ULTRA-HIGH FIBER COUNT SOLUTION GUIDE

AFL HYPERSCALE®

About

AFL HYPERSCALE®

A global leader in fiber optic technology, AFL Hyperscale brings together over 70 years of design and manufacturing expertise to create next generation, end to end connectivity solutions for all data center, telecom and enterprise networks.

Using a consultative approach we bring responsiveness, innovation, and scalability to the forefront of our solutions with the aim of innovating network connectivity forever.

AFL Hyperscale. The World, Connected.

CHALLENGES FACING TODAYS DATA CENTER:

The extraordinary growth of Cloud Computing, Internet of Things and Artificial Intelligence in the last decade has had a dramatic impact on data center scale, design and connectivity.

Cloud computing services are the fastest growing among all large systems activities worldwide, and have led to the development of new data center architectures, with Hyperscale data centers being built in clusters and multiple Co-location data centers being built in campus environments. These multi-data center designs require very rich interconnections between the buildings and within the buildings. Accommodating these new designs into existing networks has led to severe cable management issues and network degradation over time. Existing ducts are full and demand for increasing connectivity and bandwidth are showing no signs of slowing.

At AFL Hyperscale, we develop and deliver advanced, scalable network infrastructure solutions to facilitate the ultra high fiber counts, bandwidth and connectivity required today and in the future, for Hyperscale and Co-Location data centers alike.

Our ground-breaking Ultra-High Fiber Count solution is the answer to your evolving data center network, providing interconnection between and within data center buildings on a scale, never seen before.

WHAT IS THE AFL HYPERSCALE ULTRA-HIGH FIBER COUNT (UHFC) SOLUTION?

The AFL Hyperscale Ultra-High Fiber Count Solution presents a new, innovative method for data centers to connect and inter-connect with ultra-high fiber count cable (using AFL SpiderWeb Ribbon® technology), and simplify cable management across and between data centers, from cable entry, to the customers space - using practical, high-density connectivity methods including splicing, patching and or blowing to ensure a convenient and fast deployment.

www.aflhyperscale.com/ultrahighfibercount

MAXIMIZE

- PORT CAPACITY
- FIBER COUNT IN NEW OR EXISTING DUCTS AND PATHWAYS
- NETWORK PERFORMANCE
- CABLE MANAGEMENT PATHWAY ROUTES
- INSTALLATION OPTIONS

MINIMIZE

- SOLUTION DEPLOYMENT
- CABLING INSTALLATION TIME
- FOOTPRINT IN DISTRIBUTION AREAS
- LEAD TIME (FACTORY TO SITE)
- OPERATIONAL COSTS

SIMPLIFY

- FIBER MANAGEMENT
- NETWORK ARCHITECTURE
- INSTALLATIONS OF HIGH FIBER COUNTS
- MOVES, ADDS AND CHANGES

APPLICATION MODEL

In developing the UHFC Solution, we have adopted a series of connectivity reference models including large Co-Location (Green Field), large Co-Location (Brown Field), Hyperscale and Large Enterprise/Multi-Hall scenarios. These models include campus or cluster cabling, internal Data Center trunk cabling and connections from cable entry all the way to the customer space or edge network equipment.

In this document, we look at the large Co-Location (Green Field) reference model, adopting a simplified version of the ISO/IEC 24764 standard.
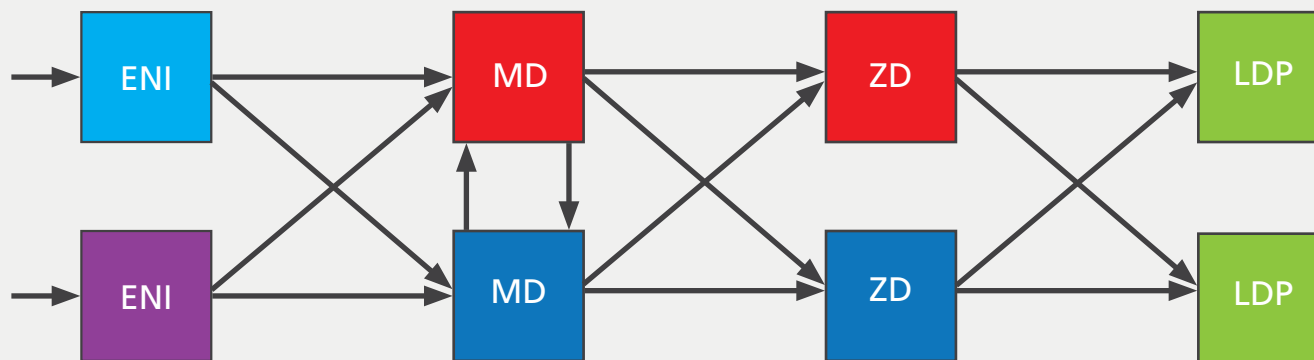
ENI - External Network Interface
MD - Main Distribution
ZD - Zone Distribution
LDP - Local Distribution Point

CAMPUS INTERCONNECTION

In our large Co-Location (Green Field) Reference Model, three Co-Location Data Centers are located within a campus and connected with two or more diversely routed cables.

