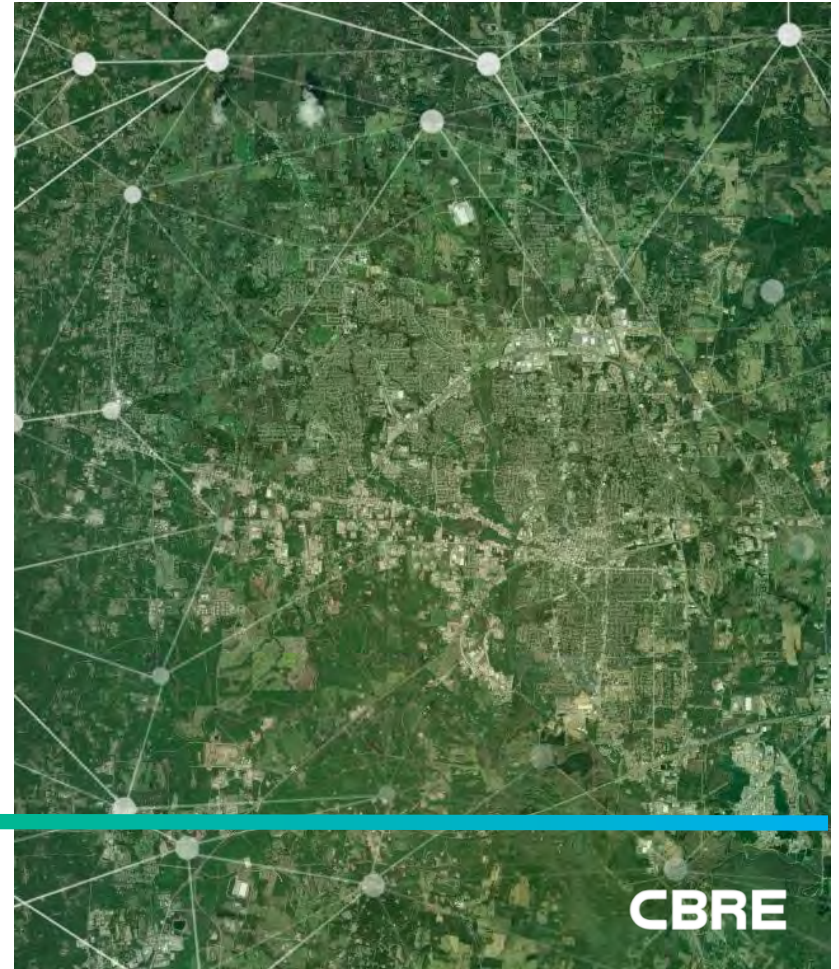


JUNE 2021

NETWORK ADVISORY SERVICES
CONNECTIVITY REPORT

LONGVIEW, TEXAS

Prepared for



CBRE

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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- vi *Latency*
- vii *Assessment*
- viii *Recommendations*
- ix *Appendices*



SECTION 1

EXECUTIVE SUMMARY

CBRE

EXECUTIVE SUMMARY

PROJECT OBJECTIVE

CBRE was engaged to research and evaluate the telecommunications and network infrastructure that supports Longview, Texas. The area of focus includes the metro and long-haul fiber systems and associated interconnection facilities.



Target Area Overview

The Longview Metropolitan Area is the seventeenth largest in Texas, covering three counties – Greg, Rusk and Upshur. The largest population areas include the cities of Longview, Henderson and Kilgore. Longview is located approximately 115 miles east of Dallas and 170 miles north of Houston. Two interstate highways, along with Union Pacific and MNSF railroads transit the area, all of which provide pathways for a portion of the fiber systems.



Network Infrastructure

Longview has both metropolitan fiber and long-haul fiber systems that support the area. Three unique long-haul systems interconnect in the downtown core of the city at 119 West Tyler Street. There are over a dozen service providers that service or interconnect in Longview. Additionally, several other companies capable of providing services that transit through the area.



EXECUTIVE SUMMARY (CONTINUED)



Right of Way Environment

The Target Area has plenty of highways and byways to accommodate various routes – using both aerial and underground construction methods. Additionally, there are two railroad systems that transit through the core of Longview; these pathways played an essential role in the formation of the area's long-haul system.

Strengths



The area significantly benefits from the numerous long-haul systems that interconnect Longview's metro providers with Dallas and the national data backbone. Dallas is the regional hub for virtually every service provider in the US. Moreover, the presence of multiple metro-fiber systems such as Conterra and AT&T establishes service provider and path diversity.



Wireless Infrastructure

There are over a dozen wireless tower sites that are within a 10 mile radius of the center of Longview. 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 city.



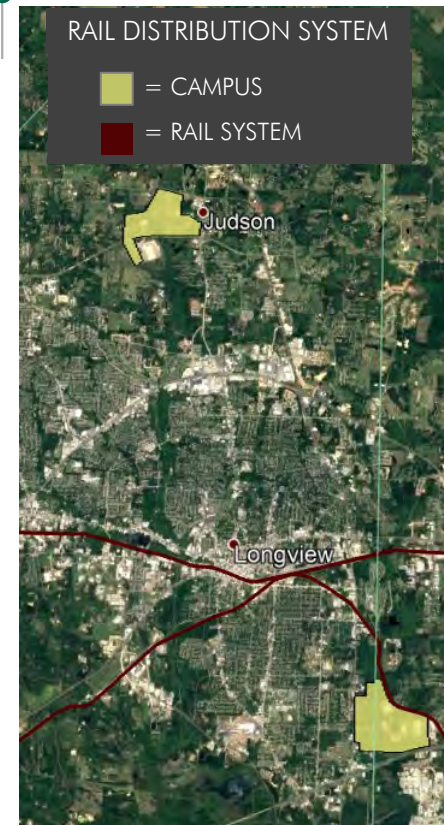
Areas of Concern

The majority of network service providers interconnect at one concentrated point. This will self-remedy within the next 18 months, as bandwidth demand & network growth is at an all-time high.

