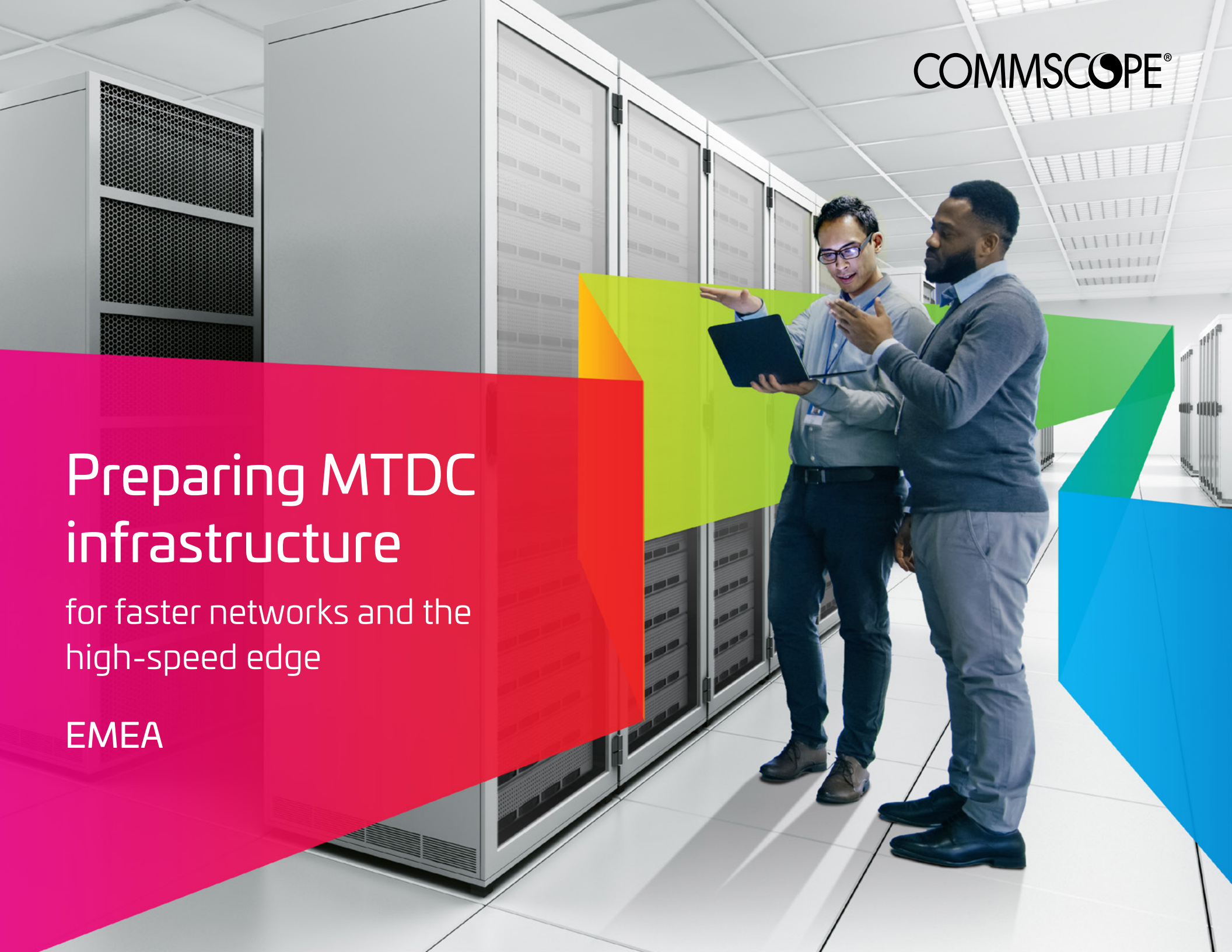


COMMSCOPE®

Preparing MTDC infrastructure

for faster networks and the high-speed edge

EMEA

An edge-first distributed computing paradigm is needed to service huge volumes of data.

As networks ramp up support for 5G, cloud and the internet of things (IoT), computing that had been focused on centralized data centers (DCs) is now adding an edge-first distributed computing paradigm.

A growing number of distributed applications and micro-services are being deployed in edge locations to service huge volumes of data that are generated at the edge. Local computing that offers higher bandwidth, lower latency and availability at the network's edge is growing with this rising tide.

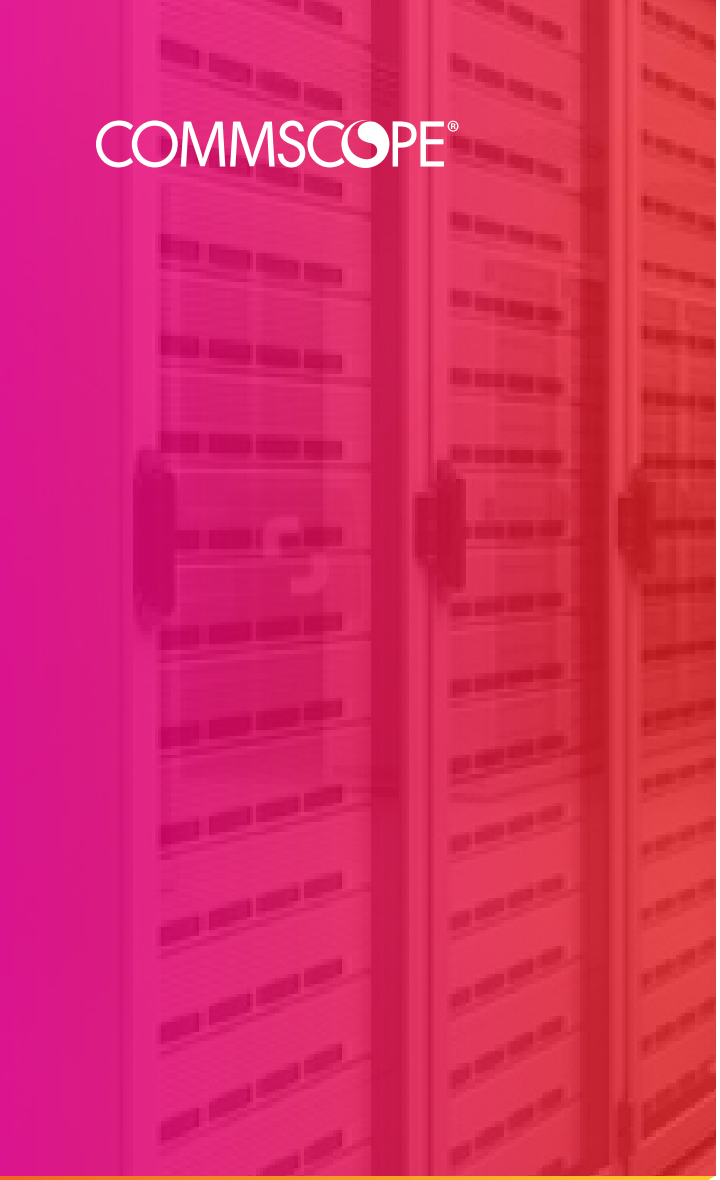
Co-Location DCs (Co-Lo's) or multi-tenant DCs (MTDCs) are well equipped to support customers' need to host the compute layers closer to the data sources in urban areas—offering high-quality white space, networking equipment, and cross-connections to differ-ent cloud and service providers. IT organizations take advantage of the efficient, low-cost and low-risk option of renting space—from a server rack to a complete purpose-built module—to host and process data and to easily scale IT capacity based on business needs **without the high capital expenditure** and the lengthy period required to build new private DC facilities.