Cables run in ducts from External Network Interface (ENI) rooms to other ENI rooms, with fiber counts often in excess of 1000 and link lengths running from 100 meters to several kilometers.
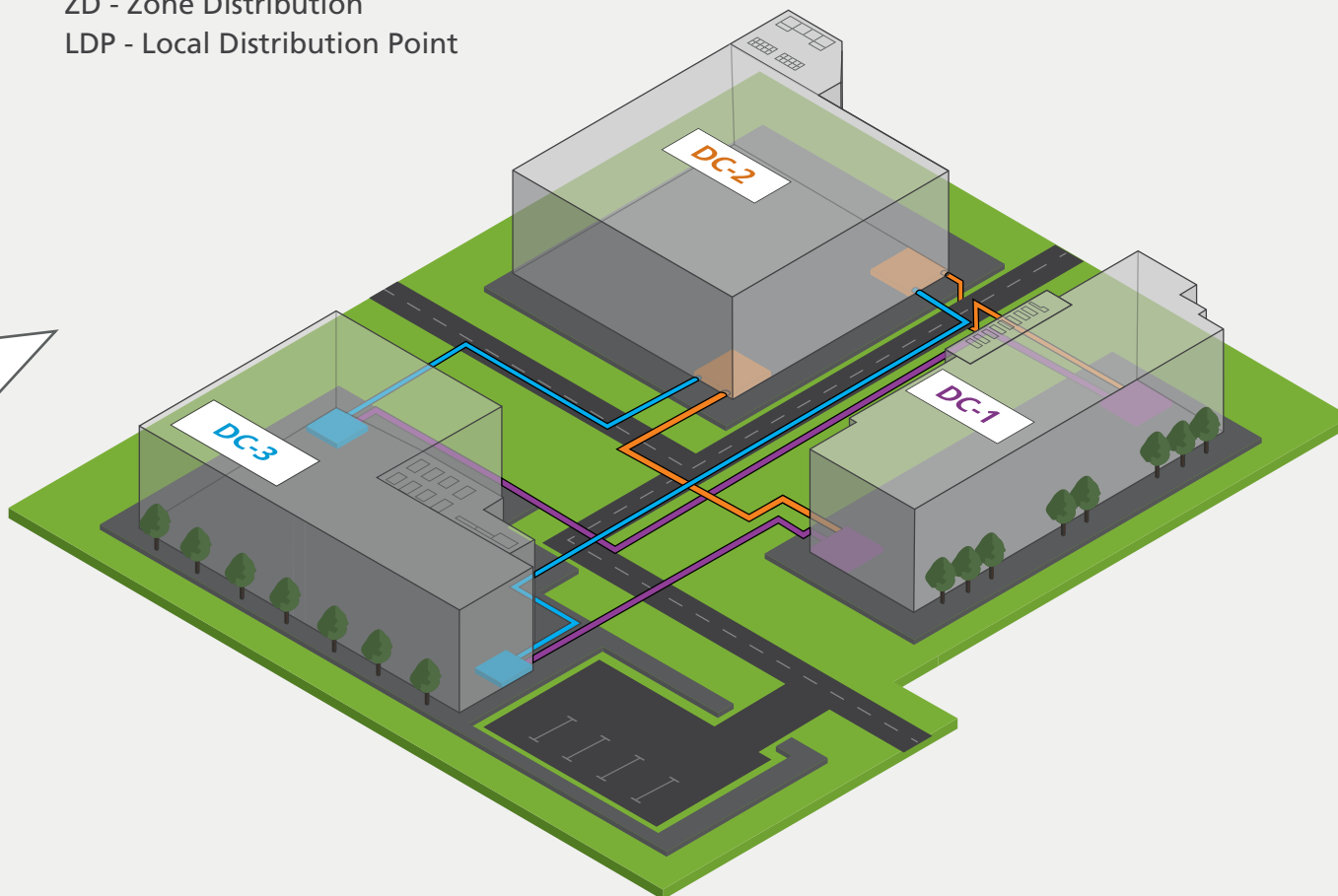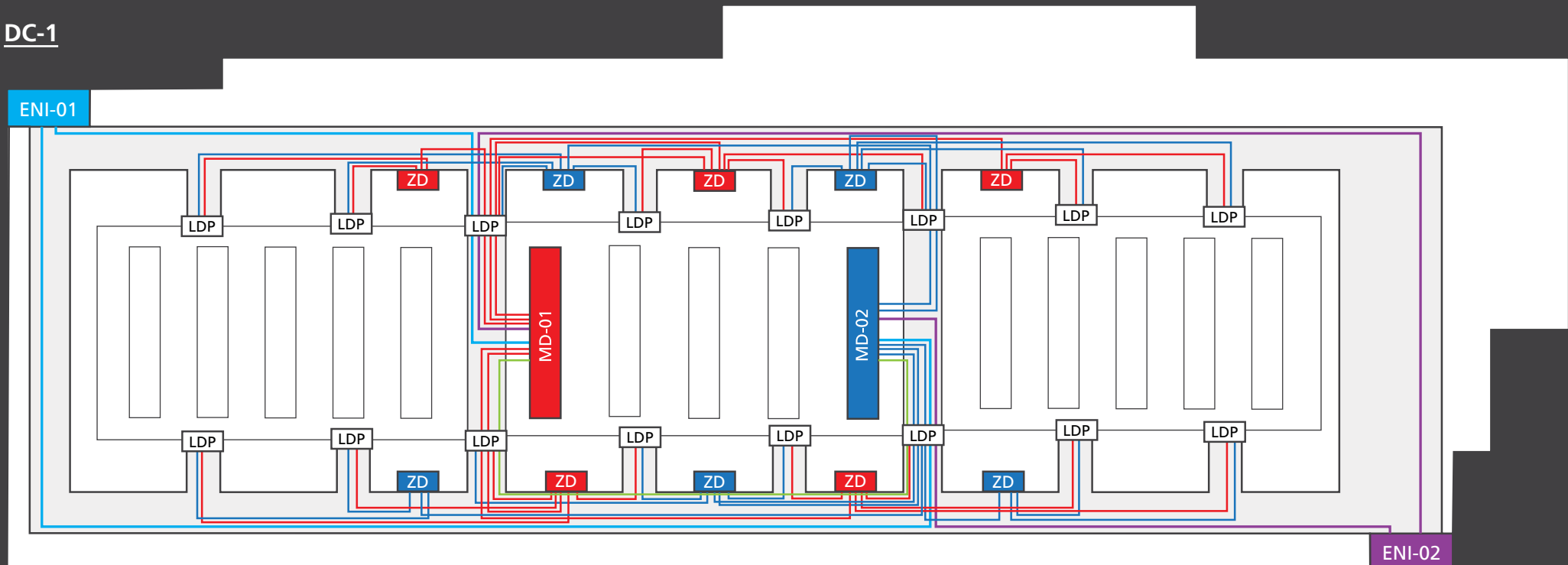
CO-LOCATION APPLICATION MODEL

In our Co-Location reference model, the network design adopted, provides maximum flexibility of connectivity between all spaces within the data center building and also to the other data centers on the campus. The design can be split into two discreet sections – the backbone and the horizontal cabling.

In the horizontal cabling, all of the equipment racks are cabled back to the Main Distribution frames using medium fiber count cables.

