



An Interstate Fiber Utility

Executive Summary

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Prepared by:

Fiberutilities Group, LLC
222 Third Street, SE, Suite 500
Cedar Rapids, IA 52401
(319) 364-3200

www.fiberutilities.com

AN INTERSTATE FIBER UTILITY

“The basic fallacy is the assumption that broadband service is fundamental. It is not. CFR (Copper, Fiber, Radio) is fundamental.” Bob Frankston¹

Without CFR (Copper, Fiber, Radio), broadband service doesn't exist. It's that simple. CFR is absolutely fundamental because it is the infrastructure that powers 21st century communication and bridges the global community. The purpose of this Executive Summary is to outline how an Interstate Fiber Utility (IFU) will serve as an essential, cost-efficient foundation for that infrastructure and, at the same time, help transform the American economy.

INTRODUCTION

There is no better example of what is meant by “essential infrastructure” than the country's 160,000 mile National Highway System (NHS), comprised of both interstate and national highways. It is open to all, operates on a non-discriminatory basis and offers the physical assets necessary for an agreed upon public purpose of providing a national roadway system to connect America. Further, it is priced at cost and its ownership and operation falls within the realm of government.

Now, the country is at a point in time in which a new kind of “essential infrastructure” is needed. Creating a low-cost fiber optic infrastructure, leveraging the established rights-of-way of the NHS, will empower individuals, businesses, municipalities and countless other entities to fully realize the benefits of very high-speed broadband connectivity anywhere, and everywhere.

Based on the utilization of “dark fiber” and the installation of empty conduits for additional fiber, an Interstate Fiber Utility will have a national presence, offering an open and virtually unlimited capacity² for broadband products and services. It will provide ubiquitous and affordable connectivity at a fraction of today's costs; dramatically improve the security, stability, and growth of the public Internet; have a profound impact on the economy and creation of new jobs; and position the United States as the global leader in open access fiber infrastructure.

INTERSTATE FIBER UTILITY

The Interstate Fiber Utility (IFU) will deploy several empty conduits for later deployment of fiber cables within those conduits. It will also utilize at least one of the conduits to install “dark fiber,” which refers to fiber optic cables that are deployed without the electronics needed to

¹ Bob Frankston worked on the Multics projects as well as used the predecessor of the Internet beginning in 1969. Commercially he supported online services since 1966. In 1979 he went from the mainframe world to the PC industry and co-founded Software Arts with Dan Bricklin where he implemented VisiCalc. He was with Lotus Development from 1986 to 1990 where he created Lotus Express (and started Lotus.com though it was before the Web). He was at Microsoft from 1993 to 1998 where he championed "IP Everywhere" thus making networking accessible to consumers as "Home Networking". He is now pursuing a number of projects among them, trying to explain the larger concept of ambient connectivity. See <http://frankston.com>

² Capacity is constrained not by the fiber, but by the electronics that “light” the fiber. In addition, using multiple light paths (lambdas) on the same fiber eliminates almost all capacity issues and allows completely separated users on the same physical medium without any possibility of interference. Current theoretical limits are estimated at 200 terabits of data per second per strand of fiber. One Terabit is 1,000 Gigabits per second.

activate or “light” the individual fiber strands contained within the cables.³ The deployment will use the rights-of-way of the entire National Highway System, and the IFU structure will be specifically designed to allow users to lease empty conduits and/or dark fiber at the individual fiber strand level. Users will be the federal government, other public entities, and private entities operating for any public or private purpose, and will specifically include the existing telecom carriers.

