MOBILE DATA DEMAND: GROWTH FORECASTS MET

Significant Growth Projections Continue to Drive the Need for More Spectrum

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In 2010, the FCC forecast significant future growth in mobile data usage.[1] Based on those demand forecasts, the National Broadband Plan called for making 500 MHz of spectrum available for wireless broadband by 2020, including 300 MHz for mobile by 2015.[2]

Five years later, a look back at those forecasts shows that collectively they were remarkably accurate: In 2010, the FCC's growth rate projections predicted mobile data traffic of 562 petabytes (PBs) each month by 2014; the actual amount was 563 PBs per month.[3]

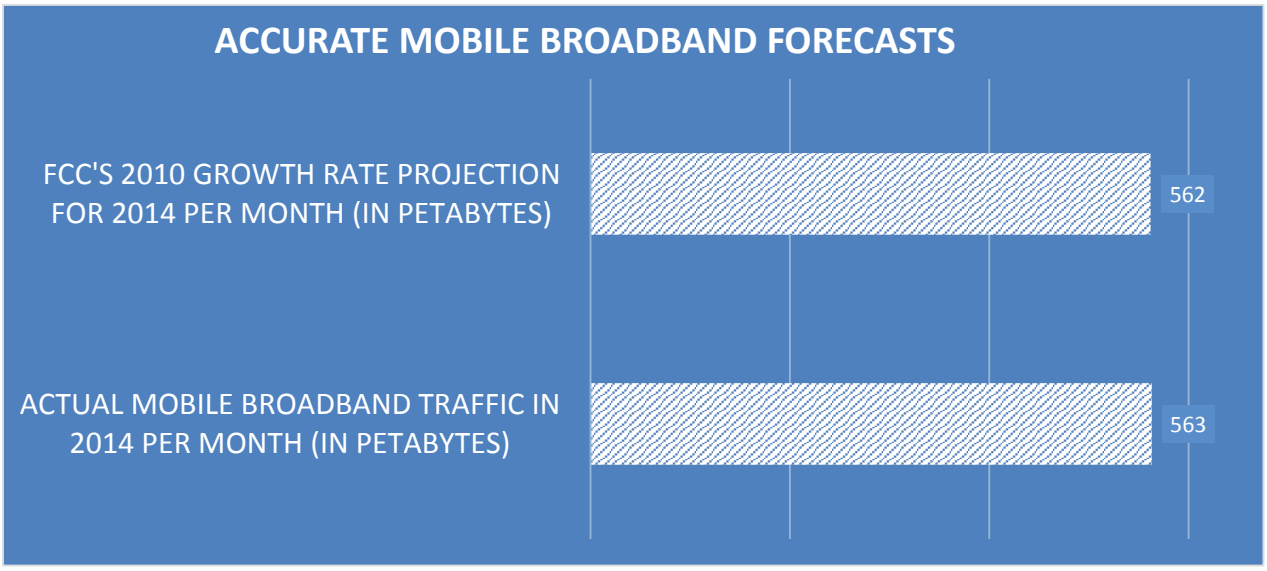
Looking ahead, projections predict that mobile data traffic by 2019 will be nearly *six times* the 2014 amount. The U.S. commercial wireless industry cannot meet this explosive growth simply through improved engineering, more infrastructure, and the spectrum that is currently scheduled to come online. Rather, the government, industry, and other stakeholders must come together to find additional spectrum bands that can be repurposed from existing uses to mobile broadband.

MOBILE DATA DEMAND PROJECTIONS ACCURATELY CAPTURED MOBILE BROADBAND'S EXPLOSIVE GROWTH

U.S. mobile broadband growth since 2009 has been dramatic.

In 2009, approximately 191 billion megabytes (MB) traveled across U.S. wireless networks, or roughly 21.8 million MB an hour. By 2014, wireless providers reported handling more than 4 trillion MB.[4] That level of mobile data means that every hour, over 462 million MBs flowed across U.S. wireless networks, or roughly 7.7 million MBs every minute of every day.

Anticipating this increase, in 2010, the National Broadband Plan referenced demand forecasts to call for 500 MHz of spectrum to be made available for wireless broadband by 2020, including 300 MHz between 225 MHz and 3.7 GHz for mobile use by 2015.[5] As discussed below, the FCC's estimates were informed by projections of mobile data traffic growth – which it used to make a forecast that was truly prescient. Given that the U.S. has only made a partial down payment on the spectrum



