Maximum freedom at the speed of light

Managed Dark Fiber: The unlit diamond

eurofiber

Table of Contents

Looking for stable and reliable connectivity?

Are you responsible for IT and do you use an external datacenter for your software applications or data storage? Are you plagued by network failures or delays? In this e-book, you can read about all the advantages of Managed Dark Fiber, such as lower latency, higher availability and increased reliability.

Connections that organizations can rely on

ICT changes the world. Organizations work in the cloud and increasingly use smart technology. That requires high-quality connections with high bandwidths that can scale up or down in response to shifting needs – connections that organizations can rely on in terms of speed, stability, scalability, security and options.

Flexibility: now and in the future

Enjoy the benefits of a flexible infrastructure that allows you to respond to all developments, now and in the future. Running your business-critical IT systems at multiple locations makes it possible for you to safeguard the continuity of your organization. By doing so, you ensure that your employees and other users will be able to continue to work uninterrupted, even in the event of system failure at one of your locations.

Freedom to choose services and suppliers

Managed Dark Fiber provides the right solution for demanding applications. It offers you complete freedom to choose which services and service providers you use. You can use it to design the optimal configuration for your ICT environment.

About this e-book

This e-book explains why Managed Dark Fiber might be the most suitable solution for your connectivity needs, and what aspects are particularly relevant when choosing a dark fiber provider. It presents several case studies involving organizations from the healthcare, education and government sectors for which Eurofiber provided Managed Dark Fiber solutions. At the end of the e-book, you can find technical specifications and a glossary of the terminology used in this e-book.

Management summary

Managed Dark Fiber is the best choice when connectivity is business-critical for your primary IT process and needs to be operational at all times. Managed Dark Fiber has great relevancy when it comes to connections that are used to send massive amounts of data within a short time frame and the speed at which this data can be transferred. The availability and bandwidth on these connections is of crucial importance as well as flexibility and scalability. The major benefit of Managed Dark Fiber is that you can configure your connectivity completely according to your preferences – and easily expand and scale up the solution as needed.

Lighting

When you decide to choose Managed Dark Fiber, you will need to arrange the lighting yourself. You will get your own fiberoptic connection up to the entry point to your location. Bigger IT departments usually have people on staff who know how to light a fiberoptic connection. If that expertise is not available in your organization, then Eurofiber can advise you on choosing the right lighting equipment or suitable network integrator. Eurofiber will guarantee the physical availability of your fiberoptic connection. If the connection is damaged, of course you'll want to have it repaired in the shortest time possible. That reliable repair service is why Eurofiber refers to this service as Managed Dark Fiber. When choosing a provider, we advise you to compare maximum repair times for various suppliers.

Managed Dark Fiber is perfect for:

- Organizations that want to arrange their own lighting
- Organizations that have physically separate datacenter locations
- Comprehensive schools with multiple branch locations
- Alliances of healthcare institutions and hospitals with multiple locations
- Collaborative or merged municipal authorities
- Smart energy grids and water networks
- Networks for camera surveillance and traffic control systems

Benefits of Eurofiber Managed Dark Fiber:

- Suitable for high-bandwidth applications
- High availability
- Reliability
- Secure underground network
- High-quality network
- Multi-purpose applications
- Suitable for all bandwidths, for instance 10Gb/s
- Future-proof up to 100 Gb/s and in conjunction with WDM
- Highly scalable
- Dedicated 'private' network with fast repair times

Bandwidth for business data traffic continues to increase

Digital transformation may seem like a trendy concept. But anyone who's paying attention can see how government authorities and other organizations are already reaping the benefits of digital technology. Consider the introduction of digital learning and testing methods in education. Or domotics that provide remote care for the elderly this way increasing the safety and longevity of independent living. Around the globe, countless metropolises are launching smart city projects to create increasingly livable and sustainable urban environments. Digital transformation is today's reality.

Broadband technology as a catalyst

The most important catalyst for digital transformation is the availability of broadband technology. According to Statistics Netherlands, huge strides forward have been made in this area in the past five years. In 2017, 68% of organizations with ten or more employees had a capacity of 30 Mb/s or higher. That figure was only 36% in 2012. In the last year alone, more than 25% of organizations have started working with bandwidths over 100 Mb/s

31 billion connected devices

Whilst organizations might still be managing fine with their available capacity right now, one thing is crystal clear: the demand for capacity will increase rapidly across all sectors in the next few years. One key reason for that trend is the Internet of Things (IoT). Projections indicate that an impressive 31 billion devices around the globe will be connected to the internet in 2020. These devices collect data and send it to the cloud over the internet.