The IFU will be owned and operated by a public company with the Federal Government providing loan guarantees and buying a substantial portion of the total available capacity.⁴ The mission of the IFU is to provide dark fiber and empty conduits on a cost-effective basis—with the exception of first/last mile connectivity—to the following networks:

- **Public Purpose Networks (PPN)** – These networks serve public safety, health care, education, libraries, local government entities, the Department of Transportation, the Department of Homeland Security, the Department of Defense and community anchor institutions. Depending on their level of need and expertise, these entities would use some combination of dark fiber and empty conduit for network creation.
- **Entrepreneur and Enterprise Networks (EEN)** – These private, vertical “Intranets” provide highly secure, very high capacity connectivity to new and existing businesses, and “unload” their traffic from the public Internet. Private networks would be the most likely use of dark fiber installation, using third party expertise to create highly secure, purpose built networks for their own use.
- **Carrier (Wireline and Wireless) Networks (CN)** – These networks serve existing carriers and will be used for augmenting and enhancing carrier capabilities, especially their ability to expand coverage of next-generation wireless networks with very high speed backhaul (recognizing that most wireless towers parallel the highway system). Existing carriers would be the most likely customers for empty conduit, given their expertise in fiber installation, activation and operation.

The IFU approach recognizes that the Federal Government can exercise control over highway rights of way via funding availability, and that as a loan guarantor (and “anchor tenant”), it can provide the necessary impetus for state and local government cooperation with the public company creating and operating the IFU. Additionally, the cost of constructing the infrastructure is relatively independent of the number of optical fiber strands in a cable or the number of empty conduits installed at the same time. Installing and/or activating dark fiber is left to users and is independent of the services to be provided. Finally, the applications enabled by users can be provided independently from the operation of the dark fiber/conduit infrastructure.

JUSTIFICATION

Creating an Interstate Fiber Utility (IFU) will have a significant, positive impact on a number of fronts. The current approach to network deployment—an illogical and highly inefficient practice

³ The majority of the cost of construction for any fiber optic network lies in construction process, with the cost of the fiber itself being a significantly smaller portion. The industry has developed techniques for “blowing fiber” into previously installed conduit at significantly reduced cost.

⁴ “Capacity,” in this context, is used in its generic sense, with the Federal Government getting access to sufficient dark fiber or empty conduit to meet its current and planned future needs. See footnote 8 below, and also the discussion below in the section entitled “Public Ownership.”

involving multiple construction projects and multiple owners throughout the same highway rights-of-way—would be replaced by a more streamlined, logical, and cost-effective approach. The NHS rights-of-way are a public resource, and an IFU will take advantage of that resource. By implementing a policy of “digging once” for any construction, installing very high fiber count cables along with empty conduit for those entities that wish to install their own fiber and for future expansion and by limiting the ongoing operational and maintenance complexities of multiple owners building in the same physical rights-of-way, an IFU will create significant cost and operational efficiencies. It also will make available an abundant supply of dark fiber and conduit for countless public and private uses, including:

- Enhancing the government’s ability to fully enable Public-Purpose Networks;
- Creating a business-friendly environment for Entrepreneur and Enterprise Networks; and
- Providing an opportunity for Carrier Networks to expand and enhance existing carrier services.

Creating and operating empty conduit and dark fiber as a shared, open, equal access “utility” will firmly establish the basis for much lower cost structure for all networks. The savings from “digging once” and a single utility approach frees up billions of dollars for government, entrepreneurs, enterprises and carriers to fund new approaches and applications that will improve the end users’ experience.

THE UTILITY CONCEPT

Without question, among America’s greatest accomplishments of the 20th century was the creation of the interstate highway system, which effectively brought the nation together and sparked unparalleled economic growth and development. At its heart, the creation of the Eisenhower Interstate Highway system was the creation of a public utility—an entity that exists to provide an essential public service at cost.

Utilities, whether owned by the government or by private entities, provide a fundamental service, lower costs because they are shared, are open to all on a neutral basis and empower commerce and connectivity. Just as the interstate highway system was created to meet the very real transportation needs of Americans in the 20th century, a national Interstate Fiber Utility will serve the same essential, unifying purposes in today’s increasingly interconnected global community.

By providing an abundant and available supply of empty conduit and dark fiber for use by Public Purpose Networks, Entrepreneur and Enterprise Networks and Carrier Networks—and doing so in a more cost efficient manner—government, individuals, businesses, municipalities and countless other entities will benefit from essential service at a fraction of today’s cost.