In the backbone cabling all of the MDs on the campus are interconnected, using very high fiber count cables. This allows a client in any space on the campus to be connected to a service provider located anywhere on the campus, scaling the campus into a single Hyperscale space.
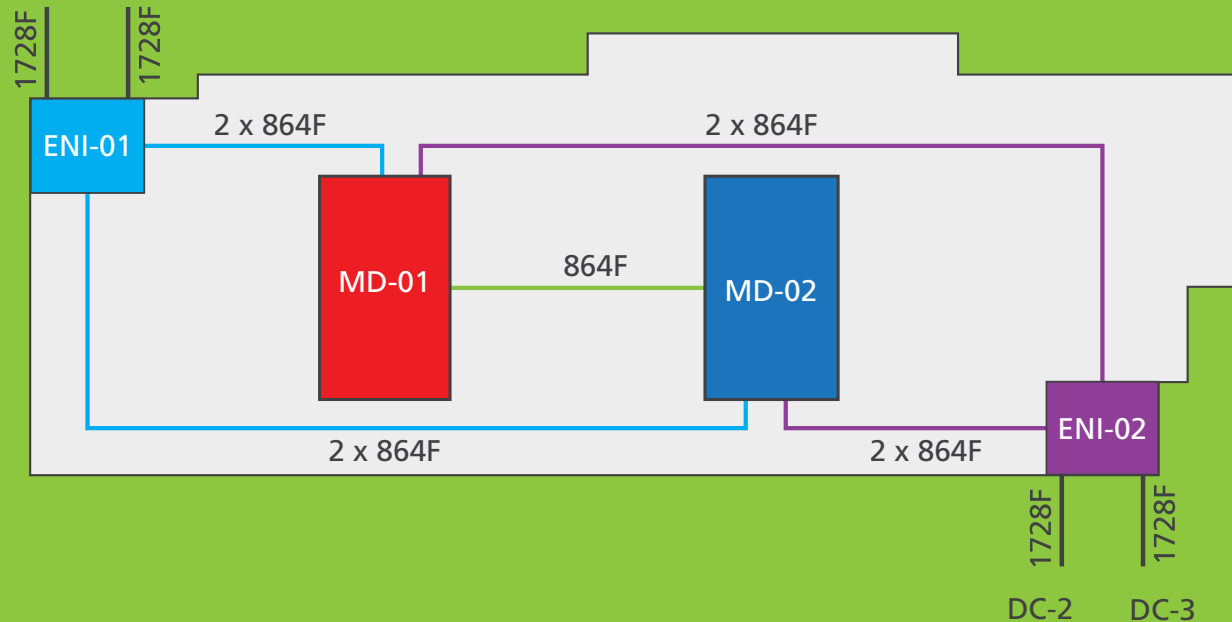
DC-1

DC-1

DC-2   DC-3

1728F   1728F

ENI-01

2 x 864F   2 x 864F

MD-01   864F   MD-02

2 x 864F   2 x 864F

ENI-02

1728F   1728F

DC-2   DC-3

DATA CENTER BACKBONE

The MD connections to the ENI, to the other MD within the data hall and to the other MDs within the data center building are often referred to as the data center backbone. These are typically linked with high density cable of 144 fibers to 864. Due to the routing of the high fiber cables through walls and between floors, routes are usually run as bare cable and fusion spliced at the termination points. Alternatively, they can be installed as single end pre-terminated cable , with the free end, pulled (or blown) from the source to the destination.

DC-1

MD-01   MD-01

ZD   ZD

LDP   LDP   LDP   LDP
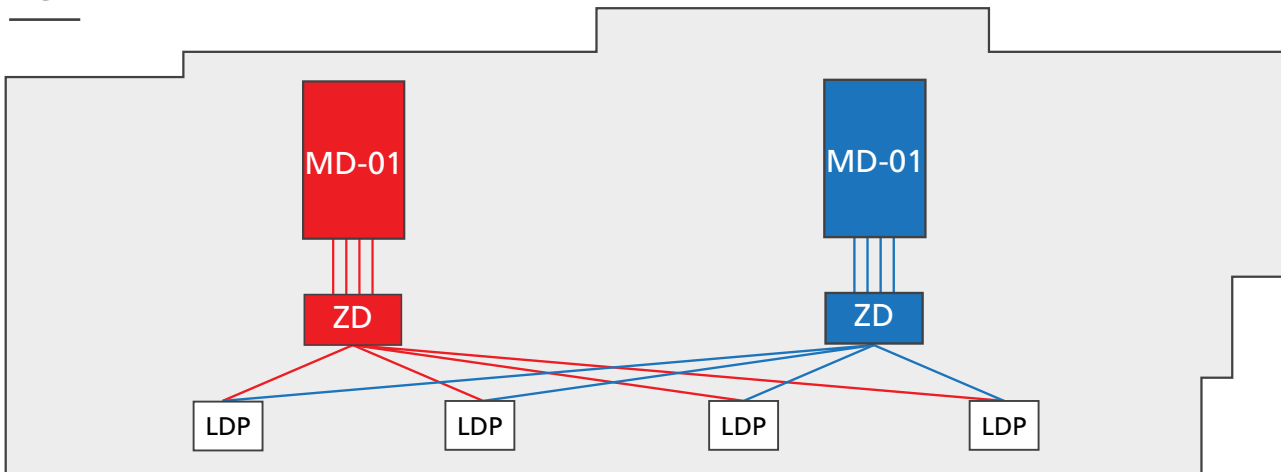
HORIZONTAL CABLING

The MD connections out to the client space and equipment racks are referred to as the data center horizontal cabling. In our Co-Location model, these links need to be provisioned to offer the maximum flexibility for deploying connectivity to the client space as and when it is needed. The architecture needs to accommodate very low density fiber deployments as well as very high fiber count deployments in the same space.

