JUNE 2021

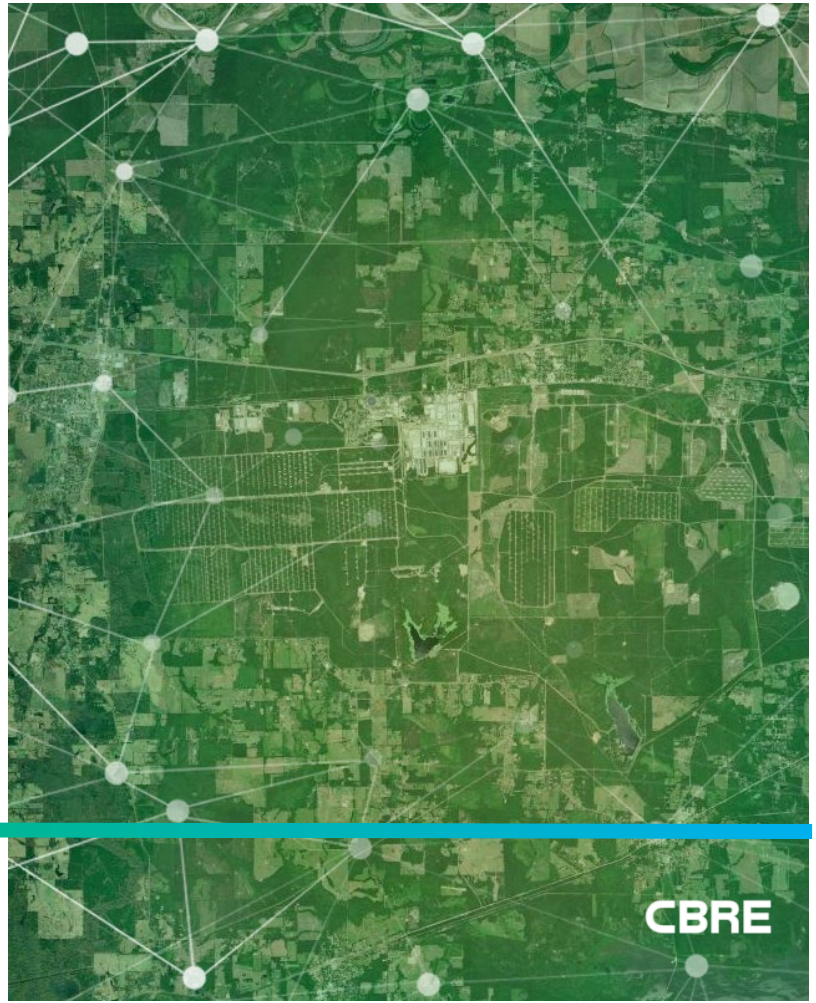
NETWORK ADVISORY SERVICES

CONNECTIVITY REPORT

TEXAMERICAS CENTER

Prepared for

TexAmericas CENTER®
Texarkana USA



REPORT BACKGROUND

DISCLAIMERS AND WAIVERS

This presentation has been prepared in good faith based on CBRE's current views of the market. The information contained within is based on opinion and/or projections formed from CBRE's subjective analyses of current market circumstances, and data obtained from a wide variety of sources, including, but not limited to telecom service providers, proprietary data sources, historical records, publicly available records and interviews with subject-matter experts. Other firms may have different opinions, projections and analyses, and actual market conditions in the future may cause CBRE's current views to later be incorrect.

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SECTION 1

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

PROJECT OBJECTIVE

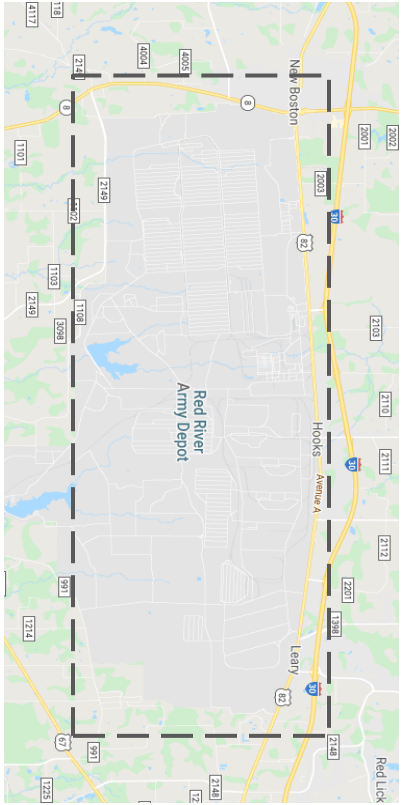
CBRE was engaged to research and evaluate the telecommunications and network infrastructure that supports the TexAmericas Center. The area of focus includes the long-haul systems from Dallas, Texas to Little Rock, Arkansas and a 15-to-30-mile radius surrounding the TexAmericas Center Campus.

Target Area Overview

The TexAmericas Center Campus consist of 12,000 development-ready acres and is ensconced within the 40,000+ acres that make up Red River Army Depot, Day & Zimmerman and the TexAmericas Center Campus. The Campus is located 18 miles west of Texarkana, Texas and continues a parallel to Interstate 30 until it reaches the borders of New Boston, Texas. The entire footprint is situated in Bowie County. The TexAmericas Center Campus is approximately 170 miles from Dallas, Texas, 165 miles from Little Rock, Arkansas and 100 miles from Shreveport, Louisiana.

Network Infrastructure

Windstream is the predominant carrier in the region, as part of their formation they absorbed Valor Communications (GTE Southwest). Additionally, Windstream built a special network for the Red River Army Depot in 2015. Sparklight (CableOne) and Vyve are the two local cable providers, and Conterra Networks has a 144-count fiber network deployed around the Campus. Windstream's long-haul network is immediately available by way of the fiber from the Campus back to Windstream's 500-507 Olive Street point of presence (PoP). CenturyLink is also located in Windstream's facility, which provides broader and diverse long-haul access.



EXECUTIVE SUMMARY (CONTINUED)

Right-of-Way Environment

The TexAmericas Campus has several Right-of-Ways (ROWs) that can be used to further enhance or augment the connectivity profile of the Target Area. These ROWs include the rail distribution system and roadways such as Routes 82, Route 67 and State Highway #8 - all of which offer cost effective underground construction pathways through methods like vibratory plowing or direct trenching. Additionally, aerial construction is certainly an option as most poles have very little loading on them.

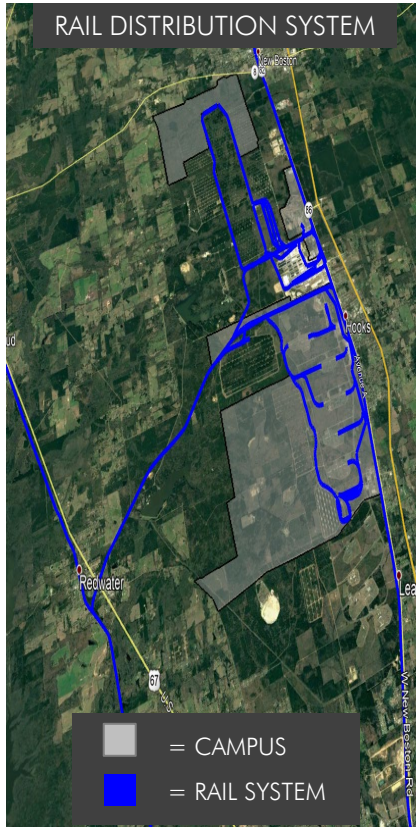
Strengths

The Campus has dark fiber and high-capacity 100Gigabit services immediately available, using Windstream Communications and Conterra Networks. Both Windstream and Conterra built custom networks to service the campus. Additionally, the TexAmericas campus ROW pathways, ensure that other diverse pathways can be created. Interconnection to the core long-haul networks already exists and is powered with high-capacity equipment.

Wireless Infrastructure

There are more than a dozen wireless tower sites that are within a 10-mile radius of the center of the Target Area. The area's topography, ease of wireless tower siting/zoning and availability of fiber-based feeds would allow for the development of a high-capacity meshed wireless system across the campus.

