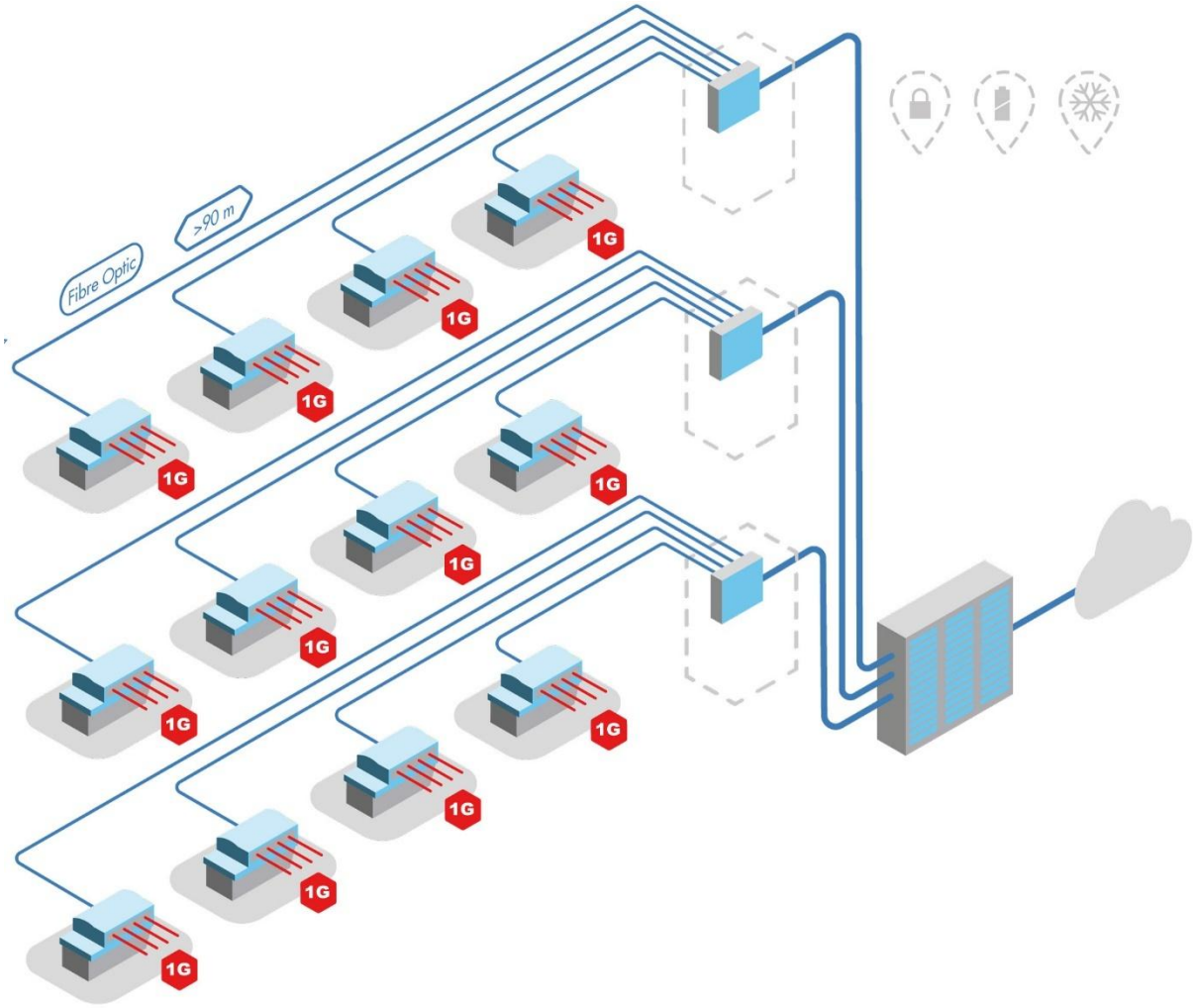
FTTO Cabling System
Design guidelines



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1. Introduction

Aginode LANactive is a new alternative approach for office networking. It is a Fibre To The Office (FTTO) solution which uses passive fibre cabling and components together with locally distributed active FTTO switches to provide Ethernet services via standard copper based RJ45 technology to the end devices.

As floor distribution rooms are no longer needed, it provides significant cost savings and benefits in office buildings and especially in specific types of environment such as hospitals, universities and airports where:

- long transmission distances within the building are required
- space and/or cost restrictions limit the use of floor distributors
- cable containment has limited capacity
- refurbishment is required with minimum disruption
- redundancy at user level is required

This document describes various possible configurations to design a FTTO cabling system for customer premises.
It also covers the applicable recommendations, requirements, rules and limitations to be applied when designing such FTTO systems.

2. Standards compliance

FTTO design and installations must follow industry best practice and shall demonstrate compliance to the relevant sections of ISO/IEC11801, EN50173, EN50174 and TIA/EIA 568 C series of documents.
Testing of FTTO cabling systems shall be performed in accordance with the ISO/IEC 14763-3 Standard.
Please refer to the Aginode OF field testing procedure for detailed information.

3. FTTO cabling topologies

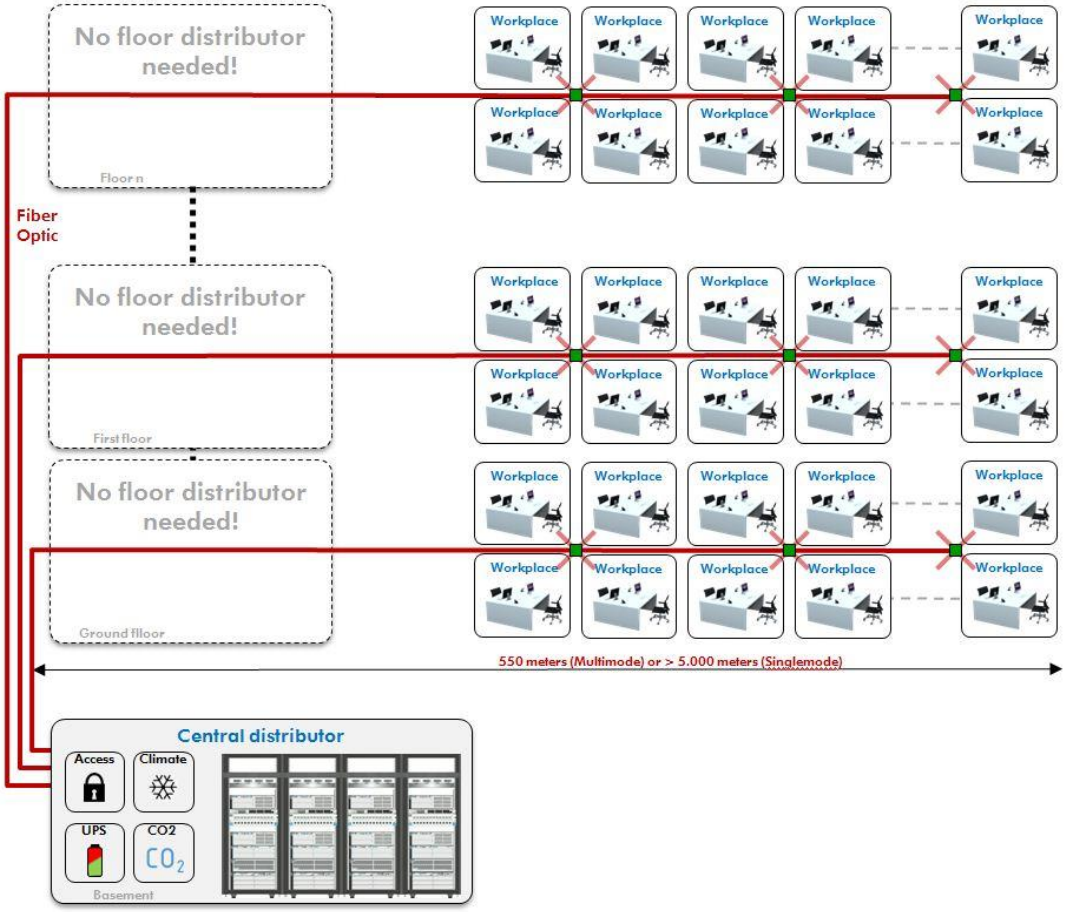
In fibre-based structured cabling, fibre is distributed to the workplace (connection point).
By using fibre optic lengths of 550 metres and more can be bridged, avoiding the need for floor distributors.
The maximum length of the OF link will mainly be defined by the type of SFP transceiver that will be selected for the FTTO switches.
When using the conventional SFP module the (2 connectors) link length limitation will be

- 550 metres when using MM Gigabit Ethernet SFP transceivers
- 10,000 metres when using SM SFP Gigabit Ethernet transceivers
- 10,000 metres when using SM SFP+ 10 Gigabit Ethernet transceivers

Note: Longer lengths are allowed using other available SFP modules – see chapter 6.3

At the workplace, the media conversion from copper to fibre occurs via intelligent Fibre To The Office (FTTO) FTTO switches, which are permanently installed in the trunking or in the floor box.
Up to four connected twisted pair devices such as PCs, laptops, IP phones can be connected with full Gigabit performance via the FTTO switch to one fibre port.

The devices can also be supplied with Power over Ethernet (PoE) via the data ports of the FTTO switch.
The cabling system is always designed as a logical star structure but the physical topology of the system can be designed as a star structure or as a physical ring structure.
The design can also include redundancy (highly recommended) and be built around one or two building/campus distributors to increase network availability.