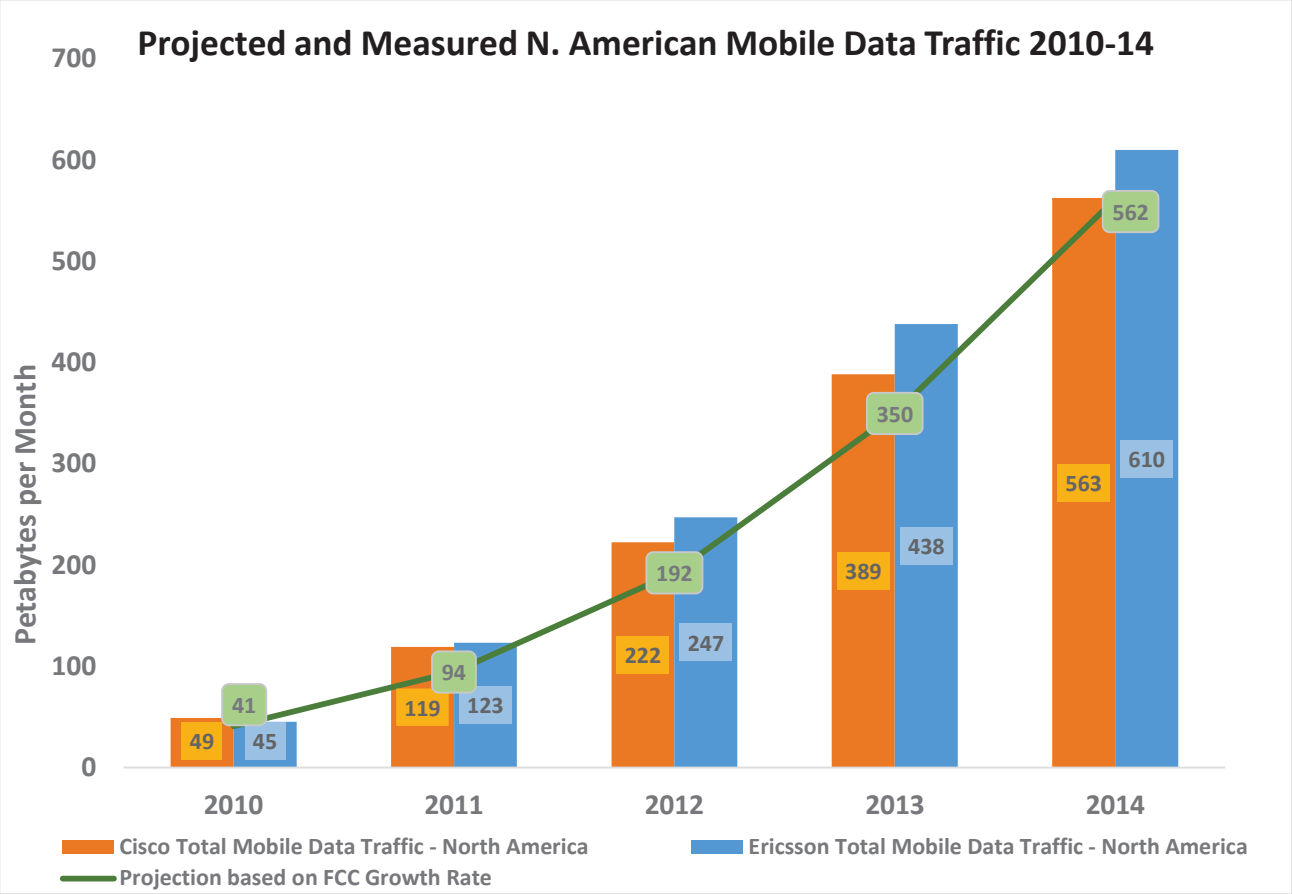
repurposing goals set by the FCC, and demand in the *next five years* will continue to explode, the U.S. will need significantly more spectrum – licensed as well as unlicensed.

The FCC's mobile data demand projections made in 2010 proved a reliable indicator of future demand.

To substantiate the call for 300 MHz of spectrum by this year, the FCC averaged the growth rates from Cisco, Coda Research, and the Yankee Group, to derive an average rate of growth in future mobile data traffic.[6]

The chart below identifies the FCC's demand projections *and* the actual mobile data traffic for the first half of this decade. The green line shows that the FCC's projected growth rate applied to the original base year (2009) traffic data produces an estimate for 2014 that yields essentially the same value as the actual reported data traffic for 2014: a projected 562 PBs a month in 2014 versus 563 PBs per the actual data subsequently reported by Cisco.[7]

These mobile data traffic figures negate the claims of "spectrum crunch" naysayers, who argued that a national response to the looming spectrum deficit was unwarranted.[8] One such consultant called the FCC's analysis "biased and unreliable" as it "relies on suspect data," and is "skewed toward a pre-ordained decision."[9] The only aspect of the FCC's analysis that was pre-ordained was its commitment to reasoned, data-driven policymaking, the



results of which – a growth forecast prediction accurate within one-fifth of one percent – can now be seen clearly.

Tellingly, the FCC said in 2010 that even if their projection overestimated future demand by 20 percent, the nation would still reach a spectrum deficit within a year or two.[10] As it turned out, the FCC's average estimated growth rate was remarkably precise, demonstrating that the use of demand projections is reasonable, that they are reliable indicators, and that the need for more spectrum was – and remains – real.

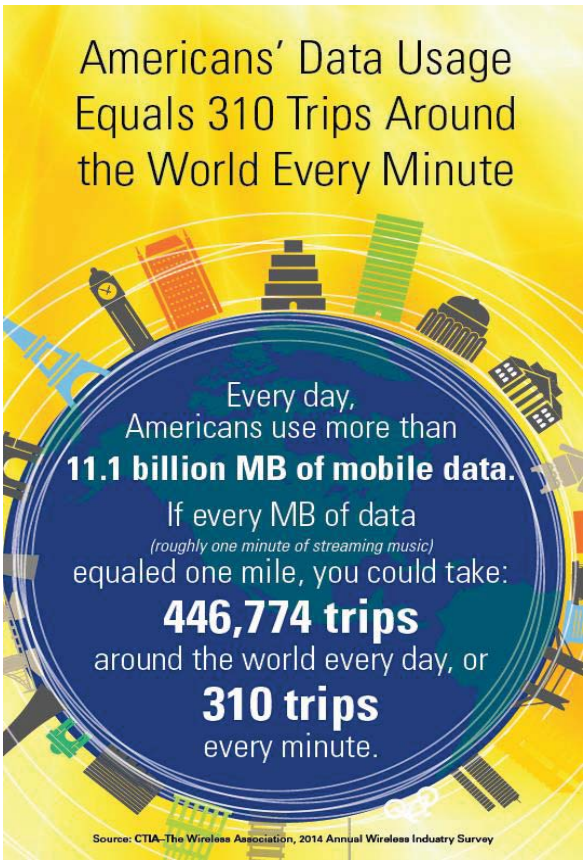
THE ASTONISHING GROWTH OF MOBILE DATA TRAFFIC IS THE RESULT OF A CONFLUENCE OF DYNAMIC MARKET TRENDS.