Fast network

All of these trends have resulted in a growing need for a strong foundation in the form of a solid network. Fiberoptic technology plays a crucial role here. The current maximum internet speed possible for fiberoptics is already incredibly high. That speed will increase dramatically in the future – and it will have to, if we want to tap into the full potential of digitalization in the future. We refer to a fast network when large volumes of data can be transferred in a short time, or when the delay on a connection is minimal (low latency), ensuring that data can be transported within a short time frame.

Reliable network

In addition to a fast network, it is also key to have a reliable network to encourage and facilitate organizations in their digitalization efforts. Particularly in critical environments such as hospitals or universities, the primary process will immediately grind to a halt if the network fails. And it's not just those key institutions; small and mid-sized enterprises, industrial companies, government authorities and the fintech sector also rely heavily on constant availability based on a reliable network. To that end, network providers build in redundancy, and organizations often purchase dual connections so they can immediately switch from one connection to another in case of calamity. One of the characteristics of a high-quality network is that it only comes above ground at a customer location and it does not have any connection points or patches in between. After all, chances of failure are minimized when cables are installed underground.

Managed Dark Fiber compared to other fiberoptic solutions like WDM and Ethernet

Managed Dark Fiber

Managed Dark Fiber or unlit fiberoptic connection is a connection that you light yourself with your own equipment and employees. You have complete control of what you will do with the connection and which applications you run through it. Bandwidth is determined by the equipment you use and you can change the bandwidth constantly according to your needs. In other words, you have maximum flexibility at your fingertips. Managed Dark Fiber makes it possible to achieve low latency, which makes the connection ideal for real-time applications. Since Managed Dark Fiber gives you a dedicated fiberoptic connection which is completely underground, you also achieve maximum security on the connection. When you lease a redundant Managed Dark Fiber connection, you also have the security of a connection with maximum uptime. In terms of technology and pricing, Managed Dark Fiber is particularly suitable for connecting many locations across shorter distances by means of a ring network or cascade network.

WDM (Wavelength Division Multiplexing)

A WDM connection is a static route based on a fiberoptic connection which is already lit by Eurofiber. WDM makes it possible to achieve bandwidths as high as 100 Gb/s. That makes a WDM connection perfect for organizations that have a need for high capacity connections. The latency (network delay) of this connection is considered one of the lowest latencies achievable in the market, which makes the connection highly suitable for real-time interfacing. Like Managed Dark Fiber, WDM comes with an underground, dedicated connection, which also provides optimum guarantees for your security. WDM is perfect for connecting IT environments (server and storage solutions) in Twin Data Centers and for secure access to the cloud. From a configuration perspective, WDM is similar to Managed Dark Fiber, involving point-to-point networks, ring networks and cascade networks. The primary distinction is that WDM it can be used across larger geographical distances.

Ethernet

An Ethernet connection gives you an active, lit connection by Eurofiber with a predetermined bandwidth. This bandwidth is provided from 100 Mb/s up to 10 Gb/s, which makes this type of connectivity appealing for many smaller organizations. An Ethernet connection is priced regardless of distance, which makes it perfect for longer distances, star networks and point-to-point connections. The active Ethernet network can route traffic across the entire Eurofiber network, achieving higher uptime. With an Ethernet connection, you can also gain secure access to providers of such services as VOIP and/or specific cloud solutions.

Which type of connectivity will ultimately be most suitable for your organization depends on your specific needs. Many factors influence this decision. A connectivity provider can give you advice tailored to your situation and needs.

What is Managed Dark Fiber?

A Managed Dark Fiber connection gives you a fiberoptic connection consisting of two fibers that you light yourself with your own equipment. The bandwidth of the connection is virtually unlimited; you define your available bandwidth based on which equipment you choose to deploy. You lease the Managed Dark Fiber connection based on the distance that is bridged between your locations. Managed Dark Fiber could be compared to an extended patch cable between your locations.

Light it yourself

In terms of the Open Systems Interconnection (OSI) model: with Managed Dark Fiber, you only purchase the bottom layer that connects locations each other. If you prefer, a provider can also provide lighting based on WDM, Ethernet and IP services. A network provider can also arrange internet access. The end point of the connection (demarcation point) as delivered to your location will be installed on an optic patch panel, via two optical connectors. From that point, you can configure everything entirely as you see fit. With Managed Dark Fiber, you take care of the lighting yourself.

