

# THE SPECTRUM TOOLBOX

In the first article in a two-part paper, **BRYAN TRAMONT** and **ADAM KRINSKY** describe the policies shaping spectrum optimisation from a US perspective

In the United States, as in other nations, demand for spectrum-based services has been growing exponentially. The numbers speak for themselves:

- According to the Federal Communications Commission (FCC), wireless connections on US commercial mobile networks grew from 128 million to over 316 million in the decade from 2001 to 2011
- Mobile internet connections are the fastest-developing segment, growing by 45% from 2010 to 2011 alone, reaching 142 million
- Ericsson forecasts that LTE mobile devices will predominate, going from about 20% of North American subscriptions in 2013 to 85% by 2019
- Cisco estimates that US mobile data traffic will increase at a rate of 56% a year from 2012 to 2017, with the average mobile connection's data traffic growing from 617 MB to over 4.4 GB monthly over that time
- Video, the most demanding application for mobile devices today, will make up two-thirds of mobile data traffic by 2017, growing at 63% annually
- Many of the countless applications being developed – from mobile gaming to m-health – will require higher speeds, improved latency, and high-definition capability. And the 'internet of things' is just beginning, as wireless data



**Whereas policymakers traditionally have reallocated underused spectrum to meet increasing demands, these opportunities are fewer than ever before.**

capability is increasingly incorporated into e-readers, parking meters, household appliances, industrial equipment, the energy grid, bicycle rental networks, heart monitors, and even cattle...

Today's wireless communications networks rely on finite spectrum resources to carry mobile traffic, and the extraordinary growth in mobile traffic places tremendous pressure on network capacity and the spectrum resources on which networks rely. Whereas policymakers traditionally have identified an unused or underutilised block of spectrum and reallocated it for mobile service to meet increasing

demands, these opportunities are fewer and farther between than ever before.

In recent years, US policymakers have increasingly recognised the need to find new ways to make more spectrum available for mobile broadband. At the direction of Congress, in 2010 the FCC issued the National Broadband Plan, which placed significant emphasis on the importance of spectrum-based services and the need for more spectrum.

Then-chairman of the FCC, Julius Genachowski, cited the "looming spectrum crisis" as the biggest threat to mobile broadband and noted, "While it's not the time to panic, it is the time to plan." The plan recommended making available 500 MHz of additional spectrum for wireless broadband over the course of a decade through a variety of means.

President Obama subsequently issued two Presidential Memoranda on repurposing spectrum for wireless broadband. He emphasised the critical importance of spectrum to the nation's future: "America's future competitiveness and global technology leadership depend, in part, upon the availability of additional spectrum. The world is going wireless, and we must not fall behind."

He endorsed the 500 MHz initiative and called on all stakeholders to do their part to achieve this goal. President Obama then recognised that spectrum sharing – with an emphasis on commercial access to government spectrum – is a critical component of the spectrum initiative:

*"We must make available even more spectrum and create new avenues for wireless innovation. One means of doing so is by allowing and encouraging shared access to spectrum that is currently allocated exclusively for Federal use. Where technically and economically feasible, sharing can and should be used to enhance efficiency among all users and expedite commercial access to additional spectrum bands, subject to adequate interference protection for Federal users."*

Congress has also taken additional important steps to facilitate making additional spectrum available, including directing spectrum reallocations of some federal spectrum, mandating auctions for more commercial mobile spectrum, granting the FCC authority to conduct innovative, market-based two-sided 'incentive' auctions, and taking steps to consider more unlicensed spectrum use relying on dynamic spectrum access to share frequencies with incumbent users.

Today's FCC chairman, Tom Wheeler, is equally committed to an expansion of spectrum availability for innovative services:

*"We need to bring more spectrum capacity to market ... and fast. We have not had a major spectrum auction since 2008. I am pleased to say that due to years of effort, the spectrum pipeline is reopening... Spectrum management needs to evolve. Existing practices have served us well but are often still rooted in analogue concepts. More dynamic use of spectrum compels us to innovate in spectrum management."*



This two-part paper identifies the policies and techniques that have been recently employed or considered in the US to optimise the use of the spectrum resource and promote the most efficient use of spectrum. This part examines repurposing cleared spectrum from existing licensees – through secondary market transactions or the new two-sided incentive auction model – which enables the market to determine the highest and best use of spectrum.

The second part will look at how shared use – whether with government incumbents or among commercial users – offers significant promise for meeting the growing demand.