This e-book outlines:

Trends in the EMEA region that are driving an increasing preference for MTDCs versus building from scratch—and trends driving demand for MTDCs

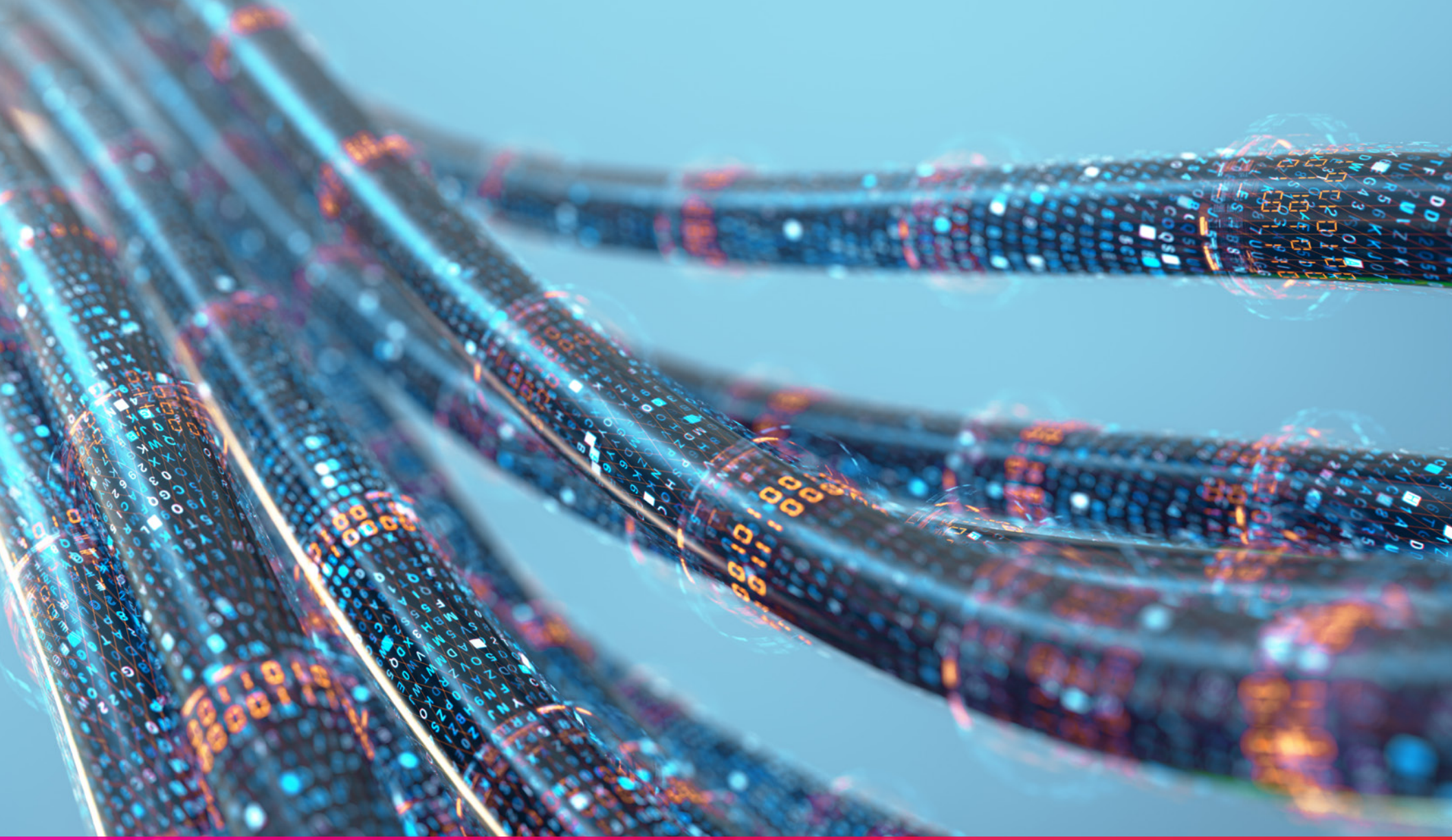
Smart approaches that help MTDC operators adapt and scale infrastructure efficiently to meet diverse customer requirements in dynamic cloud and edge environments

How MTDC operators can accelerate time to revenue and boost return on investment (ROI)



Preparing MTDC infrastructure

for faster networks, high-speed edge

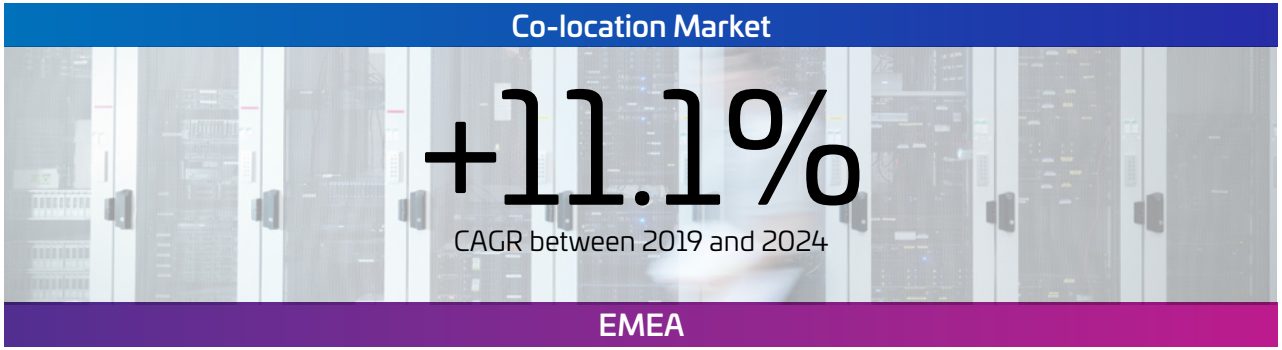


Chapter 1: MTDCs built for agility

MTDCs built for agilty

As demand for online services and platforms surges and data traffic volume explodes, DCs that can be built in shorter time frames with ever-increasing efficiency meet capacity requirements while leveraging scale and improved IT and facility technologies.

