Broadband Gap Analysis

Northern Arizona
Council of Governments

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1 Acknowledgements

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2 Rationale for the Study

The communities covered by NACOG have a long reputation of being one of the more successful, progressive and high growth areas within the State of Arizona. Teri Drew and her team provide the foundation for prosperous businesses and invest heavily in quality and efficient services utilizing the Business Assistance Centers (BOC). NACOG recognizes an adequate infrastructure is necessary for economic development and growth. Infrastructure in the 21st century not only includes water, power, roads and bridges – infrastructure includes the necessary backbone (aka: Better Internet) required to attract and maintain a healthy business climate. Most recently the world business leaders are detailing this same need on an international scale.

In an article published online by IFO Institute for Economic Research University of Munich; published 6June 2011, provides proof that GDP per head showed measurable improvement with the addition of Better Internet aka: Broadband.
http://www.wik.org/fileadmin/Konferenzbeitraege/2011/Fibre_Network/Kretschmer.pdf

"Broadband connectivity for Better Internet (multi-gigabit speeds) is now one of the top three criteria for corporate site selection committees. Fifteen years ago, it was not even on the list of requirements."

For these reasons governments all over the world are conducting a Better Internet style gap analysis to identify issues related to economical broadband access. Solutions should be developed to address each unique Internet infrastructure shortcoming hindering NACOG's development.

Why?

Two reasons: 1) The solution is "Distribution" upgrades. Which by nature must be custom and will require investment. 2) Because everyone agrees it is our economic lifeblood!

Access to broadband services in poorly served locations, particularly in rural areas.

For the purposes of this GAP Analysis, we have used the definition of "broadband and Better Internet" to the standard set forth by the National Telecommunications and Information Administration ("NTIA"), that is, at least 768 Kbps downstream and 200 Kbps upstream.

It is our belief that these lower bounds of capabilities are significantly understated based on the widely anticipated 10 to 50 Mbps to the home and possibly up to 1000 Mbps or more by some accounts. These are the speeds being discussed for such things as distance/at-home learning, remote medical opportunities, First Responders and advanced business applications. Therefore, while we are using the NTIA standard, we recommend that NACOG consider options meet the current needs as measured by ASET and the State Education Leaders.

3 Executive Summary

The data gathered by ORAct,LLC indicate that broadband offerings in the NACOG Region are diverse in capacity and cost, and very spotty in coverage, leaving many residents and businesses without a Better Internet experience option. Our team specifically reviewed three areas outlined in our agreement. Prescott – Prescott Valley to include Chino Valley, Cottonwood – Verde Valley, Pinetop Lakeside and NACOG as a whole.

A map developed during this process shows several "dead zones" (Appendices A-D). In addition to these areas that lack coverage it is important to understand that a number of homes and businesses within the shown wireless coverage areas cannot obtain wireless service because they are blocked by trees or located in a low-lying area which wireless signals cannot reach.

For the purpose of this study we have left Wireless both fixed and mobile out. We have anecdotal evidence to suggest that as many as 25% of the homes within the indicated coverage areas cannot receive an adequate wireless connection. In some areas where DSL is generally available, the quality of the copper cabling to some homes is too poor for DSL to work at published speeds.

Overall, while there are a number of providers, not one of them can (or tries to) claim it can provide service throughout the entire NACOG population centers. Current wireless Internet service providers have been and seem to be continuing on a path of expanding coverage areas and increasing bandwidth (speed), but understandably aren't willing to make guarantees regarding future services.

It has been our experience that many of the larger businesses located in and around NACOG are generally satisfied with available services. This is a result of customization of the service provided at a much higher monthly rate. However, smaller businesses and home-based businesses in more rural areas often have either just one or no broadband Internet service options.

From a regulatory standpoint we are living in a historic time as it relates to rural broadband. The Federal Communications Commission (the "FCC") recently issued a report that recognized that "rural communities have long been unserved or underserved by broadband technology" and that "broadband service in rural America is generally inadequate." The FCC also recognized that deploying "broadband throughout rural America will fundamentally benefit the nation's economy." Thus, the FCC's national broadband goal is to achieve "ubiquitous and affordable broadband for all, regardless of location, socioeconomic status, ethnic background, or any other factor."

In support of that reality, ASET along with legislature and our Governor have taken steps to improve our regulatory environment including passage of SB1402. This Bill will allow providers to use ADOT rights-of-way to place fiber optic cables along roadways. In the very near future we will see our first use of that bill to improve the fiber technology along a major north-south State highway.

Recognizing that there are areas of rural America whose broadband needs are unserved or underserved, Congress through the American Recovery and Reinvestment Act of 2009 (the "Recovery Act"), appropriated $7.2 Billion for broadband grants, loans, and loan guarantees to be administered by the United States Department of Agriculture's Rural Utilities Service (the "RUS") and the Department of Commerce's NTIA. Much of these funds are expected to help with the investments needed to bring broadband to poorly served rural areas of the country. These funds have been placed with the hope that our Broadband deployment will improve.

Connecting rural America with adequate broadband is being compared to the Rural Electrification Act of 1935 and the Federal-Aid Highway Act of 1956, which respectively first helped to bring electric and telephone service to all rural areas of the country and later connected rural areas to urban areas through interstate highways, both of which transformed rural economic and social life. Subject to the terms of the Recovery Act and administrative rules of NTIA and RUS, NACOG, along with selected partners (if any), had the opportunity to apply for funding under the Recovery Act for broadband infrastructure projects, public computer centers, and sustainable broadband adoption projects. The status of these projects are for another time and place but should be investigated by NACOG.

While there does not seem to be an overwhelming groundswell of demand in the NACOG area for Better Internet, there are instances in which the lack of broadband capacity leaves rural small businesses and residents at a distinct disadvantage when compared to their counterparts in more densely populated areas like Phoenix and Tucson. For instance, the FCC has found that access to fixed and mobile broadband services has the potential of benefiting the agriculture business, enhancing educational opportunities, improving health care, enhancing the County's public safety and homeland security needs, assisting individuals with disabilities and offering potentially enormous environmental benefits.

3.1 Recommendations for Action

Through consultation with NACOG we should engage the Counties Planning and Zoning and the City-County Information Technology Leads, we suggest NACOG undertake a series of short-term (tactical) options followed by a longer-term plan to pursue other, more strategic options. See list below:

3.1.1 Short Term Activities

1. Educate citizens about options that already exist.
2. Support the expansion of wireless coverage in each County by facilitating use of existing towers by wireless providers and advocating that wireless providers expand coverage in known problem areas.
3. Work with ATII to apply for grants and loans to improve middle mile bandwidth.
4. Consider subsidizing infrastructure enhancements through grant funding.

3.1.2 Strategic Plan

In order to use the Internet to its greatest potential (such as operating online businesses, telecommuting, and participating in video-based education) NACOG should plan for a long-term future that provides reliable Internet speeds in excess of 10Mbps – perhaps 50-100 Mbps – in all

homes and businesses. In some cases the schools and businesses will require 1000Mbps. Because current offerings don't reach everyone and most are quite limited in bandwidth, NACOG could undertake the following longer-term activities to improve the situation.

1. Encourage wireline telephone providers to apply for grants and loans that would allow them to expand coverage.
2. Seek out partnerships to build out a fiber backbone within the cities that would allow either a) fiber to the home (FTTH) or b) fiber as a middle mile technology. A fiber backbone like this potentially would be able to be shared between multiple providers and technologies. (See Graham County)
3. Research and consider pilot studies of other wired technologies, such as Broadband over Power Lines (BPL). Today, the most likely implementation of BPL would blend fiber in the middle mile with BPL for last mile connectivity.
4. Support efforts toward a community area network now being planned.

3.1.3 Priorities

Recognizing that there are diverse needs with many potential solutions, these strategic options are considered priorities:

1. Options that support improved connectivity to local units of government.
2. Options that support economic development.
3. Options that support educational activities.
4. Options that support service to residential users of Better Internet as a service.

4 Future Planning

The logical progression of this study began with researching the current broadband offerings followed by analyzing the gaps between those. Using that information, NACOG needs to begin to address the gaps outlined here and start the remediation of limited access to Better Internet. Some of the potential next steps are outlined below.

4.1 Outline

The study then needs to move into outlining feasible ways to fill the broadband chasm and estimating costs to implement. Following is a summary of the activities needed.

4.1.1 Phase 1 – Inventory, Needs Identification and Gap Analysis

This phase requires a significant effort to gather data about the current status of broadband services, including:

1. Open forum style meetings for businesses to provide information about their uses of and needs for broadband.
2. Meetings for municipal officials throughout the Region.

3. Hold public meetings with a target audience of citizens from the poorly served areas.
4. An invitation to hundreds of area businesses to participate in an online survey regarding needs.
5. Brief interviews with businesses located in business parks and a physical review of observable facilities in business parks.
6. Additional phone call interviews with NACOG's largest businesses.
7. A survey mailed to residents regarding service quality.
8. Pool the Internet Service Providers to request and obtain information about offerings, prices and coverage areas.

4.1.2 Phase 2 - Cost Estimating

4.1.3 Phase 3 - Ownership/Operations Models and Potential Partnerships

If after the first two phases there is a good case to take action, NACOG may choose to give the go-ahead for a study team to evaluate various models to enhance broadband infrastructure to meet current and future needs. The Phase 3 deliverables would include information regarding potential take rate, ownership/operations options, and potential partnerships.

5 Potential Broadband Technologies

In keeping with the State's desire to consider longer-term economic development, we also examined some broadband technologies that are not currently available throughout NACOG but may be in the future. Specifically this section discusses 4th Generation Cellular (4G), Broadband over Power Line (BPL) and Fiber to the Premise.

5.1 *4G (WiMAX and LTE)*

Several carriers are just beginning the process of upgrading their cell systems to a newer version known as 4G (4th generation). As the carriers install these network upgrades users will see significant improvements in performance.

The fight between the competing next generation cellular technologies LTE (Long Term Evolution) and WiMax (Worldwide Interoperability for Microwave Access) is well underway. WiMax has been quicker to market and already has operational networks in a few cities in NACOG, but more carriers worldwide have announced they will use LTE. Since Intel is the primary backer of WiMax, laptops have already started to come out with that technology built in alongside WiFi. On the other hand, inexpensive LTE USB plug-in modems will soon become readily available.