OUR SOLUTION IN ACTION

1. 3456F Mass Fusion Splice Wall Cabinet
2. 9U Ribbon Mass Splice and Patch
3. UHD 2U Chassis
4. Octagonal Junction Box
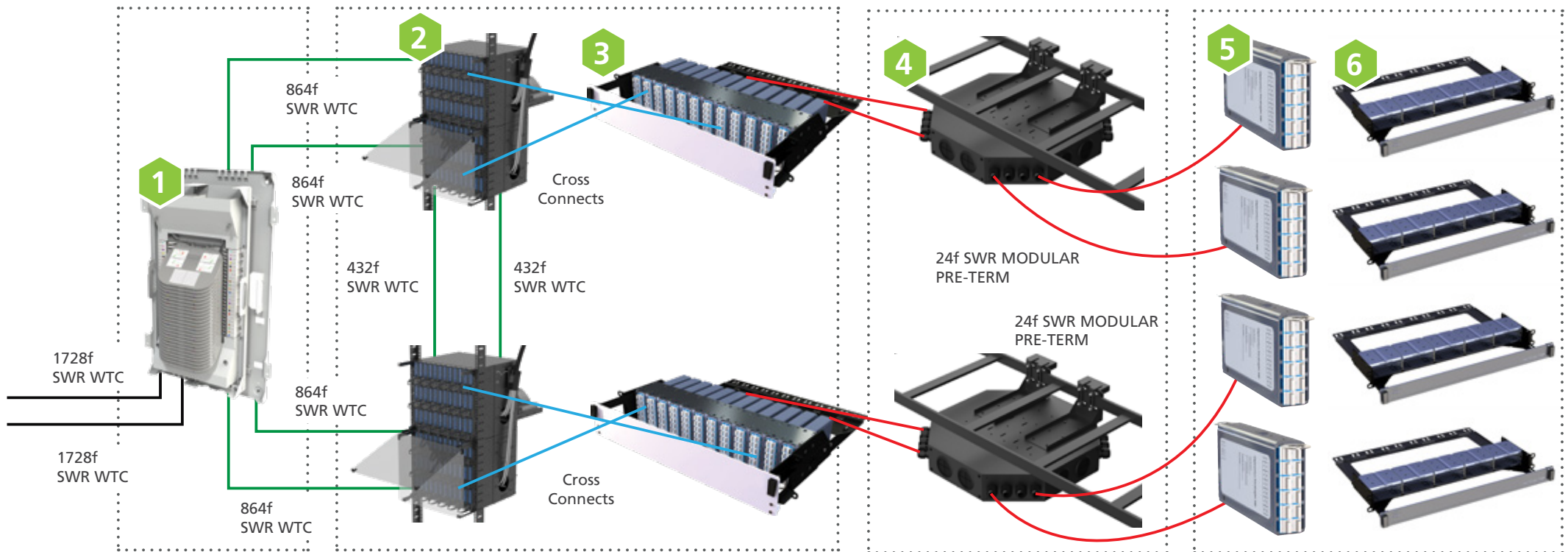5. UHD MPO to LC/SC Module
6. UHD 1U Chassis

ENI **MD** **ZD** **LDP**

864f SWR WTC

864f SWR WTC

432f SWR WTC

432f SWR WTC

Cross Connects

864f SWR WTC

1728f SWR WTC

1728f SWR WTC

864f SWR WTC

Cross Connects

24f SWR MODULAR PRE-TERM

24f SWR MODULAR PRE-TERM

This diagram takes the large Co-Location (Green Field) reference model, (simplified version of ISO/IEC 24764 standard), and shows how the AFL Hyperscale UHFC Solution can maximize the density, and minimize the footprint of your data center space.

Across the next few pages, we will be exploring these different network areas in more detail, giving a more in-depth look at the features and benefits of the products that make up this next-generation data center solution.

Up to
6912
easy to manage fibers
in one cable

Up to
44%
smaller diameter to
similar fiber counts

40%
reduction on
installation time from
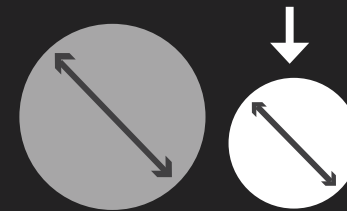cable preparation to
mass splicing

INTRODUCING SPIDERWEB RIBBON® (SWR®) TECHNOLOGY

SpiderWeb Ribbon® is a bonded fiber design that allows for both highly efficient ribbon termination and legacy discrete fiber termination. Compact, ultra-high fiber count cables fabricated using SWR fiber are central to the UHFC Solution.

12 fibers are intermittently connected together using a resin bond, the intermittent nature of the bond allows the ribbon to be bunched and collapsed similar to a bundle of loose fibers. It further lets the ribbon act as either a traditional ribbon for mass fusion splicing, or be broken out into individual fibers for single fiber handling.

SWR® technology significantly reduces cable diameter and weight, and is used in ultra-high fiber count indoor and outdoor cable types, resulting in lower installation costs and major improvements in utilisation of cable pathways and duct space.

12 or **1**

Mass fusion splice
12 fibers at a time

Single splice

More than
73%
lighter than todays
ribbon cables
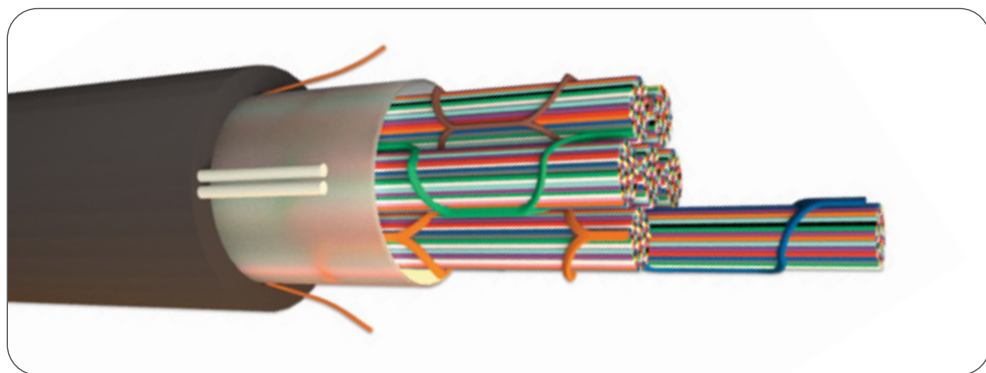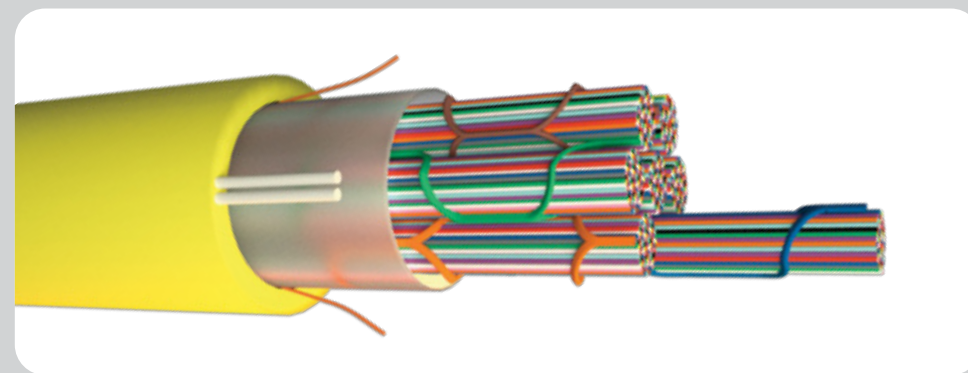
WRAPPING TUBE CABLE (WTC) WITH SWR®

