IIA 2013 BROADBAND GUIDE FOR THE 113TH CONGRESS

An easy-to-understand guide to all things broadband
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SECTION ONE: INTRO

Few American innovations have changed the world more profoundly and positively than the Internet. Originally created as a government research project, the Internet was quickly expanded by private innovators, entrepreneurs, and businesses around the country and, eventually, around the world. Today more than 2.5 billion people are connected to the Internet and have access to information and opportunities that did not exist 20 years ago.

Innovations in broadband technology are not exclusively relegated to the wired world anymore. Today, mobile devices act as general-purpose computers, complete with nearly 1.5 million available apps. Massive amounts of data are necessary to operate these mobile devices, and carriers are struggling to deliver ever-increasing network coverage and speed to meet consumer demand. The future of lightning-fast, mobile communications depends on migrating America’s communications networks away from outdated legacy phone line networks and toward Internet Protocol-based, or IP-based, infrastructure.

The vast majority of network upgrades and day-to-day operation of the Internet are overseen by private businesses, universities and organizations. Yet governments – domestic and international - continue to exert influence over the environment in which the Internet evolves. Over the years, government policy makers have sought to protect, promote and encourage expansion of Internet access and adoption. Many actions by the U.S. government have helped facilitate the build-out of America’s broadband infrastructure. For example, decisions were made to make more government-controlled spectrum available for high-speed commercial broadband services, not to impose monopoly telephone regulations on competitive new IP-based services, and to encourage agencies to use the Internet to connect, serve and inform citizens.

We created this 2013 Broadband Guide for the 113th Congress to provide the next generation of policy makers and leaders with the information they need to make informed decisions about Internet policy. We attempt to provide critical information, define technical terms and answer basic questions about the Internet of today and the networked world of tomorrow. As a bipartisan organization with both for-profit and not-for-profit members, we are committed to offering an unbiased set of facts for consideration.

The Internet Innovation Alliance welcomes feedback and recommendations at info@internetinnovation.org.
SECTION TWO: THE IP (R)EVOLUTION

Since 1958, technology has been transitioning to all-Internet Protocol (IP). Here are some of the big steps along the way.
SECTION THREE: INTERNET PROTOCOL

Communications have changed dramatically over the past two decades. Newer Internet-based technologies are rapidly replacing traditional landlines. Over the past three years, American smartphone adoption has increased from 16.9 percent to 54.9 percent, according to Nielsen.

Millions of Americans are turning to mobile and Internet-based voice communication, such as Voice-over-IP (VoIP). In fact, one out of three American homes now relies on wireless-only technologies, according to the U.S. National Health Interview Survey (NHIS). Three in five (59.6%) 25 to 29-year-olds live in cell-only households, while about half (50.9%) of 30 to 34-year-olds and 18 to 24-year-olds (48.6%) report going without a landline. As a result of this shift, fewer and fewer people are relying on the public switched telephone network (PSTN) – the old, traditional copper line network – for their communications needs.

Cable, fiber-optic and high-speed Ethernet loops are quickly displacing the antiquated, legacy copper networks of traditional phone companies. Copper phone lines cannot handle the speeds and data traffic necessary for exploding IP-based services. The future of lightning-fast, mobile communications depends on America’s ability to successfully migrate its communications networks to all IP. This shift is often referred to as the “IP Transition.”

IP stands for Internet Protocol, but it might as well stand for Internet Progress.

What is IP?
IP is the common language that almost all forms of technology can understand and use to ‘talk’ to each other.

IP allows voice, data and Internet applications to come together on various devices including TVs, phones, laptops, machines and tablets.

Think of Internet Protocol as the next step in progress and innovation that only occur if communications networks are changed over from antiquated copper (based on Time-Division Multiplexing (TDM) technology) to modern IP-based technology.

What is the IP transition?
The IP transition represents the migration of America’s current communications network to modern, high-speed, all-IP networks. It is the future of communications.

Unlike the slower, antiquated legacy wired networks of the past, which were built to handle one-to-one voice communication, new IP-based networks are capable of acting
as a multimedia and multiparty platform, enabling everything from voice and text messages to social networks, video conferencing, online gaming, digital TV, streaming video and more.

IP-based networks (IP infrastructure built on digital technologies) will provide users with not just a variety of choices as to when, how and where they communicate, but with access to much more – including information, entertainment, and opportunities for better health care and education.

IP-based networks and services can unlock a world of opportunity, drive technological innovation, create and sustain new jobs, foster powerful economic growth, and spur immense capital investment so that the United States can continue to lead the world.

