Testimony of Mary Brown

CISCO SYSTEMS, INC.

Before the

Subcommittee on Technology and Innovation

Committee on Science, Space, and Technology

U.S. House of Representatives

Hearing on "Avoiding the Spectrum Crunch: Growing the Wireless Economy through Innovation"

April 18, 2012 2 p.m.

Rayburn House Office Building – Room 2318

Summary

The explosive growth in the wireless economy is a global phenomenon. The U.S. technology sector has led that mobile broadband revolution. The U.S. is where global technology companies come to develop mobile broadband technologies, where the mobile app industry took root, where innovation is happening, and where thousands of new jobs are being created. Innovation in the private sector occurs when there is a market for entrepreneurs and innovators to sell their inventions. Spectrum tailored for use by mobile broadband networks is a necessary ingredient in the creation of that market. Without the market opportunity presented by additional radio spectrum for broadband, our country's technology leadership could stagnate and huge economic and social benefits may not be fully realized.

Cisco's US mobile data forecast projects that mobile data traffic will increase 16 times from 2011 to 2016 for a compound annual growth rate of 74 percent. If those numbers are too large to comprehend, then think of it this way -- the increment of growth in mobile data traffic from 2012 to 2013 will be twice as large as all the traffic that was carried on US mobile networks in 2011. Consumers will use more data, transmit and consume much more video of all types, operate more devices per capita, and utilize much more powerful devices than available today.

Even taking into account all types of technology efficiencies, from the introduction of LTE networks, to adding additional cell sites, to the creation of small cells to offload traffic more quickly to wired networks, antenna technologies, and improved network management technologies, it will not be enough. More spectrum is needed, and needed soon. Congress, the FCC, and the NTIA are already at work to find more spectrum, but much more work remains to be done. It's important that the Congress understand the dynamic growth occurring in this industry, and why public policy is critical to that growth. This Committee provides an excellent platform for making these connections more obvious to all.

Testimony

Good afternoon, Chairman Quayle and Ranking Member Edwards. Thank you for the opportunity to talk with you about the dynamic changes Cisco is seeing in the wireless economy.

Cisco is a San Jose based manufacturer of broadband networking equipment and services used by service providers, enterprises and consumers worldwide. Among other things, we produce advanced networking technologies used by mobile operators and are the largest manufacturer of Wi-Fi devices in the world. Cisco spends $5.8 billion per year on research and development, which is 13 percent of our revenue. Cisco ranks eighth among U.S. companies in number of U.S. patents issued in 2011, with total of 8,600 US patents. Globally, Cisco earns $43 billion in revenue, employs 63,000 people, and has relationships with 52,000 partner companies who implement Cisco technologies in their customer networks. From this description, you can see that Cisco's success is tied to innovation.

The explosive growth in the wireless economy is a global phenomenon. The U.S. technology sector has led that mobile broadband revolution. The U.S. is where global technology companies come to develop mobile broadband technologies. This is where the mobile app industry took root. This is where innovation is happening. It's creating thousands of new jobs fueled by access to spectrum. As this committee knows better than most, innovation in the private sector occurs when there is a market for entrepreneurs and innovators to sell their inventions. Spectrum tailored for use by mobile broadband networks is a necessary ingredient in the creation of that market. Without the market opportunity presented by additional radio spectrum for broadband, our country's technology leadership could stagnate and huge economic and social benefits may not be fully realized; without radio spectrum, the economic activity and investment in wireless broadband will gravitate to other regions of the world that are making spectrum available, such as the European Union and the AsiaPac rim.

Understanding this story – and the role of a critical government-controlled input such as spectrum to the development of a vibrant wireless economy – is important. This hearing, and other activities sponsored by this Committee, are necessary in order to educate Congress about the vital role policy-makers play in fostering not just research and development or innovation, but jobs and global technology leadership.