OSI Model	Medium	Format
Layer 4 - 7	Software	Data
Layer 3	IP	Packets
Layer 2	Ethernet	Frames
Layer 1	Wavelength Division Multiplexing	Bits
Layer 0	Managed Dark Fiber	Light

Figure 1: Open Systems Interconnection (OSI) model

Managed network services and maintenance

With Managed Dark Fiber, the provider provides managed network services and handles the maintenance of the fiberoptic connection. Additionally, your Managed Dark Fiber network will be registered with the Cable and Pipeline Information Center (KLIC) of Kadaster, the Dutch Land Registry Office. For instance, when a municipality builds a roundabout, they will report the digging activities to KLIC beforehand. This report reveals there is a fiberoptic connection at that location which might need to be moved. The network provider will move the fiberoptic connection if requested by the municipality. Absolutely no hassle for you at all. More importantly, this registration will prevent any damage to the cable during the excavations.

Which network configurations are possible with Managed Dark Fiber?

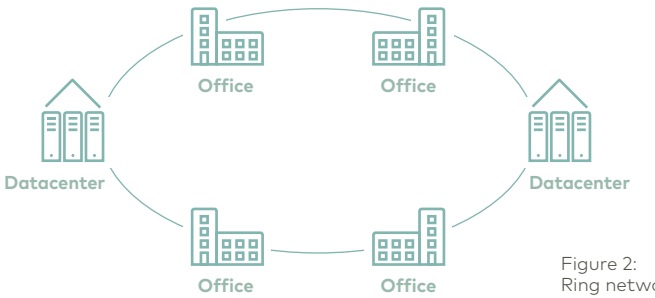


Figure 2:
Ring network

Ring network

In a ring network, the locations are threaded into a connection like beads on a string. Since the final result is ring-shaped, two-way communication is possible. That creates a structure that is intrinsically redundant. If there is a failure somewhere in the ring, it is still possible to communicate to all locations in the ring by sending data in the other direction. As a result, a ring network achieves constant availability.

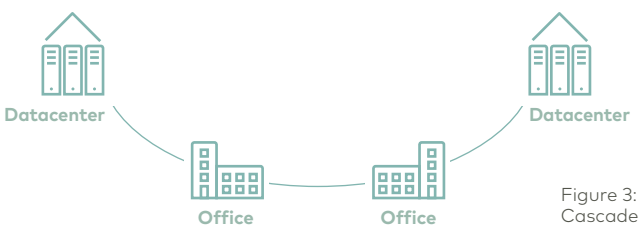


Figure 3:
Cascade network

Cascade network

A cascade network is suitable to connect a series of objects in sequence. It is more or less U-shaped, i.e. an open ring network. Since the connection is not closed, it will be more efficient in the length of the connection as well as in costs.

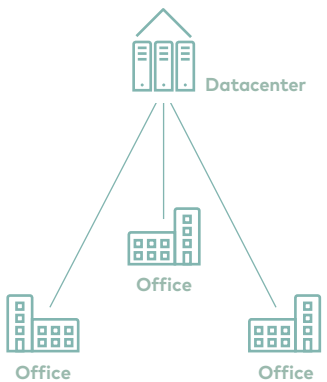


Figure 4:
Star network

Star network

A star network consists of point-to-point connections. Each location or object is separately connected to a single central point. This type of connection is generally used to connect locations that are geographically dispersed. Since this involves covering more connections over longer distances, this type of network is more expensive.

What aspects are relevant in choosing Managed Dark Fiber?

More and more organizations are using Managed Dark Fiber. This trend is not surprising considering the global digital transformation that is taking place which requires connections that provide increasingly higher bandwidths. What do you need to focus on when you are considering Managed Dark Fiber? We have listed all the relevant aspects for you.

Bandwidth

With Managed Dark Fiber, you have complete control of your bandwidth and can easily scale it up depending on your preferences and needs. The quality of the connection is determined largely by the quality and properties of the fiber and the way the connection is established. Because the fiberoptic connection is installed completely underground and connected to a national network by means of fusion splicing, it is possible to design short, efficient routes in many cases. As an added benefit, you can also use equipment with less expensive optic interfaces in some such cases. After all, the shorter the route, the less attenuation on the connection.

The way in which fiberoptic cables are connected end-to-end is certainly a key consideration in choosing a provider, as there are market parties that connect fibers by adding connectors (patching) in above-ground installations. The downside of above-ground installations and patching is that the connection quality is affected by attenuation. Additionally, the susceptibility to network failure increases due to pollution and human error. Bandwidth is determined by which transmission technology is used and by the type of equipment. For instance, if you connect a 10 Gb/s Ethernet switch, the hardware will determine the maximum speed. If you also use a CWDM filter, you could e.g. use 8 x 10 Gb/s on the same fiber.