3.1. Star topology

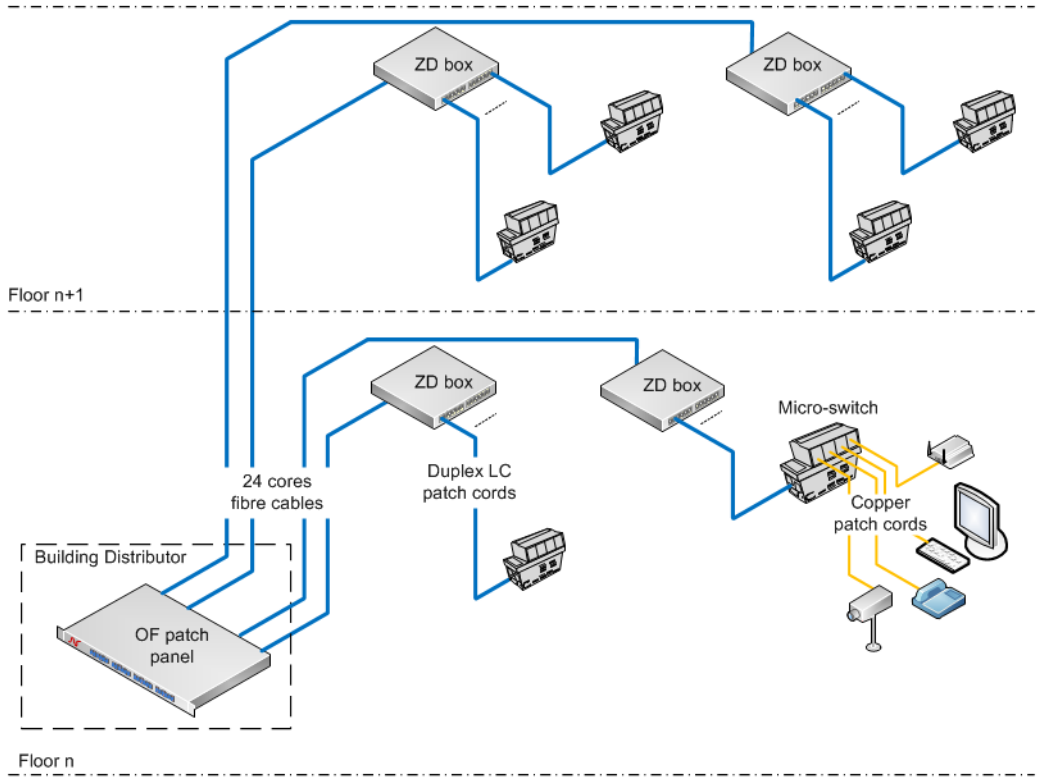
In star topology every node is connected to a central hub or switch with a point-to-point connection.

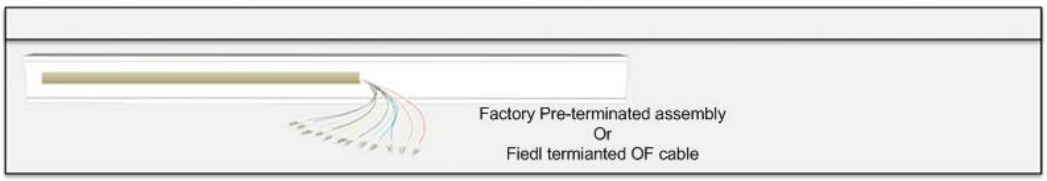
Main characteristics of the star topology

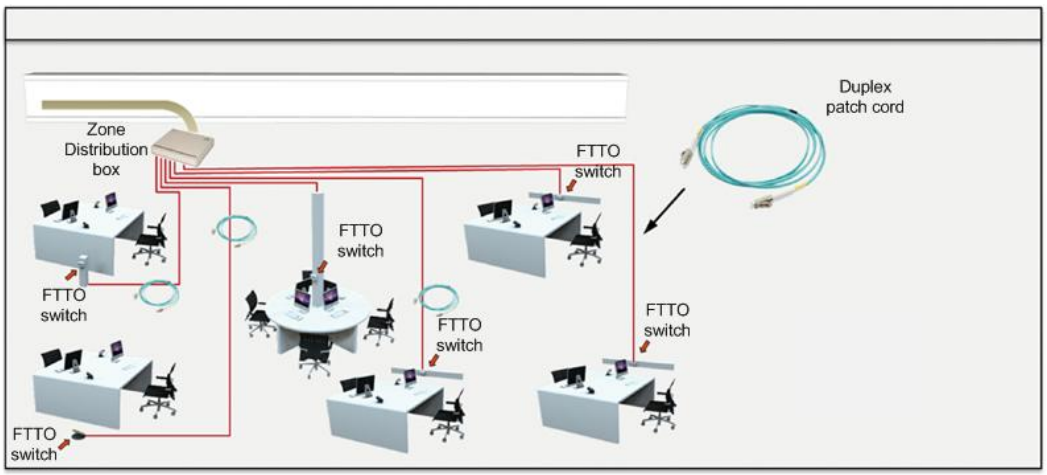
- One link from the Building Distributor to every ZD box
- Small bend radius of the cable in any direction
- Standard OF cable structure: no MOQ and delivery time potential issues
- Fixed number and fixed location of the ZD boxes
- Additional cable installation required for future expansion
- Choice between on-site splicing and Preterm

3.1.1. Star topology without redundancy

The 12 duplex LC ports of every Zone Distribution box (ZD box) will be directly connected to a patch panel installed in the Building Distributor (located in the main computer room (Data Centre) of the building) using a dedicated 24 core fibre cable.

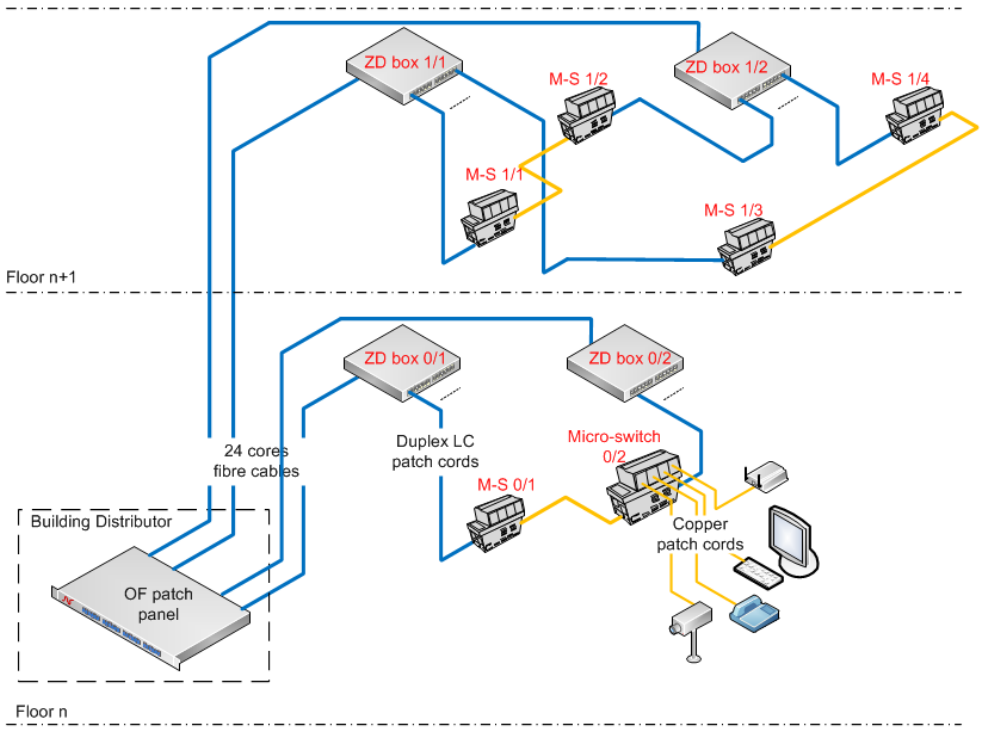






3.1.2. Star topology with redundancy and one Building Distributor

The 12 duplex LC ports of every Zone Distribution box (ZD box) will be directly connected to a patch panel installed in the Building Distributor (located in the main computer room (Data Centre) of the building) using a dedicated 24 core fibre cable.



To provide redundancy the design will be created according to the following rules as shown on the drawing above:

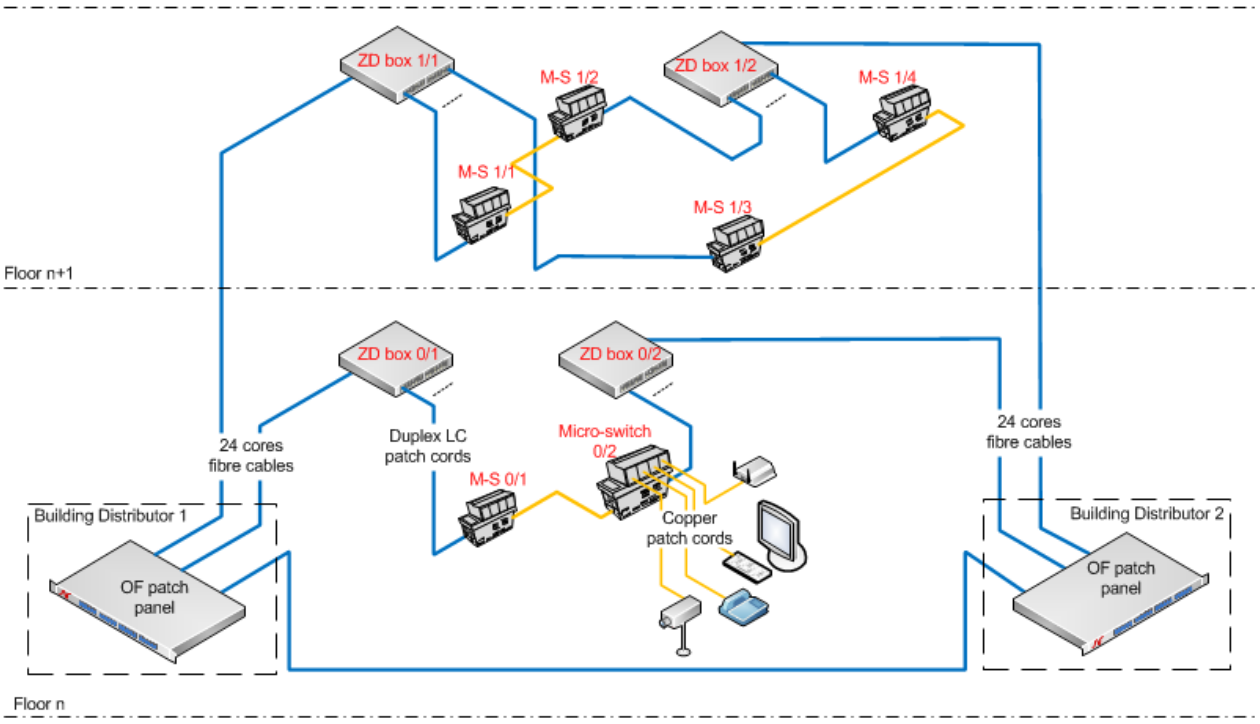
- On every floor both the ZD boxes and the FTTO switches will be numbered from 1 to n according to their geographical location
- Every even numbered FTTO switch will be connected to an even numbered ZD box and every odd numbered FTTO switch will be connected to an odd numbered ZD box
- Every even numbered FTTO switch will be connected to the next odd numbered FTTO switch using an RJ45 cord

This configuration will allow every FTTO switch to be connected to the network through two different backbones OF cables: Direct fibre connection + indirect connection through the copper connection with the other FTTO switch that is connected to a different fibre cable.

Wherever possible the two OF cables serving the odd and even ZD boxes shall follow a different route back to the Building Distributor. If this is not possible in the backbone, the horizontal path should at least be diversely managed.