EFFECT

The creation of an Interstate Fiber Utility (IFU) would positively impact nine out of ten Americans. Since 90 percent of the United States population is within five miles of the National Highway System (NHS), interconnection would become more affordable, allowing private and/or public/private initiatives to create local broadband solutions using very high speeds in a very secure environment for their customers and constituents. Further, because almost 70 percent of the NHS runs through rural areas, an IFU would remove the rural distance penalty and greatly improve broadband connectivity between rural and metro areas of the country.

Figure 1

The general approach is to create local access at every conceivable point via “local” conduit and dark fiber cable(s) to enable users to gather traffic and deliver it to access “plazas” or service centers at regeneration sites, approximately every 30 to 60 miles. These plazas could become the “carrier motels”⁷ of the future and greatly improve the ability of users in rural areas to connect with metropolitan areas. Transit or “express” conduits and dark fiber cable(s) between the plazas will connect to major Points Of Presence (POPs) in metropolitan areas. The plazas/sites will be established with initial structures/huts, power and generators, but without the electronics needed to activate the dark fiber.

The resulting infrastructure will be managed by a public company as a “utility,” with uniform standards for interconnection. As noted above users could be Public Purpose Networks created by various levels of government; Carrier Networks created by telecom carriers for augmenting, connecting or extending their existing networks; Entrepreneur and Enterprise Networks, both public and private, creating purpose-built networks for their specified uses and users; and any other entity that needs highly secure, limited access connectivity between two or more geographic points.

- An estimated capital budget of \$19.3 billion to \$21 billion⁸ will cover the total capital costs required for deployment of dark fiber plus additional, empty conduits along the 46,700 miles of interstate and 116,700 miles of national highway systems. Annual IFU operating costs are estimated at \$114 million per year and will be covered by user fees. The Federal Government will contract with qualified private entities for staged operational support during construction and initial deployment.
- The project can begin immediately upon approval by the appropriate legislative and regulatory bodies, and a commitment by the Federal Government to acquire and pre-pay for a significant portion of the installed infrastructure.⁹ If given high national priority, it can be completed within five years.
- The IFU will be operated on a completely passive basis, meaning the actual activation of any fiber-based connectivity solution will be left to users.¹⁰

⁷ Fred R. Goldstein coined this term in 2009; he is the principal of Ionary Consulting (www.ionary.com) and author of *The Great Telecom Meltdown*, Artech House, 2005.

⁸ The lower number is based on three conduits with one 864-count fiber cable; the higher number includes three additional empty conduits along the entire 163,400 miles of the National Highway System. Lighting one pair of fibers with multiple wavelengths for the entire route for network management purposes would cost about \$800 million, and would, by itself make tens of Gigabits of capacity available for, e.g., the Federal Government.

⁹ The Federal Government could, for example, reserve one-third of the conduit, one-third of the installed dark fiber for a pre-payment commitment of one-third of the construction cost.

¹⁰ In current network terminology, an Interstate Fiber Utility would consist of empty conduit plus some dark fiber (no electronics) operated and controlled at the physical layer only (Layer 1 for fiber, Layer 0 for empty conduit). Users would add electronics to light their leased fiber strands in a manner and using the technology chosen by them (Layer 2 and above), paying only for the right to use the dark fiber for a period of time, and at an allocated rate (e.g., based on the number of fibers leased to the total number of fibers available) that covers operational costs and provides a reserve for future growth, extensions, moves, adds and changes. Conduit users would install their own fiber, then light and use it in any manner they choose, paying only for the right to use the conduit for a period of time, and at an allocated rate (e.g., based on the number of conduits leased to the total number of conduits available).

- Typical contracts for the use of fiber strands or conduits will be for five to twenty-five years and will mirror current Indefeasible Right of Use (IRU) agreements used in the telecom industry. These agreements will be subject to forfeiture if the fiber strands are not activated/installed or in use for a designated period of time.
- A neutral (non-carrier) public management company will operate and maintain the infrastructure, as well as manage and facilitate interconnection to leased dark fiber strands for IRU holders and conduit lessees.
- Depending on the structure of the public company, the Federal Government may have some oversight responsibilities.¹¹

