A photograph of a long, dark server rack in a data center aisle. The rack is filled with server units and has a glass door in the middle. The aisle is brightly lit with overhead lights. A red rectangular box highlights the text 'Data Center' on the left side of the rack.

Data Center



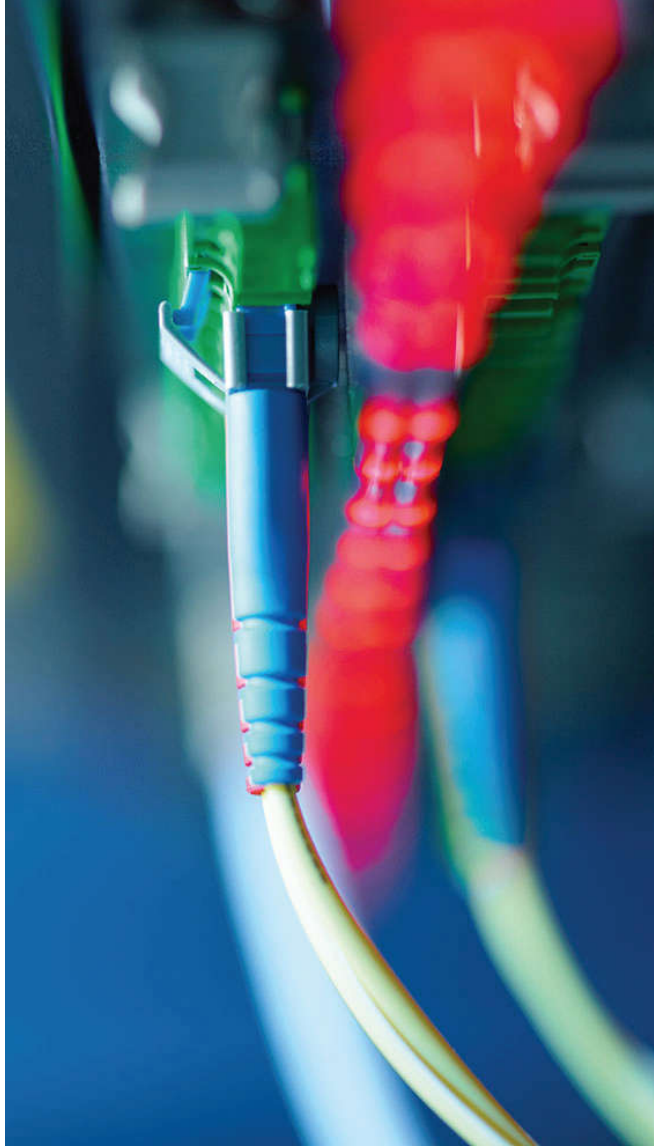
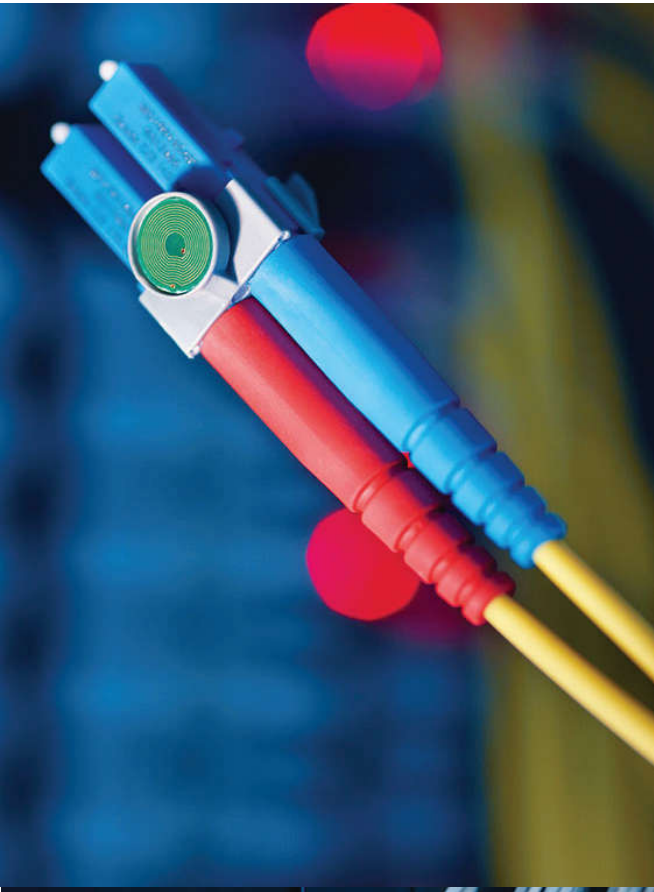
Convincing cabling solutions



High Performance Network Connectivity

R&M knows that an optimized data center network is a mission critical component of a business-oriented IT infrastructure strategy. From this understanding, R&M has established best of breed physical network solutions for High Performance Network Connectivity (HPNC). R&M HPNC Solutions are a set of fiber, twisted-pair and twinax cabling technologies designed for our customers' bandwidth-demanding data center applications.

HPNC Solutions increase the data throughput and availability of your network, while reducing its latency by minimizing frame loss. R&M is committed to delivering connectivity that exceeds industry standards and yields more stability and security to your networks – and peace of mind. Our Swiss approach to superior quality standards ensures reliable, uninterrupted operation to satisfy the highest service levels.





R&MinteliPhy - Intelligent Cabling Solution

R&MinteliPhy opens up a new era for network managers. Now, they can manage their physical infrastructure intelligently and fully automatically. It combines intelligent RFID-based hardware and software to provide Infrastructure and Operations Managers with end-to-end network infrastructure visibility and control.

Documentation and monitoring of the cabling plant is automated through a client-server solution with a central database installed on a Server in the LAN or available as a cloud-based service.

The result is a full, real-time overview on the status and configuration of the network at one central location. R&MinteliPhy replaces manual activities with standardized processes. The payback period for an investment in an R&MinteliPhy system is typically less than a year.

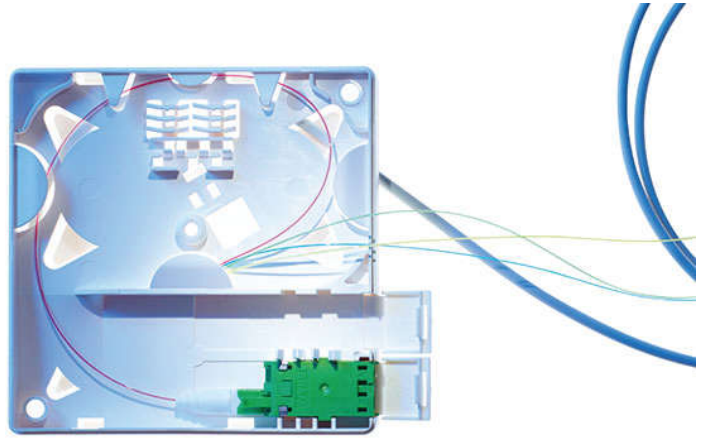




Optical Distribution Frame - Into the future

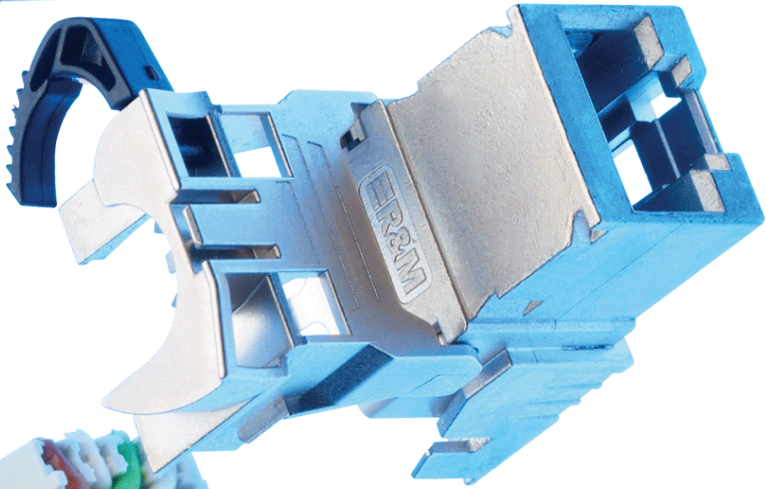
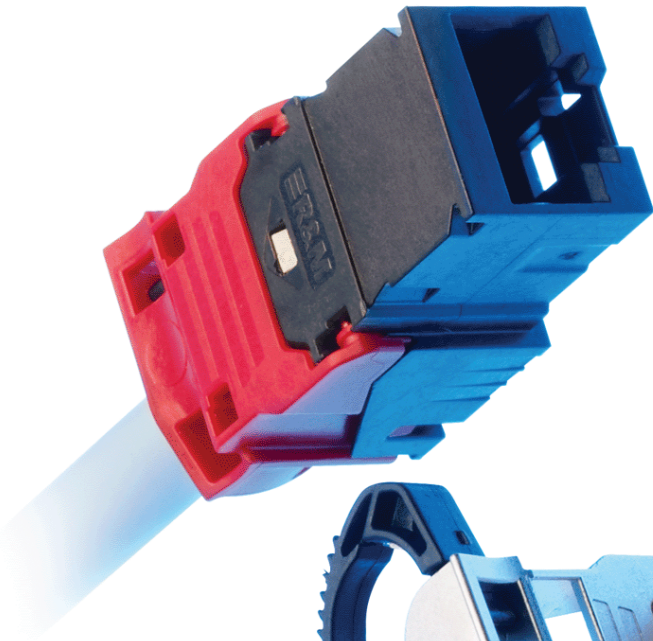
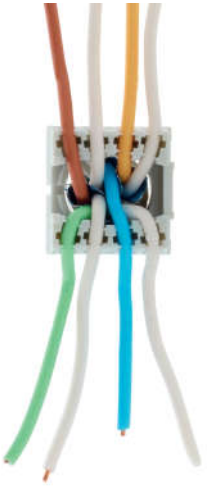
Next generation networks are spreading steadily. The desire for bandwidth and new services requires the use of an increasing amount of fiber optics. Commercial data centers need new ideas for meet-me rooms to expand optical infrastructure efficiently and organize it flexibly.