Slightly over 63 percent of enterprises still owned and operated DC facilities in 2019, according to 451 Research. As facilities age and new applications raise performance and density requirements, MTDCs are ideally positioned to enable enterprises to outsource their IT infrastructure and connect to a wide array of cloud, connectivity and service providers securely and efficiently and with improved uptime and support for growth.



US$17.2Billion

EMEA total market size by 2024

EMEA

7 of the top 10 data centre cities globally, least likely to be impacted by environmental risk factors, are located in EMEA.

Shift to MTDC/Co-Location

Gartner predicts that, by 2025, **80 percent of enterprises** will migrate entirely away from onpremises DCs with the current trend of moving workloads to co-location, hosting and public cloud. Workloads can be located based on business outcomes. Physical location and timeto- market restrictions can be bypassed using outsourced facilities.

Beyond a wide variety of co-location options and short installation intervals, MTDCs also ease network provisioning and management with self-service, on-demand connections. Further, the Uptime Institute estimates that a shared facility can be **more than 64 percent more cost effective** than a private Tier 2 DC depending on the facility's scale.

The MTDC market size in EMEA will expand by a compounded annual growth rate (CAGR) of **11.1 percent between 2019 and 2024**, according to Cushman and Wakefield.

In EMEA's primary markets of London, Frankfurt, Amsterdam, Paris and Dublin, demand for DC and cloud services is also driven by a young and tech-savvy urban population, the consumption of ecommerce, over-the-top services and financial services. These traditional hubs have been challenged in recent years by emerging hubs—such as such as Warsaw, Madrid, Stockholm, Zurich, Nairobi, Moscow, Abu Dahbi, Cape Town and Muscat.

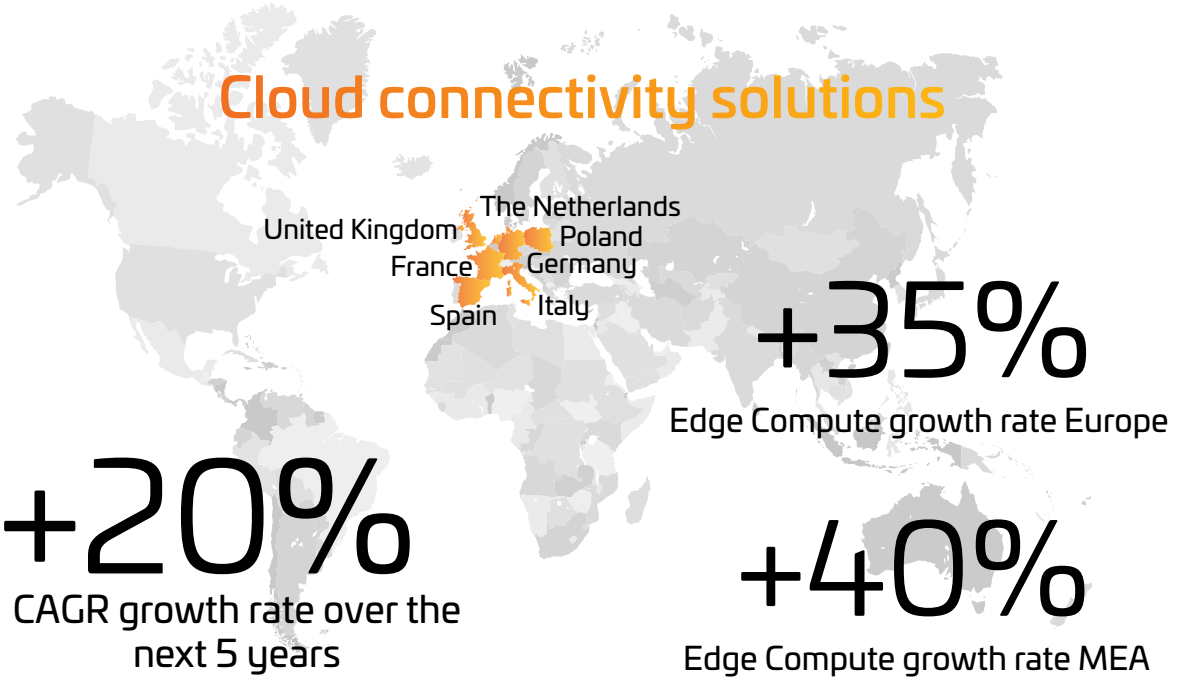
Key drivers of growth include IoT-driven technologies such as artificial intelligence (AI), data and analytics, security, and communication; rapid growth in the
use of cloud computing services and applications; and increased investments worldwide from telco operators, governments and cloud providers in subsea cable projects, which have led to faster network speeds and more capacity while lowering latency and improving redundancy.

Shift to the edge and the cloud

Major MTDC providers, including hyperscale providers, are investing in their own network edge DC infrastructure. This investment is predominantly focused on locating facilities to support compute resources close to markets that offer significant demand.

MTDC edge facilities often provide cloud connectivity/interconnection and hybrid cloud infrastructure services. European Cloud Computing is set to grow at a **CAGR of 20 percent** over the next 5 years in the major European countries such as the United Kingdom, Germany, France, Italy, Spain, Poland and The Netherlands.

Whilst Edge compute market itself has been growing a rate of between 35% and 40% in Europe and MEA respectively. Hybrid cloud, in particular, has become an essential enabler of successful digital transformation efforts.



Since cloud-based applications and services require physical infrastructure that extends optimally to the network's edge, MTDC managers must seize the opportunity to address diverse customer requirements as well as the increased complexity of scaling and orchestrating distributed infrastructure.

