An Interstate Fiber Conduit Utility (IFCU): Critical Infrastructure for the 21st Century

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AN INTERSTATE FIBER CONDUIT UTILITY

"The basic fallacy is the assumption that broadband service is fundamental. It is not. CFR (Copper, Fiber, Radio) is fundamental." Bob Frankston[1]

Without CFR, broadband service doesn't exist. It's that simple. CFR is absolutely fundamental because it is the infrastructure that powers 21st century communications and bridges the global community. The purpose of this white paper is to outline how an Interstate Fiber Conduit Utility (IFCU) would serve as an essential, cost-efficient infrastructure to meet the country's broadband needs 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. Further, it is priced at cost and its ownership and operation falls within the realm of government.

> *Our unity as a nation is sustained by free communication of thought and by easy transportation of people and goods. The ceaseless flow of information throughout the Republic is matched by individual and commercial movement over a vast system of interconnected highways crisscrossing the country and joining at our national borders with friendly neighbors to the north and south.*
>
> *Together, the united forces of our communication and transportation systems are dynamic elements in the very name we bear—United States. Without them, we would be a mere alliance of many separate parts.*
>
> President Dwight D. Eisenhower
> February 22, 1955

Now, the country is at a point in which a new kind of "essential infrastructure" is needed. Creating a low-cost network support infrastructure by 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 dark fiber, an IFCU would have a national presence offering open and virtually unlimited capacity[2]. It would

[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

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 CONDUIT UTILITY

The IFCU would deploy several empty conduits for later deployment of fiber cables within those conduits. It would 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 activate or "light" the individual fiber strands contained within the cables.[3] The deployment would use the rights-of-way of the entire NHS and the IFCU structure would be specifically designed to allow users to lease empty conduits and/or dark fiber at the individual fiber strand level. Users could be the federal government, other public entities, private entities operating for any public or private purpose, and will specifically include the existing telecom carriers.

The IFCU could be owned and operated by a private, publicly traded company with the federal government providing loan guarantees and buying a substantial portion of the total available capacity.[4] The mission of the IFCU would be 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** – These networks serve community anchors, such as public safety agencies, health care providers, educational facilities, and libraries, as well as local, state, and federal governments. 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 –** 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 most likely use dark fiber to create highly secure, purpose-built networks for their own use.

- **Carrier (Wireline and Wireless) Networks –** These networks serve existing carriers and would 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

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[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.

[3] The majority of the cost of construction for any fiber optic network lies in the construction process, with the cost of the fiber itself a significantly smaller portion. By placing fiber in conduits , replacement or upgrading is much less expensive than construction of a completely new fiber route. The industry has developed techniques for "blowing fiber" into previously installed conduit at a 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."

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 IFCU approach recognizes that the Federal Government can provide highway rights-of-way and that as a loan guarantor (and "anchor tenant"), it can provide the necessary impetus for state and local government cooperation with a publicly traded company creating and operating the IFCU. 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 dark fiber and conduits that would be provided by IFCU. Moreover, the applications enabled by users can be provided independently from the operation of the dark fiber/conduit infrastructure.

JUSTIFICATION

Creating the IFCU would have a significant, positive impact on a number of fronts. The current approach to network deployment—an illogical and highly inefficient practice involving multiple construction projects and multiple owners throughout the same 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 IFCU would take advantage of that resource. By implementing a policy of "digging once" for 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, the IFCU would create significant cost and operational efficiencies.

IFCU would also 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" would firmly establish the basis for much lower cost structures 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 user's experience.

THE UTILITY CONCEPT

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 NHS was created to meet the very real transportation needs of Americans in the 20th century, the IFCU would serve the same essential, unifying purposes in today's increasingly interconnected global community.

EFFECT

The creation of the IFCU would positively impact nine out of ten Americans. Since 90 percent of the United States population is within five miles of the 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 IFCU would remove the rural distance penalty and greatly improve broadband connectivity between rural and metro areas of the country.

Counties that contain NHS highways also host 99 percent of all jobs in our nation, including 99 percent of manufacturing jobs, 97 percent of mining jobs, and 93 percent of agricultural jobs.[5] Because of the high fiber count and potential interconnection points at easily reachable locations, the IFCU would provide the required public access framework for new and existing last mile connections, including critical community anchor institutions.

