NEW AMERICA FOUNDATION

Issue Brief #27 *October 2009*

Mobile Data Demand and the Need for Increased Spectrum Access

*By Michael Calabrese and Benjamin Lennett**

There is no doubt that consumer demand for mobile data applications is exploding worldwide. As Smartphones with PC capabilities and broadband aircards gain access to faster 4G networks beginning next year, total wireless data consumption will increase geometrically. Cisco's annual projection of global Internet traffic predicts a 129% compound annual growth rate (CAGR) for mobile data over the next five years in North America (through 2013).[1]

WIRELESS FUTURE PROGRAM

In addition to reallocating bands cleared completely for exclusive licensing, promoting pervasive connectivity, innovation and consumer welfare suggests that any Administration initiative also lay the groundwork for complementary spectrum access models that are sustainable and pro-consumer. Policy should facilitate hybrid networks managed equally from the edge, by consumer preference.

As the chart on the following page indicates, increasing market penetration and use of Smartphones with capabilities similar to today's iPhone and G-1 promise to increase mobile data demand by a factor of 16 or more within five years (conservatively growing from approximately 3,700 to 62,000 terabytes). The network capacity needed for mobile Internet applications will dwarf the capacity currently used for voice and texting, each of which are low-bandwidth applications. Actual mobile data demand is likely to be far greater than this, for several reasons:

First, the Smartphone data projection here is conservative. It assumes the penetration of devices with capabilities similar to today's iPhone will increase from 17% to 50%. We also make the extremely conservative assumption that the average Smartphone user will consume only as much data (400 MB/month) as today's iPhone user.

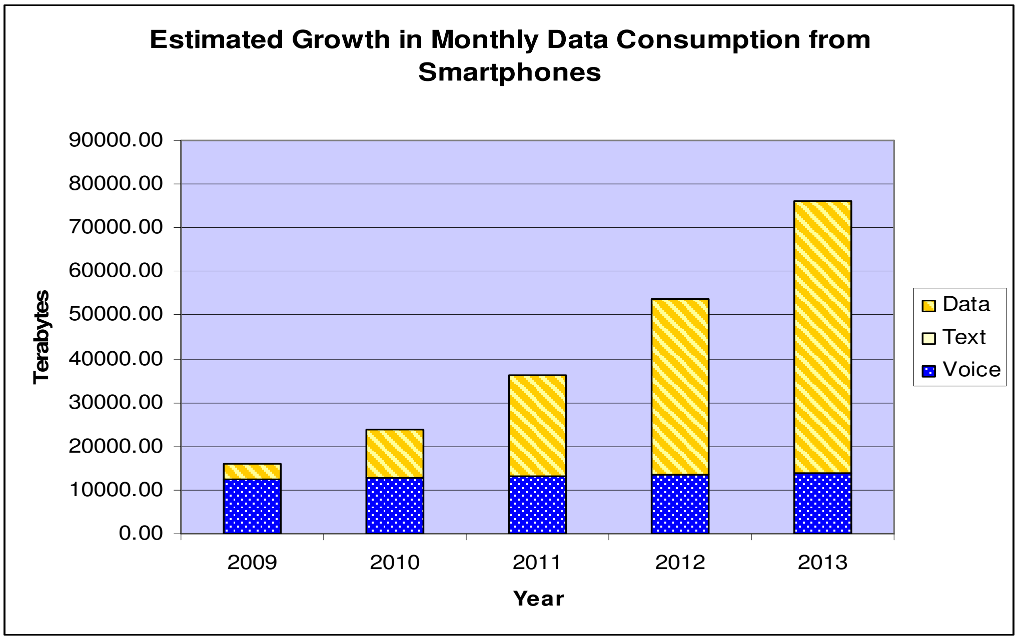
Second, this handset projection does not include the projected growth of mobile broadband aircards used with laptops, notebooks and netbooks. According to Cisco's study, a single laptop generates as much wireless data traffic as 450 basic-feature phones.[2] In comparison, a Blackberry generates as much traffic as 30 basic-feature phones. Cisco projects a 117% CAGR for aircards through 2013, with aircard/PC data consumption nearly as large as Smartphone demand.[3] 4G data rates over low-frequency spectrum (which penetrates well indoors) will make wireless data substitution for low-demand (and/or lower-income) residential consumers quite compelling and common – just as cell phones are steadily replacing wired lines.