An Equinix report shows that Europe will take 23% of all interconnection bandwidth worldwide. Growing at a rate of 45% CAGR.

MTDCs can help organizations manage these workloads. Customers will need an understanding of the physical infrastructure, design requirements and strategic considerations that must precede a successful deployment. Solutions encompassing half and full cabinets, cages or even full white space can be tailored to meet each customer's unique service needs and budget.

In all, continued adoption of the cloud, the rise of IoT, and the massive amounts of data to be created, processed and stored continue to fuel demand for DC space, DC suppliers, and service and network providers. As technology evolves, MTDC operators that innovate, refresh and scale quickly to spread risk and reduce cost will have an advantage.

Figure 1: Typical areas within an MTDC

MTDC Solutions Overview

In the MTDC, multiple secure customer areas—contained in a cage or within a particular cabinet in a row—are connected to a meet-me room (MMR) where the MTDC's own cross-connection equipment, like **optical distribution frames** (ODFs), reside. The MMRs are then connected to the entrance facility (EF) where services from multiple telecommunications providers enter the building. Customers are interconnected to cloud and other service providers in the MMR.

The MTDC's own backbone infrastructure must be robust, flexible and globally scalable. It must allow customers to turn up new applications and services as fast as needed, remotely visualise and optimise infrastructure in real time, and keep track of changes.

CommScope's SYSTIMAX® Tier 1 infrastructure solutions—coupled with logistics, engineering, and sales and technical support—have helped MTDC operators provide customers with a sustainable path to higher network speeds and capacity.

CommScope's MTDC portfolio includes solutions to support outside plant, facility entrance, MMR and customer cage applications, such as:

- High-performance preterminated fiber-optic and copper solutions that enable faster turn-ups and high-speed migration.
- **Automated infrastructure management** that remotely monitors and manages the physical layer and all connected equipment in real time in the customer cage. The need for such automated tools is non-negotiable as infrastructure grows denser and more complex and human resources become increasingly stretched.
- Fiber management systems that provide fast, simple installation and orderly cable routing with optimal bend management.

High-fiber-count rollable-ribbon **fiber cables** and **fiber splice closures** extend fiber connectivity between multiple DC buildings in an MTDC campus, while building entrance products provide the transition between outside plant and inside plant networks.

High-density ODFs offer several connectivity options, including splice/splice and splice/patch SC, LC and MPO modules—all in a space-saving front access footprint. Additionally, the FiberGuide® **fiber raceway systems** deliver fiber throughout the MTDC facility, protecting the fiber and maintaining correct bend radius management.

Chapter 2: MTDCs geared for speed

MTDCs geared for speed

Demand for increased infrastructure capacity and density is driving transformation and innovation in DC architectures and technologies. Rapid growth of the hyperscale cloud market has enabled a new wave of enterprises to seek alternatives to traditional DC real estate assets. In this shifting landscape, MTDCs are essential to the delivery of new technologies.

IDC forecasts that the worldwide spend on cloud services is **expected to exceed US$1 trillion by 2024**. Alongside cloud computing, the enterprise and automotive IoT market was expected to hit **5.8 billion endpoints in 2020**—a 21 percent increase from 2019, according to Gartner.

IoT deployments in industries such as manufacturing and transportation, as well as large-scale smart city projects, will generate much larger quantities of data for real-time processing and analyses in DCs (See Figure 2). Additionally, big data analytics, machine learning, telemedicine and AI are creating demand for high-performance computing infrastructure and for DC space.

As co-location becomes an obvious vehicle for connecting enterprises, service providers and public cloud platforms, new needs for time-sensitive applications are **pushing requirements further toward the edge**, according to 451 Research.

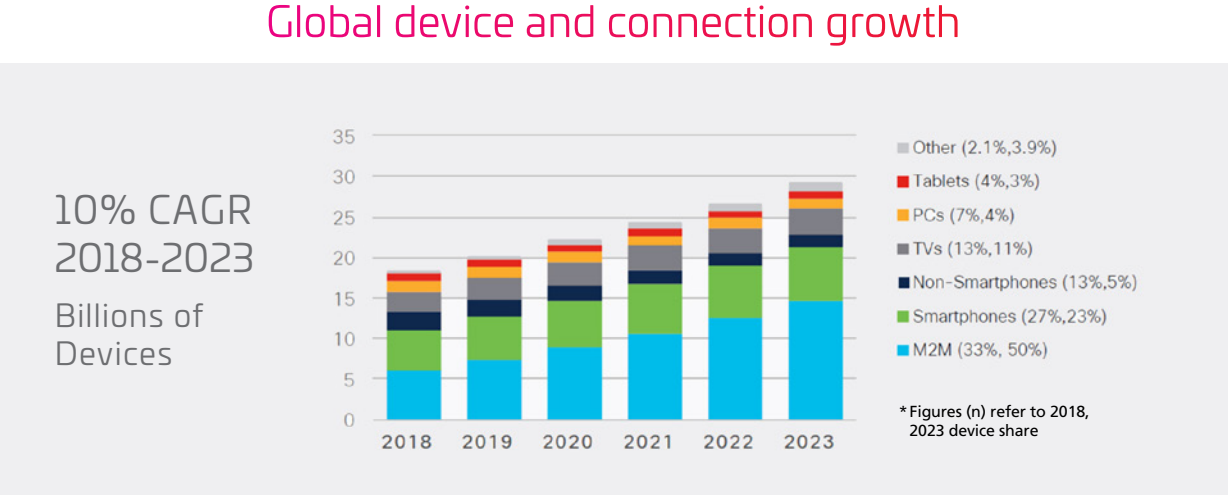


Figure 2: Growth of M2M traffic in the data center
Source: CISCO Annual Internet Report, 2018-2023

To keep up with the exponential growth in demand for data capacity and higher computing speeds, deploying many smaller distributed DCs has been considered the most viable solution. These facilities are often called **edge data centers** (EDCs).

An EDC's scale can range from a few racks to 150 kilowatts of capacity. Multiple EDCs may interconnect to boost capacity, mitigate failure and migrate workload within the local area. The EMEA MTDC market expects **an increase in deployment of EDCs** to be one of the key drivers of growth in the market due to growing use of connected IoT devices among businesses and consumers.

