Connectivity Report

Central Atlanta

2014

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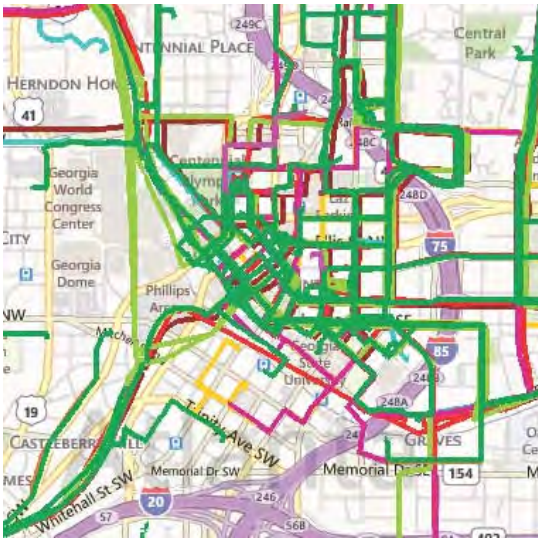
Executive Summary

Area Network Viability

The Atlanta Central Business District (ACBD) area has a very dense metropolitan fiber optic infrastructure, built by myriad telecommunications companies over the years. Additionally, significant long-haul fiber optic network routes originating from all points of the compass transition through the downtown core interconnection facilities -- making Atlanta the Southeast's nexus point for internet, voice and data traffic.

Atlanta is better connected than most of the large metropolitan areas within the United States. These networks can support any standard business applications, in most cases "out of the box."



ATLANTA METRO FIBER

ATLANTA LONG-HAUL FIBER

The Atlanta Central Business District has over a dozen telecommunications companies that own and operate fiber networks in the area. These networks operators, in turn, provide access and end-point service support to hundreds of telecommunications companies across the globe. For instance, a telecommunications company in India can facilitate an international circuit between a client in their country that has a presence in one of the many large office buildings within the Atlanta Central Business District.

Atlanta houses one of the "key" internet hubs in the United States, housed at 56 Marietta. Each region in the U.S. has a super-data center where most of the internet and corresponding data traffic traverses, and 56 Marietta is that facility for Atlanta.

Service Available

All potential telecommunications services are available within the Atlanta Central Business District (ACBD), including large capacity data services, latency optimized international transport services, standard voice, internet and cable TV. The fiber bandwidth capabilities are virtually unlimited.

Additionally, dark fiber, a requirement for many large corporations and commercial data center operator/owners, is available as a product from a handful of carriers. The ability to procure dark fiber is not always an option for many locations. The ACBD has several providers that have leased dark fiber infrastructure in the past and have enough infrastructure in place to support such a service in the future.

Latency

Latency is an emerging requirement and important for specific applications. The latency requirements for each client will differ, ranging from non-essential to mission critical. Given Atlanta's excellent long-haul fiber distribution capabilities and core internet transit points, network latency is minimal and among the best marks among major metropolitan areas. A separate section has been included to address the network latency characteristics, including a matrix of Atlanta's latency numbers to other key landing points.

Report Background

NEF is professional services firm that provides research, analysis, consulting and planning for large infrastructure projects such as fiber optic network deployments, municipal conduit systems, data center site selection and more. The information in this report is based upon data obtained from a wide variety of sources, including, but not limited to service providers, in-house resources, historical records, interviews with subject matter experts and facility owners/operators.

For the network portion of the report, NEF focused primarily on facilities-based providers. Facilities-based service providers are those that own and operate their own fiber network. Some service providers routinely lease fiber from other service providers; others lease fiber when they are out of their own operating area. Of the facilities-based service providers, some will lease dark fiber to other service providers or end users, while others only sell telecommunications or "lit" services. The telecommunications industry is evolving quickly and the best source for information about what the service providers are currently selling will always be from the service providers directly. Likewise metro networks are constantly expanding, and new buildings are being lit by service providers every day.

Most service providers have been generous in providing network maps and information; however, many do not allow public dissemination of their routes. The physical layer of the networks is always expanding, and the service providers and the services they offer continue to evolve. The service providers, of course, have the most up-to-date network and service information available. The service providers are presented in no specific order in keeping with NEF's provider neutral position. The maps show the routes which the fiber networks take into and near the locations of interest.

NEF's team of analysts strives to be accurate and thorough in the research and creation of this report; and while reasonable care has been taken in the preparation of this report, there is the possibility of errors and omissions in facts, figures or material. Information, statistics and data from a wide span of time has been included for the directional and historical value it represents. The intent of this report is to provide data and analysis that would be valuable in the data center site selection process and is not meant to take the place of any due diligence, specific investigational work or similar fact finding endeavors.

Area Overview

Georgia's deregulated telecommunications industry provides a competitive environment, with access fees that are among the lowest in the United States. Telecommunications companies like Atlanta Gas and Light Networks, AT&T Mobility, Bell South, Sago Networks and FiberLight headquarter their operations in the Atlanta area and aggressively built networks to support their operations.

Telecommunications Infrastructure

Atlanta is one of the fastest growing high-tech urban centers in the nation. Projections indicate that within the next three to five years technology companies will invest more than $1 billion in the state of Georgia, with a majority of those funds invested in the city of Atlanta. Often referred to as "America's Most Wired City," Atlanta has extensive fiber access and ranks in the top five U.S. markets for total bandwidth. Atlanta also serves as a hub for the country's two largest fiber trunk lines which feed to Europe, Asia and South America. A majority of the largest telecommunications companies have a strong presence in the region.

Population Information

Atlanta is Georgia's capital and largest city with a population of more than 5.3 million residents. The city is comprised of 29 counties and is the ninth largest metropolitan statistical area, or MSA in the United States. According the U.S. Census, the Metro Atlanta region is comparable in size to the state of Massachusetts.

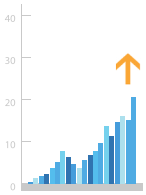
POPULATION

CENTRAL BUSINESS DISTRICT
28,000

ATLANTA
5,457,831

GDP
$ 294.6
(BILLION)

JOB CREATION



1.9%
GROWTH RATE

ANNUAL NET JOB CREATION
43,900

+ MANUFACTURING
+ FINANCE
+ BIOSCIENCE & HEALTH IT
+ DIGITAL MEDIA
+ TECHNOLOGY

Business Climate

More than 150,000 businesses make up Atlanta's diverse economy, which has been dubbed the "Engine of the Southeast." Atlanta is an extremely desirable location to operate due to the low costs associated with doing business. With the lowest relative business costs among the nation's top 10 largest metro areas, as well as the lowest commercial real estate rent (per square foot, per year), Atlanta has a competitive business environment that has experienced significant growth in recent years.

> "Georgia was named the **#1 State for Business Climate** by Site Selection."

PROJECTED GROWTH RATES: *2013-2015*

Atlanta, GA	Boston, MA	Chicago, IL	Dallas, TX	Los Angeles, CA	New York, NY
6.4%	1.2%	2.5%	6.4%	1.8%	1.7%

Sources: U.S. Census and American Community Survey

Atlanta ranks third in the nation among cities with the most Fortune 500 Headquarters, following only New York City and Houston. Large corporations and startups alike are enticed with the city's considerable growth potential. In addition to the companies like Coca-Cola and Home Depot, Atlanta is also home to 192 of the nation's fastest growing private companies. The large number of universities in the region has played a pivotal role in building the market's competitive talent base and the city's reputation for strong entrepreneurial spirit.

Educational Information

Atlanta is home to the largest concentration of colleges and universities in the southern United States. The largest universities in the metro area are Georgia State University (GSU), Kennesaw State University (KSU), Georgia Institute of Technology (Georgia Tech), Emory University and Mercer University. Some 35% of the population has earned a bachelor's degree or higher, with 13% earning a graduate or professional degree. The emphasis on building strong programs in the sciences has played a vital role in cultivating Atlanta's technology and bioscience industries.

Transportation

Atlanta's robust transportation network connects individuals and businesses to the global marketplace. The proximity and interconnectedness of the railways, interstates and airports make the city a distribution hub, promoting optimization of supply chain technology

Rail & Mass Transit

The abundant rail service in Georgia consists of more than 5,000 railroad miles. Metro Atlanta is considered a leading U.S. railroad hub with CSX and Norfolk operating as the two largest railroad companies. Between the two companies, there are nine intermodal yards in Georgia and five in Metro Atlanta. The Metropolitan Atlanta Rapid Transit Authority (MARTA) also has a strong role in boosting Atlanta's interconnectedness with bus and rail services that cover more than 1,000 miles.