In 2009, Rysavy Research identified the factors "that are acting together to increase spectrum demand at an accelerating pace," which included "ever-more mobile life- and work-styles, greater device sophistication, new bandwidth-consuming applications, an increasing percentage of mobile users taking advantage of data applications, and ongoing industry innovation."[11]

In 2014, the FCC confirmed this developing, mobile-centric society and its impact on mobile networks: "[t]he rapid adoption of smartphones, as well as tablet computers and the widespread use of mobile applications, combined with the increasing deployment of high-speed 3G and now 4G technologies, is driving significantly more intensive use of mobile networks."[12]

This wireless future is now our reality. Americans use more than 11.1 billion MBs of wireless data every day. If every MB of mobile data equaled one mile, you could take 446,774 trips around the world every day, or 310 trips every minute.

As just one indicator of the shift to a mobile-connected life, Google recently reported that mobile searches have now – for the first time – outpaced PC searches.[13]



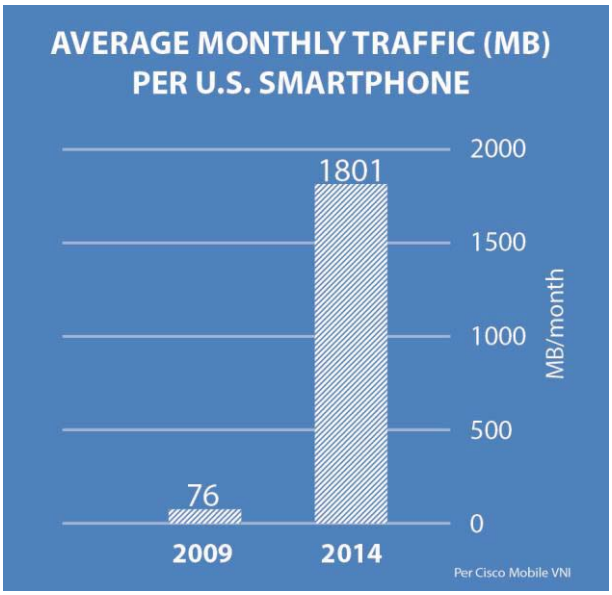
A brief review of a few data points illustrates how U.S. mobile data traffic increased so dramatically since 2009.

4G Networks. The U.S. is the global leader in 4G. Today's U.S. mobile broadband networks are paving the way for innovation in devices, applications, and services that drives demand in a virtuous cycle.[14]

As a senior member of the FCC's leadership team recently noted, "[O]ur mobile

broadband networks are the envy of the world."[15]

To quickly recap: at the turn of the decade, LTE networks had yet to be deployed in the U.S.[16] By 2012, LTE networks covered 211 million people, and nearly 80 percent of U.S. households.



Today, 98 percent of Americans have access to 4G LTE, thanks to four national carriers blanketing the country and regional operators that serve areas home to millions.[17] For the first time ever in the U.S., every major provider is using the same digital technology, 4G LTE.

U.S. consumers embraced this latest network evolution, with over 158 million LTE connections at year-end 2014, representing a penetration rate of nearly 50 percent.[18] These users enjoy increasingly faster mobile broadband speeds. The average 4G speed was 12.3 Mbps in 2014, roughly three times the average 3G speed,[19] and smartphone speeds overall have increased eight-fold since 2010.[20]

When wireless networks get faster, consumers use more data: Subscribers of LTE service consume nearly twice as much cellular data compared to 3G subscribers.[21]

In a demonstration of wireless providers' engineering abilities, the U.S. has the most LTE subscribers (158 million connections) in the world despite having the third lowest amount of spectrum dedicated for LTE.[22] The transition from 3G to 4G networks enabled the U.S. to transform itself from "a wireless backwater"[23] and reclaim its global mobile leadership.

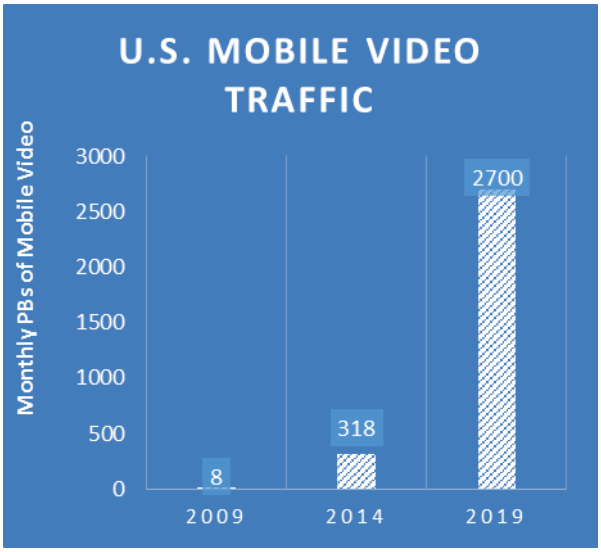
Smartphones and Tablets. The number of active smartphones in the U.S. increased from 50 million in 2009 to over 200 million in 2014, and the average monthly traffic skyrocketed 2,268 percent from 76 MB in 2009 to 1.8 GB per month per smartphone in 2014.

The number of active CMRS-enabled tablets and laptops in the U.S. also increased, from 14 million in 2010 to 35.4 million in 2014. With Cisco estimating that tablets and laptops generate 1.5 to 2.3 times more traffic than the average smartphone,[24] tablets and laptops have a significant multiplying effect on mobile traffic growth.

