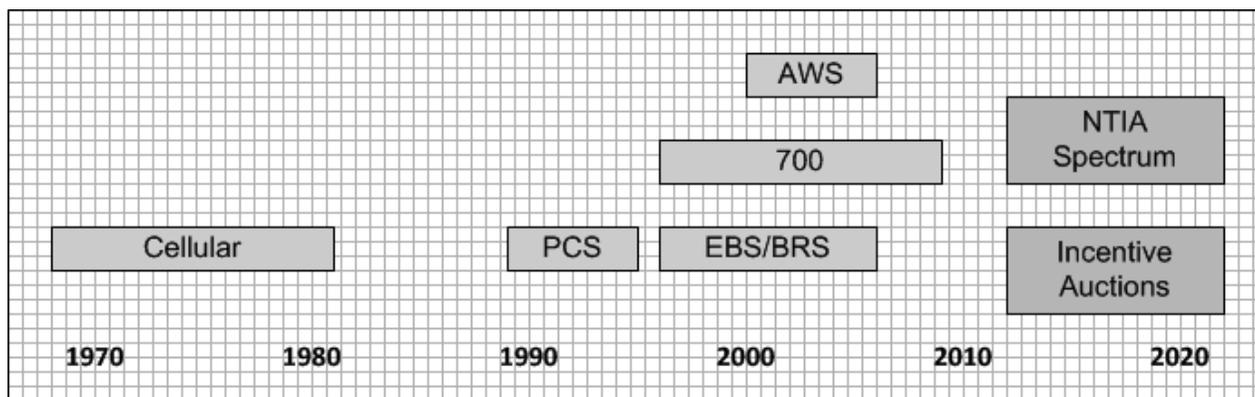
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Length and Uncertainty of the Government Spectrum Allocation Process

How spectrum becomes available for deployment in a wireless network is both an unpredictable and drawn-out process. The government has only made significant new blocks of spectrum available five times over the previous 40 years. The bars depict the time from when government first repurposed that spectrum to when it became available for use.

Given uncertainty now (and in the past) about whether and how much clean spectrum the government

Figure 1: Spectrum Acquisition Time



can and will make available to support commercial wireless services, it is almost impossible for operators to plan with any certainty when they might acquire new spectrum. A huge concern of wireless carriers is that the government's current spectrum plans do not adequately address the FCC's own projected need of 300 MHz of additional spectrum by mid-decade and 500 MHz of additional spectrum by the end of the decade. The new spectrum-sharing processes proposed by the President's Council of Advisors on Science and Technology (PCAST) in July 2012 adds further uncertainty. This is the challenging environment in which cellular operators must design, build, and manage their networks.

Spectrum Deployment Complexity

Deploying spectrum is extremely complex and time-consuming. Operators must consider multiple factors, including the level of infrastructure investment needed, an effective business model that can produce the revenues needed to support the required capital expenditures, the need to support multiple concurrent versions of technology, the characteristics of different frequencies, and regulatory requirements.

Even if an operator wanted to deploy spectrum immediately upon receiving government approval to do so, there are multiple sources of delay between obtaining government permission to use spectrum and being able to actually deploy it.

First, there may be incumbent users (e.g., government, microwave) that have to vacate the spectrum, a process that, in itself, can take years. Next, standards-specification work must occur to accommodate the new spectrum bands if they have not previously been allocated for mobile broadband. Then, it takes time to actu-

ally get infrastructure equipment designed, developed, ordered, and finally deployed. For spectrum not already occupied or already allocated for commercial, mobile broadband use, providers may need to modify every single tower in a network to add new antennas, filters, and other equipment.