RAIL DISTRIBUTION SYSTEM

■ = CAMPUS

■ = RAIL SYSTEM



SECTION 2

TARGET OVERVIEW

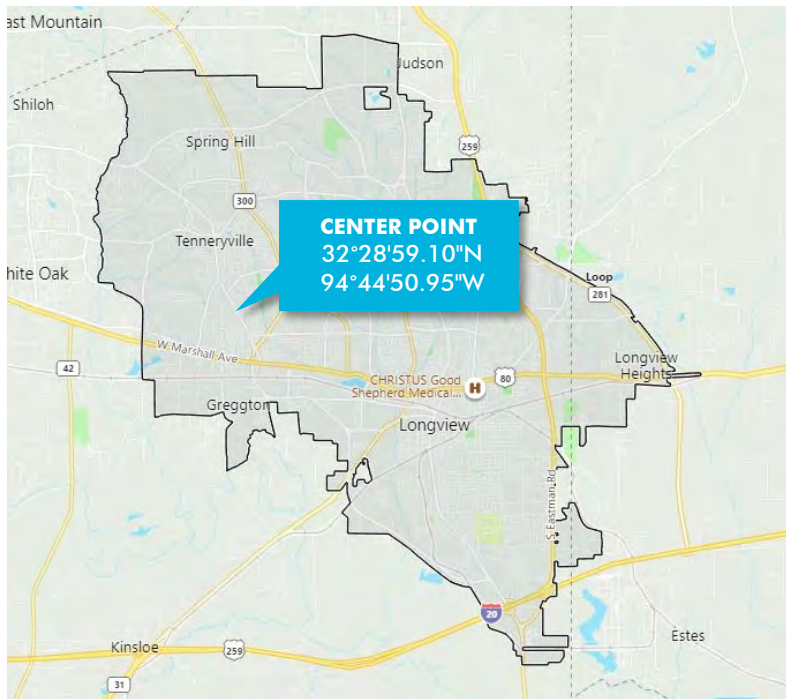


CBRE

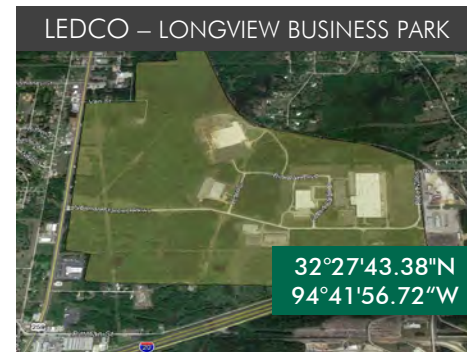
TARGET AREA



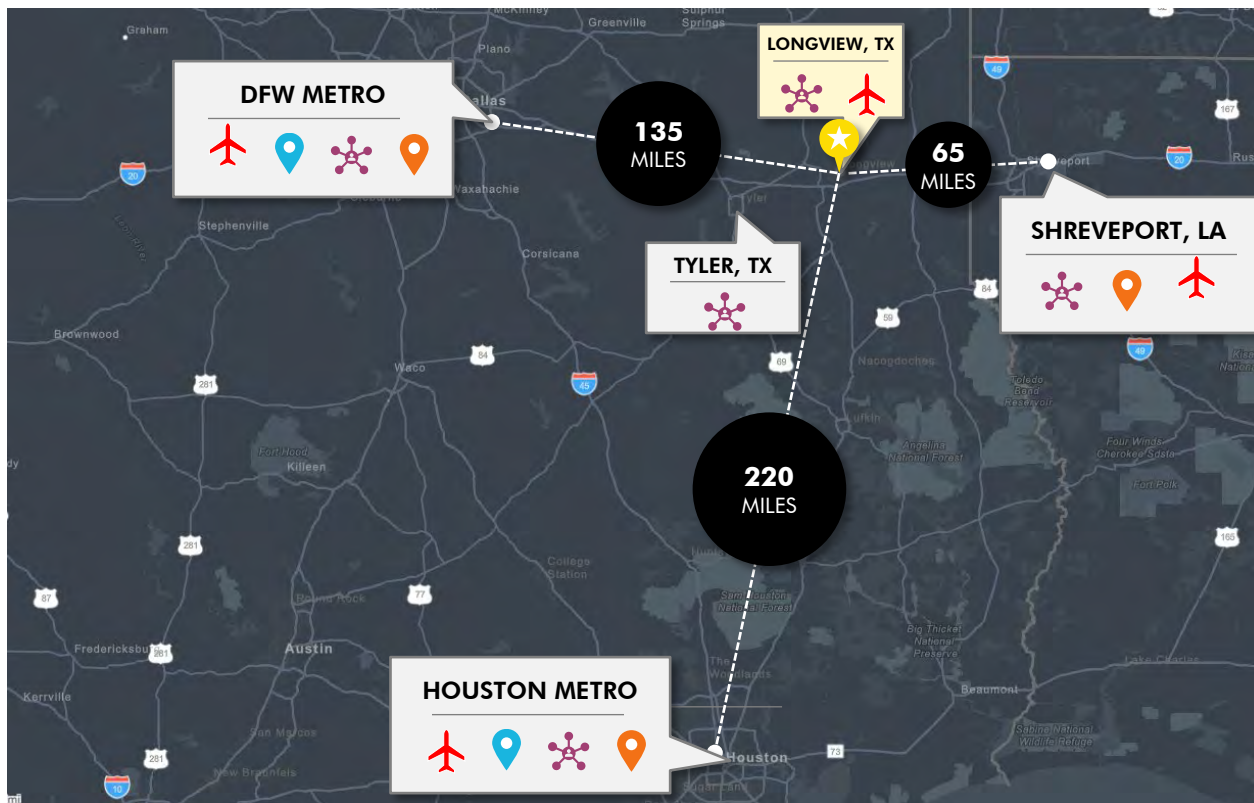
LONGVIEW MARKET








KEY DEVELOPMENT AREAS



RELATIVE ENVIRONMENT | REGIONAL VIEW



MAP LEGEND






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

* Mileage is based on fiber network

RELATIVE ENVIRONMENT | LOCAL VIEW



MAP LEGEND

-  High Density Business
-  Data Center
-  Tele Switching Center
-  Long Haul Network Interface
-  Wireless Systems



SECTION 3

NETWORK INFRASTRUCTURE

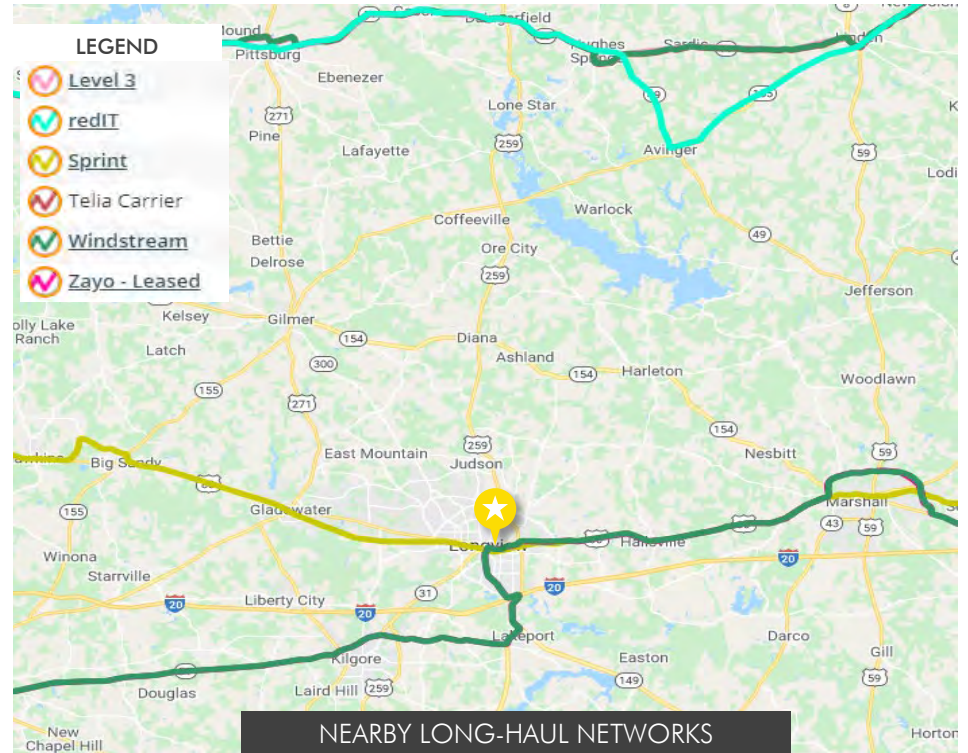
LONG-HAUL FIBER

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.

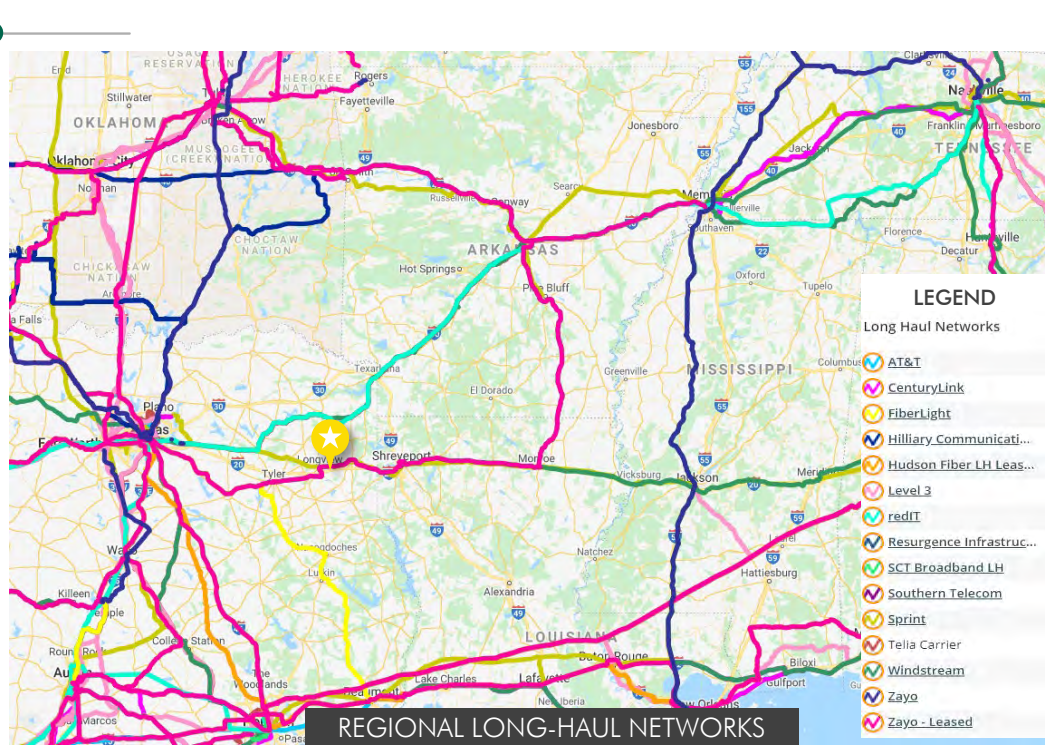


LONG-HAUL FIBER | REGIONAL VIEW

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 Datacenters, 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 also exists; examples of these include 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.