Today's topic is the spectrum crunch. "Crunch" is a term intended to convey a shortage or scarcity of spectrum where demand exceeds supply. More poetically, "crunch" could also be the sound of your teeth gnashing when a call drops, your connection fails, the Internet fails to launch from your mobile device, or you can't send that important email. Cisco, as a technology vendor, sees evidence of the spectrum crunch all around us – from our analysis of traffic data and consumer usage, to the technologies our service provider customers are asking us to develop, to the activity we observe in the spectrum market.

This testimony discusses several topics related to the spectrum crunch: (1) Cisco's projections of mobile data traffic growth through 2016 demonstrating that we are very early in the transition to mobile broadband; (2) how consumers will experience the crunch; (3) the need for more spectrum; and (4) progress toward finding more spectrum. If more spectrum is not put into the hands of commercial operators quickly, then dropped calls, slower downloads, failed applications and more, will be a very common experience for consumers. According to the FCC, the first wave of these impacts could come as early as next year.

Because Cisco has to anticipate the networking needs of our service provider customers, including our wireless customers, Cisco invests heavily in understanding current traffic trends and projecting those trends forward. A few years ago, we decided to formalize this activity in the form of a publicly released

report we call the "Visual Networking Index" which is available to you and your staffs at

www.cisco.com/go/vni

Each February, we have been publishing a "Global Mobile VNI" tracking mobile broadband traffic worldwide and in individual countries such as the US. The results indicate that we are at an important pivot point in the wireless economy – we are early in the transition from mobile technology that supported voice and email to new broadband technologies that provide the full Internet experience from the palm of your hand. And as with any new technology, consumer usage is growing at an astonishing rate.

Our US mobile data forecast projects that the volume of data traffic on mobile service provider networks will increase 16 times from 2011 to 2016. That statistic represents a compound annual growth rate of 74 percent. That's just a stunning growth rate. Here are several ways to try to grasp the significance of this growth.

- U.S. mobile data traffic will grow at a rate that is four times faster than U.S. fixed IP traffic from 2011 to 2016.
- The increment of growth in mobile data traffic from 2012 to 2013 will be twice as large as all the traffic that was carried on US mobile networks in 2011.
- By 2015, the pace of growth has gathered even more steam – just the increment of traffic growth between 2015 and 2016 is projected to be five times all of the traffic carried on US mobile networks in 2011.
- By 2016, mobile data traffic will be equivalent to four times the volume of the entire U.S. Internet in 2005.

What is causing mobile data demand to rise so steeply? Cisco has identified four big trends.

First, consumers are receiving, and transmitting, more mobile data. In 2011, 4 percent of users were generating more than one gigabyte of mobile data per month. By 2016, 74 percent of users will be generating that much data each month. The average user in 2011 used 324 megabits of data a month. Roughly speaking, that's the equivalent of downloading 160 songs or 32 apps or 2 videos. In 2016, the average user will be consuming 4.2 gigabits a month or roughly 25 videos.

Second, the data that those consumers are going to be consuming will mainly consist of video in many forms – from YouTube, to video embedded in advertisements, to long form programming, and video "calls" which will become more frequent than they are today. Mobile video traffic will nearly double every year between 2011 and 2016, and by 2016, over two thirds (68%) of mobile traffic in the US will be video.

Third, more consumers are going to mimic the behavior of many of you on this committee, by owning and using more than one mobile device per person. In 2011, 8% of US subscribers used multiple mobile devices. By 2016, that number advances to 25% of subscribers. In addition, to multiple devices per person, mobile broadband will also support machine to machine connections – connecting not just people, but things. These machine to machine connections will be deployed into a wide variety of sectors – from energy supporting smart home energy meters as well as transmission and distribution networks, public safety supporting sensor networks and mobile video imaging, to healthcare such as home healthcare services. When we look at the total number of mobile connections that will be supported by operator networks, by 2016 there will be 726 million mobile connections for 348 million people in the US.

