

BROADBAND

The second American revolution

SiFi Networks

Vol.2





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1

THE SECOND
American Revolution



BEN

As CEO of SiFi Networks, Ben Bawtree-Jobson was instrumental in the formation of the company and it successfully raising over \$1 billion – continuing to direct its private wholesale offering in the fiber-to-the-premise sector.

Ben has been at the forefront of developing FTTP models in the USA, building a unique business with a world leading team that will enable privately financed, large scale multi-tenant FTTP networks in the USA.

A handwritten signature in black ink, appearing to read 'Ben Bawtree-Jobson'.

MIKE

Mike Harris is a successful entrepreneur and technologist, having previously founded Total Network Solutions Ltd in 1989, which he later sold to UK telecoms giant BT in 2005. He subsequently co-founded SiFi Networks and is a current investor in the company.

He is also the chairman and owner of the New Saints Football Club in Wales, UK.

A handwritten signature in black ink, appearing to read 'Mike Harris'.



THE AVERAGE AMERICAN BROADBAND CUSTOMER MAY NOT KNOW IT, BUT THEY'RE NOT GETTING A VERY GOOD DEAL ON BROADBAND.

Their European and Asian counterparts in places like Iceland and Taiwan are already using next-generation Gigabit fiber networks, while American networks are still battling over the basic definition of what constitutes acceptable broadband.

At the same time, American cities are preparing to become smart cities of the future, laying the foundations for everything from smart traffic management to e-health apps — and in doing so, tackling inequality in the form of the digital divide.

It's clear that change is here. In the same way that colonialism, taxation, bad trade deals and poor governance triggered the American Revolution, the shortcomings of the American broadband model are prompting a technological revolution.

This revolution, in the form of open access fiber networks, seeks to challenge the century-old model used in the telecommunications industry, to bring it in line not only with the needs of consumers today, but the needs of smart cities of the future.

Since its inception over 100 years ago, the US telecoms industry has been characterized by a lack of competition. Whether it was the unregulated monopoly and duopoly of the original Bell System or the regulated

natural monopoly of AT&T, large companies have dominated.

Today, there is more competition in the sector than there has ever been, but still not enough to make it as dynamic as it could be. Far from satisfying the needs of consumers, the current makeup of the market continues to severely limit consumer choice for millions across the country.

As this book will go on to examine, the open access model of broadband seeks to build on the private model of broadband ownership, by separating the owner of the network — typically the service provider that invests in and builds the physical infrastructure — from the service providers that subsequently lease the network to provide retail services to consumers.

In doing so, we'll explore just how open access ultimately benefits consumers, because better competition results in better value offerings. But open access is more than just a wholesale platform — it's designed to provide the basic infrastructure for everyone from Internet Service Providers (ISPs) and mobile carriers to service providers and even municipalities, to live and work in the smart cities of the future. And so, we'll also explore how this is actually beneficial to service providers of all sizes, giving flexibility to large businesses and a lower barrier to entry for smaller ones.

The following chapters also contain interviews with specialists from all areas of the industry; from a business leader in Iceland, to the mayor of one of the first FiberCities® in the US, all the way to politicians, network architects and community advocates.

TIMELINE OF US TELECOMS

ADAPTED FROM MCDONOUGH, C.C. ET AL. (2017). US TELCO INDUSTRY HISTORY AS A PROLOGUE TO ITS FUTURE. AUSTRALIAN JOURNAL OF TELECOMMUNICATIONS AND THE DIGITAL ECONOMY, 5(2) 98.

1877

Unregulated duopoly between American Bell Telephone company and Western Union Telegraph

1879

Bell buys out Western Union Telegraph network and becomes unregulated monopoly protected by patent rights

1881

Bell acquires Western Electric, Western Union's manufacturing division, to block competition ahead of patent rights expiring

1885

American Bell creates American Telephone and Telegraph (AT&T) to provide long-distance telephone service

1893

Bell's basic patents expire, widespread competition ensues

1913

AT&T divests from Western Union and opens up long-distance network to independent exchanges

1913

Kingsbury Commitment. AT&T settles US Government antitrust challenge out of court

1910

Mann Elkins Act gives ICC jurisdiction over interstate rates charged by phone companies

1907

AT&T begins aggressive campaign to buy out independents with slogan "One policy, one system and universal service."

1907

49% of telephones now controlled by independent phone companies

1899

AT&T acquires Bell's assets. Divisions are: Long-lines, Equipment manufacture, R&D and Bell Operating Companies

1918

WWI, AT&T placed under Post Office control for a year. Rates go up, demonstrating problems with government ownership

1921

Willis-Graham Act gives ICC power over telco mergers: "there is nothing to be gained by local competition in the telephone business."

1922

AT&T signs Hall Memorandum, and agrees not to buy or merge with independent telcos

1934

Communications Act means FCC is now responsible for regulating interstate telephone services and wired and wireless services

1934

Under new FCC, AT&T becomes regulated monopoly with 80% market share

1959

FCC opens market to lease microwave frequencies to private users

1984

AT&T divests its 22 Regional Bell Operating Companies (RBOCs), bringing an end to 100 year dominance of telco market

1982

DoJ and AT&T agree to settle antitrust lawsuit. Terms of divestiture agreed

1980

FCC issues Computer II Order, distinguishing between basic (telephone) and enhanced (computer) services

1974

DoJ and MCI file antitrust suit against AT&T. Court rules in favor of MCI in 1980. Awards MCI \$1.8bn

1971

FCC rules in favor of more competition: "there is a public demand... and competition... is reasonably feasible."

1963

Microwave Communications Inc. (MCI) files request with FCC to become common carrier, approved 1969

1994

FCC begins competitive bidding process for wireless spectrum across US. RBOCs begin to buy

1996

Telecommunications Act modifies 1934 Act, promotes competition and reduces regulation

2002

FCC rules cable, DSL, and other wireline ISPs are information services not telecommunications services

2006

Four of the original RBOCs now form part of new AT&T Inc. Two are acquired by Bell Atlantic, rebranded as Verizon

2010

FCC Open Internet Order introduced, reinforcing net neutrality. ISPs must be transparent, not block content or discriminate traffic

2018

Following a challenge, the FCC repeals net neutrality, classifying it once again as an information service, not subject to common carrier regulations

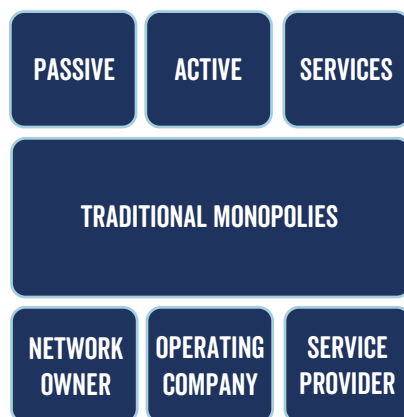
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WHAT IS
Open Access?

For much of the 20th century, telecoms networks were made up of copper cables, whether it was telephone wires, coaxial cables or even power lines. This was fine for the needs of consumers at that time because they were transmitting voice and low-bandwidth data.

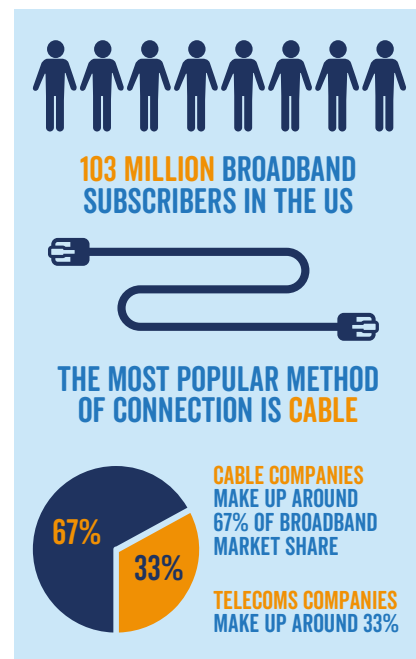
However, the needs of today's consumer are far removed from days gone by. Now, much of our lives are conducted online, whether it's learning a new skill using YouTube, spending time with friends and family streaming movies and TV shows on Netflix, or working from home and interacting with colleagues using video chat — all these activities require vast amounts of bandwidth.

THREE LAYER MODEL GRAPHIC



This is where network infrastructure is limiting. The upfront cost of building a large-scale network, along with digging trenches and navigating right-of-way permits has historically led to two problems. The first is that only big ISPs with the resources can build viable citywide networks, and secondly, rural and under-developed areas miss out on access to the fastest broadband.

Today there are around 103 million broadband subscribers in the US. The most popular method of connection is cable; cable companies make up around 67 per cent of broadband market share, while telecoms companies make up around 33 per cent. However, this structure is changing quickly, according to Broadband Communities magazine, "Fiber-to-the-home (FTTH) deployment in the United States is beginning to outpace legacy copper broadband, a trend that is impacting service providers and their vendor suppliers.



"Fiber continues to be a significant factor in the broadband race. Market research firm RVA revealed in its 2019-2023 North American Fiber Broadband Report that broadband providers had passed 49.2 million homes with fiber, up 17 per cent in 2019.

"RVA reports that smaller players will continue to have a role. In 2019, smaller providers represented 25 per cent of new homes marketed and 41 per cent of FTTH capital expenditures. Interestingly, the research firm said smaller providers have higher take rates – a higher per cent with connections completed. As they continue to participate in FCC broadband funding programs such as the Rural Digital Opportunity Fund, electric co-ops will continue take an active role in building out FTTH services. About 12 per cent of U.S. rural electric co-ops have announced fiber builds."

Despite this progress, what's most interesting is that just 16 companies

dominate the US broadband market. Of those, just four companies: Comcast, Charter, AT&T and Verizon account for close to 82 million subscribers.

According to the Institute for Local Self Reliance, "Millions of Americans still do not have a real choice when it comes to their Internet service. In urban areas, a thin majority can choose between the monopoly cable company and the often slower monopoly phone company. In rural areas the situation is worse. Residents and businesses are often lucky to have access to high-quality Internet access at all."

This is where open access broadband comes in. Imagine a broadband market where, as a consumer, you had the choice between dozens of providers and hundreds of services, from broadband and phone to music and movies — maybe even bundles tailored to your home automation or Internet of Things (IoT) needs.



WHAT IS OPEN ACCESS?

An open access network is one where the owner and operator of the network is separate from providers of content and services over the network — one where the owner and operator chooses to make the network available to multiple service providers.

For as long as telecoms have existed in the US, telecoms services have typically been delivered to customers by the same provider that owns the network. This means consumer choice is limited by the local physical infrastructure and the business model of incumbent broadband providers.

THE PURPOSE OF OPEN ACCESS IS TO IMPROVE COMPETITION AND CONSUMER CHOICE BY PROVIDING WHOLESALE ACCESS TO SEVERAL PROVIDERS, INCLUDING ISPS, CELLULAR CARRIERS AND EVEN CITY MUNICIPALITIES, TO DELIVER RETAIL SERVICES TO CUSTOMERS USING A SHARED INFRASTRUCTURE. NO DUPLICATION, NO DISCRIMINATION, JUST TRANSPARENT COMMUNICATION AND CHOICE.

For broadband customers, these retail services are typically provided on the

last mile of the network, which is the portion of the telecommunications network that connects individual homes and premises to the wider regional and national backhaul and backbone networks that make up the nation's telecommunications network.

The last mile is also the most complex and expensive part of the network to build, with very dense networks deployed through busy urban streets occupied by homes, traffic and people above ground and existing utilities below. The challenge and cost of overbuilding has restricted open access network construction and protected the existing integrated broadband provider model but at the expense of quality, choice and price competition for consumers.

FIBER IS THE GAMECHANGER

Against the backdrop of established incumbent providers and the high cost of construction it has been hard for open access network developers to build an economic case.

Full-fiber networks have changed the landscape because now new infrastructure developers can deploy knowing they have not just got a competitive advantage but a technology which, with the right network architecture, is permanently upgradeable and flexible — to address the needs of today's consumers and the needs of society in the coming years.

Where existing, incumbent providers have been reluctant to upgrade their copper-based networks, open access fiber broadband is fast becoming a reality through fiber-to-the-home (FTTH) connections.

Fiber, of course, is not itself a new innovation; the use of fiber optics for sound transmission dates back almost 50 years and there have been FTTH networks for at least 15. The key differences today are:

REAL-WORLD BANDWIDTH

Consumer needs are rapidly making DSL networks obsolete. While coaxial networks can still provide most consumer needs adequately there is rapidly increasing understanding among consumers of the benefits of fiber, whether it's for reliability and symmetry or outright speed, where it cannot be surpassed.

EQUIPMENT AND CONSTRUCTION COSTS

Better public-private funding models and improvements in labor productivity, combined with lower equipment costs and novel deployment techniques such as microtrenching and distributed tap architecture will drive down the cost of building fiber open access networks.

PROLIFERATION AND DISAGGREGATION OF SERVICES

Until recently most consumers purchased a bundled package from service providers for voice, TV and internet. Now the choice has exploded while the lines between services have blurred. Over the top (OTT) TV is perhaps the clearest example, but how much data people consume and how they want to buy and access it is changing across the board. Many of these services are available today, some we can see arriving soon while others are still over the horizon, but more connectivity, needing more bandwidth, is inevitable.

CELL SITE DENSIFICATION

While mobile broadband, particularly 5G is sometimes seen as a future threat to wired networks, and there is no doubt more data is now consumed on the move, 5G needs dense, small cell coverage particularly in built up environments. Transmitters also need fiber connectivity.

AVAILABILITY OF FUNDING

This is really a consequence of the points above, but there is no question that, globally, FTTH is now attracting investment from a range of sources that were simply unavailable a few years ago. This is enabling network development by new entrants like SiFi Networks who is also championing the open access model because, unlike incumbent integrated operators, they have no existing interest in either worse-performing infrastructure or content provision.

With the right models, we see a virtuous circle of better infrastructure, better services, higher usage and more attractive investment opportunities enabling FTTH to be built out across the US, enabled by the combined advantages of fiber and open access.

“COMBINING FIBER AND OPEN ACCESS IS THE ONLY NETWORK APPROACH THAT SUPPORTS THE CHOICE AND FLEXIBILITY TO MAXIMIZE THE FUTURE OPPORTUNITIES CONNECTIVITY CAN OFFER.”

HOW DOES OPEN ACCESS WORK?

Although there is no single definition of open access, and there are a number of ways of achieving it, there are a few commonalities that broadly make up open access:

1. THE PHYSICAL FIBER CABLE

and the passive duct work that makes up the constructed network. This can either be publicly owned, or privately owned by a dedicated infrastructure owner, either industrial or financial.

