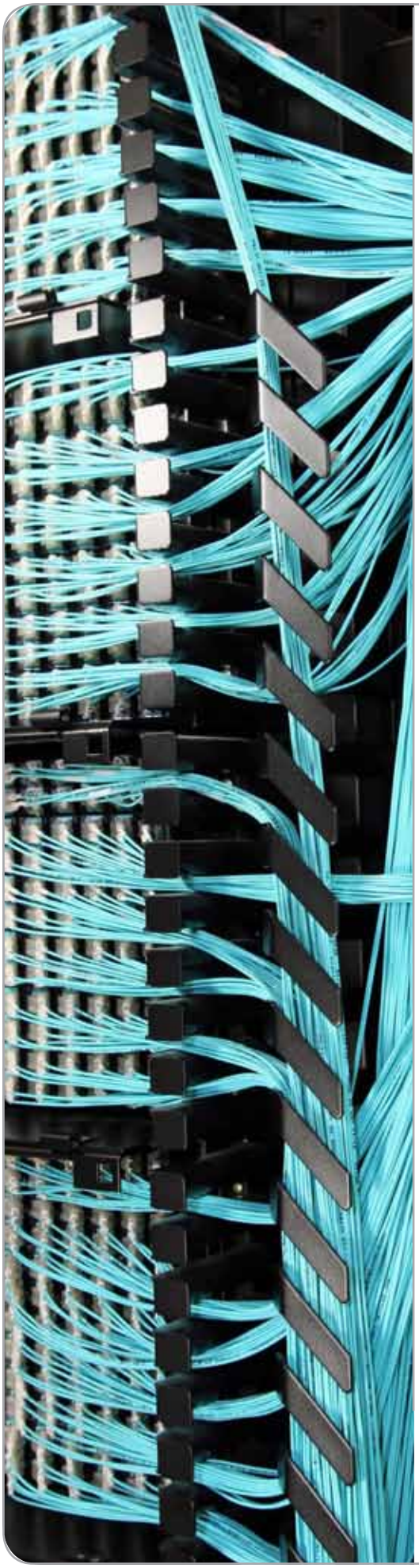

WHITE PAPER

Understanding the Pros and Cons

of Fibre Termination Methods

ADC KRONE

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As enterprises implement more fibre optic cabling to support bandwidth and storage requirements in the data centre and backbone infrastructures, fibre termination methods are under intense scrutiny. Data centre managers need to understand the key performance, installation, management, and cost considerations surrounding primary fibre termination methods. Each method has its own pros and cons, and the need has never been greater for comprehensive information to help data centre managers make the right choice for their environment. In this white paper, you will learn the about the pros and cons of the following fibre termination methods:

- Preterminated Plug-and-Play MPO Solutions
- Factory-Terminated Pigtails with Splicing
- Field Termination

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Overview

As bandwidth and storage requirements evolve, fibre links are more vital than ever for transmitting data to and from a large number of sources. With so many types of fibre, connectors, and deployment strategies available, data centre mangers have become increasingly concerned with making the best choices to ensure performance, rapid deployment, manageability, and reduced total cost of ownership, as well as scalability for future growth. Every data centre environment is unique with several aspects to be considered. Determining answers to the following questions will help data centre managers as they explore the pros and cons of each fibre termination method:

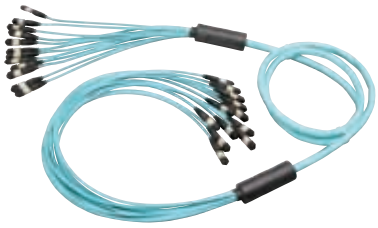
- What type of fibre and connector interface is required for bandwidth and equipment?
- How many fibre terminations are required both now and in the future?
- What is the overall insertion loss budget?
- How quickly do systems need to be deployed?
- Is expertise and equipment on hand for termination and splicing?
- Can cabling lengths be easily predetermined?
- How much space is available for terminations, cable slack, and splices?
- How frequently will moves, adds, and changes need to be made to individual circuits?
- What is my overall material and installation cost budget?