R&M has just the answer: the Optical Distribution Frame (ODF) that can handle planning, installation and operation masterfully and efficiently thanks to the modular design and ingenious quick installation features. Now there are no limits to the growth of fiber optic networks.



Field Termination – The Solution for Many Situations

Project managers, installation technicians and customers want field terminable fiber optic connections. R&M has the no-compromise Swiss quality standards to achieve both and did so with the FO Field. This product delivers excellent performance on a par with good splice connections and is incredibly easy to use. Installation technicians require neither high-end splicing equipment nor special training. Nor do they have to have expensive patch cords and pigtails on hand. All they need are the cable and the components. In light of the cost-benefit ratio, the FO Field is the optimum solution for many FO projects.

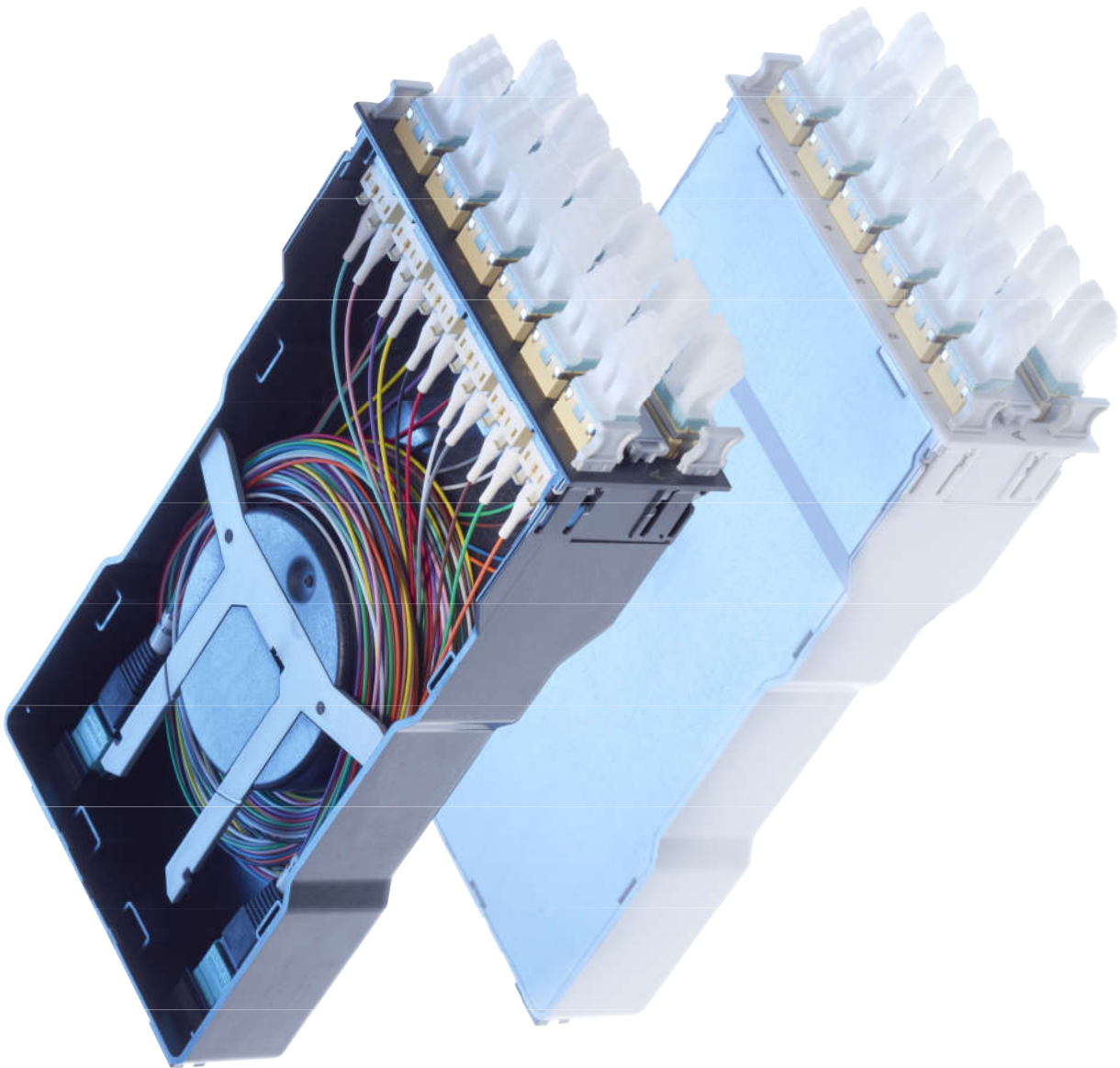




R&M - 10 Gigabit Experts in Copper Cabling

The more demanding the application, the easier the installation. R&M makes this wish come true with the Cat. 6A EL shielded and unshielded connection modules. It is the productive solution for high-end copper cabling in offices and buildings. With Cat. 6A EL from R&M, installers pave a reliable way to the future and 10 Gigabit Ethernet for their customers. The letters EL stand for “easy lock.”

The procedures for wiring and installing the RJ45 module are as easy as can be to learn and surprisingly quick to carry out. Cat. 6A EL comes into play in situations where simple, quick installation is desired and the permanent link has to deliver solid performance conforming with standards.

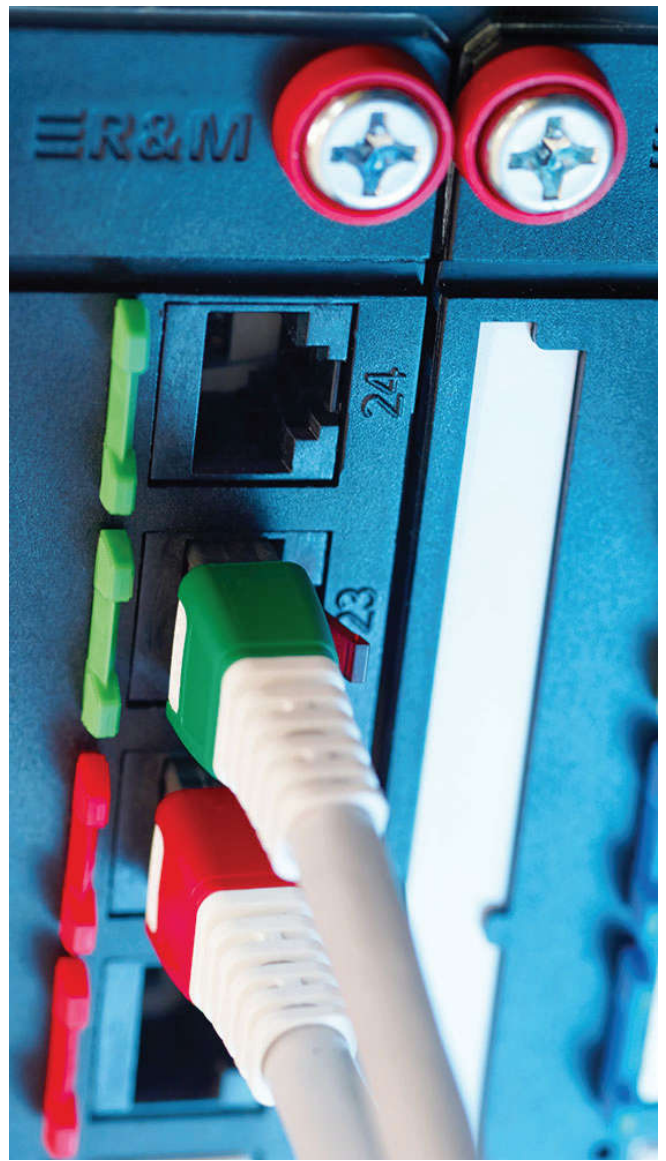
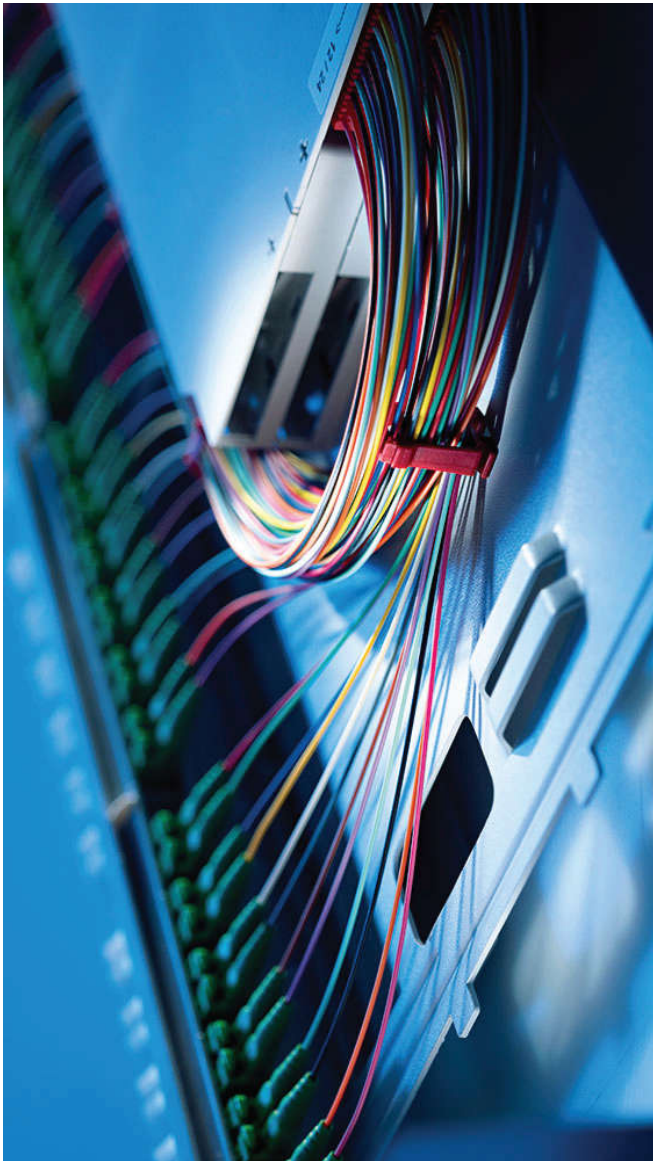