3.1.3. Star topology with redundancy and two Building Distributors

The 12 duplex LC ports of every Zone Distribution box (ZD box) will be directly connected to a patch panel installed in one of the two Building Distributor of the building using a dedicated 24 core fibre cable.



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- On every floor both the ZD boxes and the FTTO switches will be numbered from 1 to n according to their geographical location
- Every even numbered FTTO switch will be connected to an even numbered ZD box and every odd numbered FTTO switch will be connected to an odd numbered ZD box
- Every even numbered FTTO switch will be connected to the next odd numbered FTTO switch using an RJ45 cord
- Every even numbered ZD box will be connected to the Building Distributor 1 (BD1) and the odd numbered ones will be connected to the BD2
- The two BDs will be connected together with a 24 or 48 core fibre cable

This configuration will allow every FTTO switch to be connected to both building distributors: Direct fibre connection + indirect connection through the copper connection with the other FTTO switch that is connected to the other BD.

Wherever possible the two OF cables serving the odd and even ZD boxes shall follow a different route back to the Building Distributor. If this is not possible in the backbone, the horizontal path should at least be diversely managed.

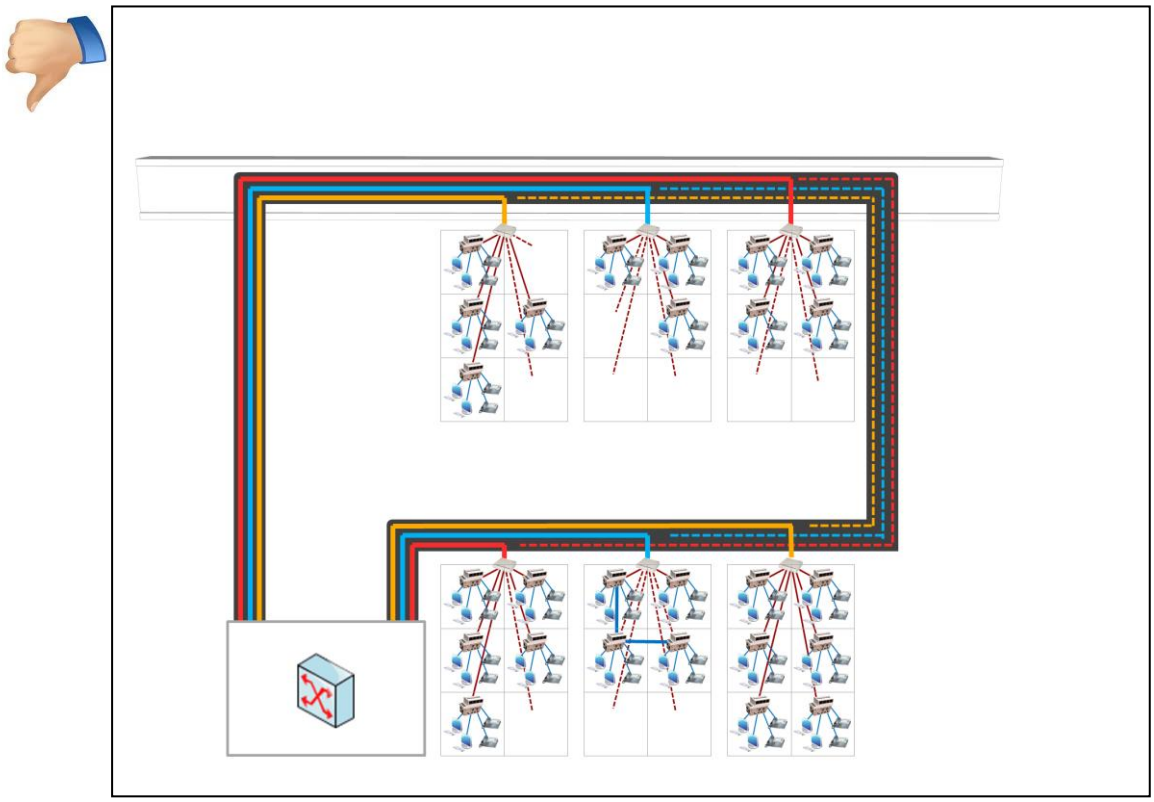
3.2. Physical Ring topology

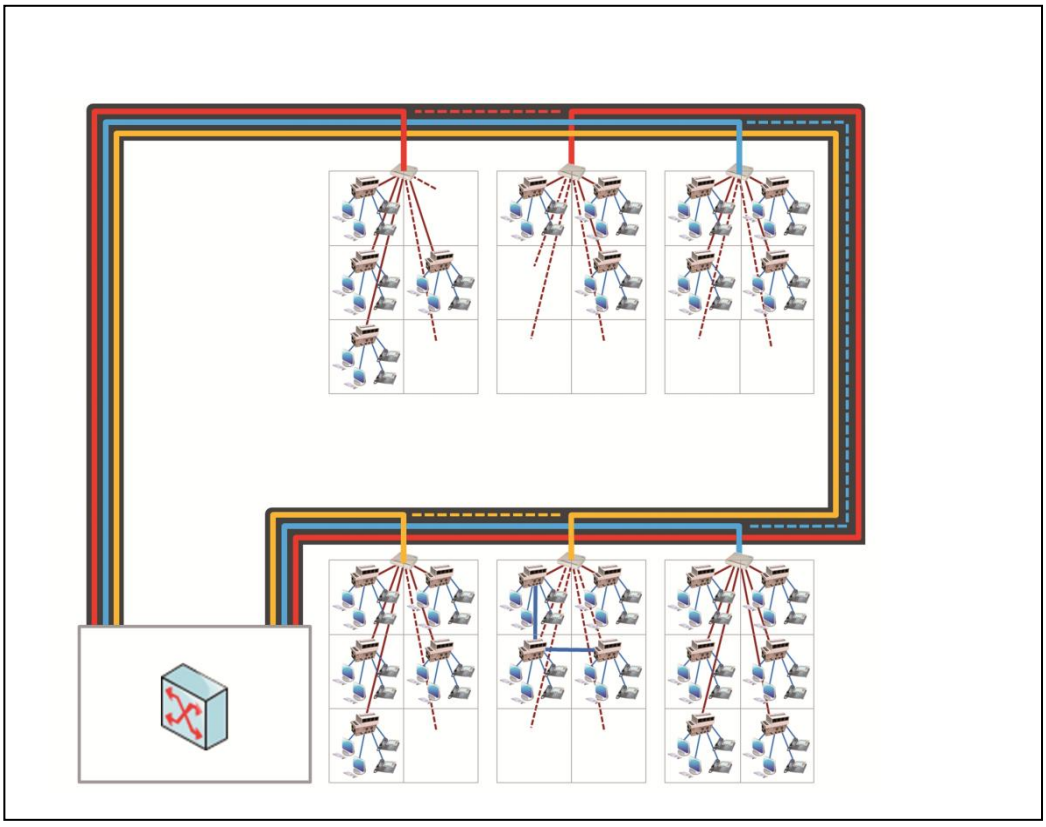
One or several high-density fibre cables (up to 144 fibres) with extractable bundle technology will be installed in a loop trough the selected parts of the building.

However, this physical ring structure will create a logical star topology.
In star topology every node is connected to a central hub or switch with a point-to-point connection.
Main characteristics of the ring topology

- Innovative cable design with extractable bundles
- High fibre count cable (up to 144 fibres – 12 bundles of 12 fibres)
- Cable structure with 8 or 12 bundles
- Number of fibres per bundle: 4, 6 or 12 cores
- One or just a few cables to be installed reducing pulling cost and installation time
- Specific OF cable structure subject to MOQ (1070 m) and longer delivery time
- Flexible number and location of the ZD boxes (Provided that spare bundles are available)
- No additional cable installation required for future expansion
- Up to 576 users served with a single cable
- Pigtail splicing in ZD boxes dedicated to the termination of extractable bundle cables
- Most flexible and scalable solution

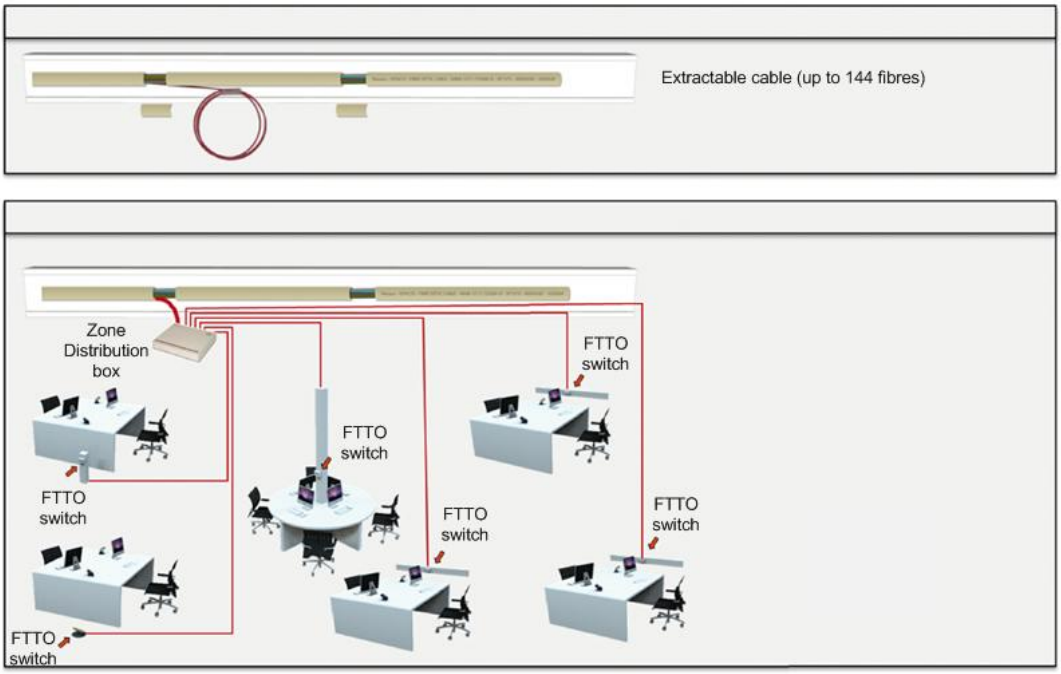
How to use bundles efficiently?
It is highly recommended to implement diverse routing using the forward and return loop of the same bundle as shown in the following figures.