Option Number 1: Plug-and-Play MPO Solutions

The MPO connector is a high-density, multi-fibre connector that typically terminates 12 fibres in one connector approximately the same size of a one SC-style fibre connector. MPO plug-and-play cassettes include an MPO interface on one side broken out to12 individual fibre interfaces on the other side. These cassettes can be deployed in an optical distribution frame for higher density applications or in fibre panels to connect the main distribution area (MDA) to the equipment distribution area (EDA) in the data centre.

Plug-and-play trunk cables are round 12-fibre cables that are preterminated in the factory with MPO connectors on both ends. These trunk cables are purchased in predetermined lengths and are typically easier to manage than traditional ribbon cables. They can be quickly connected to the MPO plug-and-play cassettes at the cross-connect or interconnect in the MDA, EDA, or other areas of the data centre. This method eliminates the need for on-site fibre termination and splicing. Consequently, customers can rapidly complete fibre connections in high-density applications.

MPO Plug-and-Play Cassettes



Plug-and-Play Trunk Cables

Advantages to plug-and-play MPO solutions include:

- Reduced Labor Cost
  Less time is required for plug-and-play installation vs. splicing or field termination. Less expertise and resources are required of installation staff.
- Enhanced Performance
  MPO connectors are factory terminated and tested in a clean environment with comprehensive quality control processes and documented test results that correspond to serial numbers stamped on each assembly.
- Easiest and Fastest Installation
  MPO solutions offer the easiest and fastest installation time because they are simply plugged in. MPO 12-fibre trunk cables are also more robust and easily pulled through pathways.
- Better Manageability and Density
  MPO cassettes offer the highest density for fibre connections, maximizing space savings in the data centre. They are easily deployed in a cross-connect scenario for better cabling management.
- More Environmentally Friendly
  The use of plug-and-play MPO solutions eliminates the waste and consumable associated with splicing and field termination and requires less packaging material.
- Better Prepared for Beyond 10-Gigabit
  40- and 100-Gbps speeds on multimode fibre will likely require parallel optics where data is transmitted and received over multiple fibres. MPO connectors are more prepared for this technology because they already encompass multiple fibres.

Disadvantages to plug-and-play MPO solutions include:

- Increased Material Cost
  Plug-and-play MPO solutions are typically more expensive than other options.
- Higher Return Loss and Insertion Loss
  The additional mated pair increases the return loss and insertion loss. Insertion link loss with MPO solutions can account for an addition 0.5dB per cassette, requiring careful planning of the loss budget.
- Limited Access to Individual Circuits
  With 12-fibre MPO trunk cables, individual circuit access to backbone cabling is limited. However, when used in a cross-connect scenario, individual circuits should not need to be accessed once installed.
- Predetermined Lengths Required
  MPO trunk cables are made to order in predetermined lengths, so lengths and lead-time must be part of the planning process. In addition, measurements need to be exact or slack storage will be required.

Option Number 2: Factory-Terminated Pigtails With Splicing

When cable runs are longer than 25 meters or a degree of permanency is required, using factory-terminated pigtails at both ends and splicing fibres together offers an attractive alternative. With this method, a splicing unit can be located at one end of the fibre run or in a central location. At the patch panel, factory-terminated pigtails plug into the back of the panel. ADC KRONE's intra-facility cable (IFC) cable ships with the fibre panel and blocks, leaving a factory-prepared stub end ready for splicing to the individual strands of the cable.