LONG-HAUL FIBER | LONGVIEW

The local long-haul interface is a high-density Interconnect Facility (ICF) which is where the long-haul and local networks meet. This facility is located at 119 E Tyler in downtown Longview.

Most of the U.S. and Texas service providers have some long-haul system connections that in this ICF. Additionally, there are over a dozen networks that interconnect here, providing the local service providers with international pathways for internet, voice, video and data

Facilities like 119 E Tyler are considered vital for high-tech business and datacenter demands.

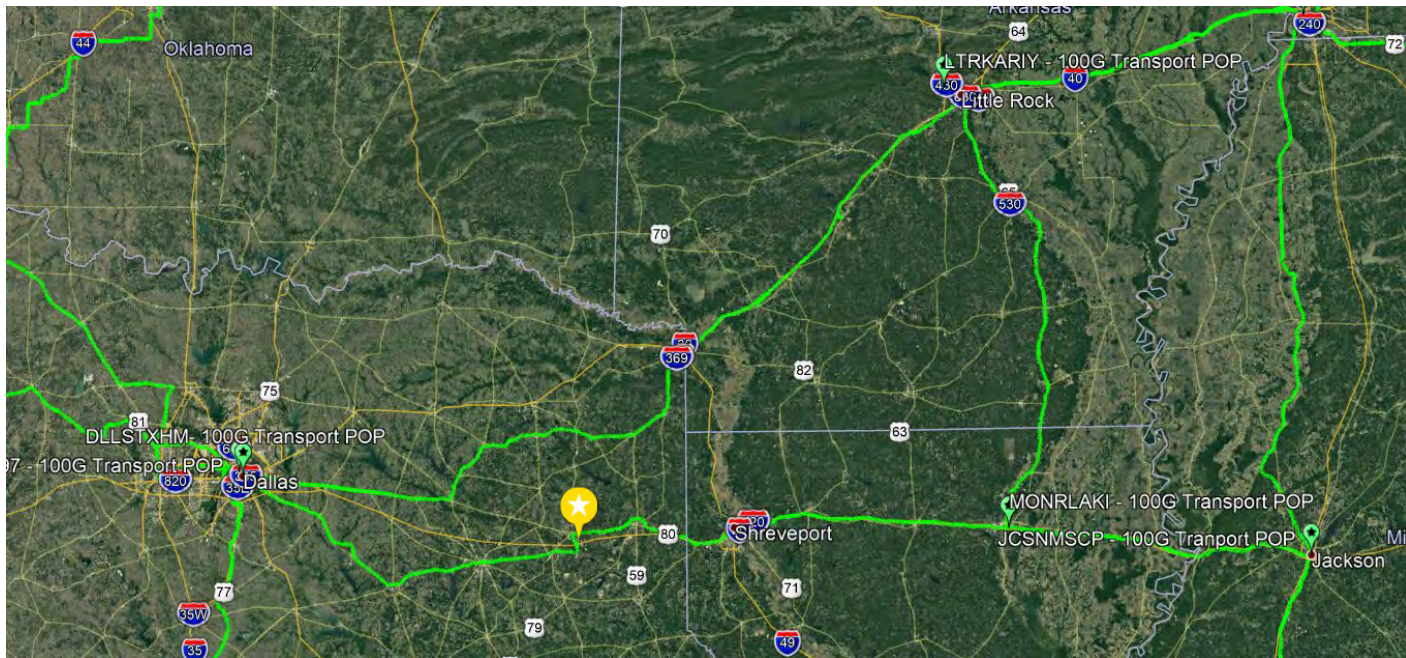


Verizon (MCI) & AT&T have long-haul systems, but map are not allowed. Most long-haul routes are physically separated by feet but follow the same general path. Sprint is more unique.

LONGHAUL NETWORK FIBER | Windstream Regional



Windstream has a 100Gig enabled national backbone network, and the system runs right through Longview – and can provide interconnectivity throughout the U.S. for internet, transport and cloud.

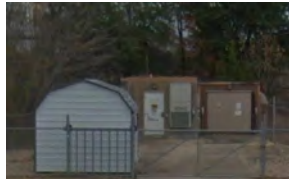
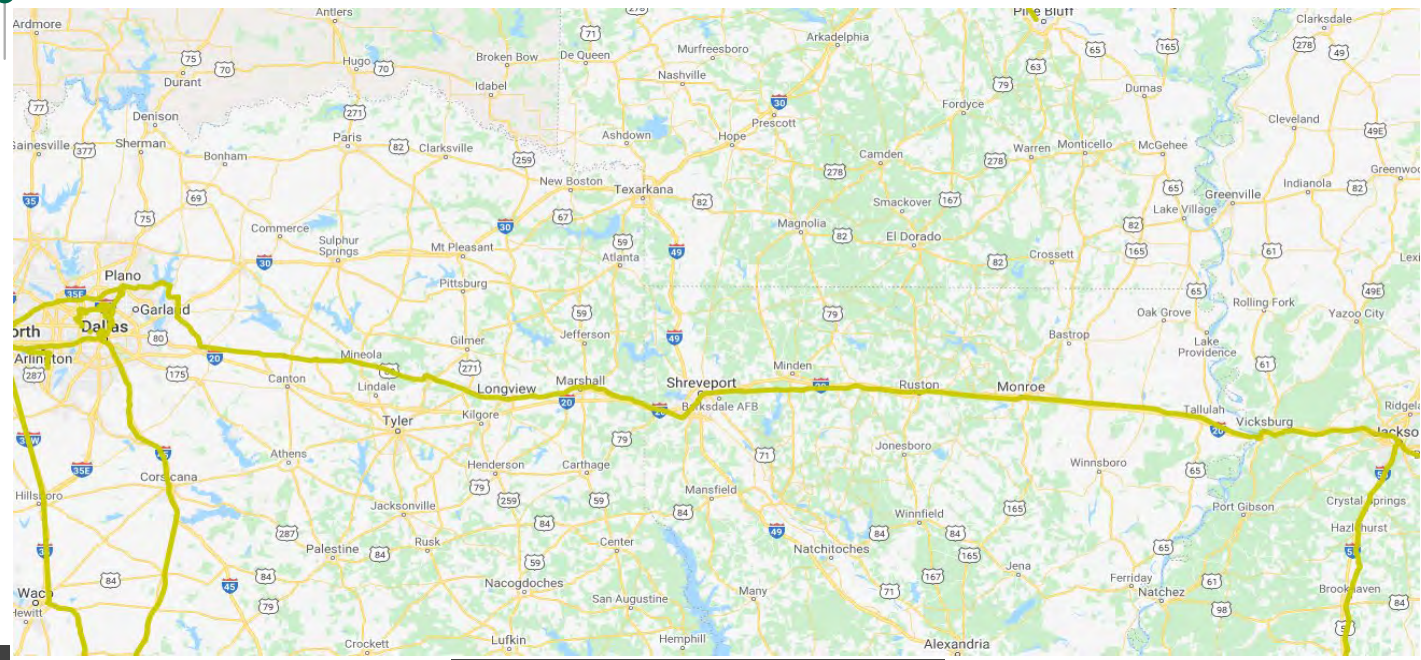