Verizon rolled out LTE in 20 to 30 US market areas in 2010 and will complete its nationwide upgrade program by early 2014. Clearwire (partly owned by Sprint) already offers WiMax in Atlanta, Baltimore, Las Vegas, and Portland, OR. Clearwire launched WiMax service in 2009 in Charlotte, Chicago, Dallas/Ft. Worth, Honolulu, Philadelphia, and Seattle; meanwhile Boston, Houston, San Francisco, and Washington D.C. were the next targeted cities for the WiMax rollout.

Since cellular upgrade efforts tend to start in larger metro areas and "trickle down" to less densely populated areas later, customers in rural Arizona may have to wait a time to reap any benefits since the previous generation (3G) of services only quite recently came online in most of this area. However, even after these technologies are implemented, the "footprints" won't necessarily cover more territory than is now the case.

Once rolled out, both LTE and WiMax will provide significantly greater bandwidth than is now available. The claims for 4G range are from 7 Mbps to more than 20 Mbps downstream. However, such claims should be taken with a grain of salt until there are enough users on the systems to indicate the true capacity when heavily used.

Interestingly, WiMAX is being implemented by smaller, regional and local wireless providers using different licensed frequencies than the big companies.

5.2 *Broadband over Power Line (BPL)*

The intent of this technology is to deliver broadband Internet access over electrical power lines. As of the date of this report, BPL has faced significant technical challenges in getting services online. The primary difficulty is interference. High and medium voltage electrical systems generate unintentional signals in some of the transmission ranges used by wireless networks, thus causing interference. Special efforts and equipment are needed to prevent this from disrupting network traffic. The excitement around BPL is that it uses existing electrical power lines to distribute broadband. This means a much smaller initial investment than bringing in new cabling, and could trump wireless if physical barriers block the use of that technology. That solution is not in the near future.

In August 2009, an IEEE working group completed main development of a BPL standard and released the first draft of technical specs. Reaching this stage of the standards process usually indicates a technology is nearly ready for deployment, but does not guarantee that it can be provided cost effectively.

That stated, as of March 2013, it is too soon to tell whether BPL will be a feasible solution for most areas, but it is worth watching.

One item to keep in mind related to broadband over power lines is the fiber cable pulled alongside the power cable. Each power company could become suppliers for middle mile Better Internet connections.

NACOG should consider contacting the local power company to see if there are possibilities to work together to address rural Arizona's need.

5.3 Fiber to the Home/Fiber to the Premise

This method of providing service involves installing fiber optic cabling directly into each building (business or house). This technology is often referred to as FTTH or FTTP. In some parts of the eastern US, Verizon Communications has installed this type of service to residential and business customers. Verizon has dubbed its service FiOS. AT&T has also installed some FTTH in portions of Texas. In almost all cases, the providers installed these systems in densely populated, high-income

areas. In less populated areas it can be difficult for for-profit companies to justify the cost to install new FTTH systems.

A variation on this, some providers install fiber most of the way and then use copper cabling to reach the last few hundred feet to individual buildings. This type of installation may be known as Fiber to the Neighborhood/Fiber to the Node (FTTN).

In the cable TV industry, that other technology is usually coaxial cabling; in the telephone industry, the outgoing cable would be the existing phone wire. FTTN can be a phased step toward fiber to the home/fiber to the premise.

A fiber to the home network is a major investment with an eye to major long-term benefits. Among those benefits:

- Using fiber rather than copper cabling vastly increases the amount of data that can be transmitted. Fiber to the premise systems typically offer speeds from 10 Mbps to 100 Mbps per subscriber, and bandwidth amounts can be guaranteed – unlike wireless. The City of Lafayette, LA is providing 10, 20 and 50 Mbps symmetrical service options to its residents.
- Fiber has virtually unlimited bandwidth potential; 100 Gigabits capacity over 25 miles has been demonstrated, and even greater speeds are expected through ongoing research and development.
- Fiber is immune to interference.
- Fiber has a long useful lifetime (30+ years) and unlike wireless technologies, can be considered a long-term asset, rather than something that depreciates in value.

Many communications experts believe fiber is the only truly viable option for the long run, and that it is simply a matter of time until everyone requires the service capacity only fiber can deliver.

6 Viable Options

While NACOG communities provide many services that support economic development, I am sure leadership believes that broadband service to residents and businesses should be available from commercial providers in a free market environment, rather than offered by government. Thus the following options involve activities that do not include end user services.

6.1 Provide Information to the Public about Existing Options

During public meetings NACOG can coach the Counties to help its businesses and residences by:

1. Publishing selected portions of this and the rest of the ATII report, including placing maps and tables on your website.
2. Developing a concise “brochure” for residents about broadband and distributing it within mailings required for other purposes.

6.2 Make Use of Existing County/Municipal Towers

Our Counties own or have access to a number of towers and water towers for public safety purposes. Not all of the towers are open for use by commercial entities, but most may be, depending on the wind load capacity and location. As an example, GovNet contracted with schools and Counties to make use of these structures. NACOG should expand that process to include other providers.

Recognizing that wireless providers already cover much of the cities, it may be in the NACOG's best interest to maximize those providers' coverage and bandwidth by offering space on available towers to wireless providers at affordable prices to encourage expansion of their coverage areas. This may require changing some policies.

Like other tower owners, rural Arizona could choose to allow commercial wireless providers to attach equipment to towers and distribute services from those sites. Typically, separate agreements are negotiated for each type of facility at each tower location.

Physically, there are many possibilities for how and where equipment might be located on a tower. Due to cabling limitations for Power over Ethernet, most wireless providers must locate their antennas at less than 300 feet above the ground. Depending on the areas to be covered with new services, providers may want only one or multiple 60-degree coverage angles and therefore may wish to lease only a portion of any particular vertical space on a tower. Space is usually allocated at 10-foot intervals, but due to wind load parts of towers may not be usable for antenna placement. Thus each installation is unique.

For any negotiated lease, those wishing to lease tower space would be responsible to conduct wind-load studies and to obtain and develop space on which to locate ground-based equipment and systems. Recommended activities include:

1. Identify Government towers in poorly served areas of NACOG.
2. Invite Cities, Villages and Towns located in the Region to partner in this effort.
3. Conduct an engineering review of each tower to determine whether each tower has capacity to allow additional providers.
4. Identify and meet with potential providers.
5. Conduct a financial and legal review.
6. Identify legal process and terms to partner with competitive carriers.
7. Distribute information about known towers to local providers who might otherwise not know this option exists (only towers taller than 200 feet must be registered with the FCC so the availability of towers less than that height would not be generally known). This will help ensure fair access for commercial entities.
8. Encourage municipalities that own water towers to offer similar terms to providers.
9. See item 6.3.1 regarding connecting public facilities via the public safety wireless system.

6.3 Expansion of Broadband Wireless Coverage by Commercial Providers

6.3.1 Service to end-users

Meet with current and prospective wireless providers to review the coverage map showing known poor or non-existent coverage areas (Appendices A-D), and encourage those providers to specifically target those areas for expanded coverage.

6.3.2 Middle mile infrastructure

Consider working with providers to apply for grants and loans to improve middle mile bandwidth.

6.3.3 Apply for grant funds to subsidize pole installations

Although current wireless providers cover a large portion of NACOG, many homes are located in heavily wooded areas or at low elevations and thus cannot receive wireless signals. In many cases, the addition of a pole of 60-90 feet would elevate an antenna above the treetops and low hills. Each pole would cost approximately $3,500 - $5,000 to install. This is cost prohibitive for most residents. An option to resolve this would be to submit a broadband grant request in which citizens paid a portion of the costs and NACOG applied for and received grant funding for the remainder. The NACOG could work with the public to learn what level of subsidization would make this affordable for citizens. ***Note: NACOG should fully understand potential liability issues before proceeding.***

6.4 Enhance Public Access

1. Provide high-speed Internet connectivity to city and village governments to facilitate public services. This would allow these municipalities to greatly speed up elections reporting and enhance employee productivity.

   One possibility is to use Government towers for point-to-point wireless links. The advantages to doing so are that the backbone already exists and is highly reliable. Another option would be to construct fiber connections between the cities and villages and downtown for the larger cities. This would be a more expensive option, but could provide more bandwidth.

2. Actively support non-profit, school and municipal entities that plan to enhance access to broadband and/or provide computers for disadvantaged residents. Examples of supportive actions the NACOG could undertake might include:

   a) Provide meeting rooms for training classes and BOCs in all areas,

   b) Establish a volunteer service program in which participants assist with training classes and/or in setting up computers,

   c) Support a community-led initiative to train and educate members of the community how to use broadband/the Better Internet,

   d) Encourage local businesses to donate computers and volunteer their services to support sustainable broadband adoption.

6.5 Identify Potential Collaborative Grant Projects

Consider collaborating with Brad Zerbe and other public-service entities, including neighboring counties, technical colleges, healthcare organizations and K-12 school districts. Each of these entities

has valid reasons to promote more available and affordable broadband services in the Region, and each has resources or assets to bring to the table

Healthcare organizations have qualified staff that could conduct remote "house calls" for homebound patients; but this requires reliable, high capacity broadband connectivity to the home. K-12 districts want to ensure students have quality Internet aka: Better Internet access at home as more and more course material is now available only online. Those districts have land and buildings that could be used to host network equipment sites.

6.6 Consider Partnering with Local Incumbent Phone Companies

As part of our research in the availability of Better Internet service in NACOG, it became apparent that in addition to the major players like Frontier and CenturyLink, the residents and businesses are served by a variety of smaller carriers, such as Integra Telecom and Level 3. These companies, while smaller in Arizona, have advertised availability of Better Internet services in their territories. While it appears that many of these small Telcos have reasonably good coverage of Better Internet, we believe that these companies are constrained by the availability of capital to expand and/or upgrade their systems especially in this tight capital market.

There may be several unique opportunities for the NACOG to partner with these smaller providers with regard to grant opportunities. We recommend that the NACOG explore these potential opportunities with the smaller providers as part of Phase 3. If these opportunities do exist to partner with these companies, NACOG has the potential to significantly upgrade the service offerings by deploying Government or shared assets for them to use in these rural areas.