Pre-Terminated Solutions

R&M's pre-terminated solutions are designed for quick deployment. These components include enclosures, panels, modules, and cable assemblies that are ideal for environments where performance, flexibility, and scalability are critical.

Data center installations and upgrades often require unique, custom products. R&M helps provide the right solution for your Data center requirements. The pre-terminated components can be customized with user-friendly configurations that take you step-by-step through the specification process.



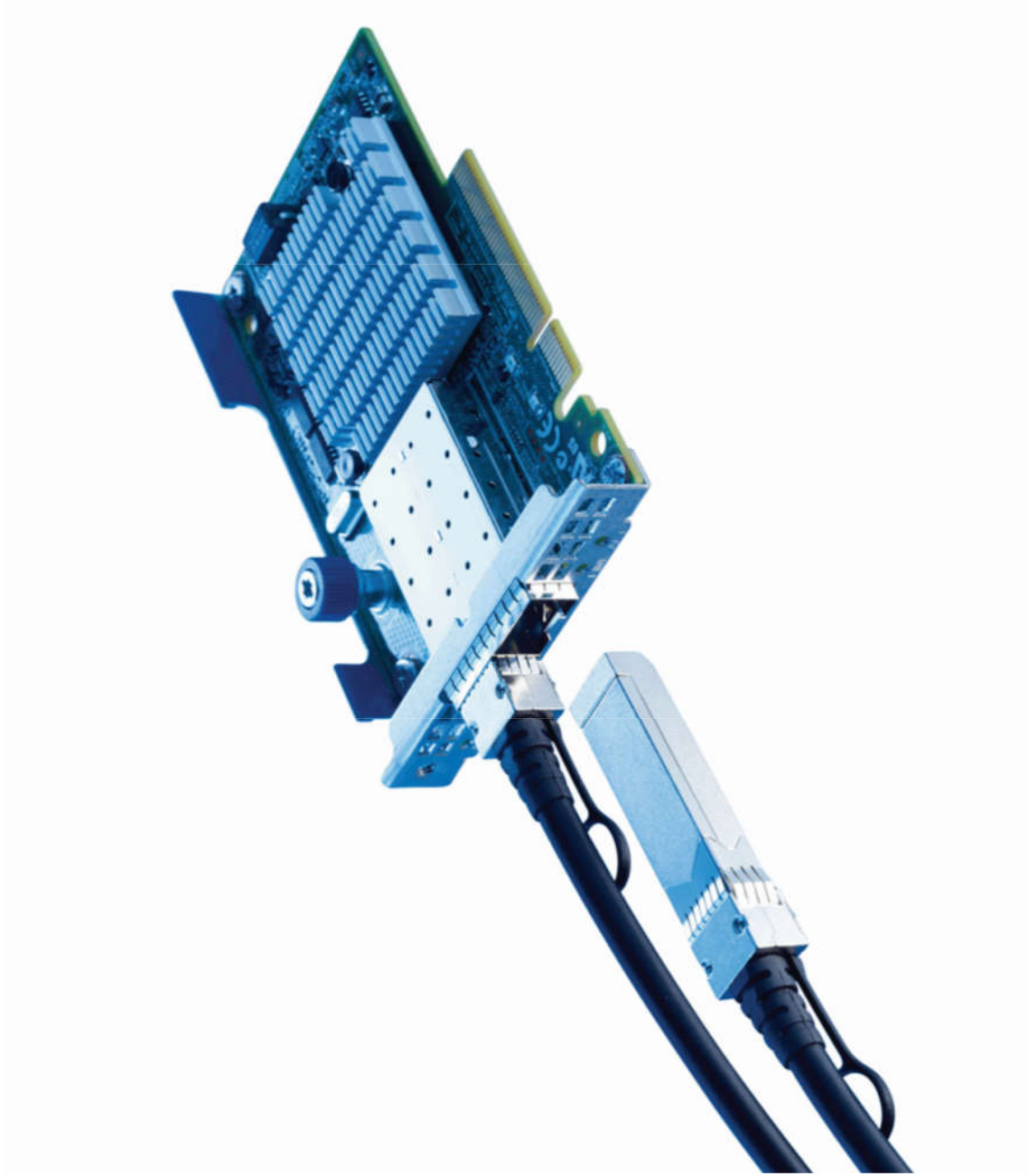


High-density patch panels for 19" racks

R&M offers a wide variety of 19" patch panels. All of our panels are extremely shallow in depth and provide centralized high density fiber and copper management solutions which simplify and speed up the deployment and servicing. Additionally, R&M's Global Rack allows the advantageous and space-saving combination of copper and fiber optic cabling on one platform.

R&M patch panels provide a sturdy and secure mounting system for shielded and unshielded structured cabling systems, proving resilient earth connections and excellent port identification. Strain relief for the incoming horizontal cable is provided, and in addition an additional strain relief is supplied, using individual cable ties on each cable.





SFP+ Direct Attach: for next-generation DCs

SFP+ direct attach is the optimum choice for highly cost-effective networking connectivity within a single rack and between adjacent racks. The cables meet application requirements for a high density cabling interconnect system capable of 10G per channel transmission rates and are ideal for point-to-point Top of Rack (ToR) applications.

Swiss precision & broad compatibility:

The SFP+ connectors meet R&M's demanding quality standards for external operating conditions, including temperature, humidity and EMI interference. By design form factor and optical/electrical connections of all cables' are fully compatible with the SFP Multi-Source Agreement. R&M SFP+ DAC assemblies are compliant to all equipment with MSA compliant ports according to SFF-8431, SFF-8432, SFF-8472, SFF-8083.



Rely on Smart Cable Raceways

R&M's Raceway System offers the most robust fiber management with the greatest breadth of products. This innovative solution is designed to protect and route fiber optic patch cords and multi-fiber cable assemblies between network elements and optical distribution frame areas. It thus has to provide all-round protection for sensitive fiber cables in these areas but remain flexible enough to support the frequent changes and additions to cabling. The modular design of the R&M Raceway Systems ensures this degree of flexibility. The capacity of a network can be expanded with ease at any time to meet requirements.

The range is lean, clearly divided and practical, allowing customized installation no matter what the building or application situation. Express outputs can be attached anywhere along the main duct for quick and spontaneous assembly and for guiding the fibers in an optimum radius out of the duct. The cable duct itself does not have to be interrupted or cut in sections. Compared to other widespread solutions on the market, the R&M Fiber Optic Raceway System drastically cuts costs. Installation and maintenance expenses can be reduced by as much as 50 percent.