WINDSTREAM 100 GIG BACKBONE

LONGHAUL NETWORK FIBER | Sprint Regional



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



SPRINT INTERFACE 305 E COTTON ST

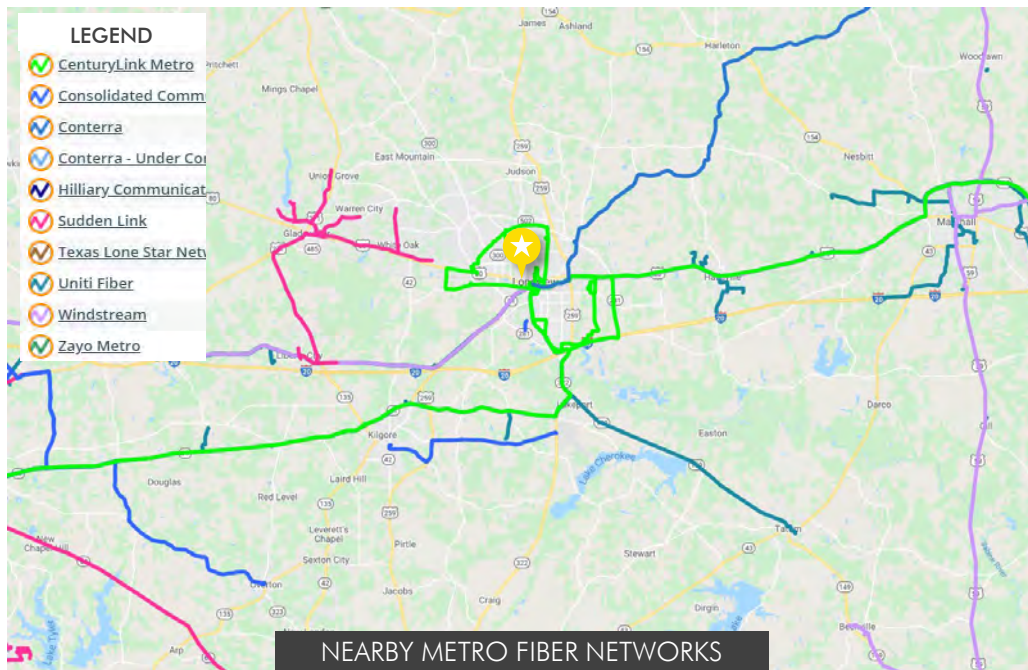
SPRINT/TMOBILE 100 GIG BACKBONE

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.



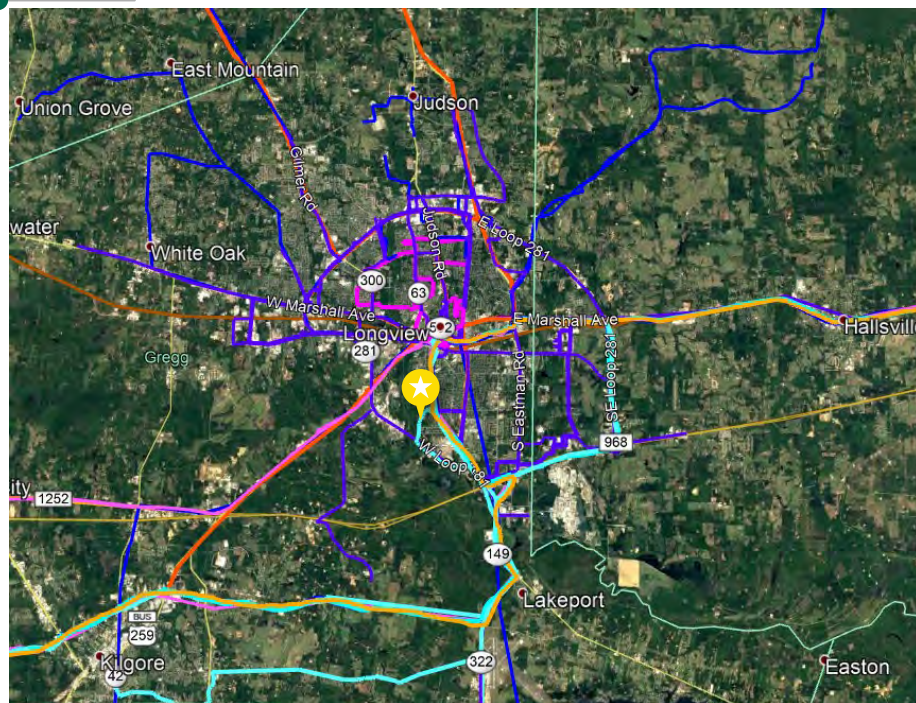
METRO FIBER | 10 MILE RADIUS

AT&T is the Incumbent Local Exchange Carrier (ILEC) – a.k.a. Ma Bell. Sparklight is the incumbent cable company. Conterra also has a strong presence in the area; through acquisitions and organic growth, Conterra has established the largest independent fiber network in the market.

*There are 8 completely **unique** metro fiber networks in the immediate area:*

1. AT&T
2. Longview Cable (Cablelynx)
3. Conterra Networks
4. Frontier/Verizon
5. Sparklight (Suddenlink)
6. Centurylink
7. ETEX
8. Windstream

** There are other companies that can and will use other networks to extend services, a common practice in the industry.*



LEGEND Metro Fiber

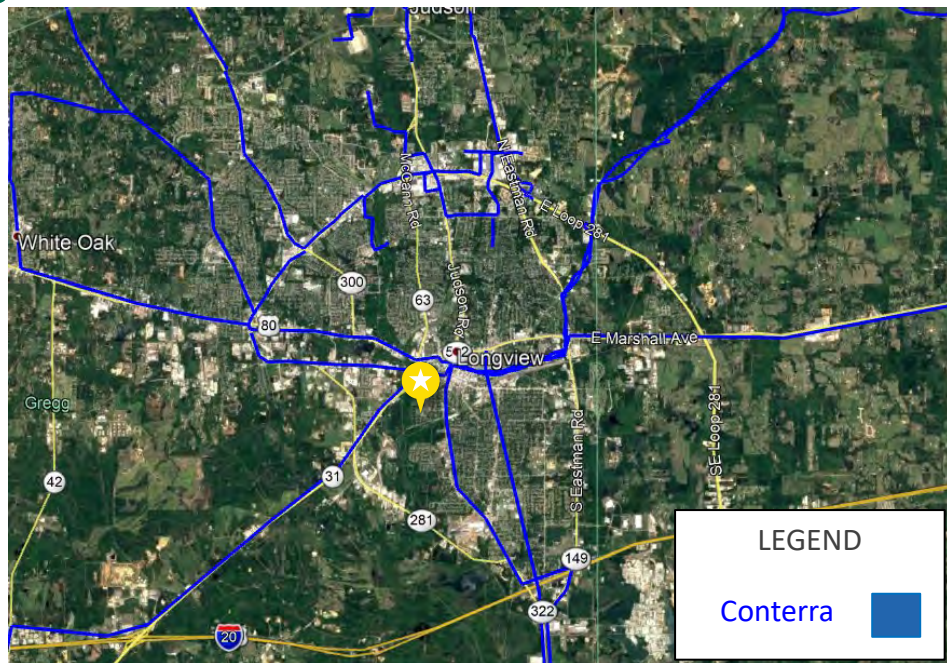
- AT&T
- Conterra
- Windstream
- Sprint
- CenturyLink
- Consolidated
- Zayo
- ETEX
- Longview Cable
- Frontier
- Suddenlink
- Texas Lonestar

METRO FIBER | Conterra Area Fiber

Conterra is one of the largest alternative fiber providers in the Texas markets, and is aggressively building out new fiber.

Conterra will provide custom build solutions for datacenters, business parks and wireless backhaul requirements.

Conterra is interconnected to most of the other providers in the area and can backhaul data traffic to Dallas and other regional areas.