2. A COMMUNICATIONS OPERATOR

also known as the network operator, is the company solely responsible for managing the active electronics and ensuring all users have reliable access at any given time. Ownership and/or operation of the electronics may be the same as for passive equipment, separated or a combination of the two.

3. INTERNET SERVICE PROVIDERS

the familiar ISPs that provide the retail services to customers. They buy wholesale access to the open access network and deliver their broadband bundles to consumers at competitive prices. The great advantage of open access networks is how they provide access to the best infrastructure to a range of ISPs, allowing choice, specialism and competition that drives inclusivity, innovation and cost effectiveness.

4. CONSUMERS

who buy services from the ISP and are free to choose different services from different providers, and free to switch or leave with the click of a button. How consumers purchase and use everything from voice to IoT technology is evolving faster than ever. Combining fiber and open access is the only network approach that supports the choice and flexibility to maximize the future opportunities connectivity can offer.

In practical networking terms, open access fiber broadband is most commonly realized using what is known as the three-layer model, also called the hierarchical internetworking model. Originally developed by Cisco as a means to improve the reliability and scalability of enterprise networks, the three-layer model splits the last-mile broadband network into three distinct layers: the core layer, the distribution layer and the access layer.

CORE LAYER

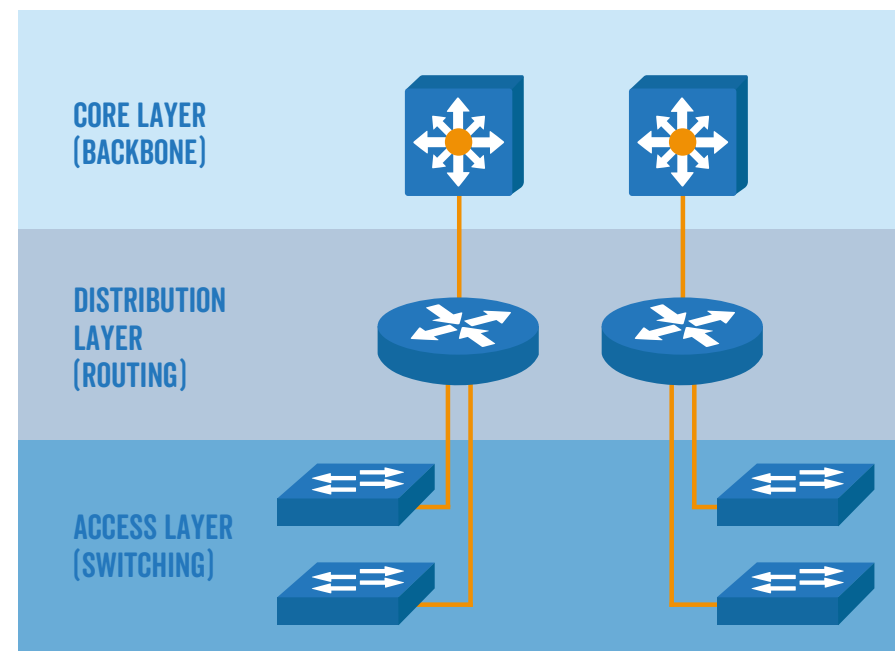
At its foundation, the core network provides the high-speed, highly redundant forwarding services to move the huge volumes of packets back and forth between the various regions of the network, quickly and without loss. This is where the unimpeded bandwidth of fiber really shines.

DISTRIBUTION LAYER

In the middle lies the smart distribution layer. This is where the network routing, filtering, firewalls, security, network policies and quality of service (QoS) are delivered. The network operator is responsible for ensuring that all users have available bandwidth, reliably at any given time.

ACCESS LAYER

On top, is the access layer, where customers connect to the network and gain access to retail services delivered by ISPs. The customer is free to choose different services from different providers, and also free to switch between them.



SO, WHAT ARE THE BENEFITS?

Here are five reasons why open access fiber broadband is revolutionizing telecoms:

1. FOCUS ON DELIVERING NOT DIGGING

For years the traditional model has meant that ISPs have to build their own network before they can start delivering broadband services. This means they need to be experts in not only broadband, but also construction, asset management and network operation. With open access, they can focus on delivering great broadband services, not on digging infrastructure.

2. DON'T DESPAIR – DIG ONCE

Speaking of digging, open access business models, such as the one from SiFi Networks, seek to minimize disruption during the construction phase of FTTH work, connecting whole communities at the same time — avoiding year-round road works and improving the quality of life for residents. Shared infrastructure, particularly if deployed underground where it is most resilient, also means less construction and less maintenance, which is good for the environment as well as residents.

3. LOW BARRIERS TO ENTRY FOR SERVICE PROVIDERS

Physical infrastructure is always expensive and, in the past, if you didn't have the capital in the form of municipal funding, or a public private partnership, you may have struggled as a smaller ISP in gaining access to the network. With funding from private capital markets, open access is now a viable option, helping all ISPs operate with a low cost-per-port.

The open access model also removes the incentive for small, integrated network / service providers to cherry pick where to build, which generally has seen selective fiber deployment into more affluent areas, deepening the digital divide rather than bridging it. The open access, ubiquitous fiber model used by SiFi means passing every home while ISPs can work with cities to tailor service offerings to less well-off households where the availability of high-speed broadband can have an important social impact.

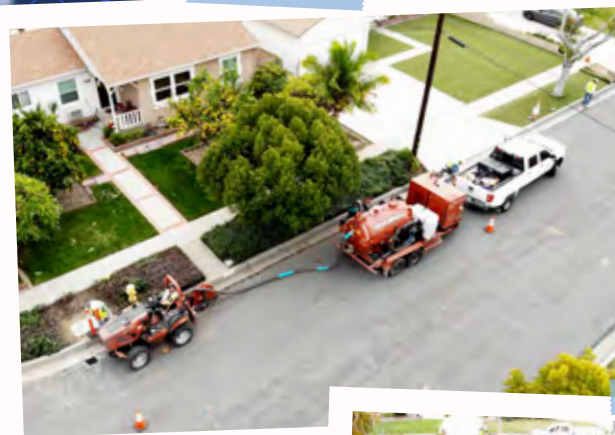
4. COMPETITION AND CUSTOMER CHOICE

More competition means more customer choice. Through open access, millions of Americans can finally access next generation broadband. No longer do you have to settle for a limited range of services from a single provider. Switch easily and enjoy improvements to your quality of life.

5. FUTUREPROOF WITH SMART CITIES

The provision of 5G cellular networks, smart traffic management, air quality sensing, autonomous vehicles, smart energy grids, intelligent buildings and sustainable manufacturing; all of these features benefit from open access fiber networks for the next 30 years and beyond.

CONSTRUCTION CREWS AT WORK IN FULLERTON, CALIFORNIA, LAYING SIFI'S FIBER BROADBAND.



SHARED INFRASTRUCTURE, PARTICULARLY IF DEPLOYED UNDERGROUND WHERE IT IS MOST RESILIENT, ALSO MEANS LESS CONSTRUCTION AND LESS MAINTENANCE.



**“THE GOOD THING ABOUT
HAVING NEW SUPPLIERS IS
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BOGGLING SPEED OF
ONE GIGABIT PER SECOND”**

JENNIFER FITZGERALD | MAYOR OF FULLERTON | CALIFORNIA | THE FIRST FIBERCITY® IN THE US

What is Open Access?

Recently the U.S. broadband market has started to change. UTOPIA Fiber in Utah adopted an open access network that allows access to multiple internet service providers.

Even the largest ISPs are starting to realize the benefits of accessing independently operated networks. For example, CenturyLink (now Lumen and Quantum Fiber) in Springfield, Missouri, and Google Fiber in Huntsville, Alabama, and West Des Moines, Iowa, have seized opportunities to expand their territories without extensive capital expenditure.

Cities becoming SiFi Networks' FiberCities® are also leading the way in terms of change.

SiFi Networks privately funds, builds and independently operates citywide fiber networks upon which multiple service providers can deliver service to residents and businesses. In addition, SiFi Networks allows the cities to utilize the networks for smart city applications. A multitude of cities are in the pipeline across a number of states to become a SiFi Networks' FiberCity®.

SiFi Networks' FiberCities® allow municipalities to access the network to implement smart city applications, enabling cities to become more efficient and improve the quality of life for residents.

Some examples of smart city applications:



**WATER METER
MONITORING SYSTEMS**
which can detect leaks
and high-usage users to
reduce water waste



AUTOMATED SYSTEMS
to lock park gates and
restrooms, eliminating the
need to do so manually



**SMART STREET
LIGHTING**
which automatically
dims street lights when
not in use



E-EDUCATION
Better access to
e-education and remote
learning



TELEHEALTH
the rise of e-health
platforms will see patients
connect with doctors
virtually



**SMART PARKING
METERS**
and applications to
reduce traffic congestion

3

ICELAND
The World's Fiber Leader

Located in the North Atlantic Ocean, just south of the Arctic Circle, Iceland is a volcanic, mountainous island with a population of just 360,000 people and an area of 103,000 km — about the same size as the state of Virginia and about one-twentieth the size of the US. It also happens to have some of the fastest internet in the world.

PERHAPS BECAUSE OF ITS REMOTE LOCATION, AND AS A MEANS OF RETAINING A HIGH-SPEED LINK TO THE REST OF THE WORLD, ICELAND HAS THE HIGHEST PENETRATION RATE OF FIBER TO THE HOME OR BUILDING (FTTH/B) SUBSCRIPTIONS ANYWHERE IN EUROPE AT 65.9% AS OF SEPTEMBER 2019, ACCORDING TO THE FTTH COUNCIL, EUROPE.

This measure of “full fiber” closes the gap between the telecoms exchange, which forms the end of the service provider’s network, and the customer’s home or building, known as the last mile or local loop. This is important because it eradicates any bottlenecks associated with the copper cable that makes up traditional xDSL broadband, and truly opens up customer access to next generation broadband and the full, high-speed potential that fiber has to offer.

The result is that the majority of the population now has access to a symmetric 1Gbps full-fiber connection,

with many subscribing to unlimited downloads. According to Iceland’s Post and Telecom Administration, between 2008 and 2019, fiber connections grew at a compound annual rate of 35.2 per cent — with a watershed in the year 2018, when fiber subscriptions outnumbered xDSL connections for the first time.

“ SO, WHY HAS ICELAND BEEN SO SUCCESSFUL WITH FIBER BROADBAND? ”

To one man, the open access model has been pivotal in securing this position for Iceland. Mr. Erling Gudmundsson is CEO of Reykjavik Fiber Network (RFN). RFN holds Iceland’s most expansive FTTH/B network, connecting 100 per cent of Reykjavik, Iceland’s capital, and adjacent municipalities’ homes to one gigabit, point-to-point fiber.

“It was a perfect storm of measures that has enabled Iceland to become a global leader in fiber broadband,” explains Gudmundsson. “It had partly to do with government incentives, partly wholesale competition in the marketplace, but most of all to our employees, municipal owners’ resolve and dedication to the open access model.

“While other countries were still mulling over ways to improve the lackluster speeds of their existing copper infrastructure, Iceland was already rolling out fiber.

“ IN 2015, FIBER MADE UP JUST 27.5% OF ALL BROADBAND SUBSCRIPTIONS; BY THE SECOND QUARTER OF 2019, IT MADE UP 59% ”

“1999 was the year when the Icelandic telecoms market was liberalized and opened up for competition. It was also the first year that ADSL became available, with just one provider at the outset. Then, in 2005, the market for fiber really changed when the Government privatized the incumbent provider, Siminn, and made the existing nationwide fiber ring backhaul network available to other access providers.”

What followed was a race between Mila, the wholesale division of Siminn, and RFN to lay the FTTH/B infrastructure that would prove to be so successful for Iceland 15 years later. The two companies took different approaches: Mila, which initially widely deployed copper-based VDSL, changed course strongly in 2015/2016, laying a point-to-multipoint GPON technology, which uses multiplexing to allow several subscribers to share the same fiber.

In contrast, RFN used point-to-point (P2P) technology to roll out fiber to individual dwellings, meaning that the company’s networks are capable of delivering 1Gbps symmetrical connections. The key word symmetrical here means that the user benefits from a connection that has equal download and upload speeds of 1000/1000 Mbps.

Despite the differences in fiber technology, the one overarching commonality between the two wholesale providers — RFN and Mila — was that they based their business on the concept of open access broadband: the two companies owned and managed their respective fiber networks but did not provide retail services to end customers. Instead, they sold access to ISPs which delivered broadband packages to the public.

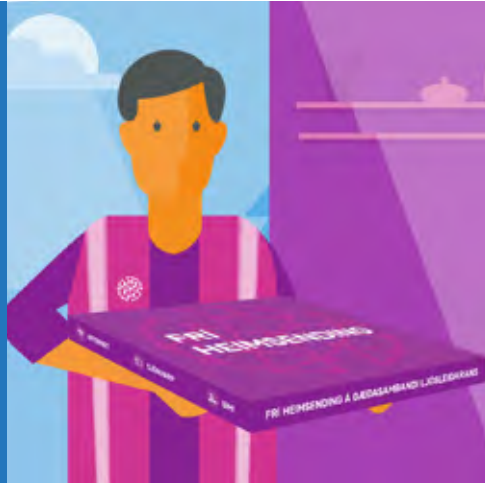
“ THIS SEPARATION BETWEEN THE NETWORK OWNER AND THE ISP IS CRUCIAL IN CREATING A TRUE FREE-MARKET ECONOMY FOR BROADBAND, ”

continues Gudmundsson. “To give consumers the best value for their money, it is vital to eliminate the monopoly or duopoly of owner-operated networks. In doing so, ISPs can instead compete on the best value offering, whether that is for the fully-fledged entertainment, movies and sports bundles that sit alongside broadband, or they can offer the cheapest no-frills package that beats others on price.”

**MR. ERLING GUDMUNDSSON
CEO OF REYKJAVIK FIBER NETWORK (RFN)**



“THE TWO THINGS THAT RFN WAS REALLY DRIVEN BY WAS SPEED AND EASE. WITH SPEED, WE WANTED TO BRING DOWN THE COST OF 1GBPS TO THE SAME PRICE OF 100MBPS, AND WITH REGARDS TO EASE, WE WANTED TO MAKE ORDERING FIBER AS EASY AS ORDERING A PIZZA.”



The company's strategy to bring down the cost of fiber lay in improving the economies of scale on the construction side. By finding a way to reduce the cost of laying fiber, and consolidate the various hurdles required to do so, the company achieved both speed and ease.