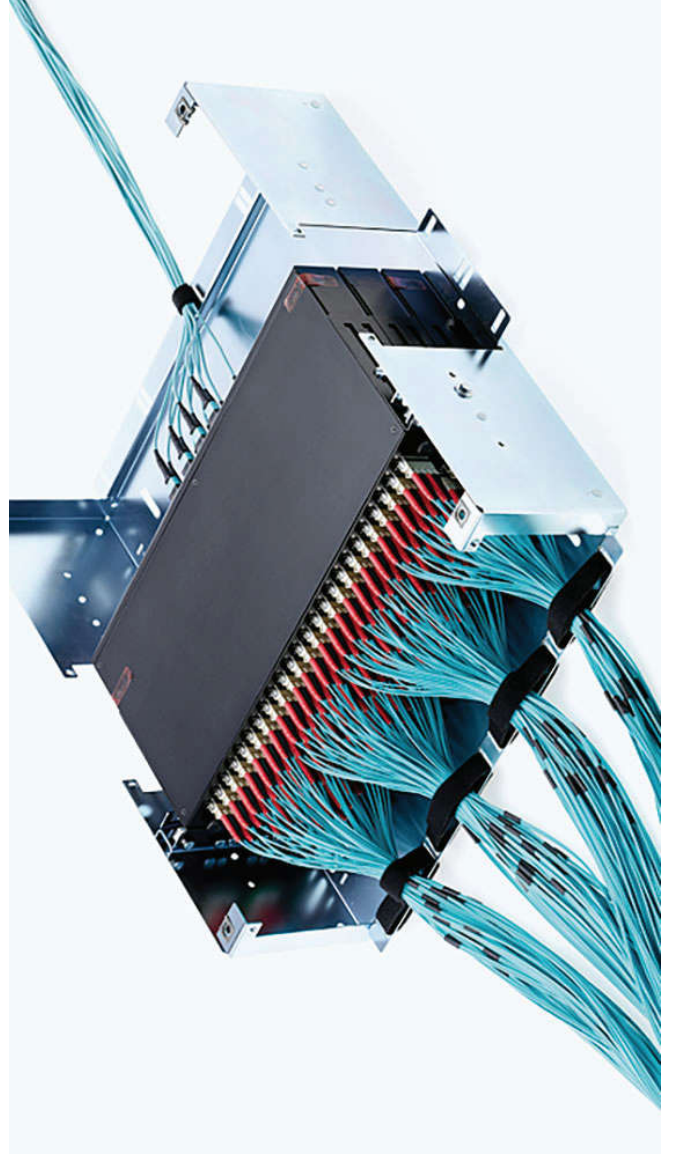
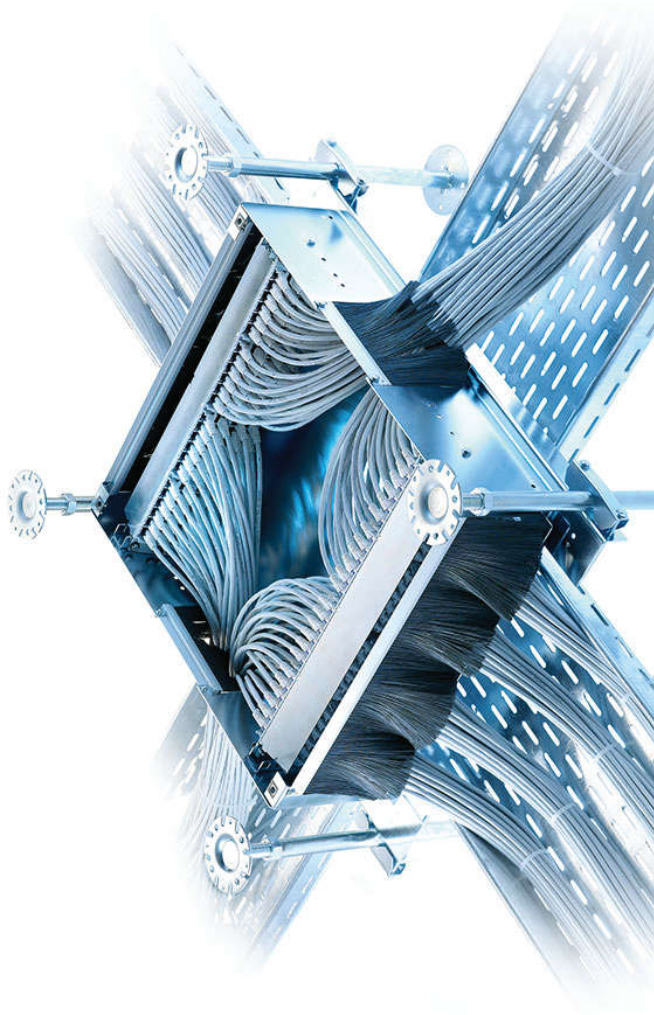
Cable Baskets

No matter whether for individual cable routing or routing of cable bundles. We have tackled the challenge of being able to offer the right system for your application.

Heavy power cables, run in the floor and in cable trays or cable ladders, to power server cabinets, lighter plastic cables which, depending on use, can easily be run through the mesh of the mesh cable trays.

Beneficial synergies occur during planning. Fibre optic cable mounting systems can also be used for power/copper cabling and vice versa.

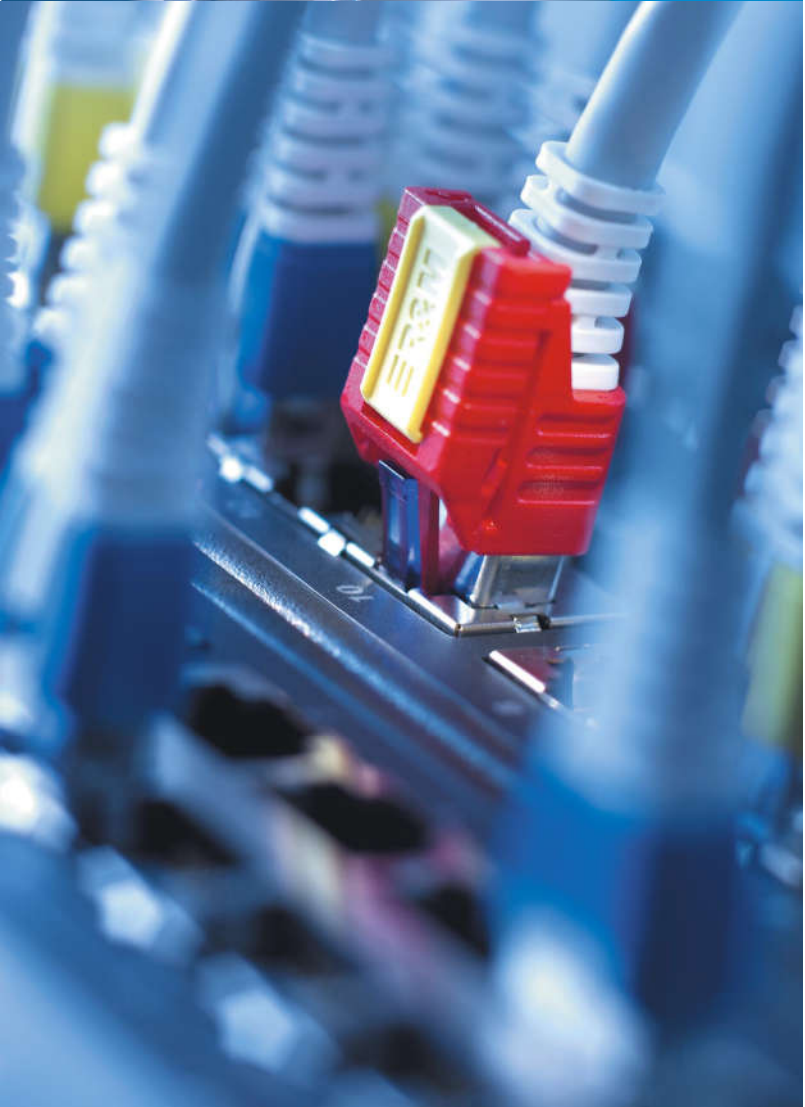
Light ceiling suspensions can, for example, be fitted with threaded rod suspensions or clamp constructions. Heavy-duty constructions are fastened to the ceiling or wall using supports or bracket suspensions.



Zone Distributor - Make Full Use of Your Floor

The raised floor of your data center has valuable potential: unused space. Why not use that space for more than just air and cables? With the Raised Floor Solution from R&M, you can shift certain connection and distribution tasks under the floor and gain additional space in the cabinets for productive units. That means you use the full potential of your computer center, economically and technically. The modular interconnection platform adds further resources to your data center. You simplify cabling projects in ultra-compact server farms and create optimum conditions for the development of new high-performance data networks.





Security Solutions for Cabling Systems



A quality cabling system can have a positive effect on data center security, and appropriate planning will allow it to be designed in such a way that it can be adapted to increasing requirements at any time. Clearness, clarity, simplicity and usability play a major role in this process. And in the end, the cost-benefit ratio should also be taken into consideration in product selection.