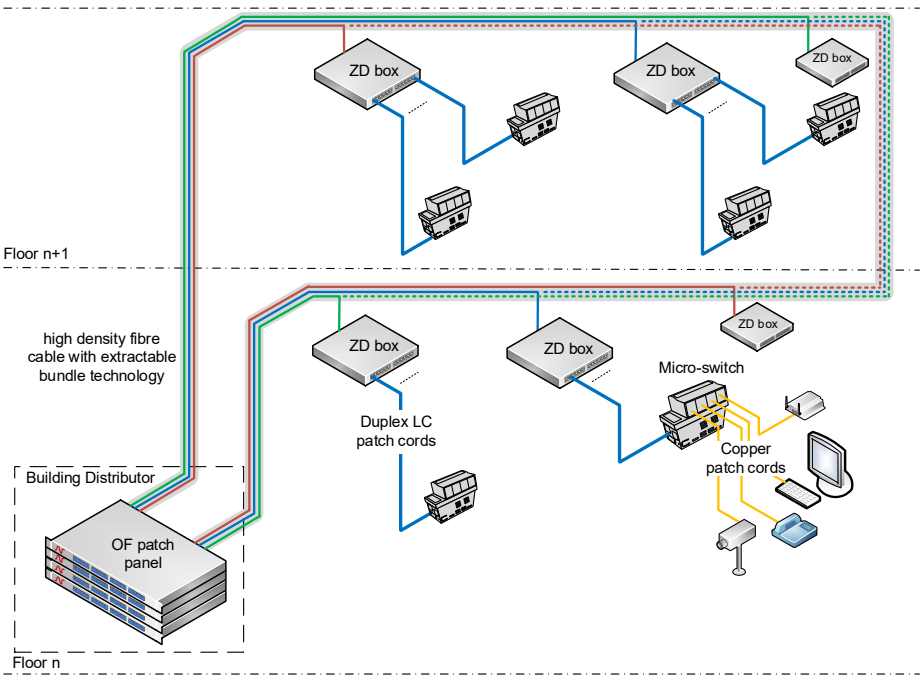


3.2.1. Ring topology without redundancy

Both ends of the looped cable will be terminated in the Building Distributor located in the main computer room (Data Centre) of the building.

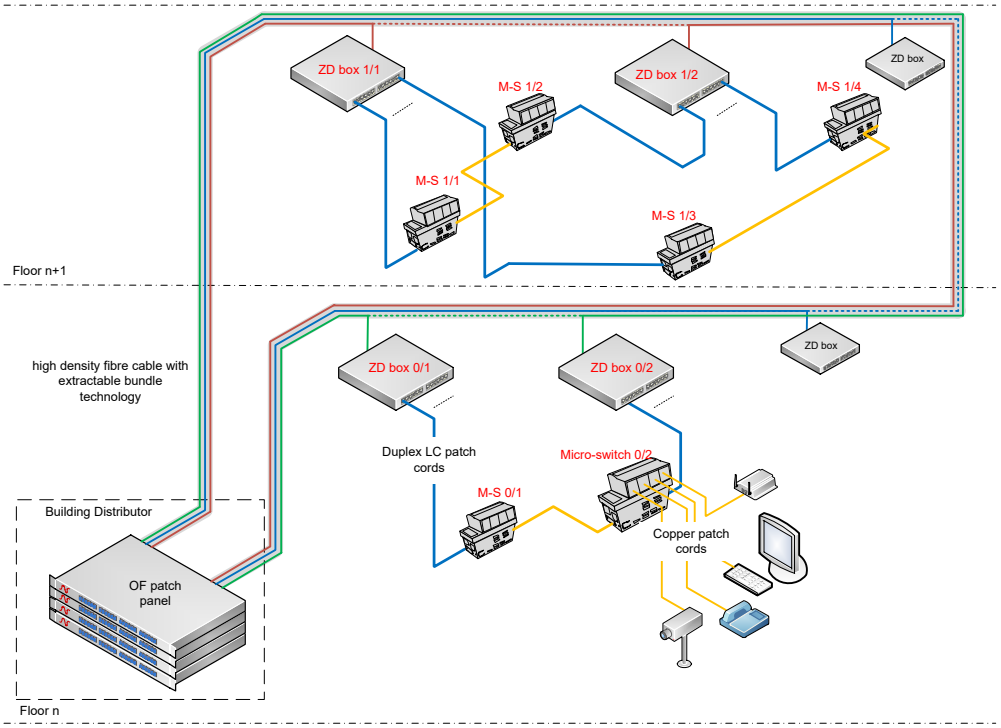


Zone Distribution boxes (ZD box) will be installed at predefined locations all along the cable. Depending on the number of users to be served, one or two bundles of 12 fibres will be extracted from the cable and terminated in the ZD box providing a direct connection back to the Building Distributor.



3.2.2. Ring topology with redundancy and one Building Distributor

Both ends of the looped cable will be terminated in the Building Distributor located in the main computer room (Data Centre) of the building.
Zone Distribution boxes (ZD box) will be installed at predefined locations all along the cable. Depending on the number of users, one or two bundles of 12 fibres will be extracted from the cable and terminated in the ZD box providing a direct connection back to the Building Distributor.



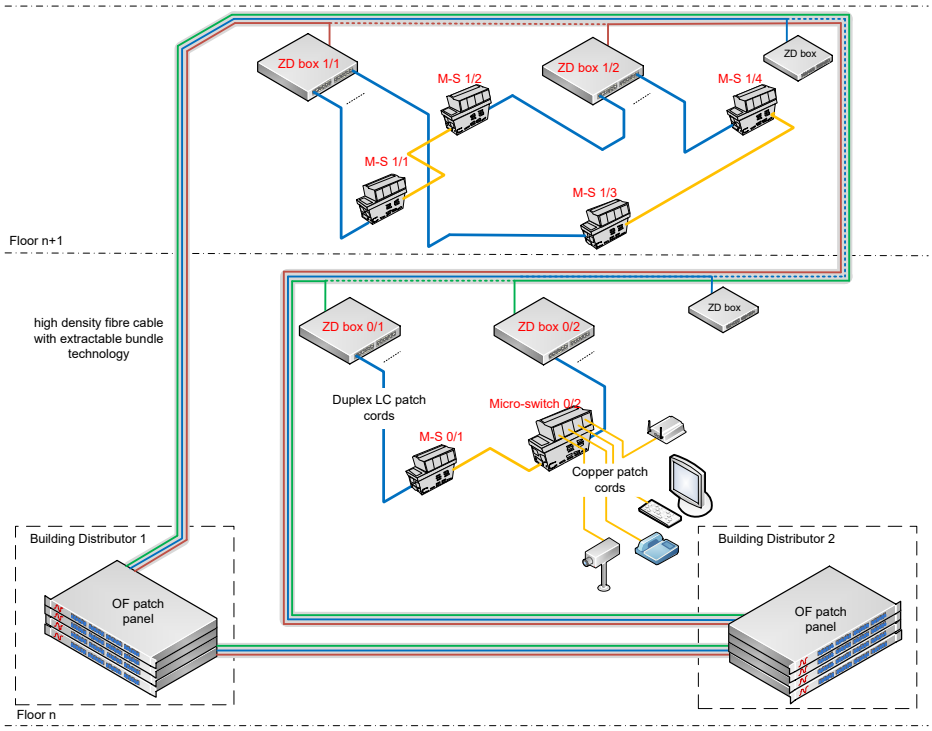
To provide redundancy the design will be created according to the following rules as shown on the drawing above:

- On every floor both the ZD boxes and the FTTO switches will be numbered from 1 to n according to their geographical location
- Every even numbered FTTO switch will be connected to an even numbered ZD box and every odd numbered FTTO switch will be connected to an odd numbered ZD box
- Every even numbered FTTO switch will be connected to the next odd numbered FTTO switch using an RJ45 cord
- Two consecutive ZD boxes will be connected to the same bundle. The even numbered ZD box will be connected to the forward loop and the odd numbered ZD box will be connected to the return loop.

This configuration will allow every FTTO switch to be connected to the network through both forward and return loops of the cable: Direct fibre connection + indirect connection through the copper connection with the other FTTO switch that is connected to the return loop.
Wherever possible the two ends of the OF cable loop shall follow a different route back to the Building Distributor.

3.2.3. Ring topology with redundancy and two Building Distributors

For this topology two Building Distributors will be created to provide redundancy and each end of the cable will be terminated in a different BD (BD 1 or BD 2).
Zone Distribution boxes (ZD box) will be installed at predefined locations all along the cable. Depending on the number of users, one or two bundles of 12 fibres will be extracted from the cable and terminated in the ZD box providing a direct connection back to the Building Distributor.



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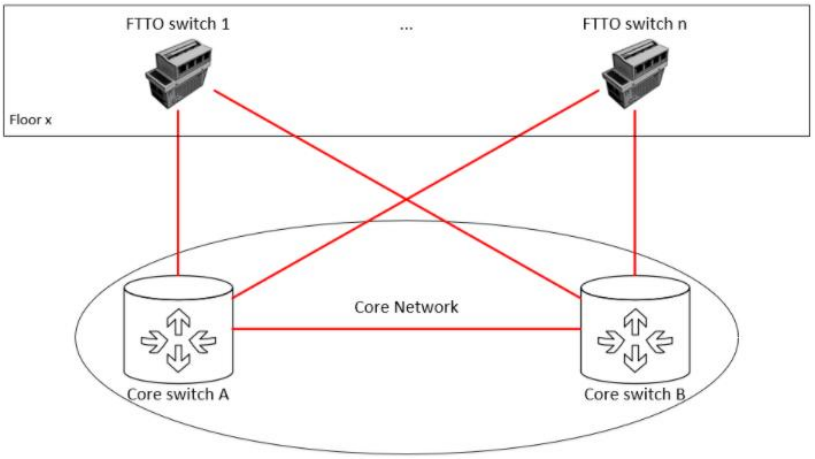
- Every even FTTO switch will be connected to the next odd numbered FTTO switch using an RJ45 cord
- Two consecutive ZD boxes will be connected to the same bundle. The even numbered ZD box will be connected to the forward loop and the odd numbered ZD bow will be connected to the return loop.
- Every even numbered ZD box will be connected to the Building Distributor 1 (BD1) and the odd numbered ones will be connected to the BD2
- The two BDs will be connected together with a 48, 96 or another 144 core fibre cable

This configuration will allow every FTTO switch to be connected to the network through both forward and return loops of the cable: Direct fibre connection + indirect connection through the copper connection with the other FTTO switch that is connected to the return loop.
Wherever possible the two ends of the OF cable loop shall follow a different route back to the Building Distributor.

Pour la redondance, on peut choisir d'opter plutôt pour le protocole LACP. Cela permet de prévenir la chute d'un cœur ou d'une liaison optique (câble multifibres) qui pourrait perturber grandement des services entiers de l'établissement.

Le switch FTTO sera connecté simultanément aux 2 cœurs de réseau via ses 2 ports SFP.