### THE BASICS OF SPECTRUM ACCESS

Ultimately, all spectrum is a shared resource. Licences are awarded that give licensees certain rights vis-à-vis others in the shared electromagnetic spectrum continuum. In the simplest analysis, spectrum rights are divided up by frequency, area, and time. What follows is a brief review of the spectrum access framework.

**Spectrum demand is reaching ever new heights**

**Command-and-control.** Traditionally, the US regulated the use of spectrum principally through what has become known as the command-and-control model, under which the government assigns frequencies to specific spectrum users for specific government-defined uses, and establishes detailed service rules and technical limits, build-out requirements, and other rules. This model still predominates for government and public safety licences, where market forces will not, or have not been allowed to, work.

The traditional model has been subject to significant criticism over time, prompted by Ronald Coase's 1959 article, 'The Federal Communications Commission', which argued for establishing clearly defined property rights concerning licensees' spectrum usage, and for allowing the market to be the primary means of regulating these property rights, just as the market, coupled with property law, regulates land ownership and use.

**Exclusive use.** An alternative to the command and control model, the exclusive use model, moves in the direction of the Coasian ideal. As the FCC has noted in the exclusive use model, "a licensee has exclusive and transferable rights to the use of specified spectrum within a defined geographic area, with flexible use rights that are governed primarily by technical rules to protect spectrum users against interference". This exclusive, flexible use licensing model is used, to one or another degree, for most commercial wireless services in the US.

With flexible use rights under the exclusive use model, US wireless operators have been able to introduce new services and technologies rapidly. Instead of having blocks of spectrum designated by the FCC for mobile or fixed, for voice or data, for 2G/3G/4G technology, etc., the flexible use rules have permitted wireless operators to evolve from one service or technology to another, repeatedly. The same spectrum that was once used for voice service has transitioned to 2G data, 3G data, and now 4G data, without restriction. Network operators are able to transition services from one band to another while reconfiguring for the deployment of new services and technologies.

These flexible use rights did not come into being all at once. In the early 1980s, the FCC granted cellular operators large blocks of spectrum with the flexibility to reconfigure and split cells to tailor coverage and capacity in response to market demand within geographically-defined service areas. Next, it provided operators with the flexibility to move from government-prescribed analogue technology to new digital technologies of their choice. When PCS (personal communications service) was authorised in the mid-1990s, the FCC gave both PCS and cellular licensees even more flexibility, both technical and service-related.

And the process has continued, with flexible-use rules consistently applied to new wireless spectrum bands. In the US market, new technologies and services abound. →

← **Commons.** A third way to enable access to spectrum is through a commons model. As the FCC has explained, spectrum commons “allows unlimited numbers of unlicensed users to share frequencies, with usage rights that are governed by technical standards or etiquettes but with no right to protection from interference. Spectrum is available to all users that comply with established technical ‘etiquettes’ or standards that set power limits and other criteria for operation of unlicensed devices to mitigate potential interference.” The commons model has been enormously successful in the US under the unlicensed Part 15 device regime, enabling baby monitors, garage door openers and the like, as well as broadband connectivity through WiFi.

**REPURPOSING CLEARED SPECTRUM FROM EXISTING LICENSEES**

Traditionally, when new service demands dictated changes in the desired use of particular bands of spectrum, government forced the relocation of incumbent users so that it could reallocate spectrum and satisfy the new demands. Increasingly, however, government policy is turning to the marketplace to enable transitions to more efficient, intensive use of spectrum.

In years past, the market would rely on government to reallocate a block of spectrum that, in light of technological change or shifts in demand, was larger than necessary to meet the incumbent use, and incumbents would move or repack their operations as the government assigned new exclusive-use, flexible rights spectrum licences, typically through auction. The reallocation and clearing process has been used repeatedly in the UHF television band, for example, when channels 70-83 were cleared of TV licensees in 1970 to free spectrum for 800 MHz land mobile services, and more recently when channels 52-59 and 60-69 were reallocated to make 700 MHz spectrum available for land mobile services.

As opportunities for reallocation have narrowed, US policy has increasingly relied on secondary markets to allow flexible use licences to migrate to licensees and technologies that will put spectrum to its highest and best uses.