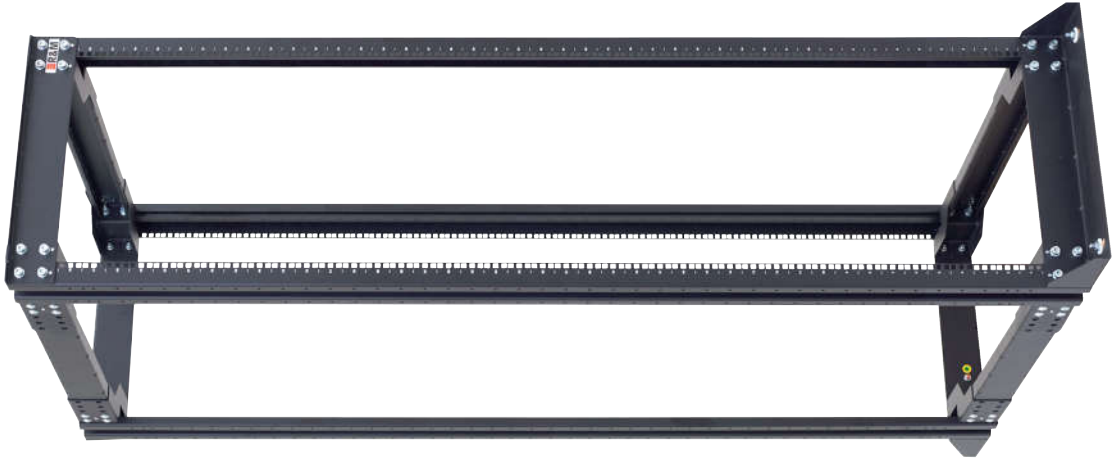
R&M's three-stage security system not only answers all of these security requirements, but also extends R&M's basic principle of modularity into the area of security. One element central to this system is its color coding scheme. The unit is fitted with sleeves so it can be easily plugged onto the ends of patch cords. These sleeves can be replaced by hand. The cable itself does not need to be unplugged or removed, so IT operation remains unaffected. Color coding units can also be added onto patch panels and connection sockets, allowing for a clear assignment of connections. Finally, this system reduces costs, since the need to stock up on color patch cords is eliminated.



Progressive Cable Management

Each detail of the network infrastructure solution from R&M helps users to handle cabling processes more efficiently and simplifies work in the computer room. The biggest step forward comes from the HD Cable Management, an innovation for data centers and a space-saving alternative to patching brackets. The patch cords are fully protected in compact conduits. The covers can be swiveled upwards, locked in place or removed entirely in no time in order to lay cables in place or take them out





Open Frames

R&M's open frames are designed to be used with High Density Wire Managers. The open frames give you unbeatable accessibility. The R&M open frames are available with two load ratings, depending on the type of equipment that you want to install.

The 500 kg-rated frame is ideally suited to high-density cabling applications, whereas the 1500 kg-rated frame is better suited for the installation of heavier equipment.

The frames are also suitable for use in testing and service rooms, where they ensure unlimited access to components installed.

INSTALLATION

vertical High Density Wire Managers can be installed in any type of standard vertical 19" extrusions

front/rear horizontal 1U High Density Wire Manager, applicable in both rack and frame deployments

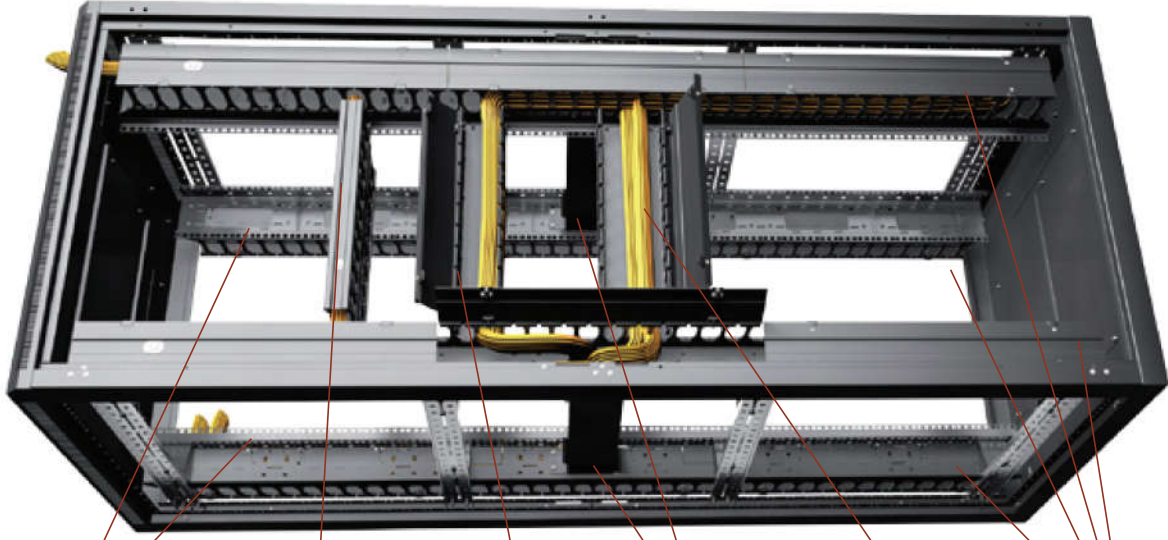
front/rear horizontal 2 or 3U High Density Wire Manager with brush also available

front horizontal 2U High Density Wire Manager, applicable in both rack and frame deployments

horizontal adjustable cable troughs to lead the cables between front and rear vertical rack High Density Wire Managers

front horizontal 3U High Density Wire Manager, applicable in both rack and frame deployments

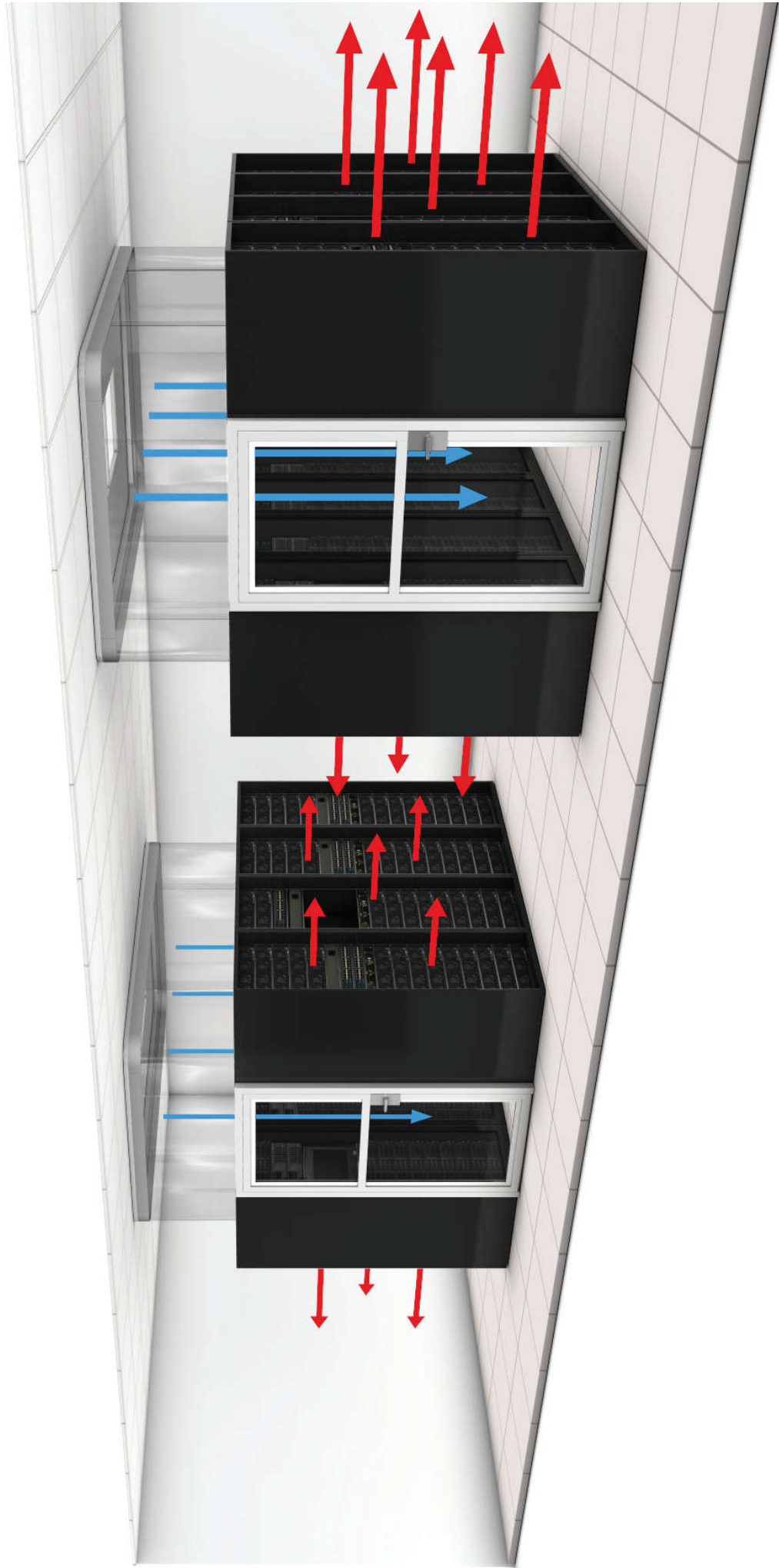
front vertical High Density Wire Managers, applicable in rack deployment



High Density Wire Management

Cable management can have a serious impact on the reliability of your data transmissions. Poorly managed cables can adversely affect network throughput, while poorly arranged patch cords can make cabling migration, addons and changes difficult to achieve.