Le 5ième port cuivre, PoE, positionné dans la partie basse, peut servir pour le branchement et l'alimentation d'un terminal distant tel que point d'accès Wifi, caméra, télévision, portier, système de réservation de salle, poste de travail distant, …



Grâce au protocole LACP, les FTTO-Switches bénéficient de 2 GbE montants et 2 GBE descendants. Ceci combiné au fond de panier de 20 GbE de chaque FTTO-Switch, la cascade est quasi sans incidence sur le débit par rapport à une redondance en RSTP/MSTP.

Ces scénarios nécessitent la configuration de la fonction Agrégation de Liens Multi châssis (MLAG) sur les switches centraux.

Dans tous les cas, dans la mesure du possible, les deux extrémités de la boucle du câble OF doivent suivre un cheminement différent pour revenir vers le distributeur de bâtiment.

4. FTTO cabling technologies

If the physical star topology is selected two different cabling technologies can be implemented:

- Conventional cable terminated on site
- Pre-terminated cable

If the physical ring topology is selected pigtails will always be spliced on the fibres of the bundles according to the procedure described in chapter 4.3

4.1. Physical star topology with cable terminated on-site

A conventional fibre cable will be installed between the BD(s) and every ZD box.
Both Tight Buffer and Micro-Bundle cable structures can be selected.
LC Pigtails will be spliced on-site on both ends of the cables in the zone distribution boxes located all around the building and in the patch panels located in the building distributor(s)
The advantage of on-site termination is that cable can be cut to the exact length required.
However the installation cost and time will be affected as all cables will have to be terminated on-site.

4.2. Physical star topology with pre-terminated assemblies

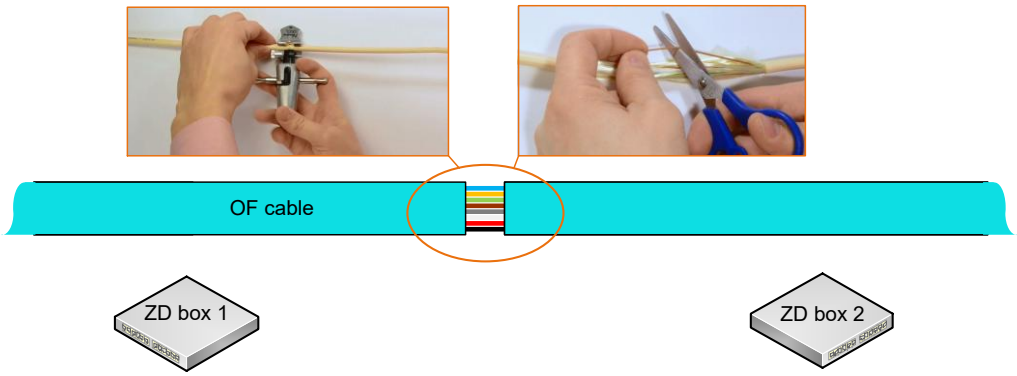
LC terminated fibre assemblies will be installed between patch panels located in the building distributor(s) and the zone distribution boxes located all around the building.
Using pre-terminated assemblies present several advantages:

- No splicing at BD and ZD boxes
- Reduced installation time
- Reliable solution: fully tested in factory and documented
- Warranted extended reach due to the lower loss of the factory terminated connectors
- Reduced specialised manpower for on-site installation

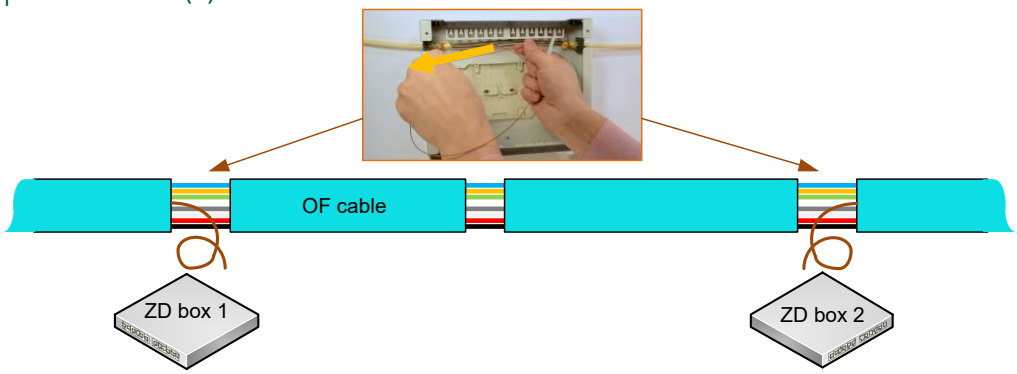
However the length of every BD to ZD box link has to be calculated in advance.
Note: Rough upfront length determination is sufficient because the position of the ZD box can be shifted and the overlength can be stored in floor or ceiling void.
The cost of pre-terminated assemblies is higher but installation time and cost are reduced.

4.3. Physical ring topology with extractable bundle technology

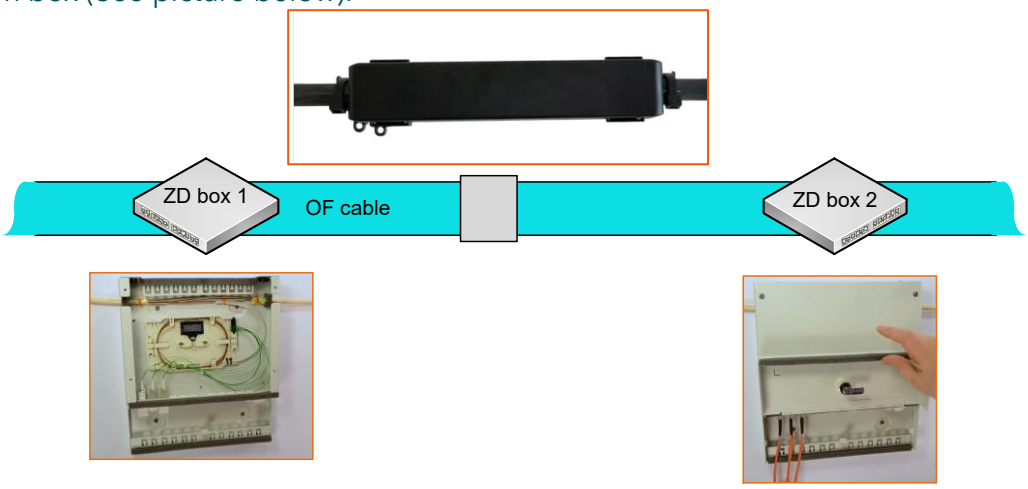
One or two bundles of 12 fibres have to be extracted from the cable and be terminated in a Zone Distribution (ZD) box.
First of all the jacket of the cable has to be opened and a piece of 5 centimetres removed a few metres away from the ZD box or in between two ZD boxes if the same bundle will be terminated in two consecutive boxes.
The OGCL stripping tool (*AGINODE part number: N890.131*) shall be used to perform this task to ensure that the bundles and the fibres will not be affected by this process (See picture below).
The bundle(s) to be terminated in the ZD box(es) will then be cut.



Using the same OGCL stripping tool the cable jacket will also need to be opened at the location where the ZD box will be installed.
A piece of the jacket having the length needed to fully expose the bundle inside the ZD box has to be removed.
The appropriate bundle(s) will be extracted of the cable.



The fibres will then be spliced on LC pigtails and these will be connected to the LC adaptors in the ZD box.
Patch cords will be connected between the ZD box and the FTTO switches.
The exposed bundles located between the two ZD boxes will be covered with a cable protection box (See picture below).



The advantage of this flexible and scalable technology is that:

- The use of high fibre count cable reduces the cable pulling cost as fewer cables (in number and in length) have to be installed

- There is no need to calculate the length of a large number of links during the design phase
- Also the ZD boxes can be installed anywhere along the cable facilitating unexpected modification during the installation phase
- Additional ZD boxes can be easily installed anywhere in the future (providing that some spare bundles are left available on day one). No additional cable or pre-terminated assembly installation is needed

Disadvantages:

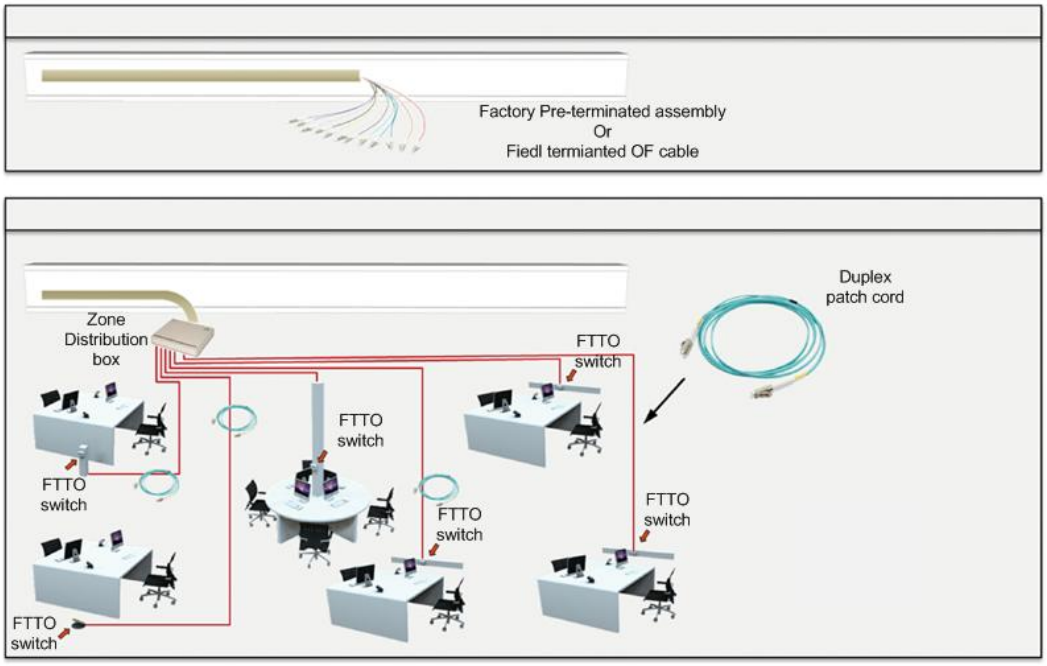
- Project specific cable type needed
- Potential manufacturing and delivery time issues
- ordering extractable bundle cable is subject to a MOQ (minimum order quantity) of 1,070 metres

Comparison between the three cabling technologies

Cabling to the zone	Cables to be installed	Termination	Flexibility	Installation Time	Material Cost
Traditional cables	One cable per ZD-box	Splicing at ZD-box and building distributor	Good		
Extractable bundle	One cable per 6-12 ZD-boxes	Splicing at ZD-box and building distributor	Best		
Pre-Term	One Pre-Term per ZD-Box	Not required	Good		