Factory-Terminated Fibre Termination Blocks Arrive from the Factory with Either IFC or OSP Cables

Fibre Cable Easily Uncoils During Installation

Fibre Termination Block Ships Inside the Drum

IFC Cables Loaded into FTB

Advantages to factory-terminated pigtails with splicing include:

- Reduced Material Cost
  Factory-terminated pigtails are less expensive than plug-and-play MPO solutions
- Best Performance and Insertion Loss
  Factory-terminated pigtails are prepared in an environmentally controlled setting with quality inspection and documented test results that correspond to serial numbers stamped on each assembly. The connectors are polished and terminated in an automated clean environment that is not as subject to human error as field termination. Splicing is also a very low-loss method of attaching two fibre strands together.
- Easy and Fast Installation
  Preterminated pigtails are fast and easy to connect, and trained technicians can splice two strands of fibre together in as little as 5 minutes compared to 15 minutes per field-terminated connector. The efficiency of splicing becomes even more pronounced when comparing splicing a 24-fibre cable to field terminating it – 2 hours vs. 12 hours. Stub-ended cable is also more robust and easier to pull because there are no connectors attached.
- Exact Lengths and Slack Storage Not Required
  Because backbone cable is cut to length before splicing, it is not necessary to predetermine lengths, which cuts down on lead times. Cutting and splicing also eliminates the need to implement slack storage.
- Individual Circuit Access
  Unlike 12-fibre MPO solutions, preterminated pigtails and splicing enables access to individual backbone circuits.
- Better Flexibility and Management
  Several splicing solutions are available for managing and storing splices either at the equipment end or at a central location. Once the splicing is complete and backbone is in place, all moves, adds, and changes can be performed via patch cords at the cross-connect.

Disadvantages to factory-terminated pigtails with splicing include:

- Increased Labor Cost & Expertise
  Higher labor rates are typically required for technicians with fusion splicing equipment and expertise, or fusion splicing equipment and expertise must be on hand.
- Lower Modularity and Not Prepared for Parallel Optics
  Factory-terminated pigtails and splicing typically required 144 or 192-count fibre compared to the 12-count fibre used with MPO solutions. Because pigtails are broken out to individual connectors, it is also not as readily prepared for parallel optics technology.

Option Number 3: Field Termination

When fibre is terminated in the field, the cable must be pulled between points and attached to patch panels at both ends of each run. Before it can be attached to the panel, technicians must attach connectors to each strand of fibre.

Advantages to field termination include:

- Lowest Material Cost
  Purchasing cable and connectors is typically the least expensive material cost with no preterminated pigtails or assemblies required.
- Exact Lengths and Slack Storage Not Required
  Because backbone cable is cut to length before adding connectors, it is not necessary to predetermine lengths, which can cut down on lead times. This also eliminates the need to implement slack storage.
- Individual Circuit Access
  Unlike 12-fibre MPO solutions, individual fibre connectors enable access to individual backbone circuits.
- Easy Cable Pulling
  When using field termination, bulk cable can be easily pulled from either end of the circuit.

Disadvantages to field termination include:

- Highest Labor Cost and Slowest Installation
  It takes much longer to field install connectors, which increases labor costs and requires more time for installation.
- Termination Quality Concerns
  The yield of acceptable connections is directly related to the skill level and experience of the technician, and reliability is jeopardized as field terminated connectors can fail or perform below acceptable signal loss tolerances. This can require the cost of re-doing work that has failed, as well as the cost of additional connectors. Field termination may be less expensive at time of purchase, but extraneous expenses encountered in the field can mount rapidly.
- Least Environmentally Friendly
  Field termination results in more waste and consumables and typically requires more packing materials for individual connectors and cable.