**Enabling a higher valued use: secondary markets**

Secondary market transactions negotiated among private parties allow spectrum to flow to its most valued use through market-based mechanisms, subject to FCC review. In 2000, breaking with decades of case law and policy pronouncements that restricted the development of secondary markets in spectrum use rights, the FCC emphasised the critical importance of promoting secondary markets in order to facilitate efficient spectrum use:

*“An expanded system of private sector markets will serve the public interest by creating new opportunities for increasing the communications capacity and efficiency of spectrum use by licensees... While secondary markets are not a substitute for finding additional spectrum when*

*needed and should not supplant our spectrum allocation process, a robust and effective secondary market for spectrum usage rights could help alleviate spectrum shortages by making unused or underutilised spectrum held by existing licensees more readily available to other users and uses and help to promote the development of new, spectrum efficient technologies.”*

Secondary market transactions can take several forms. The simplest form is spectrum acquisition through licence transfers and assignments (which also may involve extensive assets other than the licences). The FCC also has provided a regulatory scheme for the leasing of spectrum usage rights in the secondary market. Finally, licensees can provide others with spectrum capacity without transferring spectrum rights through a variety of methods.

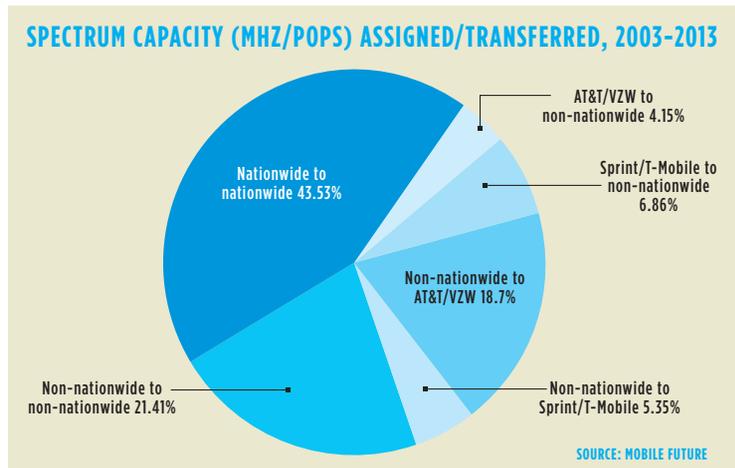
**Spectrum acquisition.** After licences are initially issued by the FCC, a secondary market exists for these licences (subject to FCC review and approval of any transfers or assignments). Such assignment and transfer transactions have facilitated value creation in the mobile service marketplace. Nextel, for example, acquired SMR spectrum from numerous licensees and converted these holdings, through rule changes, into nationwide CMRS (commercial mobile radio services) spectrum.

More recently, DISH acquired 2 GHz mobile satellite service spectrum from two bankrupt licensees and converted these licences, through rule changes, to enable terrestrial-only CMRS. Incumbent providers have also used assignment and transfer transactions to acquire the spectrum needed to expand mobile broadband

**US policy has increasingly relied on secondary markets to put spectrum to its best uses.**

Future shows that secondary market transactions not only have benefited nationwide providers but also are enabling smaller providers to acquire the spectrum they need to compete in the mobile broadband marketplace. As Mobile Future’s study noted, such transactions “have been highly effective in creating a timely and efficient path for spectrum resources to be optimised across a broad array of operators”.

As detailed in the chart below, both nationwide and non-nationwide operators have been active in acquiring spectrum in the secondary market.



**Spectrum leasing.** In 2003, the FCC provided wireless licensees with additional flexibility by allowing them to lease out spectrum usage rights, either through short-term and long-term de facto spectrum leasing, under which the lessee becomes responsible for FCC compliance as though it held the licence, or through 'spectrum manager' leasing, where the licensee remains responsible for ensuring FCC compliance. The FCC adopted these rules to "facilitate significantly broader access to valuable spectrum resources", continuing the agency's "evolution toward greater reliance on the marketplace to expand the scope of available wireless services and devices, leading to more efficient and dynamic use of the important spectrum resource to the ultimate benefit of consumers throughout the country".

Several companies, including Spectrum Bridge and Cantor Fitzgerald, have established clearinghouses or exchanges to facilitate secondary market transactions, including both spectrum leases and licence purchases, creating a marketplace that allows buyers and sellers to locate and deal with each other in a variety of bands.