5. ZD boxes number and location

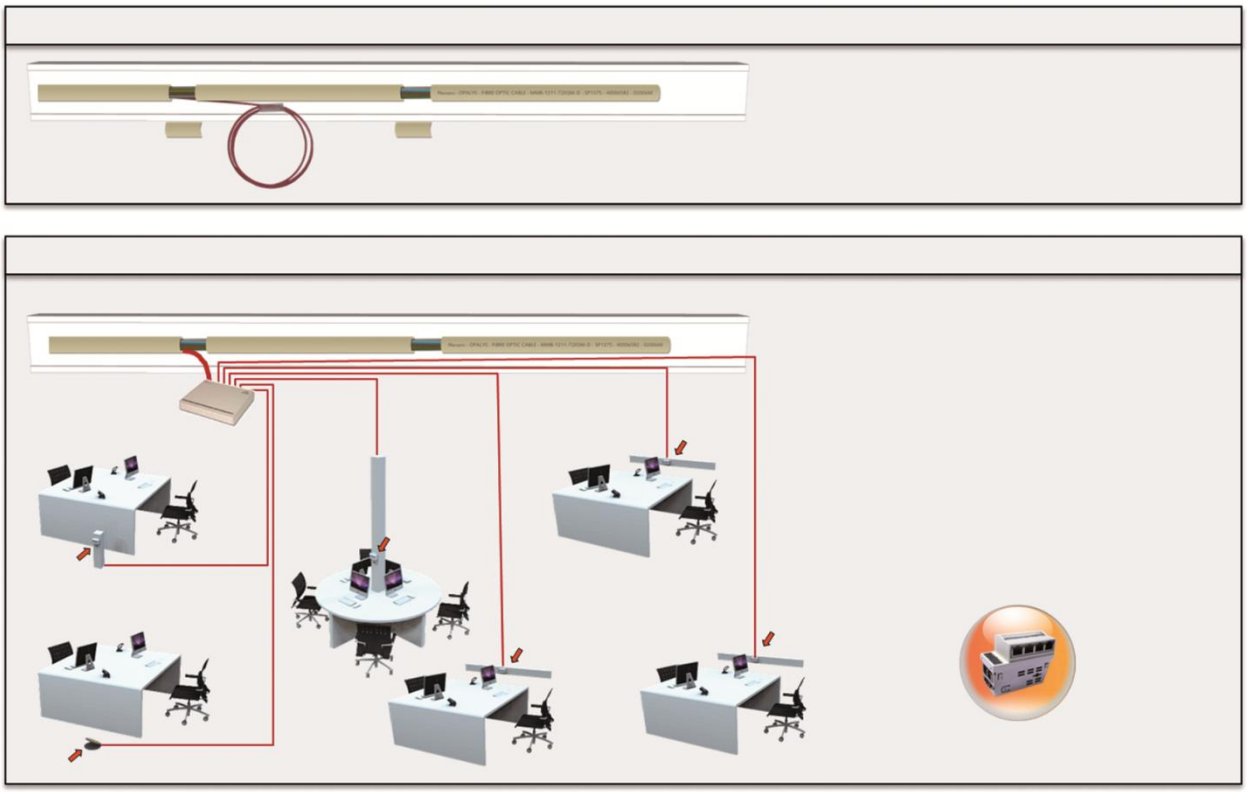
On day one a maximum of 9 FTTO switches can be connected to the ZD boxes ports using duplex LC patch cords. The three remaining duplex ports will be available for future expansions.
Five RJ45 Ethernet network ports are available on every FTTO switch, each ZD box can serve up to 45 workplaces on day one and 15 additional workplaces can be added in the future (3 FTTO switches).



The number of ZD boxes required is dependent on the number of people to be served.

5.1. Specific recommendations for the Ring topology

Zone Distribution boxes (ZD box) will be installed at predefined locations all along the cable. Depending on the number of users, one or two bundles of 12 fibres will be extracted from the cable and terminated in the ZD box providing a direct connection back to the Building Distributor.
Pigtails will be spliced with the fibres of the extracted bundle(s) and connected to 6 or 12 duplex LC ports (One or two bundles) of every zone distribution box (ZD box).
Duplex LC patch cords will connect the uplink of the FTTO switches to the ports of the ZD boxes.
On day one a maximum of 80% of the LC ports should be connected to the FTTO switches. The remaining duplex ports will be available for future expansion.

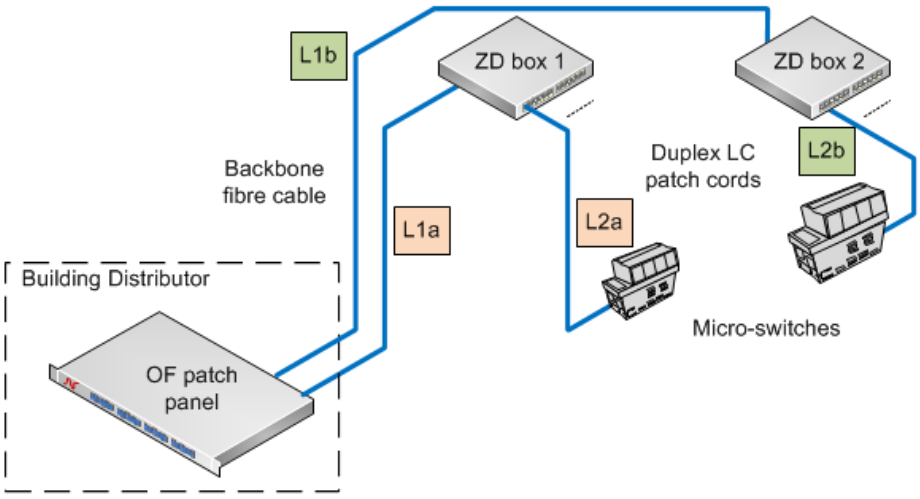


Up to 720 workplaces (540 workplaces on day one) can be connected using one loop of 144 fibre cable.
A 144 fibre cable provides a capacity of 288 fibres (144x forward loop & 144x return loop) giving a maximum of 144 switch connections (2 fibres per switch connection), which in turn provides 720 RJ45 ports (144x5).
12 ZD Boxes equipped with 6 duplex OF ports (or 6 ZD boxes of 12 ports) on forward loop and 12 more ZD Boxes with 6 ports (or 6 ZD boxes of 12 ports) on return loop can be available throughout the building.

6. OF type and length limitation

6.1. Calculation of the maximum length to be considered for the project

The maximum length of the OF links to be created for the project will need to be defined.
The length of a link is the sum of the length of the cable (or bundle) between the patch panel of the BD and the ZD box and of the length of the patch cord to be installed between the ZD box and the FTTO switch.
It will be (L1a + L2a) and (L1b + L2b) on the drawing below.



The maximum length to be considered is the sum of the longer backbone length for the project and of the longest patch cord to be installed.
Note: The length of the fibre backbone will be the length of the cable for a conventional cable or a pre-terminated assembly (star topology) and the length of the bundle for an extractable bundle cable (ring topology).

6.2. Data rate selection

Aginode FTTO switches are available for both Gigabit Ethernet (1000Mbps / 1Gbps) and 10Gigabit Ethernet applications.
When equipped with the conventional SFP (Fibre uplink transceiver of the FTTO switches) the maximum lengths of the multimode link are:

- 550 metres for Gigabit Ethernet applications

If the maximum fibre length calculated is above the maximum length allowed for the concerned application singlemode fibre will have to be selected together with a different SFP module to equip the FTTO switches.

6.3. SFP transceiver selection

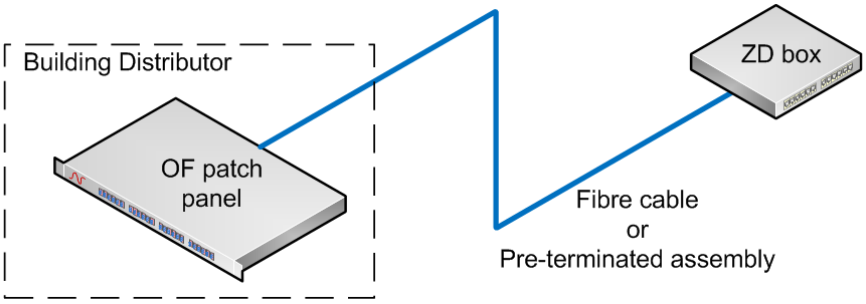
The following table provides the references and the performance of the SFP transceiver of the Aginode FTTO switches.

Article Number	Ethernet Standard	Fibre Type	Wavelength [nm]		Distance
			TX	RX	
88646015	1000Base-SX	Multimode, duplex	850	850	550m
88646016	1000Base-LX	Singlemode, duplex	1310	1310	10km
88646390	10GBase-SR	Multimode, duplex	850	850	400m@OM4 300m@OM3 80m@OM2 30m@OM1
88646391	10GBase-LR	Singlemode, duplex	1310	1310	10km

7. FTTO product guide

The following guide only presents a selection of the available components of the Aginode range.
Should you consider using alternative products please contact your Aginode representative.