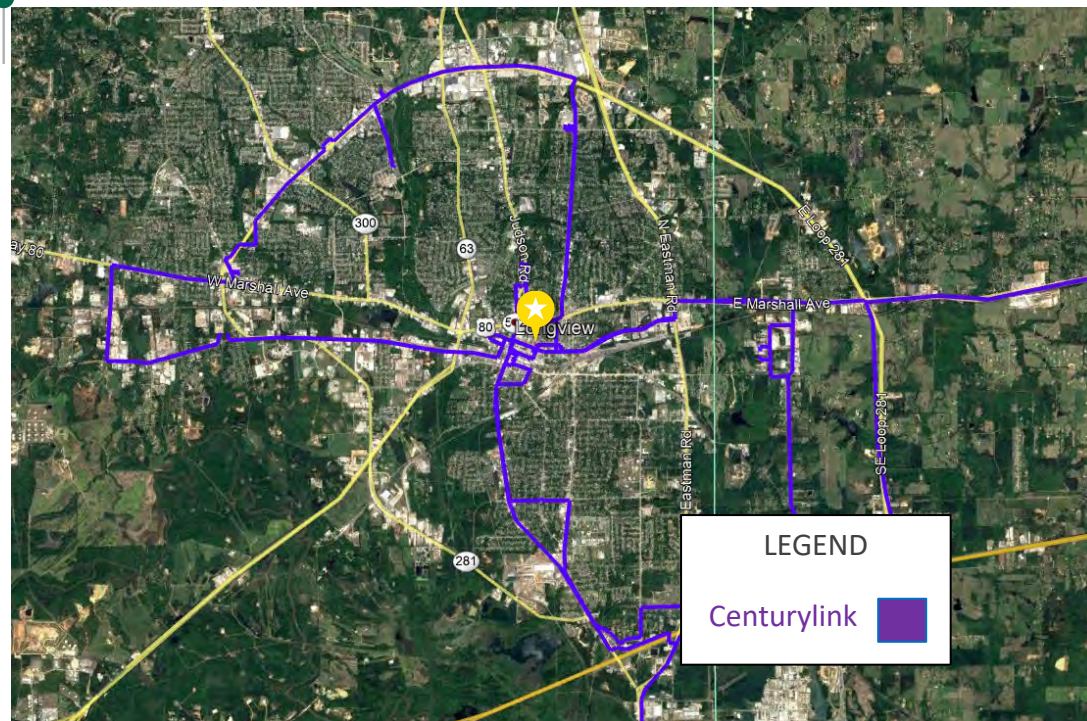


METRO FIBER | Conterra Area Fiber

Centurylink is the largest CLEC in the U.S.

After acquiring Qwest & Level 3, Centurylink has the largest number of long-haul fiber miles of any company in the U.S. Most other Telecommunication companies lease or have purchased fiber from Centurylink.

Centurylink has both a long-haul and metro fiber system in the Longview market, and can provide high-capacity, long-haul connections to virtually any where in the world – to include cloud and other services.

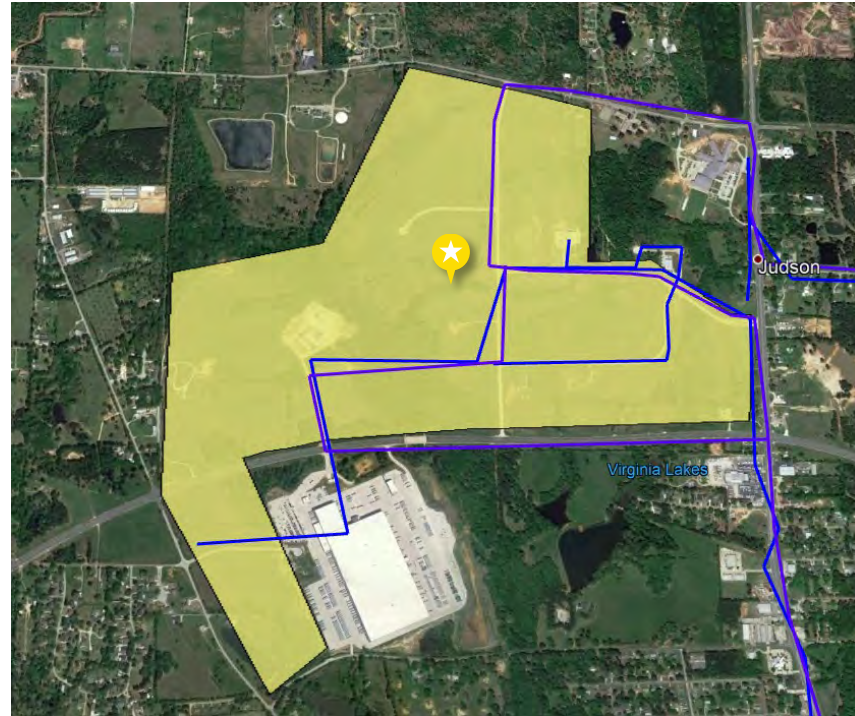


METRO FIBER | LEDCO NORTH BUSINESS PARK



AT&T and Conterra have service installed in the business park and can support virtually any type of service or business requirements. Both providers have diverse paths, which ensures diversity and resiliency standards can be maintained.

Additionally, there is ample room on the utility poles and Right-of-Way (ROW) for additional providers.

This site is approximately 7.2 fiber route miles to the interconnection facility located at 119 W Tyler Street in downtown Longview.



LEGEND Metro Fiber

-  AT&T
-  Conterra

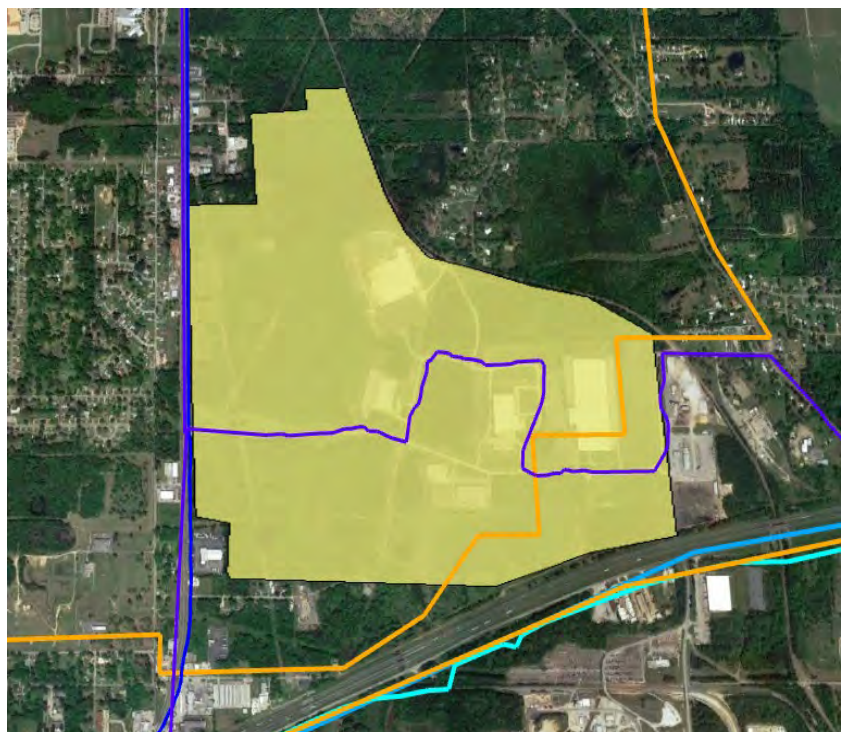
METRO FIBER | LEDCO LONGVIEW BUSINESS PARK

AT&T and Conterra have service installed in the business park and can support virtually any type of service or business requirements. Both providers have diverse paths to ensure diversity and resiliency standards can be maintained.

CenturyLink and MCI have a long-haul system that is within serviceable proximity to the park.

Additionally, there is ample room on the utility poles and Right-of-Way (ROW) for additional providers.