The IFU approach allows for maximum flexibility and control because users provide the electronic and optical equipment technology needed to activate or “light” their leased fiber strands, or provide their own fiber in leased conduit. Because the IFU is passive, it will not be subject to obsolescence during the life of the fiber and conduit. As fiber transmission technology changes, users can take advantage of those changes by adjusting the way they use the dark fiber infrastructure without the necessity of new infrastructure deployment.¹²

Although an IFU would be owned, maintained and managed as a utility open to all users, those that choose to use it will maintain full operational control of the connectivity they create on the dark fiber strands and the conduit they lease. This is a profound benefit of the IFU approach. While other strategies rely on regulatory manipulation of privately owned networks, in an IFU individual users will control their own networks and serve as the primary drivers of access and, ultimately, cost.

PUBLIC OWNERSHIP

While it is certainly possible for the Federal Government to choose full ownership and financing of essential infrastructure there are viable and proven alternatives. The proposal here is for a public/private partnership approach in which the IFU is formed as a public company with the Federal Government providing initial loan guarantees and partial capital funding by prepaying for a substantial portion of the capacity, as well as helping to secure uniform access to rights-of-way.¹³ The remaining needed capital could be raised via a public stock offering. The FCC crafted such a model of public/private partnership when implementing the Satellite Act of 1962 (see more details on this Act in the Precedents section below). The Federal Government’s contribution should also be measured by its commitment to becoming the world leader in providing broadband services to its citizens. Ultimately, the price of broadband as delivered depends on the level of federal funding for pre-payment plus the amount of private investment available. The goal of the IFU approach is to ensure that fiber strands and empty conduits can be

¹¹ The Tennessee Valley Authority is one possible model for governmental oversight. Another is the Satellite Communications Act of 1962. See the text in the “Precedents” section below.

¹² The actual life of fiber optic cabling is dependent on many factors but is generally assumed to be at least 25 years. One other point that bears recognition: practically all existing long-haul fiber plant in the USA was built in the 1980’s and 1990’s. A significant portion is approaching 20 or more years of age, and may not be fit for the kind of very high-speed (10 Gbps or more) networks now being deployed. By placing fiber in conduits where efficiently possible, replacement or upgrading is much less expensive than construction of a completely new fiber route.

¹³ The intent is to have a self-sustaining operation once deployed, with user fees sufficient to cover operations, maintenance and upgrades. Initial government investment is the catalyst for infrastructure creation.

leased at a very low price to any public or private entity, while still covering operations and maintenance costs in addition to a regulated return to the public shareholders.

IMPACT ON EXISTING CARRIER INFRASTRUCTURE

Today's privately owned fiber infrastructure remains essential for connecting many important locations throughout the country. This will continue as long as it is financially viable and technically useful. While the first purpose of the Interstate Fiber Utility is directed at Public Purpose Networks, the Carrier Networks will be augmented and enhanced over time by having an abundance of dark fiber and conduit available to them on a nationwide basis.

In addition to Public Purpose Networks and Carrier Networks, there is high public and private demand for Enterprise and Entrepreneur Network connectivity. Their common goal is to lower costs for the fiber infrastructure necessary, and in most cases that fiber infrastructure simply is not available from existing carriers. While there is a significant number of privately lit networks around the country—which indicates a solid understanding of the value of dark fiber¹⁴—this doesn't alleviate the great public need for dark fiber infrastructure on a national scale.

IMPACT ON PUBLIC INTERNET

Without question, the impact that an Interstate Fiber Utility (IFU) will have on the public Internet is profound. While the consensus is that it is unlikely anyone could bring down the entire Internet¹⁵, there is little doubt that there are major problems that an IFU would address. With a newly created fiber infrastructure in place, and countless new independent and unaffiliated networks created, a huge volume of traffic would be "unloaded" from the public Internet onto the IFU networks—which ultimately would have a positive impact on privacy, piracy and capacity issues.