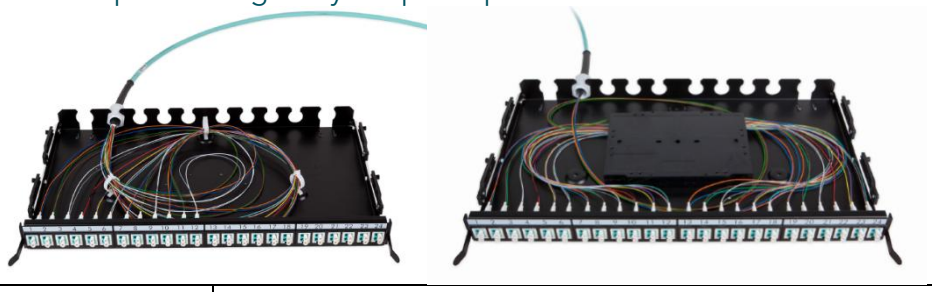
7.1. OF backbone – BD to ZD box links



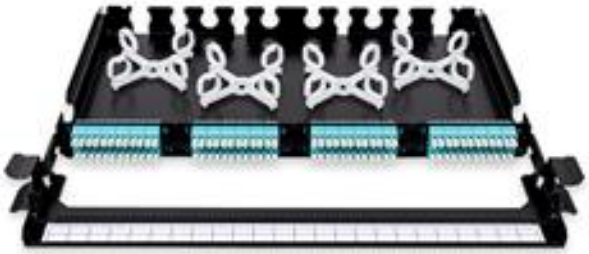
The components that are common to the various topologies and technologies are:

A. LANmark OF patch panel

Both Snap-In or Plug&Play OF patch panel can be selected



N439.4SNB	LANmark-OF Patch Panel Snap-In Sliding Black
N205.617	LANmark-OF Duplex LC Snap-In Adaptor Multimode Aqua
N205.627	LANmark-OF Duplex LC Snap-In Adaptor Singlemode



N439.3MPP	LANmark-OF Plug&Play Patch Panel Integrated Cord Guide Sliding Black
N205.ALC12MMA	LANmark-OF Adaptor Plate 12 LC Multimode Aqua
N205.ALC24MMA	LANmark-OF Adaptor Plate 24 LC Multimode Aqua
N205.ALC12SMB	LANmark-OF Adaptor Plate 12 LC Singlemode Blue
N205.ALC24SMB	LANmark-OF Adaptor Plate 24 LC Singlemode Blue

B. ZD box

N521.612	LANmark Ruggedised Lockable ZD Box 12 Snap-In White
N205.617	LANmark-OF Duplex LC Snap-In Adaptor Multimode Aqua
N205.627	LANmark-OF Duplex LC Snap-In Adaptor Singlemode

7.1.1. Star topology – On-site termination

A. OF cable

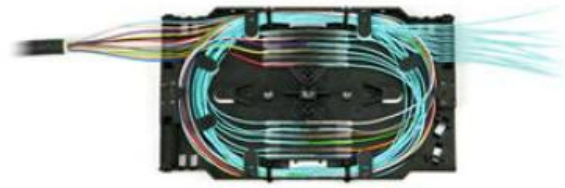
Conventional Tight Buffer or Loose tube universal cables can be selected

N165.TBUN12-AC	LANmark-OF Tight Buffer Universal 12x Multimode 50/125 OM3 LSZH Cca Aqua
N165.TBUN24-AC	LANmark-OF Tight Buffer Universal 24x Multimode 50/125 OM3 LSZH Cca Aqua
N164.TBUN12-YC	LANmark-OF Tight Buffer Universal 12x Singlemode 9/125 OS2 LSZH Cca Yellow
N164.TBUN24-YC	LANmark-OF Tight Buffer Universal 24x Singlemode 9/125 OS2 LSZH Cca Yellow

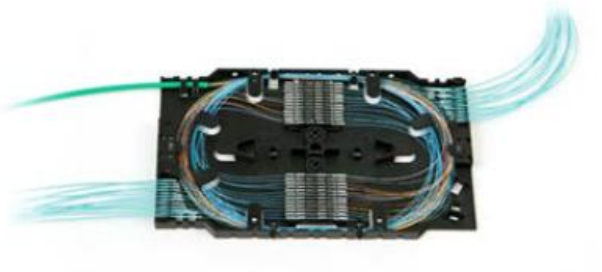
N165.LTUN12-AC	LANmark-OF Loose Tube Universal 12x Multimode 50/125 OM3 LSZH Cca Aqua
N165.LTUN24-AC	LANmark-OF Loose Tube Universal 24x Multimode 50/125 OM3 LSZH Cca Aqua
N164.LTUN12-YC	LANmark-OF Loose Tube Universal 12x Singlemode 9/125 OS2 LSZH Cca Yellow
N164.LTUN24-YC	LANmark-OF Loose Tube Universal 24x Singlemode 9/125 OS2 LSZH Cca Yellow

B. Patch panel splicing accessories and pigtails

Patch panels have to be equipped with the optional splice cassettes. Furthermore pigtails are required to terminate the fibres.
Note: the Snap-In and Plug&Play patch panels require large splicing cassettes and covers whereas the ZD box shall be equipped with small ones.
A maximum of 4 cassettes (+ 1 cover) can be installed in the patch panel (Any type) providing space to arrange 4x12 (48) splices using heat shrink protections or 4x24 (96) splices using aluminium protections. Select the suitable type of cassette as shown below.



12 x heat shrink protectors



24 x aluminium protectors

N890.095	LANmark-OF Splice Cassette 12 Heat Shrink Protection Small
N890.021	LANmark-OF Fusion Splice Heat Shrink Protection 45mm 100x
N890.096	LANmark-OF Splice Cassette 24 Aluminum Protection Small
N890.003	LANmark-OF Fusion Splice Aluminium Protection 150x
N890.004	LANmark-OF Tool For Aluminium Fusion Splice Protection
N890.097	LANmark-OF Cover Splice Cassette Small

N890.090	LANmark-OF Splice Cassette 12 Heat Shrink Protection Large
N890.021	LANmark-OF Fusion Splice Heat Shrink Protection 45mm 100x
N890.091	LANmark-OF Splice Cassette 24 Aluminum Protection Large
N890.003	LANmark-OF Fusion Splice Aluminium Protection 150x
N890.004	LANmark-OF Tool For Aluminium Fusion Splice Protection
N890.092	LANmark-OF Cover Splice Cassette Large

N121.5MLS	LANmark-OF Pigtail LC OM3 Maxistrip LSZH 50/125 1m 12 colours
N121.4MLS	LANmark-OF Pigtail LC Singlemode Maxistrip LSZH 9/125 1m 12 colours

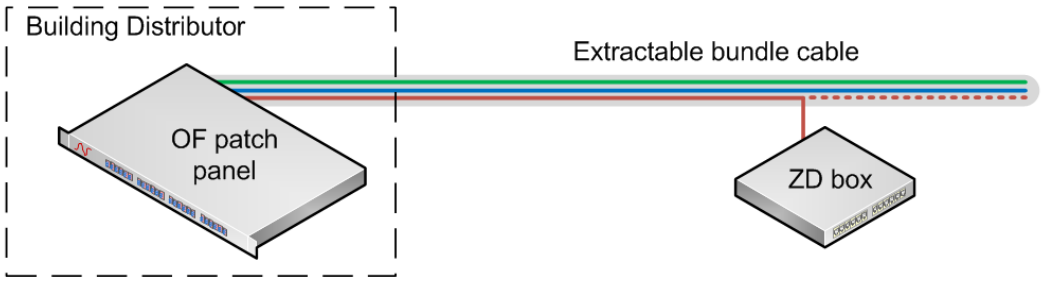
7.1.2. Star topology – Pre-terminated assemblies

Note: No optional accessories are needed in the patch panels

N15a.DnnnccExxx-eB:
ENSPACE LC/LC Pre-Term

a: fibre category	4: Singlemode OS2 7: Multimode OM4 9: Multimode OM5
D: ENSPACE LC/LC Pre-Term	
nnn: fibre count	12, 24, 48 or 96
c: Connector type	L: LC-connector P: LC/APC connector
E: Fan-out optimised for ENSPACE panel	
xxx: length in m	
e: colour cable jacket	Y : Yellow for Singlemode A : Aqua for OM4 V: Violet for OM4 L : Lime Green for OM5
B: fire performance class B2c	Cca

7.1.3. Ring topology



A. OF cable

Module Universal cable shall be selected. Modules can be extracted over 2 m.
The number of bundles (4, 8 or 12) and the grade of fibre (OM3 or OS2) have to be defined according to the project requirements.

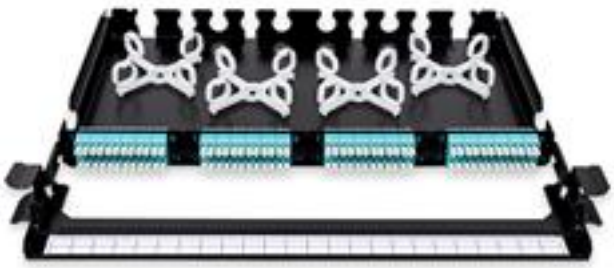
The following product list only presents some possible combinations (Number of Modules and grade of fibre).
Other combinations are available. Please contact your Aginode representative.

N165.MUN96-AC	LANmark-OF Module Universal 96x Multimode 50/125 OM3 Cca s1ad0a1 Aqua
N164.MUN96-YC	LANmark-OF Module Universal 96x Singlemode 9/125 OS2 L Cca s1ad0a1 Yellow
N165.MUN144-AC	LANmark-OF Module Universal 144x Multimode 50/125 OM3 Cca s1ad0a1 Aqua
N164.MUN144-YC	LANmark-OF Module Universal 144x Singlemode 9/125 OS2 Cca s1ad0a1 Yellow

B. Patch panel and ZD box splicing accessories and pigtails

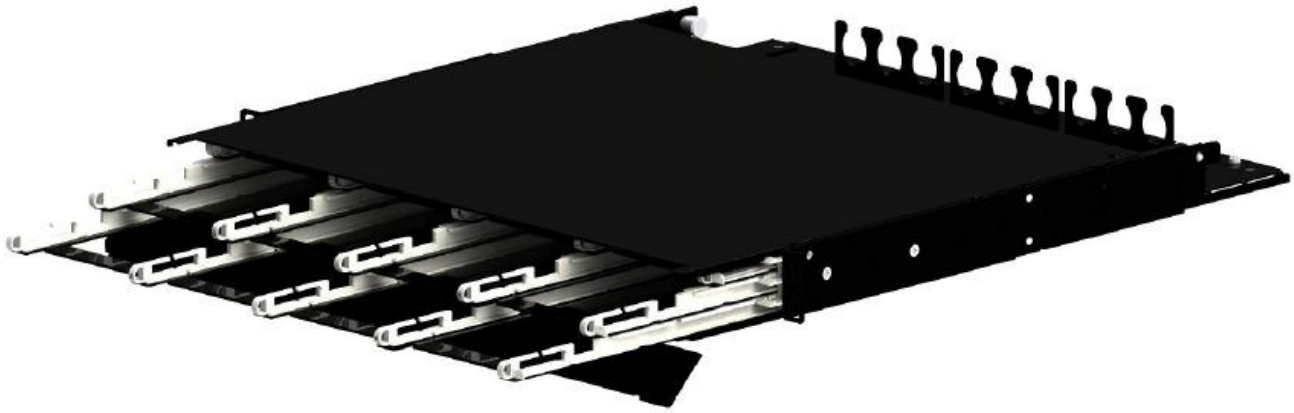
Both patch panels and ZD box have to be equipped with the optional splice cassettes and pigtails required to terminate the fibres.
Refer to 7.1.1 B for detailed information about these accessories.
The ruggedised ZD box shall be equipped with one or two splice cassettes (12 or 24 splices).

To terminate a cable containing up to 96 fibres, the Plug&Play patch panel has to be selected.