***Mobile Device Usage*.** Thanks to smartphones and tablets, consumer usage trends shifted dramatically since 2010.

U.S. consumers spent 131 billion minutes engaged in smartphone Internet usage in December 2010. By November 2014, that number rose to 574 billion minutes. Similarly, tablet Internet usage increased from 11 billion minutes in December 2010 to 172 billion in November 2014.[25]

Just like usage itself, use cases also expanded, driving more data consumption. Indeed, "most of the growth in digital media consumption over the past four years has occurred on smartphones (up 394 percent) and tablets (up 1,721 percent)."[26]



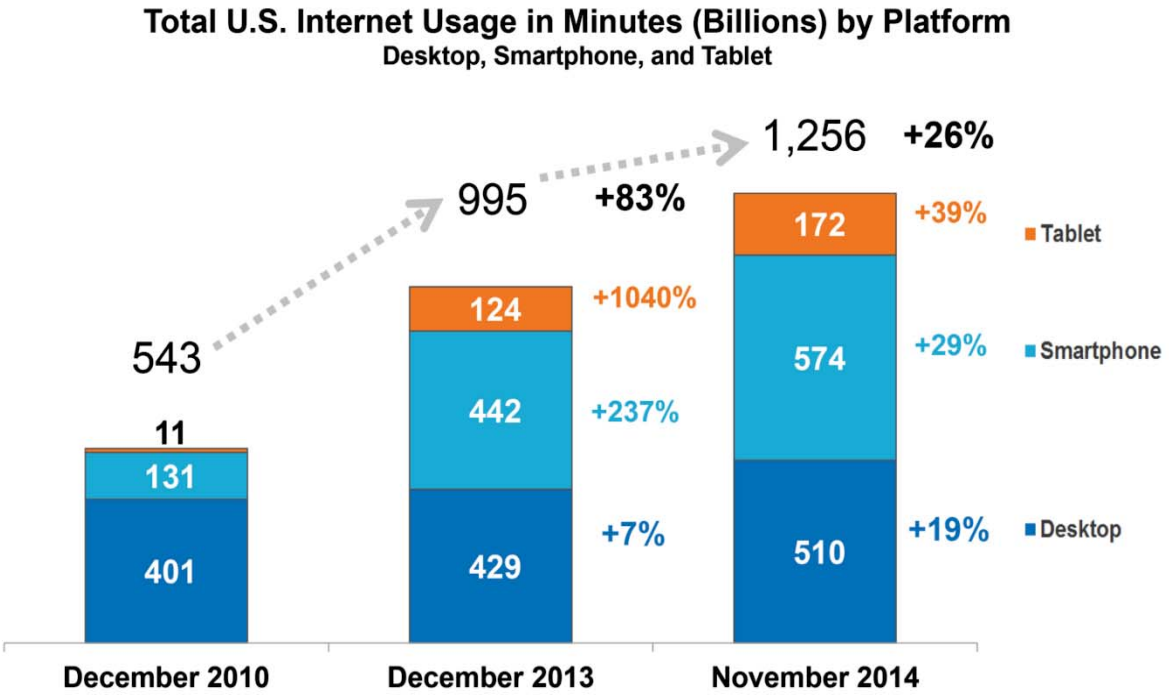
For instance, in 2008, just 13.1 percent of the wireless subscriber market accessed news or information via their devices.[27] Today, 99.5 percent use mobile devices for that purpose.[28] Just 6.7 percent listened to music on their mobile phones in 2008. Today, that figure is nearly 50 percent.[29]

Here too, the U.S. leads the world: "Americans use their mobile devices to watch videos and TV, as well as make video calls, more often than mobile users in any other country."[30]

Mobile Video. More than anything, however, these mobile data consumption patterns are heavily influenced by the widespread and growing viewing of mobile video offerings, which accounted for 60 percent of all mobile data traffic at the end of 2014.[31]

Data consumption attributable to mobile video grew over 3,700 percent from 2009 to 2014, and it is projected to grow nearly *nine times* above 2014 levels.[32]

YouTube now reaches more of the 18-49 year-old demographic – on just mobile devices – than any cable television network.[33] Mobile device viewing grew from less than 30 minutes a day in 2010 to 2.8 hours a day in 2015.[34]

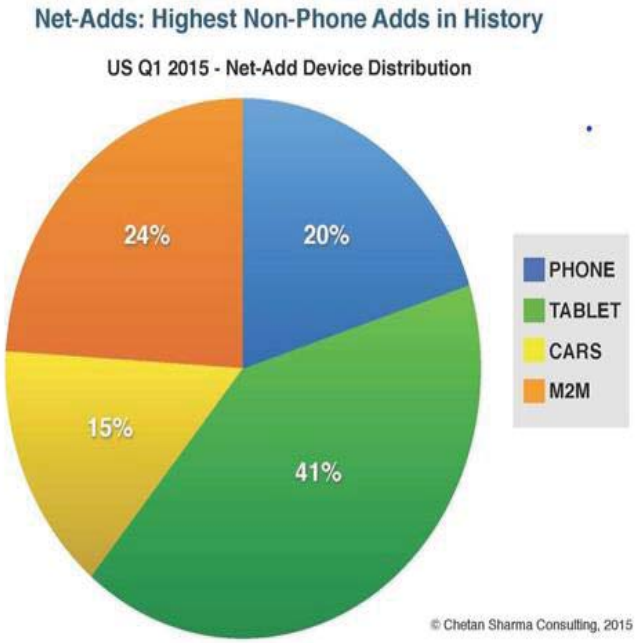


Gian Fulgoni, comScore, Inc., *A Digital Update by the Numbers* (2015). Data from comScore Media Metrix Multi-Platform, Dec13 and Nov14.

Furthermore, with every network evolution, from 2G to 3G to 4G, the proportion of video traffic increased. Today's LTE networks see five times as much mobile video traffic as 3G.[35]

The Connected Life. The mobile experience is also now far more than a smartphone. Wireless connectivity is enabling the rapidly emerging Internet of Things market that includes home security and automation, smart metering in utilities, and connected cars, to name a few.

Net-adds of devices in the verticals market doubled phone net-adds during the first quarter of this year.[36]



Globally, M2M connections alone grew at a 38 percent Compound Annual Growth Rate between 2010 and 2013.[37]

Mobile Apps. The apps economy has been a bright spot for the U.S. economy, and exemplifies the power of wireless to create an entirely new industry in just a few years.