Low latency for synchronous replication

In case of an underground fiberoptic network, it is possible to design a short route, resulting in lower latency in the connection. Fiberoptics will then make it possible to exchange data in real time. Consider two datacenters that need to be completely synchronized (identical data at both locations) in case one of them fails. To have identical information at two places at the same time requires an extremely low latency of maximum 5 milliseconds round trip (there and back again). With Eurofiber's Managed Dark Fiber, such extremely low latency can generally be achieved by establishing short routes. By combining Managed Dark Fiber with WDM (Wavelength Division Multiplexing), the capacity of a Managed Dark Fiber connection can easily be increased to as high as 100 Gb/s (or a multiple thereof).

Amplification of signal transmission

Unless you take certain steps to optimize your connection, the possibilities of fiberoptics are sadly not unlimited, despite the extremely low attenuation per kilometer. For instance, there is a direct correlation between cable length and bandwidth, which is referred to as dispersion. This pulse distortion occurs due to the properties of the fiberoptic cable (chromatic dispersion), while imperfections in the fiber itself can cause random imperfections and asymmetries, known as polarization mode dispersion. If these considerations are not taken into account in the design when bridging long distances and extremely high bandwidths – over 40 km distance and 10 Gb/s bandwidth – this could lead to a situation in which pulses can no longer be distinguished from each other by the receivers. It is very important that a CD and PMD measurement is conducted during the delivery of connections extending beyond 40 km.

Scalability and flexibility

One of the many benefits of Managed Dark Fiber is that it is scalable. You can even change your bandwidth during the term of the contract. Managed Dark Fiber gives you maximum flexibility at your fingertips. If you decide to connect your locations in a Dark Fiber Ring, it is easy to add locations or splice out sites if they are relocated or sold off. In case of a relocation, it is also possible to move your Managed Dark Fiber connection to your new location(s). In such situations, a new Managed Dark Fiber is often constructed, parallel to the existing Managed Dark Fiber connection before splicing out the relocated sites. This ensures that you can move your IT environment without any risk of interruption of service.

Security

It is safest to build fiberoptic connections underground at a depth of 60 centimeters in high-quality conduits (ducts). At places where fiberoptic connections need to be spliced, it is best to do that in underground hand-holes with watertight enclosures, preferably below ground level. The connection only emerges above ground at the locations that you want to connect to each other. That will ensure maximum protection for your connection. Fiberoptic connections of providers that use traditional aboveground patch panels are easier to access and therefore more vulnerable to damage. A nearly 100% secure connection is also equipped with data encryption.

Figure 5
Cross-section of a hand-hole for fiberoptics (with splice box)

Reliable redundancy

The need for a physically separated infrastructure (two geographically separate fiber pairs/routes) is often underestimated. Many organizations assume, often wrongly, that using two different infrastructure providers will automatically lead to redundancy. The major benefit of a redundant connection is that when there is a failure on the connection, it automatically switches to the redundant connection (failover). What is sometimes overlooked is that those providers' connections might actually be in the same trench or could intersect at some point along the route. That will only increase the likelihood that both connections will be damaged by excavations or disasters; this risk is mitigated if the infrastructures are actually completely physically separate from each other. There is also the risk that those two different providers will schedule maintenance at the same time, making both connections temporarily unavailable. When choosing a provider, it is advisable to pay close attention how the companies you're considering have arranged this. Are all processes and procedures in the 'planned work process' designed to ensure that, in case of a customer with fully separated connections, the provider never works on both connections at the same time?