Airport

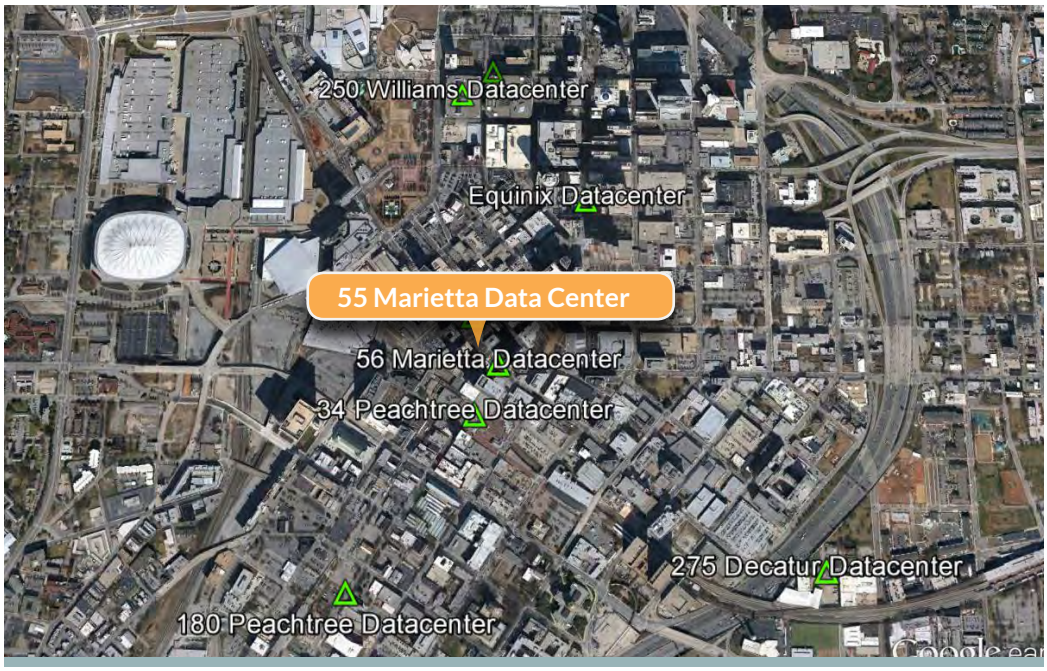
Hartsfield-Jackson Atlanta International Airport is the world's most traveled airport in the world, and has been since 1998.

95 MILLION
PASSENGERS
A YEAR

165 DOMESTIC
&
70 INTERNATIONAL
DESTINATIONS

Data Centers in the Area

- 56 Marietta Street – Telx/Equinix
- 55 Marietta Street – Cyberwurx/Cogent
- 1000 White Street – Global NAP
- 180 Peachtreet Street – Equinix/ Level 3
- 345 Courtland Street – Level 3
- 250 Williams Street – Internap
- 34 Peachtree Street – Colo34
- 2 Ravina Drive – Time Warner
- 1033 Jefferson Street – QTS
- 1000 Hemphill Ave – Broadriver



DATA CENTERS IN THE AREA

* There are over 40 commercial & private data centers within a 20 mile radius of downtown Atlanta.

Power Company	Telephone Company	Gas Company	Cable TV Company
Georgia Power, A Southern Company	at&t	Atlanta Gas Light, An AGL Resources Company	at&t U-verse

PRIMARY AT&T SWITCH : *Central Office Details*

English Name	Atlanta Main
CLLI (Common Language Location)	ATLNGAGADS0
Switch Type	5ESS
LTA (Common Language Location)	438
City	Atlanta G

Atlanta Area AT&T Switch Locations

AT&T, via the Bell South subsidiary, is the incumbent local exchange carrier/telephone company for the downtown Atlanta area. Many others can provide these services, but AT&T has the largest fiber and switching infrastructure in the area.

AT&T SWITCH LOCATIONS IN THE AREA

Connectivity Overview

The Atlanta area has a significant fiber network infrastructure from a wide variety of providers. The foundation of any telecommunications network is the long-haul fiber, and Atlanta has one of the most diverse long-haul fiber infrastructures in the U.S. The long-haul networks utilize the rights of way along the standard transportation corridors, railroad lines, gas pipeline pathways and high-tension power lines.

The junction points for these long-haul networks can be found at 55 & 56 Marietta or in some of the several other high-density carrier hotels and data centers in Atlanta's downtown core. These junction points interconnect the long-haul fiber routes to the metropolitan fiber infrastructure. Atlanta has thousands of fiber optic strands weaving through its streets, laid out neatly in grids and covering virtually all streets and avenues within the central business district.

Diverse infrastructure pathways or routes are one of the key elements in the creation of high reliability networks. For instance, having two paths or routes ensures that if one route failed the data could take the remaining route. In Atlanta, there are over a dozen true long-haul fiber routes, not including the inter-regional routes which can be used in augmentation.

The bulk of the metro fiber infrastructure in the central business district is located between Edgewood Ave SE on the south side, Marietta Street to the west, Ivan Allen Jr. Blvd. to the north and Jackson Street to the east. There are other areas that have fiber, but the density of service providers and routes change considerably outside of these boundaries, with some exceptions.

All combined the long-haul, carrier hotel and metro fiber density ensures that virtually any telecommunication service can be obtained and maintained at the highest possible levels.

Long-Haul Networks

Long-haul networks are typically designed to transport data and voice services between major markets. Most long-haul networks connect to a central "hub" facility in a given city and then exit the city in another direction. These "hub" facilities, otherwise known as carrier hotels, are designed as interconnection points for networks that support a given city or area. The majority of the long-haul networks that support the Atlanta interconnect at 56 Marietta, which also acts as the regional hub for the internet backbone.

The Atlanta area has 10 distinct long-haul fiber routes:

Route 1 – NW along the railroad system to Chattanooga

Route 2 – NW along the high tension power system and I-75 to Chattanooga

Route 3 – NE along the railroad to Charlotte

Route 4 – NE along the high tension power system to Charlotte

Route 5 – West along the high tension power system to Birmingham

Route 6 – West along the alternate high tension power system to Birmingham

Route 7 – Southwest along the railroad to Mobile

Route 8 – South along the railroad and I-75 to Tallahassee and Florida

Route 9 – Southeast along the high tension power system to Savannah

Route 10 – West along the rail to Augusta

Regional Networks

Regional networks are a type of infrastructure between long-haul and metro networks, providing additional paths in and out of a metro that do not use the existing long-haul systems. Essentially, these networks increase the capabilities and telecommunication services for the areas that they support. Due to the population density of the Atlanta area, the metro networks have grown tremendously, thereby becoming a regional network.

A new fiber long-haul network is in the process of being built from Miami to Atlanta and will eventually be extended to Ashburn, Virginia. While this route uses the same railroad right of way as some existing paths, it will be new fiber of significant quantity.

Metro Networks

Metro networks are typically designed to extend from a hub (carrier hotel or data center) to service the local market business districts and/or individual properties. Most of these types of networks are built on customer demand. Many are built in a protected ring fashion, while others are built in a linear fashion to provide services to a single building.

There are 14 metro service providers that own, operate and deploy metro fiber networks in the Atlanta Central Business District. There are over 50 other providers that can provide services in the Atlanta market, but typically the additional providers utilize an underlying owner's fiber to provide local services. As an example, a company like Cbeyond, Teliasonora or NTT will ride their long-haul network into one of the interconnection points like 56 Marietta and connect to a downtown building using fiber from a provider such as Zayo, Level 3 or AT&T, all of whom have metro fiber infrastructure in the Atlanta Central Business District.

Metro Network Service Providers

Level 3	southern light	sunesys	comcast
at&t	TIME WARNER CABLE	XO	CROWN CASTLE
zayo	CenturyLink	SAGO NETWORKS	windstream
	FiberLight	verizon	

Most of the networks in the area have been deployed in an ad-hoc fashion, built as dictated by customer demand. In the Atlanta Central Business District the fiber networks are mostly constructed underground in conduit and manhole systems. However, there are paths and areas where aerial or telephone pole attachment construction is used. Both types of network deployment and construction techniques are common and provide the came level of services and reliability.

There have been many asset trades, swaps or purchases conducted by service providers or carriers over the years, which means that some providers might have elements of one another's networks. This is completely normal and in many cases a standard operating procedure in the industry.

Zayo, AT&T, Comcast and Level 3 have some of the most dense fiber footprints in the area. Comcast and AT&T service the residential market as well, which is why they have the most diverse and proliferative networks in the market.