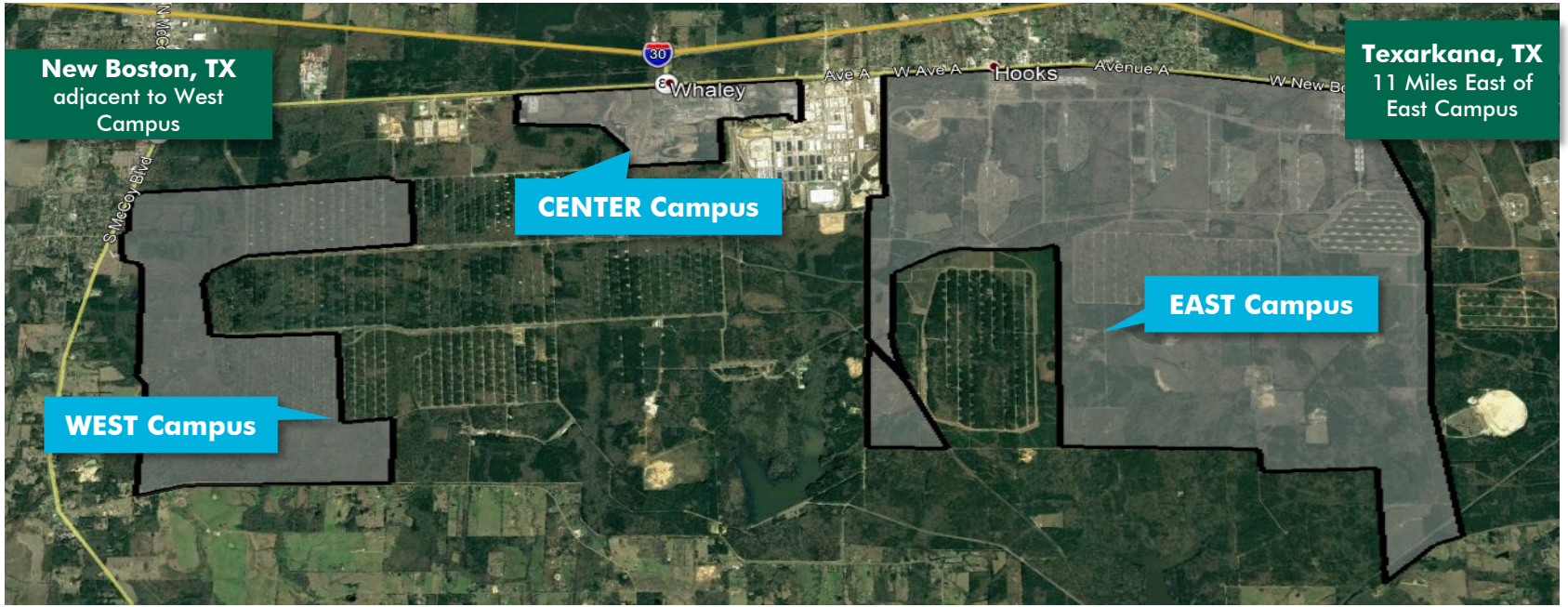
RAIL DISTRIBUTION SYSTEM



SECTION 2

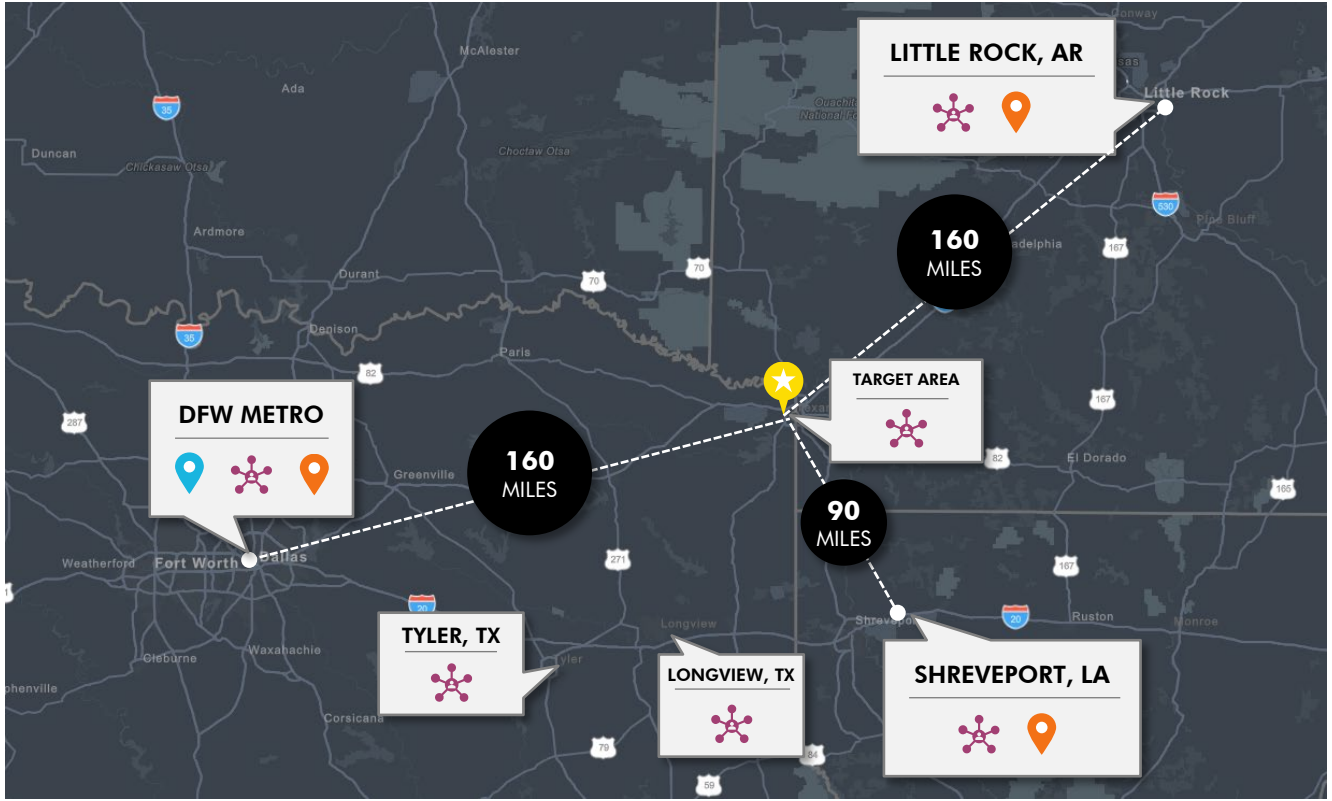
TARGET OVERVIEW

TARGET AREA



BIRD'S EYE VIEW OF TEXAMERICAS CAMPUS | CENTER-POINT 33°25'58.89"N 94°18'43.16"W

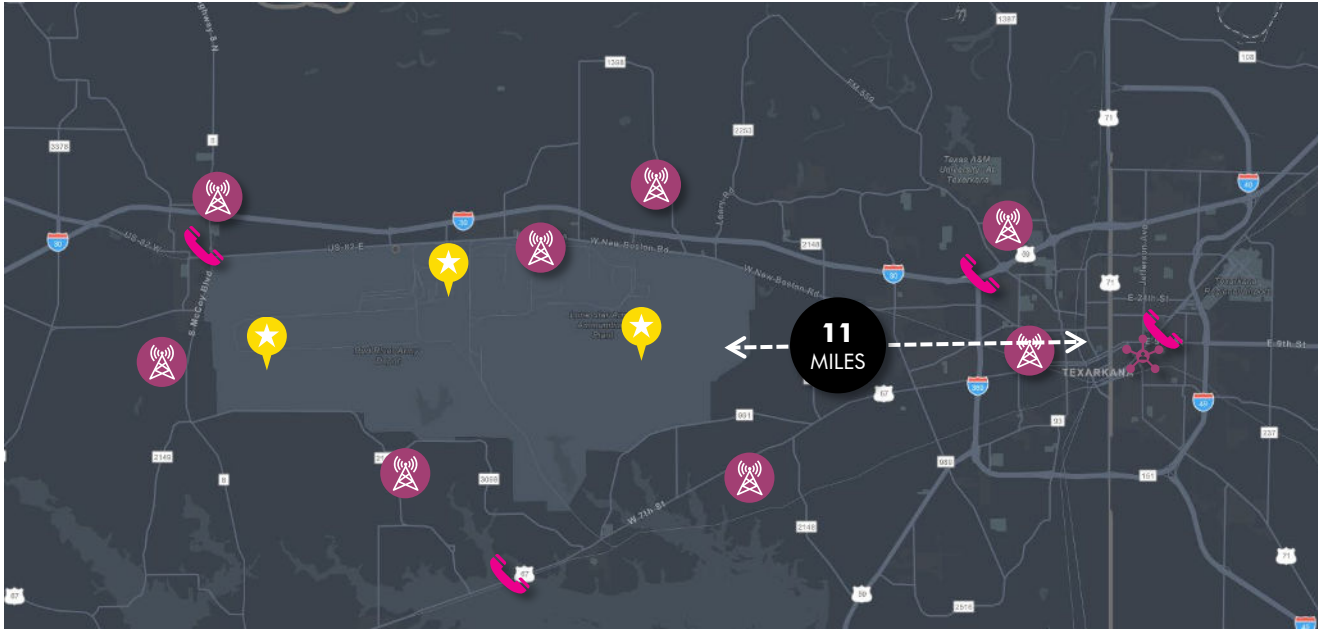
RELATIVE ENVIRONMENT | REGIONAL VIEW



MAP LEGEND

- Target Area
- Data Center(s)
- Cloud
- Long Haul Network Interface

RELATIVE ENVIRONMENT | LOCAL VIEW



MAP LEGEND

- Target Site
- Data Center
- Tele Switching Center
- Long Haul Network Interface
- Wireless Systems

SECTION 3

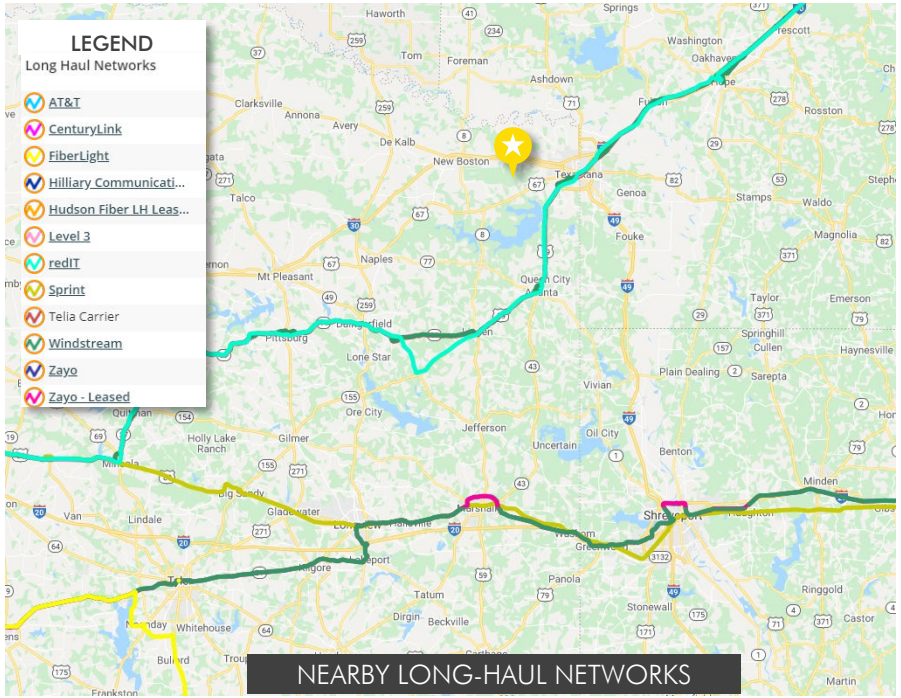
NETWORK INFRASTRUCTURE

LONG-HAUL FIBER

Long-haul networks are fiber optic-based networks that provide a standardized method of transporting data, voice and video traffic from state-to-state and city-to-city.

They can be visualized like a highway system that crisscrosses the United States.
In relationship to data centers, long-haul networks are the key backbone for transporting data and voice services, as they “mesh” with the local metro networks to ensure traffic is successfully delivered.

Most long-haul systems follow along the path of railroads, highways, high-tension power lines or pipeline pathways. Long-haul network elements are the basis of the physical infrastructure that powers the modern-day internet.

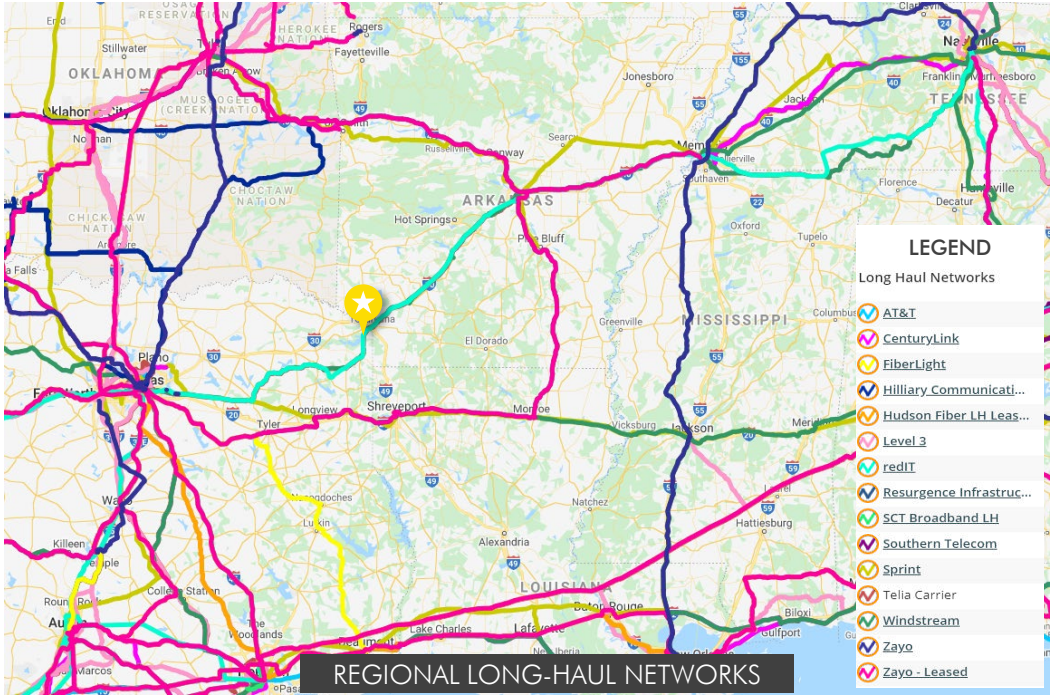


LONG-HAUL FIBER | REGIONAL VIEW

The Dallas-Forth Worth Metropolitan Statistical Area is the closet "core" network hub to the Target Site. Dallas has one of the most prominent internet and data hubs in the U.S. It is typical for most voice, video or data to pass through the closest regional hub, as that is how the bulk of the networks are designed.

Dallas has more than 100 data centers, dozens of cloud systems and is host to most of the core content delivery systems such as Netflix, Amazon, Google, Oracle and Salesforce to name a few.

Other long-haul pathways exist; examples of these include Longview, TX; Nashville, TN; Tulsa, OK; Houston, TX and Atlanta, GA. Technically, traffic can go in any direction, as the internet is designed to take the shortest path when possible.



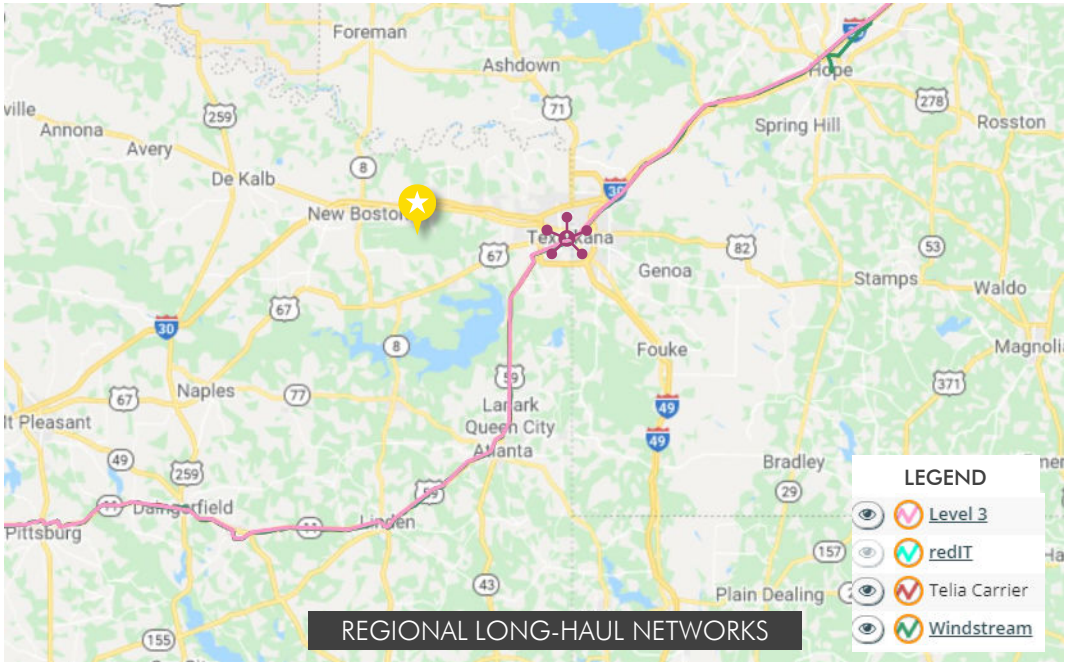
REGIONAL LONG-HAUL NETWORKS

LONG-HAUL FIBER | LOCAL VIEW

The local long-haul interface, located at 500 – 507 Olive Street, Texarkana, is owned and operated by Windstream. This is their primary switching facility in the area for all voice, data and video traffic. CenturyLink, MCI and AT&T core long-haul fiber also pass through this facility.