What are the benefits of all-IP networks?
Transitioning to high-speed, next-generation IP-based networks will mean progress and substantial benefits for consumers. It will create new opportunities for Americans in everything from health care to education, business, the economy and personal finance.

Health Care
IP-based networks can improve rural health care delivery and access, helping those who live in rural areas. Today, there are 50 million rural Americans who face challenges in accessing health care. Rural Americans often have higher levels of certain chronic diseases, yet have fewer than half the number of primary care physicians compared to consumers living in urban areas, according to HealthReform.gov and UnitedHealth.

IP-based networks are more robust, more dynamic and can support data-rich medical devices and applications including those that would allow doctors immediate access to electronic medical records and computerized prescribing systems across the United States and the globe. Other mobile apps such as ePocrates, an app for finding drug dosages and interactions, and QxCalculate, which allows doctors to create risk profiles for patients, are revolutionizing the medical field. There are many more health care mobile apps designed to improve quality of care such as the technology-enabled electronic stethoscope, which amplifies heart sounds while canceling out ambient noise.

These mobile tools and many others improve data transmission for remote analysis by medical personnel, help increase access to physicians and treatment centers, and provide new tools to monitor patients remotely in both rural and urban areas of the country.
**Education**

IP-based networks can improve education in a variety of ways, including:

**Distance learning:** Education in which students receive instruction from any Internet-connected location, rather than having to physically travel to a school.

**Blended learning:** A method combining online instruction with face-to-face teaching, allowing smaller student-to-teacher ratios in classrooms, higher student engagement, real-time performance scores and access to on-demand learning materials for teachers and students.

Thirty-two states have virtual schools delivering online courses to students in any district in the state, according to Evergreen Consulting. In the United States, 75 percent of school districts offer online courses in K–12 education, and student enrollments are growing at a rapid pace of 30 percent annually, reported the Sloan Consortium.

David Teeter, director of policy for iNACOL, said during an IIA webinar in 2012 on education that, "without sufficient broadband capacity and access, schools and students are out of luck."

**Business/Economy**

Building and expanding IP infrastructure will generate hundreds of thousands of jobs at every stage of the process, from the physical installation of new network infrastructure, to network management, to the thousands of new businesses and jobs that will result from the rapidly-expanding, high-speed IP broadband economy.

Access to IP-enabled networks will also assist those looking for employment by making it easier to find and apply for work online at home or through job kiosks using broadband. Over 80 percent of Fortune 500 companies, from Target to Wal-Mart, require online job applications, as cited by the Federal Communications Commission (FCC).

A 2011 Deloitte study estimates that investment in 4G high-speed mobile broadband networks, which is already underway, will add up to $151 billion in GDP growth over the next four years, creating up to approximately 771,000 new jobs.

http://www.deloitte.com/us/impactof4g
TECH SECTOR JOB FACTS

The U.S. high-tech industry employed nearly 6 million people as of June 2012.

The tech industry added nearly 100,000 jobs from January to June 2012, a 1.7 percent increase.

High-tech manufacturing added U.S. jobs – 9,200 from January to June 2012.

The high-tech services sectors added 90,000 U.S. jobs from January to June 2012, a 1.9 percent increase.

Software services and engineering and tech services added jobs in the first six months of 2012, 50,800 and 49,900, respectively.

How do we migrate America's communications to all-IP networks?
Today America's incumbent telephone companies are required to maintain and operate antiquated copper-based legacy networks. None of their cable, wireless, satellite or non-incumbent competitors face similar obligations and burdens. To transition towards all IP-based network technology, incumbent telephone companies will have to spend hundreds of billions to upgrade and modernize their networks and facilities (e.g., replacing antiquated, copper transmission facilities with modern, high-speed fiber optic cable) to provide consumers and businesses with advanced IP-based services.

What is needed to help the IP transition in America?
In order for consumers to enjoy the speed and bandwidth capacity of IP networks and to take advantage of the programs and services (including education, gaming, entertainment, social media) that require fast and robust data transmission, the United States should encourage the upgrade to a digital, all-Internet Protocol (IP) broadband infrastructure. Current legacy wired networks fail to meet the FCC's definition of broadband, yet outdated laws essentially assume that incumbent telephone companies continue to maintain and operate these slow, antiquated networks, even as incumbents invest and deploy separate IP infrastructure and fewer and fewer consumers rely on the outdated voice-only networks.

