



ETHERNET V. DARK FIBER

# THE DARK SIDE OF DARK FIBER

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## ABSTRACT

*There are several ways to provide network access outside business premises, including Finished Ethernet, dark fiber, and even wavelength services. For most circumstances, the best choice is Ethernet, but it is important to consider other methods of networking, especially if your company has highly specialized requirements.*

Companies today face a seemingly bewildering array of data networking choices. While the protocol wars of the last century have now been settled by a solid win for Ethernet, longer distance networking is another matter.

Ethernet meets most campus and metropolitan area networking requirements, but other solutions are also available, including dark fiber and wavelength services. Dark fiber installations exist in most urban and metropolitan areas, and may be purchased from the companies that installed it, or from companies that manage and market dark fiber.

While the initial cost of purchasing access to dark fiber may seem attractive, it's not the best solution to all networking needs. In fact, the total cost of acquiring and operating a network that takes advantage of dark fiber may be far higher than Ethernet or another means of networking over a distance. As with everything else in information technology, the best decision for your company depends on what you need to accomplish, and on how much money that you're willing to spend.

## WHAT IS DARK FIBER?

Technically, dark fiber is optical fiber that's not active. Most commonly it refers to optical fiber cables that were installed in urban or suburban areas in the hope that a demand would arise, allowing the company that owns the fiber to sell access. In some cases, the term may refer to fiber that was installed, used, and then abandoned; it may also refer to fiber that exists within a building or campus, but isn't currently being used.

Dark fiber is a point-to-point solution. In addition, dark fiber is only available where the company installing it decided to put it, or in some cases only where they could get permission to lay the fiber cable. Dark fiber is not available everywhere, and a terminus for the dark fiber may not be available near you.

## THE CASE FOR DARK FIBER

Dark fiber excels at providing extremely low-latency solutions with little added overhead. This makes it ideal for data center mirroring, for example, where primary considerations might include extremely low latency with very high throughput, where no network protocol is desired, and distances are relatively short. Dark fiber also works well in situations that require either specialized network protocols or a wide variety of network protocols.

Dark fiber also excels in situations where the fiber can be connected directly to the network router with no extra equipment, such as in a campus environment where connectivity between adjacent buildings or nearby data centers is necessary. In these circumstances, dark fiber may be able simply to be terminated and attached to the building router.

## THE CASE AGAINST DARK FIBER

Dark fiber installations exist in a variety of locations, and they can cover widely varying distances. While local and metropolitan dark fiber is the most common, especially in large metropolitan areas, dark fiber sometimes can run much longer distances. In fact, dark fiber is available on undersea cables and can cover transcontinental distances. However, long distances require amplifiers, and amplifiers require maintenance. "Maintenance" potentially translates to more dollars.

Likewise, when dark fiber crosses long distances, it's also exposed to a greater chance of accidental damage. Those stories you hear about a construction backhoe cutting a fiber-optic cable are true; and if it happens to be your data connection, your downtime could be lengthy. Worse, repairs likely depend on the third-party cable owners, unless you have a second, diverse, dark fiber installation that's available for backup.

Dark fiber also requires maintenance and management of the network equipment at each end when you take it over and light it up. Some dark fiber providers offer this service. They may also make available service-level agreements and even diverse routing. But those features and services cost money and aren't optional purchases.

## ALTERNATIVES TO DARK FIBER

One of the more useful alternatives to buying dark fiber facilities and then trying to manage them is to use a more advanced service such as Finished Ethernet. This is a service that's provided by a communications company such as a cable provider, and it provides Ethernet services from nearly any location point to any other. Equally important, Ethernet is not necessarily a point-to-point installation.

Ethernet services move to a backbone design with central and edge switching, so that an Ethernet customer can effectively have any number of remote endpoints. While the physical network may have shared switch locations, logically it's a single network. This means that your company has its own pathway to central locations, and discrete pathways to remote locations. Your organization does not see any other user's network presence.

The network carrier can provide alternate routing to remote locations. If the dreaded backhoe affects your network at all, it will affect it only briefly. Under normal circumstances, the network routes around damage automatically. If not, your carrier should have a service level agreement (SLA) as part of your contract to motivate them to restore communications quickly.

Maintenance for Ethernet systems is normally handled by the carrier once the communications infrastructure is off of your property. The carrier is responsible for maintaining and configuring infrastructure equipment. Your responsibility ends at the point where the Ethernet service connects with your building router.

Because the Ethernet appears to be part of your existing internal network, many network management systems can manage at least part of the Finished Ethernet service. While the carrier's routers and infrastructure equipment remain managed by their own hardware and personnel, it is possible to manage some aspects with existing management systems.

## WAVELENGTH SERVICES

An option that's frequently marketed as being similar to dark fiber is wavelength services. With this option you buy a specific wavelength on an existing fiber. In effect, your data uses lasers of a specific color, sharing the same fiber with other traffic. Your traffic is received according to its specific color or wavelength. This method of fiber multiplexing can be less expensive than the total cost of a dedicated section of dark fiber, but there are limitations.