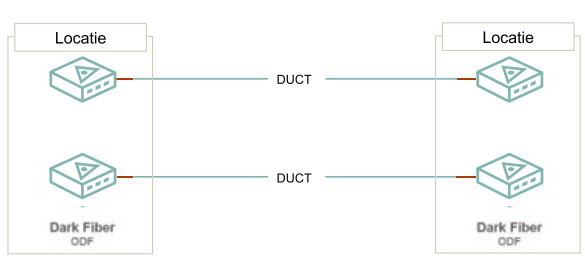
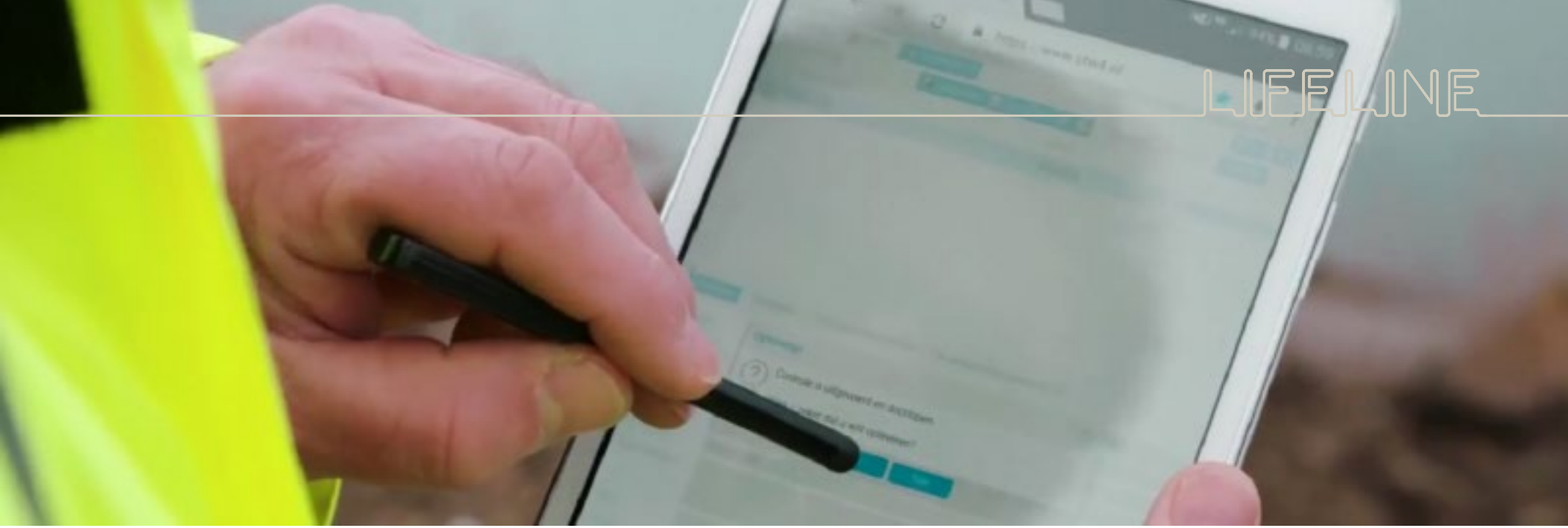


Figure 6
Dual route: redundant fiberoptic connections, geographically separated



100% verifiable quality

It is important that you have a 100% guarantee that the cables are actually fully separate from each other. If your fiberoptic provider uses the Cocon digital fiberoptic registration system provided by Speer IT in conjunction with Google Earth, you can see for yourself that the routes never come close to each other. During maintenance activities, the technicians will log in on site using a tablet equipped with a real-time data feed. On site, they check the data for the planned work. After finishing their work, they immediately report the new situation, which concludes the assignment. It is an advantage if your provider has been entirely responsible for construction and central registration of a network which is 100% theirs, and preferably has been from the outset. Anyone that wants to dig in the ground needs to submit an excavation notice (KLIC notification) to the Dutch Land Registry Office. This notice ensures that everyone who wants to start digging in the ground will know the exact locations of cables and pipelines, thus preventing excavation damage. When the registration of the entire network is fully digitized, people can take proactive steps based on comprehensive data.

Preventive maintenance and quick repair times

A Network Monitor Center can proactively monitor the fiberoptic network 24/7. If the Cocon digital fiberoptic system is used, failures are quickly resolved and preventive maintenance can be performed. If a network failure occurs, a provider that works with Cocon will know where the break is located and can pinpoint where to start digging in the ground. When choosing a provider, we advise you to compare maximum repair times for various organizations. Keep in mind that it makes quite a difference how many fiberoptic cables are in a conduit. The more fiberoptics per conduit, the longer the repair time and the longer it takes to resolve a network failure. Repair times for Managed Dark Fiber connections in the market can be up to 8 hours.

Figure 7
Cross-section of a fiberoptics conduit (duct)

Curious to hear more about what we could achieve for your organization?

Eurofiber has been a fast-growing international provider of industry-leading digital infrastructure since 2000. Relying on our own fiber optic network and data centers, we provide smart, open, future-proof infrastructure to companies, government bodies and non-profit organizations. Customers have complete freedom to choose the services, applications and providers they need, allowing them to tap into the full potential of digital innovation. Eurofiber has an extensive fiber optic network in the Netherlands and Belgium, it unlocks its four data centers of its own and almost all public data centers in the Benelux.

This is a Lifeline eBook brought to you by Eurofiber. The Lifeline platform offers information and inspiration in the field of digital connectivity. Eurofiber.be/lifeline.

Eurofiber. Lifeline for the digital society

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