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Building a 21st Century Broadband Superhighway
A CONCRETE BUILD-OUT PLAN TO BRING HIGH-SPEED FIBER CONNECTIONS TO EVERY COMMUNITY

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U.S. technological leadership is in a state of decline. Once the unequivocal frontrunner in information technology and telecommunications, the U.S. has fallen from 1st to between 15th and 21st in the world in terms of broadband access, adoption, speeds and prices. The most recent data from OECD (through June 2008) underscores the fact that the U.S. broadband penetration ranking remains stagnant.[1] Such a dramatic decline has prompted calls for a "broadband Apollo project," a nation-wide initiative to build advanced fiber-optic communications infrastructure to connect every community, constituency, and interested individual in the country.

Although members of Congress and the incoming Obama administration have all expressed interest in a national effort to promote universal broadband, the discussion thus far has lacked a coherent means to correct the current market failures and keep pace as other nations have race ahead. Critical questions remain unanswered; namely, what will a government investment look like and how will it create a more open, competitive, affordable, universally accessible high-speed communications network, and avoid reinforcing the deficiencies that have lead to our current woeful international standing?

A great deal of the discussion on improving broadband access in the U.S. has focused on last-mile issues, connecting the residences and businesses in a local community. While this remains a difficult challenge in many areas, particularly low-income and rural communities, another key obstacle to universal high-speed broadband access is the connection of those last-mile networks to the Internet backbone. No community or network is an island. Increasingly access to the high-speed middle-mile links that carry Internet traffic to the backbone, and the escalating costs associated with transporting traffic among networks, have become fundamental barriers to spreading connectivity, promoting broadband competition, improving speeds and lowering prices.

Broadband has become the essential input good for an increasing number of sectors of the economy and the society as a whole. We can no longer view broadband and the telecommunication infrastructures that facilitate high-speed connectivity as a luxury, but realize their import as a mission critical infrastructure. This requires a long-term approach, with sustained policy initiatives and government investment.

Much as the construction of the interstate highway system linked the country with a network of high-speed highways and transformed transportation and commerce in the 1950s, by leveraging this same transportation infrastructure we can construct a public access high-speed fiber highway system to transform and democratize broadband and advanced telecommunications. In 2009, Congress will develop a five-year reauthorization of the omnibus transportation bill to fund capital improvements and maintenance of the national transportation grid.[2] This transportation bill creates an opportunity to leverage federal spending on traditional infrastructure (roads, bridges and possibly railways) by earmarking $1.2 to $3.6 billion to mandate and fund the build-out of open access, fiber-optic infrastructures into the construction, resurfacing and upgrading of our nation's highway system. Integrating the installation of high-capacity, dark fiber bundles into all Federal-aid and direct Federal highway projects offers the most cost-effective means to bring high-speed fiber connectivity to nearly every community in the nation and create a nationwide fiber infrastructure of unrivaled capacity.

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The Challenge

Broadband is the highway of the 21st century for small towns and rural communities; the vital connection to the broader nation and increasingly the global economy. Rural communities across the country continue to have little or no access to broadband, with many residents and businesses still relying upon dial-up modems as their primary connection to the Internet. These communities are often still reliant upon antiquated, copper telephone infrastructures, which often lack the capabilities to deliver high-speed, broadband access.

The lack of middle-mile infrastructure is a considerable problem for existing rural ISPs and a formidable obstacle to building sustainable rural broadband networks. The telecom industry spent billions installing redundant long-haul fiber strands to connect large cities in the 1990s, but left many communities in between unconnected.[3] The typical rural ISP is 91 miles from its primary backbone Internet connection and faces considerable costs to transport traffic to and from the backbone.[4]

Although prices per megabit have come down in some instances, total capacity costs are increasing much faster than the razor thin profit margins of many rural ILECs and ISPs. As network usage increases, small rural broadband providers are buying more and more capacity to handle the increased traffic. A National Exchange Carrier Association (NECA) report found that this "increased IP traffic will exacerbate, rather than ameliorate" the difficulties of these networks since "existing revenue shortfalls are multiplied as the scale of operations increases." NECA's sobering conclusion underscores the necessity for an intervention: "high-speed Internet service may not be sustainable in many rural areas based on pure economics."[5]

