OPTICAL DISTRIBUTION FRAME CONFIGURATION FOR HEAD-END POPS

(DISTRIBUTED SPLITTING ARCHITECTURE)

IMPORTANT:

This technical normative only applies to the "Distributed Splitting Architecture" of UGG.

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INDEX

1. OBJECT

This document aims to define the configuration of the Optical Distribution Frames (ODFs) installed in the Head-end Points of Presence (HE-POPs) in the FTTH network deployment of UGG in urban areas.

The document gives a general overview of the new architecture for urban areas, includes a basic description of the optical distribution frames to be used and the main elements that composes. Also includes the front view configuration for all the ODFs in the different POPs and how must be done the patching between the OLTs and the ODFs IPVs.

1.1 REVISIONS

EDITION	DATE	REVISED SECTIONS	CHANGES	OBSERVATIONS
1st	JULY 2023			The document is created.
2nd	DECEMBER 2023	All	New codification of the document	The document is codified with the document code: TEF-NORM-00014. The logo of UGG is updated in the page header.
		4.1 ODF configuration for Head-End POP type 5	The front-view configuration of the ODF in the POP Type 5 is modified by reducing the positions reserved in the IPV to 2 OLTs (instead of 3 from the previous edition).	
		4.3 IPV-OLT connections for headend POP TYPE 5 4.4 IPV-OLT connections for Headend-POP TYPE 1	The text explaining the use for the first 4 positions of the IPVs of the ODFs reserved for backhaul connections is updated for both types of POPs (Type 1 and Type 5).	

2. GENERAL OVERVIEW (ARCHITECTURE FOR URBAN AREAS)

The FTTH network architecture defined for urban areas change completelly comparing with the architecture used for rural areas by UGG. The splitters for the PON network are distributed in several points out of the POP.

Conceptually the network introduce new elements and naming as can be see in the next picture:

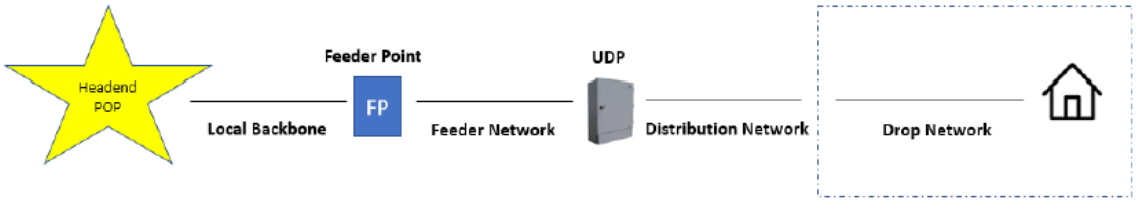


Figure 1. General view of the architecture for urban areas (distributed splitting architecture)

The FTTH network with the new architecture is NOT a point-to-point network from the Headend POP to the house premises. There are fibers reserved for these possible services, but the main strategy of the architecture for urban areas is based in the reduction of fibers to manage in the POPs and in the pipelines. The architecture is a point-to-multipoint network based in a distributed splitting architecture with a total split ratio of 1:64, that can be formed in different ways depending on the type of buildings to be served.

- **HEADEND POP**: The Headend POP is the node in which start the ODN (Optical Distribution Network) in the new distributed splitting architecture for urban areas.
    - The headend POP is equipped with one or more ODF (Optical Distribution Frames), and with racks with active's equipment.
    - The headend POP has not splitters installed inside.
    - Only Feeder Points can hang directly from the headend POP.
    - Internally can be equipped with the following active equipment:
        - An aggregation switch, only for the Aggregation Headend POP
        - 1, 2 or 3 OLTs for an Aggregation Headend POP
        - 1 OLT for an Active Headend POP
- **FEEDER POINT (FP):** The Feeder point (FP) is a fully passive splice enclosure used in the new architecture where Local Backbone cables (coming from the Headend POP) are spliced to Feeder cables fibers.
- **URBAN-DP. (Urban-DP):** The urban DP is a fully passive node (initially a street cabinet) in which are finalised the feeder cables. Inside are installed splitters that can works as a unique splitter 1:64 (formed in cascade by 1:4 followed by 1:16 splitters) to connect SDUs, or as first level using a 1:16 splitter to serve MDUs.