This ultra-high density fiber outside plant cable is designed for data center interconnect applications, and provides the smallest cable diameter, lowest weight, and highest-fiber count ribbon cable in the industry. The WTC SWR® armoured cable is available with up to 1,728 fibers, and up to 3,456 fibers in the non-armoured configuration.

144 Fibers	288 Fibers	432 Fibers	576 Fibers
10.5mm	12mm	13.5mm	15mm

864 Fibers	1152 Fibers	1728 Fibers	3456 Fibers
17.5mm	18.5mm	23mm	30mm
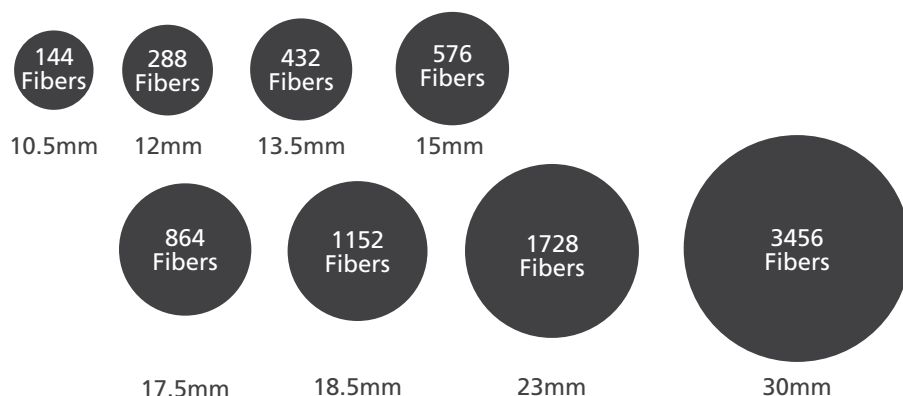
Application: OSP Inter-Building links ENI-ENI


FLAME RETARDANT (FR) WRAPPING TUBE CABLE (WTC) WITH SWR®

(INDOOR WTC WITH SWR®)

Suitable for inside plant and indoor/outdoor network applications. The FR WTC is available with an OFNR (Riser) or LSZH Jacket and can be deployed wherever an OFNR (riser) or LSZH rating is required. Due to the core water-blocking feature, the cable can also be routed outside providing the cable is housed within a covered pathway space.

| 288 Fibers	432 Fibers	576 Fibers	864 Fibers	1728 Fibers
13mm	15mm	16.5mm	18.5mm	24mm
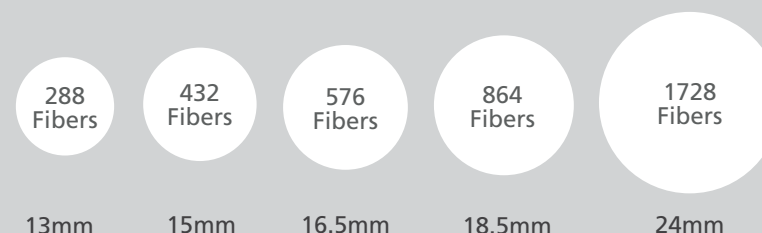
Application: ISP ENI-MD & MD-MD
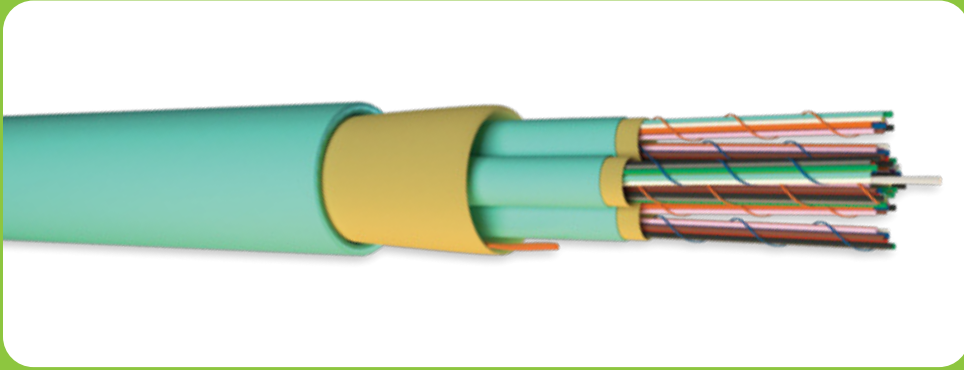
SUB-UNITIZED MICROCORE® 3.0 WITH SWR® TECHNOLOGY

Sub-unitized cable offers maximum utilization of cable routes while providing a broad range of termination options. Sub-units contain either one or two 12-fiber SWR® bundles in an individual cable construction, allowing routing to different modules, trays or even different cabinets in the data center. Cables contain 4, 6, 8 or 12 sub-units yielding a maximum fiber count of 288 fibers. The SWR® fiber bundles allow for time saving mass fusion splicing or direct termination with an MPO splice on connector.