Middle-mile connectivity challenges are not just isolated to rural areas. Control of key interconnection and peering points in major cities has become increasingly consolidated, often leading to monopoly or duopoly markets. This has created bottlenecks and limited options for competing ISPs, keeping transport prices much higher in the U.S. compared with many European and Asian countries where bandwidth costs have plummeted. The problem has implications not just for the wired world but also increasingly for next-generation "4G" cellular data systems, WiMax and Wi-Fi networks. Wireless providers such as T-mobile and Sprint-Nextel, who lack their own wireline infrastructure, often must utilize backhaul and middle-mile links that are controlled by their main competitors, AT&T and Verizon.[6] The 2007 merger of AT&T and BellSouth has consolidated the ownership of much of the backbone into three major players. Currently, there are no regulations on backbone transport costs and the competitive conditions imposed on the AT&T and BellSouth merger are set to expire in 2009 adding even further uncertainty into the broadband service provision market.[7]

Without a substantial investment to bring adequate fiber connectivity to rural communities, an increase in the number of interconnection points and routes, and improved competition in the middle-mile, the U.S. broadband market and the sectors of the economy that rely upon it will continue to lag behind other industrialized nations. Competitive broadband networks will hit a wall in terms of speed and pricing as the capacity costs associated with increased traffic to the backbone will grow faster than profits, forcing prices higher and limiting competition. The current nationwide economic decline is likely to further diminish private investment in telecommunications infrastructure, thereby creating conditions that increase the digital divide, inhibit competition, lessen our ability to gain parity with other advanced nations, and further hamper economic recovery and expansion. This financial fallout will impact not just the technology sector, but all sectors of the economy that benefit and rely upon high-speed communications. Such a daunting challenge requires a new approach and a bold plan.

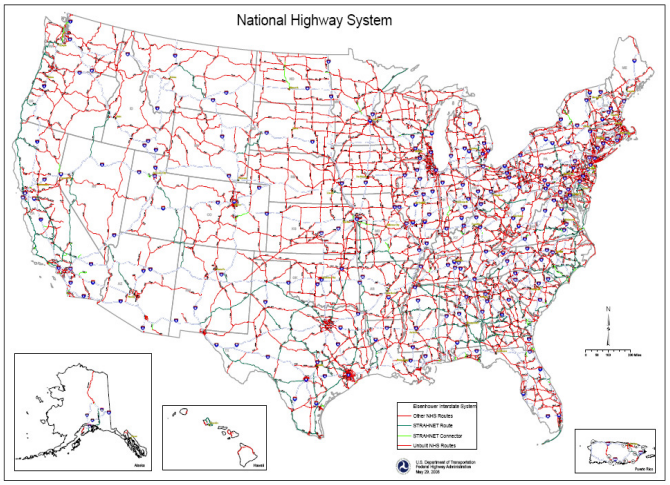
The Solution

As economic growth and success becomes increasingly linked to technological advancement, prosperity will migrate to those countries willing to make the necessary investments to support 21st Century economies. The 21st Century Broadband Superhighway initiative would fund and *mandate* the installation of high-capacity, dark fiber bundles along all federally-subsidized and direct federal highway projects, thus creating over time a fully interconnected, public access fiber infrastructure to bring high-speed connectivity to every community served by these highways. This "fiber to the community" approach would provide the essential wholesale fiber links necessary to facilitate high-speed broadband deployment by incumbents as well as new broadband providers.

The National Highway System (NHS) comprises of approximately 163,000 miles (262,000 kilometers) of roadway, including the Interstate Highway System (46,837 miles) and significant rural and urban roads serving major population centers, international border crossings, intermodal travel facilities, and major travel destinations.[8] The NHS reaches nearly every part of

the country. Nearly 90 percent of the U.S. population lives within 5 miles (8 km) of an NHS roadway, as does nearly all of the urban areas with a population of more than 50,000 and 93 percent of urban areas with a population of between 5,000 and 50,000.[9] Thus, integrating the deployment of fiber in the building and repairing of federal and federally subsidized highways and roads offers a cost-effective and sustainable means to bring robust fiber connections to nearly every community in the U.S.

The 2009 Omnibus transportation bill is expected to be a multi-hundred billion dollar allocation over a five-year time-frame, funding major surface transportation projects in numerous Congressional districts as well as general funding to maintain, expand, and improve the country's transportation infrastructure, including highways and roads in the NHS. Extending funding to mandate and deploy conduit and fiber along Federal-aid and direct Federal highway construction and resurfacing projects would create, over the life of the transportation bill, substantial new options for interconnecting broadband networks, decreasing bottlenecks, increasing competition, and spurring a new generation of broadband entrepreneurship.