High Density Wire Managers will help to improve network performance and reliability by reducing the risk of attenuation due to fiber micro bends. They can hold a large number of path cables without exceeding the TIA/EIA/ISO recommended fill factor. With the longer size option you can manage up to 48 patch cords (Cat.7 or higher) in a 1U position. Thanks to their modern design, backbone and patch, cables are well organized in accordance with industry standards and recommendations from major cable manufacturers. They will easily meet all your cabling needs.



Air Flow Management

The hot aisle/cold aisle data center design involves lining up server racks in alternating rows with cold air intakes facing one way and hot air exhausts facing the other. This in turn increases cooling efficiency of the data center. The cold aisle containment system can save you upto 20%~30% of power.

R&M's air flow management system is flexible and can be adapted to different room layouts.

Migration Path to 40/100 Gigabit Ethernet



Plug Connectors

Since MPO plug connectors contact up to 24 glass fibers in only one connection, it is extremely important that the connection be both stable as well as correctly aligned so it maintains the required transmission parameters. A faulty connection can lead to component damage or even complete link failure. MPO connectors come in both male versions (with pins) and female versions (without pins). These pins guarantee that the fronts of plug connectors match up exactly so that fiber ends do not shift out of place. The catches or guide grooves (keys) located on the top of plug connector units are clearly recognizable, and ensure connectors are correctly aligned when they are inserted in an adapter.



Adapters

Type A: Key-up to key-down

The groove lies at the top on one side of the adapter and at the bottom on the other side, so that the two connectors are shifted by 180° toward one another when they are connected.

Type B: Key-up to key-up

Both grooves are at the top, so both connectors are in the same position when connected.

Connection Rules

1. Always create an MPO plug connection using one male plug and one female plug, as well as an MPO adapter.
2. Never create a male-to-male or female-to-female connection. The fiber cores of the two connectors in a female-to-female connection will not be exactly at the same height, since guide pins are missing. This will result in performance losses. A male-to-male connection experiences even a greater loss in performance, since in this case guide pins bump up against guide pins. Not only does this prevent contacting, but plugs may also be damaged.
3. Do not disassemble MPO connectors. The pins in an MPO plug can be removed only with great difficulty, and fibers can become broken in the process. Not only that, the warranty becomes invalid when the connector housing is opened!

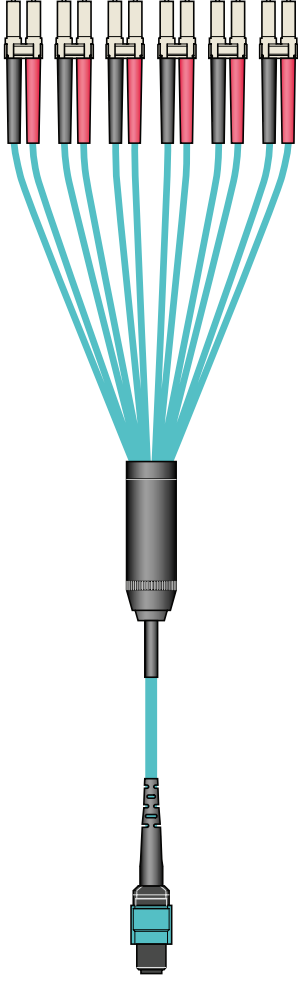
Trunk Cables/Patch Cables

Trunk cables are used to establish the connection between MPO modules, as a permanent link. These cables are available in fiber counts of 12, 24, 48 and 72, with their ends fitted with either 12-fiber or 24-fiber MPO connectors. MPO patch cords are used only in applications with 40-gigabit and 100-gigabit active devices (with an MPO interface). The ends of MPO patch cords are likewise fitted with either 12-fiber or 24-fiber MPO connectors. Trunk/patch cords come in male – male (left) and female – female (right) versions



Harness Cables

Harness cables make it possible for multi-fiber cables to transition to single fibers or duplex connectors. The 12-fiber harness cables provided by R&M, for example, come pre-assembled with MPO-side male or female connectors; fan-out legs are available with LC or SC connectors.



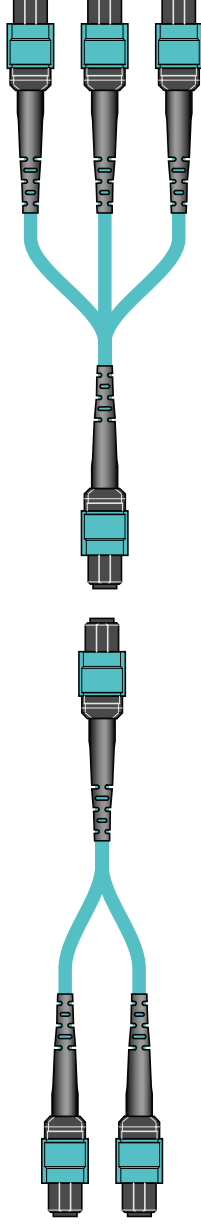
X Cables

24-fiber X cables are typically used to connect MPO modules. In this process, each of the two ends are terminated with two fan-out legs, and therefore two 12-fiber MPO plugs.



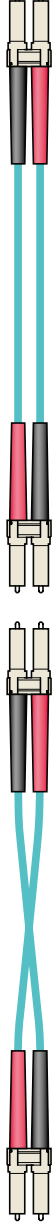
Y Cables

Y cables are normally used in a 2-to-1 design. One typical application of this design is combining two 12-fiber trunk cables into one 24-fiber patch cord when migrating up to 100 GbE. The 1-to-3 design is rather uncommon, but makes it possible to combine three 8-fiber MPO connectors with a 24-fiber permanent link, e.g. for a migration to 40 GbE.



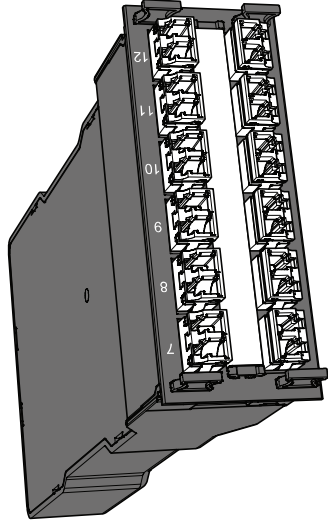
Duplex Patch Cables

These cables are not MPO cables, just conventional duplex cables. They are available in crossed (A-to-A) and uncrossed (A-to-B) versions, and come pre-assembled with LC or SC connectors.

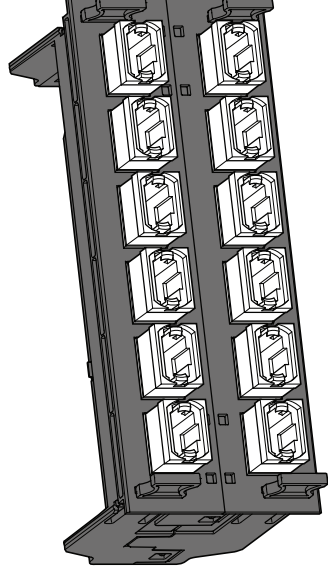


Modules and Adapter Plates

These devices represent the connection between permanent links and patch cords. The MPO module makes it possible to distribute the fibers supplied by trunk cables to duplex cables. Pre-assembled MPO modules come fitted with 12 or 24 fibers, front-side LC, SC or E-2000™ adapters and rear-side MPO.



MPO module with duplex adapters



MPO adapter plate (6 x MPO/MTP®)

An adapter plate connects MPO trunk cables with an MPO patch cord or harness cable. MPO adapter plates are available with 6 or 12 MPO adapters in Type A or Type B.

Polarity Methods

While the coding on MPO plug connectors and adapters are intended to ensure that the plug connection is always oriented correctly, the polarity methods A, B and C defined under TIA-568-C are intended to guarantee the bi-directional assignment is correct. This section contains a brief explanation of these methods.

Method A

Method A uses straight through-connected Type A backbones (pin1 to pin1) and MPO adapters of Type A (key-up to key-down). An uncrossed patch cord (A-to-B) is used at one end of the link, while a crossed patch cord (A-to-A) is used at the other end. The pairwise polarity inversion therefore occurs on the patch side. Note that only one A-to-A patch cord per link may be used.

R&M has been providing MPO components for method A since 2007. This method is very easy to implement, since, for example, only one case type is required, and the method is certainly the most widely distributed.

Method B

Method B uses crossed Type B backbones (pin1 to pin12) and MPO adapters of Type B (key-up to key-up). However, as the Type B adapters are used differently on both sides (key-up to key-up, key-down to key-down), a higher level of planning is required. An uncrossed patch cord (A-to-B) is used at both ends of the link. Method B is not widespread, due to the higher amount of planning required and also because the method does not allow for use of single-mode MPO connectors. In addition, R&M does not support this method (or rather, only upon specific customer request).

Method C

Method C uses pairwise crossed Type C backbones and MPO adapters of Type A (key-up to key-down). An uncrossed patch cord (A-to-B) is used at both ends of the link. The pairwise polarity inversion therefore occurs in the backbone, which involves an increased level of planning in the case of linked backbones. An A-to-A patch cord is required when the number of linked backbones is even.
Method C is not very widespread, due to the increased planning effort required and also because the method does not provide for a migration path to 40/100GBE. R&M does not support method C (or rather, only upon specific customer request).