96 Fibers	144 Fibers	216 Fibers	288 Fibers
10.2mm	12.7mm	15.5mm	18.4mm

Application: ISP MD-ZD
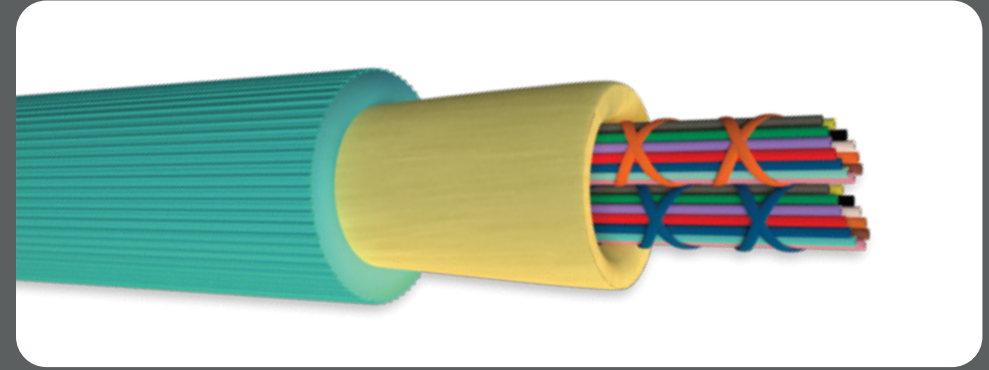
eABF® WITH SWR® AIR BLOWN CABLE

Quickly and easily deploy high density indoor cable when you need it by air blowing SWR® cable hundreds of meters in the Dura-Line FuturePath® MicroDuct pathway. With the ability to easily remove cables without disturbing neighbouring cables and redeploy a higher count or reroute the cable to a different area in the data center, blown SWR® fiber bundles can be mass fusion spliced, or directly terminated with an MPO splice on connector.

24 Fibers	48 Fibers	72 Fibers	144 Fibers
3.5mm	4mm	4.5mm	8mm
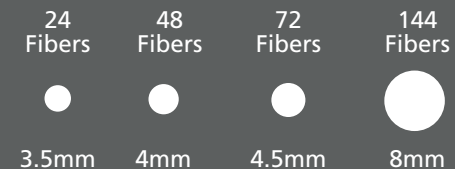
Application: ISP MD-LDP

Our comprehensive range of ultra-high fiber-count, outdoor and indoor/outdoor SWR® fiber cables enable inter-building fiber connectivity on an unprecedented scale. Coupled with this, our building entrance solutions provide the ultimate transition between Outside and Inside Plant networks and cabling infrastructure.

In this scenario, ultra-high fiber count external grade Polyethylene (PE) SWR® cables are converted to high fiber count indoor rated SWR® cables in the ENI, this is a permanent connection so is best suited to fusion splicing.

In our example, we have two 1,728 WTC SWR® cables coming into each ENI and four 864 fiber indoor WTC SWR® going out to the Main Distribution area.

By taking full advantage of the SWR® technology, the ultra-high fiber count cables are mass fusion spliced using Fujikura's 70R Ribbon Fusion Splicer. The splices are then managed and stored in specially designed mass fusion splice trays, each of which hold up to 12 splices (144 fibers). The splice trays are then either mounted in a bespoke 3,456f wall mount enclosure or in a traditional splicing frame, depending on the available space and customer preference.

The 864 fiber indoor WTC cables are then routed to the Main Distribution area where they are Mass Fusion spliced into specially designed 9U 864 fiber splice and patch housings. This high density splice and patch housing is an AFL Hyperscale bespoke designed housing to meet the needs of terminating a ultra high fiber count SWR cable.

3456 MASS FUSION SPLICE WALL CABINET

3456f

Quickly ribbon splice and store up to 3456 fibers

Designed for one person installation

Adjustable working tray for easy installation

Top and bottom cable entry

Increase security with a padlock **(not included)**

ENI

Recommended for use in the ENI

9U
MASS SPLICE & PATCH

864 LC Ports

864 easily accessible LC Ports in 9U

Designed for ribbon splicing for fastest possible installation

Integrated front patching management

Easy rear access to splice tray system

Front screen for additional port protection

MD

Recommended for use in the MD

6U
MASS SPLICE & PATCH

864 LC Ports

864 easily accessible LC Ports in 6U

Designed for ribbon splicing for fastest possible installation

Effective cable management with V-shape front plate

Easy rear access to splice tray system

Front screen for additional port protection

MD

Recommended for use in the MD

AFL Hyperscale has a selection of unique products that allow you to terminate the data center backbone in a number of different methods, in a manner most suited to your MD area:

1 Raw cable and mass fusion splice

2 Both ends pre-terminated with either MPO or stubbed cassettes

3 One end pre-terminated with either MPO or stubbed cassettes   and the unterminated end is free to be fusion-spliced
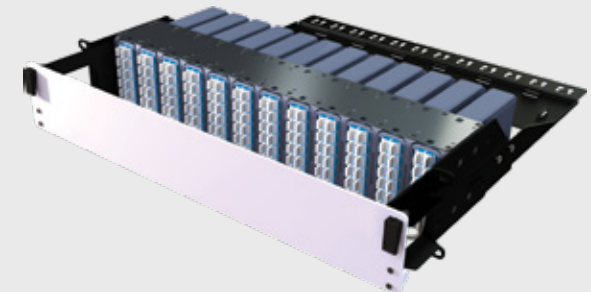
1 RAW CABLE AND MASS FUSION SPLICE:

Specifically designed to make management of high fiber counts an easy process, our 9U or 6U splice and patch housings can be deployed. Optimized for WTC SWR® cables, up to 864 fibers can be mass fusion spliced or patched for cross connects in the same housing.