There are dozens of third-party networks that utilize CenturyLink's infrastructure. Primary examples include Telia and GTT.

Every service provider in the area has some type of interface that interconnects at this switching facility, making it a key location for services.



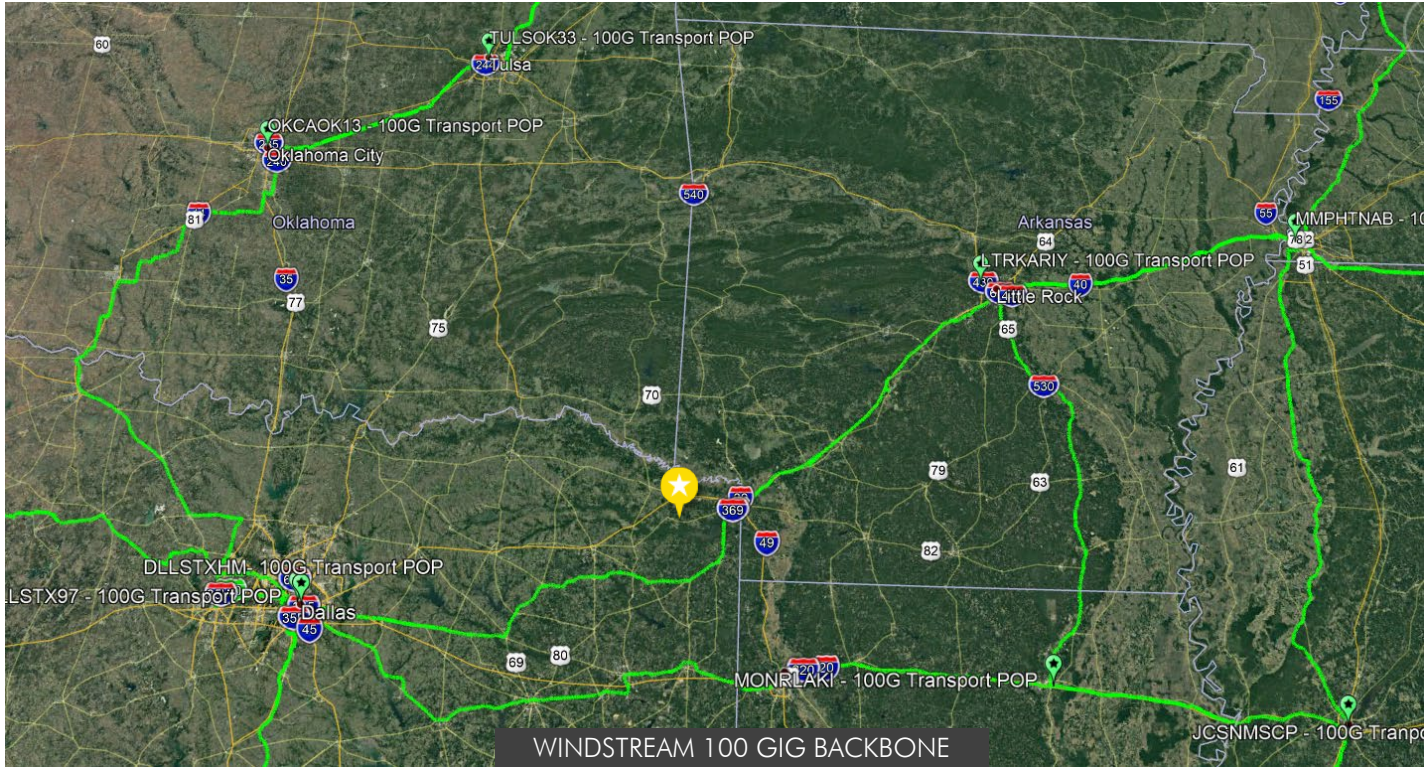
MAP LEGEND

Interconnect Facility

LONGHAUL NETWORK FIBER | WINDSTREAM REGIONAL

windstream

Windstream has a 100Gig enabled national backbone network, and the system runs right through Texarkana.



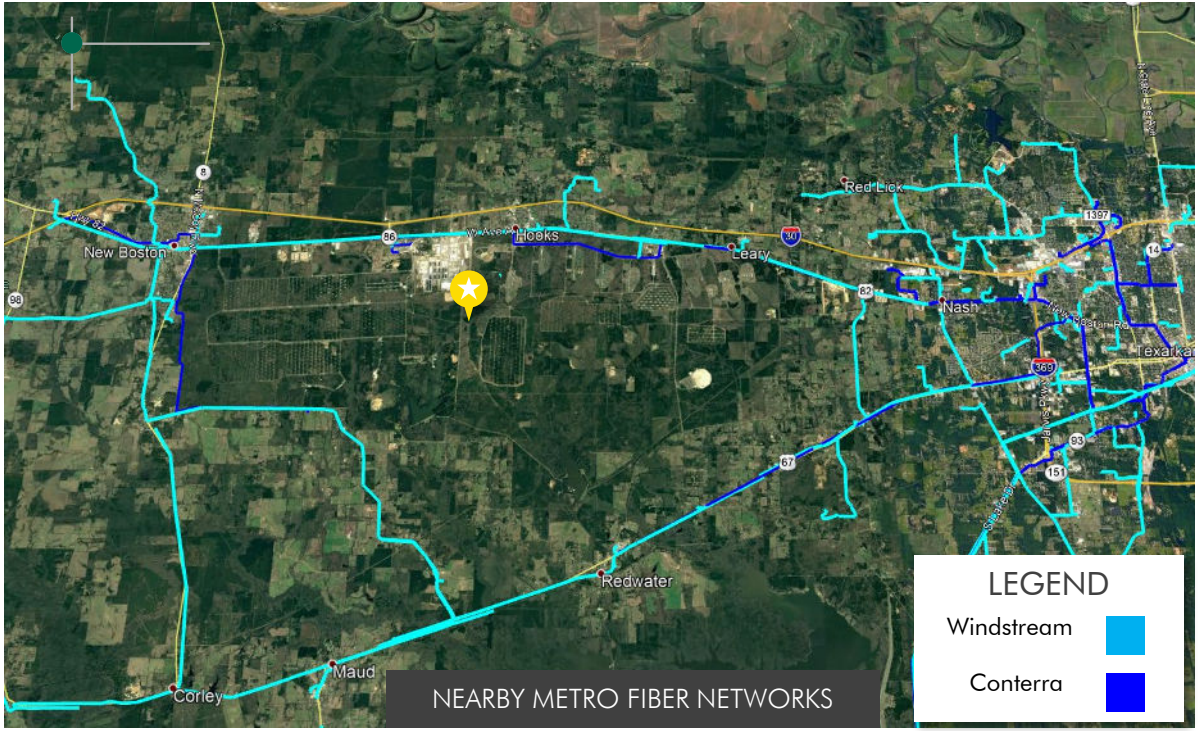
WINDSTREAM 100 GIG BACKBONE

METRO FIBER

Metro networks are typically designed to extend from a carrier hotel, data center or carrier point of presence (POP) to service the local market, business districts and/or individual properties. The construction of metro networks is largely driven by customer demand. Many metro networks are built in a protected ring fashion, while others are built in a linear fashion to provide services to a single building.

Metro fiber is also known as the "last-mile" fiber system and is the system that interconnects with long-haul fiber.

There are enough fiber providers in the immediate area to support any type of application, such as a data center or high-tech business campus.

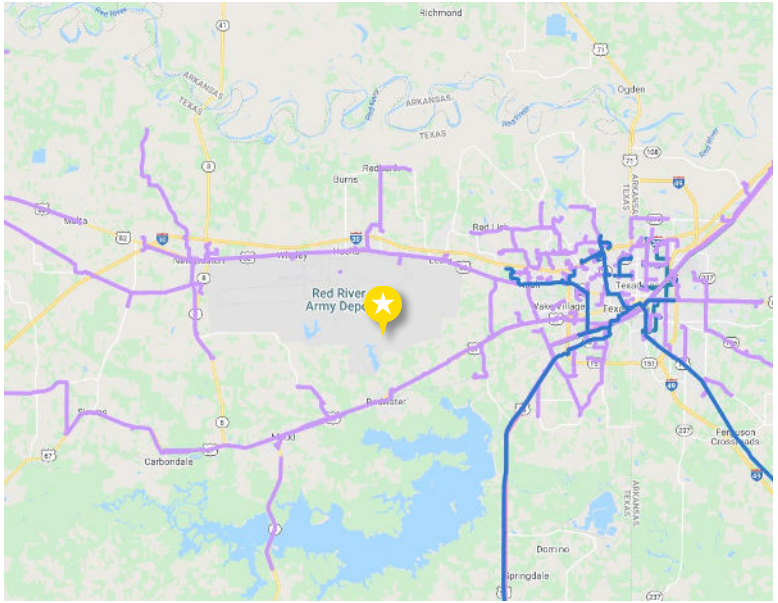


NEARBY METRO FIBER NETWORKS

METRO FIBER | RECENT NETWORK CHANGES

The Texarkana metropolitan area has grown in both population and business density in recent years, which in turn has increased the demand for broadband. New networks have come into the area and older, more established providers have upgraded their networks and services to accommodate the changes. *Examples of such changes include the following:*

- Southwest Arkansas Rural Electric (SWREA) – New fiber
- Ritter Communications – New fiber
- Sparklight – upgraded system & new fiber
- Southwest Arkansas Telephone Coop – upgraded system
- Windstream – upgraded system & new fiber
- Conterra – upgraded system & new fiber
- WanRack – new fiber
- Vyve – expansion into New Boston



These network changes have a ripple and cascading effect, as increased data traffic means additional long-haul demand, increased requirements for path diversity, increased network interconnection requirements and the protected equipment space necessary to power the service equipment (i.e., data centers).

METRO FIBER | 10 MILE RADIUS

Windstream is the Incumbent Local Exchange Carrier (ILEC) operating two distinct networks under the Windstream name (Valor & GTE Southwest are part of the larger company). Additionally, Windstream built a network specifically for the Red River Army Depot, which ensures that the Target Area has high-capacity fiber available.

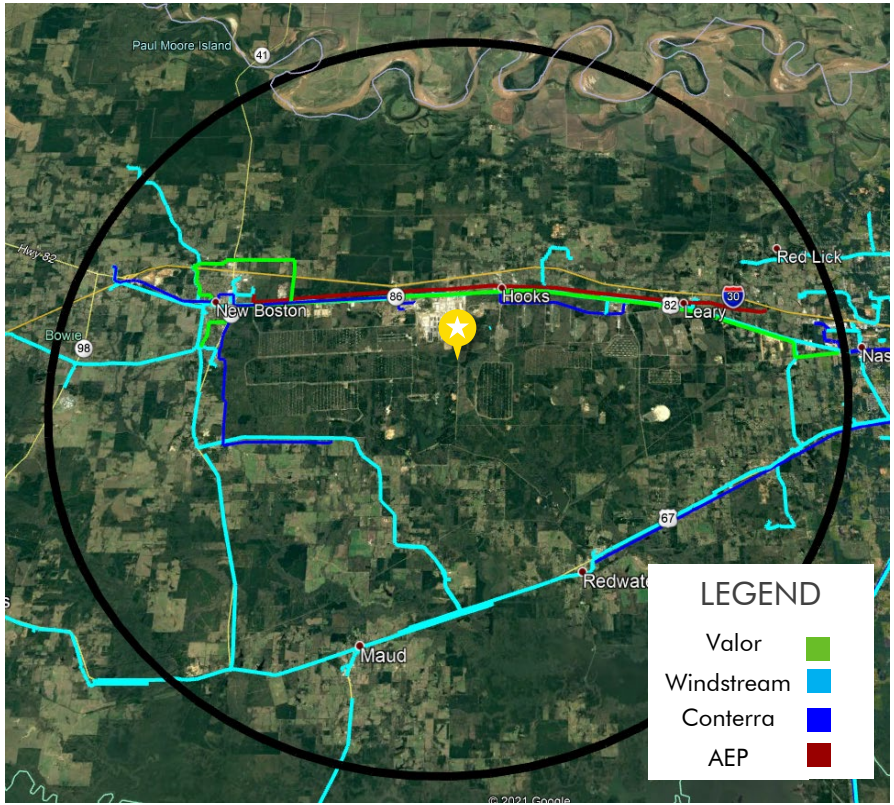
Conterra acquired Network USA (a local fiber provider) and has built a significant network in the area that connects to Dallas and Little Rock. Conterra installed 144 count fiber throughout the campus, in a purpose-built fashion.

