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Essentials of Fiber
## Network Planning

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To meet the needs of today's networking capabilities, more companies are turning to a fiber infrastructure. Fiber has a greater transmission speed than other connectivity options such as cable, ethernet, and copper. In addition, fiber has bandwidth capabilities up to 100 gigabytes per second (Gps), and private networks have the ability to reach up to 200 Gps—and these speeds don't take into consideration future technological developments that would allow for an even faster network. Unlike copper, fiber does not decrease speed as demand increases. Fiber is built off of dense wavelength division multiplexing (DWDM) and has the potential to carry up to 80 wavelengths or channels over a single fiber strand.

Enhanced security is another benefit of fiber networks. While fiber is not impossible to tap, in order to tap the line, it must first be cut, which will end all active network transmission. Unlike other connectivity methods, fiber is also not susceptible to electromagnetic interference and is not a fire hazard due to the lack of electricity running through the lines.

There are many other perks to constructing a fiber network, such as its flexibility. Additionally, fiber is more reliable than other forms of connectivity; fiber is stronger than copper, with fiber having 150 pounds (lb) of pulling force as opposed to copper's 25 lb of pulling force. Fiber is also 24%–40% lighter than copper and takes up 15% less space. The signal strength of fiber is unparalleled, with some studies showing that fiber only loses 3% of signal strength over 100 meters (m), whereas copper loses up to 94% of its signal strength.

Fiber exists as either single mode or multimode. Single-mode fiber strands are only designed to carry a single mode of light, transverse waves. Multimode fiber will carry in both directions. The operation of either type depends on the size of the fiber strands. Speed can be affected, with single-mode 1 gigabyte (GB) lines running approximately 100 kilometers (km) and multimode 1 GB lines running a maximum distance of 550 m.

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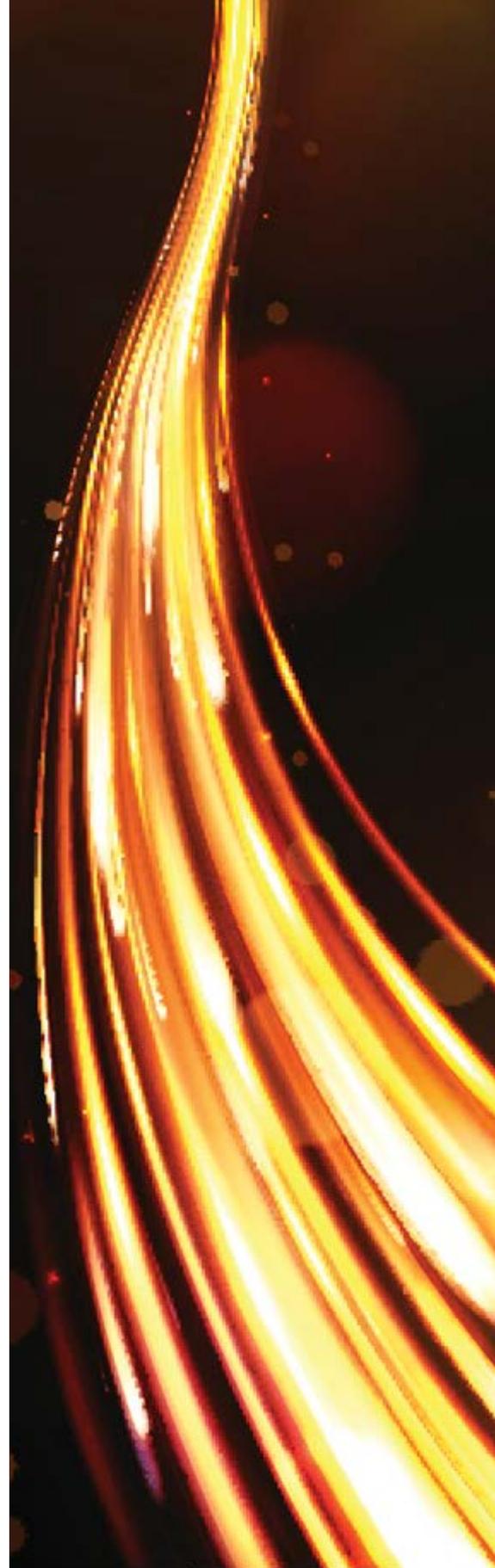
Considerations of Fiber

Of course, as with any potential solutions, there are some disadvantages that must be considered. Fiber networks require installation, which comes with costs and potential roadblocks. Fiber lines are also more difficult to splice than other types of lines and cannot be curved beyond a few centimeters, making it more difficult to install in certain areas and potentially more costly. There are also location considerations with fiber, as many carriers are only available in certain regions, and rural areas may not have any connectivity options, as fiber is not yet the industry standard and is still expanding.