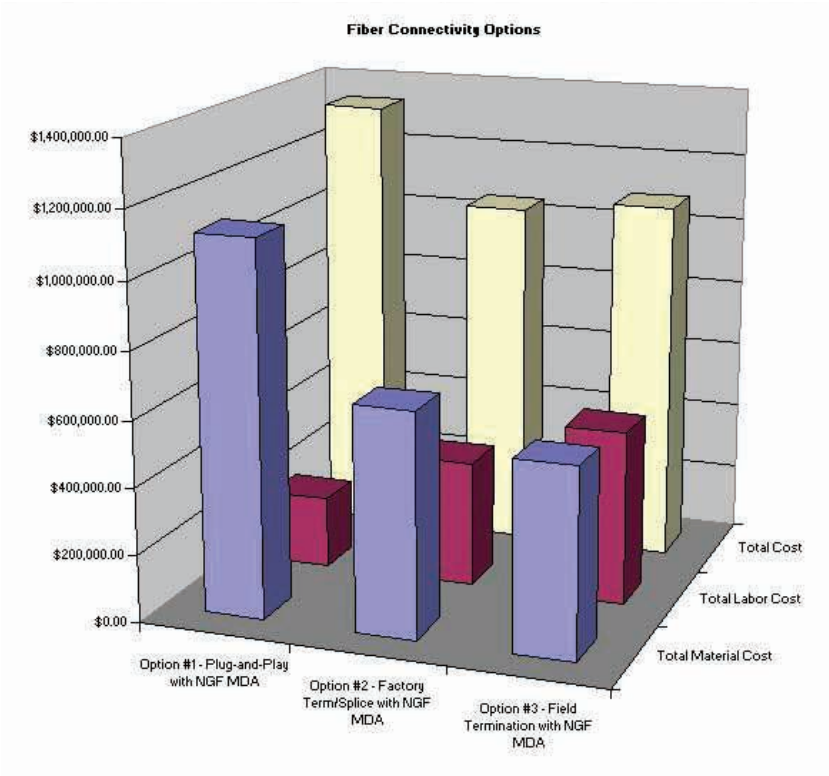
Fibre Field Termination

Cost Analysis

Data centre managers have long faced the decision of terminating fibre in the field or purchasing factory-terminated solutions. With today's fiscal frugality and budget constraints, the cost of the chosen fibre termination method now needs to be considered more than ever, as well as the total cost of ownership associated with each method. That requires considering material cost, labor cost, and potential costs incurred over the life of the network.

The following cost analysis was conducted for a typical data centre fibre MDA cross-connect using laser-optimized multimode fibre and 8,000-fibre ports housed in fibre panels.

Termination Method	Material Cost	Labor Cost	Labor Hours	Total Cost
Plug-and-Play MPO	$1,117,788.80	$214,847.50	2865	$1,332,686.30
Factory Terminated Pigtails with Splicing	$669,975.31	$376,297.50	5017	$1,046,272.81
Field Termination	$563,787.97	$521,397.50	6952	$1,085,185.47



Note: The pricing used in this analysis is for reference use only and does not depict actual pricing of materials or labor, which will vary by project

The cost analysis clearly demonstrates that factory terminated pigtails with splicing is the least expensive option. Because this termination method also offers the highest performance, it will likely ensure better reliability and bandwidth capabilities over the life of the system.

For those customers who do not have the capability or expertise to splice fibres, plug-and-play MPO solutions can be a better choice than field termination. While field termination is typically a total lower cost option, labor hours associated with the plug-and-play MPO option can be less than half that of field termination. Therefore, deployment can be faster, which can potentially lower the total cost of ownership. Plus, plug-and-play MPO solutions avoid the need for field termination expertise and redoing any field terminations that have failed.

Summary

Today's business environment leaves little margin for error. In most instances, the cost savings and performance enhancement associated with using factory-terminated pigtails and splicing makes it the best choice in fibre termination methods. Plug-and-play MPO solutions are also an attractive option for those customers requiring extremely high densities and fast deployment in the data centre.

ADC KRONE recognizes that fibre termination in the data centre has much to do with a customer's overall preference and with the method they have traditionally been comfortable using. However, increased fibre optic links in the data centre and backbone infrastructures may justify re-evaluation of fibre termination methods. Not only do factory-terminated cables and MPO solutions eliminate the labor costs associated with installing connectors in the field, they also do away with the need to spend money on re-doing work that has failed and potentially losing thousands of dollars associated with network downtime. It's truly a situation of pay now or pay later.

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