Method S

Method S (designation defined by R&M) has been available since April 2013. This method requires only one patch cord type (A-to-B). The fiber cross-over for duplex signal transmission (10GBASE-SR) takes place in the pre-assembled case. The connectivity scheme for trunk and patch cords or light guidance always remains the same, even for parallel transmission in the construction of 40/100 GbE systems.
As the twelve LC ports are divided up by Tx and Rx, all Tx fibers are routed to one 12-fiber MPO and all Rx fibers to the other 12-fiber MPO. These two MPOs can be bundled, for example into one X cable. The modules include Type B adapters.
This makes symmetric cabling for 1G, 10G, 40G and 100G possible when the method is implemented in combination with Type B trunks. As a result, a direct upgrade can be realized cost-effectively and completely without complication, since cases just need to be replaced with adapter plates.

The following table reviews and summarizes the methods described above:

	Polarity Method	MPO/MTP Cable	MPO Module	Duplex Patch Cord Type
TIA-568.C Standard (Duplex signals)	A	Type A	Type A (Type A adapter)	1 x A-to-B 1 x A-to-A
	B	Type B	Type B1, Type B2 (Type B adapter)	2 x A-to-B
	C	Type C	Type A (Type A adapter)	2 x A-to-B
	S	Type B	Type S (Type B adapter)	2 x A-to-B
TIA-568.C Standard (Parallel signals)	A	Type A	Adapter Plate	MPO/MTP Patch Cord 1 x Type A 1 x Type B
	B	Type B	Type B	2 x Type B

Polarity Methods and Component Types



Type A Adapter
Key-up to key-down



Type B Adapter
Key-up to key-up



The construction of a completely new data center is definitely not an everyday occurrence. In this case, planners and decision makers have the possibility to immediately build upon the latest technologies and provide for higher bandwidths. By contrast, the gradual conversion and upgrade of an existing data center infrastructure to 100 Gbit/s will, indeed must, involve a broadscale effort implemented over a number of years. A sensible approach in this case is a gradual replacement of existing passive components followed by a replacement of active components as soon as these become available and economically viable. This upgrade is normally carried out in three stages:

Upgrading Existing 10G Environments

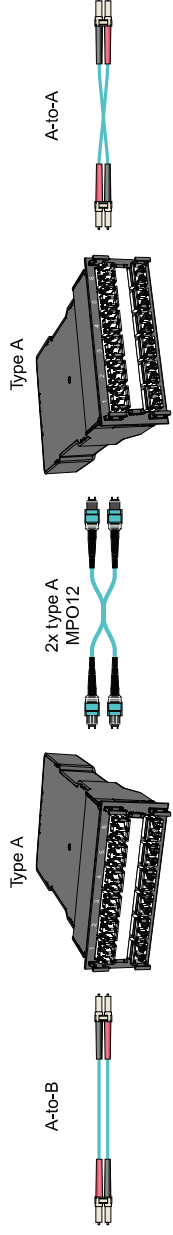
Guidelines for data center network planning can be found in the standards TIA-942-A, EN 50173-5, EN 501742:2009/A1:2011, ISO/IEC 24764 and the soon-to-be-available IEC 50600-2-4. The steps below only describe the steps involved in migration, and require that the network is appropriately planned and installed.

Without a doubt, the first step in migrating from 10 GbE to 40/100 GbE is to upgrade the existing 10 GbE environment. In this process, the backbone is replaced by a 12-fiber MPO cable, and LC/MPO modules and patch cords establish the connection to 10G switches.

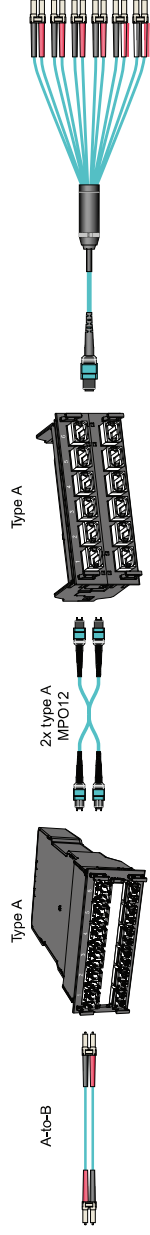
It is important to note here that the TIA-568-C standard for duplex signals refers to female trunk cables and male modules. However, for reasons of simpler migration, R&M recommends that trunk cables be installed as male versions and modules as female versions, so that female-female MPO patch cords can be connected to the trunk during the migration up to parallel optical signals. This is one step to reducing the complexity of the cabling systems. Migration is also possible using conventional methods and female-female trunk cables. However, because transceivers have an MPO male interface, either the existing trunk cables must be replaced or "hybrid" patch cords (male-female) used.

A number of different configurations result depending on the existing infrastructure and polarity method used.

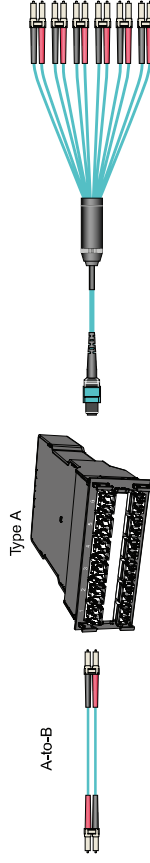
Method A



10G, case 1 – MPO trunk cables (Type A, male-male) replace the existing duplex trunk (center), MPO modules (Type A, female) enable the transition to the existing A-on-B (left) and A-on-A (right) LC duplex patch cords. Since HD MPO modules have two trunk-side MPO adapters, the option is available of consolidating the two 12-fiber MPOs into one 24-fiber X cable.

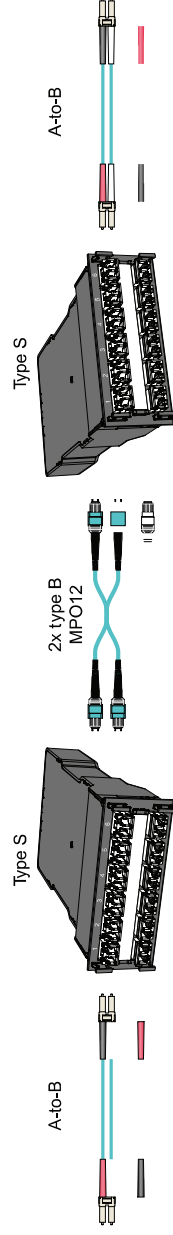


10G, case 2 – MPO trunk cables (Type A, male-male) replace the duplex trunk (center), an MPO module (Type A, female) enables the transition to the existing A-to-B LC duplex patch cord (left), adapter plate (Type A) and harness cable (female) replace the LC duplex patch cord.



10G, case 3 – Connection from A-to-B LC duplex patch cord, MPO module (Type A, female) and harness cable (male).

Method S

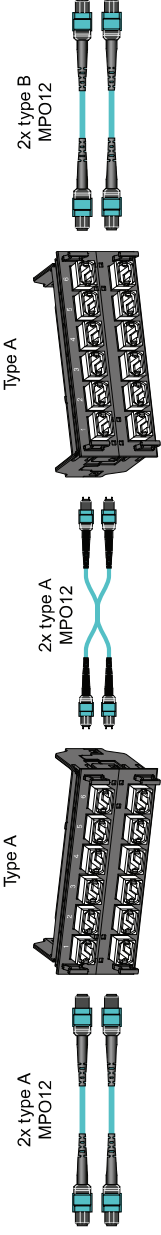


10G – MPO trunk cables (Type B, male-male) replace the duplex trunk (center), MPO modules (Type S, female) enable the transition to the existing A-to-B LC duplex patch cords (left, right). Since the Type S module divides Tx and Rx up onto one MPO each, an X cable, or two trunks, is required.

Upgrade from 10G to 40G

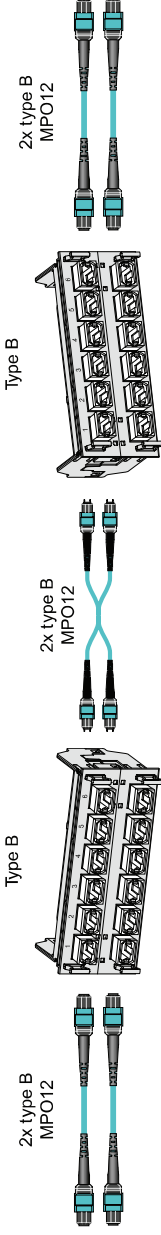
If the next step involves replacing 10G with 40G versions, the next adaptation can be carried out very easily by using MPO adapter plates in place of MPO modules. In addition, the polarity method in use must be observed.

Method A



Replacement of MPO modules with Type A adapter plates and LC duplex patch cords by MPO patch cords of Type A, female-female (left) and Type B, female-female (right). An existing X cable can now serve two 40G links.

Method S and Method B

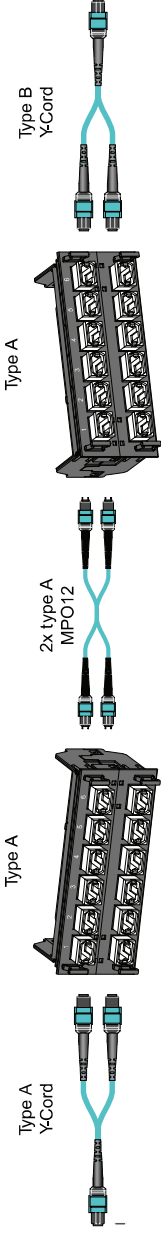


Replacement of MPO modules with Type B adapter plates and LC duplex patch cords by MPO patch cords of Type B, female-female (left, right). When this configuration is compared to the TIA-568.C standard, we notice immediately that methods S and B are identical for parallel optical signals. An existing X cable can serve two 40G links in this case as well.