Carrier Matrix

Provider	Service(s)	Fiber Footprint	Products
at&t	International Service Provider	Highest density of fiber in the downtown core area, with long-haul connections to other markets.	Business and residential telecommunications products, including cable TV and triple-play services.
CenturyLink	International Service Provider	Moderate fiber footprint in the downtown core area, with long-haul connections to other markets.	All business telecommunication products, including voice and video.
comcast	Cable and Business Services Provider	Dense metro fiber footprint in the downtown core area, with leased connections to other markets.	Business and residential telecommunications products, including cable TV and triple-play services.
CROWN CASTLE	Multi-market Provider	Small footprint in the downtown core area.	Specialized for mobile/cellular systems. No long-haul service offering.
FiberLight	Multi-market Provider	Moderate fiber footprint in the downtown core area, with leased long-haul routes.	Dark fiber, transport and internet services.
Level(3) COMMUNICATIONS	International Service Provider	Dense fiber footprint in the downtown core area, with long-haul connections to other markets.	All business telecommunication products.
SAGO NETWORKS	Local Provider	Small fiber footprint in the downtown core area, with leased long-haul connections to other markets.	Some business telecommunications products.
SOUTHERN COMPANY	Regional Service Provider	Moderate fiber footprint in the downtown core area, with some long-haul routes.	Dark fiber only.
sunesys	Multi-market Provider	Moderate fiber footprint in the downtown core area, with leased long-haul routes.	Dark fiber, transport and internet services.
TIME WARNER CABLE	National Service Provider	Small self-owned fiber footprint in the downtown core area, with leased long haul and metro access	All business telecommunication products.
verizon	International Service Provider	Small fiber footprint in the downtown core area, with long-haul connections to other markets.	All business telecommunication products.
windstream	Quasi-national Service Provider	Small fiber footprint in the downtown core area, with long-haul connections to other markets.	All business telecommunication products.
XO	National Service Provider	Small fiber footprint in the downtown core area, with long-haul connections to other markets.	All business telecommunication products.
zayo	National Service Provider & Small International Reach	Dense fiber footprint in the downtown core area, with long-haul connections to other markets.	All business telecommunication products. Restricted voice and video product set.

Latency Overview

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). When data is sent, an acknowledgement that the data has been received is returned to the sender, ensuring that 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. For some businesses latency is a critical requirement in their IT infrastructure planning and for others a "nice to have" element of their network. Still others may not have any need for a lower latency network solution. It 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.

The general rule of thumb for calculating latency is using **8.2 microseconds per mile** for a fiber-based solution with newer equipment designs.

The latency of a terrestrial network is based on two main factors:

- *Fiber route length (most important factor)*
- *Architecture (Metro Ethernet, SONET, Optical Waves, Hybrid)*

Because the actual length of the fiber route is the overriding element in calculating latency, long-haul fiber has the greatest impact on the speed of a network. In calculating long-haul latency, the metro network latency must be factored in to the measurement along with the long-haul paths themselves. Because metro networks are typically built over shorter distances, their effect on the overall latency is relatively minimal. However, there are cases where the metro network design and equipment are not optimized to support latency-sensitive services.

Compounding the inefficiencies of human-created media and technology, deployed fiber optic networks rarely follow a straight and direct line. Instead, networks have followed the railways, highways and transportation corridors which are never straight due to geological obstacles and right-of-way disputes. Most of the networks that are currently available are not "as the crow flies" routes. However, many providers have optimized their routes to create shorter connects between two points.

Companies with a business model based on speed of data transmission are constantly seeking a faster network alternative, and in turn fiber providers have sought to create solutions that address that demand. In some cases, these "ultra" low latency networks use a microwave transmission design because such a design is considered "line of sight" which delivers the shortest possible distance between two points. Deploying this technology has its drawbacks, but for some applications it is the best fit.

The majority of latency sensitive networks are centered on similar locations or hubs, and thus several providers have optimized fibers along a specific path in order to create low latency routes between two points. The optimization focuses on the two key factors of physical path distance and the latest advancements in equipment. These routes are typically owned by larger providers including AT&T, Verizon, Windstream and Level3; however, there are some smaller, niche providers that focus their business entirely around offering the lowest latency services available. Their networks are designed, deployed and optimized solely for the purpose of being faster than the next.

Types of Networks

There are five (5) basic network architectures that are prevalent in latency and transport services:

1. Long-haul Legacy Non-Optimized
2. Long-haul Optimized
3. Low Latency Networks
4. Ultra Low Latency Networks
5. Metro Networks

Long-haul Legacy –this category includes networks that are fifteen plus years old. The legacy categorization encompasses both the equipment powering the networks as well as the fiber deployed. These older networks have equipment that was primarily designed for lower speed networks with very little emphasis on latency. Technically, these networks were designed and deployed primarily for voice. Because efficiency and capabilities tend to increase considerably over time, these legacy networks have been outperformed by and in some cases replaced with newer technology and infrastructure.

Long-haul Optimized – these are essentially legacy networks that have either undergone optical gear upgrades, some redesigns to cut out excess fiber mileage, or generally been "optimized" to provide more capabilities and lower latencies between city pairs.

Low Latency Networks – this classification of networks were specifically engineered and designed (and continue to be) to provide exceptional latency characteristics at higher bandwidth (typically 10Gigabit). Initially, low latency networks were deployed or optimized for the financial services sector, but as the low latency demand has increased for other business applications more of these low latency networks are being deployed or created. For instance, there are at least eight low latency networks between Chicago and New York City today.

Ultra Low Latency Networks – these are true purpose-built latency sensitive networks using the straightest paths possible to ensure that the minimum latencies were achieved between two points. These networks, to date, have been deployed exclusively for the financial services sector as their costs are extremely high. Some of these networks are using point-to-point microwave to create the shortest possible path between two points. As is true with many advancements in telecom, these networks will be open for use by other business applications as the costs come down. Most of these networks are configured between New York, Chicago, New Jersey, Washington DC, Philadelphia and London.

Metro Networks –metro networks typically "hub" from a carrier hotel or large data center. In the case of Boston, for instance, most networks touch or can touch 1 Summer Street in the core of the city. This design ensures access to many interconnection options to both other metro networks as well as the long-haul routes. Essentially, these "hubs" act as the backbone of the modern day "internet" for each city. Normally, there are multiple "hubs" in each city.

Because every metro network has its own unique characteristics, the latency associated with metro networks is a critical element of the overall latency equation. One service provider may use SONET architecture, which will have very good latency characteristics for some applications while another provider might use older metro Ethernet equipment that could add ten to fifteen milliseconds of latency depending upon the design. The long-haul transport latency can be fixed, especially in an all Layer 1 optical network; whereas the latency in a metro network can fluctuate based on the number of nodes or "hops". Many metro networks can be designed as Layer 1 (pure transport), but most operate on a Layer 2 or Layer 3 architecture, which has more latency.

Historical Perspective of Latency

Latency has always been an issue in one form or another in communications. From postal mail a few centuries ago to today's cutting edge global communications networks, transmitting information faster from one point to another has always been the goal. When voice calls had to be manually patched through by an operator, it was annoying enough that an undertaker named Almon Strowger invented a switch to replace the manual operator patch panels. More recently, the wireless telecommunications and internet revolution created latency issues that had to be addressed by innovation. Many can recall the early days of AOL and other destination web-based services that were wrought with inefficiencies and slow delivery.

There have been many advances in equipment, networks and the respective applications all focused on negating or limiting the effects of latency. However, because latency is a factor in voice, video, storage, transactional and a variety of other applications or services, companies should be mindful when selecting facilities to ensure that required services can be delivered.

Latency Sensitive Applications

The New Latency Dynamic – Financial Networks

Around 2006, financial institutions and hedge funds became a powerful force driving low latency networks. Financial firms began to understand and exploit the variations in latency and created divisions within their companies that focused on trading financial instruments. These groups are known as algorithmic and high frequency traders.

Algorithmic trading (algo) -- is automatic trading methodology based on the use of software applications that enter and manage trade orders using mathematically-based rules with no manual intervention.

High Frequency Trading (HFT) -- an off-shoot of algo trading, high frequency trading takes transactions involving world markets to a new level, manufacturing fractional cents based on the timing of the trades and the speed of the transactions. This niche's entire existence revolves around creating the lowest latency possible.

Speculations of profits associated with algo/HFT are as numerous as the dollars themselves. It has been postulated that firms that employ these trading techniques made profits in excess of $21 billion in 2012. In recent discussions with industry players, NEF has learned that a first place position in trading (lowest possible latency for a single financial instrument) is thought to be worth in excess of $20 million per month. It stands to reason that the amount of money spent by these firms to ensure their networks are streamlined and optimized is substantial.