Fourth, the mobile devices themselves are changing, and driving new traffic demands on networks. Let me caution you that the changes in this part of our analysis remain highly dynamic and difficult to predict. Two years ago, Cisco did not even consider tablets to be a device category, and yet today these

devices are too popular to be ignored. By 2016, the amount of annual U.S. mobile data traffic generated by tablets (145 petabytes) will be nearly one and a half times more than all U.S. mobile data traffic generated in 2011 (100 petabytes). Smartphones are having a huge impact as well, and by 2013 will become the most dominant device type responsible for mobile data traffic. Dominance of the smartphone as a device category continues to multiply through 2016, according to our projections. Moreover, all of these devices, regardless of category, become more powerful, placing new demands on networks. The average smartphone today uses about 200 megabits of traffic per month. By 2016, the device manufacturers will be selling smartphones that we project will generate 4,520 megabits per month. They will be smarter, faster, more fun, and there will be many more things that consumers do with their smartphones than we do today.

How good are these data points? As good as they were on the day in February when we released our most recent study. What Cisco has produced is a snapshot of a highly dynamic, fast growing market. That's why each year we update our data and learn new things. Our study relies on actual traffic data measurements from carrier networks, analyst reports and our own modeling. Since we began releasing the report, we have found that our projections of the current year have been accurate and slightly conservative – we underestimate what actually happened by a few percentage points.

With numbers as breathtaking as the ones Cisco is projecting, one logical question is – are we going to run out of spectrum? And what does that look like to the consumer? The answer is that the spectrum crunch will evidence itself differently by carrier (depending upon the spectrum licensed to that carrier and the technologies the carrier is using) and by geography. We can expect that in places like New York and San Francisco, where millions of consumers are competing for radio spectrum each time they use their devices, that once their carrier has released all available spectrum into that market, and the spectrum in use becomes congested, then consumers will experience the spectrum crunch in a broad

way. This is already happening in a few major cities during rush hours for some carriers. Quality of service suffers – e.g., dropped calls and connections, inability to access the Internet, failure of a favorite app to load, and inability to send email. You probably have already had an experience like this – especially in places where there are many users trying to connect to the network simultaneously like at a ballgame or in a large traffic jam.

The Federal Communications Commission (FCC) staff, using Cisco's VNI data, projected in the fall of 2010 that the US needed to find 275 MHz of radio spectrum for broadband in five years to keep pace with the rising traffic demand. In their earlier-released National Broadband Report, the FCC estimated they would need 500 MHz of spectrum for broadband in 10 years (2020). The Administration embraced the 500 MHz goal in a Presidential Memorandum in 2010, directing the National Telecommunications and Information Administration to assist the FCC in finding 500 MHz of spectrum, including by identifying federal spectrum uses that could be moved to make way for commercial mobile use.

Progress is being made toward finding additional spectrum. Congress led the way with adoption of HR 3630 earlier this year, creating for the first time voluntary incentive auction authority that will allow the FCC to repurpose part of the television broadcast spectrum for mobile broadband. The bill also extended the FCC's regular auction authority and made important improvements to the Commercial Spectrum Enhancement Act governing the transition of federal spectrum to commercial use. Congress now needs to ensure that the FCC follows through on its grant of auction authority by conducting the voluntary incentive auction for broadcast spectrum as soon as possible. It will take several years for the FCC to complete its work. How much spectrum is actually cleared through this effort is unknown, but we do know that the best case scenario would clear 120 MHz, thus leaving us significantly short of the needed 500 MHz identified by the FCC and the Administration.

The NTIA is also continuing its efforts to identify federal spectrum that can be repurposed to commercial use. NTIA just released its report on the 1755-1850 MHz band, evaluating the cost and challenges of relocating federal uses of that band to other bands. This 95 MHz of spectrum is of great interest because globally, the band is in use or in transition to mobile broadband. That's important for the technology sector because it means there is a global technology market opportunity. The NTIA report has signaled that relocating federal users will be difficult and expensive, and will take years. From the vantage point of future benefits to the economy, to jobs, and to consumers, we should not shy away from these difficult problems. Clearing as much of this spectrum as possible is an important way to meet consumer demand for mobile broadband and to keep the US at the forefront of technology leadership. We are hopeful that progress can continue to be made on transitioning this band.