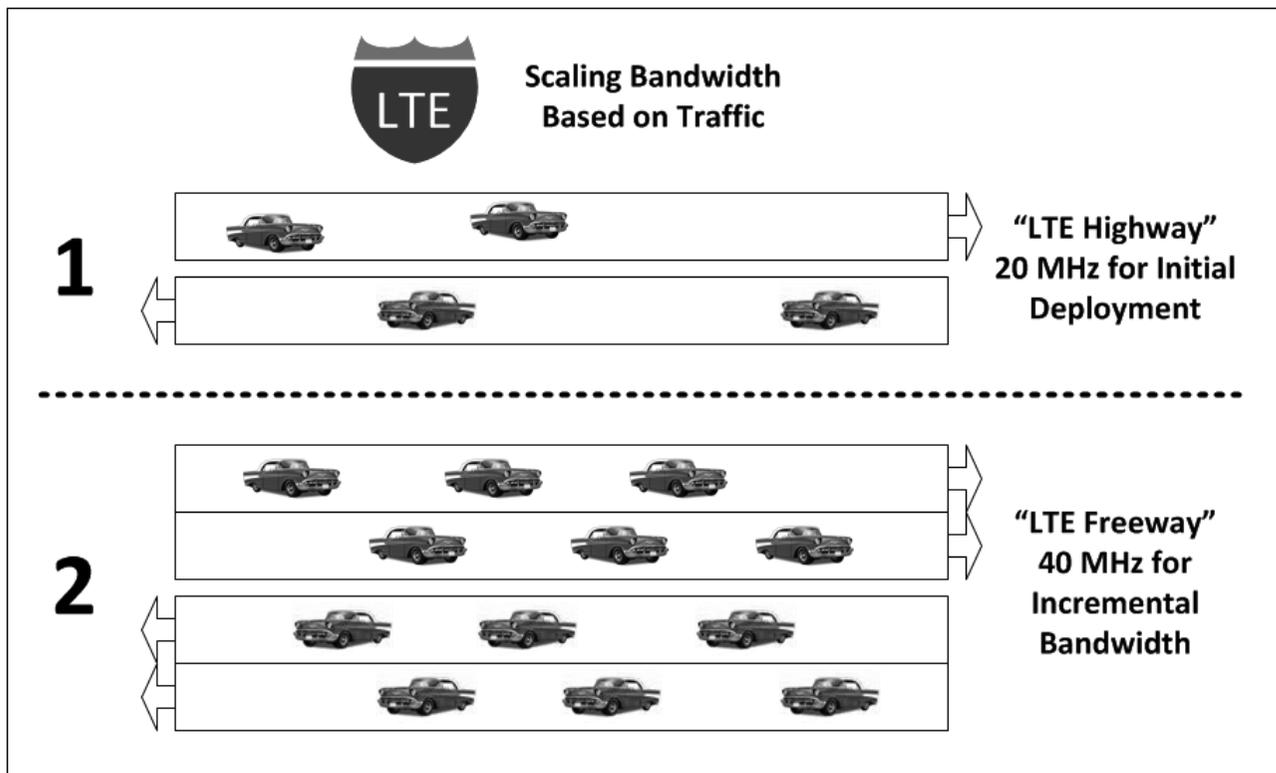
Further, time-consuming engineering studies may be needed before a carrier can actually load additional or new equipment to a site as part of its deployment efforts. In addition, adding new backhaul with more bandwidth consumes additional time. This stems from traditional backhaul connections often based on copper circuits, which need to be replaced by either fiber-optic cable or high-speed microwave in order for the network to be able to support the enhanced capacity of today's advanced wireless technologies.

Another difficulty that sometimes arises is when engineering tests identify interference to systems that use adjacent bands, requiring operators to work with other entities to install filters. Further, even after spectrum has been loaded into a network, chipsets and devices may not be ready in production volume, further delaying the activation of the spectrum to support services. Finally, once all of these technical, engineering and logistical issues have been resolved, regulatory hurdles can still delay use, as has been the case with Wireless Communications Service (WCS) spectrum.

WCS Case Study

The FCC originally auctioned these bands (2305-2320 MHz and 2345-2360 MHz) in 1997 for fixed, mobile, radiolocation, and satellite communications services. There have been prolonged efforts to develop service rules that would allow reasonable data usage while protecting audio service from interference.

Figure 2: Scaling Highways Is Similar to Scaling Networks



In an attempt to break the regulatory log jam, AT&T and Sirius XM jointly proposed to the FCC in July 2012 an accommodation with the goal of WCS being able to support LTE while protecting satellite radio. Part of the proposed technical solutions is a 5 MHz “guard band” at each end of the WCS band. In addition, AT&T and Sirius would agree to cooperate with each other to resolve issues if interference is identified. In August 2012, AT&T announced its intention to acquire NextWave, a company with extensive WCS holdings. If the FCC approves the technical solutions being proposed, and if equipment suppliers create the ecosystem to support WCS LTE, only then will AT&T be able to use this WCS spectrum to expand its LTE capacity.