AEP and Vyve are very small and unique infrastructure deployments.

There are five (5) unique fiber networks in the immediate area:

1. Windstream
2. Conterra Networks
3. American Electric Power (AEP)
4. Vyve (small footprint)
5. Valor (Windstream ILEC)

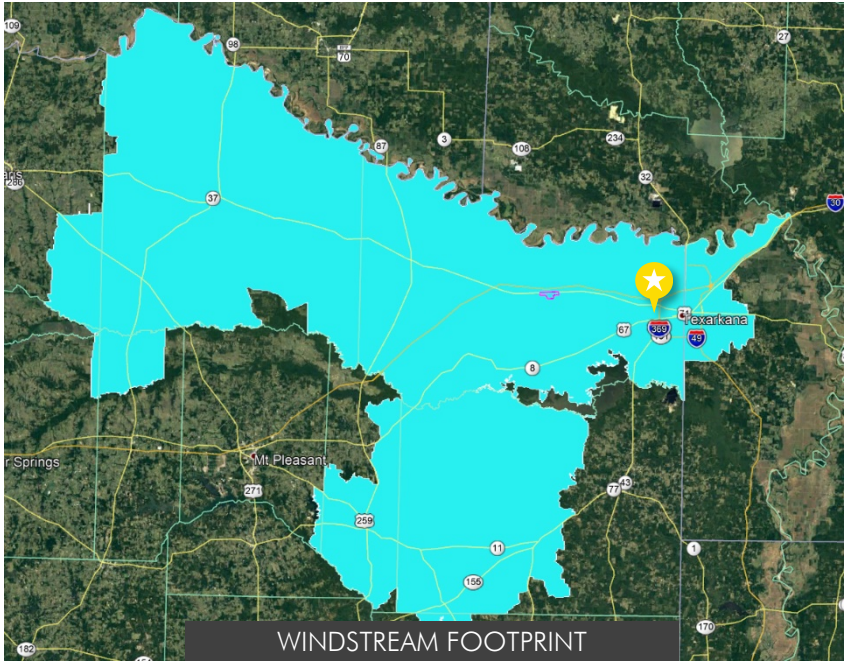
** Not all carriers listed are shown in map, as Vyve has not provided data at this time.*



METRO FIBER | WINDSTREAM LOCAL OPERATING AREA

Windstream is the Incumbent Local Exchange Carrier (ILEC). Their footprint covers a large portion of the cities and towns in and around the Target Area.

Valor Communications was the telephone company operator prior to the formation of Windstream.



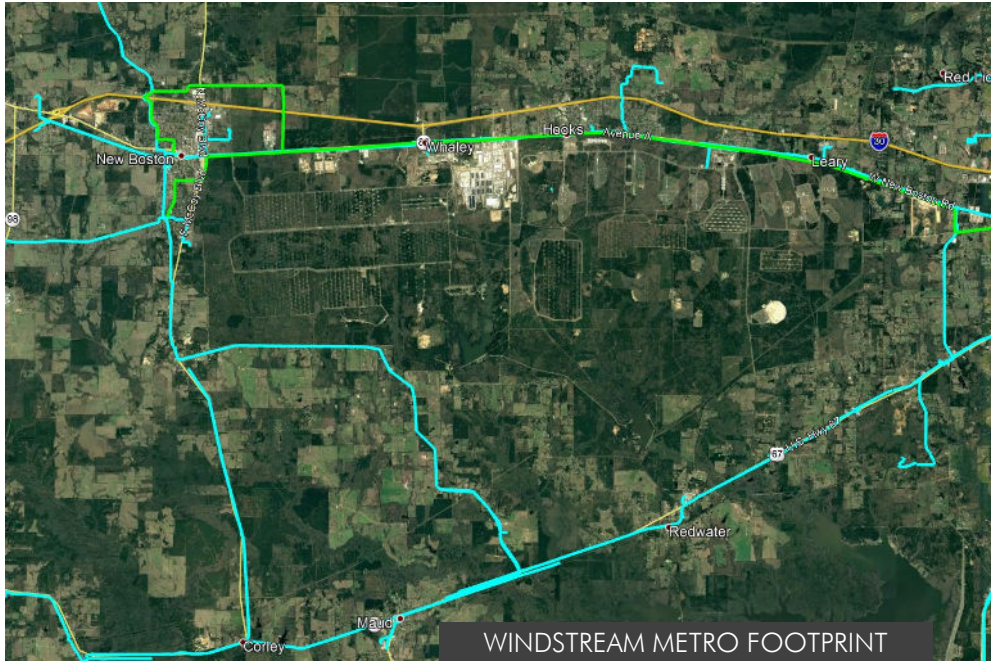
WINDSTREAM FOOTPRINT

METRO FIBER | WINDSTREAM FIBER SYSTEM

Windstream has multiple fiber systems, most of which can support high-capacity services of at least 100Gigabit.
Windstream has upgraded portions of the network with new fiber and access vaults, with multiple interface points along route Routes 82, 67 and 8.

Windstream's metro fiber interconnects into their long-haul system, which is a national 100G enabled, diversely routed backbone located in downtown Texarkana

Consequently, Windstream could provide physical path diversity in a few different ways, and provide cost-effective, high-bandwidth services. Windstream's product suite is exceptional, allowing the company to support virtually any requirements.



WINDSTREAM METRO FOOTPRINT

The Windstream systems are deployed underground in a unique access pathway.

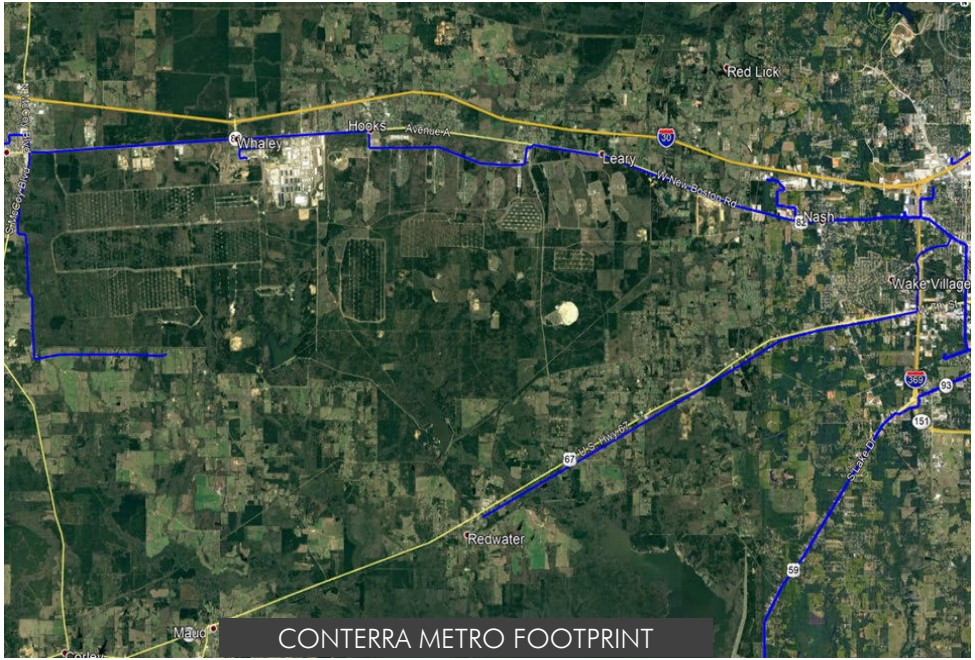
METRO FIBER | CONTERRA FIBER SYSTEM

CONTERRA NETWORKS
Fiber Driven. People Powered.

The Conterra is one of the fastest growing fiber companies in the U.S., aggressively acquiring, interconnecting systems and building new fiber.

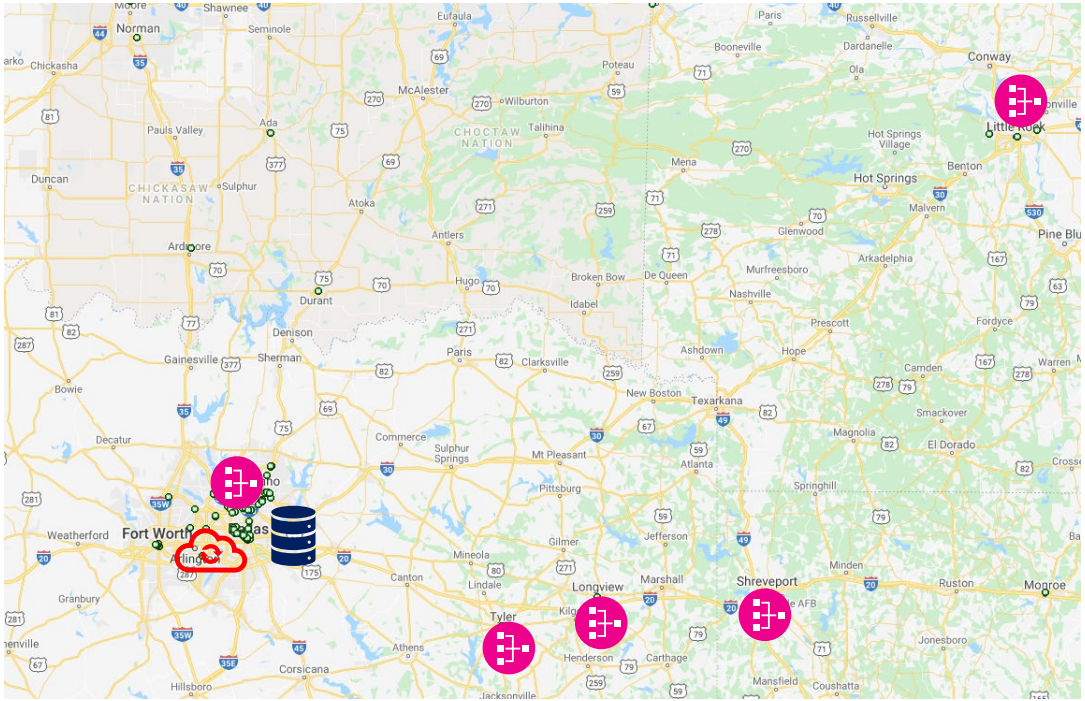
Conterra built a 144-count fiber system that supports a great many locations on the TexAmerica's campus. This system was designed to accommodate an overbuild if more fiber is required.

Conterra interconnected the acquired Network America fiber system to an intermediate-haul network that connects it to Dallas and Little Rock, allowing for on-network, high-capacity services in an efficient and cost-effective manner.
Conterra's network interfaces with all other area providers.



The Conterra network is deployed underground in a unique access pathway.

INTERCONNECTION LOCATIONS



There are more than 100 data centers within a 200-mile radius of the facility. Among these are key data centers in Dallas, TX which are some of the largest and most interconnected data center campuses in the world which. The Target Area's proximity to these hubs ensures that the facility could support any kind of voice, video or data-centric application. Most of these regional data centers are directly connected to cloud providers such as Azure, AWS, SoftLayer, Google and Apple.

MAP LEGEND

- Interconnection Point
- Cloud Services
- Storage Services
- Data Center

SECTION 4

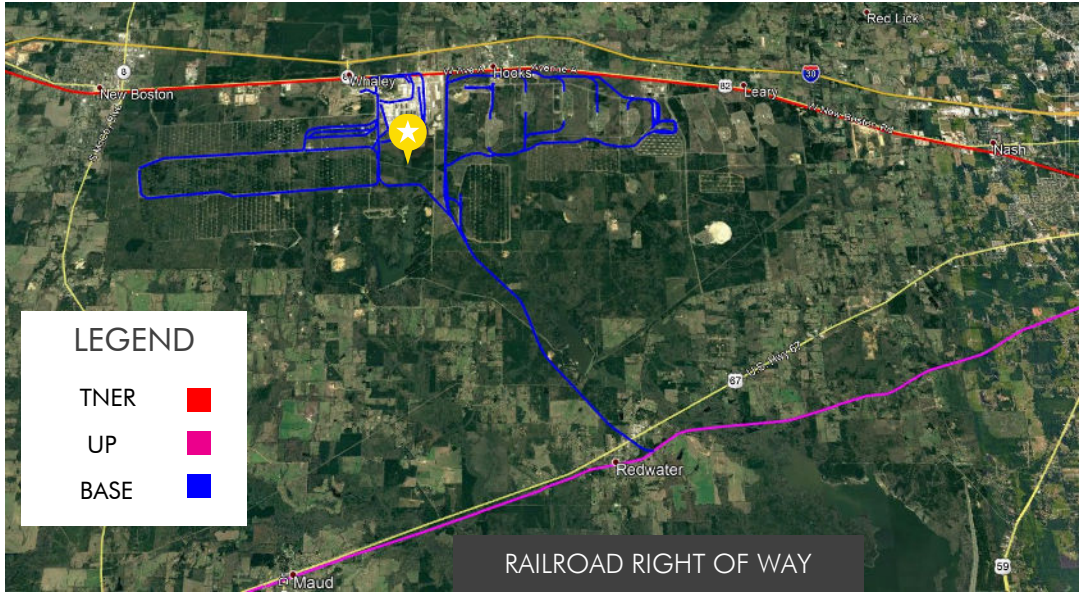
INGRESS/EGRESS

RIGHT-OF-WAY| RAILROAD PATH DISTRIBUTION

The Texas Northeast Railroad operates the Texarkana to Sherman, Texas spur that interconnects to the Union Pacific and BNSF Rail systems. This railroad path follows U.S. 82 and could be used for fiber which would create a physically separate pathway.