2 BOTH ENDS PRE-TERMINATED WITH MPO OR STUBBED CASSETTES

Connecting 12 or 2 x 12 fiber MPO to MPO trunk assemblies to our Ultra-High Density (UHD) MPO Module provides one of the fastest plug and play installation methods on the market. UHD Modules when mounted into our 12 port 2U UHD chassis, present 288 LC ports on the front of the chassis, or a best-in-class 576 fibers when used in 4U of space. Conversely, UHD modules can be pre-terminated directly from module to module providing the lowest link loss possible.
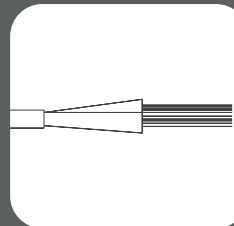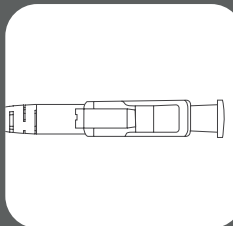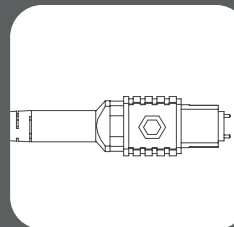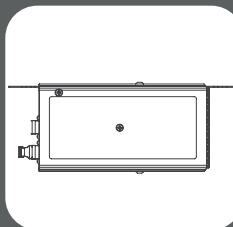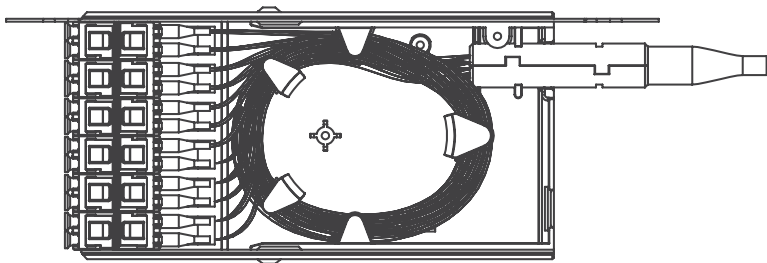

UHD 2U CHASSIS

– Up to 288 LC ports in 2U or 2304 fibers using MPO Interface
– Open chassis for front and rear module access
– Secure easy access lock/release/service mechanism
– Facilitated patch cord installation and front plate protection
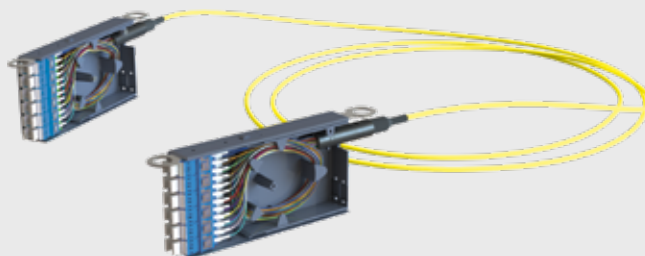– Rear cable management available

One end pre-terminated with either MPO or stubbed cassettes and the unterminated end is free to be fusion-spliced, terminated directly to MPO, or ruggedized or 900um single fiber tails.

3

UHD MPO TO LC/SC MODULE

- MPO to 24 LC or 12 SC ports
- Low loss MPO termination
- SM and MM (OM3/OM4) Version
- Polarity A, B or C

MODULE TO MODULE PRE-TERMINATED ASSEMBLY

- High performance factory made and tested modules
- Reduced amount of interconnections leads to improved power budget
- Improved economics

MPO TRUNK ASSEMBLY

- 12-144 fiber assemblies
- 12 or 24 fiber MPO connectors
- Number of polarity options available
- Select your cable construction and trunk length
- Compact 12 fiber 3mm and 4.5mm MPO assemblies available

HORIZONTAL CABLING OPTIONS

The MD connections to the Equipment Cabinets (EC) within the data hall are usually referred to as the data center horizontal cabling. In designing these links, consideration must be given to the flexibility required on the infrastructure over its lifetime. If the fiber count per EC is known and will remain fixed, then direct links from the MD to the EC can be installed. If the fiber counts are unknown but can be averaged, medium fiber count trunks can be deployed to a Zone Distributor (ZD) and terminated there, then when fibers are required in equipment cabinets, they can be run from the ZD to the Cabinet.

In scenarios where there are likely to be a lot of changes to the horizontal cabling, it is recommended to install the horizontal cabling through air blown ducts, simplifying the removal, replacement or redirection of installed cables.

PRE-TERMINATED CABLING

In a Large Co-Location datacenter, fiber counts per client space are unpredictable. One option to cater for this uncertainty is to run medium density (96f – 288f) cables from the MD out to the ZD. These cables can be pre-terminated on both ends with MPO or LC connectors on the MD end, and MPO connectors on the ZD end. When a client connection is to be deployed, the required fiber count assembly can be run from the client space to the ZD. This assembly should be pre-terminated with a UHD cassette on the client end and connected by an MPO at the ZD end.
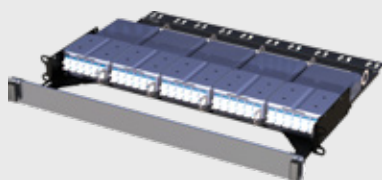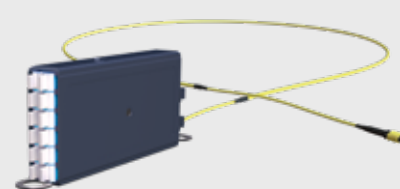

UHD 1U Modular Chassis

UHD MPO TO LC/SC Module

MPO Assemblies

UHD Pre-Terminated Module

A data center air blown solution utilizes AFL's industry leading eABF® with SWR® cable for the highest density cable in the smallest diameter. The cable paths are pre-installed with MicroDuct bundles that range in size from single, to 24-way ducts. Larger bundles can be broken out and split into smaller bundles using a MicroDuct Distribution Panel (MDP) and routed to individual Equipment Cabinets or pods of cabinets.