Through the creation of ~~–f~~undamental" fiber infrastructure resulting in lower cost and higher speed broadband, the IFCU would positively impact the lowering of green house emissions by reducing the need for personal/business travel.

PLANNING, BUILDING AND OPERATION

The IFCU will be planned, built and operated by a private, publicly traded utility that is non-carrier affiliated and non-vendor affiliated. This is essential in order to assure neutral, open, non-discriminatory access to any entity wishing to use the conduit or dark fiber to create broadband networks for public or private use. The IFCU would contain empty conduit plus hundreds of individual fiber strands installed in the established rights-of-way of the 160,000 miles of interstate and national highways that comprise the NHS (see Figure 1 below).

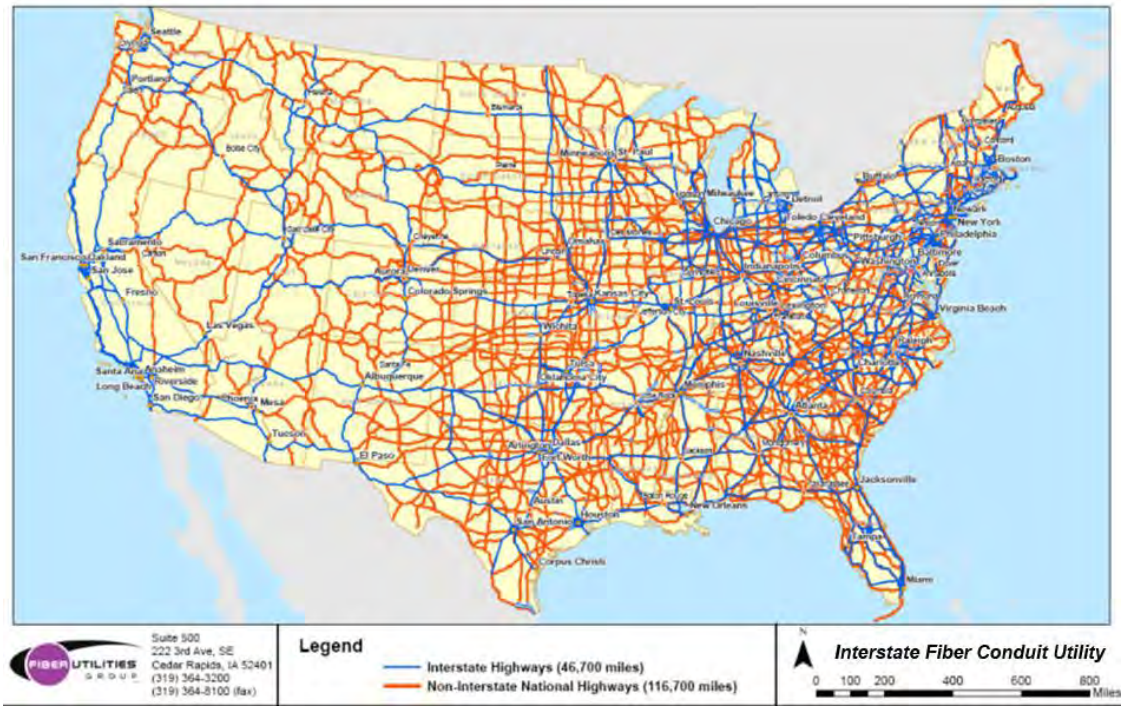

Figure 1

[5] The National Highway System: A COMMITMENT TO AMERICA'S FUTURE by Rodney E. Slater, Federal Highway Administrator, FWHA, PUBLIC ROADS On-Line (Spring 1996). http://www.tfhrc.gov/index.html

The general approach of the IFCU is to create local access at every conceivable point via "local" conduit and dark fiber cables 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 greatly improve the ability of users in rural areas to connect with metropolitan areas. Transit or "express" conduits and dark fiber cables between the plazas could connect to major points of presence in metropolitan areas. The plazas/sites could be established with initial structures/huts, power and generators, but without the electronics needed to activate the dark fiber.