Source – Federal Highway Administration

Federal highway regulations already strongly encourage the accommodation of utility facilities along the existing right-of-way of highway projects.[10] Additionally, current highway funding can be utilized to offset the cost of accommodating a utility, including the cost of buried "utility tunnels" to accommodate telecommunication lines.[11]

The Federal Highway Administration (FHA) estimates that 90 percent of the cost of deploying fiber in public rights of way along roadways is associated with digging up and repairing the road to install the buried fiber.[12] Thus, it is both expedient and significantly cheaper to install conduit and fiber while a roadway is already being substantially repaired, reconstructed or built. Installing conduit and fiber in open trenches during road construction, costs between $10,000 and $30,000 per mile.[13] Low-end construction costs for highways are around $3 million per lane, per mile, although they can be substantially higher depending upon the area.[14] Thus, adding fiber would increase highway construction costs by as little as 1 percent on average.

The 2005 Safe, Accountable, Flexible, Efficient Transportation Act (SAFETEA-LU) provided guaranteed funding for highways, highway safety, and public transportation totaling $244.1 billion.[15] This included the authorization of $193 billion to the Federal-aid highway program (funded from Highway Trust Fund receipts) and $24 billion in earmarks for 6,371 special projects.[16] SAFETEA is set to expire in 2009 and Congress will need to pass a new transportation bill in order to reauthorize the Federal-aid highway program. This provides an enormous opportunity to begin a systematic effort to build and upgrade a nationwide broadband infrastructure.

In FY 2007, nearly 24,000 miles of Federal-aid highways and roads or approximately 15 percent of the NHS system was newly constructed, reconstructed, upgraded, restored/rehabilitated, and resurfaced.[17] Using this as a baseline, a conservative estimate (conduit and fiber costs = $30,000 per mile) of the cost of funding and mandating the installation of fiber over the five-year span of the transportation bill is approximately $3.6 billion to install 120,000 miles of conduit and fiber. Assuming the baseline is much lower and just 5 percent of the system, the cost would be approximately $1.2 billion to install over 40,000 miles of conduit and fiber.

The Benefits

- **Increase high-speed broadband access across the nation.** The fiber build-out will provide the necessary middle-mile and backbone connections to facilitate high-speed connectivity in communities across the country. This proposal would reduce barriers to market entry by lowering build-out costs for a multitude of service providers. This would benefit everyone from private industry to rural telephone cooperatives and municipalities seeking to provide their communities with advanced telecommunication services, such as IPTV and high-quality voice and video telephony. The infrastructure would also dramatically improve the reach and capacity of wireless

broadband networks. For example, once a fiber build-out is completed along a stretch of highway or major thoroughfare, wireless routers could be easily connected, offering considerably faster speeds and capacity than many current wireless networks that currently lack ubiquitous wireline backhaul. This would boost the deployment and improve the affordability of both commercial and community WiMax and mesh Wi-Fi networks. The infrastructure would also facilitate a switch to intelligent transportation systems, a priority for the Department of Transportation.

- **Promote economic growth and entrepreneurship, especially in rural areas.** The new growth sectors that will drive the U.S. economic recovery include medicine, agriculture, energy, and clean technology – all of which greatly benefit from a major build-out of telecommunications infrastructure. Lack of access to high-speed broadband continues to be a considerable impediment to attracting industry and business to low-cost rural areas.[18] With fiber running along a highway, a company that might not otherwise locate its offices in a rural or exurban area could build its own connection and purchase wholesale access to that link. Increased capacity also provides improved prospects for desperately needed distance learning, telehealth services, and telecommuting job opportunities.

- **Create a more secure and robust telecommunications network.** Currently, there are eight interconnection regions for the Tier 1 ISPs who control the core of the Internet.[19] This relatively small number of interconnects are increasingly susceptible to equipment failure and potential security concerns. Facilitating the dramatic increase of interconnection points bolsters the redundancy and robustness of this critical national telecommunications network, helps eliminate points of failure, and thus creates a more secure and faster network.

- **Technological advancements in transportation.** The Department of Transportation (DOT) has expressed serious interest in utilizing wireless communications for an intelligent transportation system to manage traffic flows and improve safety. With fiber running along highways and interstates across the country, DOT would have ample access to the high-capacity network infrastructure necessary for these uses. As transportation infrastructures become increasingly "smart," they will need broadband capacity. Laying fiber in a systematic manner is a proactive measure that will both lessen disruption and dramatically decrease the overall costs of these necessary upgrades in coming years. By laying adequate fiber capacities for multiple services and users, this initiative creates the foundation for a diverse array of next-generation transportation infrastructures.