Importance of Lit Buildings

Lit buildings are a necessity for 21st-century businesses. Lit buildings are buildings in which the primary infrastructure for fiber is already in place, and it is connected to an existing network by one or more carriers. Lit buildings allow for lower nonrecurring installation costs, as the networks are in place, so the charges are more likely only to reflect the setup of connecting an organization's network footprint into the existing infrastructure. Setting up a network in an existing lit building also allows for a faster start-up time than working with a nonlit building. Installing a new network in a lit building only takes 30–60 days on average, but only select carriers will be available.

There are two general definitions of nonlit buildings:

1   **The building has fiber installed but is not connected to an external network.**

2   **The building has fiber, but only dark fiber networks are available.**

Nonlit buildings come with higher installation costs. Much of these costs involve the carrier negotiating with the building to connect in a colocation area, and these costs are often passed along to the end user. If only dark fiber is available, it would result in

Costs Associated with Lit and Nonlit Buildings

	Lit Buildings	Nonlit Buildings
Start-Up Costs	Have primary infrastructure in place and connections to a carrier	Cost of purchasing equipment
Recurring Costs	Monthly lease charges	Lower monthly charges if utilizing own equipment
Other Cost Considerations	Inexpensive nonrecurring charges	Negotiations with building and fiber network owners for access and connections (known as access agreements)

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the end user creating its own network, which can be quite costly. Carrier availability may also be limited depending on your location—similar to lit buildings.

Building a Fiber Network

It is important to decide when setting up a network whether your organization would better benefit from installing fiber or leasing fiber. Ultimately, it comes down to preference of constructing fiber infrastructure via lit networks or dark networks.

Lit Networks

Lit networks have lower installation costs, as all components are in place. Because components are in place, it takes a much shorter time to connect an organization's footprint. Lit networks also provide support in the form of monitoring from the carrier, as the network is more than likely being used by multiple customers. Monitoring typically includes quality checks and ensuring there have not been any cable cuts that could result in service interruption. Working with a carrier on lit networks is beneficial, as well, as service-level agreements (SLAs) are widely available. These SLAs can be negotiated with the carrier and can guarantee your level of connectivity and quality, which is typically not available with dark fiber networks.

However, lit networks may also have drawbacks, depending on what you are looking to accomplish. There are geographic limitations for many carriers, so if an organization decides to relocate or open a new office, it may not be able to remain with the same provider. There is also a possibility there may not be any carriers available in a location, making a

move quite cumbersome. Furthermore, a carrier may be present in the area of interest but not connected to the specific building your organization chooses. Either way, negotiation with the carrier is necessary. Additionally, there are traditionally monthly fees associated with lit networks—similar to monthly fees involved when leasing ethernet networks. These fees may or may not include maintenance or other SLA-level agreements. Upgrading bandwidth and adding additional strands can be a long process, taking anywhere between 90 and 120 days. For this reason, it is best to discuss a carrier's ability to perform upgrades before signing a contract to ensure that expectations are set and met and that any potential upgrades needed are available through the carrier.

Dark Networks

Dark networks can come with one of two types of leases.

The first is a standard lease, which is not as common. Essentially, the end user leases a backbone network

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on a monthly basis, potentially through a long-term contract (5 years) and the opportunity for renewal. If leased from a carrier, it may offer monitoring to a certain extent, including for cable cuts—similar to the service acquired with lit networks. Tax and accounting departments typically view this as an expense.

The second type is a hybrid between a lease and a purchase, which is an agreement called Indefeasible Rights of Use (IRU). This is a permanent contract agreement that cannot be undone between the owners of a cable and the customer of the system. This lease typically has a term of 20 years, which is the average life span of fiber. Tax and accounting departments view IRUs as an asset rather than an expense. As a result, users do not pay a monthly fee, and 100% of the cost is typically paid upfront, though, at times, payment terms may be negotiable.