Requiring incumbent telephone providers to maintain costly antiquated networks siphons investment away from deployment of advanced, high-speed next-generation IP-based networks that consumers prefer. Reforming antiquated 1930s regulations designed for monopoly providers in a copper-wire, analog era will encourage the private sector investment needed to upgrade non-IP-based facilities with newer and faster broadband infrastructure, creating jobs and growing our economy.

In addition, today’s 4G LTE wireless networks are IP-based, but the spectrum required to fuel consumers’ advanced wireless devices on these networks is becoming severely congested. Releasing more spectrum, the radio waves that carry everything from television to texts to mobile video, is necessary to maintain and improve service quality on wireless networks. The government controls the allocation of spectrum and should reallocate more of it for consumer use in order to sustain the increasing public demand for data and continue the benefits offered by the mobile revolution (see page 15 for more on spectrum).
US HOME BROADBAND ADOPTION BY YEAR

Pew Internet & American Life Project, pewinternet.org, 4/13/12
BROADBAND SPEEDS BY TECHNOLOGY


DIAL-UP ACCESS
- 2400 bps – 56 Kbps
  - On-demand access using a modem and regular telephone line (POT).

ISDN
- 64 Kbps – 128 Kbps
  - Dedicated telephone line and router required.

FRAME RELAY
- 56 Kbps – 1.54 Mbps
  - Provides a type of "party line" connection to the Internet.

T1
- 1.544 Mbps
  - Special lines and equipment (DSU/CSU and router) required.

BROADBAND OVER POWER (BPL)
- 500Kbps – 3Mbps
  - Uses existing electrical infrastructure to deliver broadband speeds using BPL "modems".

SATELLITE
- 6 Mbps or more
  - Latency is a problem with this technology, which makes satellite difficult to use for applications such as video streaming and gaming.

ADSL/DSL
- 128 Kbps – 8 Mbps
  - Uses the digital portion of a regular copper telephone line to transmit and receive information.

CABLE
- 512 Kbps – 20 Mbps
  - Special cable modem and coaxial cable line required. (Bandwidth varies greatly depending on other users and time of day.)

WIRELESS
- 30 Mbps or more
  - Access is gained by connection to a high-speed, cellular-like Local Multipoint Communications System (LMCS) network via wireless transmitter/receiver.

T3
- 44.736 Mbps
  - Typically used for ISP to Internet infrastructure.

4G/LTE
- 100 Mbps
  - Next-generation wireless access (only available in certain areas).

OC-3
- 155.52 Mbps
  - Typically used for large company backbone or Internet backbone.
TECHNET’S 2012 STATE BROADBAND INDEX
Ranking the states in adoption, network quality, and economic structure

Index Value (100=AVERAGE)
SECTION FOUR: COMMON QUESTIONS & ANSWERS

1. What is the origin of the Internet?
The Internet began as a project of the Defense Advanced Research Projects Agency (DARPA) in 1969 to connect networks of computers working on defense-related issues. The National Science Foundation (NSF) carried on computer network development when the DARPA project concluded. In the early to mid-1990s, the Internet transitioned from government ownership to the private sector. Over the next two decades, academic, commercial and government researchers, in a private multi-stakeholder model, developed the protocols for the networks we recognize today as the World Wide Web, or the Internet. Companies invested trillions to build out infrastructure, databases and networks. The first commercial traffic crossed the Internet in 1992, and the use of this network to communicate, entertain, conduct commerce and improve the fields of education, health care and more has grown exponentially ever since. Greater access and increased adoption are driving the United States toward the all IP-based networks capable of delivering the greater speeds and higher data traffic consumers want and need.

2. What is the law that governs telecommunications generally in the United States?
The basic legal framework for telecommunications is the Communications Act of 1934 as amended in 1996. The last time the law was substantially modified was on February 8, 1996, when President Clinton signed the landmark telecommunications reform legislation into law. The 1996 Telecom Act amendments contained several new provisions, including:

- Opening the local telephone market to competition among various providers such as long distance providers, cable companies, and other new entrants.

- Creating a pathway for local phone companies to provide nationwide long distance service.

- Enabling more competition in the local market for cable TV.

- Helping connect all classrooms, libraries, hospitals, and rural areas to the information superhighway.

- Note: the term “Internet,” however, appears just once in the 1996 Telecommunications Act.
3. What are the roles for various bodies - including FCC, Congress and legislators, and regulators at the state level - in regulating communications networks in the U.S.?