The Key Elements

The key to this proposal is a fundamental commitment to building an open and accessible high-speed links, allowing a multitude of service providers and services to utilize the infrastructure on a wholesale, non-discriminatory basis, and ensuring that this public investment is as beneficial as possible to the maximum number of potential users.

The fiber build-out is composed of seven key facets:

1. Fiber bundles of between 144 and 288 strands should be laid to ensure ample capacity for the foreseeable lifespan of the equipment. An easily accessible ductwork and conduit system should be installed to allow for additional fiber bundles to be deployed;

2. Fiber links should have easily accessible interconnection points and specific community connection points to provide local ISPs, municipalities, and businesses with access to the infrastructure. Interconnection points and facilities for providers to co-locate equipment should be made available on a non-discriminatory basis, allowing for a diverse array of services to utilize available fiber resources;

3. Common carriage and wholesale access on these links must be mandated. Any entity (lessor) can bid to build, operate, and maintain the roadside fiber assets; however, they must allow wholesale access and common carriage along both these links as well as any additional links necessary to reach an open interconnection point to any and all entities (lessees);

4. Lessors must provide AUP-free use of these fiber assets and any additional links necessary to reach an open interconnection point to lessees;

5. Lessees include any and all entities seeking to offer data services, both for-profit and non-profit, including municipalities;

6. A system must be set up to accurately assess and map the build-out process and functionality. This network research and data collection

will enhance transparency and provide critical information for operators, service providers, lessors, and lessees seeking to utilize fiber facilities and provide services in particular areas; and,

7. To ensure a long-term return on investment for taxpayers, a revenue-sharing agreement must be implemented wherein lessors contribute, on a yearly basis, to a "Digital Excellence Fund." This fund could mirror the "Community Technology Fund" negotiated as part of the Pacific Telesis/SBC merger in California, in which the merged entity provided $50 million over ten years to NGOs to bring technologies to traditionally underserved communities. The Fund should also support continuing fiber build-outs and provide funding for digital literacy and educational programs to increase broadband adoption.

States and localities own and therefore are responsible for the maintenance and upkeep of Federal Interstate Highways and the urban and rural roads in the National Highway System.[20] They will similarly own the conduit and fiber assets running along their highways and roads. The Federal-aid Highway Program is not a "cash up-front" program. States are first notified of funds available for their use, projects are approved and the work is started, and then the Federal government makes payments to the states for costs as they are incurred on projects.[21]

It is imperative that no matter what entity a state or locality contracts to build and/or operate the publicly-funded fiber links, conditions attached to federal funding must require that all facilities remain open, accessible, and transparent. This entails either a multi-tier separation plan whereby operators that offer wholesale fiber connections and business fiber connections are not service providers, or it could allow for a service provider to vertically integrate, but with clear requirements to provide for wholesale access to end-to-end transport services. These operating parameters ensure that both new entrants as well as telecommunication and cable incumbents can build, operate (light-up) the fiber, and access this fiber infrastructure.

Conclusion

The Interstate Highway System and broader National Highway System serve as the backbone of transportation and commerce in the United States. A 21st Century Broadband Superhighway would serve as the backbone for communication and commerce in the 21st century. Given the nation's current woeful standing in terms of broadband adoption, availability, speeds, and prices compared to other developed nations, a dramatic intervention is necessary to maintain U.S. technological and economic competitiveness.

It was federal leadership and funding that helped build ARPANET and NSFNET, the research networks that served as the foundation for the Internet. Once again, it will take a national effort to regain our technological standing. The U.S. needs a sustained broadband build-out effort that brings the necessary infrastructure to communities across the country and provides the speeds and capacity to meet, not just the communication needs of today, but the demands of tomorrow. Mandating and funding the deployment of high-speed, open access fiber bundles along all Federal-aid highway and direct Federal highway projects offers a cost-effective and sustainable means to achieve these goals, bringing high-speed connectivity to nearly every community and providing the foundation for universal, affordable access to high-speed broadband.

Endnotes

[1] *See* "OECD Broadband Portal," Organisation for Economic Cooperation and Development, http://www.oecd.org/sti/ict/broadband.