As noted above, the resulting infrastructure would be managed by a private, publicly traded company as a "utility," with uniform standards for interconnection. As also 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 billion[6] would 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 highways. Annual IFCU operating costs are estimated at $114 million per year and would be covered by user fees. The Federal Government could contract with qualified private entities for staged operational support during construction and initial deployment.
- The project can begin immediately upon approval and a commitment by the Federal Government to acquire and pre-pay for a significant portion of the installed infrastructure.[7] If given high national priority, it can be completed within five years.
- The IFCU would be operated on a completely passive basis, meaning the actual activation of any fiber-based connectivity solution would be left to users.[8]
- Typical contracts for the use of fiber strands or conduits would be for five to twenty-five years and would mirror current Indefeasible Right of Use (IRU) agreements used in the telecom

[6] 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 160,000 miles of the NHS. 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.

[7] 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.

[8] In current network terminology, the IFCU 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 could 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).

industry. These agreements would be subject to forfeiture if the fiber strands are not activated/installed or in use by or for a designated period of time.

- A neutral (non-carrier) private utility company could 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 utility, the Federal Government could have some oversight responsibilities.[9]

The IFCU 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 IFCU would be passive, it would not be subject to obsolescence during the life of the fiber and conduit. As fiber transmission technology changes, users could take advantage of those changes by adjusting the way they use the dark fiber infrastructure without the necessity of new infrastructure deployment.[10]

Although an IFCU 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 they use and the conduit they lease. This is a profound benefit of the IFCU approach. While other strategies rely on regulatory manipulation of privately owned networks, the IFCU allows individual users to control their own networks and serve as the primary drivers of access and, ultimately, cost.

A PUBLIC-PRIVATE PARTNERSHIP

While it is certainly possible for the Federal Government to choose full ownership and financing of essential infrastructure, the IFCU proposal envisions a public-private partnership approach in which the IFCU is formed as a publicly traded, private company. The Federal Government would act as project catalyst by providing initial loan guarantees. It would also provide partial capital funding by prepaying for a substantial portion of the dark fiber and conduit space, as well as helping to secure uniform access to rights-of-way.[11] 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 become 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 IFCU approach is to ensure that fiber strands and empty conduits can be leased at a very low price to any public or private

[9] 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.

[10] The actual life of fiber optic cabling is dependent on many factors but is generally assumed to be at least 25 years. Considering that practically all existing long-haul fiber plant in the U.S. was built in the 1980's and 1990's, A significant portion ot this fiber may not be fit for the kind of very high-speed (10 Gbps or more) networks now being deployed. Thus, the IFCU is ripe for implementation.

[11] 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.

entity, while still covering operations and maintenance costs in addition to a regulated return to the public shareholders.

Other nations are aggressively moving ahead with similar infrastructure projects that rely heavily on partial public funding, private partnerships and wholesale open access. Those countries are leading the world in broadband deployment.

- The Australian government intends to spend $43 Billion (AUS) to subsidize construction of a next-generation, open access fiber optic network. The network will connect 90% of homes and businesses in Australia with speeds of 100 Mbps and will serve the remaining 10% by next generation wireless and satellite. Access to the network will be offered wholesale to all service providers. The Australian government will establish a new company that will own 51% of the network, with private companies invited to invest and provide technical expertise and resources.
- Singapore is developing its next generation fiber-to-the-home National Broadband Network (NBN). Singapore's Infocomm Development Authority selected a private firm to design, build and operate the NBN's fiber passive infrastructure, and will be given a grant of up to S$750 million. Another private firm, Nucleus Connect, was selected to design, build, and operate the NBN's active infrastructure and provide wholesale broadband connectivity to other operating companies and retail service providers.
- The Netherlands is a leader in European broadband, which is attributed in part to considerable government and municipal investment in fiber broadband infrastructure. While the Dutch government firmly believes in market forces shaping the next generation broadband infrastructure, it also sees the value of public-private partnerships and its role as stimulating development and competition, as well as providing aid and incentives. It established The Nederland Breedbandland, a public-private partnership, as an organization to bring together participants in the broadband industry, trade organizations, and the government to encourage broadband deployment and use. The Dutch government has provided $155 million in grants for three high-speed networks for research, as well as limited funding for municipal networks.

IMPACT ON PUBLIC INTERNET

Without question, the impact that the IFCU would have on the public Internet is profound. While the consensus is that it is unlikely anyone could bring down the entire Internet, there is little doubt that there are major problems that an IFCU 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 IFCU 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 the IFCU would 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 invested in broadband. Based on that scenario, an IFCU would create, directly and indirectly, 950,000 jobs.[12]

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 NHS transformed 20th century America, an IFCU would catalyze entirely new categories of employment with incalculable benefits for the 21st century and beyond.