This demand for reduced latency created new fiber pathways between financial hubs most notably Chicago to New York, Chicago to Washington DC and New York to Washington, DC. While other low latency paths that have been created, the Chicago-NY-DC routes are the main networks that have been built or optimized to satisfy the push to create "zero" latency. These routes reflect the locations of the two largest financial areas within the United States, NY and Chicago. The Washington, DC destination is used primarily for data associated with the algorithmic trading programs.

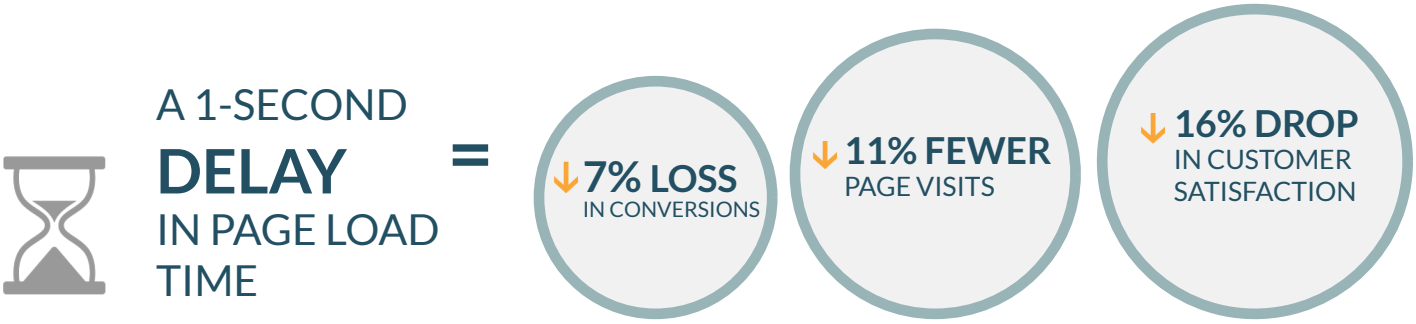
CONTENT DELIVERY NETWORKS (CDN)

Fast or Slow – Content Delivery

Content Delivery Networks, also known as CDNs, are simply large, national or international, well-distributed networks that interconnect at the carrier hotels or data centers along the path. In simplest terms, these networks power much of the Internet. Think of all the applications like Facebook, Twitter, YouTube, even on-line banking, etc. These sites are all using some kind of CDN to create the best delivery of services. When a user clicks on a web-page, quite a bit goes on in the background during the time it takes for the user to see the result of his or her click.

The CDNs are responsible for making sure the Internet experience is the best that it can be within the limits of both a network connection and a network's capabilities.

Latency in this instance is simply,delay. If a user has too much delay in a video, for example, the user would quickly become disenchanted with the video and move on to something else. The value in a well optimized, high performance CDN can be clearly seen in companies like Amazon or Google, where most transactions happen as fast as a user can click, with the only limiting factor being the connection speed to their services. If a business requires content, video, and/or streams of data for its workforce, then the experience is only as good as the company's connection to the networks that provide such quality content.



Real-time Data – Storage/Replication, Cloud or Intelligence

From large, multi-national enterprises to small, local companies, today's businesses run on core applications that either generate revenue or are used to manage operations or both. Consequently, companies require a network design that enables applications to run smoothly and ensures the survival or continuance of their business in the event of a failure or a catastrophe. Such a design includes factoring in some level of system redundancy and diversity; this includes alternative data centers or off-site storage/replication facilities. Latency is one of key components to understand, calculate and manage to ensure the required applications work effectively to support the business.

Physical location is the primary factor in calculating network latency, as it would apply to any application demanding real-time performance. For example, if a company locates a primary or alternative critical network element in a remote location that has poor network connectivity options or is too far from their corporate core network, the application's response time would ultimately be delayed by the connection. This delay could impact the business as a whole, even hampering revenue generation in some cases.

Types of business applications that are latency-sensitive include the following:

- Storage/Replication
- Cloud Computing
- Business Intelligence

Storage/Replication applications or systems are designed for the specialty task of creating fault tolerance by replicating all critical and non-critical data or programs. For example, if there were a failure in the system, even with an operational server that supported one component of a business process, the storage/replication application would allow for the system managers to restore the critical process in a very short time frame.

Obviously, latency could be a very important factor in such a restoration, as the business process would be stopped until such time as the restoration and reintegration was completed. In the past, this restoration could take hours or even days. In today's network environment, these applications have reduced this kind of restoration to milliseconds in some cases. Real-time business data must be stored and replicated as quickly as the network can allow.

Cloud Computing applications are remotely hosted services that support an organization. The "cloud" could be internal data-oriented systems or applications spread across multiple physical locations. Or the "cloud" can refer to an external, managed service provided by companies like Amazon, Apple, Microsoft or Google. Typically, cloud computing is used to reduce costs of the programs themselves or the management of the infrastructure to support hundreds of users.

An example of a cloud-based application can be illustrated with a 500 employee operation which runs document processing using remotely hosted applications like Word, Excel or Powerpoint. The users simply use the programs as if they existed on their desktop computers, when in fact the programs and the documents are being stored or manipulated at the remote hosting facility. Latency in the context of this cloud related example could be seen and measured in the delay to a user in opening an application or a document. This latency or delay has a cost to the individual and the organization and is an expense that companies are constantly attempting to reduce or eliminate to optimize productivity.

Business Intelligence (BI) applications are an umbrella of many different applications and their respective datasets which are used to provide insight and decision-making for the business. BI networks have grown tremendously over the years, and more recently they have become real-time components of large businesses and revenue machines in their own right. Any application that operates based on real-time effectively demands an effort to reduce latency. BI network designers have three areas of concern when it comes to latency:

- Data latency -- how quickly the data is available – mostly external network and equipment functions
- Analysis latency -- how quickly the data can be digested – mostly internal design functions
- Action latency -- how quickly results can be disseminated – both internal and external functions

If the network speed is too slow, the real-time intelligence tool quickly loses value, and the investment associated with the application becomes wasted. Latency is a key variable.

Latency Specifics for Atlanta

As previously mentioned, latency is measured as the delay between two points. Moreover, latency measurements include two primary factors: distance and network architecture. NEF has provided the expected latency to 10 key metros across the U.S.

Standard Transport Latency: *56 Marietta*

City	Average Latency
Washington, DC	18.04
Chicago, IL	19.95
Miami, FL	20.18
Kansas City, MO	22.34
Dallas, TX	23.18
New York, NY	24.19
Boston, MA	31.50
Phoenix, AZ	55.04
Los Angeles, CA	59.97
Seattle, WA	69.36

Latency reported in milliseconds
Latency calculated using 10Gigabit Layer 1 Transport Services
The most interconnect points or data center in each market used to calculate latency

*The latency figures for the routes take into account the route distances for the shortest optical network segments without regard to route diversity or deployment topology. The service providers will guarantee latencies or other metrics only on routes that they certify as capable of supporting the requirements.

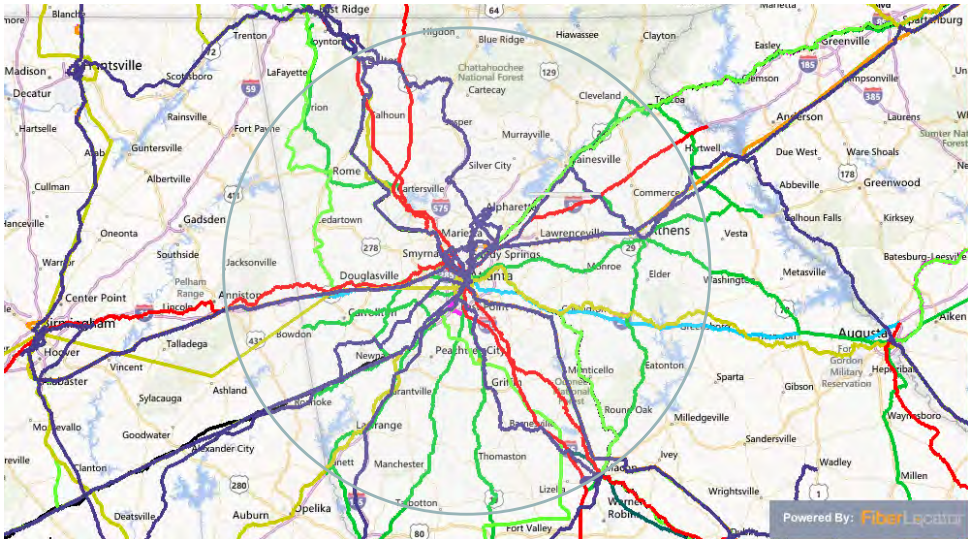
Note: Some providers have not published their maps in the FiberLocator database; therefore certain providers will not be visible in the maps that follow. However, NEF does have knowledge of the unpublished providers' infrastructure and how it interfaces with the property and market.