“RFN's approach to ‘passing homes’ is different to many FTTH methods being used across Europe,” says Gudmundsson. “Our method connects directly to the home rather than the premises or the street. **Before we lay any fiber or start any construction work, we first get consent from the city and from every homeowner in a given street**, regardless of whether the homeowner goes on to sign up for a fiber package, and there's no obligation for the homeowner to do so.

“Once approved, we install a building entry point (BEP) box that allows the house to be connected, and then civil construction work begins. **This early engagement with all the homeowners in an area means that we only need to dig once**, allowing us to make all the meaningful connections to futureproof

the network for the life of the fiber.

“This is not only a very efficient process, it also results in minimal disruption. A major benefit that we have found in using this approach is that **ISPs on our networks experience a fast take-up of new customers once we have passed an area.**”

The result is that, since 2019, 100 per cent of RFN's network, which serves the greater Reykjavik area, is 1Gbps-capable. However, despite the rapid roll-out of fiber broadband across the country, many rural parts of Iceland, where commercial FTTH projects are not viable, don't have access to next generation broadband.

To tackle this problem, the Icelandic Government launched its Rural Fiber Project in 2016. The project is on schedule to connect approximately 6,100 households and commercial buildings with 1 Gbps-capable fiber by the end of 2021. Total state funding of the project, which may not exceed 50 per cent of investment cost, is estimated around ISK 3,000 million (around \$22m) over the period.

State funding goes strictly through municipalities mostly by means of competition. Other necessary funding comes from municipalities, building owners and fiber infrastructure companies.

The route to full-fiber in Iceland has not always been smooth sailing. Following privatization, Mila and RFN began deploying two separate and sometimes overlapping fiber networks, with Mila benefiting from its existing copper network and RFN seeking out new greenfield sites. They realized that not only was this more expensive, but caused greater disruption with regard to civil works. The two companies ended up signing a collaboration agreement to work together to reduce the cost of deployment and minimize disruption.

In 2018, the Icelandic Competition Authority made a ruling, announcing that the two companies might cooperate on the laying of fiber optic cables, stating that, “This is a limited project in implementation and time that involves that each firm manages the installation of two ducting systems and fiber optic networks simultaneously, in certain residential areas, in the capital area of Iceland, and then cross-sell fully ready fiber network to each other.

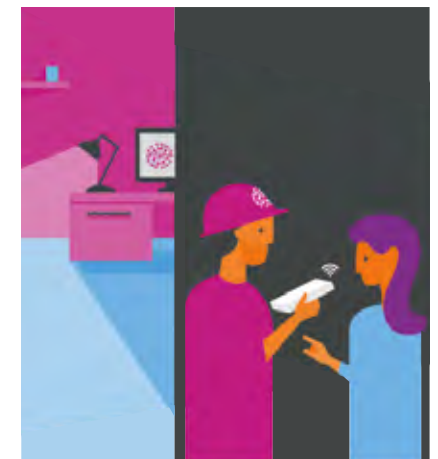
“It is the aim of the above-mentioned partnership to increase the efficiency and optimization of fiber optic installation, as well as to minimize the disturbance, construction related hazards, and environmental impact associated with such construction in the streets and in municipal and local areas.

“It is expected that the cooperation will have a positive effect on competition and increase consumer options by

establishing two independent fiber-optic networks in the areas where a contract is reached. The cooperation will be limited to utilizing the same construction in order to provide two fiber-optic networks that become fully separate and totally independent, thus creating a basis for competition for the relevant customers.”

Indeed, it did have a positive effect on competition, helping Iceland reach the number one position for full-fiber subscriptions anywhere in Europe. Four major ISPs — Vodafone, Hringdu, Hringidan and Nova — have offered their respective services using RFN's network and recently Kapitalvaeding and the incumbent telco Siminn, also entered an agreement with RFN providing consumers with more choice than ever before, without any obligation to stay with one provider. In fact, consumers are free to buy one service from one provider, say broadband and phone, while choosing another for TV and streaming services.

So, what advice does Gudmundsson have for other countries looking to adopt the open access model for broadband?



“2020 HAS FUNDAMENTALLY CHANGED SOCIETY AND WE NOW LIVE IN A DIFFERENT WORLD...”

“2020 has fundamentally changed society and we now live in a different world,” he says. “The US especially has been hit hard by the COVID-19 pandemic and the old ways of working simply don’t apply anymore. The nature of offices, working from home, local governance and education; all these things require a fast and stable connection for people to communicate and remain productive. It also counts that these dramatic changes reduce our carbon footprint by less travelling.

“A higher capacity fiber network is a fundamental starting point to achieve this as it provides redundancy and future proofing. The open access approach provides a level of choice and responsiveness that moves away from the outdated models of the past towards one that will adapt to fit society’s needs as we adapt and change.”



AERIAL SHOT OF REYKJAVÍK

4

THE POLITICS
OF SETTING
Broadband Free

While much has been said about the technological advancements that will drive forward a revolution in broadband, a revolution in its truest sense is one driven by political and regulatory progress. As we have already discussed at the outset of this book, the history of telecommunications in America has been one dominated by monopolies and duopolies, with regulatory reform often struggling to keep pace.

To get a better understanding of the regulatory landscape today, we spoke to two key political representatives from both sides of the political spectrum; one a Texas Republican Representative from a rapidly transforming area that has shifted from rural to suburban growth, and the other a Democratic Senator representing a largely urban community in California.

Taking office in 2007, Republican State Representative Tan Parker represents House District 63, which includes the southwest portion of Denton County, Texas. Communities in the district include Flower Mound, Roanoke, Lantana, Argyle, Bartonville, Ponder and portions of Fort Worth, Lewisville, Highland Village, Southlake, Westlake and Trophy Club.

For Representative Parker, the regulatory landscape across Texas is one characterized by a need for better awareness around broadband innovation and a need for modernization.

"As more people begin to recognize the necessity of broadband in this COVID-19 impacted world, we are seeing an increasing push for modernization of policy in this area, which is critical," explains Parker. "In the 2019 Texas legislative session, for example, we saw more bills than ever before seeking to address

changes that are taking place in the broadband marketplace.

"Whether it's tele-work, children's education, commerce, healthcare or essential services, the need for

“ IN TEXAS, THE LARGEST POPULATION WITHOUT BROADBAND ACCESS RESIDES IN RURAL AREAS, REPRESENTING OVER 800,000 PEOPLE. ”

broadband has grown significantly. These areas of our state are still lacking the basic telecommunications infrastructure needed, and if left unaddressed, this will create an even larger digital divide. As demand for high-speed internet continues to increase in every area of our state, broadband becomes an even bigger policy issue, which will drive the regulatory framework in 2021 and beyond."

A lifelong conservative, Representative Parker is an advocate for limited government, and wants Texas to facilitate market competition as part of a larger state plan.

“ FOR ME, IT'S IMPORTANT THAT REGULATION SERVES TO ENCOURAGE AND FACILITATE A LEVEL PLAYING FIELD ACROSS THE BROADBAND MARKET. I WANT TO SEE LARGE PROVIDERS, ALONG WITH SMALLER ENTREPRENEURIAL PLAYERS COME AND COMPETE ACROSS THE COUNTRY. ”

We want to be able to provide our citizens with a wide range of options from companies invested in making the next generation of broadband a reality.

"The district I represent in Texas was historically comprised of rural pockets. Over time, these have largely become high-growth suburban communities with good access to broadband, though disparity still exists. While some communities struggle with accessing reliable high-speed internet, the bigger problems have less to do with the physical infrastructure and more to do with the lack of provider choice and affordability, which in many cases could be improved.

“ ONE OF THE REASONS WHY OPEN ACCESS HAS BEEN SLOW TO BE ADOPTED IS BECAUSE IT FOLLOWS A VERY SIMILAR JOURNEY TO THAT OF THE RETAIL ELECTRIC MARKET. CLASSIC UTILITIES IN AMERICA WERE MONOLITHIC; THE REGULATORY ENVIRONMENT IN THE SECTOR WAS SLOW IN KEEPING PACE WITH THE SPEED OF TECHNOLOGICAL DEVELOPMENT AND INNOVATION. ”

"In my assessment, this is a non-partisan issue. In the 2019 legislative session, the Governor's Broadband Development

Council was established to focus on providing internet access to our state's underserved areas. When COVID-19 shuttered our schools in March 2020, local school districts, in conjunction with the Texas Education Agency and Governor Greg Abbott, launched Operation Connectivity to help students access virtual learning and close digital gaps.

"The Texas Legislature convened in January 2021, and Governor Abbott has announced he is making the expansion of broadband access an emergency item during the 87th Legislative Session.

“ LAWMAKERS ARE COMMITTED TO WORKING TOGETHER TO ADDRESS OUR STATEWIDE BROADBAND NEEDS AND ENACT LEGISLATION THAT:



ADDRESSES CURRENT ACCESS CHALLENGES



REMOVES THE REGULATORY BARRIERS



STRENGTHENS CONNECTIVITY IN ALL GEOGRAPHIC AREAS ACROSS TEXAS ”



“ COVID-19 HAS PRESENTED SOME OF THE GREATEST CHALLENGES IN MODERN HISTORY ON COUNTLESS FRONTS AND CONTINUES TO CAUSE TREMENDOUS HARDSHIPS. HOWEVER, IT HAS CLEARLY HIGHLIGHTED THAT THE QUALITY OF LIFE FOR MILLIONS OF PEOPLE DEPENDS ON CONNECTIVITY, WHICH IS A DIRECT RESULT OF RELIABLE ACCESS TO BROADBAND. ”

TAN PARKER | REPUBLICAN STATE REPRESENTATIVE | HOUSE DISTRICT 63 | TEXAS

At the other end of the political spectrum is Senator Lena Gonzalez, who represents the 33rd district in the California State Legislature. Home to nearly one million residents, the district covers Los Angeles County, including Long Beach, and the Southeast Los Angeles cities of Bell, Bell Gardens, Cudahy, Huntington Park, Lakewood, Lynwood, Maywood, Paramount, Signal Hill, South Gate, Vernon and part of Los Angeles.

For Senator Gonzalez, the regulatory landscape for broadband in California is characterized by inadequate legislation that fails to serve those hardest-hit in the community.

“The district I represent is made up of a mixture of diverse industries including textile manufacturing, technology and transport, among others. In some parts of the district, there are areas that are entirely unserved by any broadband provider. In others, there are just one or two providers who usually charge a high amount for their service.

“Despite families paying upwards of \$80-100 per month, the speeds are less than adequate and service can be spotty,” continues Gonzalez.

“ IN SOME CASES, FAMILIES HAVE NO COMPUTER OR CANNOT AFFORD BROADBAND AND ARE FORCED TO RELY ON SMARTPHONES. A NUMBER OF THESE COMMUNITIES ARE FROM UNDERPRIVILEGED LATINO, CAMBODIAN REFUGEE AND MONO LINGUAL COMMUNITIES. MANY PEOPLE DON'T REALIZE THAT THEY CAN, AND SHOULD, HAVE BETTER. ”

“ IN CALIFORNIA, WE'VE REVIEWED THE REGULATORY LANDSCAPE, LOOKING AT WHAT'S AVAILABLE AT FEDERAL LEVEL AND WHAT ELSE IS NEEDED. AS PART OF THIS, WE CONSULTED WITH TOM WHEELER, THE FORMER CHAIRMAN OF THE FEDERAL COMMUNICATIONS COMMISSION (FCC), WHO FAMOUSLY RAISED THE FEDERAL DEFINITION OF BROADBAND FROM DOWNLOAD SPEEDS OF 4 MBPS TO 25 MBPS AND UPLOAD SPEEDS FROM 1 MBPS TO 3 MBPS. THIS CHANGE IN DEFINITION IMMEDIATELY TRIPLED THE OFFICIAL NUMBER OF US HOUSEHOLDS WITHOUT BROADBAND. ”

“Because broadband standards are used to distribute state and federal funds to providers to use to extend and improve internet service, the definitions matter,” says Gonzalez. “Unfortunately, Californian law still allows state grants to fund broadband infrastructure at speeds of 6 Mbps download and 1 Mbps upload. Additionally, improvement projects don't qualify for funding in areas deemed to be 'adequately served', defined as speeds of 6 Mbps download and 1 Mbps upload, and so rural areas are further disadvantaged.”

In February 2020, Senator Gonzalez introduced a new bill: SB-1130. According to the Electronic Frontier Foundation, the bill reforms the current California Advanced Services Fund (CASF):

"Raising the fund's minimum standards of what constitutes being 'served' by broadband, requiring that any broadband network funded by the state to be high-capacity, and holding companies subject to open access rules that promote competition. The legislation would put California on par with its international competitors, end the digital divide for Californians, and prevent a repeat of the lack of connectivity challenges residents have faced as they engage in social distancing, remote education, and working from home."

On June 26, 2020, the California Senate voted 30-9 to pass the bill. However, on its presentation to the California Assembly in one of the last nights of the 2019-2020 legislative session, the Assembly refused to hear the bill, blocking it from fruition.

"We're going to continue to push to get this bill passed," explains Gonzalez.

“ THE STATE OF CALIFORNIA IS THE LARGEST ECONOMY IN THE US, IF IT WAS A COUNTRY IT WOULD BE THE WORLD'S FIFTH LARGEST. IT ALSO HAS THE LARGEST PORTS IN THE US, AND YET WE STILL HAVE CHILDREN AND SENIOR CITIZENS WITHOUT BASIC BROADBAND INFRASTRUCTURE. ”

We have to ask companies to do more and to promote competition for ISPs of all sizes.

“ THIS WILL BE ACHIEVED BY BUILDING CREATIVE SOLUTIONS LIKE OPEN ACCESS BROADBAND, AND GIVING LOCAL GOVERNMENTS ACCESS TO SUBSIDIZED FUNDS. ”

I hope other states will see the success and replicate it, driving change in rural and low-income, urban communities."

Next-generation broadband is not the only issue troubling the state. The 2020 California wildfires were particularly damaging, not least because they came in the midst of a global pandemic. So, what kind of rebuilding work will be necessary, and does the Senator see it as an opportunity to upgrade fiber infrastructure to enable the community to come back stronger?

"Absolutely, we're dealing with many crises, including COVID-19 and the digital divide, as well as the wildfires that happen every year," explains Gonzalez. "It's a reminder of the impact of climate change, but also the importance of the arteries that make up our community."

"To solve these challenges, we must increase awareness around the concept of broadband-for-all, using innovative models like open access and working collaboratively regardless of our politics, in the interest of all Americans."