U.S. app-related jobs went from virtually none in 2007 to over 750,000 in 2013.[38] The number of apps continues to surge, from 800,000 apps in 2010 to 5.6 million in 2014 – a 607 percent increase.

Furthermore, as devices and networks improve, apps are developed to leverage that innovation, driving more mobile data use. For instance, users of WhatsApp – which was not even created until 2009 – sent 100 million video messages per day last year.[39]

By all accounts, the past five years saw extraordinary growth in apps and device adoption and use, and these seismic changes prompt an exciting – and unknowable – question: "Can you imagine what the next five years will be like?"[40]

The only thing we can be sure of is continued innovation and significant growth in mobile data traffic volumes.

NEW FORECASTS SHOW MUCH MORE SPECTRUM IS NEEDED.

By 2019, mobile data traffic will be nearly six times 2014's traffic.

The following chart projects mobile data traffic demand through 2019 using Cisco and Ericsson forecasts.[41] This chart retains the FCC's green line projection through 2014, and adds a blue line that reflects an

average of the Ericsson and Cisco projections for 2015-2019.

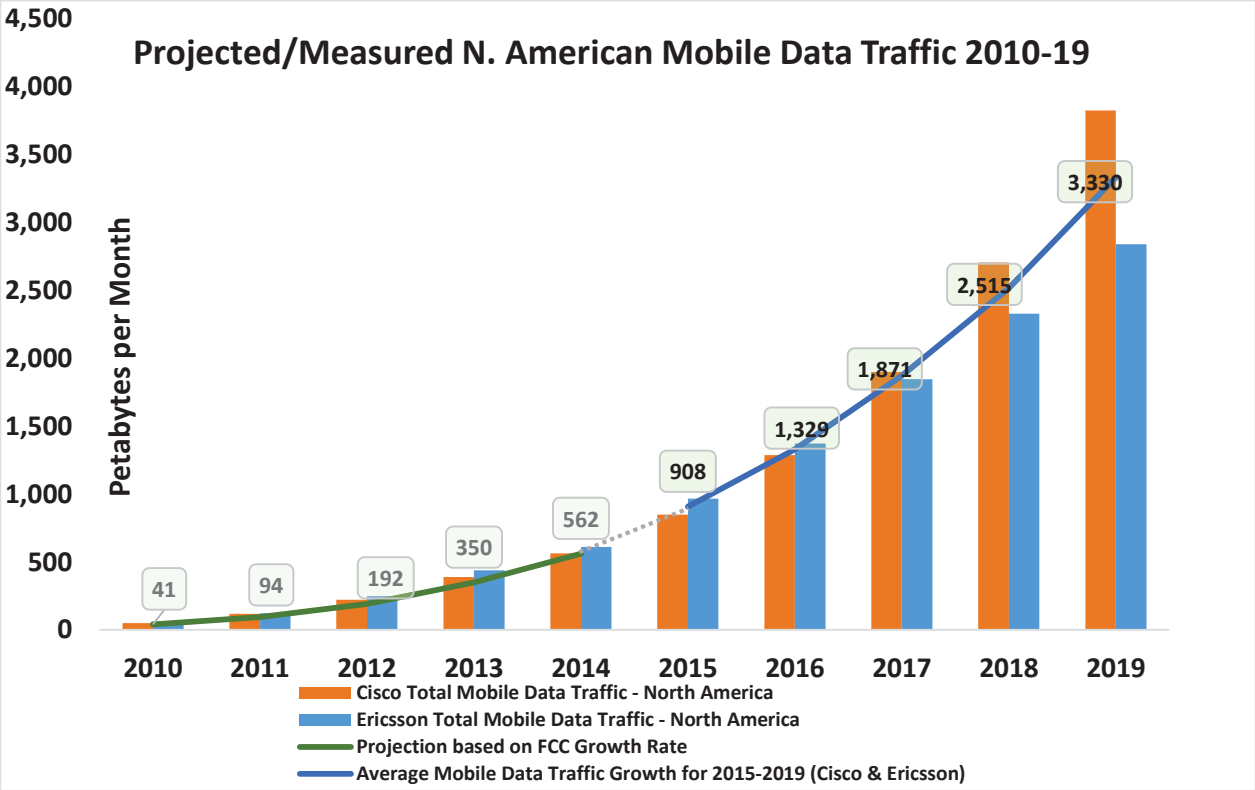
Ericsson projects traffic in 2019 will be five times the traffic in 2014,[42] while Cisco projects traffic in 2019 will be seven times the traffic in 2014.[43] Averaging the two indicates that traffic in 2019 will be about six times higher than the traffic in 2014. The growth drivers are clear: more users, more mobile connections, and more data-intensive services and apps. By 2019, mobile users in the U.S. are projected to increase by 21 million and mobile connections will surge by over 600 million.[44]

Dramatic changes in the marketplace will also drive mobile data consumption. For one, there will be twice as many M2M devices in the U.S. market than smartphones by 2019.[45] By the end of 2020, M2M connections are projected to represent 27 percent of total mobile connections in North America, up from 10.5 percent in mid-2014.[46]

We can't build our way out – these projections confirm more licensed spectrum is needed.

These projections are reminiscent of the growth curve expected in 2010 (and then realized, as discussed earlier). While mobile data traffic in 2019 is projected to be six times what it was last year, we will not have six times the spectrum available to support that traffic – even with AWS-3 and spectrum made available through the incentive auction.

There are three core ways to increase capacity: more cell sites, improved spectral efficiency, and more spectrum. Operators will continue to deploy new cells, including small cells, and will continue to upgrade networks to state-of-the-art 4G LTE technology to take advantage of improved spectral efficiency, but that is not enough.



The U.S. cannot simply engineer its way out of this spectrum deficit.