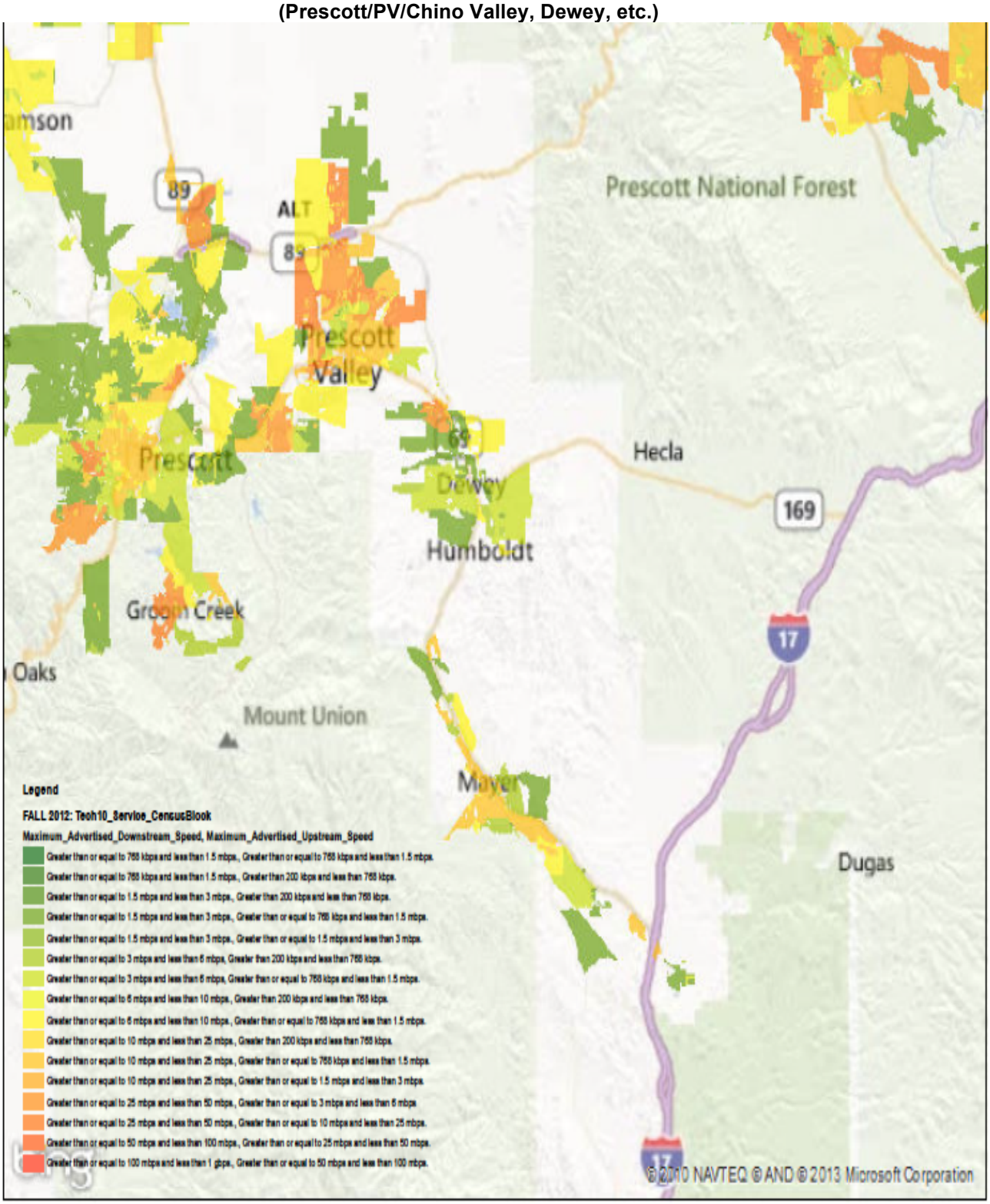
Glossary of Telecom Terms

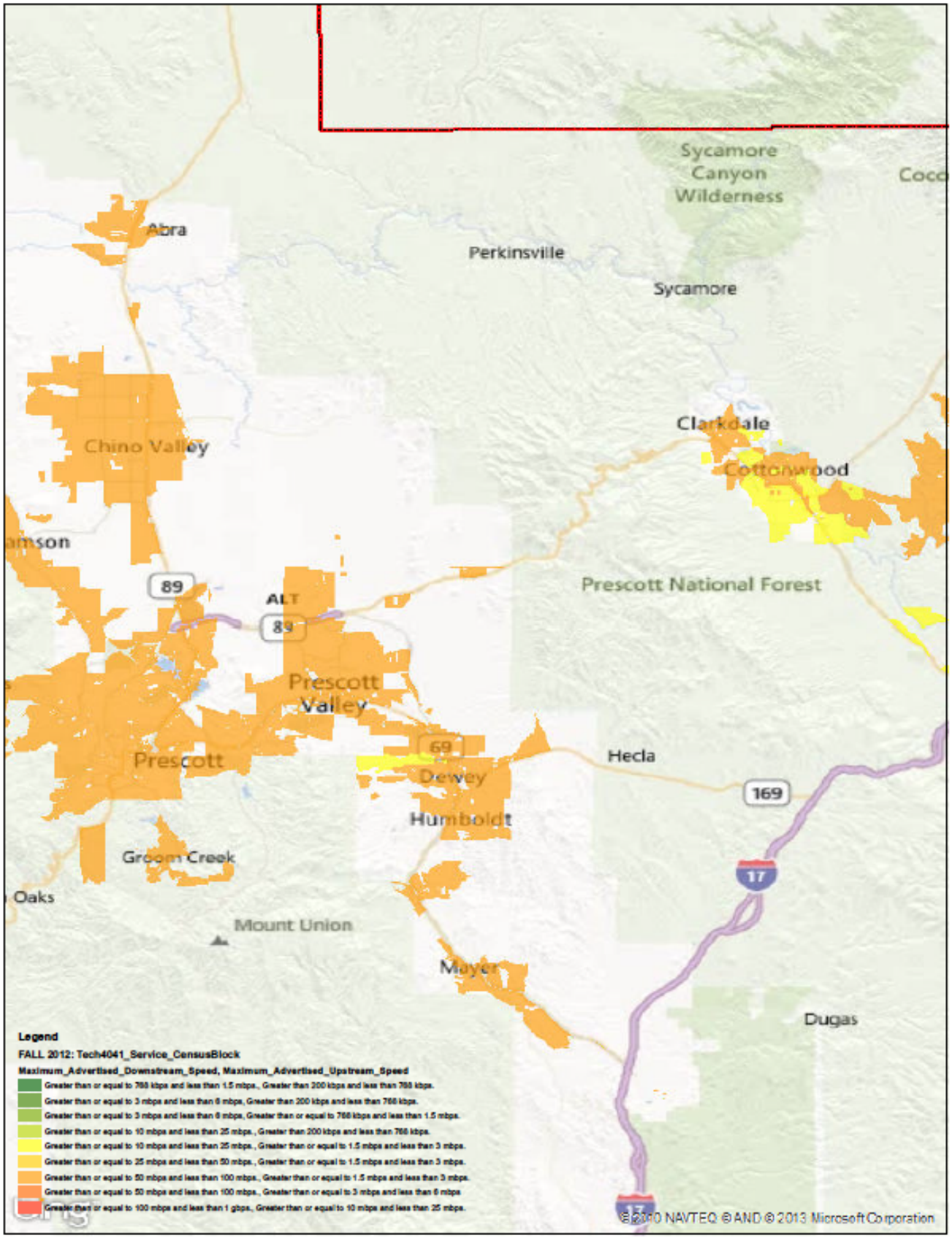
3G or Third Generation Wireless: The current state of cellular wireless data communications. The first generation was analog and the second was digital (CDMA, TDMA and GSM).
4G or Fourth Generation Wireless: refers the next step up for mobile wireless. Fourth generations systems will provide higher-speed data connections - both fixed and mobile.
Asymmetric: A connection with more capacity in one direction than the other. Most DSL and cable modem links are asymmetric, with higher capacity (speed) in the downstream path.
Attenuation: the deterioration of a signal over distance. Also may be referred to as "loss"
Backbone: Refers to the highest speed and widest bandwidth point of a communications circuit or path. In most cases data sources such as shared servers are connected to the backbone, with lower bandwidth circuits extending to user stations.
Backhaul: the intermediate links between the backbone of the network and the sub-networks or provider networks. See also "middle mile."
Bandwidth: The amount of data (capacity) that can be carried by a circuit between two points of a network. Bandwidth is typically measured in kilobits per second or Megabits per second (shortened to Kbps and Mbps). The top speed of modems is 56 Kbps. One strand of fiber optics can carry 20,000,000,000 bits per second (20 Gbps) or more.
Base Station: The central radio transmitter/receiver that maintains communications with end user sites within a given range. Although many base station site antennas are placed on specially constructed towers, where existing structures provide a site that is higher than its surroundings, antennas can be placed on those structures. For example, antennas have been placed on water towers, grain silos, and building rooftops.
BPL: Broadband over Power Line. A technology that allows broadband services to be delivered via electric lines. BPL is discussed in Section 6.2 of this report.
Broadband: A generic term for high-speed data transmissions. The current federal definition of broadband is a minimum of 768 Kbps downstream and 200 Kbps upstream.
Cable Modem: A device used to provide data services over a cable TV network. Users in a given locality (determined by the provider) share the available bandwidth, so when many local users are connected simultaneously they experience slower network performance.
Cell: The basic geographic unit of a wireless system. Also the basis for the generic industry term 'cellular.' A geographic area is divided into 'cells,' each of which is equipped with a low-powered radio transmitter/receiver. The cells can vary in size depending upon terrain, capacity demands, etc. See also Base Station, Cell Site.
Cell Site: The place where communications equipment is located for each cell. A cell site includes antennas, a support structure for those antennas, and communications equipment to connect the site to the rest of the wireless or wired network. The equipment is normally housed in a small shelter or "hut" at the base of the site. See also Base Station, Cell.
Central Office: A term used by carriers when referring to switching points. May also be called a local exchange or telephone exchange.
CLEC: Competitive Local Exchange Carrier. A new entrant in a telecommunications market previously limited to one carrier. Contrast with ILEC.
Co-location: The siting of two or more separate companies' (or departments') equipment in or on the same structure/tower or building.
Contention: When multiple customers share a finite amount of broadband capacity and simultaneous use, they "contend" or compete with one another for that limited resource. Contention may be due to increased use or to inherent system design constraints. Synonymous with **oversubscription**.