“ I’VE VISITED PEOPLE IN THEIR MOBILE HOMES WHO DIDN’T HAVE WATER, WHO STILL HAVEN’T COMPLETELY REBUILT FROM LAST YEAR’S WILDFIRES. REBUILDING COMMUNITIES IS NOT JUST ABOUT THE BRICKS AND MORTAR, IT’S ALSO ABOUT INFRASTRUCTURE. TAKING THE OPPORTUNITY TO BUILD FIBER CONDUITS MAY WELL BE A WISE MOVE. AFTER ALL, RESEARCH SHOWS THAT REBUILDING IN THIS WAY COULD BE 80 PER CENT MORE COST-EFFECTIVE COMPARED WITH A NEW BUILD. ”

5

AN
ENTREPRENEUR'S
PERSPECTIVE
Mike Harris

Today we imagine the humble beginnings of the internet as a neat timeline of diligent technological advances, research papers presented at conferences by academics and the coming together of technology, scale, information and culture; a phenomenon that combined into what we now take for granted as the internet. While all of that is certainly true, the real story of the internet is not too dissimilar to the creation of the railroad network in America.

The advent of the steam locomotive, the Tom Thumb, in 1827 in Baltimore was a turning point in American history, but it was the blood, sweat

and tears that went into building the First Transcontinental Railroad, a 1,912 mile continuous railroad line that connected the east and west coast, that opened the doors for people to travel vast distances.

It was this passion that led Mike Harris to play a part in the growth of the telecoms market in the United Kingdom. Mike co-founded SiFi Networks alongside Roland Pickstock, and is a current investor in the company. Here, Mike talks us through his background and what brings him to the US today to pursue a similar goal of transforming the way America thinks about and uses the internet.

The Pacific Railroads



CAN YOU TELL US A LITTLE BIT ABOUT WHAT LED YOU INTO THE WORLD OF THE INTERNET?

My background is in telecoms, and back in the 1980s I was an apprentice at British Telecom, or BT as it's now known. During my time there, I worked on telephony networks, maintaining telephone exchanges, and eventually moved to data center networks as that technology emerged.

This was a time when the world was becoming much more connected.

MORE CUSTOMERS THAN EVER WERE CONNECTING TO THE TELEPHONE NETWORK, MOBILE TELEPHONY WAS TAKING OFF AND LONG-DISTANCE NETWORKS WERE BEING ESTABLISHED.

To cope with the growing demand, BT invested in data centers, using a large concentration of IBM and ICL machines from which information was distributed to desktops, known as dumb terminals, using time-divisional multiplexing, an early form of ethernet.

BT used these data centers primarily for holding customer billing information among other records, and these data centers were located regionally across the UK, distributing data to the various office locations.

IN THOSE DAYS, THERE WAS NO SUCH THING AS BROADBAND, INFORMATION WAS DISTRIBUTED ON COPPER-PAIRED MODEMS USING KILOSTREAM AND MEGASTREAM LINES.

These lines were fixed point-to-point links for the exclusive use of leasing customers, allowing them to transmit voice and data across different geographic sites.

I had big dreams and career aspirations so, towards the end of the 80s, I set out on my own in business. I started a telecoms consulting business called Total Network Solutions (TNS). We offered full integrated solutions to corporations and local government across the UK. We also helped companies to migrate their telecoms systems, to benefit from the huge amounts of computing power offered by data centers and have it distributed to the desktops where it could be easily manipulated.

This process was not easy, and we were involved early on in structured cabling as well as X.25, one of the oldest packet-switching protocols, and a precursor to standards like IPv4 and the OSI reference model that today, along with TCP/IP, form the foundation on which the internet is built.

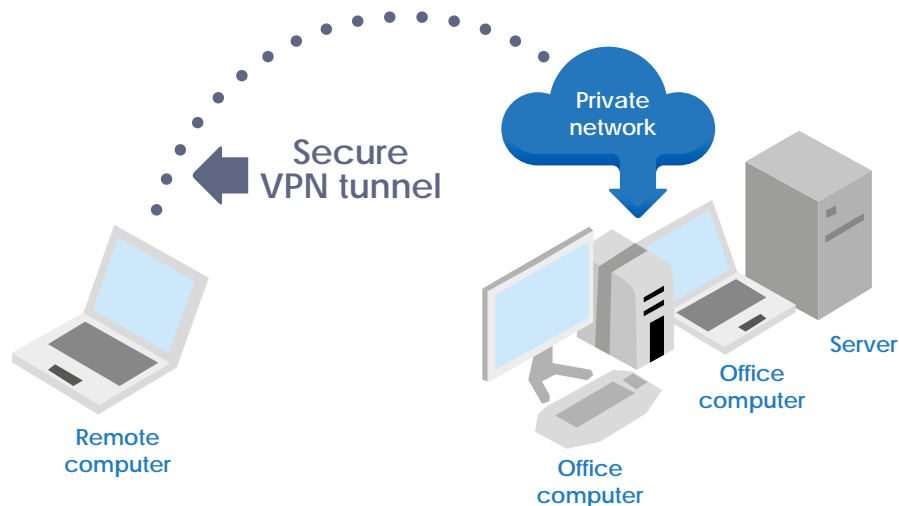
The need to disseminate information has always been at the heart of every organization, but it was during the 80s when we also saw another big trend — the rise of the home computer as an extension of the workplace. Office workers and managers wanted access to their office computer from home. As more and more people demanded this, companies realized that costs would spiral. Like many internet service providers, they provided a modem at both ends, with the home user dialing into the corresponding unit over a telephone line.

So came the revolution of connectivity straight to the company's backbone using an Ethernet network with a router managing traffic. My organization, TNS, installed and maintained many of these devices for the likes of AOL, BusinessNET and Planet Online, eventually becoming the largest privately owned Cisco Gold Partner in the UK.

While ISPs adapted to this shift in the industry, it was still very expensive to provide connectivity for the last mile.

This describes the part of the telecoms network that physically reaches the end-user's home or business premises from the local telephone exchange. As legislation developed and BT was privatized, there was a need to look at how BT's dominance and state monopoly could be unlocked. A process of liberalization and deregulation that occurred over more than a decade led to the emergence of the open access model of internet in the UK, and one that was subsequently adopted by many countries around the world.

The open access model of the internet separates the company that owns the physical cable in the ground from the service providers that use the network. This levelled the playing field and meant that various ISPs could operate on the same physical network but offer different value-added services. Crucially, it also means that customers are free to change suppliers if they're unhappy with the service or get a better price from someone else.



“ IT SEEMS STRANGE TO THINK TODAY THAT THERE ARE STILL PLACES THAT DON'T HAVE ACCESS TO THE INTERNET, BUT THIS WAS TRUE FOR MANY PARTS OF THE UK AS RECENTLY AS 20 YEARS AGO. ”

YOU SOLD TNS IN 2005 TO BT AND WENT ON TO INVEST IN AND CHAIR A FOOTBALL CLUB IN THE UK. MOST RECENTLY, YOU CO-FOUNDED SIFI NETWORKS, THE LEADING NORTH AMERICAN DEVELOPER OF OPEN ACCESS FIBER OPTIC NETWORKS. WHAT WAS IT THAT ATTRACTED YOU TO THE COMPANY AS AN INVESTOR?

During my time at TNS, we started using some of the early technologies that would later form the basis of open access broadband. The basic premise was to give cities and regions their own telecoms network that would then attract ISPs to offer competitive services to consumers.

One of the great things about this approach was that it allowed TNS to do what wasn't profitable for BT, bring broadband to areas of the UK that weren't connected. It seems strange to think today that there are still places that don't have access to the internet, but this was true for many parts of the UK as recently as 20 years ago.

We were heavily involved in bringing broadband to smaller islands off mainland UK, like Guernsey, Anglesey and the Isle of Man and to around 40,000 homes in Ireland.

The real attraction for me in investing in and co-founding Sifi Networks was the potential this offers in the US market. Telecoms in the US is still largely owned and operated by a few large corporations.

Sifi Networks has evolved to the point that we've developed construction and deployment techniques, put

together the legal framework, developed maintenance agreements and warranties, and identified contractors that are capable of laying fiber into the ground.

We've also established relationships with design companies because each city has a unique footprint with different trunking layouts and system of transfer stations known as fiber huts that relay light signals to each home and business in the city's network.

SIFI NETWORKS HAS RAISED OVER \$1 BILLION IN CAPITAL WITH MULTIPLE CITIES UNDER CONSTRUCTION AND MANY IN THE PIPELINE.

I expect that, once more people realize the benefits of open access broadband, we will see this model become the norm in North America as it has done in other parts of the world.



LARGE ISPS

For these large ISPs, open access offers a way of reaching into untapped cities without having to build the entire infrastructure first, or to change regional investment in a more responsive way, without being tied into a network with a long-term payback period. It means more of their network is operational and delivering a return on investment.



SMALL AND MEDIUM ISPS

For small and medium ISPs, open access offers a way to do business without the huge capital costs required, or the construction and planning expertise required to get going. It also gives smaller ISPs the ability to differentiate their broadband packages, allowing them to focus on value-added sports, TV and broadband deals, better customer service, and more competitive prices.



THE CITY

For the city, it means respite from what can feel like constant road works and construction. Only digging once to lay the cable means there is less disruption and city officials can better future-proof themselves to deliver smart city services. Over time, these measures result in better real estate value, and ultimately happier residents.



THE CONSUMER

And finally, for consumers, open access broadband means more choice. Customers no longer have to remain with one provider for a lack of alternatives. If they're unhappy, they can change service provider, if they want a more comprehensive package, they can change provider.

6

AN INVESTOR'S
PERSPECTIVE
Matteo Andreoletti

From the moment we wake up in the morning, to the moment we fall asleep at night, infrastructure forms a key part of our everyday lives.

Some of it is visible; the roads, bridges, buildings, and electricity lines that allow us to move around and give us shelter and warmth. Other types of infrastructure are hidden underground; the gas and water pipes that supply our homes, and the telecoms networks that allow us to communicate with those around us.

Infrastructure not only determines the quality of life for people, it also directly affects the health of the economy, driving productivity and employment across the nation.

To understand how funding plays a role in the development of infrastructure,

and specifically open access networks, we spoke to Matteo Andreoletti, Head of Infrastructure Equity for Europe and North America at Patrizia. The company was pivotal in funding SiFi's initial FiberCity® deployments, allowing the roll out of citywide open access fiber networks, and investment is planned for future cities.

CAN YOU TELL US ABOUT PATRIZIA AND THE FOCUS OF THE FIRM?

We are a global fund manager dedicated to infrastructure. That has been our focus for the last 24 years. We facilitate long-term investment by long-term investors, such as pension funds or other institutional investors, into the long-term assets of an economy.

Infrastructure is a critical asset that has been the backbone of producing a sustainable future for our planet. For us, infrastructure is effectively the capital-intensive projects that underpin the economy. We measure it in terms of its capital intensity and how essential the service is; the likes of water, waste, and social care systems all need large investments.

Over the last 24 years, we've invested around €7bn Euros across 103 investments. We started in Australia where there were major opportunities in the capital and pension fund markets and then expanded to North and South America, as well as Europe and Asia.

Crucially, we are agnostic on the type of funding strategy we use — our goal is to fund a project in the most efficient way. To achieve this, we use a portfolio of products and can fund projects using everything from private equity, listed securities and debt investment, or loans to companies.

It's really interesting that you've been focusing on this for so long. In 2015, the United Nations announced its Sustainable Development Goals (SDGs), which form a blueprint to achieving a better future for all. Infrastructure is the ninth SDG. In fact, according to the UN:

“ INCLUSIVE AND SUSTAINABLE INDUSTRIALIZATION, TOGETHER WITH INNOVATION AND INFRASTRUCTURE, CAN UNLEASH DYNAMIC AND COMPETITIVE ECONOMIC FORCES THAT GENERATE EMPLOYMENT AND INCOME. THEY PLAY A KEY ROLE IN INTRODUCING AND PROMOTING NEW TECHNOLOGIES, FACILITATING INTERNATIONAL TRADE AND ENABLING THE EFFICIENT USE OF RESOURCES. ”

Turning specifically to connectivity, what has been your experience of funding telecoms networks and how is this market developing in the US?

Telecoms and broadband infrastructure has been on our radar as far back as the early 2000s when we backed some highly innovative communications companies. Our first fiber investments were in 2002 when we backed a project in Australia, to provide fiber connectivity across the Australian Capital Territory region and the state of Victoria.



Around the same time, we also backed the creation of the leading media infrastructure and technology company in the UK that provides much of the infrastructure behind television, radio and wireless communication in the UK.

FROM THESE EXPERIENCES, WE'VE IDENTIFIED TELECOMS AS AN ESSENTIAL SERVICE TO GET THE ECONOMY RUNNING.

We've been following the evolution of telecoms, from the dot-com bubble of the late 1990s, to the turbulence of the global financial crisis of 2007-2008, and now most recently through the global COVID-19 pandemic. We've seen that telecoms projects need to be futureproofed.

IN 2018 WE LAUNCHED A DEDICATED FUND CALLED THE SMART CITY INFRASTRUCTURE FUND. I BELIEVE IT WAS THE FIRST AND LARGEST PRIVATELY FUNDED INITIATIVE THAT HAS BEEN CREATED TO INVEST PENSION FUND MONEY INTO SMART INFRASTRUCTURE PROJECTS.

Some of the early initiatives we backed were smart city programs including Cisco's City Infrastructure Financing Acceleration Program and the European Innovation Partnership for Smart Cities and Communities. These programs were designed to equip cities with smart technologies that would reduce energy usage, ease traffic, or boost public transport use among other things. However, despite being backed by a proven technology

and a sound funding model, these early programs have not yet delivered deployments at scale because of a lack of adoption by municipalities.

In 2017, when we first came across SiFi Networks, we initially turned down investment in the business because we didn't think the market was ready. However, in late 2018, we met with Mike Harris, Roland Pickstock and Ben Bawtree-Jobson who presented a new model; an independent, privately funded open access fiber network that enables municipalities to become a smart city. The model was a great match for our Smart City Infrastructure Fund and so Patrizia provided the initial funding to SiFi for deployment of its network in several cities, starting with the City of Fullerton, CA.

What's different about Patrizia's Smart City Infrastructure Fund — how does it compare to the traditional models of funding?

Traditional models of funding, whether they are public, or public-private partnerships work best for traditional infrastructure like highways and bridges, but they come with constraints. These models are rigid, often check-box approaches that are focused on defined use-cases, demonstrable uptake, the ability to produce revenues and ultimately minimizing commercial risk. This is understandable to some degree, because there is no certainty that new technology projects will attract the commercial usage that we believe they will.