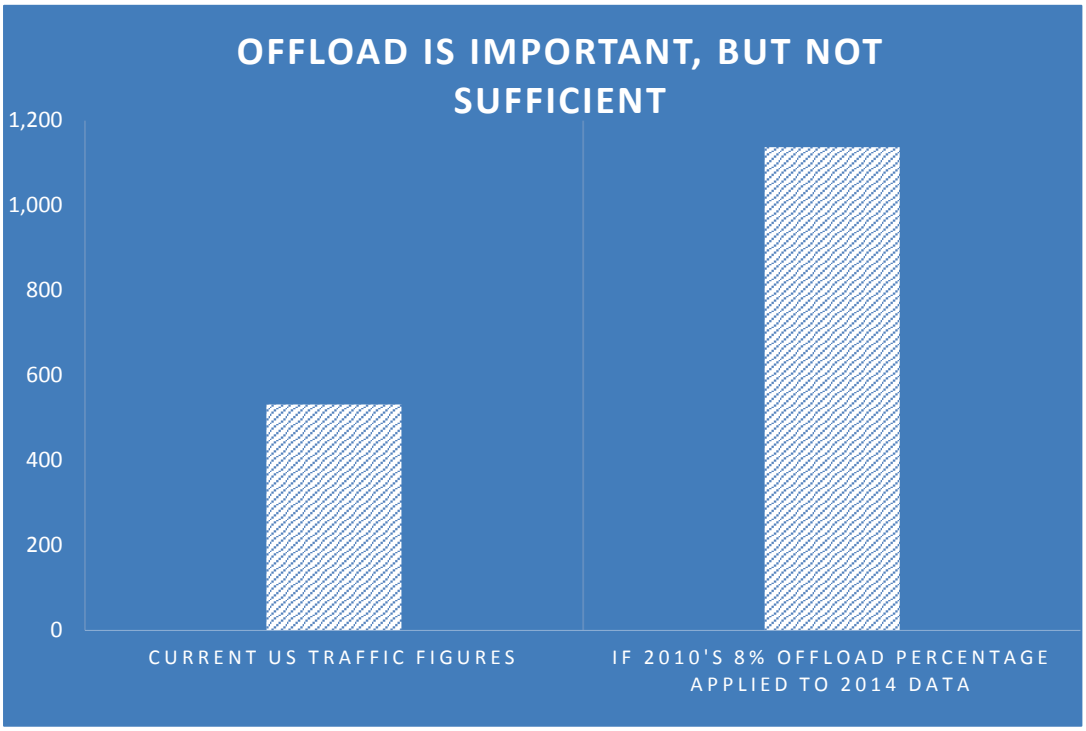
Offloading mobile data to Wi-Fi or another technology on unlicensed spectrum is an important network response to the ever-growing traffic levels on mobile networks. However, off-loading is not a solution that will obviate the need for more licensed spectrum.

Last year, 57 percent of U.S. mobile data traffic was offloaded – up from just 8 percent in 2010.[47] That is critical – because if only 8 percent of 2014's mobile traffic was offloaded, wireless network data would have more than doubled, to 1,138 PBs last year.

Nor is spectrum sharing a stand-alone solution. While new technologies may increasingly allow for more flexible sharing arrangements than traditional geographic and temporal sharing techniques, these options cannot take the place of licensed spectrum and must be proven to be viable before large scale deployments. To continue the U.S. wireless success story, more licensed cleared spectrum is critical.

WITH NO SPECTRUM IN THE PIPELINE AFTER THE INCENTIVE AUCTION, THE TIME TO ACT IS NOW.

To the credit of the FCC, NTIA, and other stakeholders, the government made more licensed spectrum available for the provision of mobile wireless services since 2010. This includes 135 MHz to date: 65 MHz of AWS-3 spectrum and 10 MHz of H-Block spectrum made available by auction; 20 MHz of WCS spectrum following the adoption of new interference rules; and 40 MHz of MSS spectrum repurposed as AWS-4.[48]



That 135 MHz is still less than half the amount – 300 MHz – that the National Broadband Plan said was needed for 2015. As a nation, we still have a long way to go to satisfy currently projected demand. The challenge is heightened because after the upcoming broadcast incentive auction, there is no meaningful spectrum in the pipeline for future auctions.

> **"Policymakers need to identify hundreds of MHz of additional licensed spectrum so America remains the global leader in all things mobile."**
>
> **– CTIA President and CEO Meredith Attwell Baker**

Now that prior demand projections have borne out, and future estimates show demand in 2019 will be nearly six times what it was just last year, we must renew the effort to bring more licensed spectrum to market.

CTIA and its members stand ready to work with government partners and other stakeholders to build on our mutual history of collaboration to identify more licensed spectrum and ensure that the U.S. remains the world leader in mobile.

CONCLUSION

This report demonstrates that prior mobile data projections were accurate and that the National Broadband Plan's call for 300 MHz within five years rested on a solid analytical foundation.

[1] *See* FCC, *Connecting America: The National Broadband Plan*, at 75, 84 (Mar. 2010) ("NBP"); *see* FCC, *Mobile Broadband: The Benefits of Additional Spectrum, FCC Staff Technical Paper*, at 2, 9 (Oct. 2010) ("FCC TECHNICAL PAPER"), https://transition.fcc.gov/national-broadband-plan/mobile-broadband-paper.pdf.

[2] NBP at 75, 84.

[3] Based on the CISCO VISUAL NETWORKING INDEX: GLOBAL MOBILE DATA TRAFFIC FORECAST UPDATE 2009-2014 report used in the FCC's original forecast calculations, and Cisco's February 2015 update. The U.S. accounts for 95 percent of North American traffic.