This highlights regulatory action and inaction as yet another factor that network operators must often take into account as they plan for spectrum deployment, even after the operator holds an FCC authorization to access the spectrum.

Hoarding or Customer-Friendly Spectrum Management?

Balancing the flow of traffic with the pace of spectrum deployment is key if carriers want to avoid artificially inflating service prices to recoup investment made well before there is traffic demand. Figure 2 shows this process. Assume that an operator has 20 MHz of spectrum at 700 MHz and another 20 MHz of spectrum in another band. Initial LTE deployment might occur with a 20 MHz of spectrum commitment at 700 MHz, resulting in a network that can address customer demand for perhaps a period of two to three years. As usage continues to grow in general, and as users migrate to the LTE network with new LTE-capable devices, the capacity of this initial LTE network will eventually be reached and the operator must then expand capacity. This is possible by deploying LTE in additional spectrum, such as in the AWS or WCS bands using an additional 20 MHz.

An operator’s deployment and usage of spectrum varies over the life of the deployment. Figure 3 illustrates how this occurs. The upper bars show growing annual

demand for bandwidth, and the lower bars show how much spectrum the operator needs to address that demand. In this example, during the first three years, the operator has more spectrum than needed for the level of demand, so it deploys the portion of its spectrum needed for that demand. By year four, however, the demand for services on the spectrum has exploded and the operator applies its entire spectrum portfolio and in year five, the operator starts experiencing network congestion as it is left with no more spectrum left to deploy to support continually increasing demand.

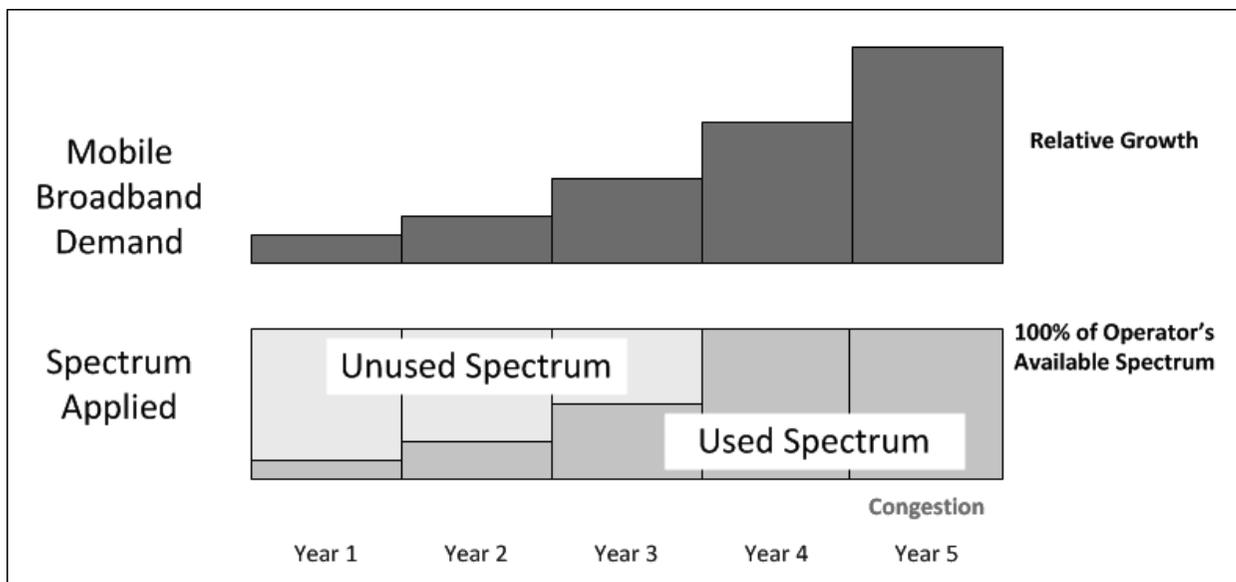
When it licenses spectrum, the FCC recognizes that spectrum cannot be immediately deployed; however, the agency does establish build-out requirements intended to prevent licensees from hoarding spectrum.

Some argue that if an operator is not using every MHz in its entire spectrum portfolio at every minute of every day in every market immediately upon acquiring it, the operator is “hoarding” spectrum; however, the FCC’s build-out requirements provide a bulwark against hoarding. One can make subjective assessments about whether a specific operator’s build-out plan for specific spectrum is reasonable or not reasonable; ultimately the deadline for build is determined by the government. Companies that have an embedded customer base, established brands and a need to take in revenue to cover capital expenditure costs are typically in favor of meeting FCC construction obligations and avoiding their spectrum licenses being taken away for failure to put it into service.