IRUs are essentially permanent agreements, so if anything happens to the carrier or the fiber itself, the end user still has access and the rights to use the fiber lines. These rights cannot be taken away through a bankruptcy proceeding, unlike when renting fiber via a standard lease. There is also the possibility of outright purchasing the fiber at the end of the IRU, which would need to be discussed with the carrier. It is important to know that there is little potential for an SLA with IRUs.

There are many benefits to establishing a dark network. Your organization has full control of the network, as you are acting in place of the carrier, and you can determine when you want to add additional bandwidth, speed, or other changes. Dark networks allow for faster implementation without negotiation, lower monthly costs, and reduced upgrade time and costs.

However, with every positive, there is likely a corresponding negative. Dark networks come with high implementation costs, especially when building a network through laying new fiber lines. Network design is quite complicated, as the planned connected building(s), the existing infrastructure in the neighborhood, the topography, and environmental considerations must be taken into account, such as railroads and waterways. Many of the tasks associated with implementation can be outsourced to other companies or consulting firms; these tasks include construction of the network, the purchase and installation of the network equipment, and the acquisition of fiber, provided you opt to lay your own fiber lines.

Connecting dark fiber to an unlit building comes with its own set of considerations, such as where the colocation point or points should be, especially in the case of planning for a backup network. Regulatory licensing is also imperative, as is installing backbones. Many agencies and laws may come into play. Planning for future growth is considerably more important when constructing a new network, with acquisition of fiber at play. Power costs can also be high, as your organization will be "lighting" the network, which will need to be available 24/7, and backup power such as a generator would be a necessity.

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Choose the Network for Your Needs

With every consideration, it can be tough to determine whether you should implement a lit network or a dark network.

Here are some tips to help you make the decision.

If you need your network up and running quickly, try a lit network, as dark networks take longer to install, and lit networks are already in place. Lit buildings also have lower power requirements, as the network is powered by the carrier, so the end user is only paying for what is necessary to its operation. With dark networks, the end user ultimately becomes the carrier and will be responsible for all power and operating costs, as well as any associated logistical concerns.

Execute a Fiber Network

When setting up a fiber network, there are multiple major considerations to be made.

+ Usage decisions—What bandwidth and speeds are needed to meet business objectives?

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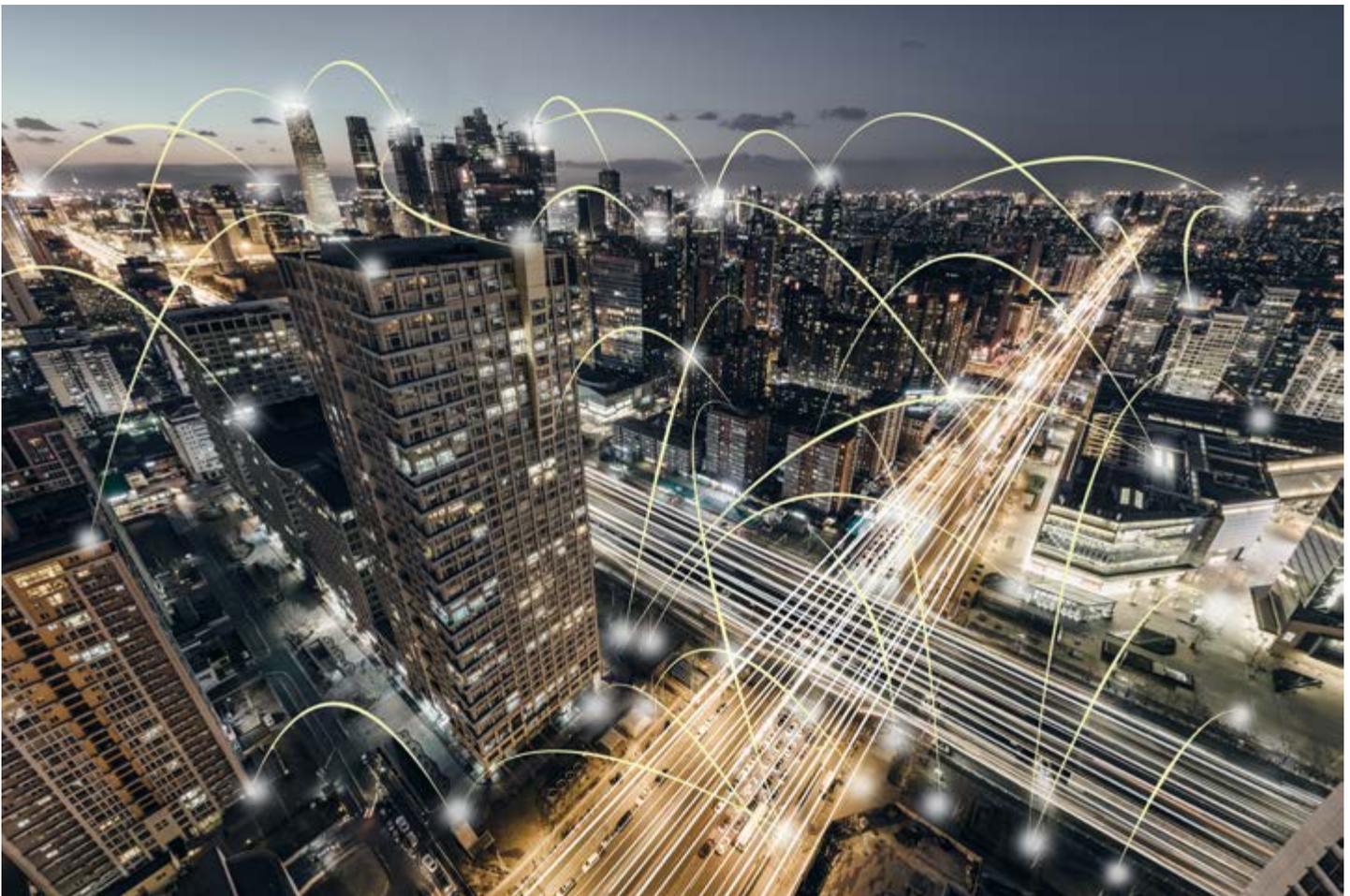
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- **Amount of control**—Do you want a carrier network that allows for monitoring? Do you want to do everything on your own in a dark network environment?