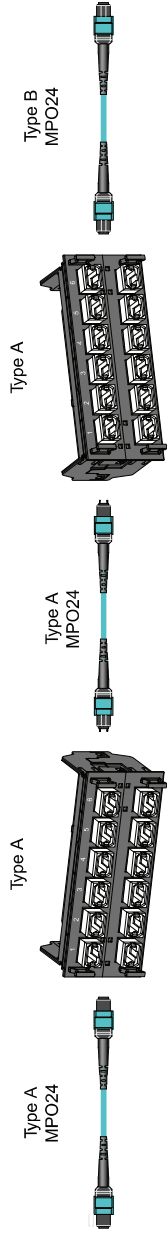
Upgrade from 40G to 100G

In the final step, the use of 24-fiber MPO cables may also be necessary when 100G switches are being implemented¹). In this case either the existing 12-fiber connection can be extended by a second 12-fiber connection, or replaced by one with 24 fibers.

Method A

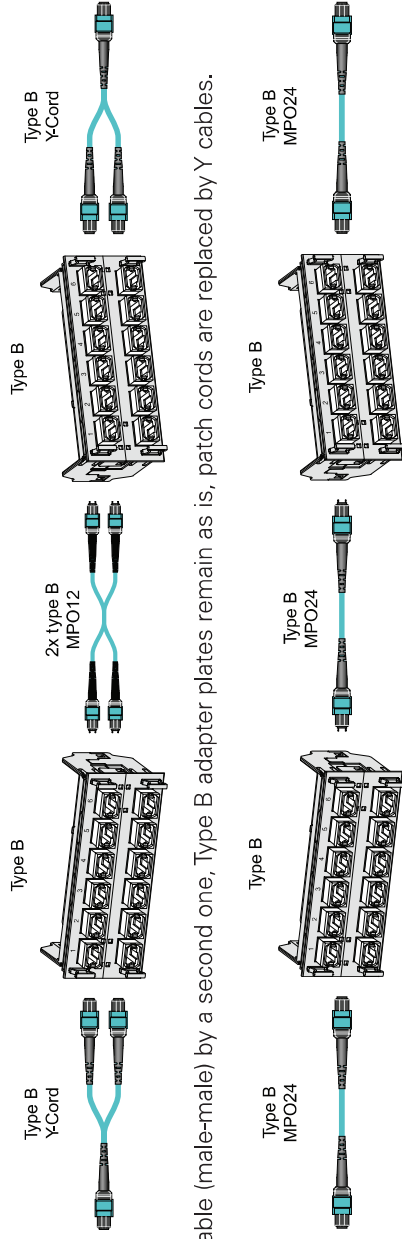


Extension of MPO trunk cable (male-male) by a second one, Type A adapter plates remain as is, patch cords are replaced by Y cables.



The MPO-24 solution – Use of an MPO-24 trunk cable of Type A male-male, Type A adapter plates remain as is. MPO-24 patch cords of Type A, female-female (left) and Type B, female-female (right) are used as patch cords.

Method S and Method B



Extension of MPO trunk cable (male-male) by a second one. Type B adapter plates remain as is, patch cords are replaced by Y cables.

The MPO-24 solution – Use of an MPO-24 trunk cable of Type B male-male, Type A adapter plates remain as is. MPO-24 patch cords of Type B, female-female are used as patch cords on both sides.

Summary

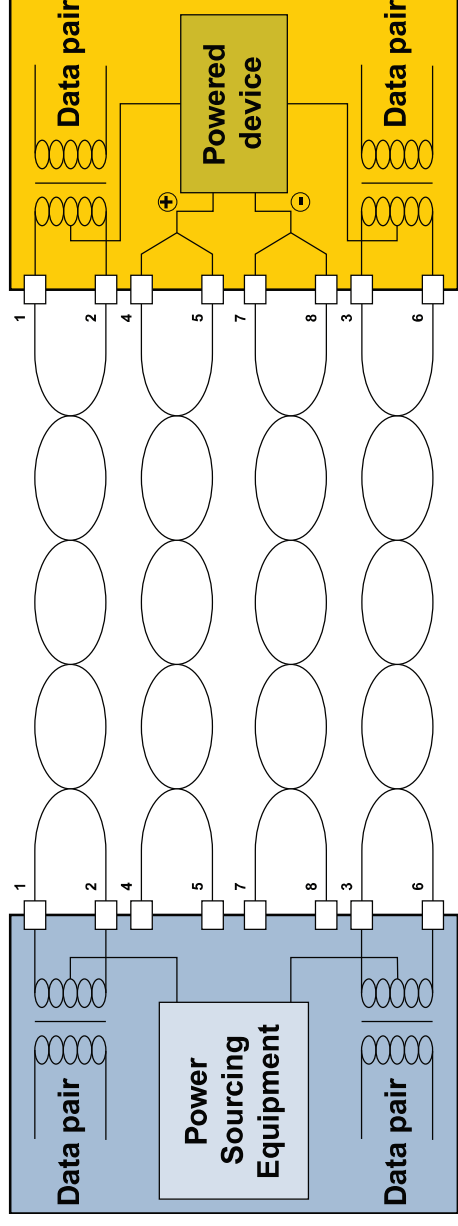
The implementation of MPO components and parallel optical connections translates into new challenges for data center planners and decision makers. Cable lengths must be carefully planned, MPO types correctly selected, polarities maintained over the entire link and insertion loss budgets calculated precisely. Short-term changes are either barely possible or are not possible at all, while errors in planning can be expensive. Nevertheless, it is very worthwhile to switch to the new technology, especially since it is already becoming a technological necessity over the medium term. It therefore makes sense to have switch points already placed early on, and to at least adapt passive components to future requirements. The high expense is more than offset by the technology's short installation times, quality that is inspected and documented for every single component, and operational reliability and investment security that will bring peace of mind for years to come.

Power over Ethernet (PoE / PoEplus)

PoE and PoEplus can be used in data centers to remotely supply power to infrastructure and monitoring devices. The standard and performance of the supported device (powered device = PD):

- **IEEE 802.3** Section Two: Power over Ethernet (PoE) = 12.95 W power
- **IEEE 802.3** Section Two: Power over Ethernet (PoEplus) = average 25.50 W power

The new standard, IEEE 802.3 Section Two, was released in October 2009. The definitions of PD (powered device) and PSE (power sourcing equipment) are the same as in the PoE IEEE 802.3 Section Two standard.



An endspan example as defined in the PoE IEEE 802.3 Section Two standard.

Compatibility between PoE and PoEplus PD/PSE Versions

PD operation on PSE	
PoE-PSE	PoEplus-PSE
Operational	Operational
PoEplus-PD < 12,95 W	Operational ^{Note}
PoEplus-PD > 12,95 W	Operational ^{Note}

PD = Powered Devices PSE = Power Sourcing Equipment Note: Operation with extended performance classification

The terminology makes a distinction between devices with low power consumption and those with high power consumption:

- Type 1: Low power consumption
- Type 2: High power consumption

The following table shows some of the differences between PoE and PoE-plus. Heat generation is a problem with these technologies due to the higher current flow into cabling. Some suppliers recommend using higher category cables in order to mitigate this effect.

PoE	PoEplus
Cable requirement	Type 1: Cat. 3 or higher Type 2: Cat. 5 or higher
PSE current (A)	Type 1: 0.35 A Type 2: 0.6 A
PSE voltage (Vdc)	Type 1: 44-57 Vdc Type 2: 50-57 Vdc
current (A)	Type 1: 0.35 A Type 2: 0.6 A
PD voltage (Vdc)	Type 1: 37-57 Vdc Type 2: 47-57 Vdc

Differences between PoE & PoEplus / Source: Ethernet Alliance, 8/2008

Problems Due to Cable Heating

The transfer of energy via a universal communication cabling system leads to a temperature increase in the cabling, based on the amount of energy transferred and the conductor cross-section. The cable in the center of a bundle naturally heats up more since heat cannot be dissipated here. With heat increasing in the cable bundle (ambient temperature + temperature increase), insertion loss increases as well, which can lower the maximum permissible cable length. In addition, the standard limits the maximum temperature (ambient temperature + increase) to 60° C.

Cable Type	Conductor Cross-Section	Approx. Temperature Increase
Cat. 5e / u	AWG 24	10° C
Cat. 5e / s	AWG 24	8° C
Cat. 6 / u	AWG 24+	8° C
Cat. 6A / u	AWG 23	6° C
Cat. 6A / s	AWG 23	5° C
Cat. 7	AWG 22	4° C

Temperature Increase in PoEplus

These effects result in two limiting factors:

- Reduction in the maximum permissible cable length due to higher cable attenuation as a result of the higher temperatures
- The maximum temperature of 60° C established in the standard

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