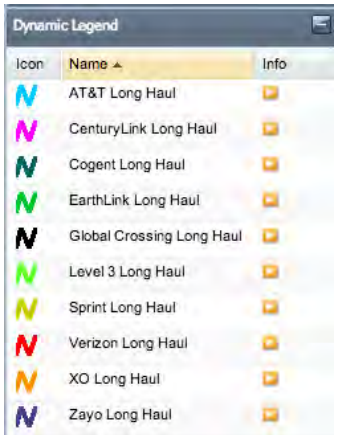
Area Fiber Network Maps

Long-haul Network Maps

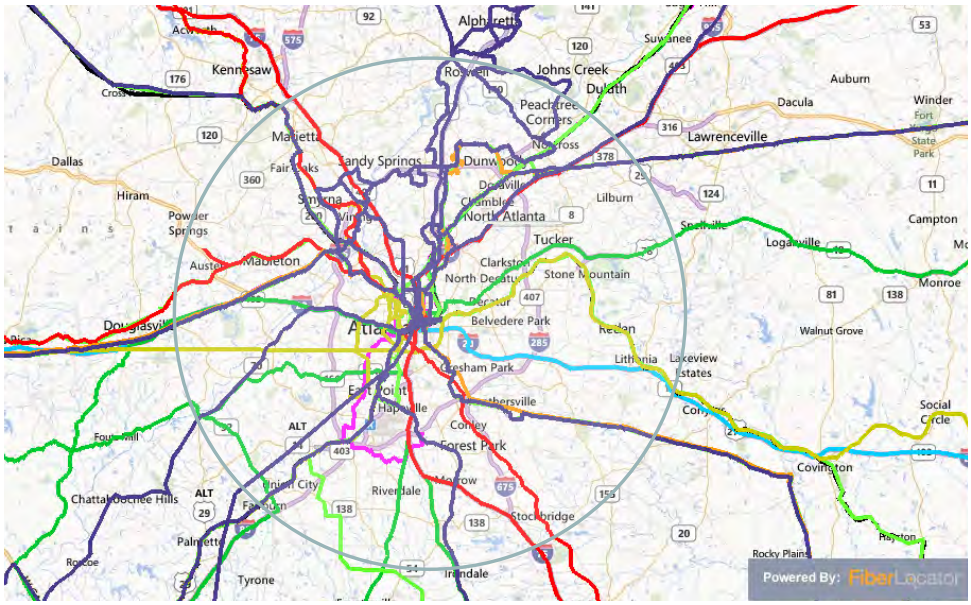
1,000 Mile Radius, Long-haul Networks

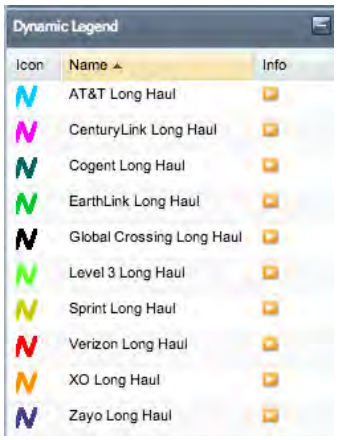
500 Mile Radius, Long-haul Networks





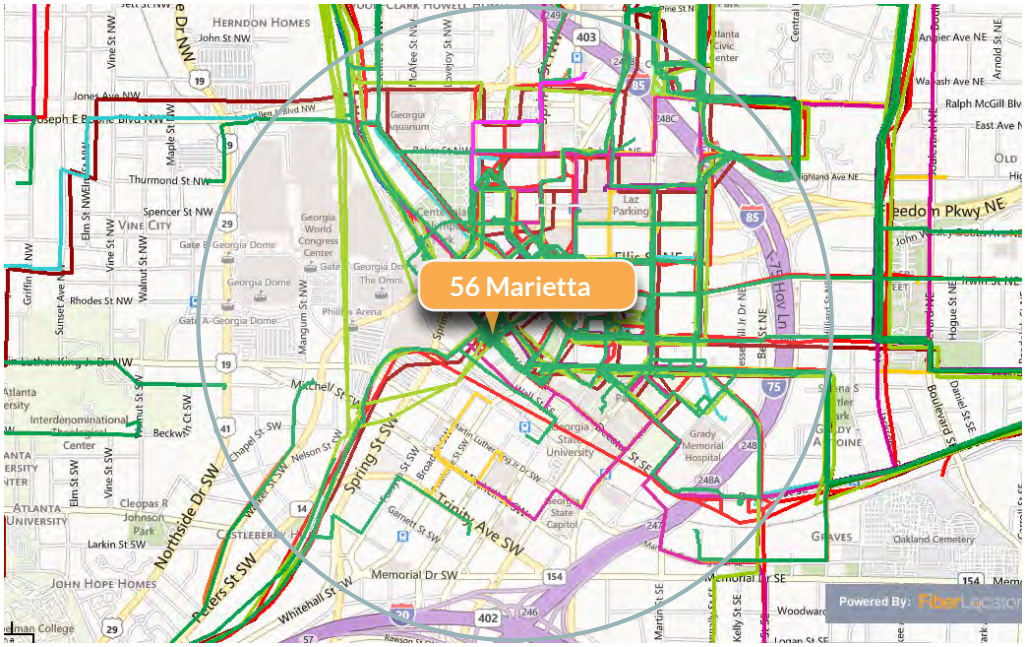
100 Mile Radius, Long-haul Networks

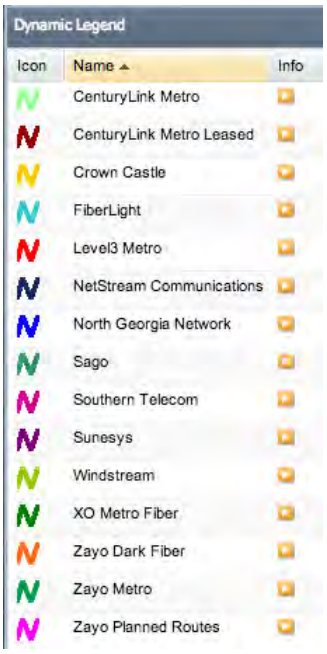




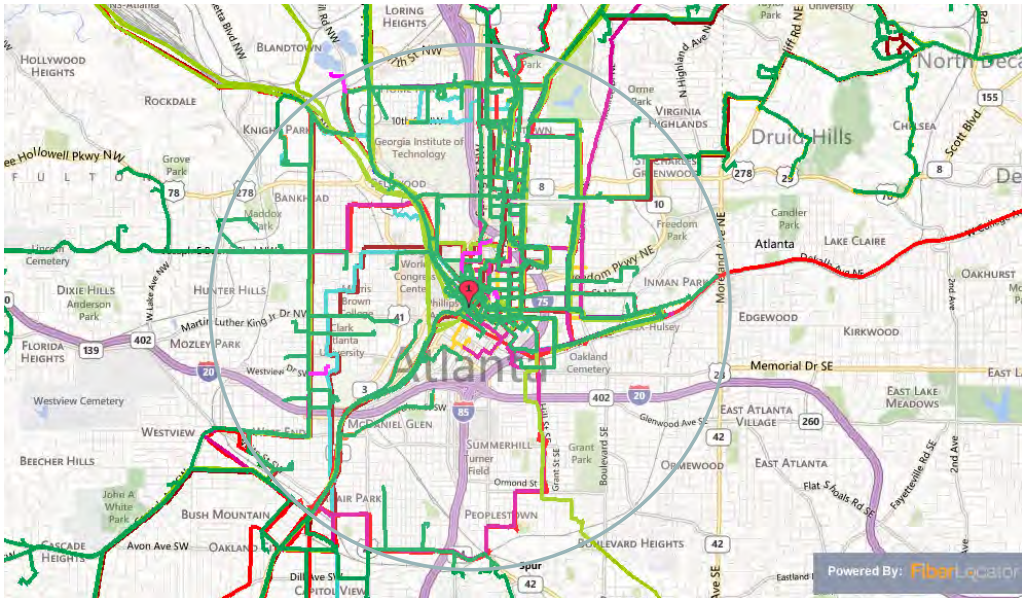
25 Mile Radius, Long-haul Networks

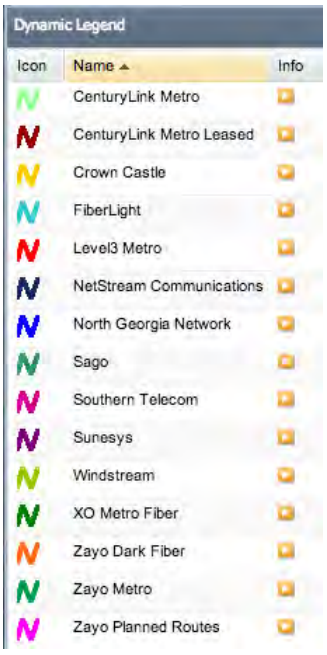
Metro Network Maps



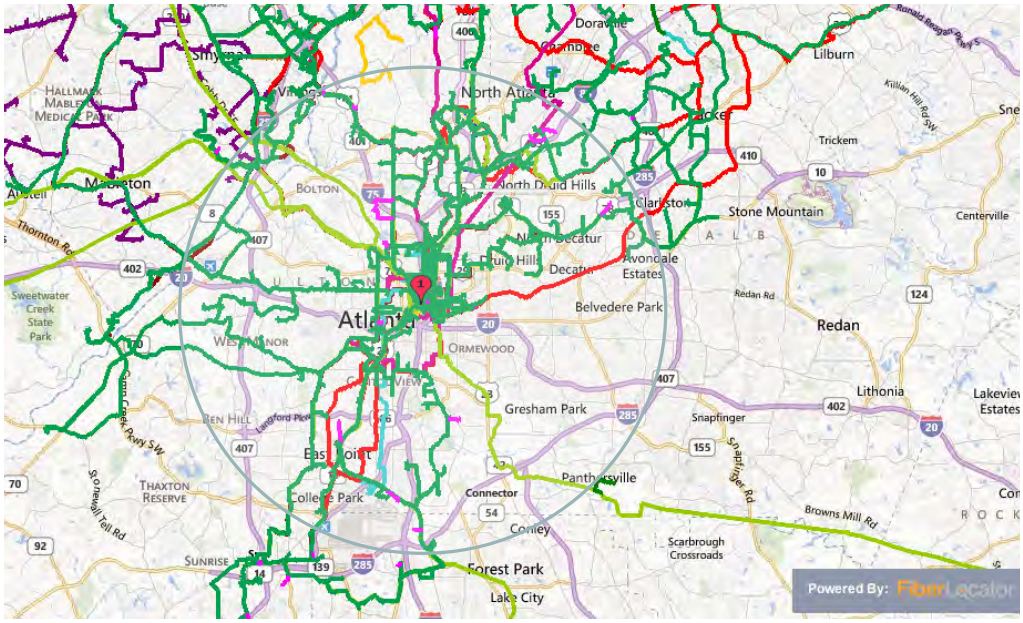