PRECEDENTS

There are at least two instances in U.S. history that demonstrate how government efforts, such as the IFCU proposal, have completely reshaped the American landscape.

- The Interstate Highway System (which is part of the NHS) 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) for domestic and international satellite deployment that provided Americans with an alternative route and technology to meet their communications needs. 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.

Both of these established precedents could serve as foundational models for the implementation of the IFCU.

CONCLUSION

An IFCU would 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 the infrastructure that supports broadband services, and an IFCU will drive the cost of a new fiber infrastructure to a fraction of what is spent today. In sum, an IFCU would:

- 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 as well as local,

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[12] 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

state and federal governments, 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 and upgrading and replacement of 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 those areas 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, the IFCU would provide 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. The IFCU would accomplish this feat by lowering costs in the most direct manner possible—by providing a huge increase in the total supply of dark fiber. The IFCU would provide an essential fiber infrastructure for the entire nation.

The IFCU would also position the United States as the world leader in ‗open access' fiber infrastructure laying a foundation for 21st century jobs, while transforming the way we learn, work and play for the next 100 years.

ABOUT FIBERUTILITIES GROUP LLC

Fiberutilities Group, LLC is a professional utilities management company created in 2003. Its first project was to foster the formation of open access, fiber-optics based utilities by Iowa municipalities. The effort evolved from a focus on local government needs, to assisting health care, education and Fortune 500 clients create purpose built fiber networks, then to the realization of the importance of essential fiber infrastructure for the entire nation. The effort also 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. 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, Fiberutilities Group manages over 8,000 route miles of fiber infrastructure with associated electronics and equipment on behalf of clients in health care, finance, education and government. Its management team has more than 300 years of combined industry expertise in comprehensive network planning, building, operating and management. Fiberutilities Group is pioneering the nationwide initiative, an "Interstate Fiber Conduit Utility," which will change the "fundamentals" of broadband delivery in America and usher in a new era of entrepreneurial activity and job growth.

BIOGRAPHIES

Clark McLeod

Clark McLeod has been at the forefront of highly-competitive communications companies for three decades and is a recognized leader in the American telecommunications industry. The founder and Chairman of Teleconnect in 1980, Mr. McLeod led the effort to create America's first transcontinental fiber cable which preceded the later builds of the major carriers, AT&T, MCI and Sprint. By 1988, Teleconnect was the fourth largest long distance carrier in the United States. In 1992, Mr. McLeod founded McLeodUSA, which, by 2002, grew to become the largest independent competitive local exchange carrier in the nation employing over 10,000 people. In 2003 Mr. McLeod founded Fiberutilities Group in Cedar Rapids, Iowa.

H. Brian Thompson

H. Brian Thompson has been involved in the telecommunications industry in the United States and abroad since 1968 when he first served as a consultant to COMSAT and INTELSAT during their startup phases, and then during the 70's with ATT, and GTE. Mr. Thompson was in the executive leadership of MCI during the 1980s and as Chairman and CEO of LCI, and as Vice Chairman at Qwest during the 1990s. As Chairman of CompTel, Mr. Thompson was greatly involved in shaping the Telecommunications Act of 1996. Internationally, Mr. Thompson was Chairman of Comsat International, served as non-Executive Chairman of Telecom Eireann, and Chairman and CEO of GTS. Mr. Thompson was a founder of and later became Chairman of the Global Information Infrastructure Commission. Today, Mr. Thompson serves as Executive Chairman of Global Telecom & Technology (GTT) a worldwide telecommunications network integrator.

Rob Smith
Rob Smith has over 20 years of entrepreneurial, marketing business operations experience in the telecommunications and information technology industries. Rob's experience includes management and operations in local telephone service, long distance telephone service, data networking and facilities wireless telephone service, cable television and telephone directory publishing. Rob and a partner formed TeleGuam Holdings LLC in October of 2003 for the purpose of acquiring the Guam Telephone Authority from the government of Guam. TeleGuam Holdings partnered with Shamrock Holdings of Anaheim California to compete with several other bidders to acquire the 70,000 access line local exchange carrier for $150 million.

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