CPE: Customer Premises Equipment. CPE is a term that refers to any equipment that is located at the customer's site.
Downstream/download: data transfer from the web/Internet "down" to the customer. Typically measured in thousands of bits per second (Kbps) or millions of bits per second (Mbps). See also Upstream/upload.
DS-3 (Digital Signal, Level 3): A 44.736 Mbps carrier facility, (also referred to as a T3, and generally thought of as 45 Mbps), which is the equivalent of 28-T1 connections
DSL: Digital Subscriber Line. A service providing data connectivity (to the Internet or private networks) over ordinary copper telephone lines. DSL circuits are switched, not shared as cable modems, but bandwidth can vary greatly, based on both distance and the quality of the circuit. There is a typically a distance limitation of approximately 12,000 to 18,000 feet from the nearest main facility (telephone company central office or equivalent).
DSLAM: DSL Access Multiplexer. Used to aggregate many DSL connections onto a single higher-bandwidth connection/link. DSLAM equipment is typically placed in above-ground equipment cabinets within or at the edge of neighborhoods.
FCC (Federal Communications Commission): The government agency responsible for regulating telecommunications in the United States.
Fixed wireless: Refers to wireless systems that are permanently installed and designed to cover a specific area or site.
ILEC: Incumbent Local Exchange Carrier. The former monopoly local telephone carrier. Contrast with CLEC**.**
ISP: Internet Service Provider **Kbps:** Kilobits per second. Thousands of bits per second.
"Last-mile" (sometimes referred to as "first mile"): This term is used to describe the final connection to a building as opposed to the high capacity circuits extending across a city or county. This connection is often the bottleneck that prevents high-speed network connectivity, due to lack of high capacity cabling options. Contrast with "middle mile."
Latency: The time it takes for a signal to travel between two points on a network. Also referred to as "delay". When there is significant latency a normal voice conversation may be very difficult as the parties must wait for responses and may "talk over" each other.
Leased Line Services: These are typically communications circuits provide by a telephone company or cable company and leased for a monthly fee to a customer such as a city or school district. Typical leased lines include T-1 and T-3.
Line of Sight (LOS): Transmission limited to straight lines and in which the transmitting/receiving locations can be viewed/seen from one another. Most wireless wide area network transports require a line of sight from the sending location to the receiver.
Mbps: Megabits Per Second - Million bits per second. Telephone modems operate at Kbps (thousands of bits per second) speeds, whereas local area networks operate at Mbps.
Microwave: The portion of the electromagnetic spectrum, beginning with 1 GHz, which is used for many different wireless communications. Microwave links are often used in links where there is a line of site and a distance of less than 30 miles.
Middle mile: may also be referred to as backhaul. The links between ISPs and local or regional broadband service providers are considered "middle mile" connections. Contrast with "last mile".
Monopole: A slender, self-supporting tower on which wireless antennas can be placed.
Oversubscription: see **contentio**n.
PROW (Public Right-of-Way or Public Rights-of-Way): The land/areas owned by a public entity such as a city or county that are used for installation of telecommunications and other services. For example, most counties own and control the PROW along county roads.

Right-of-Way (for outside plant cable): Refers to a designated space alongside a street or other access (such as a railroad line). An entity wishing to install cable among buildings must obtain the rights to a pathway for that cable. Right-of-way access must be granted by the owner of the path to be used, which may include public landowners (city, county, etc.), private landowners (railroad companies), or the owners of poles such as cable, telephone, or power companies. Cities typically require written permits for the use of their rights-of-way – usually for a fee. See also PROW.
Router: a device that "translates" among different types of network connections and speeds, and can also perform basic security functions. Routers are most frequently used at the point of incoming services such as ISP or carrier WAN connections.
Site Survey: Internet service provider personnel visit your home or business location to determine whether service is/can be made available there.
Symmetric: Used to describe communications technologies in which the upstream and downstream data rates are identical – e.g., High Bit-rate Digital Subscriber Line.
T-1 (DS1): In the United States the T1 standard has a speed of 1.544 Mbps. T-1 circuits usually are provided by telephone companies using copper cabling, but fiber and wireless systems can be set up to provide T-1 connectivity as well.
Take Rate: The percentage of households or business that are offered service who choose to subscribe to that service. For example, if DSL service were available to 100 households and 33 elected to "take" that DSL service, the take rate would be 33%.
Underserved and Unserved: the FCC recently defined these terms that describe areas that lack broadband access. For complete definitions refer to the July 9, 2009 federal register Notice of Funds Availability: http://frwebgate3.access.gpo.gov/cgi-bin/PDFgate.cgi?WAISdocID=97311421117+1+2+0&WAISaction=retrieve
Upstream/upload: data transfer from the customer back to the web/Internet or provider. Typically measured in thousands of bits per second (Kbps) or millions of bits per second (Mbps). See also Downstream/download.
VoIP: Voice over Internet Protocol. A technology that puts voice (telephone) conversations over an IP "data" network. Can be used to aggregate (or "trunk") multiple calls between buildings, or for individual calls from an IP-enabled telephone or from a computer equipped with a microphone and speaker. Skype is one example of VoIP.
VPN: Virtual Private Network. A network set up for specific sites and users and open only to authorized users. A VPN uses encryption to prevent communications from being deciphered by non-authorized personnel.
WAN (Wide Area Network): A wide area network is used to extend connectivity beyond a building or campus, usually through telephone carrier facilities, but may also be privately installed and owned. See also LAN and MAN.
Wind load: the designed capacity of a tower to withstand wind forces. Each structure (mast, antenna, etc.) added to a tower adds to the overall wind load of that tower.
WISP: wireless Internet service provider. A company that distributes Internet service via wireless networking. In order to provide service to a given location or territory a WISP may develop its own tower sites and/or may lease space on towers or structures owned by others.

Appendix A
Wide Map of DSL (pg1) then Cable (pg 2) coverage NACOG
(Prescott/PV/Chino Valley, Dewey, etc.)