The Union Pacific Rail system follows U.S. 67 on the south side of the TexAmericas Campus and could be used for two separate pathways for the West and Center portion of the TexAmericas campus.

The Red River Army Depot had a significant railroad system in place for logistical purposes, which connected to both the TNER & UP rail systems. This system could be used as a right-of-way pathway, as most rail systems are cleared to 3' depth, making installations less costly.

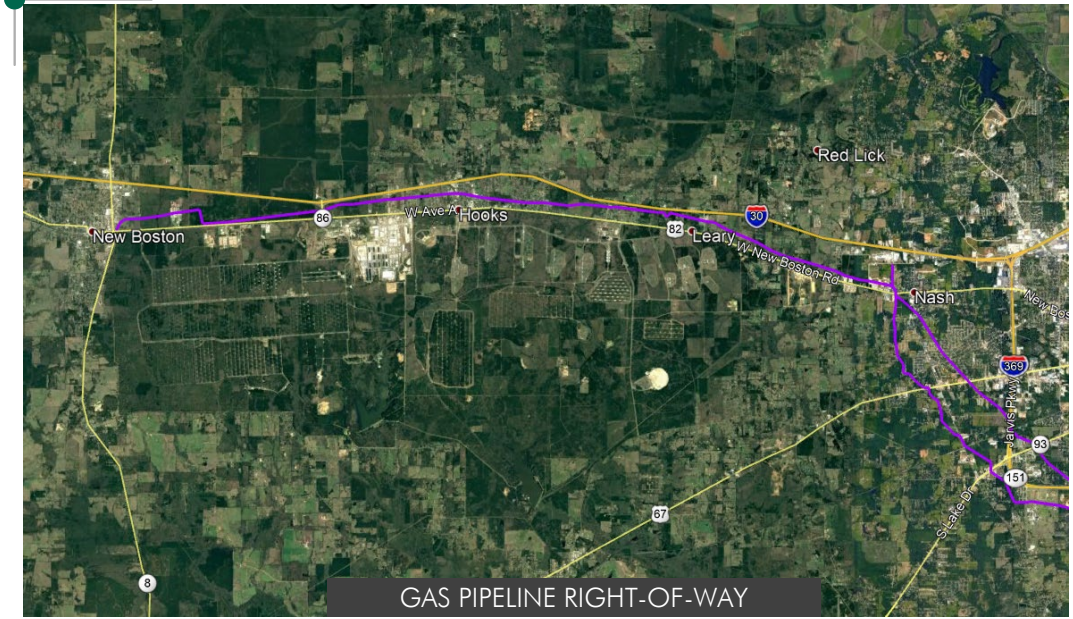


RIGHT-OF-WAY| GAS LINE RIGHT-OF-WAY

Centerpoint Energy has a gas main pipeline just north of U.S. 82 that runs from New Boston to Texarkana and points south.

This Right-of-Way could be used for fiber.

Centerpoint Energy has historically used their rights-of-way for fiber optic networks.



GAS PIPELINE RIGHT-OF-WAY

ALEX BARRERA
Alex.Barrera@CenterPointEnergy.com
713-207-6386

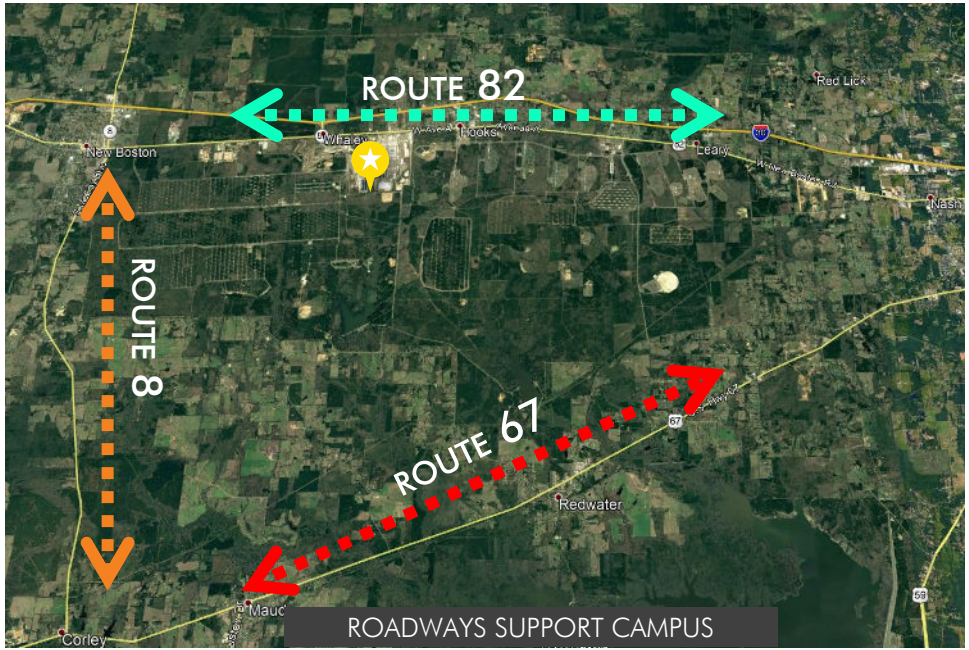
RIGHT-OF-WAY| EASE OF CONSTRUCTION

The TexAmericas Campus is bordered by U.S. Routes 82 and 67 and Texas Route 8. These three routes have ample Right-of-Way clearance for additional underground utilities. Additionally, the soil composition is a mix of sandy load, clay and sand, with little rock.

These two factors ensure that the cost of underground utility placement is amongst the lowest possible.

It is expected that direct placement can be performed using a static or vibratory plow. Trenching could also be used, with the same general results. Boring would be required on roadway and railbed crossings.

The pathways have utility poles available, which further enhances the route's physical separation capabilities and cost effectiveness.

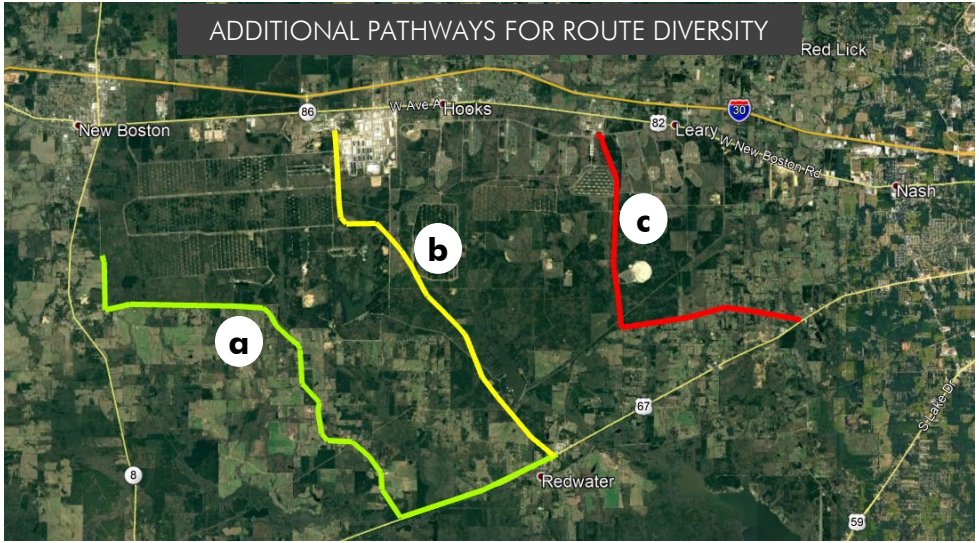


INGRESS/EGRESS | ADDITIONAL PATHWAYS

Currently, there are pathways that support the TexAmerica's campus, for both Windsteam & Conterra. However, in order to provide dual pathways on both systems, additional network extensions are required for both companies.

The additional pathways would be mutually beneficial to all providers extending services to the area. The pathways are summarized as follows:

ROUTE KEY	ROUTE MILES	ESTIMATED COSTS
a	14	$1.5 million
b	9	$1 million
c	8	$900k



SECTION 5

WIRELESS ENVIRONMENT

Wireless Systems

Cell, Wifi, Fixed & Hybrid Wireless

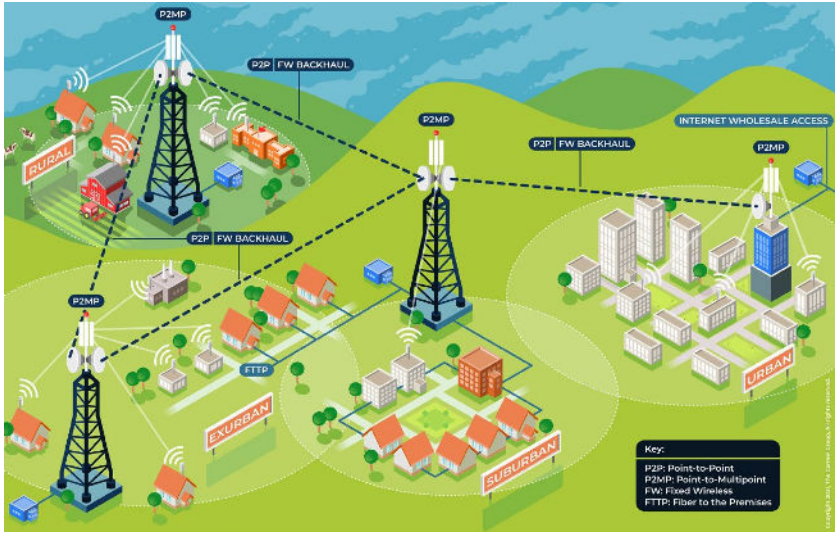
The four commonly known types of wireless systems are:

1. CELLULAR – system of wireless nodes that allow a mobile user to move from one area to the next seamlessly, regardless of who the underlying tower or system owner is. Cell sites are those ubiquitous "sticks', towers or antenna clusters you see virtually everywhere.

2. WIFI – used conjunction with broadband systems, such as those that support a given public area or residential home. These are normally single use-style systems with a very limited coverage area.

3. FIXED WIRELESS – is a point to point or point to multipoint type of system that transmits from one location to another (tower to a business)

4. HYBRID WIRELESS – is the same concept as a fixed system but uses fiber as well to enhance capabilities and ensure flexibility.



It should be noted that high-capacity wireless services are limited by distance, line-of-sight and some environmental conditions – this is why 5G uses many sites to cover areas.

CELLULAR SYSTEMS

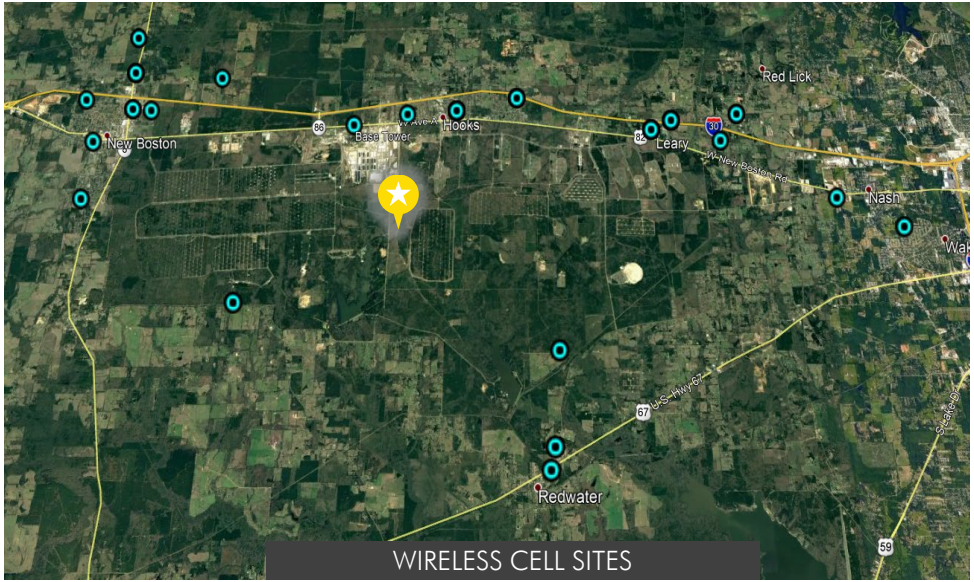
Cellular Wireless systems are comprised of three (3) common components: 1) cell sites, 2) backhaul infrastructure and 3) switching facilities. System variations outside of this list exist based on the provider and service platform (5G, LTE, 4G, etc.).