1 Mile Radius, Metro Networks

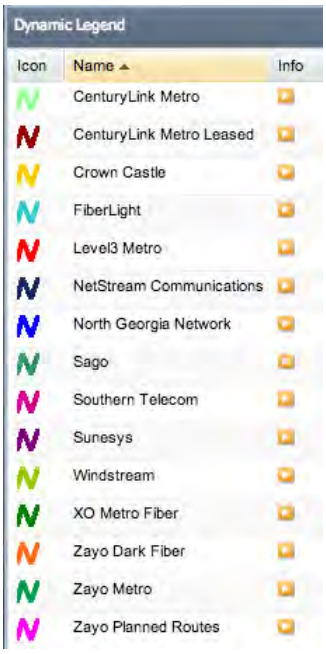




3 Mile Radius, Metro Networks



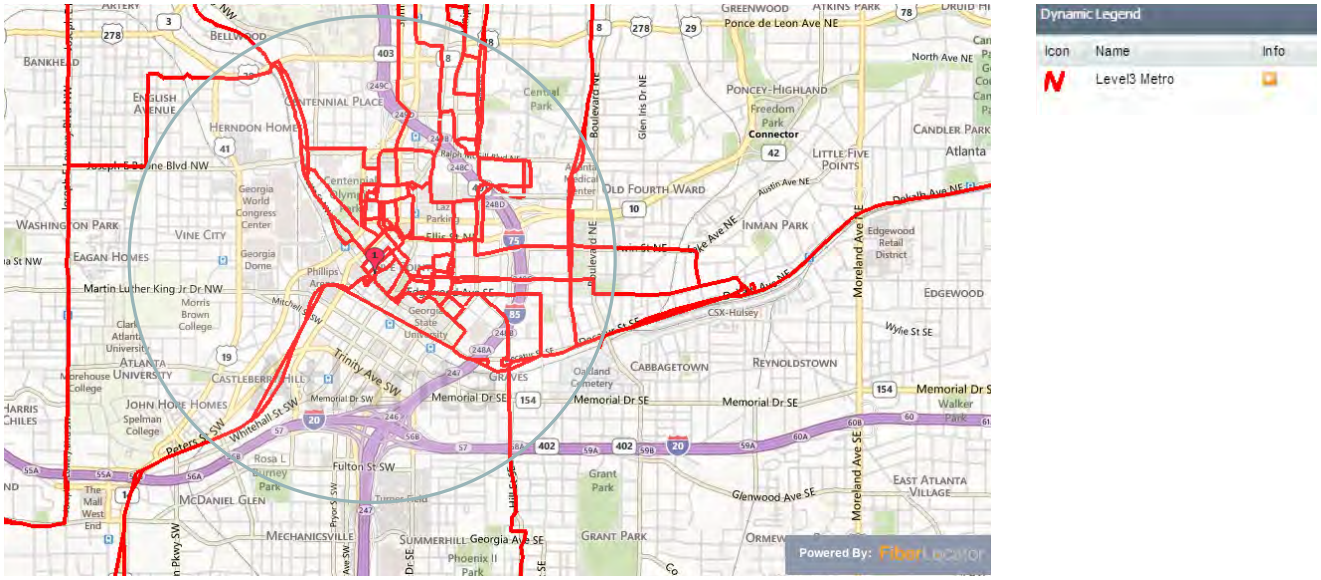
10 Mile Radius, Metro Networks



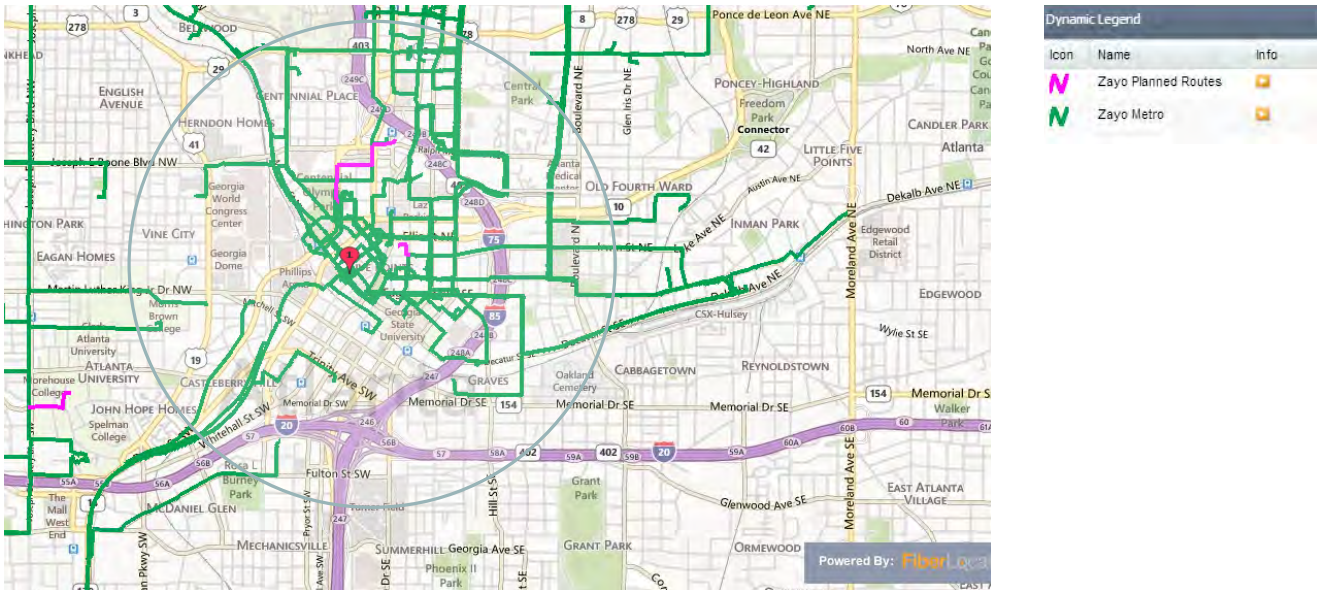
Dynamic Legend

Icon	Name	Info
	CenturyLink Metro	
	CenturyLink Metro Leased	
	Crown Castle	
	FiberLight	
	Level3 Metro	
	NetStream Communications	
	North Georgia Network	
	Sago	
	Southern Telecom	
	Sunesys	
	Windstream	
	XO Metro Fiber	
	Zayo Dark Fiber	
	Zayo Metro	
	Zayo Planned Routes	