Sycamore Canyon Wilderness
Abra
Perkinsville
Sycamore
Clarkdale
Cottonwood
Chino Valley
Prescott National Forest
89
ALT 89
Prescott Valley
Prescott
69
Dewey
Humboldt
Hecla
169
Groom Creek
17
Mount Union
Mayer
Dugas
Legend
FALL 2012: Tech4041_Service_CensusBlock
Maximum_Advertised_Downstream_Speed, Maximum_Advertised_Upstream_Speed
Greater than or equal to 768 kbps and less than 1.5 mbps., Greater than 200 kbps and less than 768 kbps.
Greater than or equal to 3 mbps and less than 6 mbps, Greater than 200 kbps and less than 768 kbps.
Greater than or equal to 3 mbps and less than 6 mbps, Greater than or equal to 768 kbps and less than 1.5 mbps.
Greater than or equal to 10 mbps and less than 25 mbps., Greater than 200 kbps and less than 768 kbps.
Greater than or equal to 10 mbps and less than 25 mbps., Greater than or equal to 1.5 mbps and less than 3 mbps.
Greater than or equal to 25 mbps and less than 50 mbps., Greater than or equal to 1.5 mbps and less than 3 mbps.
Greater than or equal to 50 mbps and less than 100 mbps., Greater than or equal to 1.5 mbps and less than 3 mbps.
Greater than or equal to 50 mbps and less than 100 mbps., Greater than or equal to 3 mbps and less than 6 mbps
Greater than or equal to 100 mbps and less than 1 gbps., Greater than or equal to 10 mbps and less than 25 mbps.
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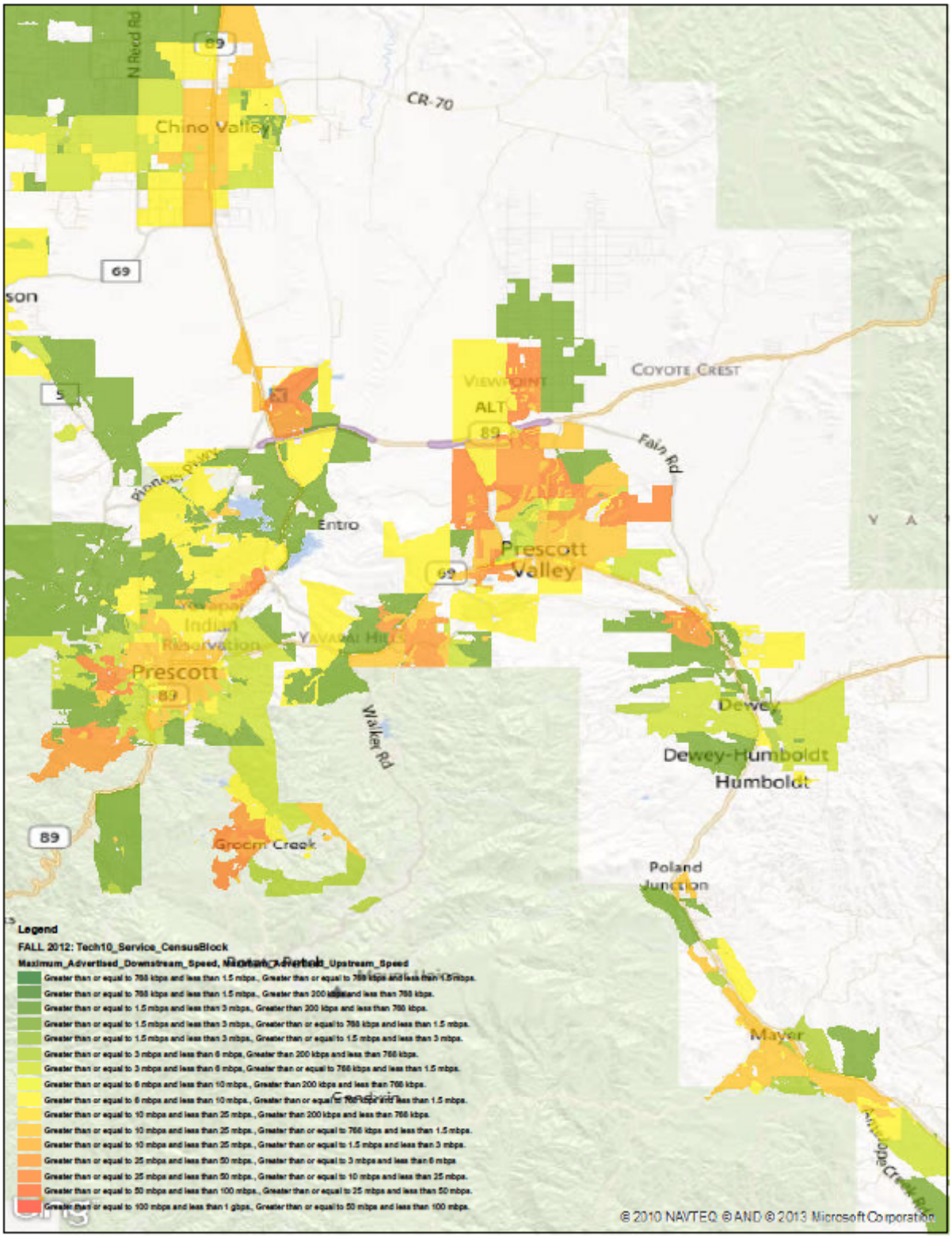
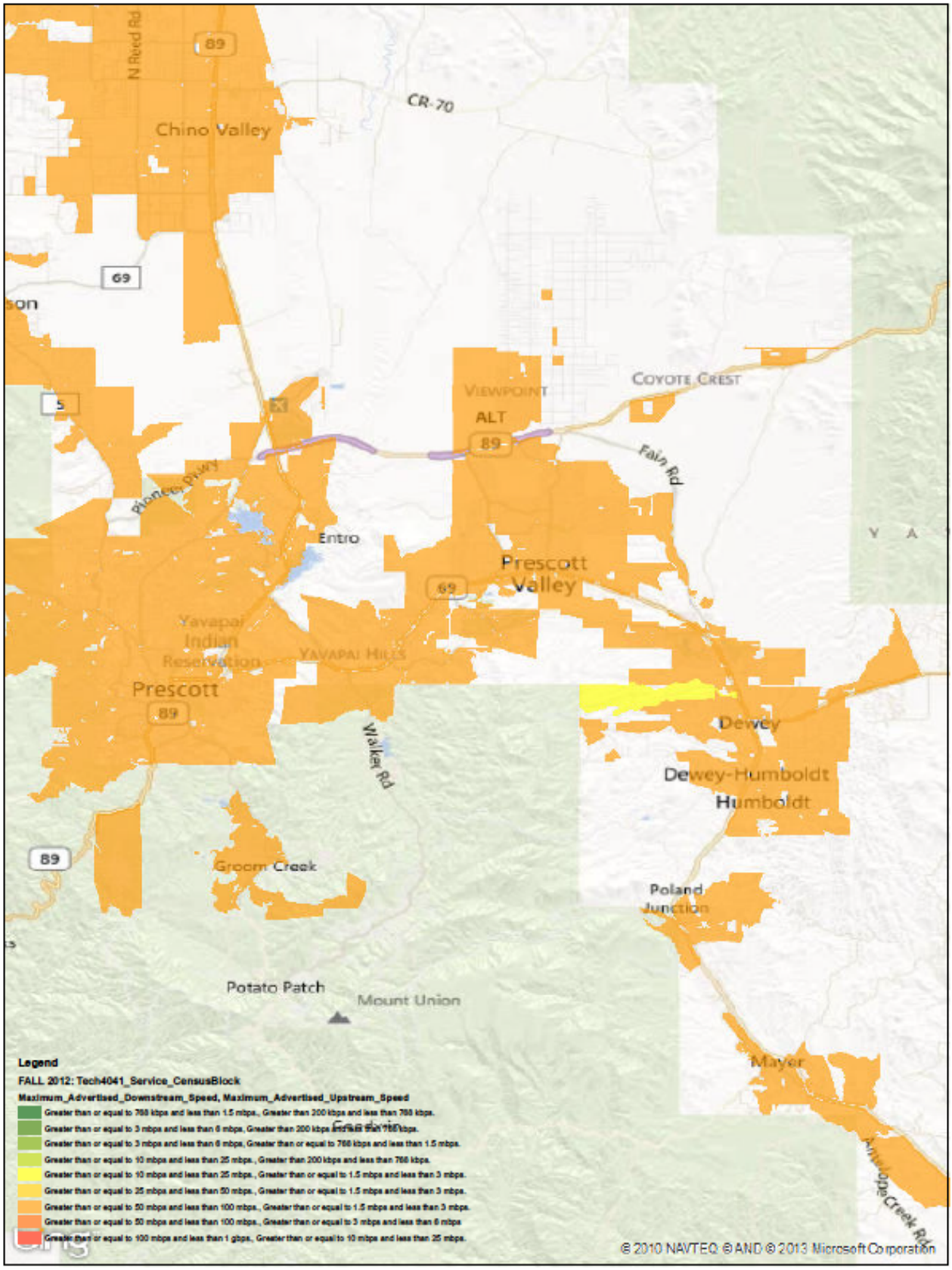
Appendix B
Urban Map of DSL (pg 1) then Cable (pg 2) coverage NACOG
(Prescott/PV/Chino Valley, Dewey)




Chino Valley
CR-70
N Reed Rd