Wavelength services can typically only handle a limited bandwidth, and they're a point-to-point solution like dark fiber. On the other hand, wavelength services

## MAKING THE NETWORK DECISION

The fact is that every company's networking needs are different. Because of this, there's no single solution for networking beyond the borders of the building. In fact, some companies may need more than one solution because of their diverse needs.

- Standard office communications, even among distant locations, usually require an Ethernet connection. This allows you to use existing networking infrastructure and security solutions without having to add personnel skills or additional hardware.
- Most storage traffic, including iSCSI communications with storage area networks, will (or at least can) work with Ethernet, which helps control costs and retains flexibility.
- A virtualized computing environment requires Ethernet under normal circumstances. While virtualized drivers for other protocols and adapters may exist, Ethernet is the default for every virtualized environment and operating system.
- A campus networking environment nearly always requires Ethernet, except in specialized applications where very high bandwidth and low latency are required.
- Some specialized applications, such as data center mirroring or storage mirroring, require very high bandwidth, coupled with very low latency. These can only be achieved with a direct fiber connection, which can include dark fiber and may include wavelength services. Normally these applications are distance limited due to propagation delays.
- Long distance communications, such as undersea or transcontinental links, require alternatives to Ethernet between metropolitan areas. However, they can be provided by the network service provider and likely are transparent to the end user.
- Dark fiber and wavelength services require the acquisition of geographically diverse network paths to avoid a single point of failure if the fiber cable is damaged. Ethernet services may provide redundancy as part of the package.

vendors normally handle the network maintenance, and they may provide network management, and a variety of commonly used protocols, including Ethernet. Normally the wavelength services provider provides the connectivity from the user's premises to the endpoints, but expect additional charges that usually depend on distance. However, depending on the contract details and the circumstances, damage to the optical fiber may not be restored quickly, so the backhoe threat may be a significant issue.

Under normal circumstances, wavelength services vendors can provide access equipment as part of their package, but the equipment may be provided at extra cost. Likewise, while the basic network management of the wavelength service itself is normally part of the package, more complete network management is usually available for a fee. However, you may be able to incorporate existing network management systems into at least part of the wavelength solution, as you can with Ethernet services.

## REASONS TO USE ETHERNET

For the vast majority of business users, the best choice for day-to-day network access is Ethernet. For companies with multiple locations, Metropolitan Ethernet is the best option as it uses a network provider with access to the required infrastructure and facilities.

Metro Ethernet can be delivered to nearly any business location. Normally the implementation includes a fiber-based "last mile" solution, in which the physical access to the Metro Ethernet is brought to the customer site. Customers then access the network using their existing routers and other network equipment.

The advantage to using Ethernet for metropolitan and campus networking is both in the relatively low cost for the total solution, and the transparency. While access to dark fiber and to wavelength services looks inexpensive, by the time the total cost is considered, including the cost of service and support, Ethernet is often less expensive. In addition, by using an Ethernet provider, customers don't need to provide network support staff and networking infrastructure equipment that would be required with dark fiber or similar services.

Ethernet is also transparent to your users and to your network management solution. When your entire network is connected via Ethernet, the fact that there's a third-party network provider in the mix won't be visible to users or to network managers. Likewise your security solutions are more likely to be fully functional across the entire network.

The use of a network provider of finished Ethernet services also adds to the reliability of your entire network. The

provider can deliver diverse pathways, a SLA that ensures quick restoration of any network downtime, and a full-time network management staff to solve problems before they bring down the network.

## ETHERNET LIMITATIONS

Ethernet bandwidth is not unlimited. In addition, virtually all Ethernet services are contained within a metropolitan area, or in a few cases among nearby metropolitan areas where sufficient demand exists. This means that you won't find an existing Ethernet connection between New York and Seattle, for example. However, such Ethernet connections do exist in closely linked metropolitan areas such as Washington and Baltimore.

Currently, Ethernet bandwidth tops out at 100 gigabits per second, and implementations with that much bandwidth are extremely limited. More commonly, Ethernet bandwidth is limited to 10 or 40 gigabits per second using existing technology. 10 gigabit availability is ubiquitous, while the availability of 40 gigabit Ethernet is growing rapidly.

While long distance Ethernet communication is possible, latency issues restrict usefulness. Ethernet communications are mainly kept within a metropolitan area, and the traffic is offloaded to a specialized long-distance network for long distance transmission.

## CONCLUSION

While dark fiber may appear to be an inexpensive means of connecting a data network between two points, for most users it's a false economy. The dark fiber itself is simply a physical asset. To be useful, it must be equipped with endpoint hardware, there must be staff to manage it, and implementation requires additional hardware at both ends.

Dark fiber must also be available at the customer's location, or additional network infrastructure needs to be acquired. However, there are specific situations where a direct fiber link (dark or otherwise) is the only solution, especially for applications such as data center mirroring.

For the vast majority of networking needs, the preferred solution is Ethernet, which normally does not require additional infrastructure or the hiring of additional staff. IT departments are already familiar with Ethernet, and the addition of Metro Ethernet requires little if any retraining.

Under normal circumstances, networking beyond the confines of a single building requires a Metro Ethernet, and normally is operated by a networking provider. The networking provider has the management, the staff, and the redundancy to bring reliable operations with adequate bandwidth to satisfy the needs of nearly any company.