IMPACT ON THE ECONOMY

There is no way to accurately project the precise impact an Interstate Fiber Utility (IFU) will have on the American economy and jobs. While the creation and growth of the Internet has reshaped and transformed the nation's economy, that impact has only been measured by looking backward. There are numerous studies addressing the impact of "broadband" on economic factors. For instance, two recent studies project the creation of 50 jobs per each \$1 million

¹⁴ National Lambda Rail is probably the most visible non-carrier network; many other entities, including commercial enterprises, public governments, schools and other agencies, as well as the Department of Defense already have private networks, either owned or leased. One hospital system in Iowa, for example, owns and operates over 2,100 route miles of private fiber optic network.

¹⁵ *"Indeed, the closest the public internet has come to catastrophic failure was in January 2001 when large-scale "denial-of-service" (DoS) attacks - which typically involve bombarding a target server with spurious requests for information to slow it down or stop it - took 10 of the 13 DNS servers offline. The internet itself, however, continued to function because caching servers - computers, often owned by internet service providers (ISPs) or large commercial organisations, which operate a subset of the DNS function - were unaffected. Caching servers can function autonomously for some time. Eventually, however, they have to refer to the main DNS servers for system upgrades, which would cause disruption. As a result of the 2001 attacks, "anycast" load-balancing technology, which routes traffic to the nearest available server, was deployed. This proved effective against a second DoS attack in 2007. Six DNS servers were targeted but only three - where anycast technology had yet to be installed - failed.* United Nations Public Administration – 9/17/09.

<http://www.unpan.org/Regions/Global/PublicAdministrationNews/tabid/102/mctl/ArticleView/ModuleId/1461/articleId/20089/Internet-crash--could-it-really-happen.aspx>

invested in broadband. Based on that scenario, an IFU would create, directly and indirectly, 950,000 jobs.¹⁶

However one measures the “jobs” impact, there is no doubt that the availability of low-cost dark fiber plus empty conduit will spur an enormous amount of entrepreneurial activity, which is the true engine for jobs in the American economy. In the same way that the National Highway System (NHS) transformed 20th century America, an IFU will catalyze entirely new categories of employment with incalculable benefits for the 21st century and beyond.

PRECEDENTS

Finding direct precedents where new technology has completely reshaped America’s communicative and economic landscape is problematic. However, there are at least two instances in history that demonstrate how visionary government efforts have done just that.

- The Eisenhower Interstate Highway System championed the evolution of efficient, cost effective travel and transport of goods and services. This visionary approach resulted in the largest and most successful public works project in American history, and helped launch the huge economic expansion years of the 1960s, ‘70s ‘80s and ‘90s.
- The Satellite Act of 1962, established during the Kennedy Administration, created a government-sponsored company with partial public ownership (a public/private partnership)¹⁷ for international satellite deployment and in competition with terrestrial circuits provided by AT&T. This satellite deployment was the forerunner to satellite delivery of TV programming and is credited with the formation of the cable and satellite TV industry as it exists today.

¹⁶ Information Technology and Innovation Foundation, a technology think tank, and Speed Matters, the campaign of the Communications Workers of America: “For every \$5 billion dollars invested in broadband, according to the two groups, 250,000 jobs are created, including 100,000 direct and indirect jobs from telecom and IT equipment spending plus another 150,000 in “network effects” spurring new online applications and services.” http://broadbandcensus.com/2009/07/broadband-investment-spurs-business-growth-and-job-creation-studies-find/?utm_source=BroadbandCensus.com+Latest+News&utm_campaign=effedb47ec-News+Alert+07247+24+2009&utm_medium=email

¹⁷ “Perhaps more important would be the IPO (1964) materials for COMSAT. . . . the essence of the IPO was that it raised \$200 million in capital for the new company and spelled out the governance as well. As I recall, the raise consisted of two different classes of stock. The A units were dedicated to the Common Carriers who did international business and consisted of 5 million shares at \$20 per share. The B units were sold to the public, also 5 million shares at \$20. The incorporators appointed a Chairman and CEO—Leo Welch—retiring CEO of Standard Oil, and Joe Charyk was appointed as President. I believe there were 12 members of the board, the chairman, then the President and three others representing the private shareholders, then four from the carrier group—including two from ATT, one from ITT and one from the independent carriers, and finally the President of the US appointed three—initially the CEO of GM, the head of the AFL-CIO, and head of an university. Interesting times. . . . the essence of this was that it was a public sponsored private corporation with very well defined reasons for being and plenty of government ‘oversight’ including, importantly the FCC. Also key to this was the requirement in the act/or imposed by the FCC that the carriers were obliged to use one circuit on the satellite network for every circuit they put on their trans-oceanic cables—a forced market. The carriers were also given an opportunity to invest in the earth stations as part of a consortium so they could add those investments to their rate base.” Private correspondence from H. Brian Thompson, Executive Chairman of Global Telecom & Technology (GTT), a global telecommunications network integrator, and head of the private equity investment and advisory firm, Universal Telecommunications, Inc., Vienna, Virginia. Mr. Thompson was a consultant to COMSAT from 1968 to 1977, then became owner of the company after it transitioned from a monopoly carriers’ carrier to a direct supplier of communications services in a competitive environment.