89
69
Coyote Crest
Viewpoint
ALT
Fain Rd
Pioneer Pkwy
Entro
Prescott Valley
Yavapai Indian Reservation
Yavapai Hills
Prescott
Walker Rd
Dewey
Dewey-Humboldt
Humboldt
Groom Creek
Poland Junction
Potato Patch
Mount Union
Mayer
Legend
FALL 2012: Tech4041_Service_CensusBlock
Maximum_Advertised_Downstream_Speed, Maximum_Advertised_Upstream_Speed
Greater than or equal to 768 kbps and less than 1.5 mbps., Greater than 200 kbps and less than 768 kbps.
Greater than or equal to 3 mbps and less than 6 mbps, Greater than 200 kbps and less than 768 kbps.
Greater than or equal to 3 mbps and less than 6 mbps, Greater than or equal to 768 kbps and less than 1.5 mbps.
Greater than or equal to 10 mbps and less than 25 mbps., Greater than 200 kbps and less than 768 kbps.
Greater than or equal to 10 mbps and less than 25 mbps., Greater than or equal to 1.5 mbps and less than 3 mbps.
Greater than or equal to 25 mbps and less than 50 mbps., Greater than or equal to 1.5 mbps and less than 3 mbps.
Greater than or equal to 50 mbps and less than 100 mbps., Greater than or equal to 1.5 mbps and less than 3 mbps.
Greater than or equal to 50 mbps and less than 100 mbps., Greater than or equal to 3 mbps and less than 6 mbps
Greater than or equal to 100 mbps and less than 1 gbps., Greater than or equal to 10 mbps and less than 25 mbps.
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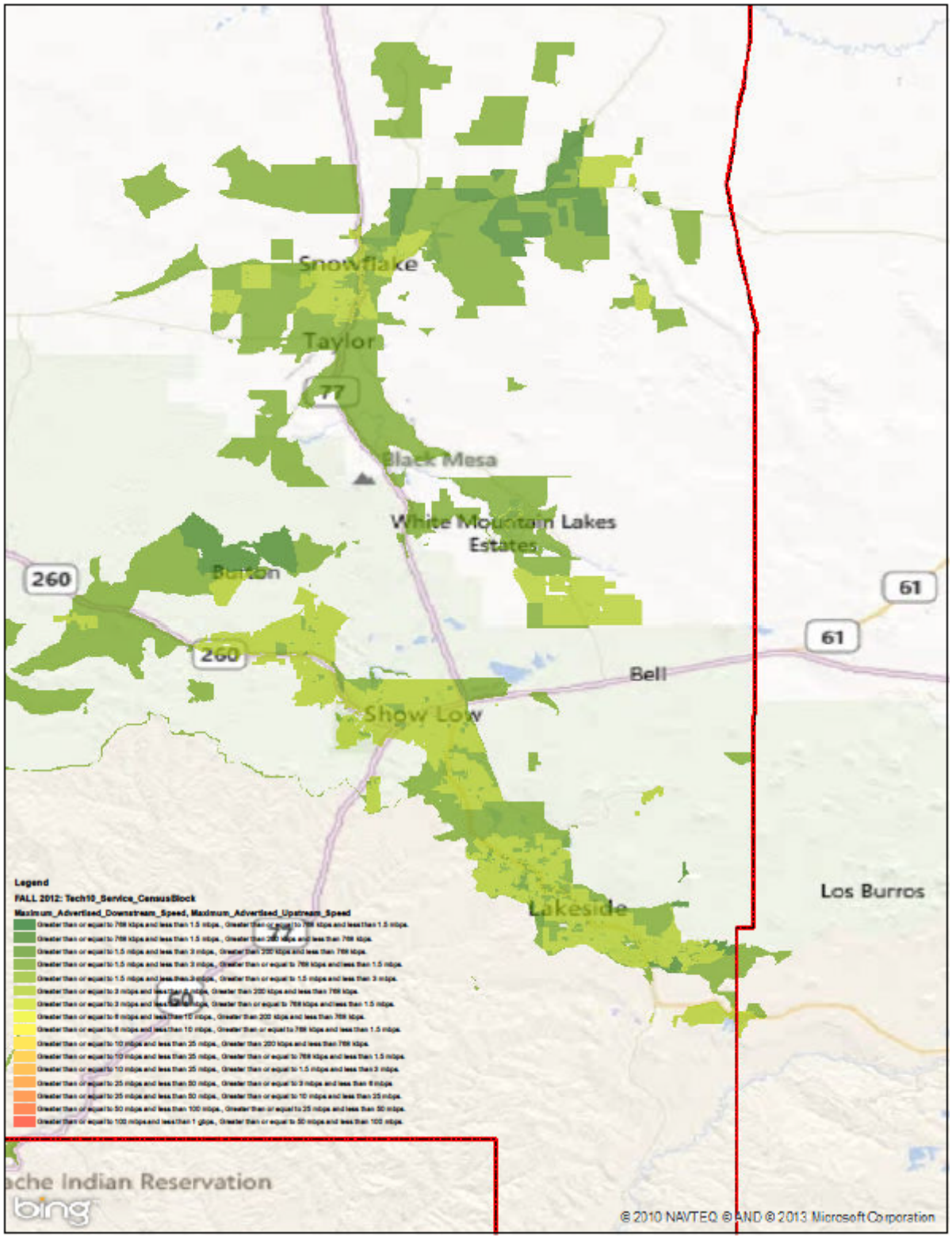
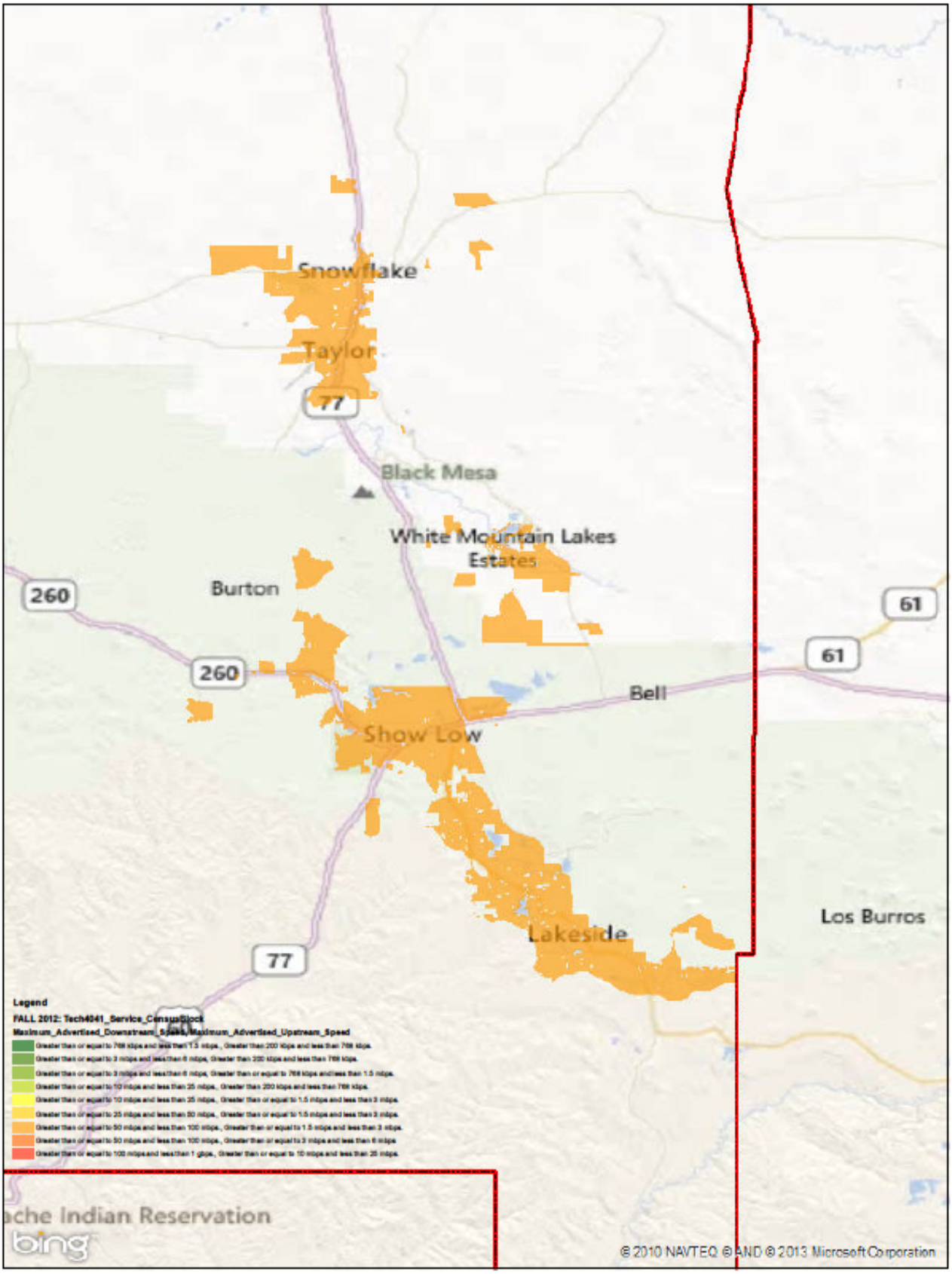
Appendix C
Wide Map of DSL (pg 1) then Cable (pg 2) coverage NACOG
(Pine Top-Lakeside, Show Low, Snowflake, etc.)