[4] CTIA, Annual Wireless Industry Survey (June 2015). Note that participation in CTIA's annual survey is voluntary and thus does not yield a 100 percent response rate from all service providers. No company can be compelled to participate, and otherwise participating companies can choose not to respond to specific questions. While the survey captures data from carriers serving a significant percentage of wireless subscribers, the results reflect a sample of the total wireless industry, and does not purport to capture nor reflect all wireless providers' traffic metrics. CTIA does not adjust the reported traffic figures to account for non-responses.

[5] *See* NBP at 75, 84-85. The FCC later issued an expanded report on mobile traffic demand forecast in support of the plan. *See* FCC TECHNICAL PAPER.

[6] *See* NBP at 76.

[7] *See* CISCO, CISCO VISUAL NETWORKING INDEX: GLOBAL MOBILE DATA TRAFFIC FORECAST UPDATE 2014–2019, App. A, Tbl. 6 (Feb. 3, 2015) ("CISCO 2015 FORECAST"), http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white_paper_c11-520862.pdf.

[8] *See*, *e.g.*, Onyeije Consulting, *Solving the Capacity Crunch*, at 23 (Apr. 2011) ("Onyeije paper") (attached to the Reply Comments of The National Association of Broadcasters and The Association for Maximum Service Television, Inc., ET Docket No. 10-235 (Apr. 25, 2011) ("[T]he impending 'spectrum crisis' is not real."); *Id.* at 2 ("The amount of spectrum that mobile carriers claim to require is little more than a wish list"). Recently, two authors resurrected such claims in a criticism of past mobile data projections. Aalok Mehta & J. Armand Musey, CFA, JD/MBA, *Overestimating Wireless Demand: Policy and Investment Implications of Upward Bias in Mobile Data Forecasts*, 23 COMMLAW CONSPECTUS 300 (2015) ("It is now taken almost as a matter of faith among telecommunications professionals that there is a 'spectrum crunch' precipitated by ever-growing demand for mobile broadband. … [This paper] suggests additional caution and scrutiny are warranted for long-term spectrum policy decisions, rather than a blind faith about ever-increasing mobile data demand."). This attempt to downplay the need for additional licensed spectrum does not withstand scrutiny, ignores the significant capital investment made by wireless providers in both infrastructure and spectrum, impugns the motives of entities making mobile traffic projections, and dismisses the wireless industry's degree of innovation across the ecosystem.

[9] *See* Onyeije paper at 4.

[10] FCC TECHNICAL PAPER at 22.

[11] Rysavy Research, LLC, *Mobile Broadband Spectrum Demand*, at 24 (Dec. 2008) (attached to Letter from CTIA to Julius Genachowski, *et al.*, Chairman, FCC, GN Docket No. 09-51 (Sept. 29, 2009)).

[12] *Policies Regarding Mobile Spectrum Holdings*, Report and Order, 29 FCC Rcd 6133, 6146 ¶ 23 (2014).

[13] *See* Jerry Dischler, *Building for the Next Moment*, Google Inside AdWords (May 5, 2015), http://adwords.blogspot.com/2015/05/building-for-next-moment.html.

[14] *See* CISCO 2015 FORECAST (profiling bandwidth consumption).

[15] Remarks of Gigi B. Sohn, Counselor to FCC Chairman Wheeler, *Moving Towards a Gigabit State* (May 4, 2015), http://transition.fcc.gov/Daily_Releases/Daily_Business/2015/db0505/DOC-333311A1.pdf.

[16] Verizon launched LTE service in 35 markets on Dec. 5, 2010. *See* Paul Macchia, Verizon Wireless, Verizon

Wireless Celebrates Three Years (and Counting) of 4G LTE (Dec. 5, 2013), http://www.verizonwireless.com/news/article/2013/12/verizon-wireless-4g-lte-three-year-anniversary.html. MetroPCS had launched LTE service in Las Vegas on Sept. 21, 2010. *See* Sascha Segan, *MetroPCS Launches First LTE Network in U.S.*, PC Magazine (Sept. 21, 2010), http://www.pcmag.com/article2/0,2817,2368986,00.asp

[17] Press Release, The White House, *FACT SHEET: Next Steps in Delivering Fast, Affordable Broadband* (Mar. 23, 2015), https://www.whitehouse.gov/the-press-office/2015/03/23/fact-sheet-next-steps-delivering-fast-affordable-broadband.

[18] Press Release, 4G Americas, *Year-End 2014: Nearly Half a Billion LTE Connections Worldwide: 4G Americas reports substantial gains for LTE in North America* (Mar. 11, 2015), http://www.4gamericas.org/en/newsroom/-press-releases/year-end-2014-nearly-half-billion-lte-connections-worldwide/.

[19] CTIA, Mobile Usage Continues to Increase + Projections Say Rocketing Demand = More Spectrum Required (Feb. 6, 2015), http://blog.ctia.org/2015/02/06/mobile-usage-more-spectrum-required/.

[20] Cisco, VNI Mobile Forecast Highlights, 2014-2019 (United States – Accelerating Network Speed – By Network Connection Type), http://www.cisco.com/assets/sol/sp/vni/forecast_highlights_mobile/index.html#~Country (last visited May 29, 2015).

[21] Andrew Burger, *Mobidia: LTE Subscribers Consuming Twice as Much Cellular Data as 3G Subscribers*, Telecompetitor (Nov. 18, 2014), http://www.telecompetitor.com/mobidia-lte-subscribers-consuming-twice-much-cellular-data-3g-subscribers/.

[22] Roger Entner, *Spectrum Fuels Speed and Prosperity*, at 3, 7, Recon Analytics LLC (Sept. 2014) ("2014 Recon Analytics"), http://recon-analytics.com/-wp-content/uploads/2014/09/Spectrum-Fuels-Speed-and-Prosperity.pdf.

[23] Olga Kharif, *The U.S. Closes the Mobile Innovation Gap*, Bloomberg (Sept. 9, 2008), http://www.bloomberg.com/bw/stories/2008-09-09/the-u-dot-s-dot-closes-the-mobile-innovation-gapbusinessweek-business-news-stock-market-and-financial-advice.