In addition, the technology sector, for its part, is hard at work to try to help our service provider customers meet consumer demand until additional spectrum can be placed in service. Many technology companies are creating offerings to forestall congestion, and the service provider industry has been quick to implement them. One of the key innovations that are helping to address the spectrum crunch is offloading data from mobile networks onto Wi-Fi networks or other small cell technologies such as Femto cells. Let's look at an example using Wi-Fi. When a smartphone or tablet switches to a Wi-Fi network for data transmission, the spectrum used is not mobile spectrum, but entirely different radio spectrum known as unlicensed spectrum. When the mobile device you hold in your hand or on your lap communicates to a Wi-Fi router, data is transmitted back to the service provider using wired networks, not mobile wireless ones. Cisco estimates that today, almost half the data traffic generated at the edge of all IP networks is offloaded to Wi-Fi on a global basis. That offloading number will rise over time, but it's important to recognize – Wi-Fi cannot replace mobile spectrum. Wi-Fi is good for connecting your device when you are at home, in the office, at a public park, or a coffee shop, but it is not a useful technology when you are in a cab heading to the airport at 60 miles an hour.

Across the technology industry, there is a broad range of innovations that are rolling out to help carriers cope with a shortage of spectrum. New chipset designs, new base stations and antenna technology, and new network management tools are a few of the offerings designed to wring more efficiency from available spectrum. This is being driven by customer demand – by service providers not just here in the US, but globally, who are experiencing the same problems. The push to deploy Long Term Evolution (LTE) networks (known as "4G") is itself evidence of this trend, as LTE networks are much more efficient in carrying data traffic than prior network technologies. But despite increased efficiencies, the LTE networks currently under construction by AT&T and Verizon Wireless will not be enough by themselves to address rising demand. The carriers have said so, and so did the FCC in its fall 2010 study. Nor will the creation of additional cell sites be sufficient, as the FCC found in its study.

The Federal government is helping too. As part of HR 3630, Congress has directed the NTIA to consider opening more 5 GHz spectrum for unlicensed devices on a shared basis with federal systems. This is important because 5 GHz is the growth band for Wi-Fi technology. More access to shared spectrum here by Wi-Fi devices will help address the spectrum crunch since Wi-Fi is one of the technologies that enables mobile traffic to be offloaded onto fixed Wi-Fi connections. Industry is working very hard to provide technical inputs into NTIA's first report, which is due back to this Congress in October. But this is not a silver bullet answer to the spectrum crunch problem either.

Will our technology improvement efforts be enough? Will the tech sector be able to generate efficiencies so great that additional spectrum is not required? No. Additional spectrum is needed. The growth in demand is simply too large and too sustained. Spectrum must be part of the answer, along with technology improvements. Network infrastructure companies like ours and the carriers themselves have repeatedly argued before Congress and the FCC that additional spectrum must be

found because there is no technology or combination of technology solutions that is likely to be available to manage rising traffic demand using spectrum now available or in the pipeline.

Our nation is the leader in mobile broadband. The wireless revolution spurs the construction of new high speed wireless networks. It drives the manufacturing of chips, routers, network equipment, and mobile devices such as smartphones, laptops, and tablets. It creates business and consumer software, the development of app stores, and substantial growth in electronic commerce.

Mobility has been an important driver of jobs and economic growth, and it has the potential to generate hundreds of thousands more jobs if the federal government acts promptly to ensure that additional spectrum is made available to fuel future mobile broadband growth. It's important that the Congress understand the dynamic growth occurring in this industry, and why public policy is critical to that growth. This Committee provides an excellent platform for making these connections more obvious to all.

Thank you again for the opportunity to appear today. I look forward to your questions.