1. *Cell Sites*
2. *Backhaul Infrastructure*
3. *Switching Facilities*

The **cells** themselves are typically towers or buildings, and service a specific area that generally overlaps with other cells. This overlay of service is by design to ensure consistent coverage, location triangulation and service reliability.

The **backhaul** is comprised of fiber, wireless or copper transport services that take the voice, video and data traffic from the Cell to an aggregation point and eventually a switch.

The **switch,** sometimes referred to as the MSC or MTSO is the controlling point for traffic flow and is the key to the network.



WIRELESS CELL SITES

LIFECYCLE

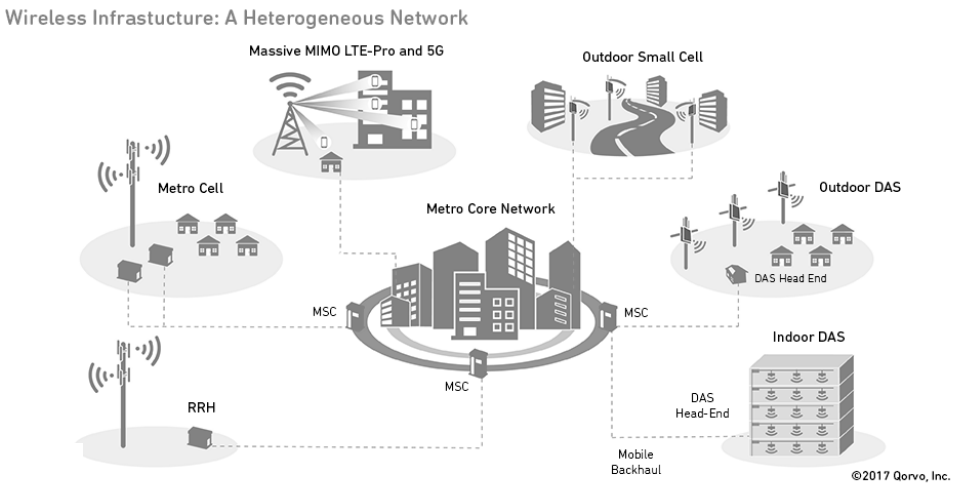
3G, LTE, 4G and 5G

5G is the next generation network that promises big gains in speed and bandwidth. 5G speeds range from 50 Mbits/s to over 1 gigabit/s.

5G networks still uses the three (3) key pillars: cells, backhaul and switches. However, 5G also uses a newer technology platform that enables faster speeds and more bandwidth to flow over the "wireless" waves. In order to support this kind of speed and bandwidth, the network requires more densely populated cells, pure fiber backhaul, and more traffic aggregation points and switches. The term to describe these requirements is **densification.**

In short, there will be hundreds of thousands of additional cells deployed in coming years to support 5G networks, along with more fiber infrastructure and necessary switching gear (traffic control).

5G AND BEYOND



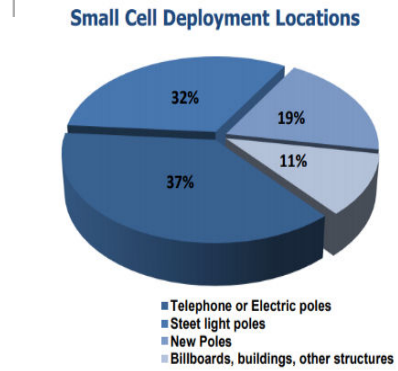
5G SITE PREDICTION

5G

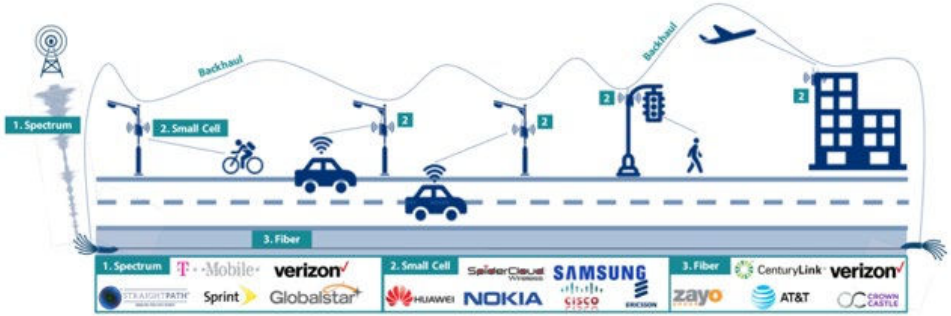
The Small Cell Forum forecasts carriers in the region will install nearly 850,000 small cells by 2025.

North American enterprises deployed a total of 400,000 small cells during 2018, up compared to 292,000 the previous year, according to a recent study by the Small Cell Forum. Non-residential small cell deployments in North America will account for nearly 14.3% of global small cell deployments this year, down from 19.2% in 2017, according to the study.

Enterprises in North America are expected to deploy a total of 552,000 small cells by the end of 2021, which would represent 12.7% of global non-residential small cell deployments. By 2025, Small Cell Forum forecasts that this number will grow to 849,000 or 10% of global deployments



5G DEPLOYMENT



SECTION 6

LATENCY

NETWORK LATENCY

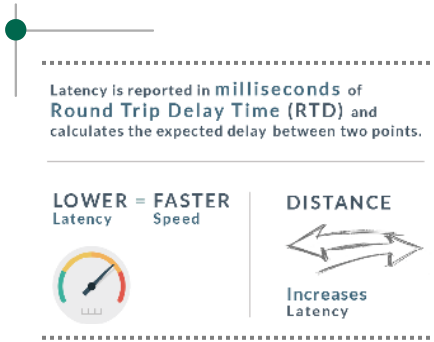
Latency is defined as the time it takes for data to be transmitted from one point to another, across a network platform. Normally, this is expressed as **Round-Trip Delay (RTD)** as data is sent and an acknowledgement of that data being received must be returned to the sender to ensure validity is maintained.

In telecom networks, "latency" is the term used to describe the amount of time it takes for data to travel round-trip from a point to a destination and back. Extrinsic factors businesses face such as competition, compliance or software applications drive the need for latency sensitive networks. Latency has become an important enough element of network design that companies should at least be aware of latency and how it affects their IT infrastructure and related applications that drive their business.

Multiple factors affect latency such as:

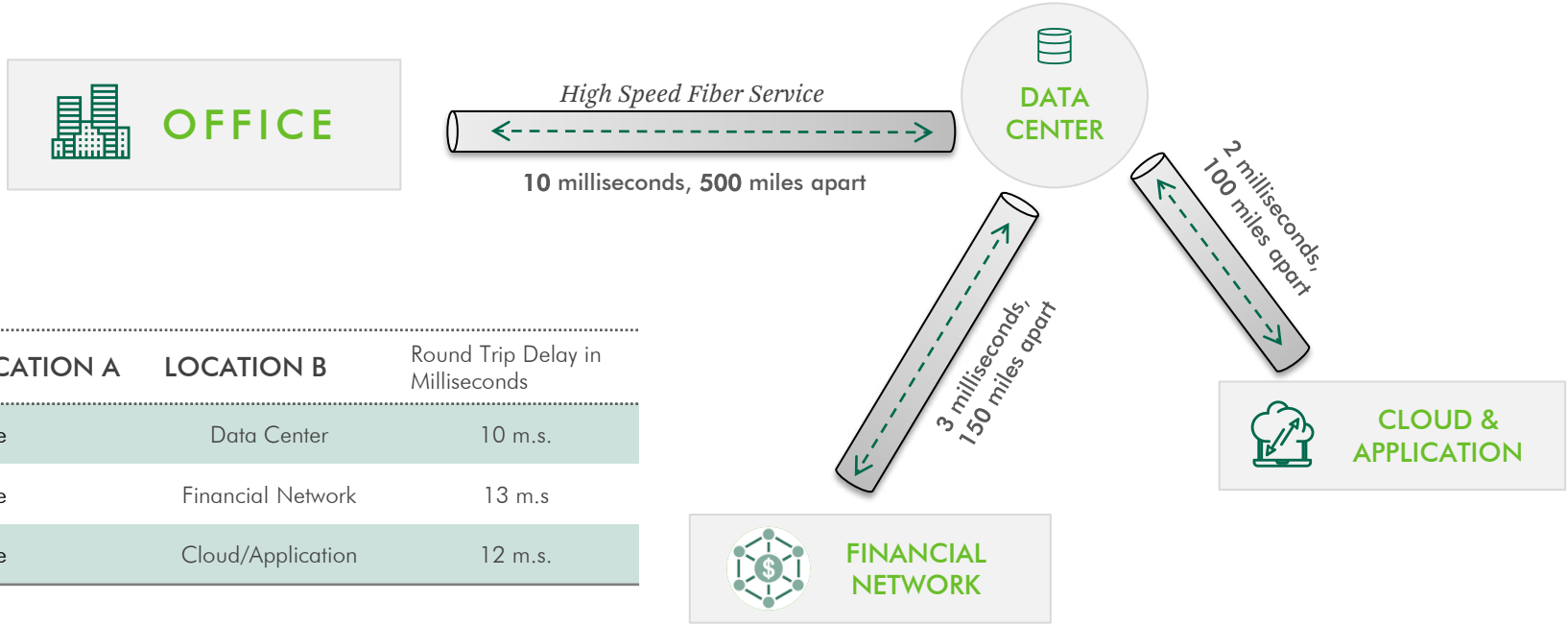
- *Physical distance*
- *Natural and man-made obstructions*
- *Equipment and data processing*

Fiber optic technology is based on light as a medium, and the speed of light travels at approximately 186,000 miles per second, which equates to 700 million miles per hour (299,792,458 meters per second). However, current technology has not completely harnessed nature's capabilities, so even with fiber optics, which is a transmission media capable of bending and controlling light-waves, only 80-85% of the speed of light can be achieved with today's equipment.



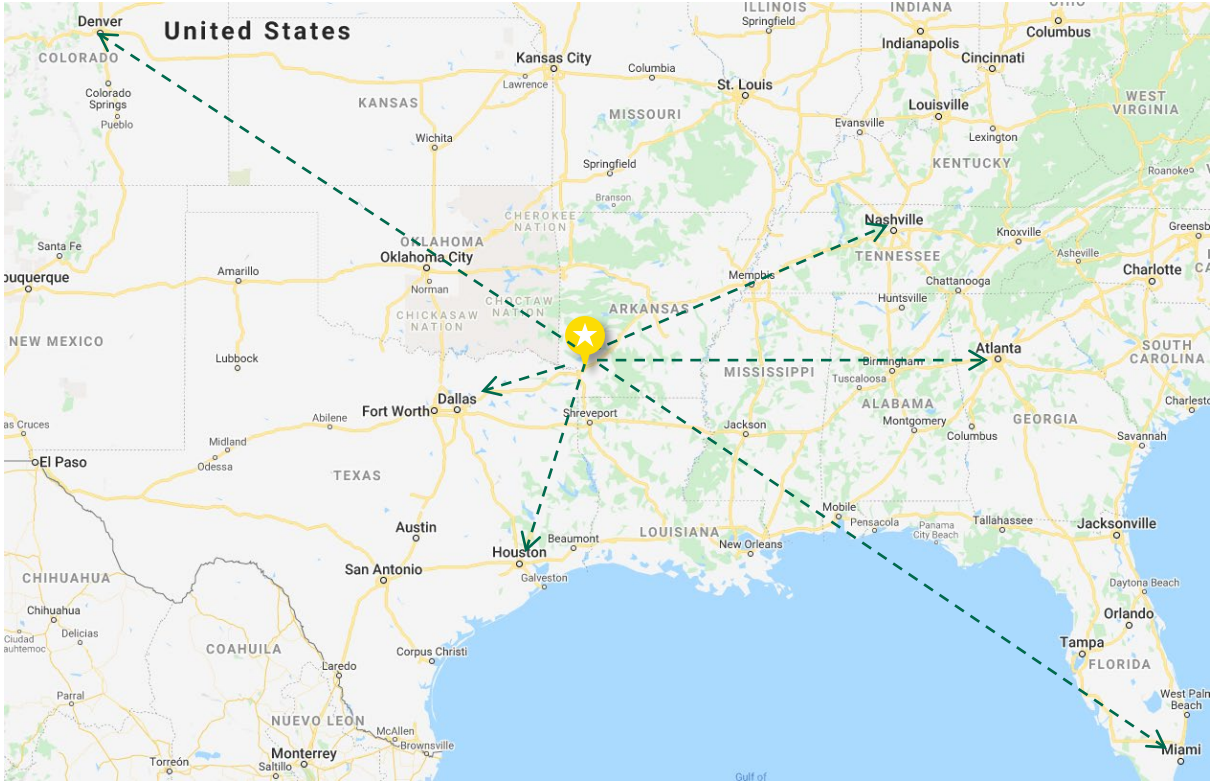
NETWORK LATENCY | DIAGRAM

Round Trip Delay (RTD) or latency is defined as the time it takes for data to be transmitted from one point to another and back again. The table below shows the RTD to and from each specific location.