EDCs will supplement large, centralized DCs. By 2025, **75 percent of data** will be created and processed outside a centralized DC or cloud, according to Gartner. Further, Bell Labs predicted that 60 percent of servers will be placed in an EDC by 2025.

Macro-view snapshot

An architecture that introduces many thousands more EDCs will need to find ways to optimize capital costs, operational complexity and speed to market—and, most importantly, minimize the environmental impact of EDCs. *TIA EDC Working Group*

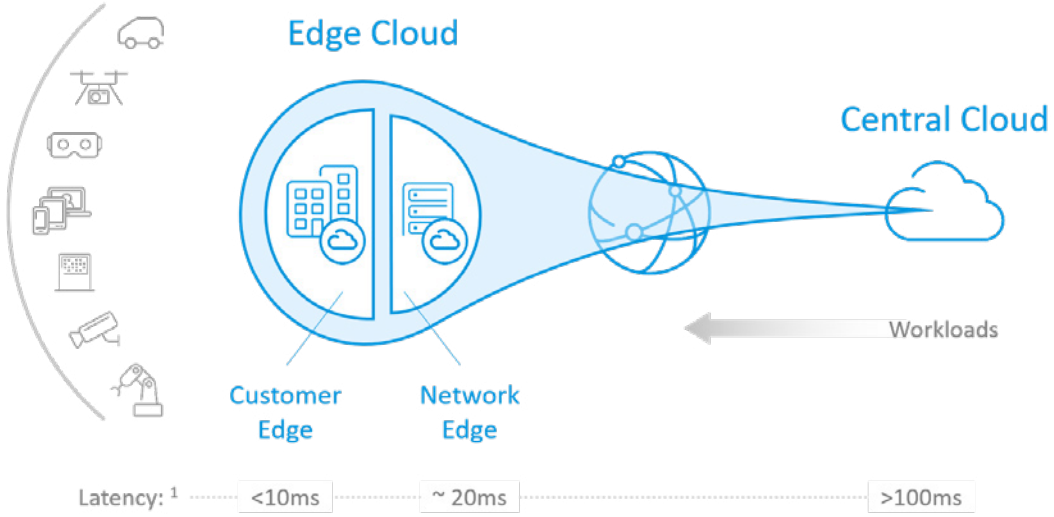


Figure 3: Bringing low-latency edge computing to enterprises.
Source: AT&T

An MTDC's physical location has often been chosen by the latency requirements of its customers and access to other utilities such as power, water, and internet connections. Application requirements and the location of end users typically define the expansion of the network "edge" (See Figure 3). Edge service providers will choose a location that provides optimum support for the capacity, resiliency and latency needed to drive the services they, in turn, supply their customers.

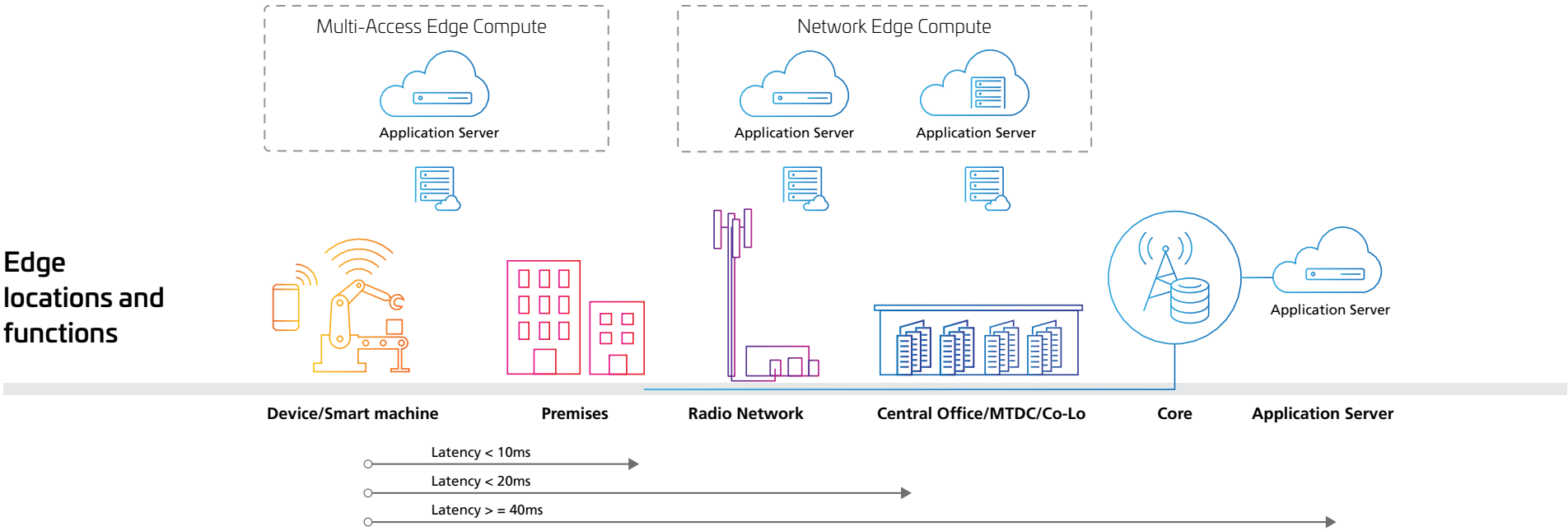
MTDC operators may seek to situate edge operations and services at a prime service area where their customers can host services and connect efficiently to other enterprises. A lucrative service area is where an MTDC can service enough customer demand to provide an adequate return on operational costs.

The service area has tended to reach out about 150 miles or more. With the potential for smaller service areas defined by lower latency requirements reducing the coverage (number of customers served), the traditional business models will be challenged.

Deployments of 5G and IoT are ramping up. Some new applications will require ultra-reliable low-latency (URLL) performance. This raises the need to evaluate the business case for smaller DCs with a reduced service area offering lower latency and higher-value services. For this same reason, MTDCs need to **re-evaluate their role** and the importance they place on this evolving business opportunity.

MTDCs have to satisfy a variety of customer configurations to fully capitalize on their location at the network edge. Customers' plans for a smooth migration to the MTDC and for flexible expansion opportunities must be addressed to ensure their DC needs can be met today and in the future.

Edge-to-core connectivity



Edge locations and functions

Macro-view snapshot

Keep building out edge-based resources to process more data locally. The aim is to not only deliver the URLL performance but also set an effective strategy for conserving backhaul bandwidth and operational costs.