Congress established the nation’s telecommunications legal framework, which is detailed in the Communications Act of 1934, as amended in 1996. The 1934 law established the FCC, which performs regulatory and administrative functions with direct oversight from Congress. Over the years, the Courts have interpreted the Communications Act as providing split jurisdiction between federal (interstate) and state (intrastate) services. The FCC has primary federal (interstate) jurisdiction. And state public utility commissions have primary jurisdiction over intrastate services.

4. Who owns the Internet?

No one owns the Internet. The Internet is the network of all the other computer networks around the world that voluntarily connect to each other. The vast majority of these networks are privately-owned, maintained and operated by organizations as big as Wal-Mart, as popular as Google, as prestigious as Harvard University or as small as an individual blogger.

No single ruler, body or government official is “in charge” of the Internet. The institutions that govern the Internet and keep it free and open are, for the most part, decentralized, bottom-up, private sector multi-stakeholder bodies. These include organizations like the Internet Corporation for Assigned Names and Numbers (ICANN), a global non-profit headquartered in California, as well as the Internet Engineering Task Force (IETF) and the Internet Society, which are volunteer public interest groups of dedicated experts. These entities focus on making sure the Internet works safely and effectively while typically avoiding political questions such as privacy regulations, free speech and commercial rules, which might be promulgated by individual countries or governmental organizations.

The physical infrastructure of the Internet is, for the most part, privately-owned and is the result of industry investment that exceeds approximately $1.1 trillion since 1996, as noted by USTelecom. In 2010 alone, industry made nearly $66 billion in Internet-related investments. A large portion of Internet traffic traverses on the networks of facilities-based communications companies such as Verizon, AT&T and Comcast, which provide consumer connections to the Internet. Intercity and international Internet traffic is frequently carried across the backbone facilities of long-haul carriers such as Level 3.
5. What is broadband?
Broadband is higher speed Internet access. The FCC recently defined broadband as data transmission speed of at least 4 megabits per second downstream (from the Internet to the user’s computer) and 1 megabit per second upstream (from the user’s computer to the Internet).

Note: Given the evolving nature of broadband and the changing speeds it provides, the FCC could revisit its broadband definition in the future.

6. What is spectrum and why is it important to American consumers?
Spectrum is the invisible airwaves that carry voice and data signals to and from electronic devices including television, radio, smartphones, tablets and other mobile gadgets. Wireless Internet is increasingly a primary source of information, entertainment, social networking and communication for consumers.

Spectrum is allocated by the federal government, which means that the federal government decides who gets to use spectrum and for what purposes. Currently, approximately 15 percent of available spectrum is allocated for consumer wireless service.
With so many data-intensive apps and high-speed Internet-based services, the strain on carriers’ networks continues to increase, and the limited spectrum available for consumer use is becoming constrained. In order for consumers’ data-heavy smartphones, tablets and other mobile devices to work as intended and to ensure continued access to the aforementioned benefits of wireless Internet, the government should reallocate additional spectrum to meet the needs of consumer wireless communications devices.

Government has three sources of spectrum to free more bandwidth for consumer wireless broadband services. They are:

- Spectrum made available from the FCC’s existing incentive auction process, in which spectrum voluntarily relinquished by certain over-the-air television broadcasters will be repurposed for consumer mobile broadband services and then auctioned to wireless providers.

- Spectrum currently in the hands of federal agencies that is underused or that is being used inefficiently that could be reallocated for consumers and auctioned to commercial wireless providers.

- Spectrum currently licensed to private companies that could be made available to the marketplace through secondary market transactions, in a “willing buyer sells to willing seller” free market business decision, subject to FCC review and approval.

7. What is special access?
Dedicated, copper-based circuits provided by incumbent carriers that connect the various business locations of individual customers or connect a single business location to the network are known as special access circuits. These are aging, antiquated connections. Typical special access examples could include lines that connect some stores of a large retail chain to each other and some lines that connect cellular telephone towers to the cellular company’s mobile switching center. The physical circuits are owned by incumbent telephone companies, and they are required to lease and provide access to these facilities to competitive carriers. Controversy occasionally arises over the lease charges between the incumbent providers who own the lines and the carriers that piggyback on the special access lines to carry their traffic.

8. What is the Universal Service Fund?
The Universal Service Fund is a federal program originally designed to subsidize voice telephone service in high-cost areas, such as hard-to-reach rural communities, and to provide access to low-income consumers. The program traditionally subsidized landline telephone service, but has been expanded to include access to wireless phone service. In 2011, the FCC expanded the program again to include, for the first time,
universal service support to broadband. The goal of universal service — i.e. the availability of basic communications services for the public at “just, reasonable, and affordable rates,” according to the FCC – has been a cornerstone of U.S. communications policy for more than 60 years. The Telecommunications Act as amended in 1996 expanded this goal by requiring that the FCC define universal service, taking into account advances in telecommunications and information technologies.