Snowflake
Taylor
77
Black Mesa
White Mountain Lakes
Estates
Burton
260
260
61
61
Bell
Show Low
Lakeside
Los Burros
77
Legend
FALL 2012: Tech4041_Service_CensusBlock
Maximum_Advertised_Downstream_Speed, Maximum_Advertised_Upstream_Speed
ache Indian Reservation
bing
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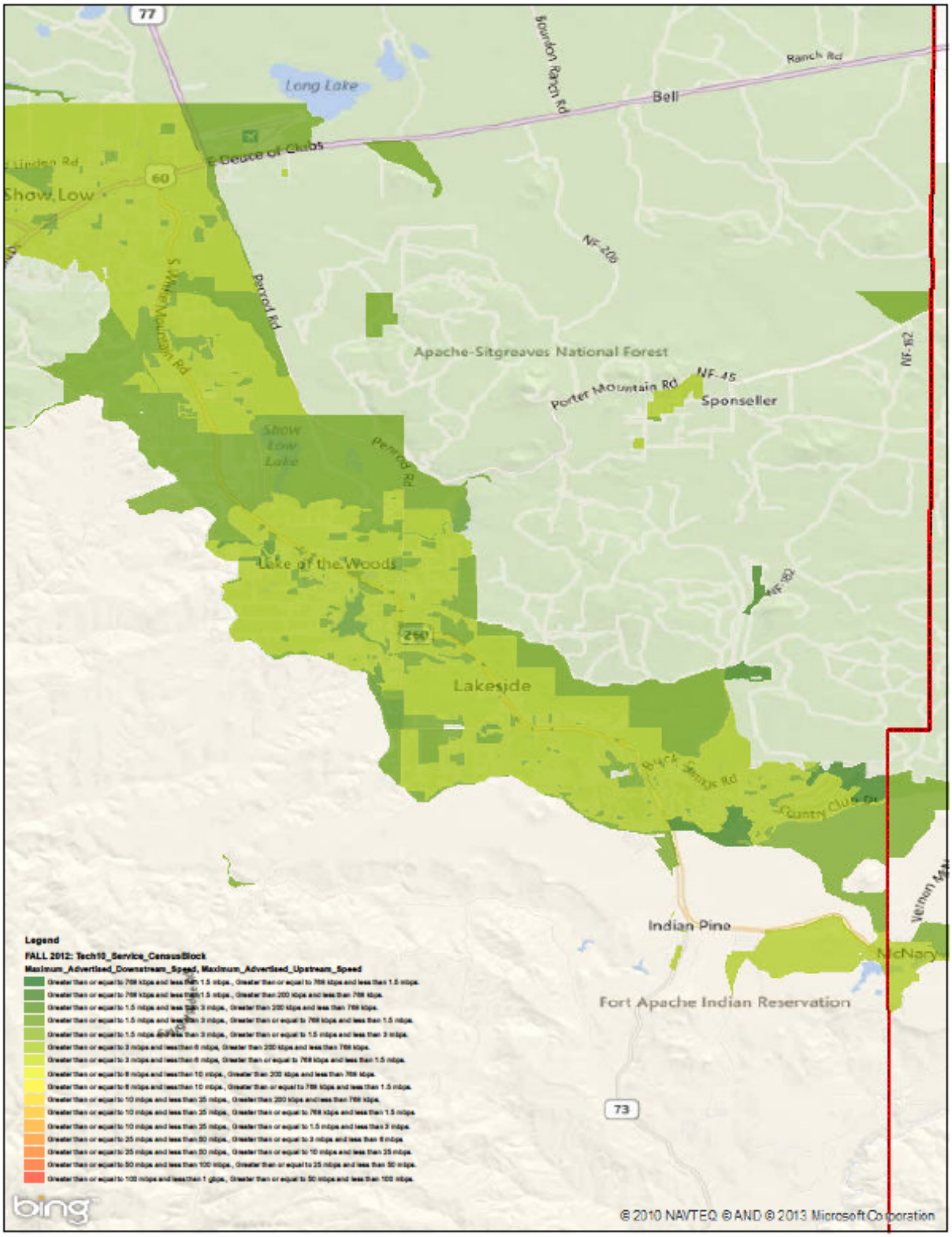
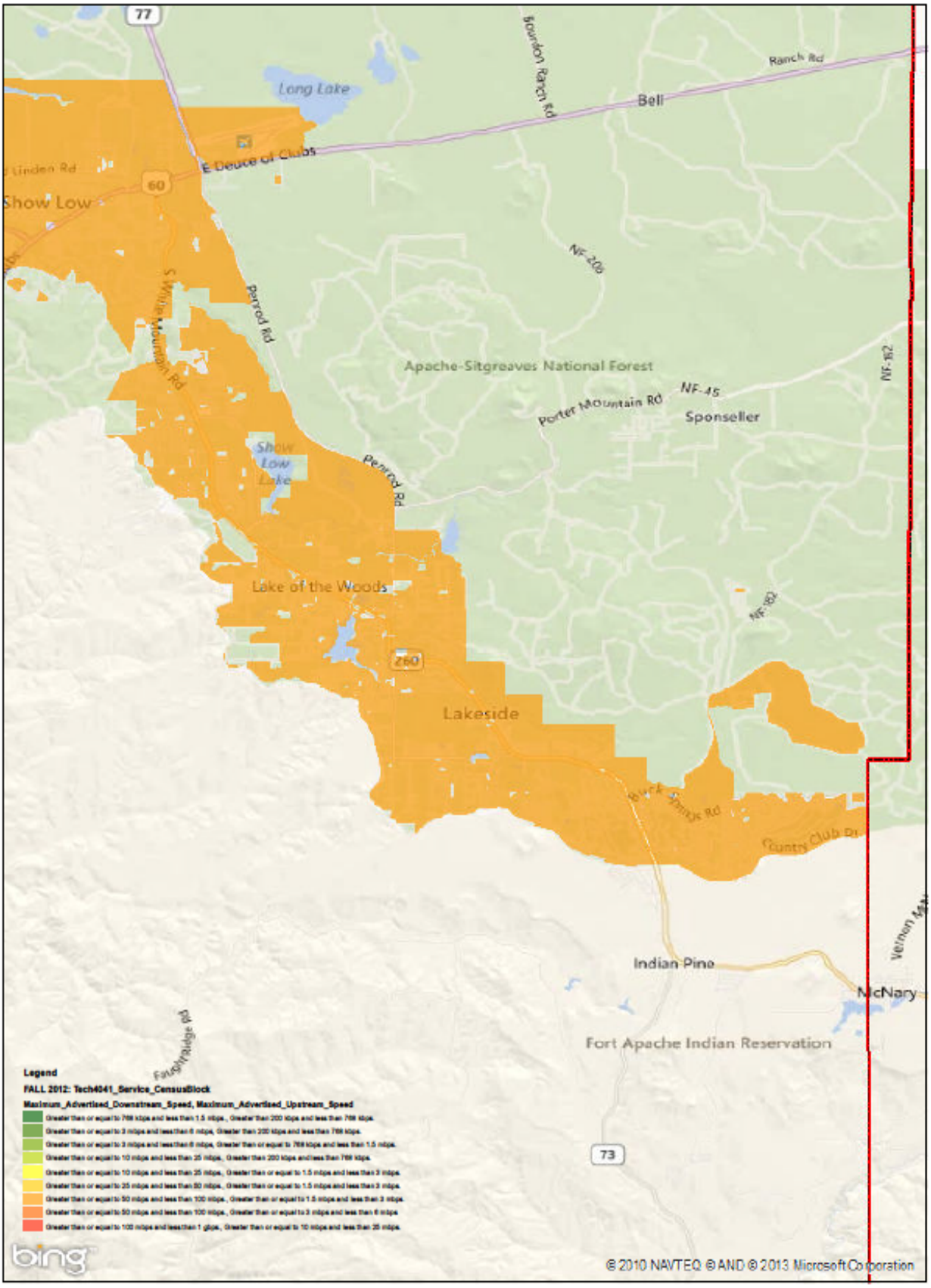
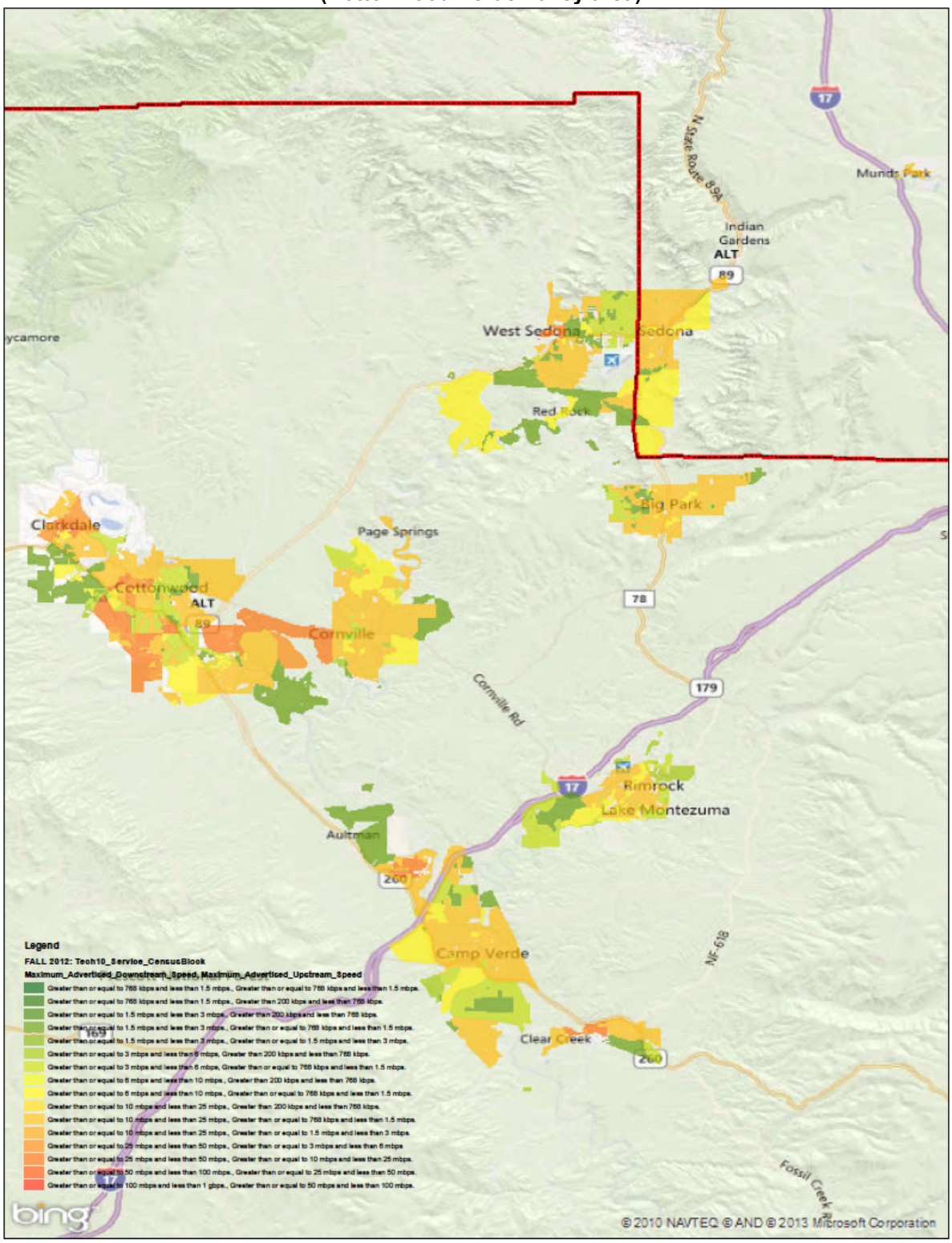
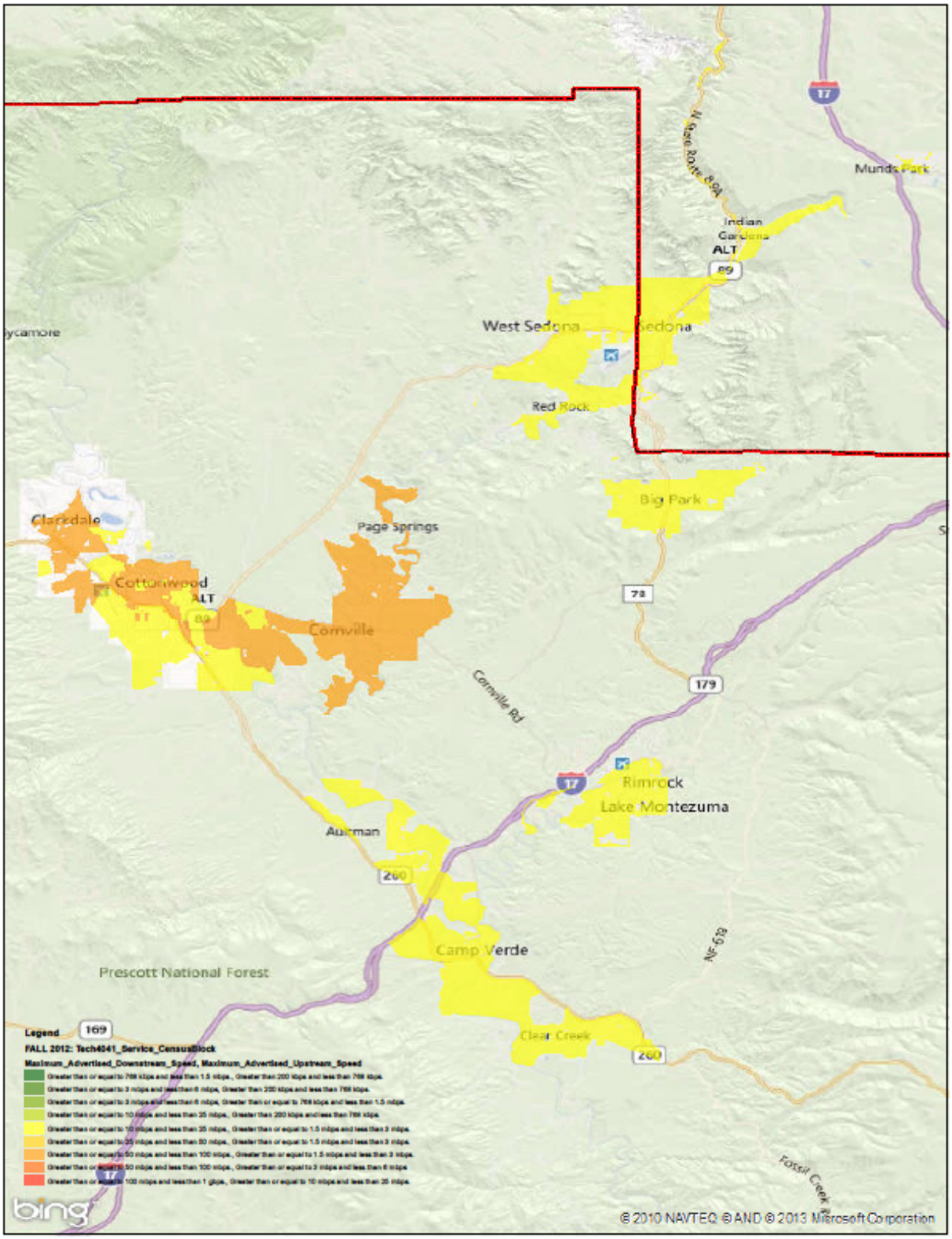
Appendix D
Urban Map of DSL (pg 1) then Cable (pg 2) coverage NACOG
(Pine Top-Lakeside)