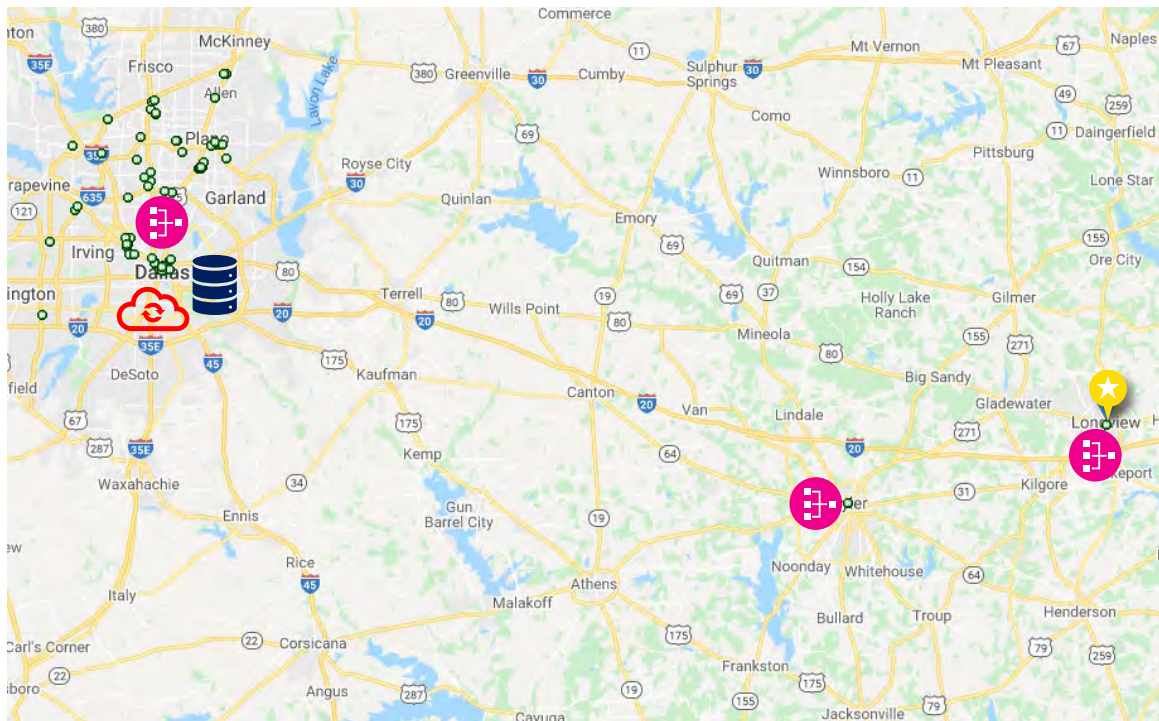
This site is approximately 5 fiber route miles to the interconnection facility located at 119 W Tyler Street in downtown Longview.



LEGEND Metro Fiber

- AT&T
- Conterra
- CenturyLink
- Windstream
- Consolidated

INTERCONNECTION LOCATIONS



There are more than 100 data centers within a 200-mile radius of the facility, including some of the largest and most interconnected data center campuses in the world located in Dallas, TX. This proximity 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

WIRELESS ENVIRONMENT



Wireless Systems

Cell, Wifi, Fixed & Hybrid Wireless

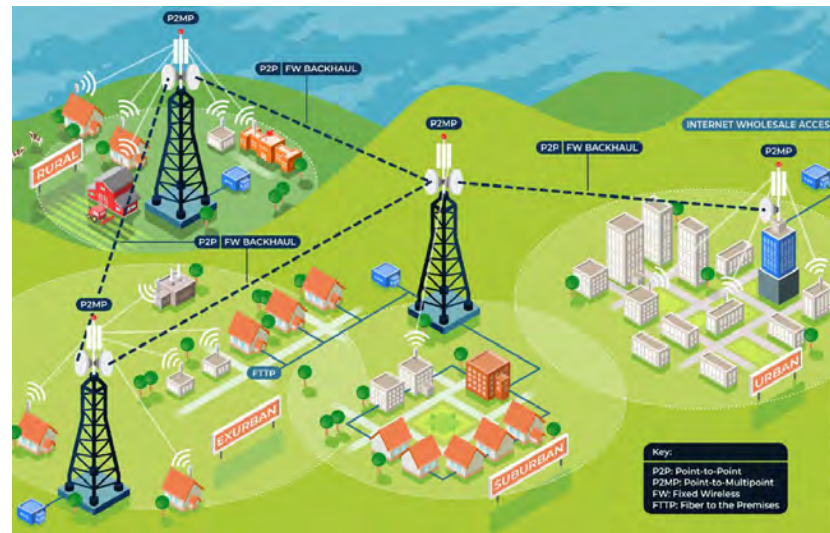
The four commonly known types of wireless systems are:

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.

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.

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)

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

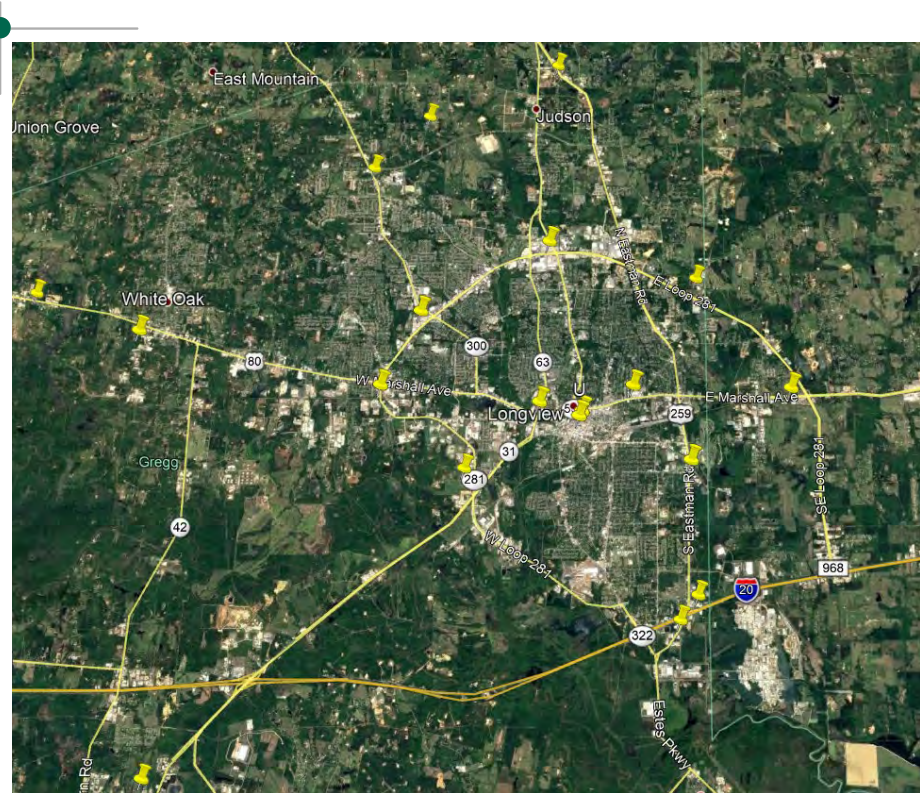
Cellular Wireless systems are comprised of three (3) common components: 1) cell sites, 2) backhaul infrastructure and 3) switching facilities. System variations outside of this list exist based on the provider and service platform (5G, LTE, 4G, etc.).

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

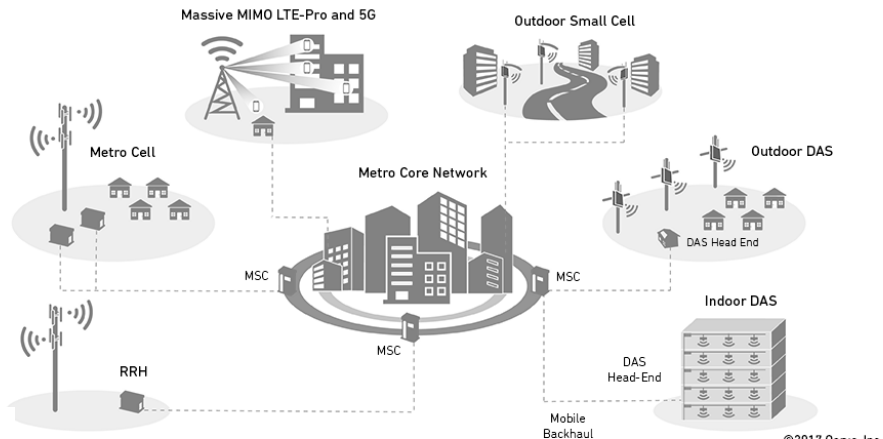
5G is the next generation network that promises big gains in speed and bandwidth. 5G speeds range from 50 Mbits/s to over 1 gigabit/s.