The goals of universal service, as mandated by the Telecommunications Act, are to:

- Promote the availability of quality services at just, reasonable and affordable rates for all consumers;
- Increase nationwide access to advanced telecommunications services;
- Advance the availability of such services to all consumers, including those in low-income, rural, insular, and high-cost areas at rates that are reasonably comparable to those charged in urban areas;
- Increase access to telecommunications and advanced services in schools, libraries and rural health care facilities; and
- Provide equitable and non-discriminatory contributions from all providers of telecommunications services to the fund supporting universal service programs.

9. How can elected officials ensure consumers have access to advanced, next-generation IP-based broadband?

Private-sector investment is critical to expanding advanced broadband availability, particularly the deployment of these next-generation, high-speed Internet Protocol-based (IP-based) networks. Taxpayers are not asked and should not be required to provide the hundreds of billions of dollars needed to build this high-speed IP-based infrastructure. Elected officials can eliminate unnecessary rules built for a bygone analog monopoly provider era to unleash private capital. In addition they can strive to make permanent the current light-touch regulatory framework on fiber and IP-based technologies. This light-touch regulation has encouraged the massive investment by private sector broadband providers into our country’s communications networks. With the certainty that onerous, investment-hindering regulations will not be imposed in the future, carriers will be encouraged to invest in next-generation, high-speed broadband networks for the benefit of consumers and businesses nationwide.

Policy makers can also advance broadband by identifying and making more spectrum available for broadband providers. One of the fastest ways regulators can help get spectrum to the mobile market for consumer use is by quickly reviewing and approving secondary market transactions that occur when a willing seller of spectrum enters into a business deal with a willing buyer of spectrum who is then able to put it to use for consumers quickly.
SECTION FIVE: A LOOK AHEAD

Perhaps the only reliable rule for predicting technology trends is that we tend to over-estimate changes in the near-term and under-estimate them in the long-term. There is no doubt that broadband is transforming how we work, live, play and learn. Every sector of our economy and every facet of our lives are being remade by real-time, high-speed connectivity. As a result, policy makers and industry leaders should view the future with a unique blend of unbridled optimism and profound humility.

While we know broadband is changing everything, we can never truly predict, “What’s next?” Investors, innovators and entrepreneurs’ efforts to guess the future are just that, guesses. Public policy makers have proven no more successful as predictors, and thus any efforts to force or regulate an unknowable future too often limits competition and misses disruptive innovations on the way.

We once thought ISDN was the vital technology. At the time, Mitch Kapor, founder of Lotus Development Corporation and the Electronic Frontier Foundation, declared, “ISDN is a critical and even necessary transitional technology on the path toward the future broadband national public network.” He was wrong. At other times we have been told that “the” killer technology is, alternatively, DSL, cable modem, third-generation wireless, fiber-to-the-home, or Wi-Fi. At the moment, LTE is the favored high-speed wireless technology. But more changes in technology are yet to come. The next greatest thing may be just around the corner.

At the start of 2013, we are witnessing exciting changes enabled by mobile broadband: an app economy that didn’t even exist five years ago now employs more than 500,000 Americans, according to Economist Michael Mandel; the inexorable shift to the cloud and its more efficient information storage; proliferating creative tools that are transforming consumers’ business and personal lives; rapacious appetite for faster speeds, greater bandwidth opportunity and more capacious storage; overwhelming competition with 90 percent of consumers able to choose from at least five different providers, as reported by the FCC; and accelerating innovation cycles where tomorrow’s technology is invented today. The future of broadband is bright and the benefits to consumers and our nation could be boundless. To realize these benefits we need only to let our innovators innovate, our entrepreneurs compete, and ensure our consumers have the knowledge and freedom to make the most of the technology available to them.
For policy makers trying to understand what makes the Internet work and how they can help, it is important to know the terms used. Engineers too often speak “engineer,” and technologists prefer an arcane language often inaccessible to mere mortals. Below we offer plain English definitions for many of the technical terms often discussed when talking about Internet policy.

3G - The third generation of cellular data networks that enables mobile devices such as smartphones, laptops and tablets to access the Internet and send and receive data at speeds comparable to DSL.