“ THE PROBLEM IS THAT YOU CAN'T SANDBOX PROJECTS WITH POTENTIAL FUTURE VALUE USING METRICS OF THE PAST. STARTUPS CAN LIVE AND DIE IN THE SPACE OF A FEW MONTHS, BUT MAY LEAD TO VALUABLE BREAKTHROUGHS LIKE E-HEALTH PLATFORMS THAT CONNECT PATIENT AND DOCTOR VIRTUALLY — A TECHNOLOGY THAT HAS NO PRECEDENT OR EXISTING USE-CASE. ”

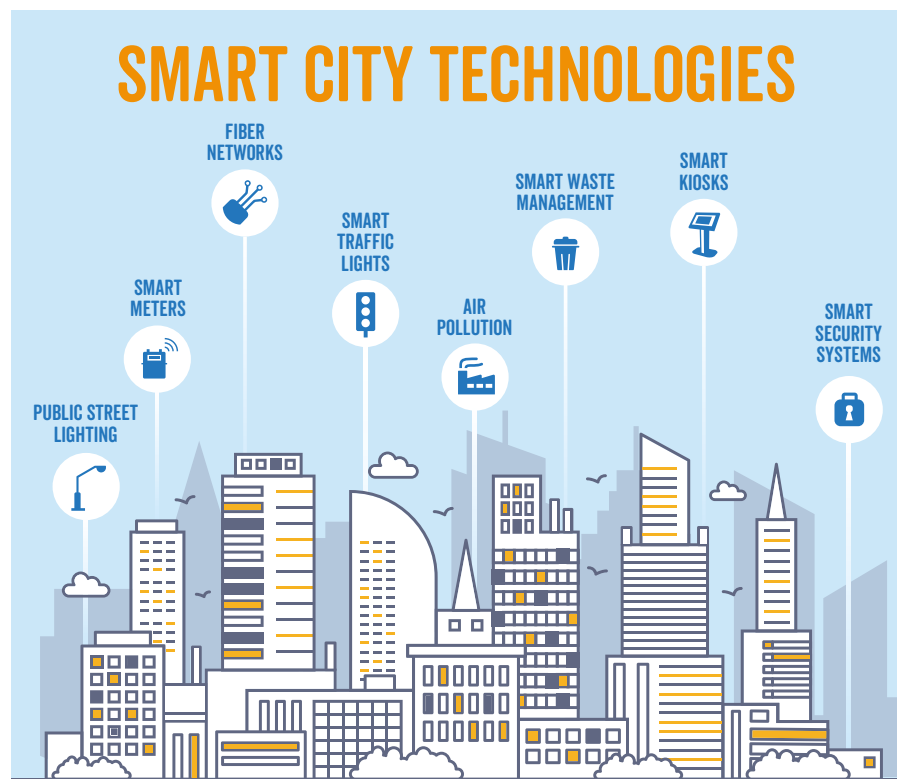
MATTEO ANDREOLETTI | HEAD OF INFRASTRUCTURE EQUITY FOR EUROPE AND NORTH AMERICA AT PATRIZIA

Traditional funding models can't serve this new approach and so we need new models of funding that are flexible. Every day we delay the uptake of technologies like fiber broadband, there is a hidden cost to the economy.

This is where Patrizia's Smart City Infrastructure Fund comes in. The fund is an investment vehicle that provides long-term private institutional capital for the development of sustainable urban ecosystems. It helps cities deal with continued urbanization, climate change and resource scarcity, the development of sustainable communities, and technological advancement and digitalization.

Using the fund, we're focused on investing in smart city technologies like public street lighting, smart meters, fiber networks, smart traffic lights, air pollution, smart waste management, smart kiosks, and smart security systems to name just a few.

The fund has a minimum investment size of €10m with a target investment term of over ten years, although many social infrastructure projects can have an investment horizon of thirty years. The result is that this funding model is good for society and also makes good financial sense.



What does the future hold for your relationship with SiFi Networks?

Following the initial funding of \$75m for Fullerton, CA, our Smart City Infrastructure Fund has committed to providing a further investment of up to \$450m to fund the growth of SiFi Networks' FiberCity® deployments. Additionally, SiFi has already identified more than 200 cities that could become FiberCities® in the future and bring fiber to over ten million households across the US.

ABOUT MATTEO

Matteo Andreoletti joined Patrizia in 2015 and leads the equity investment team in Europe and the Americas.

He is Co-founder and Senior Partner of Patrizia's European Infrastructure Fund, a pan-European mid-market focused fund providing scale-up capital to companies contributing to sustainability, resilience and resource efficiency, and the Smart City Infrastructure Fund, a global investment program with a unique focus on next generation urban solutions and smart city applications.

Matteo is a board member of SAREN Energy, an energy recovery specialist of waste-derived fuel located in Southern Norway, Kvitebjørn Varme AS, the owner of a district heating in Tromsø, one of the largest communities within the Arctic Circle, and SiFi Networks, a developer of community-wide fiber networks in the US. His investment experience at Patrizia also includes Connexin, a provider of connectivity, IoT and Smart Cities services and Kinland (formerly known as Pioneer Public Properties).

Prior to joining Patrizia, Matteo held roles at Macquarie, Societe Generale and Natixis, where he was actively involved in the development of private financing for major infrastructure projects in continental Europe.

Matteo holds an M.Sc. in Aerospace Engineering from the Ecole Centrale Paris and the Politecnico di Torino, and studied finance and business administration at the Collège des Ingénieurs in Paris.



7

WHY SHOULD
ISPS EMBRACE
Open Access Broadband?

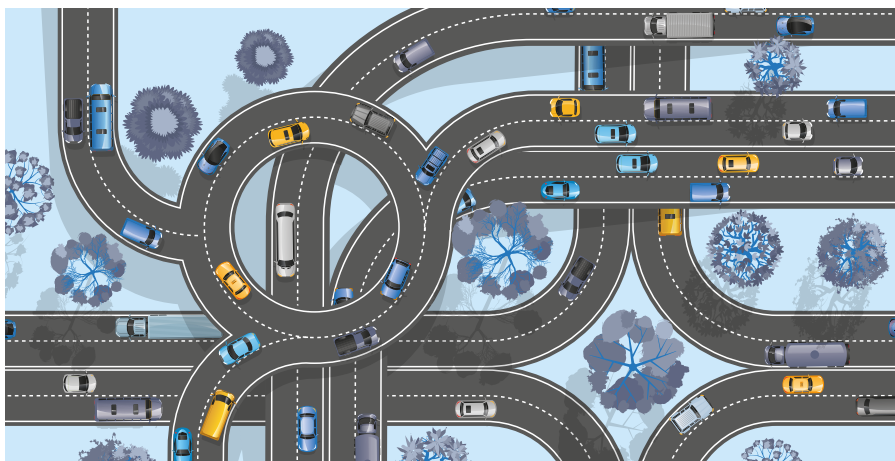
Can you imagine a world where each vehicle manufacturer was required to build its own roads? Not only would that be extremely complex and expensive for automotive manufacturers, causing a major increase in the price of their products and services, it would also lead to a chaotic street network configuration in urban and industrial areas, and to rural areas being barely accessible for lack of proper routes.

As impractical as this sounds, a similar situation represents the reality of broadband in the vast majority of the US, where Internet Service Providers (ISPs) own and operate their own network infrastructure. Traditionally, larger ISPs have seen exclusive ownership of the network infrastructure as a competitive advantage — being the only service providers in a given area, they can rest assured that its residents will rely on them for their connectivity needs. However, heavy investments in network infrastructure can be a double-edged sword. Companies have so far disregarded the costs of tying themselves up in long-term infrastructure projects and are now struggling to divest and adapt to a rapidly changing market.

Established ISPs can also make their business less responsive to change by committing to prohibitively long-term capital infrastructure projects, with equally long payback periods, meaning that they will struggle to meet consumer demand in a market characterized by rapid technological development. This is why many US cities are still served by slow, outdated cable and the national fiber coverage sits at a meagre 32 per cent.

Another issue to consider is that this model increases the barrier to entry for emerging ISPs, who may not have the financial and technical resources to build and operate their own networks and will therefore struggle to stay afloat. This effectively supports the formation of monopolies and duopolies, stifling competition and depriving consumers of choice.

The answer is to use an open access model. This model grants several providers access to a shared infrastructure, reaching a bigger pool of potential customers without the financial burden of building and maintaining their own network. As fiber becomes the option of choice to meet consumers' demand for high-speed internet, the open-access model will prove pivotal to ISPs of all sizes.



TACKLING THE BIGGEST CHALLENGE: INVESTMENT

High-speed connectivity is the backbone of a strong digital economy, ripe with opportunities for financial and social growth. In an age where the internet is critical for education, healthcare and business growth, consumer demands can only be met by retiring aging copper wires and building full-fiber networks.

However, one of the major challenges in deploying more fiber is financing. Not only can the initial investment be cost-prohibitive, operating and maintaining the network can also be extremely costly.

IN 2017, BROADBANDUSA, THE NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION'S (NTIA) PROGRAM, ESTIMATED THE COST OF FIBER BETWEEN \$0.50 AND \$4.00 PER FOOT, DEPENDING ON THE CABLE'S STRAND COUNT.

However, Beyond Broadband, a UK-based cooperative that advocates for universal broadband access, warns that the cost of fiber is actually not the most important variable to consider, and that 60 to 80 per cent of the total capital of a fiber project is actually due to civil work, ducts and cables.

The cooperative also remarks that these costs substantially vary depending on the location and level of disruption that digging will cause, and that the cost of rights-of-way and permits must also be considered.

It's not just the costs of laying fiber that might deter smaller ISPs from entering the market. Completing the construction project can take several years, meaning that ISPs cannot expect a quick return on investment (ROI).

The open access broadband model frees ISPs from the financial burden of building and maintaining their own infrastructure, allowing them to focus on the quality of their offering and the optimization of the customer journey with a much faster ROI.



FOSTERING HEALTHY COMPETITION

The latest Broadband Deployment Report, published by the Federal Communications Commission in June 2020, presents some encouraging data. The report states that more than 85 per cent of Americans now have access to fixed broadband service at 250/25 Mbps, and that in 2019 alone, fiber broadband networks became available to roughly 6.5 million additional unique homes.

However, the report also stresses that smaller ISPs account for 25 per cent of these new fiber connections, underlining their important role in improving the state of internet connectivity in the US and providing more choice for consumers.

By lowering the barrier to market entry for smaller ISPs, the open-access model ensures that they can continue to support the nation's digital growth and grant access to high-quality internet connectivity to an increasing number of people.

Sharing a common infrastructure fosters healthy competition between established and emerging ISPs, with competition centering on who can provide the best service and customer support, not necessarily who has the most capital to build and maintain a private network infrastructure.



Eliminating the cost of building and operating the network will lower the barriers to entry and bring more ISPs to the market. The presence of several competing ISPs will broaden consumers' options and allow them to choose the one that best meets their expectations.

This ecosystem will naturally encourage businesses and private citizens to subscribe, giving ISPs of all sizes a much larger pool of potential customers to serve. The larger number of subscribers means that ISPs can focus on tailoring their offer to the specific type of consumer they want to target.

ISPs can decide to differentiate their entertainment packages to appeal to residential accounts, or to specialize in providing added services to businesses, such as a variety of cloud storage options.

WHILE COMPETITION WILL REDUCE MARKET PRICES FOR BROADBAND, THIS WILL BE OFFSET BY THE INCREASED DIVERSITY OF OFFERINGS THAT ISPs WILL BE ABLE TO DELIVER.

Some may offer entertainment packages that allow consumers to choose exactly what they want to see, from regional sports to Vietnamese sit-coms. On the other hand, comprehensive packages for business accounts, which include solutions for digital security, cloud storage options and even a portfolio of options to connect industrial equipment to the Internet of Things (IoT) may be a specialist offering. Some find more niche ways to distinguish their services, with convenient packages that cater to the needs of smaller businesses.

Open-access broadband will allow ISPs to further diversify their offerings so that competition will not be based solely on price, but on the provider's ability to appeal to specific groups of potential customers.

It will also be an essential step to close the digital gap that is currently plaguing the majority of American cities. With a wider choice of providers, citizens who were previously cut-off from basic educational and healthcare services because they couldn't afford their only broadband option, should then be able to pursue more affordable subscription options.



FOCUSING ON WHAT MATTERS MOST: YOUR CUSTOMERS

The latest report on the **telecommunications sector by the American Customer Satisfaction Index (ACSI), published in June 2020, highlights that the industry isn't exactly famous for excellent customer support.**

IN PARTICULAR, THE REPORT UNDERLINES THAT ISPs HAVE HISTORICALLY BEEN AMONG THE LOWEST SCORING OF MORE THAN 400 FIRMS REVIEWED BY THE ACSI, AND THAT DESPITE SUBSTANTIAL IMPROVEMENT, THEY CONTINUE TO RANK AT THE BOTTOM AMONG 46 INDUSTRIES.

ACSI data show that ISPs, both large and small, need to invest more in what matters most – customer satisfaction. Today's customers demand functional and reliable mobile apps, more informative websites, easily understandable bills, and most importantly, competent and courteous call center staff. In other words, improving communication with their existing and potential customers will result in a competitive advantage for ISPs.

An open access network allows ISPs to save on network operation and maintenance costs and invest in better communication and customer service. This not only gives the chance to every ISP to distinguish itself in the eyes of its customers, over time it also improves the reputation of the broadband sector at large.

Ownership of the network infrastructure is no longer the only or even the best way to compete in the high-speed internet space. An open access model will diversify the market and allow a variety of ISPs to thrive.

While smaller ISPs will finally have a fair chance to enter the market, established market leaders can stay competitive by improving their customer experience and tailor their offering to satisfy the needs of their specific customer base.

There's no need for ISPs to build their own metaphorical roads. Sharing the journey can be just as rewarding, and certainly more profitable.

8

FULLERTON
The First American FiberCity®

The City of Fullerton, in northern Orange County, California, is famous for its propensity for technological innovation. For aviation enthusiasts, Fullerton is synonymous with the starting point for the Sunkist Lady's endurance flight record of 1,008 hours and two minutes. For rock fans, Fullerton is the city where Leo Fender designed the legendary Fender Telecaster, making it the official birthplace of the electric guitar.

But Fullerton is now famous for something else entirely: it is the first FiberCity® in the US, offering high-speed broadband and a choice of different suppliers to each resident and business in the city.

Fullerton is home to more than 135,000 residents and to a vibrant manufacturing and business community, known for the production of high-quality aerospace components. Despite its love for technological innovation, the city is actually quite old by Southern Californian standards. Fullerton was incorporated in 1904, which means that its infrastructure was not always up to scratch to support local businesses in the extremely competitive commercial climate of the region.