- **Time constraints**—How quickly do you need the network up and running?

- **Cost**—Would you prefer a recurring monthly cost from joining a lit network? Or would you prefer a larger onetime, upfront cost from establishing a dark network?

- **Building availability**—Is the building already lit? If not, would you be willing to work with the carrier and the building owner (if applicable) to determine the colocation point and how to make the connection?

- **Location**—Where are you currently located? Where do you want to be located? What fiber options are available in these locations? Are multiple carriers available?

- **Long-term organizational goals**—How large should this network be? How much growth is anticipated?

After these questions are answered by your organization, it is time to find fiber and establish the network.

Finding Fiber

Now that you know more about the different types of fiber networks and the considerations you must take into account when developing a network, the last question you need to answer is: How do you start building a network?

Finding fiber connections in a desired location is critical, and that starts with determining which carriers have laid fiber lines or have connectivity presence in the area. Sourcing telecommunications information can be an arduous task, as there are many ways to research and build a database. Some methods include:

- Calling carriers and collecting data from individual carriers, building out internal lists of lit buildings and fiber maps;

- Performing Internet searches and looking for fiber types, with success not guaranteed;

- Reviewing government data when available;

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+ Relying on agents or third parties for information; and

+ Conducting field surveys by going to specific locations and determining which carriers are connected to the building(s) under consideration.

While these methods may result in a somewhat comprehensive set of information, performing just one, let alone all, of these actions can be time-consuming. Additionally, your organization would be responsible for maintaining the internal data, which becomes cumbersome, particularly when working with an ever-changing document populated by multiple carriers.

The time spent on research alone can significantly impact development and implementation time. Invest in a telecommunications solution to streamline your telecom research so you can spend more time focused on your business.

FiberLocator is a leading telecommunications and colocation database. Subscribers can trust that our team works directly with over 300 carriers to obtain their data, ensuring information integrity and that data within FiberLocator are accurate and current*

+ Over 400 Fiber Map Layers

+ Over 6,000 Data Center Listings

+ 1.6 Million+ Unique Lit Building Address Records

Choose the solution that works best for your business needs.

Solution	Best For ...
FiberLocator Online	When continuous access to data is critical, as is the ability to view multiple data points for multiple locations in one convenient online platform
FiberLocator Snapshots	Customized onetime views of fiber and connectivity presence in a single location; great for onetime projects or early-stage planning
FiberLocator API	Organizations with their own geographic information system (GIS), with need to view comprehensive updated data in their own platform

Implement the fiber network solutions that are right for your business today.