While different types of data traffic between the edge and core DCs have minimal effect on existing software and control systems, edge-to-core traffic will drive the need for higher-bandwidth, Ethernet-based optics.

Advances in optical network technologies now employ cost-effective, high-speed Ethernet options that enable enterprises to easily transition to service provider facilities driving demand for additional fiber-optic cabling in the service provider's networks. High-density fiber cables and management solutions will be needed at the network edge and core to accommodate the exponential increase in fiber core counts.

However, there is a practical limit on how many fibers can be deployed cost-effectively—especially as distances increase. The drive for more capacity leads service providers and MTDC operators to consider alternative methods of adding bandwidth, such as wavelength division multiplexing, where several streams (wavelengths) of data are added together and share the same physical fiber.

Higher capacity, optimal fiber

Compact and designed for flexible routing

New technologies are helping MTDCs deploy more fiber capacity. Rollable ribbon fiber can reduce the overall diameter of an optical cable by up to 50 percent—essentially doubling the number of cables that can be added to a duct. By using this new cable type, MTDCs can support additional revenue-generating customer circuits in existing cable pathways and facility duct routes.

Rollable ribbon fiber cable contains fibers that are attached intermittently to form a loose web (see Figure 5). Fibers are free to "roll" together and form a smaller, more flexible cable. Manufacturers can build cables that contain as many as 3,456 fibers while keeping the diameter of the cable small enough to fit into one two-inch-diameter duct. The conduits and cable pathways now have twice the density compared to using conventional fiber cables. This construction is much more flexible. Reducing the cable bend radius makes these cables easier to work with inside the tighter confines of the DC.

A gel-free design further reduces the time required to prepare cables for splicing, therefore reducing labor costs. The intermittent bonding maintains the fiber alignment required for typical mass fusion ribbon splicing.

Further reduction of cable diameters

With growing demand for more fiber connectivity, cable designs have reached practical limits of diameter reduction with the standard 250-micron diameter. However, smaller-diameter fibers allow more fibers to occupy the same cable diameter. Fibers with 200-micron diameter are now being used in rollable ribbon and microduct cable.

The outside buffer coating is the only part of the glass fiber that is altered. The 200-micron fibers retain the 125-micron core/cladding diameter of conventional fibers for compatibility in splicing operations (see Figure 6). Once the buffer coating is stripped, the fusion splice procedure for 200-micron fiber is the same as for its 250-micron counterpart.

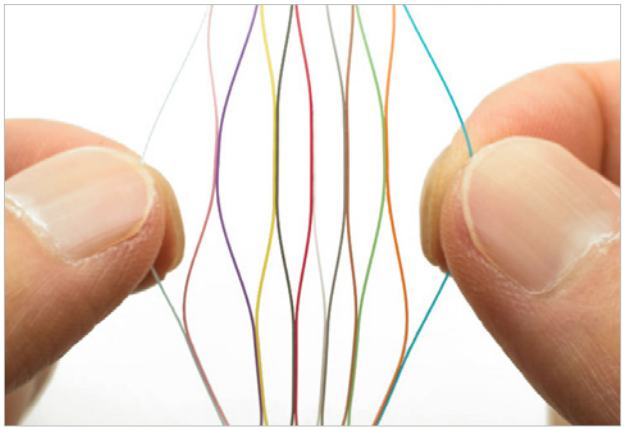


Figure 5: Rollable ribbon fiber is bonded at intermittent points
Source: ISE Magazine

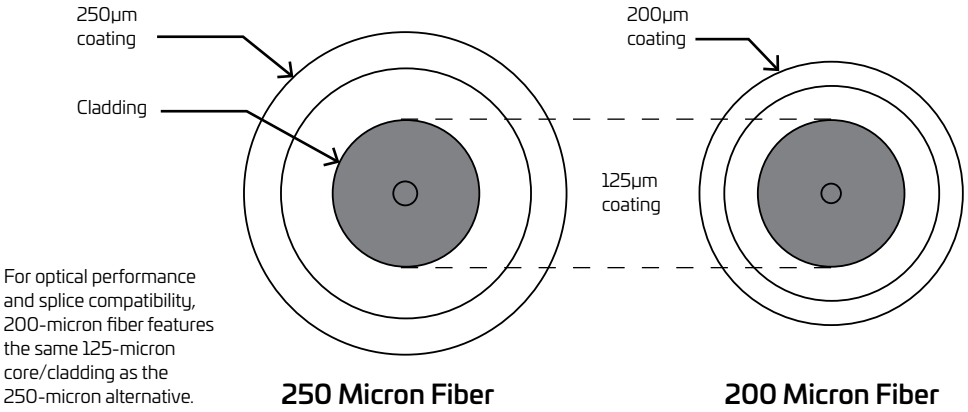


Figure 6. Splice compatibility for 200-micron and 250-micron fiber
Source: ISE Magazine

Keeping fiber count in check

Engineers have more options than ever to design and deliver increased capacity in fiber installations. Applications within the customer networks (as well as the MTDC's own backbone) take advantage of key advancements in transmission protocols incorporating the latest optic transceivers.

In short-reach enterprise networks, enhancements in technologies like vertical cavity surface emitting lasers (VCSELs) and pulse amplitude modulation-4 level (PAM4) encoding are increasing optical channel transmission to 56 Gbps over multimode fiber (MMF)—with 400G transmission enabled at 50 Gbps.

Existing MMF networks can now support much higher speeds while extending the life of the MMF cable. Also, they take advantage of lower-cost transceivers and reduced power requirements that VCSEL technology will deliver for many years to come.

OM5 supports 4X the data of OM4 for 50 percent longer reach

A new high-bandwidth MMF addition, OM5 multimode optical fiber, is designed to support transceivers that use shortwave division multiplexing (SWDM). As mentioned earlier, this technology provides much higher capacity for each fiber deployed. OM5 supports four times the data of OM4—for 50 percent longer reach (based on the 802.3 cm standard for 400G over MMF).

Chapter 3: MTDCs designed to boost ROI

MTDCs designed to boost ROI

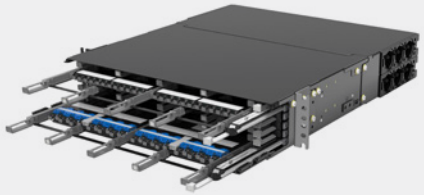
The ability to quickly establish and turn up services for a new tenant helps MTDC operators improve customer experience, **accelerate the time to revenue** and boost ROI.