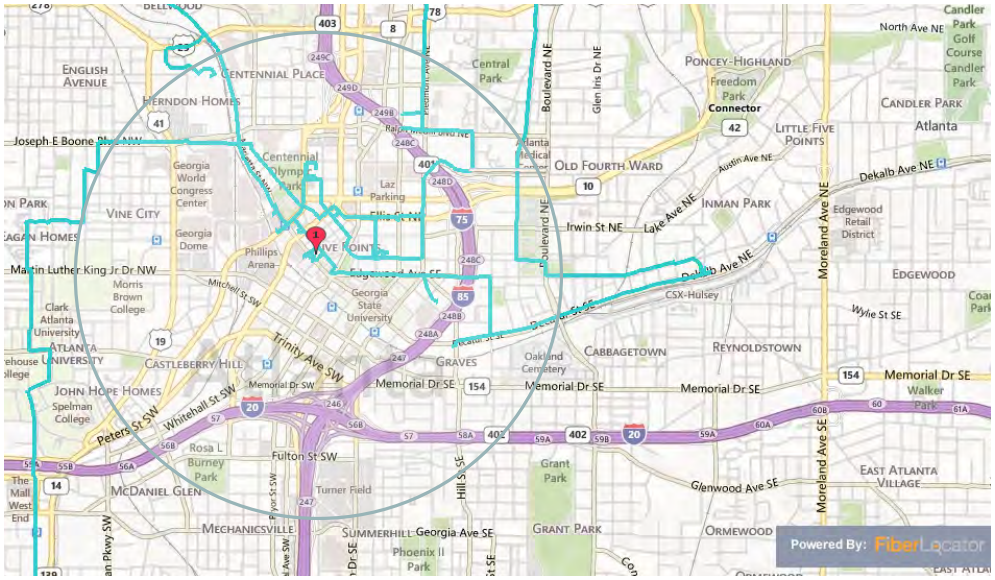
Metro Network Maps: Carrier Specific



1.5 Mile Radius, Level3 Metro Network



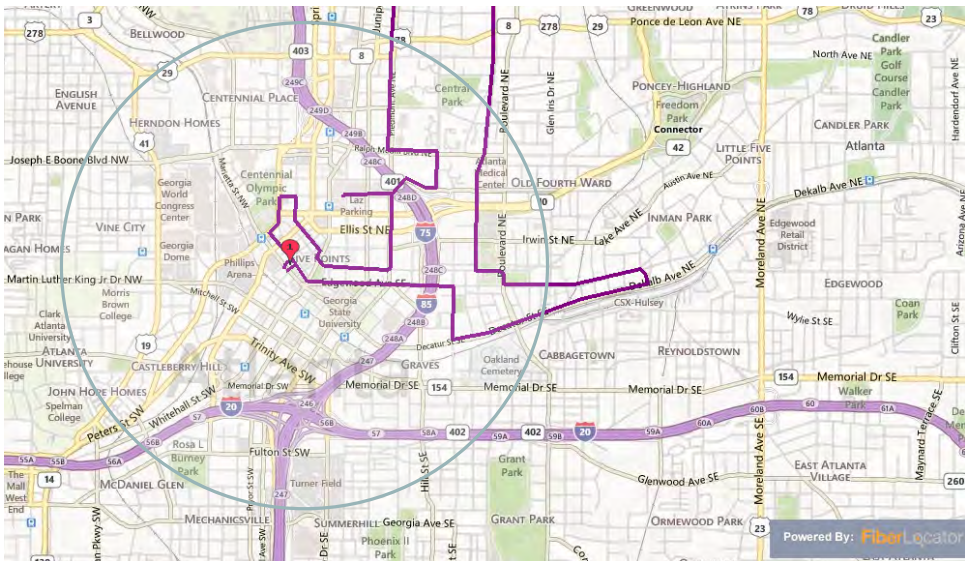
1.5 Mile Radius, Zayo Metro Network



Dynamic Legend

Icon	Name	Info
N	FiberLight	

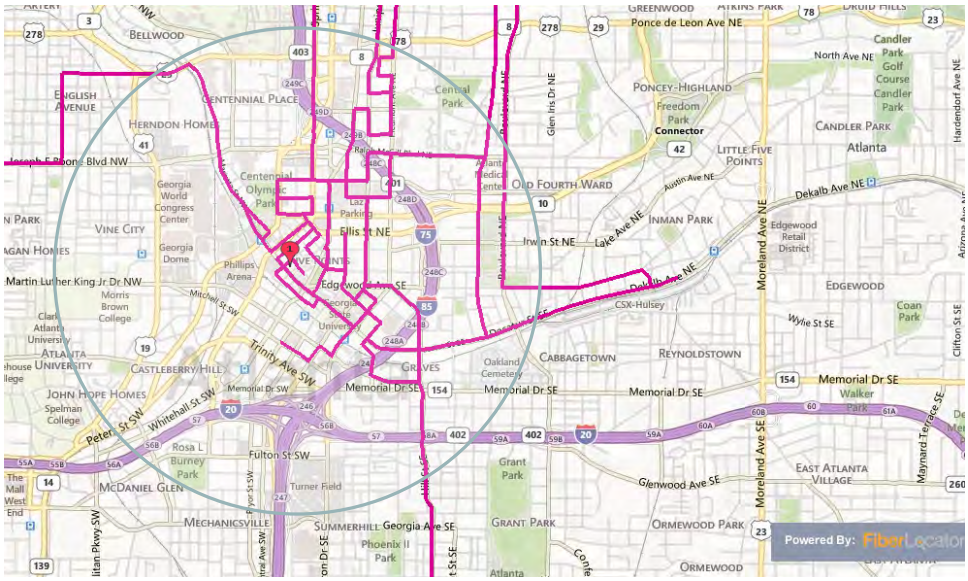
1.5 Mile Radius, FiberLight Metro Network