77
Long Lake
Bourdon Ranch Rd
Ranch Rd
Bell
E Deuce of Clubs
Linden Rd
60
Show Low
NF-209
S White Mountain Rd
Penrod Rd
Apache-Sitgreaves National Forest
NF-45
Porter Mountain Rd
Sponseller
NF-182
Show Low Lake
Penrod Rd
Lake of the Woods
NF-182
260
Lakeside
Country Club Dr
Indian Pino
McNary
Fort Apache Indian Reservation
Vernon
Fairgrounds Rd
73
Legend
FALL 2012: Tech4041_Service_CensusBlock
Maximum_Advertised_Downstream_Speed, Maximum_Advertised_Upstream_Speed
bing
© 2010 NAVTEQ © AND © 2013 Microsoft Corporation

Appendix E
Map of DSL (pg 1) then Cable (pg 2) coverage NACOG
(Cottonwood Verde Valley area)




West Sedona
Sedona
Red Rock
Munds Park
Indian Gardens
ALT
89
Clarkdale
Cottonwood
ALT
89
Page Springs
Cornville
Cornville Rd
Big Park
Rimrock
Lake Montezuma
Camp Verde
Prescott National Forest
Clear Creek
260
179
17
Legend
FALL 2012: Tech4041_Service_CensusBlock
Maximum_Advertised_Downstream_Speed, Maximum_Advertised_Upstream_Speed
bing
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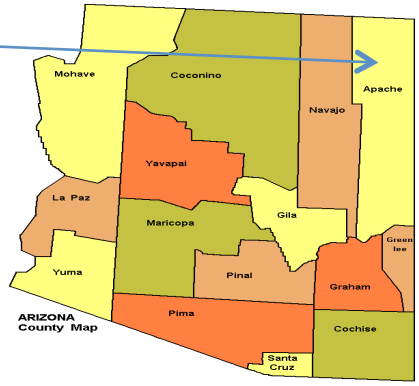
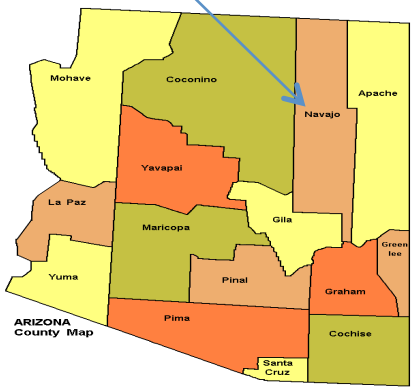
Appendix F
Internet Service Providers in NACOG

The table starting on the next page lists information about Service Providers in NACOG. This information was gathered through a variety of sources including the AZ Broadband Map provided by ASET. ORAct, LLC recommends that NACOG leadership should check directly with providers (though some chose not to respond to our inquiries) and researching information available in the public domain (e.g., providers' web sites)

Apache



Navajo

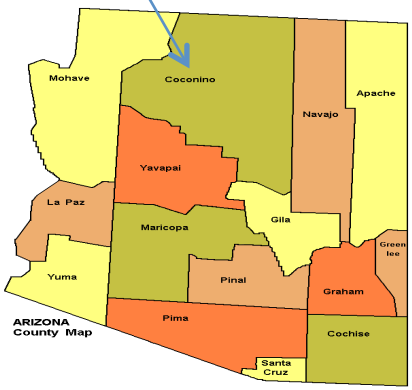


General - Regional Service Providers

Provider	Service Type	Advertised Download Speed	Advertised Upload Speed
Frontier Communications	DSL (Asymmetric)	1.5 - 3 Mbps	768 Kbps - 1.5 Mbps
Frontier Communications	DSL (Asymmetric)	3 - 6 Mbps	200 - 768 Kbps
Frontier Communications	DSL (Asymmetric)	3 - 6 Mbps	200 - 768 Kbps
Transworld Network	Fixed Wireless	3 - 6 Mbps	1.5 - 3 Mbps
Verizon Communications	Mobile Wireless	768 Kbps - 1.5 Mbps	200 - 768 Kbps
StarBand Communications	Satellite	768 Kbps - 1.5 Mbps	200 - 768 Kbps
HNS (Hughes, Echostar)	Satellite	3 - 6 Mbps	200 - 768 Kbps
ViaSat	Satellite	3 - 6 Mbps	768 Kbps - 1.5 Mbps
Skycasters (VSAT Systems)	Satellite	6 - 10 Mbps	1.5 - 3 Mbps

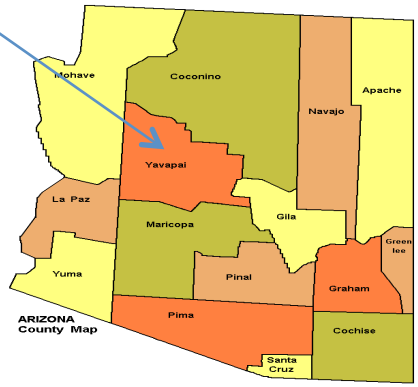
Provider	Service Type	Advertised Download Speed	Advertised Upload Speed
Frontier Communications	DSL (Asymmetric)	1.5 - 3 Mbps	768 Kbps - 1.5 Mbps
Frontier Communications	DSL (Asymmetric)	3 - 6 Mbps	200 - 768 Kbps
Frontier Communications	DSL (Asymmetric)	768 Kbps - 1.5 Mbps	200 - 768 Kbps
Frontier Communications	DSL (Asymmetric)	3 - 6 Mbps	200 - 768 Kbps
Cable One	Cable	50 - 100 Mbps	1.5 - 3 Mbps
Cable One	Cable	50 - 100 Mbps	1.5 - 3 Mbps
Transworld Network	Fixed Wireless	3 - 6 Mbps	1.5 - 3 Mbps
Verizon Communications	Mobile Wireless	768 Kbps - 1.5 Mbps	200 - 768 Kbps
StarBand Communications	Satellite	768 Kbps - 1.5 Mbps	200 - 768 Kbps
HNS (Hughes, Echostar)	Satellite	3 - 6 Mbps	200 - 768 Kbps
ViaSat	Satellite	3 - 6 Mbps	768 Kbps - 1.5 Mbps
Skycasters (VSAT Systems)	Satellite	6 - 10 Mbps	1.5 - 3 Mbps
Century Link	DSL (Asymmetric)	1.5 - 3 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	3 - 6 Mbps	200 Kbps - 768 Kbps
Century Link	DSL (Asymmetric)	3 - 6 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	6 - 10 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	10 - 25 Mbps	768 Kbps - 1.5 Mbps
Sprint Communications	Mobile Wireless	768 Kbps - 1.5 Mbps	200 Kbps - 768 Kbps

Coconino



Provider	Service Type	Advertised Download Speed	Advertised Upload Speed
Century Link	DSL (Asymmetric)	1.5 - 3 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	3 - 6 Mbps	200 - 768 Kbps
Century Link	DSL (Asymmetric)	3 - 6 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	6 - 10 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	10 - 25 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	25 - 50 Mbps	3 - 6 Mbps
Century Link	DSL (Asymmetric)	25 - 50 Mbps	10 - 25 Mbps
Century Link	DSL (Asymmetric)	1.5 - 3 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	3 - 6 Mbps	200 - 768 Kbps
Century Link	DSL (Asymmetric)	3 - 6 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	6 - 10 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	10 - 25 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	25 - 50 Mbps	3 - 6 Mbps
Century Link	DSL (Asymmetric)	25 - 50 Mbps	10 - 25 Mbps
XO Communications	T1/Tn	1.5 - 3 Mbps	1.5 - 3 Mbps
NPG Cable (Suddenlink)	Cable	10 - 25 Mbps	1.5 - 3 Mbps
NPG Cable (Suddenlink)	Cable	10 - 25 Mbps	1.5 - 3 Mbps
CommSpeed	Fixed Wireless	768 Kbps - 1.5 Mbps	768 Kbps - 1.5 Mbps
Sprint Communications	Mobile Wireless	768 Kbps - 1.5 Mbps	200 - 768 Kbps
Verizon Communications	Mobile Wireless	768 Kbps - 1.5 Mbps	200 - 768 Kbps
T-Mobile (Deutsche Telecom)	Mobile Wireless	1.5 - 3 Mbps	200 - 768 Kbps
AT&T Mobility	Mobile Wireless	3 - 6 Mbps	3 - 6 Mbps
T-Mobile (Deutsche Telecom)	Mobile Wireless	10 - 25 Mbps	1.5 - 3 Mbps
StarBand Communications	Satellite	768 Kbps - 1.5 Mbps	200 - 768 Kbps
HNS (Hughes, Echostar)	Satellite	3 - 6 Mbps	200 - 768 Kbps
ViaSat	Satellite	3 - 6 Mbps	768 Kbps - 1.5 Mbps
Skycasters (VSAT Systems)	Satellite	6 - 10 Mbps	1.5 - 3 Mbps

Yavapai



Provider	Service Type	Advertised Download Speed	Advertised Upload Speed
Century Link	DSL (Asymmetric)	1.5 - 3 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	3 - 6 Mbps	200 - 768 Kbps
Century Link	DSL (Asymmetric)	3 - 6 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	6 - 10 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	10 - 25 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	25 - 50 Mbps	3 - 6 Mbps
Century Link	DSL (Asymmetric)	25 - 50 Mbps	10 - 25 Mbps
Century Link	DSL (Asymmetric)	1.5 - 3 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	3 - 6 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	6 - 10 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	10 - 25 Mbps	768 Kbps - 1.5 Mbps
Century Link	DSL (Asymmetric)	25 - 50 Mbps	10 - 25 Mbps
Cable One	Cable	50 - 100 Mbps	1.5 - 3 Mbps
NPG Cable (Suddenlink)	Cable	10 - 25 Mbps	1.5 - 3 Mbps
Cable One	Cable	50 - 100 Mbps	1.5 - 3 Mbps
NPG Cable (Suddenlink)	Cable	10 - 25 Mbps	1.5 - 3 Mbps
Swift Wireless Internet	Fixed Wireless	768 Kbps - 1.5 Mbps	768 Kbps - 1.5 Mbps
Bolt Internet	Fixed Wireless	3 - 6 Mbps	768 Kbps - 1.5 Mbps
eSedona	Fixed Wireless	6 - 10 Mbps	1.5 - 3 Mbps
AireBeam	Fixed Wireless	10 - 25 Mbps	768 Kbps - 1.5 Mbps
CommSpeed	Fixed Wireless	768 Kbps - 1.5 Mbps	768 Kbps - 1.5 Mbps
Sprint Communications	Mobile Wireless	768 Kbps - 1.5 Mbps	200 - 768 Kbps
Verizon Communications	Mobile Wireless	768 Kbps - 1.5 Mbps	200 - 768 Kbps
AT&T Mobility	Mobile Wireless	3 - 6 Mbps	3 - 6 Mbps
StarBand Communications	Satellite	768 Kbps - 1.5 Mbps	200 - 768 Kbps
HNS (Hughes, Echostar)	Satellite	3 - 6 Mbps	200 - 768 Kbps
ViaSat	Satellite	3 - 6 Mbps	768 Kbps - 1.5 Mbps
Skycasters (VSAT Systems)	Satellite	6 - 10 Mbps	1.5 - 3 Mbps
ViaSat	Satellite	10 - 25 Mbps	3 - 6 Mbps