MTDCs need a flexible, robust and efficient infrastructure that can be upgraded or adapted to speedily meet customers' diverse and dynamic requirements. CommScope solutions allow operators to minimize not only the errors or delays that impact customer experience, but also the risk of service-level agreement fines.

These solutions can be shipped and installed quickly to improve critical time to service and revenues. Further, modular physical layer solutions let MTDCs scale up as gradually or as quickly as their customers' circumstances dictate.

CommScope's **High Speed Migration platform**—built on modular, ultra low-loss (ULL) connectivity—enables network planners and operators to seamlessly migrate their physical infrastructure designs from duplex transmission protocols to parallel ones (and back again to duplex) as higher data-rate technologies mature and migrate between connector interfaces themselves.

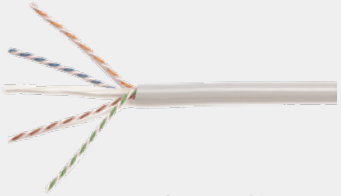
ULL Connectivity



ULL EHD Fiber Panels

OM5 Multimode

AIM—imVision



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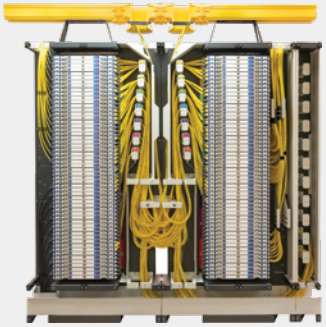


MMR—ODFs

FiberGuide

CommScope's **SYSTIMAX ULL solutions** feature embedded intelligence that leverages iPatch® intelligent cabling to monitor and manage the physical layer in real time, down to the port level. Having such visibility is essential to a customer choosing to deploy off-premises disaster recovery in an MTDC located in a different part of the country or region.

Server-switch-connectivity speed

Meanwhile, technological developments in servers, switches and connectivity are each pushing the other to be faster and more cost effective.

MTDC providers are now focused on enabling 100 GbE connectivity, with future generations of switches and servers on schedule to require 400G and 800G connections—meaning the MTDC must keep an eye on the next generation of speed for their own backbone cabling. One critical step for MTDC operators supporting ongoing in-cage transitions from 400G to 800G and beyond is to look at physical layer cabling options connecting service provider and campus circuits to customer cages.

Still, a fast-changing technological landscape is only half the challenge. Timing is equally critical with refresh cycles now running every two to three years. Grappling with the many moving pieces, MTDC operators must make difficult but necessary strategic infrastructure transitions now. Failing to get it right now will be costly later.

Flexibility via structured cabling

The recommended architecture for flexibility within the customer cage is a leaf-and-spine network connected by structured cabling. Structured cabling enables the network to continually expand and migrate to higher speeds easily.

When using high-fiber-count trunk cables, like 24-fiber MPO, the backbone cabling between the leaf-and-spine switches can remain fixed. Instead of ripping and replacing trunk cabling as optical networking technologies change, simply change the MPO module and optical fiber presentation entering or exiting the spine or the leaf cabinet.

Once the leaf-and-spine architecture is in place, a consistent and structured approach to physical layer cabling enhances the ability to expand the

network fabric by simply adding and altering server cabinets and their components as customers demand additional performance.

High-density ODFs

These ODFs aggregate many fibers into an organized and easy-to-manage fiber fabric. While ODF applications and environments vary throughout the MTDC, using a portfolio based around a common footprint of connectors, cassettes, modules and frames enables greater design flexibility and faster build-out in response to customers' changing requirements.

ODFs for cross-connecting and interconnecting applications, such as the FACT® and FlexFrame ODFs, are modular and specifically designed to support rapid installation of customer connections, turn-ups and easy maintenance.

The ODF-revenue connection

In a typical MTDC configuration, the service provider network terminates at a dedicated ODF in the meet-me room, ready for presentation out to the other suites.

One strategy many MTDCs are employing is to use additional ODFs as intermediate distribution points dedicated to serving the customer cages on each floor. This enables MTDCs to independently add capacity for new or expanding service providers as well as customers. The final connections can be made quickly using shorter runs or even patch cords.

In a tiered-ODF design, a single customer cage can cross-connect to multiple service providers via a simple patch. For MTDC operators that bill for the activity of making a cross-connection between a customer and a service provider at the cross-connect, the faster those connections can be made, the higher the potential revenue.

The connection between customer and service provider often generates monthly recurring revenue. Having the ability to easily hook up customers to more service providers makes this a rewarding strategy.

Simple building blocks

Preterminated fiber and copper cabling design allows quick installation and connection to switches and routers—guaranteeing optical and electrical factory-level performances. Scalable, modular and flexible high-density (HD), ultra high-density (UHD), and enhanced high-density (EHD) fiber patch and splice panels enable MTDCs to support **increasing fiber counts** while keeping the fibers secure and accessible.

EHD panels provide up to 72 duplex LC or MPO ports per rack unit—singlemode or multimode—allowing migration from 10G serial to 100/400G parallel transmission without expanding equipment footprint.

Further relieving cable congestion are CommScope's **MPO modules and MPO adapter panels**. By combining micro-cable, cable spooling and MPO connector technology in a single panel, they not only simplify moves, adds and changes within the cage or cabinet but also speed up ordering and inventory of equipment.

The interchangeable 8-, 12- and 24-fiber MPO modules optimize fiber configurations. Moving up to 400G and beyond, new optical connectors like the MPO-16 will become popular. It is critical to select a cabling system that considers this important connector as a part of a migration strategy.

Macro-view snapshot

Preterminated MPO modules and MPO adapter panels provide plug-and-play fiber connectivity to improve the time to turn up service for a new customer and reduce the cost of adding and connecting those customers.

Supports QSFPs

- For multimode and singlemode transceivers and breakouts
- Lowest panel density

Large installed base

- Existing multimode and singlemode preterm deployments
- Familiar interface and trunks

MPO16 is the connector of choice for new octal based 50G and 100G PAM4 transceivers offering the maximizing the number of connected edge devices switches can now support.