LOCATION A	LOCATION B	Round Trip Delay in Milliseconds
Office	Data Center	10 m.s.
Office	Financial Network	13 m.s
Office	Cloud/Application	12 m.s.

REGIONAL LATENCY



MAP LEGEND

★	Target Area

LATENCY CALCULATIONS

DESTINATION	Round Trip Latency in Milliseconds
Dallas, TX	3.5 m.s.
Houston, TX	5.2 m.s.
Nashville, TN	9 m.s.
Miami, FL	21 m.s
Atlanta, GA	11.5 m.s.
Denver, CO	17.5 m.s.

SECTION 7

ASSESSMENT

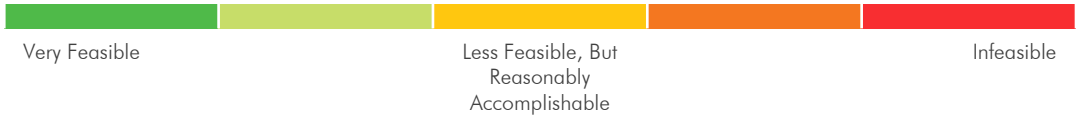
SUMMARY OF FINDINGS

- The Target Site is located adjacent to the Red River Army Depot with excellent right-of-way paths facilitated by the highways, by-ways and railroad systems that surround and cut through the TexAmericas campus.
- A custom network was built by Windstream Communications to support the Department of Defense Network. Additionally, Windstream has two separate fiber-based systems supporting the area. These networks tie into the national long-haul system, providing diverse north and south pathways.
- Conterra Networks has deployed a newer, high-capacity system that virtually surrounds the Campus.
- The Target Area is within 160 miles of Dallas, TX, the most prominent data center and network market in the Southwest.
- The latency to cloud, significant interconnection facilities and a variety of other networks is sub 5 milliseconds.
- The Target Site is equipped to immediately support 100G + network services provide by one of the largest CLECs in the in the U.S.
- A purpose-built, on-campus fiber network exists to extend fiber to the proposed data center area – built by Conterra.
- Vyve Communications operates nearby the Campus and indicated they could potentially provide 10-100G type services if required.
- Ease of aerial and underground construction in the area ensures that the lowest possible cost for new and specialized networks can be obtained.

SITE FEASIBILITY ASSESSMENT

Hyperscale, Corporate or similar Data Center Applications		Windstream and Conterra's current fiber network could be used to support hyperscale, corporate and similar data center applications; however, some construction might be required to create optimum fiber-path diversity.
Wholesale Data Center Operations		Current network and provider density is not adequate for a wholesale data center operations. Additional providers and networks would be required.
Retail Data Center Operations		Current network and provider density could support a retail-oriented hosting or data center facility without augmentation.

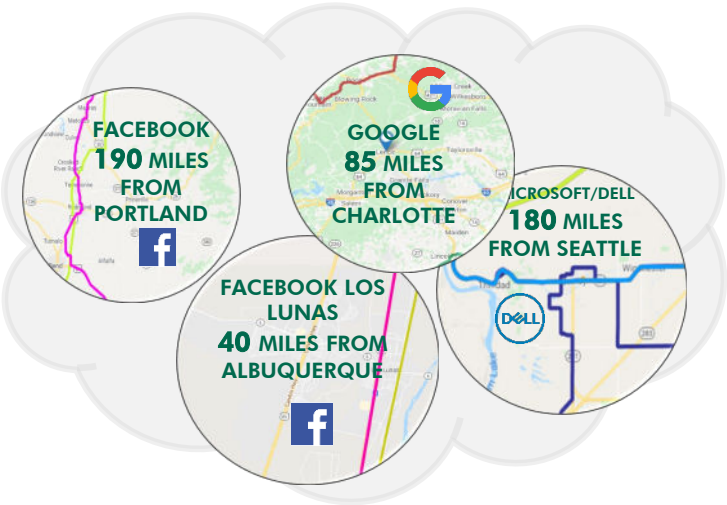
Site Feasibility Scale



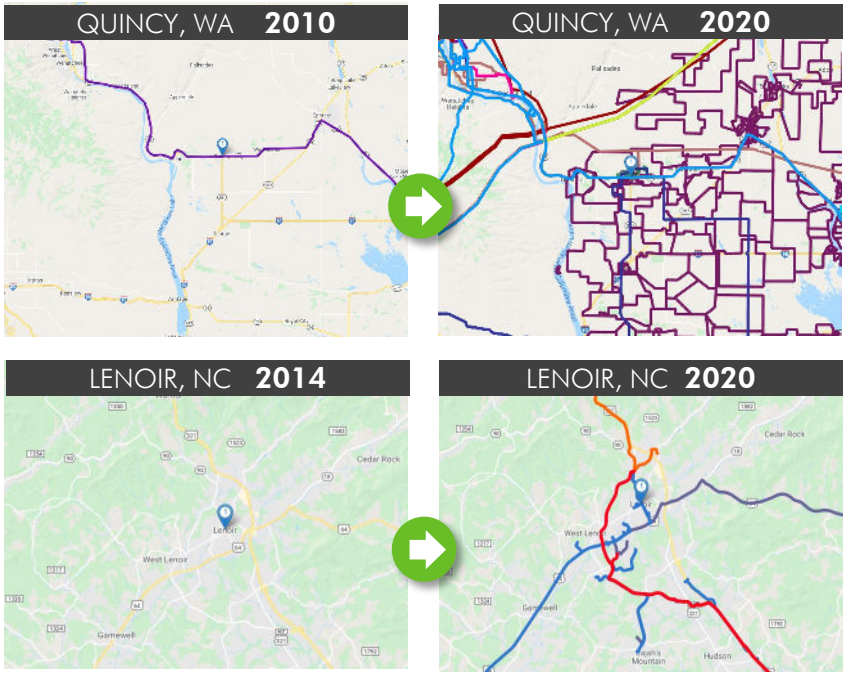
MITIGATING FACTS

Numerous Hyperscale data centers are placed in areas that are outside of the major metros, usually sited in locations for their power, land and development costs.

Most of these locations have very little in the way of network infrastructure, initially. Over time, the network elements are constructed to meet the data center's demand.



WHAT DRIVES FIBER EXPANSION? **Demand** is the key to fiber networks filling in the areas where there is need. Examples of this kind of fiber growth are found across the world.



SECTION 8

RECOMMENDATIONS

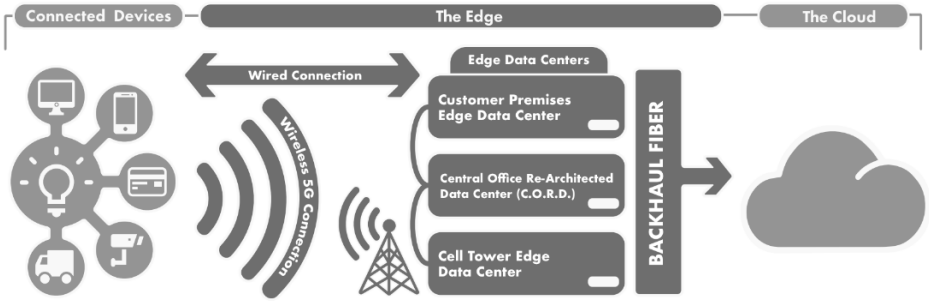
EDGE DATA CENTER CREATION

It is our recommendation that TexAmerica's Center explore the option of converting or positioning one of their current campus facilities as Edge Connection Data Center.

Edge data centers are smaller facilities which are located close to the points they serve. These facilities typically connect to the "core" network, which is comprised of service provider networks and traditional, larger data centers. Since these facilities are in the immediate area, they act as a local hub where providers and their networks can interconnect to create a lower latency (time) and higher quality experience to the users.

Characteristics of edge data centers:

- Used in place of regular data centers, service as a nexus
- Excellent for interconnecting disparate networks for data, voice and video traffic
- Can be used for content delivery and hosted solutions
- Enable 5G expansion



SECURE FIBER PATHWAYS

We recommend that TexAmerica's Center secure fiber pathways (Rights-of-Way,) such as:

Electrical Infrastructure, Power Lines, Pathways – as upgrades and power deals are negotiated it may be possible to secure fiber or right-of-way access from the underlying providers, from AEP or other entities.

Red River Army Depot – securing simply and easy pathways through the non-owned portions of the base to ensure that providers can quickly and cost effectively bring services through the various pathways that can be created. Typical easement ROW are 10' or less for utility corridors. In general, there are a lot of perimeter roads that could be used for this purpose. It would be easier and less costly to use cleared paths for such a purpose.

On Campus Rail System – Securing/clearing the way to use this ROW would ensure that quick and easy network extensions could be created using these paths.

Utility Poles across the Entire Facility – Investigating and determining ownership, ability to use and the development of a process to use the existing utility poles on the campus and base would ensure that quick and easy network extensions could be created using these paths.

SECTION 9

APPENDICES

APPENDIX 1: IMPACTS ON INTERNET TRAFFIC

Traffic Growth	1 Feb – 1 Mar Growth	1 Mar – 1 Apr Growth	1 Apr – 19 Apr Growth	Total 1 Feb – 19 Apr
Upstream	+2.07%	+123.18%	-2.95%	+121%
Downstream	-2.39%	+11.72%	+13.67%	+23%
Total	-1.74%	+28.69%	+9.28%	+38%

AMERICAS TOTAL TRAFFIC SHARE TOP 10

1. **NETFLIX:** 2019: 6.02% **2020: 19.11% (+13.09%)**
2. **YOUTUBE:** 2019: 3.80% **2020: 14.43% (+10.63%)**
3. **HTTP MEDIA STREAM:** 2019: 8.02% **2020: 6.21% (-1.81%)**
4. **PLAYSTATION D/L:** 2019: 1.24% **2020: 3.99% (+2.75%)**
5. **XBOX LIVE D/L:** 2019: 1.24% **2020: 3.71% (+2.47%)**
6. **AMAZON PRIME:** 2019: 0.26% **2020: 2.89% (+2.63%)**
7. **HULU:** 2019: 0.10% **2020: 2.85% (+2.75%)**
8. **INSTAGRAM:** 2019: 0.86% **2020: 2.10% (+1.24%)**
9. **FACEBOOK:** 2019: 1.11% **2020: 2.02% (+0.91%)**
10. **DISNEY+:** 2019: 0.00% **2020: 2.00% (+2.00%)**

Source: Sandvine, The Global Phenomena Report 2020

APPENDIX 2: CARRIER PROFILES

Windstream Enterprise provides cloud-optimized network and communications solutions, including SD-WAN and UCaaS, to empower businesses to solve today's most complex technology challenges. With deep industry knowledge, and an agile, collaborative approach to addressing unique customer needs, the Company enables businesses to optimize performance, engage customers, and protect against threats, in a constantly evolving cloud connected world.

SERVICES	NETWORK	HQ	FOUNDED	CEO	EMPLOYEES	TOP LINE REVENUE (TTM)	COMPANY TYPE
• UCaaS • Data & Contact Center Solutions • Unified Comm. • Networking • Cloud Services • SD-WAN • Network & Connectivity Solutions • Security Solutions • Internet • DDoS Mitigation • Wavelength	**Route Miles:** 150,000 **Network PoPs:** 3,700 **On-Net Buildings:** 17,000	Little Rock, AR	2006	Tony Thomas	10,284	$4.996B	Publicly Traded Company (Other OTC: WINMQ)

APPENDIX 2: CARRIER PROFILES

CONTERRA NETWORKS
Fiber Driven. People Powered.