"As many of the newer neighboring cities have grown their capacity to attract business, some of our larger companies have left Fullerton for other communities," explained Jennifer Fitzgerald, Mayor of Fullerton. "We wanted to find a way to distinguish ourselves and offer something cutting-edge, something that other cities don't have."

"Our Community and Economic Development staff brought the concept of FiberCity® to the city council with the idea of reigniting economic development and providing our constituents with the highest available internet speed."

“ WE SOON REALIZED THE POTENTIAL OF FIBER TO PUT FULLERTON BACK ON THE MAP, AND DECIDED TO COLLABORATE WITH SIFI NETWORKS TO TURN OUR CITY INTO THE VERY FIRST AMERICAN FIBERCITY® ”

A SHARED VISION

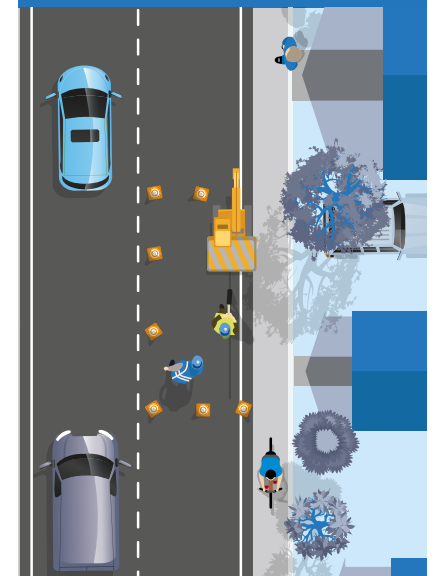
In the first phase of this project, SIFI Networks worked with Mayor Fitzgerald's administration to assess the city's needs and requirements. It soon became clear that the city council not only wanted to increase Fullerton's capacity to attract and retain business, it was also striving to bridge Fullerton's substantial digital divide and to level the playing field between more and less affluent areas.

It was very important to the city's administration that the future fiber network would pass each and every household and business in the city, offering everybody an equal opportunity to reap the benefits of fiber regardless of the residential income level of their neighborhood or the type of commercial district in which they operate.

This commitment to digital equity perfectly matched SIFI Networks' policy of building high-speed broadband networks citywide, with the same quality standards everywhere. This shared vision between the municipality and SIFI Networks convinced both that the construction phase could begin.

Any initial reservations citizens had about this cutting-edge project were quickly put to rest. The community was reassured that SIFI Networks' innovative microtrenching technology would be minimally invasive and avoid lengthy street disruptions.

MICROTRENCHING ALLOWS THE TRAFFIC TO CONTINUE TO FLOW IN AT LEAST ONE DIRECTION AND ONLY CAUSES A VERY TIGHT SCAR IN THE ASPHALT, ABOUT ONE TO ONE AND A HALF INCHES WIDE. THIS CAN BE EASILY PATCHED, LEAVING NO SIGN THAT ROADWORKS EVER HAPPENED.



AFTER HAVING PERSONALLY VISITED THE CONSTRUCTION SITES WHERE THE CREWS WERE OPERATING IN FULLERTON, MAYOR FITZGERALD REPORTED THAT THEY WERE WORKING EFFICIENTLY AND RESPECTFULLY, CAUSING MINIMAL DISTURBANCE AND LEAVING THE STREETS IN GOOD CONDITION.

THE BENEFITS FOR CONSUMERS

Consumers increasingly demand more bandwidth and faster connectivity. Most homes in Fullerton now work solely off a broadband connection, having suspended their traditional landline and cable contracts.

However, prior to the construction of a fiber network, the internet speed offering of traditional internet service providers was not able to support the demands of residents who run other parts of their homes on broadband, including entertainment and security systems. The COVID-19 pandemic has worsened the situation, since digital home schooling and remote working forced families to access their broadband network with multiple devices at the same time.

But slow connectivity is a thing of the past in neighborhoods where the fiber network has already been installed. Residents have reported a tremendous difference in the quality and speed of their internet, describing it as light years ahead of any option they had before. In those areas, people can now choose between two different internet service providers, Ting and GigabitNow.

“THE GOOD THING ABOUT HAVING NEW SUPPLIERS IS THAT THEY DON’T TAKE AWAY ANY OF THE OPTIONS THAT RESIDENTS HAD BEFORE,”

explained Mayor Fitzgerald. “This project simply expands and improves our options, giving people the chance to experience access to the internet at the mind-boggling speed of one Gigabit per second.”

THE MAYOR IS ALSO CONFIDENT THAT THE FIBER NETWORK WILL HELP BRIDGE FULLERTON’S SUBSTANTIAL DIGITAL DIVIDE BETWEEN AFFLUENT AND ECONOMICALLY DISADVANTAGED NEIGHBORHOODS.

She explained that because this is very high on her administrations’ agenda, construction started from the less affluent neighborhoods and proceeded to the wealthiest areas of the city. The administration believes that this will help level the playing field and give everyone the opportunity to experience high-quality connectivity regardless of their income level.



THE BIG SELLING POINT

The city council reported that the presence of a citywide fiber network has already revealed itself as a big selling point to attract new business in Fullerton. The project has repeatedly been featured in the Orange County Business Journal, the region’s largest business-oriented publication, and is one of the first benefits that the Economic Development Team discusses with potential buyers and tenants in Fullerton.

The new fiber network is also at the core of Fullerton’s new smart city plan, which will focus on three main areas, among others: improving information security, implementing an autonomous vehicle program, and enhancing the energy efficiency of streetlight technology.

“I think that moving forward, FiberCity® projects like the one going on in Fullerton will become standard operating procedures in every city,” stated Mayor Fitzgerald. “Smart city technology is so much further ahead of the technological capabilities of our municipalities. Fiber gives us a chance

to rise up and meet the growing technological demands of the free market.

“WHEN IT COMES TO BUILDING A FIBER NETWORK, MY ADVICE TO OTHER CITIES AND MAYORS IS AN EMPHATIC YES, JUST DO IT.”

“Your city must engage in projects like this to respond to consumer demand and to make sure that the city doesn’t get left behind as technology continues to be the driving force of our global and local economies. I would also say to fellow mayors that there are great opportunities to become partners with SiFi Networks as you enter a FiberCity® program, and this can offer added benefits to your communities.

“Finally, I would add that, while it’s understandable for municipalities to look for new revenue sources, I encourage fellow mayors to look at fiber networks not as a cash cow for the city, but rather as a constituent service that citizens are demanding and that they deserve.”

9

DESIGNING A
SMART CITY
For the Future

Designing a business's IT network is complex enough — security, redundancy, scalability and sector-specific requirements are just some of the many aspects to consider. But designing a network that spans an entire city and meets the requirements of every business, public institution and private citizen poses unprecedented challenges.

THIS IS WHY, IN 2014, SIFI NETWORKS DEVELOPED THE INFRASTRUCTURE-ARCHITECTURE MODEL FOR A FIBERCITY®. WE ARE NOW ABLE TO EASILY ADAPT THAT MODEL TO THE STRUCTURE AND REQUIREMENTS OF EACH CITY, ENSURING THAT EVERY CITIZEN AND BUSINESS WILL EXPERIENCE THE FULL BENEFITS OF FIBER.

The journey to developing that first architecture design was extremely complex. Since no one had ever developed a wholesale GPON network architecture of these proportions, there were no previous examples of similar ventures that we could use as a model to develop our original design.

Right from the start, SiFi Networks decided to base the design architecture of a FiberCity® on a three-layer, open access model, bypassing the intrinsic limitations of a traditional single-layer, vertically integrated model

approach. The US market was — and still is — relatively unfamiliar with this structure, but we were confident of the benefits that it would bring to consumers, municipalities, and ISPs.

AS A RESULT, WE STARTED OUR JOURNEY WITH THE INTENT OF BUILDING AN UNPRECEDENTED NETWORK DESIGN AND FAMILIARIZING US STAKEHOLDERS WITH WHAT WE CONSIDER THE BEST POSSIBLE APPROACH TO FIBER BROADBAND.

As the industry evolves and consumers' demands can only be satisfied by high-speed fiber-based networks, the polarization between the resources needed to build and maintain the infrastructure, and those needed to provide retail services, is only going to increase. This will make it hard if not impossible for the same company to be both an infrastructure provider and a service provider. For this reason, the existence of ISPs who are also infrastructure providers is becoming inherently obsolete.

THE THREE-LAYER OPEN ACCESS MODEL SOLVES THIS DILEMMA AND ALLOWS ISPS TO SHIFT TOWARDS A MORE FLEXIBLE AND CUSTOMER-ORIENTED BUSINESS MODEL.

THREE IS THE MAGIC NUMBER

Despite our firm belief that a three-layer open access model would be the most successful, there were significant challenges to establishing this model in the US. The first is a lack of familiarity with this model and the benefits it offers.

IN THE US, MOST HOUSEHOLDS ARE SERVICED BY THEIR TIER-ONE TELECOMMUNICATIONS OR CABLE TV PROVIDERS, BOTH OF WHOM HAVE MOVED INTO THE HIGH-SPEED INTERNET SPACE.

THESE TWO ENTITIES WORK AS A DUOPOLY AND ARE BOTH OWNER, OPERATOR AND SERVICE PROVIDERS. AS A RESULT, THE SEPARATION BETWEEN OPERATOR AND SERVICE PROVIDER IS A MODEL THAT MOST PEOPLE SIMPLY DON'T KNOW.

Another challenge is the fact that incumbent operators have traditionally viewed exclusive ownership of the network as a competitive advantage. As a result, large ISPs may lobby against changes to increased market competition, seeing this as a threat to their interests.

Nevertheless, an open access model can deliver significant benefits to large ISPs. It is true that the open access model seeks to increase competition. However, because of the high costs of building and operating the network infrastructure, ISPs who are also infrastructure providers may find it increasingly difficult to be agile, and divest from large capital infrastructure projects that have long-term payback periods, as the market experiences an overhaul in the coming years.

This is why in Europe, the great majority of these projects are publicly funded using taxpayer's dollars as part of governmental projects.

However, this comes with its own shortcomings. For example, when European Governments put pressure on operators to lay down more fiber, operators expect governments to pay for it. Over time, this mechanism disincentivizes the improvement and expansion of private networks. This doesn't happen to the same extent in the US, where the public sector subsidy of telecommunication needs is largely focused on rural markets, isolated municipalities and electrical utilities.

A privately financed network represents, therefore, the best option to guarantee the necessary funding for the initial construction phase, as well as for future maintenance and expansion. But why are private investors so interested in the potential of fiber to advance society at large, as well as generate a profitable return on investment (ROI)? To understand this, we must delve deeper into the concept of the FiberCity®.

THE SMART CITY REVOLUTION

A FiberCity® is the ultimate smart city, where fiber passes every single home, business and public building in the city, and access points for smart services are put in place as standard. The smart services available in a FiberCity® are the result of a strategic approach to the Internet of Things (IoT) that combines the remote management of services with the possibility to collect big data about those services.

For example, in a FiberCity® it is possible to connect all the traffic light control boxes in a city to allow emergency services to temporarily control the traffic flow, so that they can reach their destination fast and risk-free. The same sensors will also monitor traffic throughout the year and provide historic data on traffic conditions, which can be used by an AI solution to divert drivers in the most appropriate way.

We are in the very early phases of developing smart services and much more will be possible in the future. Building fiber networks for smart cities means we are connecting devices that have yet to be created, and that will be used by future generations. However, the fiber infrastructure that will deliver those services is available now.

DESIGNING THE FUTURE

So, how does SiFi Networks design a truly futureproof infrastructure? When designing the network for a smart city, the company works with a hugely diverse group of people, businesses and institutions to create a network with a wide variety of technical capabilities that meet all of the fundamental needs of the community. It is also essential

to think about the needs of mission-critical sectors, such as public safety and security, whose services have to work efficiently at all times.

THE NETWORK INFRASTRUCTURE OF A FIBERCITY® IS ESSENTIALLY THE COMBINATION OF THREE NETWORK DESIGNS, PLANNED AROUND THE SPECIFIC NEEDS OF MUNICIPALITIES, BUSINESSES AND PRIVATE USERS.

In terms of structure, it is a meshed network that spans an entire city, characterized by very high speed, high availability, low latency, and true diversity, meaning that there is no single point of failure. The strategy for this design took about six years to develop, but can now be easily replicated and adapted to the requirements of different cities.

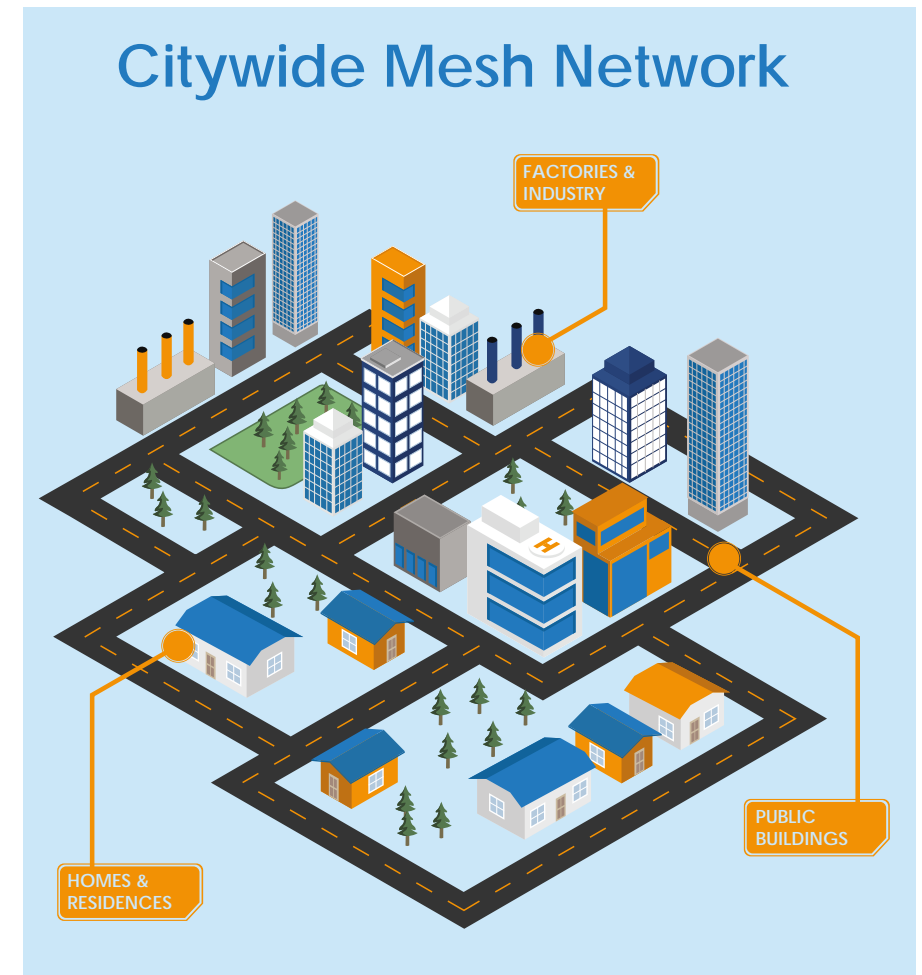
One of these requirements is the ability of the network to grow with the city — since fiber empowers economic development, it is necessary to plan for networks that can accommodate a city's growth and keep up with an ever-increasing number of customers. This is why the networks for FiberCities® are designed as a mesh which can keep growing.