[2] Since 1978, Congress has passed highway legislation as part of larger, more comprehensive, multi-year surface transportation acts. Most surface transportation acts are major multi-year bills, such as the Intermodal Surface Transportation Efficiency Act (ISTEA) and the Transportation Equity Act for the 21st Century (TEA-21)1, each of which covered a 6-year time span. They also can come in the form of a stop-gap funding bill, designed to extend the program and keep it operational while more comprehensive authorizing legislation is debated. The most recent multi-year reauthorization act for the FAHP, the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEALU). Passed in August 2005 it is set to expire in 2009. *See* "Financing Federal Highways," Office of Legislative and Governmental Affairs, Federal Highway Administration, March 2007, 2, http://www.fhwa.dot.gov/reports/financingfederalaid/financing_highways.pdf.

[3] Jim Duffy, "Don't expect video to exhaust fiber glut," Network World, Feb. 15, 2007, http://www.networkworld.com/news/2007/021507-dont-expect-video.html.

[4] *See* "Encouraging Broadband Deployment," National Telecommunication Cooperative Association, http://www.ntca.org/images/stories/Documents/Advocacy/PositionPapers/encouragingbroadbanddeployment_ntca2008.pdf.

[5] Ibid.

[6] *See* T-Mobile, "Reply Comments," Federal Communications Commission, WC Docket No. 05-25, August 15, 2007, http://www.usdoj.gov/atr/public/workshops/telecom2007/submissions/227837.htm.

[7] *See* "AT&T/BellSouth Merger Commitments," Cybertelecom, http://www.cybertelecom.org/docs/attbsconditions.htm#bac

[8] *See* "A Summary of Highway Provisions in SAFETEA-LU," U.S. Department of Transportation, Federal Highway Administration, August 25, 2005, http://www.fhwa.dot.gov/safetealu/summary.htm.

[9] Rodney E. Slater, "The National Highway System: A Commitment to America's Future, U.S. Department fo Transportation, Federal Highway Administration (Spring 1996), http://www.tfhrc.gov/pubrds/spring96/p96sp2.htm.

[10] *See* 23 CFR 645(b) § 645.205(b).

[11] *See* "Utility Relocation and Accommodation of Federal-Aid Highway Projects, Office of Program Administrator, Federal Highway Administration, Sixth Edition (2003), p. 42, http://www.fhwa.dot.gov/reports/utilguid/if03014.pdf.

[12] *See* "Telecommunications Handbook for Transportation Professionals," U.S. Department of Transportation, Federal Highway Administration, September 2004, p. 41, http://ops.fhwa.dot.gov/publications/telecomm_handbook/telecomm_handbook.pdf.

[13] *See* Rita R. Stull, "Launching Local Fiber-to-the-Premise, Network Using JULIET," Presentation, http://www.teledimensionspublicsector.com/downloads/21st%20Century%20Broadband%20rev2.pdf.

[14] The Federal Highway Administration only collects bid price data to track costs in individual states. As such available data to compare costs across states is limited. *See* "Comparison of States' Highway Construction Costs, United States General Accounting Office, November 23, 2003, http://www.gao.gov/new.items/d04113r.pdf. A 2002 report from the Wisconsin Department of Transportation surveyed 24 states to obtain cost comparisons. The average construction cost per lane, per mile for highways was $2.3 million. *See* "Highway Construction Cost Comparison Survey," Wisconsin Department of Transportation, April 2002, p. 7, http://www.wsdot.wa.gov/biz/Construction/pdf/I-C_Const_Cost.pdf.

[15] *See* "A Summary of Highway Provisions in SAFETEA-LU," *supra* note 8.

[16] Ibid.

[17] *See* Table FA-10, Highway Statistics 2007, Federal Highway Administration, http://www.fhwa.dot.gov/policyinformation/statistics/2007/fa10.cfm.

[18] For an example *see* Robert L. Mitchell, "Rural Broadband Drought Puts Hurt on Retailer," Computerworld Blogs, http://blogs.computerworld.com/node/6093.

[19] *See* W.B. Norton, "The Art of Peering: The Peering Playbook," v1.2, p. 1, http://www.blogg.ch/uploads/peering-playbook.pdf.

[20] *See* "Frequently Asked Questions," Celebrating 50 Years: The Eisenhower Interstate System, U.S Department of Transportation, Federal Highway Administration, http://www.fhwa.dot.gov/interstate/faq.htm.

[21] *See* "Financing Federal Highways," *supra* note 2, p. 11.