Conterra Networks Founded in 2003, and now operating more than 12,500 fiber route miles, Conterra is one of the largest remaining independent broadband infrastructure companies in the United States based on its optical fiber and fixed wireless network assets and annual recurring revenues. On July 1, 2020, the company announced the execution of a definitive agreement for affiliates of APG Group NV and affiliates of Fiera Infrastructure, along with significant participation by the company's senior management team, to acquire the remaining indirect equity interests of the company not already owned by Fiera Infrastructure, from affiliates of Court Square and certain other indirect equity holder.

SERVICES	NETWORK	HQ	FOUNDED	CEO	EMPLOYEES	TOP LINE REVENUE (TTM)	COMPANY TYPE
• Data & Contact Center Solutions • Networking • Network & Connectivity Solutions • Dark Fiber • Internet • Voice • Wavelength • Custom Networks	Route Miles: 12,500 Network PoPs: 220 On-Net Buildings:	Charlotte, NC	2003	Craig Gunderson	340	$100m	Private

APPENDIX 3: FIBER DEPLOYMENT METHODS

- Typically, more secure than aerial, particularly outside of dense metro areas with more regular construction activity
- Various methods including plowing, open-trenching, horizontal drilling/ boring and micro trenching
- Less common (in market & nationally), roughly 20% of U.S. deployment
- Generally higher deployment cost that is accompanied with higher value
- Longer timeline to deploy, making replication of underground routes more challenging

The Conterra and AT&T systems benefits from 100% underground deployment in a unique access pathway.

VS.

SECURITY

INSTALL METHOD

% OF DEPLOYMENT

COST

TIMING

- Exposed to the risk of environmental disturbance (wind, ice and snow) and can be at risk for utility pole ownership mismanagement
- Utility poles with supporting wire and lashing process (skill level involved in installations higher degree of variation)
- Makes up the majority, more than 80% in U.S. deployment
- Ordinarily lower deployment cost, more variation in quality of network
- Shorter timelines, however, can often lack enforcement of standardization

APPENDIX 4: GLOSSARY

A

AWS (Amazon Web Services): A subsidiary of Amazon that provides on-demand cloud computing platforms to individuals, companies, and governments.

Azure: A cloud computing platform and infrastructure, created by Microsoft, for building, deploying, and managing applications and services through a global network of Microsoft-managed data centers.

B

Backbone: A link of high bandwidth connections that carries data to smaller lines of transmission. A local backbone refers to the main network lines that connect several local area networks (LANs) together. The result is a wide area network (WAN) linked by a backbone connection.

Backhaul: The portion of a network that comprises the intermediate links between the core (central or backbone network) network and the small subnetworks at the edge of the network. The term references a transmission signal. For a satellite videoconference, a backhaul refers to a signal brought in from a secondary site to the origination site, mixed with the primary signal, and sent out over the program's satellites.

Bandwidth: A term which describes the maximum data transfer rate of a network or Internet connection. It measures how much data can be sent over a specific connection in a given amount of time. While bandwidth is used to describe network speeds, it does not measure how fast bits of data move from one location to another. The rates are measured in bits (bps), kilobits (kbps), megabits (Mbps), or gigabits per second (Gbps).

C

Carrier: A vendor of transmission services operating under terms defined by the FCC (Federal Communications Commission) as a common carrier. A carrier owns a transmission medium and rents, leases or sells portions for a set tariff to the public via shared circuits.

Carrier Hotel: A data center facility that is highly redundant in design and function, acting a place where long-haul and metropolitan networks meet. Providers within this facility can simply and efficiently interconnect their networks, a function which is necessary to complete modern network services.

CDN (Content Distribution Network): A large, distributed system of servers deployed in multiple data centers across the Internet. A CDN serves content to end-users with high availability and performance. CDNs serve a large fraction of the Internet content today, including web objects (text, graphics and scripts), downloadable objects (media files, software, and documents), applications (e-commerce, portals), live-streaming media, on-demand streaming media, and social networks.

CLEC (Competitive Local Exchange Carrier): A telephone and voice-services company that competes with the already-established, local telephone business by providing its own network and switching capabilities.

Cloud: The on-demand availability of computer system resources, especially data storage and computing power, without direct active management by the user. Cloud computing is generally used to describe data centers available to many users over the Internet. Clouds can be classified as public, private or hybrid.

Conduit: A protective tube, pipe, or trough for wires, fibers, and cables. A conduit protects the wires and is used in exposed locations, such as along the exterior surface of a wall. Early conduits for telecommunications cables were made of vitrified clay pipe, creosoted lumber, and even hollowed-out logs. Contemporary conduits commonly are made of aluminum, steel, polyethylene, and polyvinyl chloride (PVC).

D

Dark Fiber: A strand, or pair of strands, of dark fiber or unlit fiber is an unused optical fiber, available for use in fiber-optic communication. Dark fiber originally referred to the potential network capacity of telecommunication infrastructure. These are typically deployed in large-bandwith services by carriers or enterprise clients.

Data Center: A centralized repository, either physical or virtual, for the storage, management, and dissemination of data and information organized around a particular body of knowledge or pertaining to a particular business.

DWDM (Dense Wave Division Multiplexing): An optical multiplexing technology used to increase bandwidth over existing fiber networks. DWDM works by combining and transmitting multiple signals simultaneously at different wavelengths on the same fiber. Its capabilities are similar to those of dark fiber, which can provide virtually unlimited bandwidth capability.

E

ELAN (Ethernet Local Area Network): A piece of IT infrastructure that uses Ethernet cable to connect computers, servers, printers and other devices that reside within a close geographical area, typically within a single office or building. It is designed to enable fast data transmissions among devices on the local-area network and to the Internet. They typically have a distance limitation of less than 50 miles.

End User: An end user is the ultimate and last person that a software program, telecommunications system, or hardware device is designed for after it has been fully developed, marketed, and installed. The end user can be any entity, whether a student at a school, a business, or a subscriber on a cable television system.

Ethernet: The standard way to connect computers, terminals, concentrators, workstations, and hosts on a network over a wired connection and simple interface. Ethernet utilizes protocols to control the passing of information and to avoid simultaneous transmission by two or more systems. While it is still the standard for wired networking, Ethernet has been replaced in many areas by wireless networks (Wi-Fi).

F

FCC (Federal Communications Commission): An independent government agency that regulates interstate and international communications by radio, television, wire, satellite and cable in all 50 states, the District of Columbia and U.S. territories. The Commission is the United States' primary authority for communications law, regulation, and technological innovation.

Fiber Optics: A high-speed data transmission medium consisting of tiny glass or plastic filaments that carry light beams. Digital data is transmitted through the cable via rapid pulses of light. The receiving end of a fiber optic transmission translates the light pulses into binary values which can be read by a computer. Fiber optic cables provide the fastest data transfer rates of any data transmission medium and are less susceptible to noise and interference as compared to copper wires or telephone lines; however, they are more fragile than their metallic counterparts. They are used for a large part of the Internet backbone and are heavily depended on for international telecommunications.

I

Interconnect: A term that describes the connection of a control center in a cable television system where various signals are brought together and monitored before being introduced into the cable network and its hubs.

IXC (Inter-Exchange Carrier): A U.S. legal and regulatory term for a telecommunication company, commonly called a long-distance telephone company. It is defined as any carrier that provides services across multiple local access and transport areas. This term embodies long-distance telephone companies such as AT&T, MCI, and Sprint.

IRU (Indefeasible Rights of Use): A type of telecommunications lease permanent contractual agreement, that cannot be undone, between the owners of a communications system and a customer of that system. The customer purchases the right to use a certain amount of the capacity of the system, for a specified number of years. The communication system can be a wire cable, such as a submarine communications cable, fiber-optic cable, or satellite.

IP (Internet Protocol): The main protocol used on the Internet.

ILEC (Incumbent Local Exchange Carrier): Ma Bell or Telephone company.

J

Jitter: The undesired deviation from true periodicity of an assumed periodic signal in electronics and telecommunications, often in relation to a reference clock source. Jitter may be observed in characteristics such as the frequency of successive pulses, the signal amplitude, or phase of periodic signals. Jitter is a significant, and usually undesired, factor in the design of almost all communications links

L

LAN (Local Area Network): Private transmission network interconnecting offices within a building or group of buildings and usually designed to convey traffic; e.g., voice, data, facsimile, video. Usually associated now with a computer network made up of computers, printers, and mass storage units. MAN Metropolitan area network. WAN - Wide Area Network.

LATA (Local Access and Transport Area): The local access and transport area of a telephone company.

Latency: The delay between the sender and the receiver decoding it, this is mainly a function of the signals travel time, and processing time at any nodes the information traverses

LEC (Local Exchange Carrier): Companies are divided into two large categories: long distance (interexchange carrier, or IXCs) and local (local exchange carrier, or LECs). This structure is a result of 1984 divestiture of then-regulated monopoly carrier American Telephone & Telegraph. Local telephone companies at the time of the divestiture are also known as Incumbent Local Exchange Carriers (ILEC).

M

MMR (Meet-Me-Room): A designated place within a colocation center where telecommunications companies can physically connect to one another and exchange data without incurring local loop fees. Services provided across connections in an MMR may be voice circuits, data circuits, or Internet protocol traffic.

MPL (Multiprotocol Label Switching): A routing technique in telecommunications networks that directs data from one node to the next based on short path labels rather than long network addresses, thus avoiding complex lookups in a routing table and speeding traffic flows. The labels identify virtual links (paths) between distant nodes rather than endpoints.

MRC (Monthly Recurring Charge): A service fee that is recurring on a monthly basis.

N

NAP (Network Access Point): A public network exchange facility where Internet service providers (ISPs) connect with one another in peering arrangements.

N + 1: Created by the FCC, this formula forms the basis by which the FCC regulates expansion of channel capacity for non-broadcast use. The FCC requires that if the government, education, public access, and leased channels are in use at least 80 percent of the Monday-through-Friday period for at least 80 percent of the time during any three-hour period for six consecutive weeks, then within six months the system's channel capacity must be expanded by the operator.

NRC (Non-Recurring Charge): A one-time fee for services.

NTIA (National Telecommunications and Information Administration): The Executive Branch agency that is principally responsible for advising the President on telecommunications and information policy issues. It focuses largely on expanding broadband Internet access and adoption in America, expanding the use of spectrum by all users, and ensuring that the Internet remains an engine for continued innovation and economic growth.

O

Off-Net Extension: A network extension that provides an organization with fiber access to offices, locations, or areas that could not otherwise be reached with that provider's connection capabilities.

O&M (Operation & Maintenance on Network): A process which includes the day-to-day activities necessary for a building, along with its systems, network, and equipment, to perform their intended function. These services aim to reduce network complexity, improve reliability with remote/web-based/on-site technical support, repair and spare management services, and optimize the cost of operations.

P

Peering: The interconnection of multiple carriers across a single physical port. Peering is a voluntary interconnection of administratively separate Internet networks for the purpose of exchanging traffic between the users of each network. The pure definition of peering is settlement-free, "bill-and-keep," or "sender keeps all," meaning that neither party pays the other in association with the exchange of traffic; instead, each derives and retains revenue from its own customers.

Peering Location: A standardized location at which carriers can conduct peering activities.

PoP (Point of Presence): A demarcation point, access point, or physical location at which two or more networks or communication devices share a connection.

R

Regeneration Facilities: Specialized, modular colocation facilities designed for fiber optic cable signal regeneration in order to reduce latency issues by delivering data content faster.

S

SaaS (Software as a Service): A software licensing and delivery model in which software is licensed on a subscription basis and is centrally hosted typically in a cloud environment. It is sometimes referred to as "on-demand software".

Small Cell: Low-powered cellular radio access nodes that operate in licensed and unlicensed spectrum that have a range of 10 meters to a few kilometers. They are viewed as a solution to allow re-use of the same frequencies and as an important method of increasing cellular network capacity, quality, and resilience with a growing focus using LTE Advanced.

SONET (Synchronous Optical Network): A communication protocol that is used to transmit a large amount of data over relatively large distances using optical fiber. With SONET, multiple digital data streams are transferred at the same time. The purpose of the SONET standard is to guarantee that fiber, and fiber terminating equipment (e.g. digital loop carrier systems) from different central office vendors, can all interface with each other.

T

Tier Level: Within a data center, tier levels describe the availability of data from the hardware at a specific location. The higher the tier, the greater the availability (uptime) and resiliency.

U

UPS System (Uninterruptible Power Supply): An electrical apparatus that provides emergency power to a load when the input power source or mains power fails. A UPS is typically used to protect hardware such as computers, data centers, telecommunication equipment or other electrical equipment where an unexpected power disruption could cause injuries, fatalities, serious business disruption or data loss.

W

Wireless: An equipment, network system or method used to transmit data, voice and video traffic without the use of wires. These connections are secure and point to point. Wireless is the largest segment of the broadband business, a trend that will continue for the foreseeable future.

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