Third, pervasive connectivity will rapidly become integrated in applications for sensing networks, health care (e.g., remote monitoring), energy conservation (e.g., Smartgrid, home appliance net-

**Michael Calabrese is Director of the Wireless Future Program at the New America Foundation. He can be contacted at calabrese@newamerica.net Benjamin Lennett is a policy analyst for the Wireless Future Program. He can be contacted at lennett@newamerica.net.*

works), education, public safety, and e-government – much as devices like the Kindle are already embedding wireless connectivity.

Figure 1*: Estimated Growth in Monthly Data Consumption from Smartphones



*The above chart represents a best effort estimate of the future growth in U.S. mobile data consumption as result of greater adoption of smartphones. Total mobile subscribership is assumed to grow at a rate of 3% per year. Growth rates for voice and text messages are assumed to be 3% per year and based upon monthly voice minutes and text messages reported from CTIA's 2009 Semi-Annual Wireless Industry Survey Results. Data consumption for smartphones is assumed to grow from an average of 80 MB/month in 2009 to 400 MB/month by 2013 (same as the average iPhone user today) and smartphone market penetration from 17% in 2009 to 50% in 2013. Although 123 billion text messages were sent per month during the first half of 2009, each message is just 160 bytes (total of 19 terabytes/month) and therefore is not visible on the chart.

Meeting consumer demand for mobile data will require some combination of four strategies:

- Increased spectrum access
- Smaller cell sizes
- More efficient wireless architectures/technologies
- More effective use of wired backhaul

CTIA, the wireless industry association, recently called on the federal government to reallocate an additional 800 MHz of spectrum by 2015 from current uses to exclusive licensing for wireless broadband services. This 800 MHz is based entirely on a 2006 spectrum requirements study by the ITU.[4] Based on an elaborate modeling of emerging cellular technologies (such as LTE and WiMAX) and cell densities, ITU concluded that advanced market economies would require total allocations of roughly 1,300 MHz by 2015 and 1,720 by 2020. Companies have access to just over 500 MHz today. It is important to note that ITU estimated a considerably higher requirement for markets (such as the U.S.) that would want sufficient capacity for three or four competing ISPs in each market. The ITU's total spectrum requirement for three competing networks is 1,980 MHz by 2015, and 2,240 MHz to support four competitive networks (see chart below).

We know of no other credible estimate of U.S. spectrum needs. Indeed, there is a high degree of uncertainty associated with translating the likelihood of exploding consumer demand for mobile data into any specific number of MHz of spectrum capacity that would meet that demand. This is partly due to the fact that demand is extremely "lumpy" in several respects, including by geography and population density (e.g., rural vs. suburban vs. urban) as well as by time of day. The greatest needs for capacity are not nationwide or around the clock – but primarily urban and during peak use periods. Much depends on the relative size and provisioning of cells. This and other data needed for a credible estimate is not public and/or proprietary to the wireless industry.

***Figure 2*: ITU Spectrum Requirements for High-Density Markets**

	1 network	2 networks	3 networks	4 networks	5 networks
Total Spectrum (MHz)	1720	1760	1980	2240	2500

Source: *ITU, Estimated spectrum bandwidth requirements for the future development of IMT-2000 and IMT-Advanced* (2006).

Exclusive Licensing Alone is Unsustainable and Anti-Consumer

While there is no question that the existing commercial wireless architecture – based on exclusive licensing, tower-based hub/spoke channelization, centralized infrastructure and metered billing – will need substantially more exclusive-use spectrum in the short-run to meet mobile data demand, it should be equally clear that this model is not sustainable longer term.

First, while it may be feasible to clear incumbents from 200 MHz of spectrum within a few years, there appears to be no economically or politically feasible path to clearing 800 MHz, let alone the 1,700 MHz required to sustain multiple networks and technologies within the same cell area and promote the robust wireless competition that the current administration is seeking.