N439.3MPP	LANmark-OF Plug&Play Patch Panel Integrated Cord Guide Sliding Black
N205.ALC12MMA	LANmark-OF Adaptor Plate 12 LC Multimode Aqua
N205.ALC24MMA	LANmark-OF Adaptor Plate 24 LC Multimode Aqua
N205.ALC12SMB	LANmark-OF Adaptor Plate 12 LC Singlemode Blue
N205.ALC24SMB	LANmark-OF Adaptor Plate 24 LC Singlemode Blue

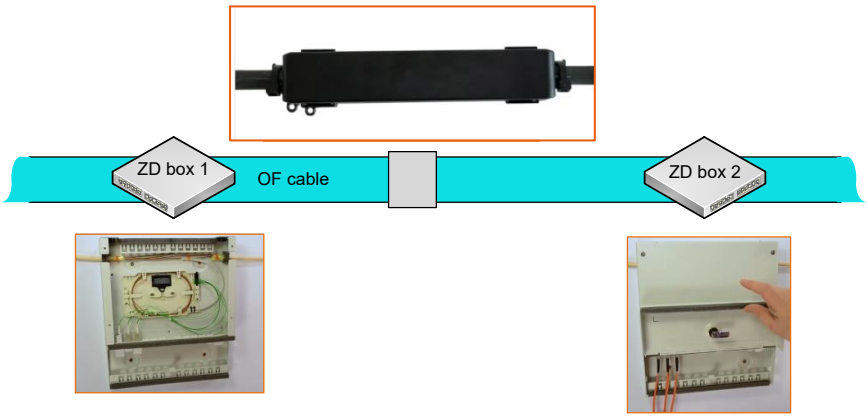
To terminate a cable containing 144 fibres the ENSPACE UHD patch panel shall be selected.
Please refer to the installation guide of the ENSPACE UHD patch panel for detailed information related to fibre termination in this panel.



NSPACE.PP1U	LANmark-OF ENSPACE UHD Patch Panel 1U 12x Modules Black
NSPACE.PLC12AS	LANmark-OF ENSPACE Adaptor Module 12 LC Multimode Aqua Shutters Integrated
NSPACE.PLC12BS	LANmark-OF ENSPACE Adaptor Module 12 LC Singlemode Blue Shutters Integrated
N890.148	LANmark-OF cable Gland Rubber Boot 20mm 10x
N890.051	LANmark-OF fan-out 3mm Tube 25m Aqua
N890.050	LANmark-OF fan-out 3mm Tube 25m Yellow
N890.060	LANmark-OF Heat Shrink Fan-Out 10x

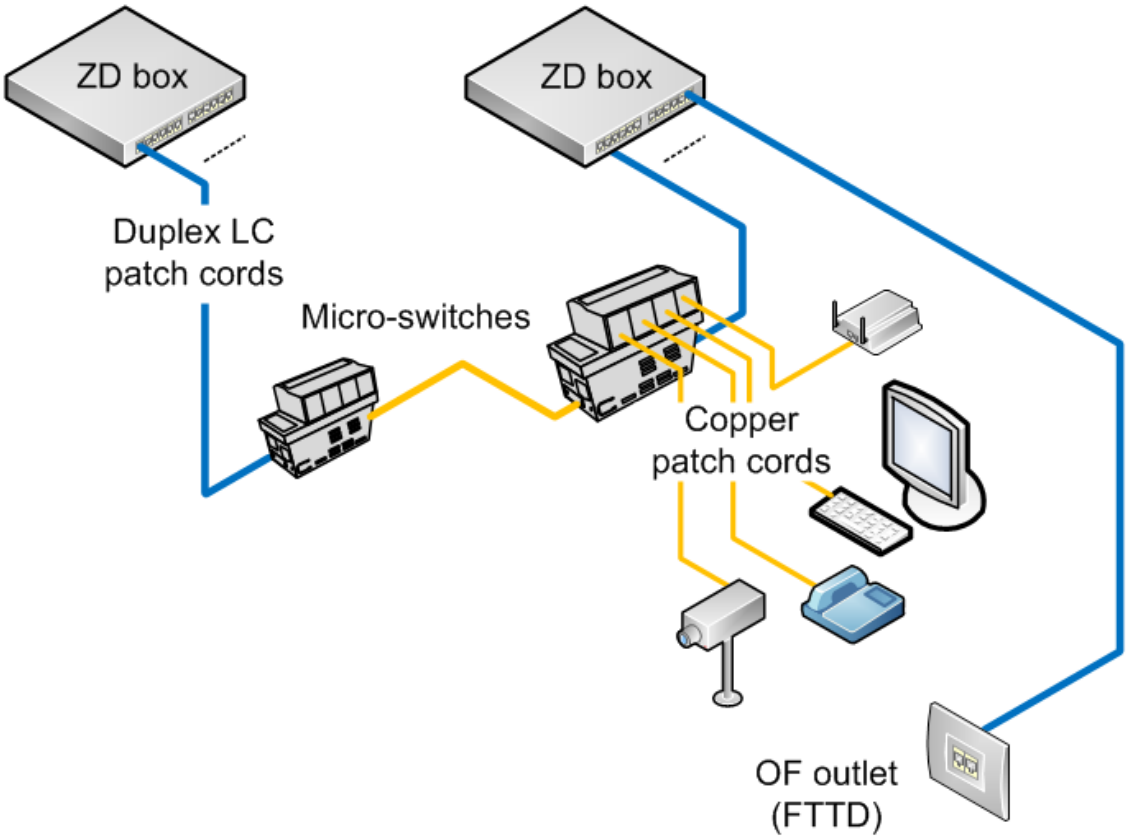
C. Cable protection box

This accessory is needed to protect the bundles exposed during the termination process (See chapter 4.3).



N890.171	LANmark-OF Window protection clip

7.2. OF distribution – ZD box to FTTO switch links



7.2.1. OF patch cords

Traditional or ruggedised LC OF patch cords have to be installed to serve the FTTO switches.

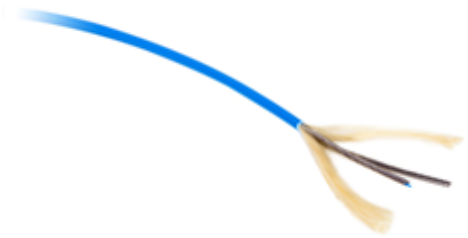
A. Traditional patch cords

With XX = length of the patch cord in metres

N123.5LLAX	LANmark-OF Patch Cord Duplex LC Duplex LC OM3 LSZH X m Aqua
N123.4LLYX	LANmark-OF Patch Cord Duplex LC Duplex LC Singlemode LSZH X m Yellow

B. Ruggedised patch cords

In order to ruggedise the patch cord each tight buffer fibre of the cord is protected by a coiled metal spring wire.
This armour provides a high level of mechanical protection while the cord remains flexible (40mm bend radius). Protective ducts are therefore not needed along the route between the ZD boxes and the FTTO switches.



N123R.5LLAXX	LANmark-OF Ruggedised Patch Cord Multimode 50/125 OM3 2LC-2LC LSZH Aqua XX m
N123R.4LLYXX	LANmark-OF Ruggedised Patch Cord Singlemode 9/125 OS2 2LC-2LC LSZH Yellow XX m

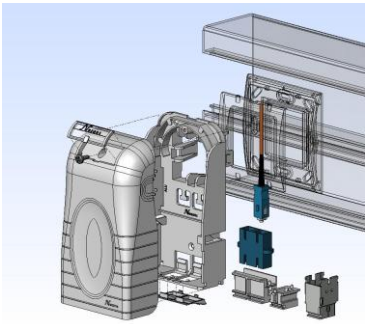
7.2.2. OF outlets

FTTO switches are required as media converters to allow terminal equipment with copper (RJ45) Ethernet interfaces to be connected to the network.
It is also possible to connect terminal equipment with a fibre Ethernet interface to the network (FTTD).
In this case the far end of the patch cord connected to the ZD box has to be installed in a fibre outlet.
Two different types of outlet can be selected:

- Conventional Snap-In angled outlet – One or two Snap-In ports version

- FTTD outlet – two Snap-In ports

This type of outlet is larger but provides a better protection to the connectors and the cord end as it has been specially developed for FTTD systems.



N423.520	LANmark EU Style Angled 45 x 45 Module 1 Snap-In White
N423.540N	LANmark EU Style Angled 45 x 45 Module 2 Snap-In White
N200.050	LANmark EU Style 45 x 45 Frame White
N420.035	LANmark-OF 45 x 45 Splicing Outlet 2 Snap-In White
N205.617	LANmark-OF Duplex LC Snap-In Adaptor Multimode Aqua
N205.627	LANmark-OF Duplex LC Snap-In Adaptor Singlemode

7.2.3. FTTO switch

88303910	GigaSwitch V5 TP(PSE+) SFP-2VI 54VDC
88303920	GigaSwitch V5 TP SFP-2VI 54VDC
88303990	GigaSwitch V5 2TP(PSE+) SFP-VI 54VDC
88303991	GigaSwitch V5 2TP(PD-F+) SFP-VI 54VDC
88303992	GigaSwitch V5 2TP SFP-VI 54VDC

7.2.4. SFP modules

88646015	Aginode SFP 1G Base-SX 850nm MM 550m
88646016	Aginode SFP 1G Base-LX 1310nm SM 10km
88646390	Aginode SFP+, 10G Base-SR, 850nm MM
88646391	Aginode SFP+, 10G Base-LR, 1310nm SM

7.2.5. Power supply unit

A power supply unit is required for each FTTO switch.

88646210	Click-In Power Supply 54VDC/70W 90x45
88646241	Click-In Power Supply 54VDC/130W 135x45

7.2.6. Accessories

Various mounting accessories are available to install the FTTO switches in walls, on walls, in ducts, in floor boxes, on poles...
Please contact your Aginode representative.

7.3. Copper patch cords

Copper patch cords are needed

- To connect the end-user devices to the 4 RJ45 ports of the switch
- To connect the odd and even switches together to provide redundancy

The use of Cat.6 screened patch cords is recommended.

N11G.P1B030OK	LANmark-6 10G Patch Cord Cat 6 500MHz Screened LSZH 3m Orange
N11G.P1B050OK	LANmark-6 10G Patch Cord Cat 6 500MHz Screened LSZH 5m Orange
N11G.P1B100OK	LANmark-6 10G Patch Cord Cat 6 500MHz Screened LSZH 10m Orange
N11G.P1B200OK	LANmark-6 10G Patch Cord Cat 6 500MHz Screened LSZH 20m Orange
N11G.P1B300OK	LANmark-6 10G Patch Cord Cat 6 500MHz Screened LSZH 30m Orange
N11G.P1B400OK	LANmark-6 10G Patch Cord Cat 6 500MHz Screened LSZH 40m Orange
N11G.P1B500OK	LANmark-6 10G Patch Cord Cat 6 500MHz Screened LSZH 50m Orange