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Communications

Wireless technology is already transforming our lives, yet we are only at the dawn of the mobile broadband era. This new future will come to us through a combination of more spectrum and the widespread deployment of the most powerful wireless technology ever deployed: Long Term Evolution (LTE). The technology is a complete architecture that includes a road map of innovation and constant improvement through the rest of the decade. LTE delivers extremely high data throughputs while making extremely efficient use of spectrum. It also enables the networks of tomorrow that will combine cells of multiple sizes, offer quality-of-service mechanisms, and use smart Wi-Fi offload. Ultimately, however, the promise of LTE can only be realized through a combination of new, additional spectrum, and allowing operators to use spectrum as efficiently as possible.

Unleashing the Wireless Power of Long-Term Evolution: Spectrum, and Lots of It

By Peter Rysavy

We are at the dawn of the mobile broadband era, a time in which mobile computing and communications technology transforms and enhances every aspect of our work and social existence. We have seen glimpses of what this era may portend in our smartphone screens, but we have yet to see the full picture, yet to understand all the ways in which innovators will take advantage of unprecedented computing power in tiny handheld devices and unprecedented wireless communications speeds while mobile.

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The two critical components that will bring this future into focus and make it a reality for millions of Americans and for billions of consumers worldwide is more spectrum and widespread deployment of a new technology platform called Long Term Evolution (LTE). American companies are at the forefront of the global rush to harness the innovations LTE makes possible, including improving their spectrum portfolios to better support faster and more efficient deployments of LTE. For example, the public documents regarding the proposed merger of AT&T and T-Mobile indicate that the need for a spectrum portfolio optimized to support LTE deployment is a driving force behind the proposed transaction.

Most people have yet to understand or experience the inherent and ultimate capabilities of LTE technology, a technology that may ultimately be the single most important tool that mankind has ever developed and which will radically transform how we work, play, socialize and otherwise live over the next decade.

The complexity of LTE is so immense that it has required the combined wireless engineering output of the planet to invent. If the machine that is LTE could be visualized, it would be an exquisite, towering edifice in the sky. This structure will continue to evolve—

 ISSN 0148-8155

technologists have already invented additional enhancements, ones that will roll out in a new version called LTE-Advanced. LTE is more than a single technology; rather, it is an architecture that will underlie multiple technologies. As each technology is added, LTE becomes that much more powerful.

Key to making LTE a success is spectrum, the fuel of mobile broadband and itself a key ingredient in expanding the capacity of wireless networks. Combining more spectrum with the most efficient wireless technology ever developed, LTE, will give consumers and businesses access to the next generation of wireless networks that support the always-on, always-mobile experience millions of consumers are saying they want and need.

A few words on the unique ability of LTE to extract the most mileage out of a given spectrum allocation. LTE radio channels can be of multiple sizes, including 1.4, 3, 5, 10, 15, and 20 MHz. However, the wider the radio channel, the greater the efficiency and the higher the capability of LTE. LTE is spectrally more efficient operating in 20 MHz channels than in 10 MHz channels. In other words, the network can deliver more bits per second using a 10 MHz radio channel (10 MHz down, 10 MHz up) than in two 5 MHz radio channels. It is important to remember that using non-contiguous radio channels to build out LTE will significantly increase the cost of the radio-access network due to the need for additional radios and antennas. Further, making additional slices of spectrum available after a LTE network build has commenced will result in devices in the field that probably will not be able to take advantage of the new spectrum. If we are to enable all that LTE wireless networks can make possible, it is critical that policymakers avoid policies that make it more difficult for providers to either aggregate spectrum into larger, wider channels or rearrange existing spectrum portfolios to better enable LTE's innovations and capabilities.