Second, as the CTIA/Rysavy report observes, although LTE technology will be considerably more spectrum efficient than 3G (EV-DO and UMTS/HSPA), "there are both theoretical and practical limits to spectral efficiency and current systems are approaching those limits." The ITU's spectrum requirements study assumes that LTE in 2020 will already be at 75% of the theoretical limits imposed by Shannon's Law – yet still less efficient than 'hot spots' (WiFi).[5]

Third, while the 802.16m (WiMAX) and LTE standards process anticipates further cell-splitting via "relay stations," there are practical limits to how close carriers can bring their owned infrastructure (transmitters and backhaul) to the individual user. According to CTIA data, over the two years since June 2007 total cell sites have increased just 14% (from 210,000 to 246,000).

Finally, while more investment in special access can improve the capacity of towers and cells, it will be extremely cumbersome and expensive to bring carrier-provisioned backhaul to each and every carrier cell – and more so if they could grow in proportion to demand.

Therefore, in addition to reallocating bands cleared completely for exclusive licensing, promoting pervasive connectivity, innovation and consumer welfare suggests that any Administration initiative also lay the groundwork for complementary spectrum access models that are sustainable and pro-consumer. Policy should facilitate hybrid networks managed equally from the edge, by consumer preference. An insight that can be derived from the trends noted above is that the quantity of available spectrum is not by itself the most important factor in meeting projected mobile data demand.

Most important is to shrink the effective size of the cell to the level of the home, business – and even to the individual. In other words, ***most of each user's data consumption should not flow through the wireless carrier's infrastructure (towers, backhaul), but should flow over short distances directly into non-carrier wireline backhaul.***

As high-capacity wireline connections and the consumer's choice of hybrid mobile devices becomes more prevalent, ***it is neither cost-effective nor pro-consumer to encourage a model whereby most data would be transported over expensive Licensed airwaves when it could go short distances over Unlicensed airwaves and consumer-owned backhaul.*** The commercial wireless provider, relying on limited exclusively licensed spectrum, should serve increasingly as a "quality of service provider," since consumers will happily pay for remote coverage, or for the transport of latency-sensitive applications. Consumer welfare and economic efficiency will be enhanced by cognitive and cooperative devices that default where feasible to a local, very low-power network transmitting on unlicensed or other shared spectrum. Indeed, as more shared spectrum enables more cognitive and cooperative devices, mobile consumers can more readily hop to wireline transit on a p2p basis even when away from open WiFi ports.

Alternative Models for Spectrum Access

To lay this groundwork, we believe it is essential for any Administration initiative to also explicitly support alternative models for spectrum access:

1. **Additional Contiguous Unlicensed with Superior Propagation**: An effective unlicensed ecosystem requires, as carriers do, a contiguous band with far better propagation than 2.4 GHz band. The TV white spaces will help, but are (a) fractured into non-contiguous, narrow – 6 Mhz – channels, and (b) limited for mobile to 40 mW power – just 4% of the Part 15 limit for WiFi.

2. **Opportunistic Access to Bands that Cannot be Cleared Soon**: There is a very serious limit on the number of bands that can be cleared of incumbent use for reallocation via auction and exclusive licensing. A far greater amount of underutilized spectrum – particularly in federal bands – could be shared opportunistically by (a) adding frequencies to the TV Bands database; and (b) expanding the purpose of the CSEA Spectrum Relocation Trust to finance the modernization of federal systems to improve performance and facilitate spectrum sharing.

3. **A Managed Wholesale Access Band**: An allocation conditioned on leasing bandwidth to any ISP or application/service (e.g., for embedded connectivity) will promote market entry, roaming, competition and innovation. The Treasury could receive payments in perpetuity – as a royalty on revenue, as Interior Dept leases natural resources – rather than a one-off auction (which does not preclude an auction, but lowers the barrier to entry, leaving more capital for infrastructure).

Endnotes

[1] *Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update*, January 29, 2009, available at http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.pdf

[2] *Id.*

[3] *Id.*

[4] *Estimated Spectrum Bandwidth Requirements for the Future Development of IMY-2000 and IMT-Advanced*, Report ITU-R M2078 (2006).

[5] Rysavy Research, *Mobile Broadband Spectrum Demand* (December 2008), at 14, 19.