4G - The fourth generation of cellular data networks that provides Internet access at speeds rivaling the fastest wired connections, such as cable modem and fiber-to-the-premises services.

Bandwidth - Transmission capacity of network infrastructure or an electronic communications device.

Bit, Byte, Megabyte, Gigabyte - Units for measuring digital information, or data. 8 Bits = 1 Byte. 1000 Bytes = Megabyte. 1000 Megabytes = Gigabyte.

Broadband - Internet access that is faster to upload and download than traditional dial-up access. Broadband can be accessed through the use of a desktop computer or mobile device. Broadband is currently defined by the FCC as 4 megabits per second uplink and 1 megabit per second downlink.
Cloud computing - Web-based applications and third-party file storage solutions that enable access to files and programs from a variety of devices regardless of the user’s location. Much of computing today relies on software applications and data files that are stored on remote servers, the powerful machines that dish up data over the Internet. The servers are typically housed in large data centers. Web-based e-mail, social networking and online games are all examples of what are increasingly called “cloud services,” and are accessible from desktop computers and mobile devices.

Content provider - The distributor to Internet users of information. E-books, TV programs, music, news and games are common examples of content accessed over the Internet and conveyed to users by content providers.

Digital Divide - A term coined to highlight disparities between those who have access to technology and those who do not.

IP (Internet Protocol) - Internet Protocol is the method by which data is transmitted from one computer, device or machine to another on the public Internet. Each connection on the Internet has at least one IP address that uniquely identifies it from all other devices on the Internet. IP is the common language that virtually all forms of technology can use to understand and communicate. IP technology enables seamless communication of voice, data and Internet applications on wireless and wireline networks and among various devices (TVs, phones, laptops, tablets, vehicles, machines, etc.).

IP infrastructure - IP infrastructure consists of the physical lines, network equipment, facilities and associated software that can communicate and transmit in IP.

Last-mile technology - Any telecommunications technology, such as telephone or cable lines or wireless radio, that carries signals from the central telecommunication facility along the relatively short distance (hence, the “last mile”) to and from the home or business.

Long Term Evolution (LTE) - LTE is the latest (4th) generation of mobile broadband, generally deployed starting in 2012. Download speeds are up to 10 times faster than 3G.

Mobile - Generally refers to Internet access accomplished through the use of a wireless device such as a smartphone, tablet or laptop.

Network - The physical infrastructure, such as cell towers, telephone lines and airwaves (spectrum), that carry voice and data communications.

Network provider - The operator of physical communications infrastructure such as high-capacity transmission and last-mile facilities that carry voice, video and data traffic to residential and business customers.
Next-generation networks - The new generation of IP-based voice and data networks that are replacing the aging, publicly-switched telephone network. Next-generation networks provide multimedia products including VoIP, videoconferencing, instant messaging, email and other services.

Public Switched Telephone Network (PSTN) - The network of lines and switches that initially carried telephone voice traffic among users nationwide and more recently has carried a combination of telephone and some low-speed data traffic. As networks are modernized with IP infrastructure, the PSTN will start to be phased out.

Secondary market spectrum transaction – A business sales agreement between holders of spectrum and those willing to buy the spectrum. These sales require approval by the FCC.

Service provider - The companies that sell voice and data services to home, business and mobile users. Examples of service providers are cell phone carriers, local telephone and cable companies.

Smart networks - A smart network is able to control how data is routed and which end users it reaches. Instead of being passive, a smart network contains built-in diagnostics, management, fault tolerance and other capabilities that keep it running.

Spectrum - The invisible airwaves that carry radio signals, television broadcasts, voice calls and data traffic, including the mobile Internet.

Spectrum crunch - The spectrum shortage now being realized by wireless carriers in major cities where consumer mobile data usage is increasing annually by orders of magnitude; the spectrum needed to carry that data is rapidly becoming constrained.

VoIP - Voice over Internet Protocol (VoIP) is an IP-based application that provides telephone voice service over the Internet.

Wi-Fi - A technology that uses unlicensed spectrum to enable devices (including computers, tablets and smartphones) to connect wirelessly over relatively short distances to existing high-speed Internet connections. Locations with “Wi-Fi” capabilities, including many homes, offices and stores, are typically called “Hot-Spots.”

WiMAX - A type of mobile broadband, also categorized as 4G, with data speeds superior to 3G.

Wireless data - Data transmitted on wireless spectrum to and from our mobile devices. Most activities on our smartphone require wireless data. Emails use small amounts of data; pictures and streaming music use much more; and watching videos uses the most data.