As the federal government considers ways to make more, ''clean'' spectrum available to commercial providers that need it to build or expand next-generation networks, multiple companies are actively pursuing strategies in the near term that will improve their spectrum portfolios and enable them to deploy next-generation wireless broadband networks using LTE sooner rather than later. From the proposed merger of AT&T and T-Mobile to Dish Networks' attempts to use its Mobile Satellite Service (MSS) spectrum to offer 4G LTE, incumbents and new market entrants alike are using secondary markets to resolve their respective spectrum and capacity shortages near term.

This is an encouraging sign for the industry and the economy as a whole because nurturing the exploding mobile broadband market and all the economic and societal opportunities it represents for this nation calls for vast amounts of additional wireless network capacity.

A few words about the benefits of LTE. Although there are other, comparable technologies such as High Speed Packet Access+ (HSPA+) and Evolution-Data Optimized (EVDO) that will provide essential communications services over the remainder of the decade, LTE is the endgame because it operates in multiple dimensions simultaneously, exploiting each dimension to the fullest extent possible; and at speed double or higher than that of HSPA+ and EVDO. These dimensions include time, frequency, and space.

Consider the following:

■ LTE has extremely high data throughputs. The currently deployed version (Third Generation Partnership Project [3GPP] Release 8) has a peak theoretical downlink rate of 300 million bits per second (Mbps) in a 20 MHz radio channel. LTE in 3GPP Release 10 (in a version referred to as LTE-Advanced) will have a peak rate of more than 1 billion bits per second (Gbps). Real-world rates on loaded networks are lower, but operators are quoting typical rates in the range of 5 Mbps to 10 Mbps, rates that make a wide range of applications possible and that are competitive with wireline connections. These rates will increase as versions such as LTE-Advanced are deployed.

■ LTE also has very low latency which means very little delay for data packets to traverse the network. With latency as low as 10 milliseconds in the radio-access network, LTE has the lowest latency of any cellular technology, rendering it a catalyst for making applications such as two-way, mobile video a reality for the masses.

■ The networks of tomorrow will be networks of networks, comprising a blend of cells of different radii, technologies, and frequencies. The LTE architecture embraces this concept in what technologists call HetNets. As the number of cells increase, with more macro cells and especially with huge eventual numbers of femtocells (household size cells) and picocells (street block size cells), LTE has the capability for these HetNets to automatically configure and optimize themselves at the radio level, eliminating the need for what is now done manually.

■ LTE will be increasingly more seamless and intelligent in how it handles offload to networks such as Wi-Fi. Future versions will allow user data sessions to continue uninterrupted while transitioning to and from Wi-Fi, and even selectively allow some applications to simultaneously remain on LTE (e.g., operator VoIP) while other applications (e.g., video streaming) use the Wi-Fi connection. This is called IP Flow Mobility and Seamless Offload (IFOM).

■ LTE also has a sophisticated quality-of-service architecture that can prioritize traffic to provide an optimum user experience and that can provide more flexible service plans.

■ Beyond capabilities, LTE has intrinsic flexibility and efficiency that make it ideal for operators, such as being able to operate in either paired or unpaired spectrum. As explained earlier, LTE is the most spectrally efficient technology ever developed but its spectral efficiency will continue to improve with radio-technology techniques such as higher-order Multiple Input Multiple Output (MIMO) antennas, successive-interference cancellation, and coordinated multipoint transmission.

Long term, it is important that the incentive auctions currently under consideration by the federal government come to fruition because they are a conduit to a pipeline of more, clean spectrum needed to realize a robust 4G LTE world.

However, while consumers wait for Washington to make new spectrum available for next generation wireless networks, it is imperative that operators continue deploying femtocells, do more offloading of data onto Wi-Fi local area networks, and continue to avail themselves of secondary market transactions that realign

   ISSN 0148-8155

spectrum holdings and make it easier and faster to build out LTE networks.

In this regard, allowing operators to combine spectrum assets that will catalyze faster deployment of LTE, maximize network operational efficiencies and guarantee a high quality of service should be a key objective of policymakers interested in driving next generation wireless network investment and deployment throughout America.