Future ready

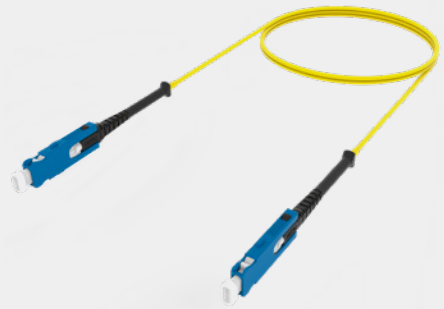
- Lowest cost duplex support for multimode applications
- Highest panel density

For over two decades, duplex fiber optic connectors supporting datacenter networks, has utilized the LC format. However, with the ever-increasing demand on data center applications, emerging architectures require the higher connectivity densities offered by very small form factor (VSFF) connectors.

VSFF connectors are the next step in connector technology, allowing data centers and carrier-based applications to prepare for the network demands of the future.

The SN connector, a VSFF duplex connector, enables high connector density by delivering an advantage over a standard LC connector, by offering up to 4x increase fiber density over LC connectors in an OSFP, or QSFP-DD transceiver footprint.

Manufactured with 1.25mm ferrule technology, it is designed to support even the most challenging applications such as high density data center cabling infrastructure and 400G+ breakout transceiver designs.



Ultra Low Loss Singlemode SN duplex patch cord

Plan, design and deploy quickly

CommScope's Fiber Performance Calculator (FPC)—an automated design planning and link confirmation tool—enables engineers to model a variety of channel and link scenarios using CommScope's fiber solutions.

The tool comprises a link loss calculator and a database of fiber performance specifications based on current industry standards as well as performance specifications for SYSTIMAX fiber and fiber connector types. It enables designers to confirm the guaranteed support of optic applications while also specifying the maximum attenuation performance of each link.

Model the future, confirm next-generation performance, and ensure your cabling is delivering the optimized and guaranteed performance with the FPC tool set.

Fiber raceway system

Complementing the structured cabling solutions are the FiberGuide fiber raceway system that ensures fibers do not exceed their maximum bend radius and are safely protected as they transition throughout the MTDC.

FiberGuide is supported by a software tool that helps planners quickly and efficiently create a raceway design. Fast, tool-less installation is an important benefit—especially given the typical 12-week window for ordering and deploying the cabling infrastructure.

Conclusion

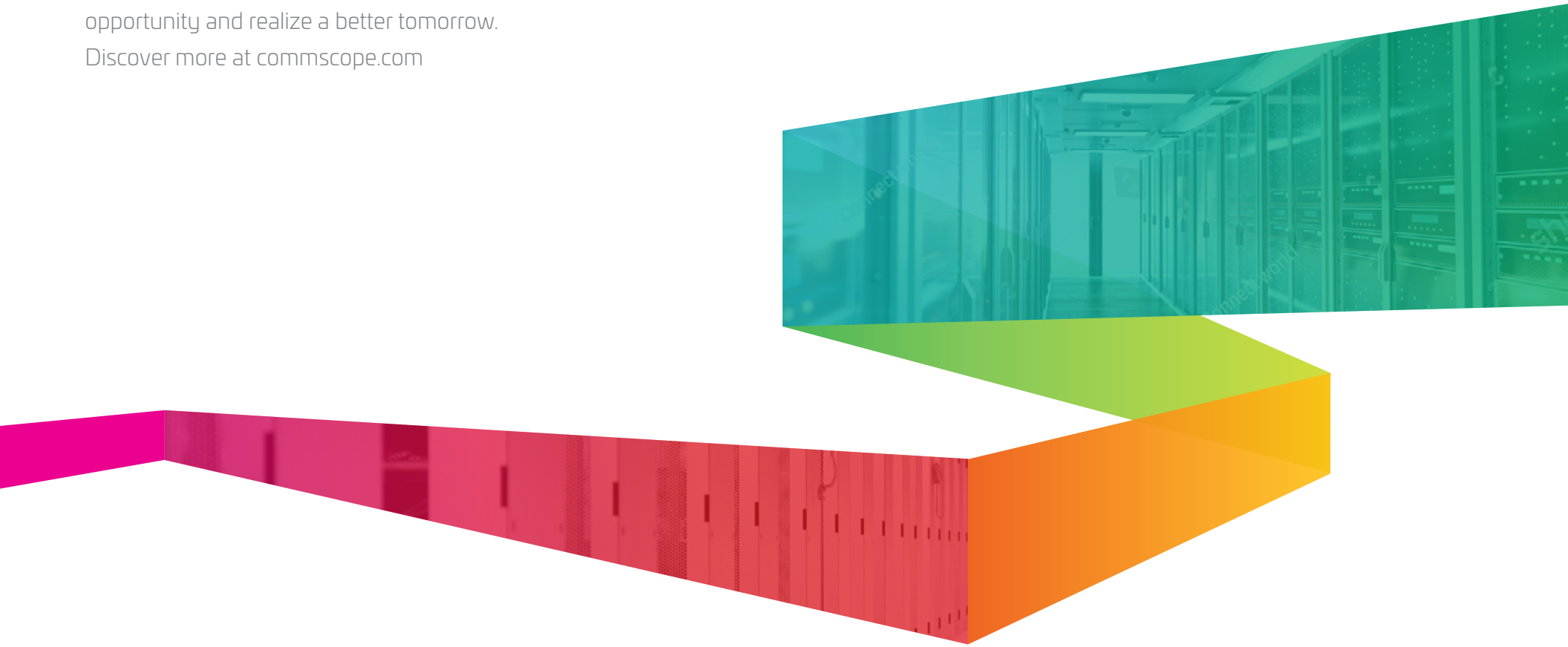
Enterprises, cloud providers and hyperscale customers are locating more capacity and processing power closer to end users, with an increasing edge-first deployment mentality.

They look to MTDC operators to provide fiber-dense backbone and flexible connectivity to keep up with ongoing technological change as well as support for applications requiring URLL performance.

To this end, MTDCs are challenged to retool DC operations to turn up customers faster, speed up customer build-outs, and accelerate revenue. An efficient, flexible and simplified cabling infrastructure is essential. CommScope's modular cabling and connectivity solutions are geared for this purpose while delivering consistently high-performance throughput from the core to the farthest edges of the network.

COMMSCOPE®

CommScope pushes the boundaries of communications technology with game-changing ideas and ground-breaking discoveries that spark profound human achievement. We collaborate with our customers and partners to design, create and build the world's most advanced networks. It is our passion and commitment to identify the next opportunity and realize a better tomorrow. Discover more at commscope.com



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Visit our website or contact your local CommScope representative for more information.

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