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

Wireless Infrastructure: A Heterogeneous Network



5G SITE PREDICTION

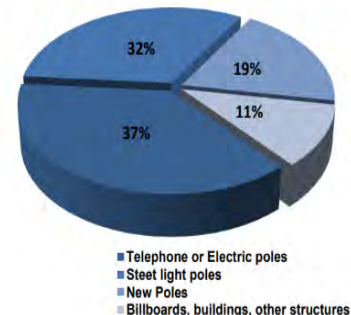
5G

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

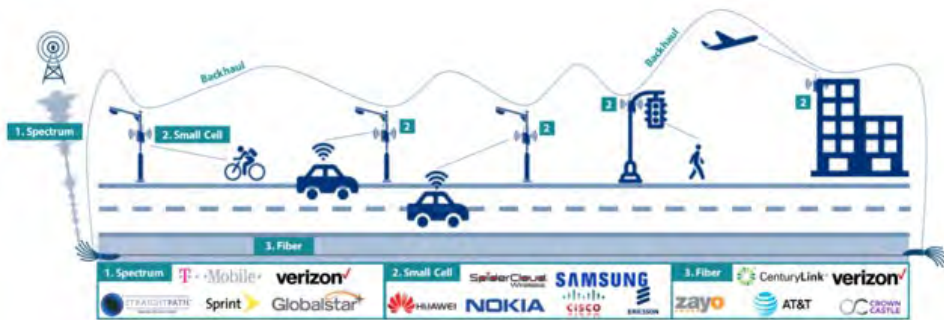
North American enterprises deployed a total of 400,000 small cells during 2018, up compared to 292,000 the previous year, according to a recent study by the Small Cell Forum. Non-residential small cell deployments in North America will account for nearly 14.3% of global small cell deployments this year,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

By 2021, enterprises in North America are expected to deploy a total of 552,000 small cells, 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

Small Cell Deployment Locations



5G DEPLOYMENT





SECTION 5

LATENCY

NETWORK LATENCY

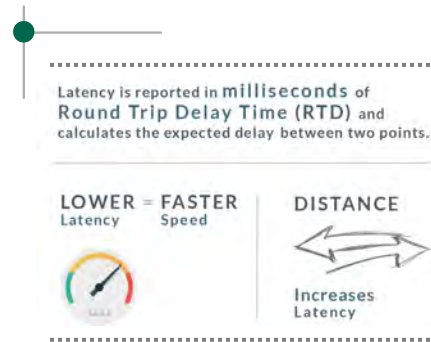
Latency is defined as the time it takes for data to be transmitted from one point to another, across a network platform. Normally, this is expressed as **Round-Trip Delay (RTD)** as data is sent and an acknowledgement of that data being received must be returned to the sender to ensure validity is maintained.

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:

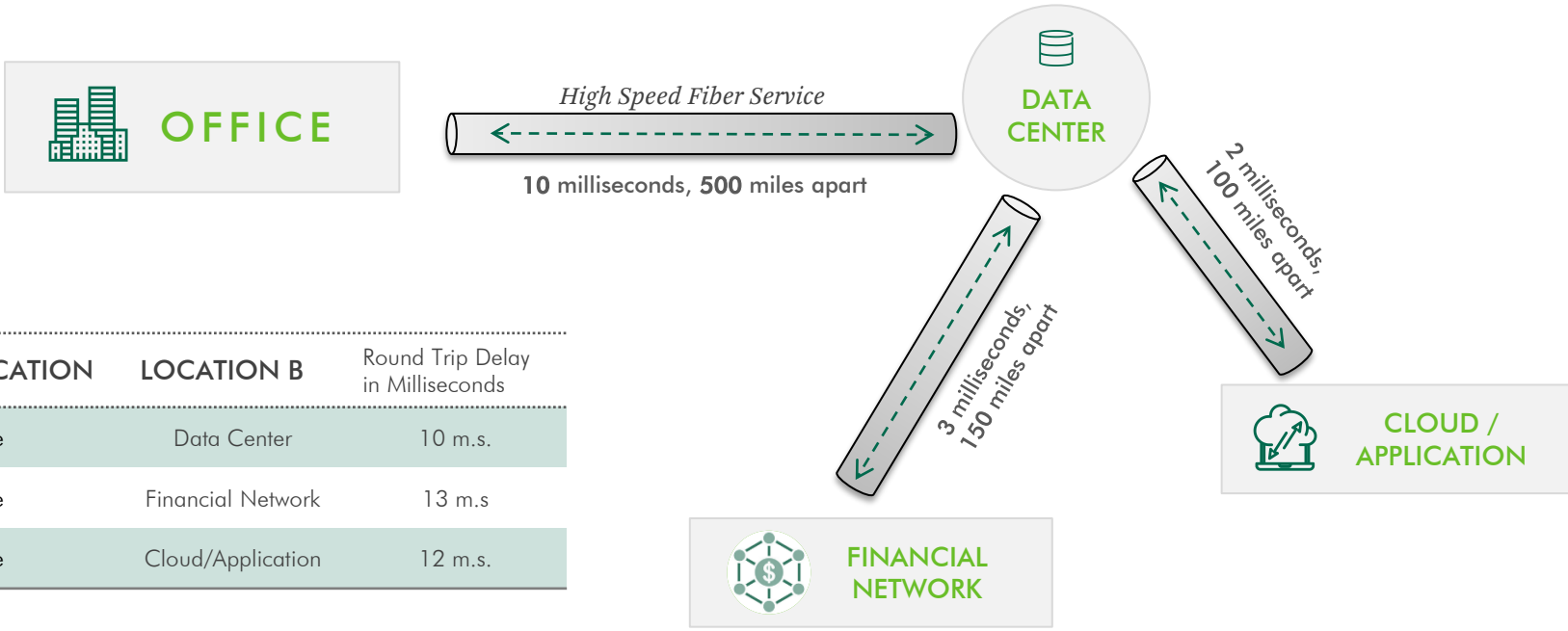
- *Physical distance*
- *Natural and man-made obstructions*
- *Equipment and data processing*

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.