Both of these established precedents could serve as foundational models for the implementation of an Interstate Fiber Utility.

CONCLUSION

An Interstate Fiber Utility (IFU) will set the stage for a new age of global communication and American economic growth. Creating an abundance of dark fiber and empty conduit for new fiber deployment is “fundamental” for providing broadband services, and an IFU will drive the cost of a new fiber infrastructure to a fraction of what is spent today. In sum, an IFU will:

- Provide for the logical and efficient use of highway rights of way by “digging once”
- Allow multiple access points to users for simplified networking
- Share essential fiber infrastructure among many users thus spreading costs and ultimately reducing prices for services
- Enable Public Purpose Networks by connecting community anchor institutions, allowing libraries, community centers, public safety agencies, schools and health care institutions to share resources and become part of the world community
- Enable Entrepreneur and Enterprise Networks by allowing the provisioning of alternative infrastructure for vertical “Intranets” dedicated to various sectors of the economy, thus creating jobs in existing companies and new jobs in entrepreneurial companies
- Enable the focus of private sector Carrier Network construction to be on last mile connections allowing them to provide more and better services based on lowering the cost of “fundamental” inputs/infrastructure for their products, as well as providing a huge increase in the availability of wireless backhaul, thus speeding the adoption of truly expansive, high speed wireless access
- Enable carriers to secure empty conduit for expansion, upgrading and replacement for their existing fiber networks without the necessity for costly construction programs and difficult rights of way issues
- Remove the “distance penalty” for rural areas thus encouraging the spread of economic development to rural areas of the country and connecting all areas of the country regardless of location
- Make America the world leader in open access, dark fiber infrastructure

By focusing on the fundamental challenge, an IFU provides a logical and cost-effective path towards achieving the stated goal of the FCC: to provide ubiquitous, high speed, reasonably priced broadband access across America. An IFU will accomplish this by lowering costs in the most direct manner possible—by providing a huge increase in the total supply of dark fiber. An IFU will provide an essential fiber infrastructure for the entire nation.

An IFU should be considered a cornerstone of the FCC’s national broadband strategy.

ABOUT FIBERUTILITIES GROUP LLC

Fiberutilities Group, LLC is a professional utilities management company created in 2003. Our first project was to foster the formation of open access, fiber-optics based utilities in Iowa municipalities. Our effort evolved from a focus on local government needs, to assisting health care, education and Fortune 500 clients create purpose built networks, then to the realization of the importance of essential fiber infrastructure for the entire nation. Our initial efforts became the genesis for the current focus on professional management services, and on developing, executing and managing strategic, long-term connectivity solutions for public and private sector clients. In our business model clients own and/or control their underlying connectivity assets (fiber, optics, switching, etc.) and Fiberutilities manages those assets to achieve their specific business objectives. Currently we manage over 8,000 route miles of fiber infrastructure with associated electronics and equipment on behalf of clients in health care, finance, education and government. Our management team has more than 300 years of combined industry expertise in comprehensive network planning, building, operating and management. We enable our clients to successfully leverage their connectivity investment, achieve their business objectives and transform the way they do business. Fiberutilities is pioneering this nationwide initiative, an “Interstate Fiber Utility,” which will change the “fundamentals” of broadband delivery in America and usher in a new era of entrepreneurial activity and job growth.