When planning the network design, SiFi Networks works with municipalities to understand how their cities are going to expand — is there public land on

the perimeter of the city that allows for horizontal expansion? Are there underdeveloped areas within the city? Is the city surrounded by other cities, meaning that it will have to grow vertically? No matter the challenge, the mesh structure will allow for expansion.

In a traditional design, where all the fiber connects back to one building,

the network will reach a point where it can't grow anymore, because the amount of fiber needed would require increasingly large trenches. However, with a mesh structure, the traffic can be distributed in many different ways across the network, meaning that there isn't one single hotspot, but multiple hop-on and hop-off spots.



LOOKING AT A BRIGHT FUTURE

Fiber networks, with their ability to accommodate the requirements of several stakeholders and grow with the city, have the potential to revive the local economy and turn cities into vibrant business communities.

There are many examples of this in the world. For instance, when Google Fiber first built its own network, young companies started to rent homes in Kansas City and turn them into business incubators, for the sole reason of reaping the benefits of fiber connectivity. The same will happen to our FiberCities®, but with a big difference — it will happen citywide, with the same quality everywhere.

Unlike current incumbents, SiFi Networks doesn't have different designs or standards for different areas of the city, meaning that everybody will enjoy the full benefits of excellent connectivity, regardless of their neighborhood's current income level or business concentration.

This is an important step forward that differentiates our business model from previous ones. Because of the high costs associated with building fiber networks, if an infrastructure provider is also a service provider, it will strive for a return on investment (ROI) of about three to five years. As a result, it will normally provide fiber to the business quarter, the tourism district and the affluent residential districts of a city.

However, because of how we structure our funding, we look at the potential of a city over a timeframe of 25 to 30 years. If we can stimulate economic growth, the economically challenged areas of today will be the affluent neighborhoods of tomorrow, because in those areas real estate prices are generally affordable. This, coupled with high-speed connectivity, will attract business like never before and allow cities to make huge progress in terms of bridging the digital divide between affluent and disadvantaged areas.



“ FIBER NETWORKS, WITH THEIR ABILITY TO ACCOMMODATE THE REQUIREMENTS OF SEVERAL STAKEHOLDERS AND GROW WITH THE CITY, HAVE THE POTENTIAL TO REVIVE THE LOCAL ECONOMY AND TURN CITIES INTO VIBRANT BUSINESS COMMUNITIES. ”

10

RETHINKING
Broadband

SIFI NETWORKS' BUSINESS MODEL COMBINES SEVERAL INNOVATIVE ELEMENTS TO BRING ABOUT A REAL REVOLUTION OF THE US TELECOM'S LANDSCAPE. BUT HOW DID THIS MODEL TAKE FORM?

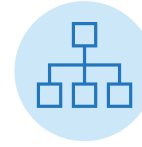
On the one hand, there was the intention to bring the benefits of last mile fiber infrastructure to the US. Despite the success of this approach across Europe and Asia, the US is still at an early stage of its adoption, and a change in perception was needed to allow consumers, municipalities and ISPs to fully appreciate its potential.

On the other, SiFi Networks wanted to pivot from a public-private partnership (PPP) funding model to a completely private one, alleviating the upfront capital costs for cities and giving investors the exciting chance to restructure the national telecommunications landscape while driving positive social change.

There were three main goals to this ambitious project — injecting new life into the market by stimulating competition, future-proofing cities with high-speed connectivity, and helping close the country's staggering digital divide.

In the following interview, Ben Bawtree-Jobson, CEO of SiFi Networks, explains the evolution of SiFi Networks' business model, from its initial conception to future plans to expand to more than 200 cities.

BEN BAWTREE-JOBSON,
CEO OF SIFI NETWORKS



SIFI NETWORKS WAS BORN FROM THE AMBITIOUS IDEA OF DEMOCRATIZING

BROADBAND ACCESS IN THE US THROUGH THE CONSTRUCTION OF OPEN-ACCESS, PRIVATELY FUNDED FIBER NETWORKS. HOW DID YOU AND YOUR PARTNERS DEVELOP THE CURRENT BUSINESS MODEL FOR THE COMPANY?

Our initial intent was to build a common fiber network infrastructure in the US, with funding relying on a traditional PPP model. However, we quickly realized that this would not necessarily be the most suitable approach for cities and that funding our FiberCities® privately would benefit the community at large. This is because a privately funded model alleviates the burden on public funding, while allowing municipalities to reap the benefits of ultra-fast, high-quality connectivity.

So, we knew that the three-layer model of open access was what the market needed, but we decided to find a way to fund it without public investment, and instead demonstrate to investors in the private capital market that

this opportunity made sense both financially and socially.

At the time, the US market was still waking up to the advantages of last mile fiber optic networks, despite the fact that these had proven to be successful elsewhere in Europe and other parts of the world. Therefore, it was important to help investors realize the potential of this opportunity and overcome the initial skepticism that accompanies the emergence of any new technology.

We started pitching to many potential investors, illustrating the advantages of open access and explaining that they would have the chance to partake in a business model with a proven track record of success in many industrialized and technologically advanced countries.

Despite some initial hesitation, investors didn't take long to realize the potential of our vision. New technologies such as microtrenching would allow for fast deployment, and the three-layer approach would make the broadband market more dynamic because it would mirror the extreme specialization that now characterizes every area of our culture. When each layer specializes in its area of expertise, it drives better results, ultimately leading to better customer service, better network architecture principles and better maintenance, which are all key to the success of our model.



THE DIG ONCE PHILOSOPHY IS ANOTHER CRITICAL COMPONENT OF SIFI NETWORKS' BUSINESS MODEL. CAN YOU TELL ME MORE ABOUT IT?

Our dig once philosophy means that all connectivity needs are put in place from day one, at the same time as we deliver fiber to businesses and residents. This guarantees that residents will enjoy a future-proofed infrastructure that enables the services and initiatives of a smart city, such as 4G/5G, dedicated private networks, e-health and remote learning. All these services will run on a single infrastructure, meaning you only need have one fiber optic network built in your city.

Furthermore, the construction itself only requires a single lane road closure, so traffic can continue to flow in at least one direction.

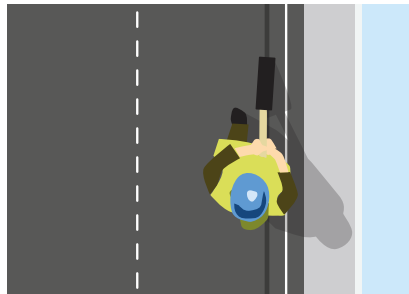
FURTHERMORE, THE CONSTRUCTION ITSELF ONLY REQUIRES A SINGLE LANE ROAD CLOSURE, SO TRAFFIC CAN CONTINUE TO FLOW IN AT LEAST ONE DIRECTION.

Construction moves at a speed of about 600-800 meters a day, meaning that a street will generally experience just a day or two of disruption, for an infrastructure that will hopefully serve its residents forever.

Moreover, our operation teams coordinate with municipalities to understand what other construction projects are taking place in that area, so that we can build together to further limit disruption, alignment of all key stakeholders helps cut costs and disruption.

The dig once philosophy comes from the idea that, in the same way that cities have single water, electricity and gas lines, they should have one single infrastructure for connectivity. Having multiple fiber, copper and cable lines is pointless, incredibly inefficient, and ultimately unsustainable. And why would you want to implement copper and cable lines, when fiber is the undisputed leader to boost technological innovation? Instead, we should look to save resources and energy, and build a more sustainable, scalable investment that offers an effective route to market for all service providers.

This kind of network should also be future-proofed. Indeed, a fiber network can support high speed 4G and 5G cellular networks, because it can handle the vast amount of traffic generated and offers virtually unlimited bandwidth potential. Once a common fiber network has been implemented, cities will have the most future-proof solution for connectivity available and there's no reason why they should dig again.



HOW DO YOU PLAN FOR THE UPGRADING AND SCALABILITY OF A NETWORK?

A network can't be truly open-access unless it's scalable, meaning that it can serve enough customers to make it attractive for multiple service providers to access the network simultaneously.

THIS IS THE REASON WHY WE PLAN FOR SCALABILITY EARLY ON IN THE DESIGN PHASE.

We also have to consider the chance that in the future, the legislation might change and force ISPs to share the network, like in the UK. If that happens, the infrastructure must be able to cope.

Moreover, as the market becomes more competitive, much of this competition will be based on traffic volume. By partnering with us, ISPs of all sizes will be able to access a platform with a huge volume of customers, which will contribute to the health and stability of their businesses. A scalable infrastructure ensures that we'll be able to accommodate increasing traffic volume, as well as an increasing number of smart services for cities.



“AS LONG AS WE DESIGN THE NETWORK TO HAVE SURPLUS END POINTS OF FIBER AVAILABLE, WE ARE CONFIDENT THAT THE CURRENTLY INCONCEIVABLE IS STILL ACHIEVABLE.”



WE EXPECT THAT MANY SMART CITY TECHNOLOGIES WILL START TO BE USED ON A LARGER SCALE IN FIVE TO TEN YEARS. WHEN PLANNING THE INFRASTRUCTURE FOR A FIBERCITY®, HOW FAR INTO THE FUTURE DO YOU LOOK?

We tend to look at a timeframe of at least 30 years. Even if we can't foresee which new technologies are going to take off, we can already put the right infrastructure in place to ensure that the network will be able to accommodate all the services smart cities will need to implement.

To cope with that, some service providers lay down thousands and thousands of fiber counts, but this kind of redundancy is unnecessary. We have a different approach, based on the knowledge that fiber capacity

hasn't been proven to be limited yet, and that the latest studies show that a single strand is capable of deploying about 100 terabits of a data per second. As long as we design the network to have surplus end points of fiber available, we are confident that the currently inconceivable is still achievable.

This approach allows us to confidently enter into long term contracts with ISPs, and to keep the price stable for that period of time. In the broadband market space, this is quite novel.



WHEN LOOKING THIS FAR INTO THE FUTURE, YOU MUST HAVE A CLEAR VISION FOR

SIFI NETWORKS. HOW WOULD YOU DESCRIBE THE COMPANY'S MISSION FOR THE YEARS TO COME?

We have ambitious plans for Sifi Networks. We have identified more than 200 cities that we could turn into FiberCities® in the future, meaning that we would be bringing fiber to over ten million households across the US.

In terms of vision, what really excites me is the possibility to help bridge the digital divide. We are working with a number of non-profit organizations to deliver subsidized high-speed internet to low-income communities.

In most cities across the US there is a large disparity in the speed and quality of internet connectivity, and this divide is clearly marked along racial as well as income lines.

We work with the Greenlining Institute, an organization committed to ending the practice of redlining. They produced a map of broadband access across California and overlapped that with data on the racial and ethnic demographics across the country. There is a clear correlation between the two things, and I think that it is appalling that network infrastructures should contribute to reinforce discrimination.

I hope that our work with non-profit associations will accelerate and expand what we are able to do to improve the status quo and guarantee high-quality connectivity for all, no one excluded.



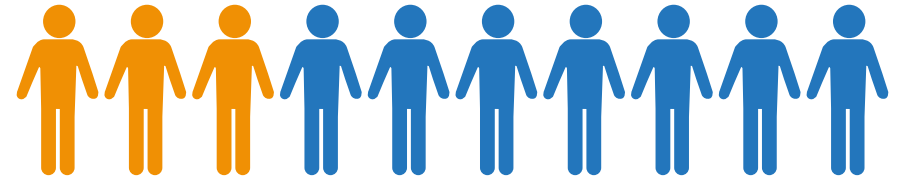
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DIGITAL EQUITY
Reading between the lines

“ UNSERVED AREAS, BOTH RURAL AND METROPOLITAN, ARE NOT RANDOMLY DISTRIBUTED. THEY ALMOST ALWAYS OVERLAP WITH LOW-INCOME NEIGHBORHOODS AND AREAS WITH A MAJORITY OF NON-WHITE RESIDENTS. ”

21 MILLION AMERICANS

THREE IN TEN PEOPLE, DON'T HAVE ACCESS TO BROADBAND



40%

OF SCHOOLS LACK A FAST AND RELIABLE INTERNET CONNECTION



60%

OF HEALTHCARE FACILITIES LACK A FAST AND RELIABLE INTERNET CONNECTION



According to the PEW Charitable Trusts, about 21 million Americans, nearly three in ten people, don't have access to broadband, defined as internet connectivity with a download speed of at least 25 megabits per second (Mbps) and upload speed of at least 3 Mbps. Their research also shows that 40 per cent of schools and 60 per cent of healthcare facilities outside metropolitan areas lack a fast and reliable internet connection.

But looking closely at a map of broadband distribution, it's easy to see that unserved areas, both rural and metropolitan, are not randomly distributed — they almost always overlap with low-income neighborhoods and areas with a majority of non-white residents. To understand why this happens and what can be done to contrast this phenomenon, SiFi Networks spoke to Paul Goodman, technology equity director at The Greenlining Institute of Oakland, California.

WHAT IS REDLINING?

Redlining emerged in the 1930s as a United States government-created policy of discrimination meant to deny access to economic opportunities for communities of color and low-income neighborhoods.

The term “redlining” originates from the fact that public as well as private entities used to trace a red line on maps to distinguish between wealthy white neighborhoods, viewed as desirable markets for financial products such as loans, mortgages and insurances, and areas perceived as unsuitable, and therefore denied access to those same services.

THE MOST INFAMOUS EXAMPLES OF REDLINING INVOLVE THE DENIAL OF ACCESS TO BANKING AND OTHER FINANCIAL SERVICES, BUT NOWADAYS REDLINING CAN EXTEND TO VIRTUALLY ANY SERVICE, INCLUDING QUALITY HOUSING, HEALTHCARE, EDUCATION, AND EVEN THE AVAILABILITY OF FRESH PRODUCE AND CLEAN DRINKING WATER.