[24] CISCO 2015 FORECAST.

[25] Adam Lella & Andrew Lipsman, *2015 U.S. Digital Future in Focus*, at 4, comScore (Mar. 26, 2015).

[26] Gian Fulgoni, *The State of Mobile*, at 6, comScore (Sept. 17, 2014).

[27] CTIA, *Wireless Crisis Foretold: The Gathering Spectrum Storm…and Looming Spectrum Drought* (Sept. 2009), http://files.ctia.org/pdf/filings/2009_09_29_Spectrum_Demand._FINAL.pdf (citing Lehman Brothers Equity Research, *Mobile Data: The Engine Behind Wireless* (April 2008)) (attached to Letter from Christopher Guttman-McCabe, Vice President, Regulatory Affairs, CTIA – The Wireless Association®, to Julius Genachowski, *et al.*, Chairman, FCC, GN Docket No. 09-51 (Sept. 29, 2009)).

[28] Rebecca Murtagh, *Mobile Now Exceeds PC: The Biggest Shift Since the Internet Began*, Search Engine Watch (July 8, 2014), http://searchenginewatch.com/sew/opinion/2353616/mobile-now-exceeds-pc-the-biggest-shift-since-the-internet-began#.

[29] *Id.*

[30] 2014 Recon Analytics at 15.

[31] Cisco, VNI Mobile Forecast Highlights, 2014-2019 (United States – Mobile Applications), http://www.cisco.com/assets/sol/sp/vni/forecast_highlights_mobile/index.html#~Country (last visited May 29, 2015).

[32] *Id.*

[33] Nic Christensen, *YouTube says it now has bigger 18-48 audience on mobile alone than US cable TV networks*, mUmBRELLA (May 1, 2015), http://mumbrella.com.au/youtube-says-it-now-has-bigger-18-48-audience-on-mobile-alone-than-us-cable-tv-networks-290819. .

[34] Mary Meeker, *Internet Trends 2015 – Code Conference* at 24 (May 27, 2015), http://kpcbweb2.s3.amazonaws.com/files/90/Internet_Trends_2015.pdf?1432738078.

[35] Citrix, *Citrix Mobile Analytics Report* at 21 (September 2014), https://www.citrix.com/content/dam/citrix/en_us/documents/products-solutions/citrix-mobile-analytics-report-september-2014.pdf.

[36] Chetan Sharma Consulting, *US Mobile Market Update – Q1 2015* (May 18, 2015), http://www.chetansharma.-com/blog/2015/05/18/us-mobile-market-update-q1-2015/.

[37] PRNewswire, *GSMA Predicts 250 Million M2M Connections in 2014: New Study Points to Strong Growth in M2M Sector as 'Connected Living' Comes of Age* (Feb. 17, 2014), http://www.prnewswire.com/news-releases/gsma-predicts-250-million-m2m-connections-in-2014-245788631.html.

[38] Michael Mandel, *752,000 App Economy Jobs on the 5th Anniversary of the App Store*, Progressive Policy Institute (July 8, 2013), http://www.progressivepolicy.org/slider/752000-app-economy-jobs-on-the-5th-anniversary-of-the-app-store/.

[39] Mary Meeker, *Internet Trends 2014 – Code Conference*, at 64 (May 28, 2014), http://kpcbweb2.s3.amazon-aws.com/files/85/Internet_Trends_2014_vFINAL_-_05_28_14-_PDF.pdf?1401286773.

[40] *See* Chetan Sharma Consulting, *2015 Mobile Industry Predictions Survey*, at 2 (Jan. 2015), http://www.slide-share.net/fullscreen/chetansharma/2015-mobile-industrypredictionssurvey/1.

[41] Coda Research and The Yankee Group have not made projections for 2015-2019.

[42] *See* Ericsson, *North America Ericsson Mobility Report Appendix*, at 5 (Nov. 2014), http://www.ericsson.com/res/-docs/2014/emr-november2014-regional-appendices-rnam.pdf; Ericsson, Traffic Exploration Tool, http://www.eric-sson.com/TET/trafficView/loadBasicEditor.ericsson (last visited May 29, 2015).

[43] *See* CISCO 2015 FORECAST at 36 (App. A, Tbl. 6).

[44] Dr. Robert Pepper, *Cisco Visual Networking Index (VNI) Forecast: Mobile Data Traffic Update, 2014-2019 (Focus on U.S.)*, Cisco (Feb. 21, 2015).

[45] *See* CISCO 2015 FORECAST.

[46] Press Release, GSMA, *New GSMA Study Highlights Major M2M Market Opportunity* (Sept. 22, 2014), http://-www.gsma.com/newsroom/press-release/gsma-study-highlights-major-m2m-market-opp/.

[47] *Cf*. Cisco, VNI Mobile Forecast Highlights, 2014 – 2019 (United States – Device Growth/Traffic Profiles) *and* Cisco, VNI Mobile Forecast Highlights, 2010 – 2015 (United States – Device Growth/Traffic Profiles).

[48] While the FCC recently took steps to make 150 MHz of spectrum in the 3.5 GHz band available to support mobile broadband, much of that spectrum is available for non-exclusive, authorized-by-rule use. Up to 70 MHz will be available for a novel, Priority Access License scheme, but such shorter term licenses are unlikely to invite investment in permanent infrastructure, and the associated technical requirements may discourage high power 4G deployment, preventing the full use of this spectrum to meet rising demand. Moreover, the Further Notice seeks comment on opportunistic use of that spectrum, raising further questions whether the 3.5 GHz band will provide the certainty of licensed spectrum necessary to be included in the count. *See Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Report and Order and Second Further Notice of Proposed Rulemaking, 30 FCC Rcd 3959, 4081-85 ¶¶ 419-30 (2015).