The availability of spectrum leasing has helped carriers optimise wireless network capacity. The annual number of spectrum lease applications or notifications has grown to an average of 560 during the period 2007-2012, and in mid-2013 there were over 3,000 active leases, nearly all of them long-term in nature. Again, both large and small operators have benefited. For example, Verizon Wireless established a programme under which it leases parts of its 700 MHz spectrum to rural carriers to allow them to deploy their own 4G LTE networks; as of mid-2013 it had signed 20 such leases covering 2.8 million people in 14 states. And Clearwire's extensive leasing arrangements to access 2.5 GHz EBS spectrum have allowed Sprint to expand its mobile broadband offerings.

**Licensee practices facilitating access to capacity.** It is also noteworthy that, separate from engaging in spectrum transactions, wireless licensees are helping others expand the mobile broadband ecosystem by enabling innovative third party devices, services and applications that ride on wireless connectivity. One way of accomplishing this involves providing access to capacity via resale. This allows non-facilities-based companies to compete in the wireless business at the retail level as mobile virtual network operators (MVNOs), enhancing the competitive nature of the wireless field. It also allows hardware and content providers to take advantage of wireless capacity by bundling it with a device sold or rented to consumers. Many e-readers are sold with bundled wireless broadband connectivity, for example.

US network operators have established innovation programmes that help companies ranging from new entrants to global conglomerates to incorporate wireless connectivity into machine-to-machine (M2M) devices for use in diverse fields. For example, wireless connectivity in 'smart grid'

communications nodes deployed throughout the energy grid help deliver energy flexibly and intelligently. Similarly, medical applications and devices are enabling consumers to collect data that tracks health and wellness information. And vehicular applications provide connectivity to enable capabilities such as remote engine diagnostics, web browsing, and access to information such as traffic, weather and navigation. Even the manufacturers of devices such as monitors for propane and chemical tanks have benefited from working with wireless operators to develop wireless M2M capabilities.

As more information flows between devices, sensors, servers and actuators over the internet through a combination of wired and wireless connections, the web of connections is becoming known as the internet of things (IoT), which wireless operators will play a prominent role in building out.

#### **Creating a spectrum market: the incentive auction framework**

The US is pursuing a new, market-based approach to free up spectrum for use by providers who value it most highly – the first of its kind anywhere in the world. In contrast to the traditional reallocation methods in which incumbent users were forced to relocate with their costs reimbursed by new licensees, this new approach – called a two-sided incentive auction – would allow incumbents to relinquish spectrum rights in exchange for a market-based payment, with new spectrum licensees bidding for reconfigured, exclusive-use, flexible rights spectrum licences. The first implementation of this new approach is focused on the further repurposing of UHF television broadcast spectrum.

In essence, the government serves as a market maker in facilitating the shift of spectrum from one use to another – in this case, broadcast television to commercial wireless. FCC economists had proposed such an auction back in 2002; the 2010 National Broadband Plan urged legislation to make an incentive auction possible, and Congress followed through in 2012.

As a result, the FCC issued a notice of proposed rulemaking to create an incentive auction system for broadcast spectrum in the 600 MHz band that would provide "a voluntary, market-based means of repurposing spectrum by encouraging licensees to voluntarily relinquish spectrum rights in exchange for a share of the proceeds from an auction of new flexible use licences using the repurposed spectrum". Broadcasters can choose not to participate but they may be forced to relocate into a smaller, repacked broadcast band. The FCC is planning to run what may be the most complex auction ever to be conducted, including:

- A 'reverse auction' in which broadcast television licensees can submit bids to voluntarily relinquish spectrum rights (either by exiting the broadcast business entirely or by agreeing to share a channel or move from a UHF to a VHF assignment) in exchange for payments
- A reorganisation or 'repacking' of the broadcast television bands
- A 'forward auction' of initial licences for flexible use of the newly available spectrum.

FCC chairman Wheeler has announced that the FCC will conduct the incentive auction in mid-2015. He recently noted: "Let there be no mistake about the degree of difficulty of this undertaking. We are attempting something never done before. But as with our original spectrum auctions 20 years ago, the risks are well worth taking."

The incentive auction framework is an exciting, innovative spectrum management tool to meet growing demand. Once implemented, incentive auctions can extend beyond broadcast television spectrum to other incumbent spectrum uses, possibly including government spectrum.

*In the next issue of Intermedia, the authors will look at sharing paradigms.*

**BRYAN TRAMONT** is a principal partner and **ADAM KRINSKY** a partner at Wilkinson Barker Knauer LLP in Washington DC.