Spectrum Sharing

Given the scarcity of large amounts of “clean” spectrum needed to satisfy commercial and government demand for it, the idea of spectrum sharing has garnered significant attention recently. For example, PCAST issued a report in July 2012 titled, “Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth” that states, “The essential element of this new Federal spectrum architecture is that the norm for spectrum use should be sharing, not exclusivity.”

Figure 3: Application of Spectrum to Growing Demand



Although spectrum sharing could eventually result in more effective use of more spectrum, sharing between government and commercial network operators is not going to be the silver bullet some hope it will be. This means that Washington should not jettison efforts already underway to clear spectrum in favor of only pursuing sharing opportunities. Consider the following: There are already a number of spectrum-sharing solutions in the market that can work under defined circumstances. But what must be understood is that spectrum-sharing approaches range from simple to extremely complex, from readily achievable and in use today to extremely difficult with technologies yet to be developed. The ones being used today solve relatively simple problems—e.g., geographic sharing or sharing between two types of fixed systems. More complex problems, such as how a mobile technology could share with multiple government systems will take many years to develop, test, and implement in an economically rational manner.

Spectrum sharing will thus entail a multi-faceted process that requires identifying what types of systems will be shared and how, determining the market for shared systems, developing specifications and standards to allow sharing including spectrum coordination systems, modifying primary and secondary systems to integrate with the new sharing architectures, and developing infrastructure and devices to implement the sharing.

Given this extreme complexity, and given the widespread agreement about rising demand for commercial mobile broadband services, Washington must maintain focus on pursuing all solutions to avert a spectrum crisis. In the short term this means placing priority on the rapid clearing and reallocation of spectrum, even as the government works in parallel with industry to develop and deploy sharing technology over the long term.

Government Action Needed Now

The promise of mobile broadband will not be realized unless government accelerates its efforts to make spectrum available as soon as possible. Futuristic approaches such as dynamic spectrum access that PCAST advocates may ultimately result in more efficient spectrum use, but it is unlikely such an approach will provide any benefit this decade. Action is needed now. The newest members of the Federal Communications Commission appear to recognize the urgency.

As FCC Commissioner Ajit Pai stated in a speech on July 18, “The FCC has long had a reputation in Wash-

ington as an agency that moves too slowly, and our current Chairman, Julius Genachowski, and the hardworking staff at the Commission have made improvements on this front by reducing the agency’s backlog. But we need to do much more to fix the problem.”

Similarly, FCC Commissioner Jessica Rosenworcel stated in July 2012, “But I do not believe that incentive auctions alone will meet our spectrum challenge. The equation here is simple. The demand for airwaves is going up. The supply of unencumbered airwaves is going down. This is the time to innovate.”

Opportunities for incumbent operators to obtain spectrum are few and far between. Given the chance to acquire additional spectrum, most operators will choose to do so any time spectrum is made available by governments or private entities, regardless of the stage of build-out of their networks. The spectrum they obtain may be used to augment their networks using current technology, or may be held for the deployment of new technologies such as what occurred with 700 MHz spectrum and LTE.

Acquiring spectrum is expensive, as is deploying it. Deciding what technology to deploy, using what spectrum and how much of it is a complex process, one that operators must manage carefully. This process is time consuming and inevitably results in periods of time when operators are not using every MHz of spectrum they might hold in various markets around the country. Over time, as operators continually augment their network capacity to address evolving consumer demand, all spectrum held by an operator will be used.

Demand for mobile-broadband capacity is so high and is growing so quickly that it will take a combination of technology advances, as well as new spectrum. Cleared spectrum enables operators to most efficiently add capacity. Shared spectrum approaches will also be beneficial in the shorter term, but only if available using simple approaches. More complex approaches, such as dynamic-spectrum access, will take many years to develop and deploy.

To realize the full potential of mobile broadband, government must act quickly and efficiently to make available the spectrum assets that are already within reach. This includes bands such as AWS 1755 to 1780 MHz combined with 2155 to 2180 MHz, WCS, MSS, and 700 MHz broadcast spectrum. In this new always-connected world, there are no silver bullets for capacity enhancement, and industry and government must pursue every available avenue.