When a customer connection is to be installed, a cable with the required fiber count can be easily blown through the ducts from the LDP, back through the ZD, and all the way to the MD. The cables can be blown as bare cable and fusion spliced on both ends in a UHD Splice Module, or pre-terminated on one end (usually the EC end) blown in, then Mass Fusion Spliced on the other end.
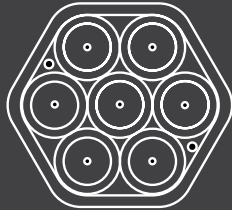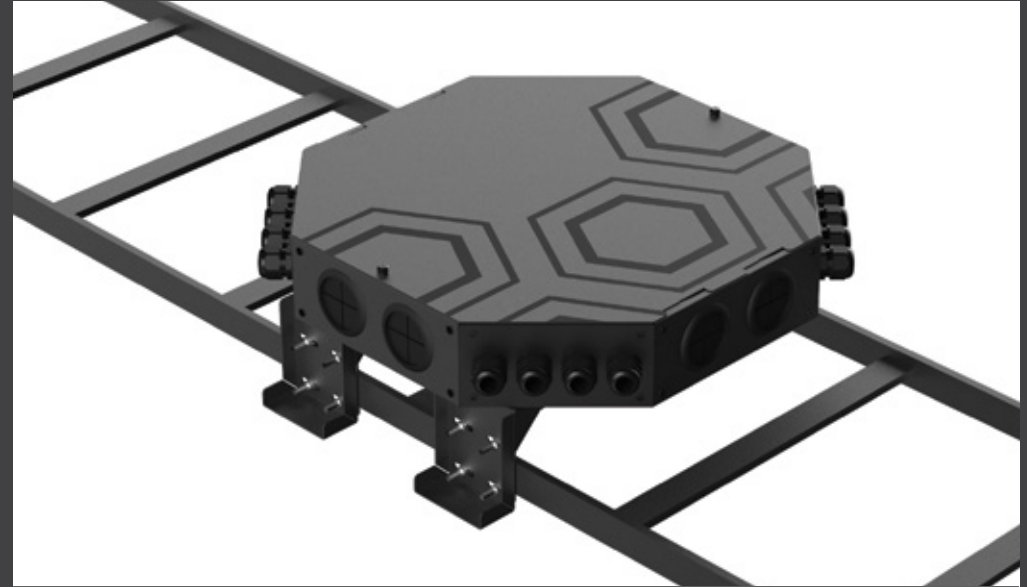

FOR USE
BETWEEN ZD
AND LDP

7-Way
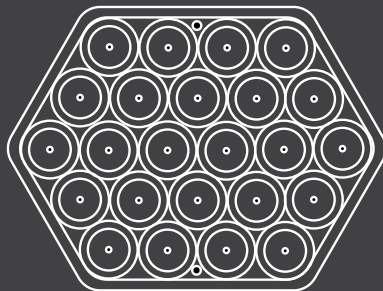
The MDP is an Octagonal "Junction Box" for routing high bundle count MicroDuct bundles to low bundle count bundles. The MicroDucts are connected inside the MDP using micro couplers to directly join the ducts, allowing cable to be routed in any direction across the data center

FOR USE
BETWEEN
MD TO ZD

24-Way

Various blowing equipment is available on the market and the Plumett UltimaZ P2P-V20 is one of the simplest. Suitable for eABF cables up to 72 fibers, it is operated by a simple corded or cordless drill

HOW TO SPLICE SWR® CABLE

Using the latest splicing technology from Fujikura®, this group of accessories make mass-fusion splicing SWR(R) cable, fast and easy, speeding up installation time by up to 40%

FUJIKURA 70R+ FUSION SPLICER

Perfect for high density applications, the ruggedized Fujikura 70R+ fusion splices 12 fibers in 11 seconds, and splice protects in 18 seconds. Whether outside or in, the 70R+ is one of the most versatile and efficient fusion splicers on the market.

MPO FUSECONNECT

FUSEConnect fusion-spliced, field-installable connectors utilize a fusion splicer to terminate the connector in the field. FUSEConnect connectors are available in MPO, LC, SC, FC & ST connector variants in both angle and flat variants.

FUJIKURA CT-30A CLEAVER

The Fujikura CT-30A is a portable, precision cleaver suitable for cleaving up to 12 fibers simultaneously. The 16 position blade yields 48,000 single fiber cleaves, or 4,000 12-fiber cleaves before a replacement blade is required.

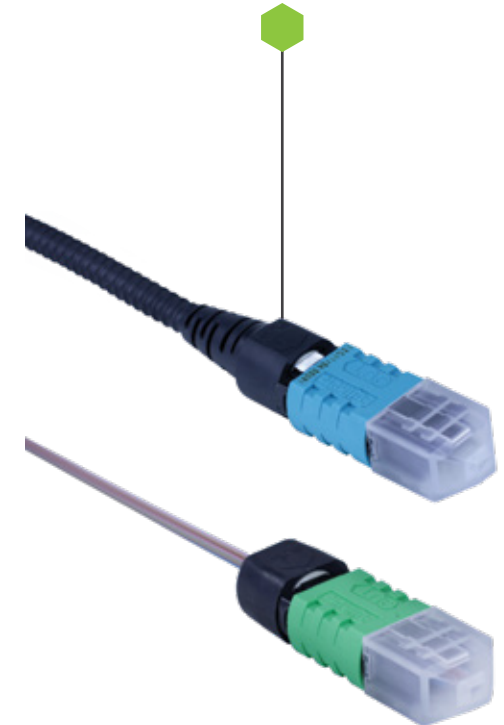## FUJIKURA RS02 RIBBON FIBER STRIPPER

The Fujikura RS02 Ribbon Fiber Stripper on one charge gives 600 strips across 12 fibers with an incredibly low heating time of just 3 seconds. With Bluetooth connectivity the RS02 ensures trouble free servicing and maintenance.

AFL INSPECTION, TEST & MEASUREMENT ACCESSORIES

FOCIS® FLEX FIBER OPTIC CONNECTOR INSPECTION SYSTEM

With the press of a single button, FOCIS Flex auto-focuses, captures and centers and displays the endface image, applies pass/fail rules, displays results, and wirelessly transfers image and results to a paired device (including mobile device, FlexScan or FlexTester OTDR. With internal storage, the FOCIS Flex can be used independently – without requiring an external OTDR or display.

ROGUE® MODULE TEST PLATFORM

ROGUE is an open, flexible, modular test platform that enables users to pick and choose the functionality they need, allowing you to test application-specific parameters that suit your network. The ROGUE platform uses state of the art hardware and software to provide accurate test results, quickly.

aeRos® is an open, cloud-based, workflow management platform that enables users to easily and efficiently manage their test process from end to end.

Test data is stored immediately and securely in the cloud enabling access to test results when and where needed.

aeRos® facilitates two-way communication and data exchange from engineering, to project management, to your technician in the field.