Dynamic Legend

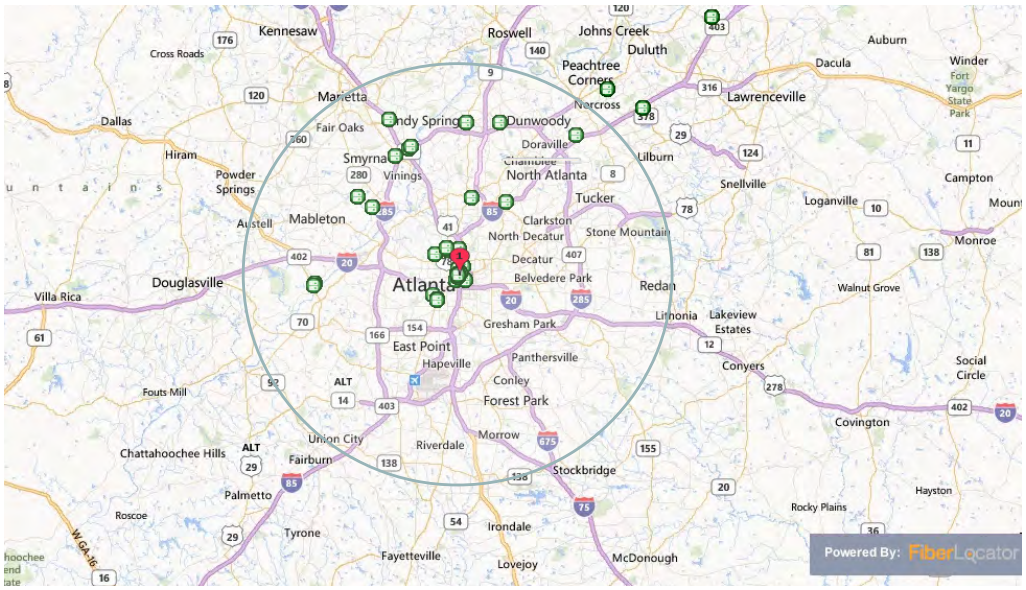
Icon	Name	Info
N	Sunesys	

1.5 Mile Radius, Sunesys Metro Network



1.5 Mile Radius, Southern Telecom Metro Network

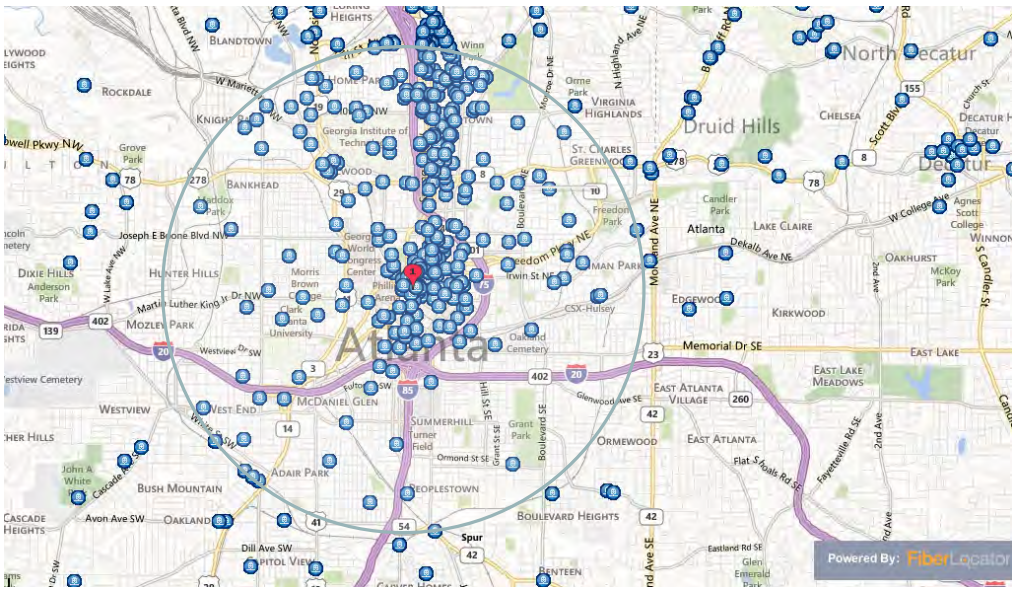
Lit Buildings and Data Center Maps



20 Mile Radius, Data Centers

Dynamic Legend

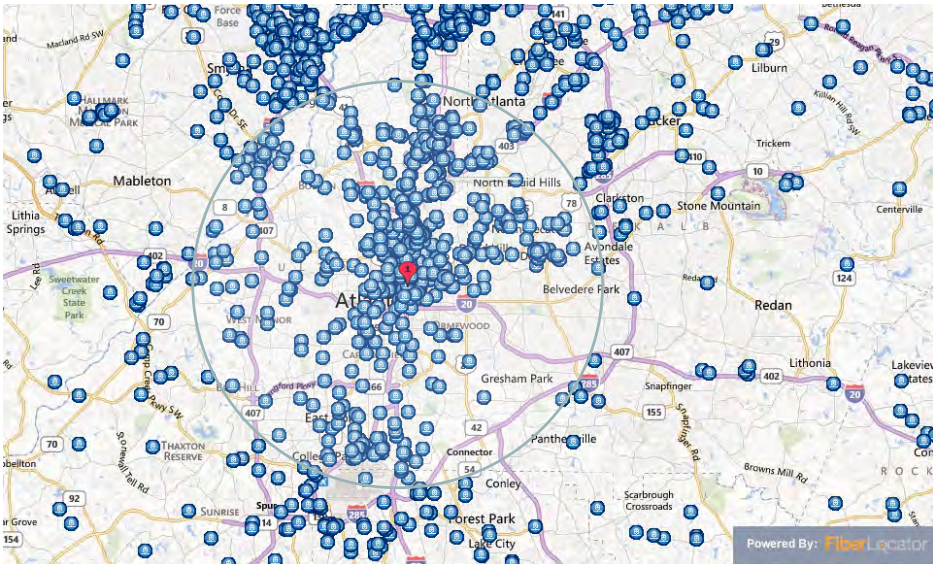
Icon	Name	Info
	Data Centers	



3 Mile Radius, Lit Buildings

Dynamic Legend

Icon	Name	Info
	Lit Buildings	



10 Mile Radius, Lit Buildings

Dynamic Legend

Icon	Name	Info
	Lit Buildings	

Carrier Contacts

Company	Contact	Title	Telephone	Email
AT&T	Will Hager	Sales	866-892-0915	bhager@nitelusa.com
CenturyLink	Patrick Hines	Sales	952-448-8310	patrick.heinz@centurylink.com
Comcast	Chris Fabbri	Sales	978-514-5775	chris_fabbri@cable.comcast.com
FiberLight	Jeremy Latimer	Sales	202-967-1429	jeremy.latimer@fiberlight.com
Level3	Greg Muiter	Sales	412-528-1711	greg.muiter@level3.com
Sunesys	Jason Katz	Sales	267-237-0316	Jkatz@sunesys.com
tw telecom	Krista Niederlitz	Sales	713-341-4106	Krista.niederlitz@twtelecom.com
Verizon	Marc Alciati	Sales	415-493-2200	malciati@intelletrace.com
Windstream	Jason Dishon	Sales	615-620-5205	jason.dishon@windstream.com
Zayo	Brian Sheehan	Sales	908-766-1080	Brian.sheehan@zayo.com

For additional carrier information or contacts, please call NEF at 877-DK-FIBER.

Disclaimer

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Quality & Integrity of Information

Because the information contained in this report and derived from the database is used to make decisions requiring significant capital investment, the accuracy of the information is critical. As such, NEF includes the following:

- Maps and data from nearly every alternative access carrier and data center provider updated quarterly or at least once per year
- Monthly updates to the lit building database
- Data resolution of the network assets or data center down to street level ...including lit building connectivity, interconnect points, and carrier POPs updated by the carriers themselves
- If applicable, budgetary estimates

Background & Expertise on NEF

For over a decade, NEF has delivered high capacity telecommunications and data center solutions ranging from concept/design to installation and upgrades – and everything in between. NEF offers a unique solution suite aimed at addressing client needs at any stage of the infrastructure lifecycle. The expert consultants at NEF can provide insights on network and colocation planning while the team of experienced brokers on the NEF team can research, compare and negotiate among hundreds of provider options to optimize clients' services and budgets.

Background & Expertise on NEF

While our legacy is in dark fiber, those custom private optical networks were just the start. In 2004, NEF began as a primary source for a Boston-area utility company's dark fiber network and quickly grew into the trusted resource for any high capacity optical fiber network or colocation solution. NEF has designed and deployed telecom networks for organizations ranging from enterprises, educational institutions, healthcare networks, global financial services firms, and even data center operators and carriers.

Deep experience and expertise in bandwidth intensive networks enables NEF to present connectivity and data center solutions that serve initial requirements as well as an organization's long-term best interests. We seek to understand what the needs and challenges are today and how communications needs might change in the future. NEF leverages the following:

- FiberLocator, the proprietary centralized searchable database of network assets, commercial buildings and data centers
- More than 100 combined years of telecommunications experience yielding an aggregated base of knowledge and relationships that simply cannot be obtained through traditional sources
- Both depth and breadth of knowledge accumulated from managing projects for hundreds of clients of various sizes, in differing industries, with project sizes ranging from small business local data center deployments to international enterprise network infrastructure
- Knowledge of the latest equipment and platforms to fit requirements and budget

Available Consulting Services

As enterprises demand more from their communications networks, NEF works as a trusted adviser to provide information and services to deliver performance and ROI. Whatever the goals of an organization, NEF understands the need for robust, scalable and affordable networks. This report's information provides insights and recommendations designed to do the following:

- Identify location options
- Address scalability requirements
- Optimize telecom budgets
- Maximize efficiency, including **low-latency options**

NEF utilizes its proprietary suite of database resources along with tribal knowledge and numerous industry relationships to add measured value to your search for connectivity. Having implemented thousands of network solutions over the past few decades, as well as helping organizations avoid costly builds in the wrong places, NEF leverages deep telecommunications experience to provide no-nonsense assessments and provider-neutral recommendations, including the following:

- Go/no-go recommendations on feasibility or availability
- Report on available providers
- Pricing for available providers (near-net and on-net)
- Online reviews of options/solutions in FiberLocator

By employing its knowledge, reach and carrier-neutrality, NEF has created a report designed specifically to help organizations avoid costly mistakes in buying the wrong network from the wrong provider. NEF works to ensure companies don't invest in a building without knowing its network capabilities first. NEF's deep and focused high cap and colo expertise, access to millions of fiber miles, and carrier-neutral mission enables trusted recommendations on the best, most feasible network solutions.