The Greenlining Institute, headquartered in Oakland, California, was founded in 1993 with the aim of fighting redlining and fostering

research, organizing and policy-making that supports racial and economic equity. It operates in five core areas: health, economic, environmental, energy, and tech equity. These areas collaborate to tackle redlining with a truly multidisciplinary approach, with the tech team taking the lead in issues concerning the digital divide.

REDLINING GOES DIGITAL

The Greenlining Institute's commitment to equity in tech and telecommunications started before the emergence of the internet, to grant access to telephone services. Its activities in this sense have now expanded to include advocacy for equity in wireless and broadband service, as well as to end algorithmic bias and discrimination in computerized decision-making.

“ THE PRACTICE OF REDLINING HAS CAUSED A DISPROPORTIONATE AMOUNT OF DISINVESTMENT IN COMMUNITIES OF COLOR, ”

explained Paul Goodman, technology equity director at The Greenlining Institute. “Whereas white people were able to access loans and mortgages, residents of redlined areas were denied those same wealth-building opportunities. Decades of redlining are at the base of what is known today as the racial wealth and income gap.”

These inequalities extend beyond the purely financial realm. Historically redlined districts in California, for example, are also the most polluted areas today according to CalEnviroScreen, a mapping tool that helps identify communities that are disproportionately affected by pollution.

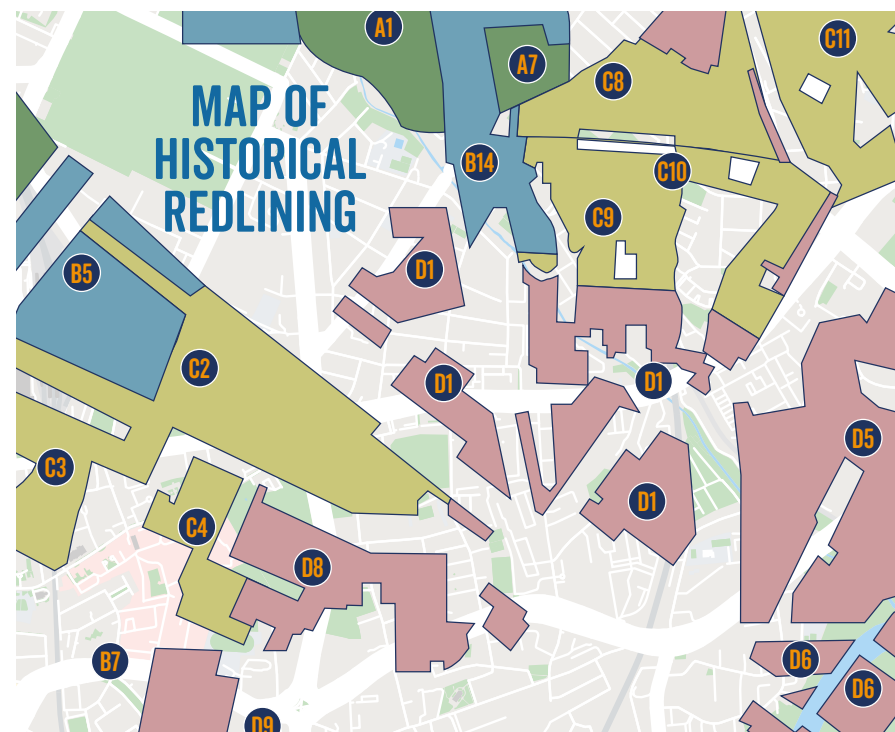
Inequality is also perpetuated in access to digital technologies. A recent study by Vinhcent Le, Technology Equity attorney at The Greenlining Institute, evidenced that historically redlined communities have the worst connectivity, both in terms of speed and quality. The result of this study challenges the traditional assumption that the digital divide predominantly impacts rural communities, showing that historically redlined urban areas also suffer the consequences of poor connectivity.

In California, this is especially visible in the areas of Watts, Lynnwood and Compton. To complicate the situation, these areas are often served by only one ISP, meaning that residents have

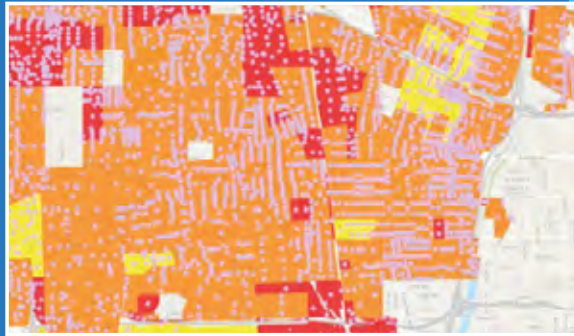
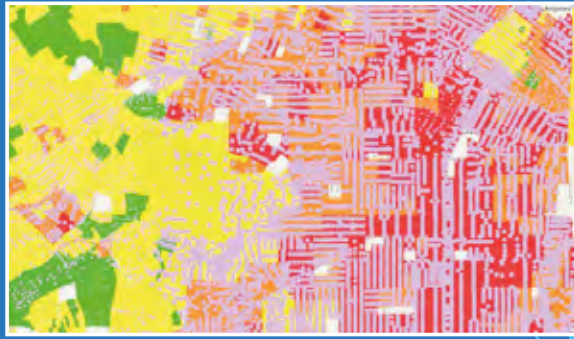
no choice but to put up with the low-quality and often overpriced service it provides.

“ IN CALIFORNIA, OUTSIDE WEALTHY URBAN AREAS, SUBSCRIBERS CAN USUALLY CHOOSE BETWEEN ONLY ONE CABLE AND ONE PHONE COMPANY, ”

explained Goodman. “In rural areas, there is usually only one ISP available, often using outdated technology such as DSL or dial-up, for which subscribers pay the same amount of money that residents of wealthier areas would pay for cable broadband.”



THE MAPS REPRESENT THE ACCESSIBILITY AND ADOPTION OF BROADBAND IN RELATION TO THE PERCENTAGE OF RESIDENTS OF COLOR. THE LEVELS OF ACCESSIBILITY AND ADOPTION VARY FROM VERY GOOD - DARK GREEN - TO VERY POOR - RED.



WE CAN SEE THAT IN AREAS WITH A HIGHER PERCENTAGE OF RESIDENTS OF COLOR, THE QUALITY OF BROADBAND IS ALMOST INVARIABLY VERY POOR OR POOR, WHEREAS AREAS WITH A MAJORITY OF WHITE RESIDENTS ARE CURRENTLY ENJOYING THE BEST BROADBAND QUALITY.

“ THE TERM “REDLINING” ORIGINATES FROM THE FACT THAT PUBLIC AS WELL AS PRIVATE ENTITIES USED TO TRACE A RED LINE ON MAPS TO DISTINGUISH BETWEEN WEALTHY WHITE NEIGHBORHOODS, VIEWED AS DESIRABLE MARKETS FOR FINANCIAL PRODUCTS SUCH AS LOANS, MORTGAGES AND INSURANCES, AND AREAS PERCEIVED AS UNSUITABLE, AND THEREFORE DENIED ACCESS TO THOSE SAME SERVICES. ”

IS BROADBAND A BASIC RIGHT?

The Civil Rights Act of 1968, which includes the Fair Housing Act, bans discrimination in accessing services on the basis of gender, color, ethnicity and other identity markers.

However, current regulations are subject to two main shortcomings. The first is that they support equality but not equity. The second is that broadband is not necessarily classified as a basic right.

“ BY THE TIME THE CIVIL RIGHTS ACT WENT INTO EFFECT, MUCH OF THE DAMAGE HAD ALREADY BEEN DONE, ”

stated Goodman. “For decades, white families had been able to access loans, invest and accrue wealth, whereas families of color could not. At that point, telecommunications service providers started building infrastructure in areas where they were likely to attract wealthy subscribers and make a profit. The Civil Rights Act and Fair Housing Act were designed to create equality, so that everyone would be treated in the same way, but what they couldn’t create is equity, which is about restoring the historical injustices of the past.”

The lack of regulations specifically targeting broadband is another major problem. Access to internet could be life-changing for low-income residents, but connectivity is often perceived as a luxury.

“Nowadays, everyone agrees that telephone service is a basic right, which is why it is protected by a robust set of regulations. For example, low-income residents can apply for the

Lifeline Program, a subsidy to access phone service,” continues Goodman. “However, virtually any major ISP argues that broadband is not a basic necessity. Although some ISPs offer low-income programs, the criteria to qualify are so narrow, and the quality of the service so poor, that people are often discouraged from applying.”

THE BENEFITS OF AN OPEN ACCESS INFRASTRUCTURE

The three-layer model embraced by SiFi Networks, based on a common open access infrastructure that can support a variety of ISPs, could help immensely in tackling the digital divide between historically redlined areas and wealthier communities. This is why SiFi Networks has partnered with The Greenlining Institute to foster technology equity.

“Because of the way that SiFi Networks structures and manages its funding, it is able to deploy fiber to areas that have traditionally been neglected by ISPs,” explained Goodman. “SiFi doesn’t expect to make a quick ROI, but is willing to make a long-term investment in communities.”

“We are working with SiFi to identify historically redlined neighborhoods, but most importantly we are collaborating with the company to educate their mid-level managers on the history of digital redlining and on issues of technology equity. This means that they will be able to look at the neighborhoods in which they build not only as business cases, but also and most importantly as communities with a unique history.”

As well as providing educational opportunities, The Greenlining Institute is collaborating with SiFi to support the

“ THE THREE-LAYER MODEL EMBRACED BY SIFI NETWORKS, WHICH IS BASED ON A COMMON OPEN ACCESS INFRASTRUCTURE THAT CAN SUPPORT A VARIETY OF ISPS, COULD HELP IMMENSELY IN TACKLING THE DIGITAL DIVIDE BETWEEN HISTORICALLY REDLINED AREAS AND WEALTHIER COMMUNITIES. ”

company’s fair employment practices and supplier diversity commitment, ensuring that SiFi’s workforce, executive team and contractors reflect the demographics of the communities they serve.

But besides the company’s commitment to technology equity, it is its business model that will inherently help bridge the digital divide.

“The open access model championed by SiFi will open up the market to several ISPs and give consumers real choice,” continued Goodman. “There aren’t many open access networks in the US, but where there are, they have shown to be very successful at

supporting a wide variety of ISPs, who compete vigorously to offer the best possible service.”

By supporting supplier diversity and giving consumers a choice, SiFi Networks is allowing historically redlined communities to rise up to meet the demands of a society in which digitalization is the driving force of innovation. Whether it is to facilitate a job search, stay in touch with loved ones, apply for their children’s school lunch program, or learn new skills online, we believe that broadband is a basic necessity and that everyone should have access to reliable, fast, and accessible internet connectivity.

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CONCLUSION

At the dawn of the American Revolution, ships, the postal service, and travelers on horseback were the fastest means to spread the ideas and sentiments that ultimately led to the formation of a new country. Despite their obvious shortcomings in the eyes of the contemporary observer, these means of communication worked for a simple reason — they served their purpose.

Today, the digital transformation that affects every aspect of life has profoundly changed the nature of communications. Yet, the predominant business model in US telecommunications doesn't always serve its purpose — millions of citizens still lack access to fast and reliable connectivity, the country's ageing infrastructure hinders the development of a strong digital economy, and a large digital gap exists between affluent and low-income communities. At the same time, smaller service providers, who could help solve these problems by providing more competitive tariffs, face huge barriers to entry.

In Europe and Asia, open access broadband has already shown to be very successful at fostering healthy competition and supporting a dynamic telecommunications market, but in the US these benefits are limited to the handful of communities that have pioneered this broadband model.

However, spreading this approach countrywide will bring about a new and exciting American Revolution that will transform telecommunications. FiberCities® represent a sustainable, long-term solution to the shortcomings of the current telecommunications landscape, with benefits for each and every layer of our society.

Consumers could massively benefit from an open access network that supports several ISPs, fostering healthy competition and pushing each of them to go above and beyond to serve their customers. This would lead to more accessible as well as more diverse offerings, so that consumers would be able to choose packages that really respond to their needs, at a fair price. These improvements could extend to customer service, allowing for faster and simpler interactions between customers and service providers.

SiFi Networks' approach of building citywide, open access fiber networks aims at levelling the playing field and closing the digital divide, connecting citizens regardless of their income level or background. By providing excellent connectivity for everyone, FiberCities® will help bridge the digital divide created by historic inequalities between affluent and low-income neighborhoods.

Open access broadband will also lower the barriers to entry for emerging ISPs, giving them the chance to deploy the fastest, most reliable fiber infrastructure available today, without having to worry about the cost-prohibitive investment of building and maintaining it.

Contrary to popular belief, even established large ISPs have much to gain from open access broadband, such as the opportunity to replace aging copper infrastructures with fully fiber-based ones, a sure way to meet customers' expectations for super-fast connectivity. The open access model offers large ISPs the exciting chance to expand and innovate without being tied-down by asset-heavy investments, modernizing their business at no extra cost.



Fully fiber-based, open access networks will also provide the foundation for the implementation of smart city services, from smart traffic management to environmental monitoring. There is a vast array of smart city services that we can only imagine today, but the fiber network that is necessary to support them is ready and available now.

In the same way that rivers and major road networks were the arteries along which cities developed and expanded in the past, fiber networks will be the catalyst for cities' expansion in the future. This means that fast and reliable connectivity will also attract new business and residents, reviving areas of the city that might have lagged behind until now.

SiFi Networks' innovative microtrenching technique means that these benefits can be achieved with minimal traffic disruption, leaving streets in excellent condition after the construction phase and serving constituents for decades to come.

Adopting an open access broadband model, based on a three-layer approach that dictates the separation between the provision of services and the ownership of the broadband infrastructure, is the first and most important step to revive the entire telecommunications sector.

OVER TIME, THIS WILL ALLOW THE US TO KEEP PACE WITH OTHER ADVANCED NATIONS ACROSS THE GLOBE, MAINTAINING ITS COMPETITIVENESS THANKS TO A STRONG DIGITAL ECONOMY.

The technology to deliver this change is available now and many American cities are already implementing it. Embracing open access fiber broadband is about so much more than just good business — it is an opportunity to invest in long-term change and ensure a more connected future for everyone, no one excluded.

For decades, America has had a problematic relationship with telecoms. Today, broadband across the US is owned by a few corporations. Outside of large cities, access is often patchy, competition is stifled, and consumers have little choice in the operator they use. To date, the concept of open access broadband, where the network is owned and used independently, has had little take-up. Now, SiFi Networks is working to solve the problem — putting forward its “dig once” philosophy, an idea that will bring together internet service providers (ISPs), cities, consumers and the government — heralding a new **American revolution in broadband.**