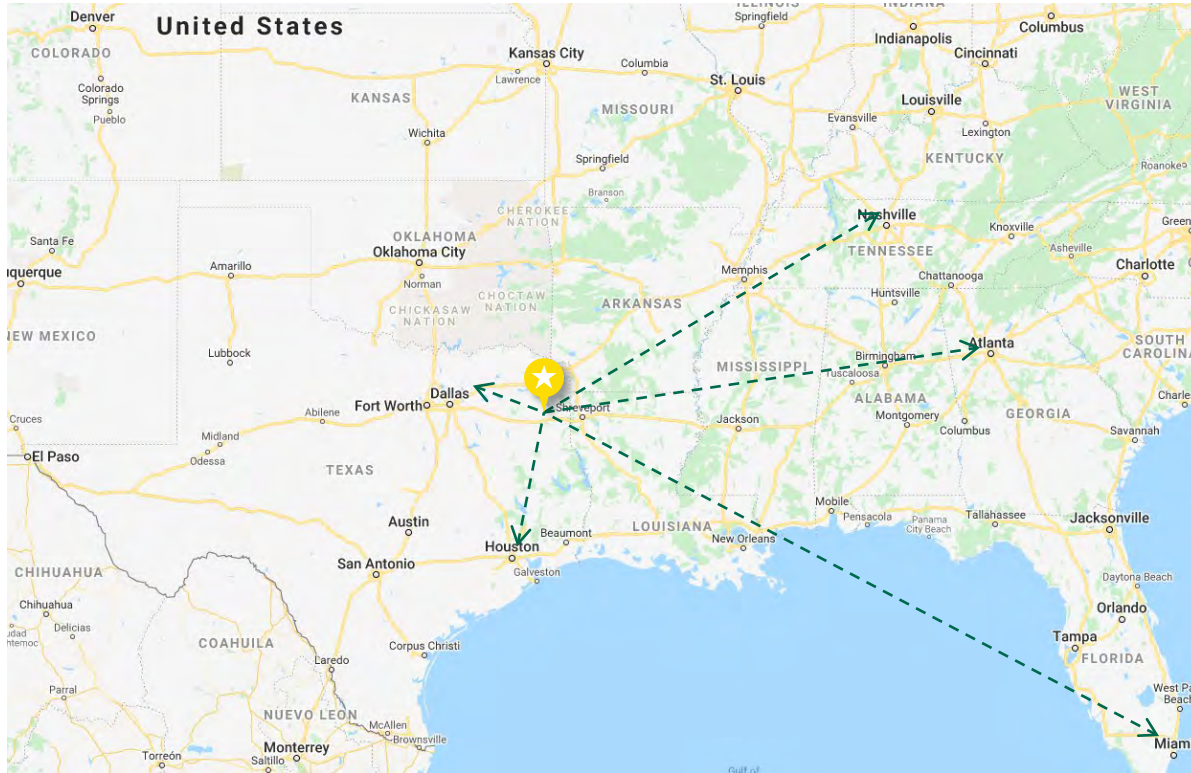
NETWORK LATENCY | DIAGRAM

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	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.

LONG-HAUL SYSTEM LATENCY



MAP LEGEND



Target Area

LATENCY CALCULATIONS

DESTINATION	Round Trip Latency in Milliseconds
Dallas, TX	2.8 m.s.
Houston, TX	4.2 m.s.
Nashville, TN	9.8 m.s.
Miami, FL	22 m.s.
Atlanta, GA	12.4 m.s.



SECTION 6

ASSESSMENT

SUMMARY OF FINDINGS

- The city of Longview is on the national long-haul fiber system with three unique infrastructures that are used by over a dozen service providers.
 - AT&T, Conterra, Centurylink, ETEX and Suddenlink provide high-capacity services in the metro area, which also interfaces to their long-haul.
 - The current carrier and network environment is well developed and can support any kind of data center operations, including hyperscaler/large content providers.
 - The Target Area is within 130 fiber miles of Dallas, TX, a prominent data center and cloud service market.
 - The Interconnection Facility (ICF) located at 119 Tyler Street is very well connected, allowing for access to numerous services
- The latency to cloud, significant Interconnection facilities and a variety of other networks is sub 4 milliseconds
 - The Target Area is equipped to immediately support 100G + network services and has access to at least five providers including: AT&T, Centurylink, Verizon, Sprint, Windstream, Zayo and Conterra.
 - The two larger business parks have at least two service providers, ensuring that any type of operational requirement, high-level of service reliability and/or large bandwidth requirement can be supported cost effectively.
 - ETEX, Conterra and Sparklight are aggressively building new fiber networks in the area.

SITE FEASIBILITY ASSESSMENT | DATA CENTER FEASIBILITY



DATA CENTER READY



✓ 100G Enabled Long-haul Access



✓ Local Interconnection Point



✓ High-capacity Metro Fiber

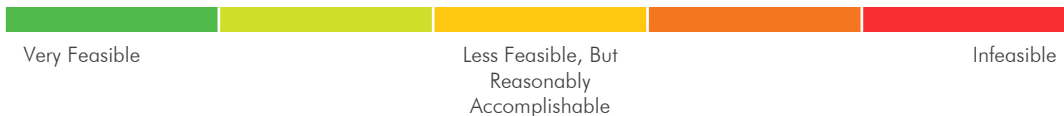


✓ Path and Service Provider Diversity = Resiliency



✓ Reasonable Latency To Core

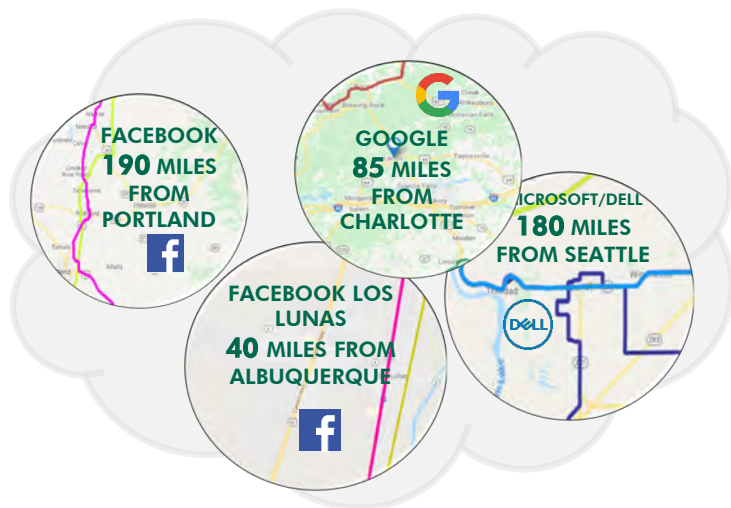
Site Feasibility Scale



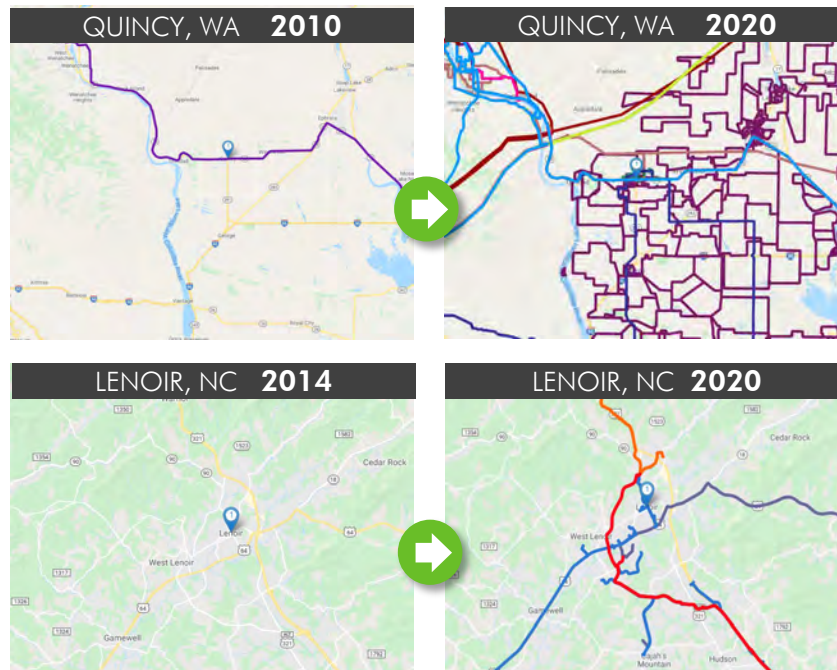
MITIGATING FACTS

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 datacenter'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.





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CBRE



SECTION 7

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%

Source: Sandvine, The Global Phenomena Report 2020

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%)

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
<ul style="list-style-type: none"> • UCaaS • Data & Contact Center Solutions • Unified Comm. • Networking • Cloud Services • SD-WAN • Network & Connectivity Solutions • Security Solutions • Internet • DDoS Mitigation • Wavelength 	<p>Route Miles: 150,000</p> <p>Network PoPs: 3,700</p> <p>On-Net Buildings: 17,000</p>	Little Rock, AR	2006	Tony Thomas	10,284	\$4.996B	Publicly Traded Company (Other OTC: WINMQ)

APPENDIX 3: CARRIER PROFILES



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
<ul style="list-style-type: none"> • Data & Contact Center Solutions • Networking • Network & Connectivity Solutions • Dark Fiber • Internet • Voice • Wavelength • Custom Networks 	<p>Route Miles: 12,500</p> <p>Network PoPs: 220</p> <p>On-Net Buildings:</p>	Charlotte, NC	2003	Craig Gunderson	340	\$100m	Private

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 datacenters.

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-bandwidth 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.

APPENDIX 5: AERIAL V.S. UNDERGROUND

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

UNDERGROUND DEPLOYMENT



- 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

SECURITY



INSTALL METHOD



% OF DEPLOYMENT



COST



TIMING



AERIAL DEPLOYMENT



- 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, less engineering and permitting required