2.1 HEADEND POPS

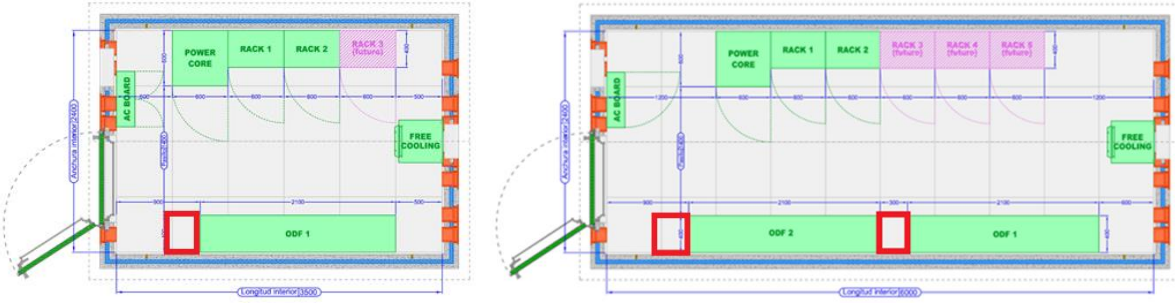
The headend POPs are a new type of actives POPs that will be used for the deployment in urban areas.

In general the quantity of homes that can be served from this types of Headend POPs are higher than in the old architecture (maximum 12.000 HPs in POP TYPE 1, 8.000 HPs in POP TYPE 5, due to software limitation in the OLTs) with much less fibers to manage.

Phisically can be implemented by using two different shelters:

- Using the standard size shelter (14 m^2) called TYPE 1.
- Using the reduced size shelter (8 m^2) called TYPE 5.

Fron the functional point of view, the Headend POP can be an an Aggregation Headend POP (including a L2 aggregation switch, and (depending the POP TYPE size) up to 2 or 3 OLTs (with 16 line cards maximum each OLT), or an Active Headend POP (without an aggregation switch and with only one OLT) and the ODFs among other equipments and systems for energy, cooling, security, etc.



Headend POP type 5 Headend POP type 1

The rectangles marked in red are spaces that must be used to install an auxiliar patch-cord management frame (APMF)

Figure 2. Top view of the Headend POPs

As was explained before, the optical splitters are not going to be installed inside the ODF in this architecture, and will be installed distributed out of the POP in different points (UrbanDP or OTBs). Due to that, the works in the ODFs will be totally different, as each patch-cord used will iluminate up to 64 possible customers (completelly different from the rural architecture in which each customer connection requires an individual patch-cord between verticals). So potentially, the number of patch-cords between verticals will be less intensive than in the rural architecture. Nevertheless, as the number of potential customers that can hang from one ODF is very high, the number of patch-cords between the OLTs and the ODFs will be much higher than in the rural architecture. To avoid patch-cord management problems in that joinin, the OLT ports will be mirrored completelly in the internal plant vertical of the ODF when an OLT is installed in the POP.

To manage this patch-cords the ODF infrastructure will include an auxiliar patchcords management frame (APMF) to manage all the patch-cords that are going to be laid between the active equipment's (OLTs) and the patch-panels of the ODFs.

3. OPTICAL DISTRIBUTION FRAMES (FOR HEADEND POPS)

3.1 GENERAL DESCRIPTION

The optical distribution frame (ODF) is the point in which UGG will finish all the optical fibers of the outside plant cables of the FTTH network.

The dimensions of the ODFs are 2200 x 2100 x 300 mm (height x wide x deep). **NOTE:** The wide dimension is not including the auxiliar patch-cord management frame. If it is included the wide change to 2300 mm or 2400 mm (depending on the ODF manufacturer).

The ODFs are fully modular and could be equipped with different modules according to the necessities of each installation.

The maximum capacity of each ODF is 2.688 optical fibers (access network).

The ODF is based in two verticals (each with 56 positions), one with the prime destination to be used to finish the optical fiber cables of the outside plant (access network), and other vertical to mirror the ports of the active components among other things. The cross-connection between both verticals is the base of the functionality of the ODF.

Between both verticals, there are a space for the patch-cord fiber management.

There are two different models of ODF (from different manufacturers: Commscope and Reichle & De-Massari) that could be used in the deployment. Each manufacturer has their own components, and they are not compatibles between them.

The functionality and the capacity of both ODFs are the same. In the following sections a detailed description of each one is made to present the main components.

Scheme of the ODF:

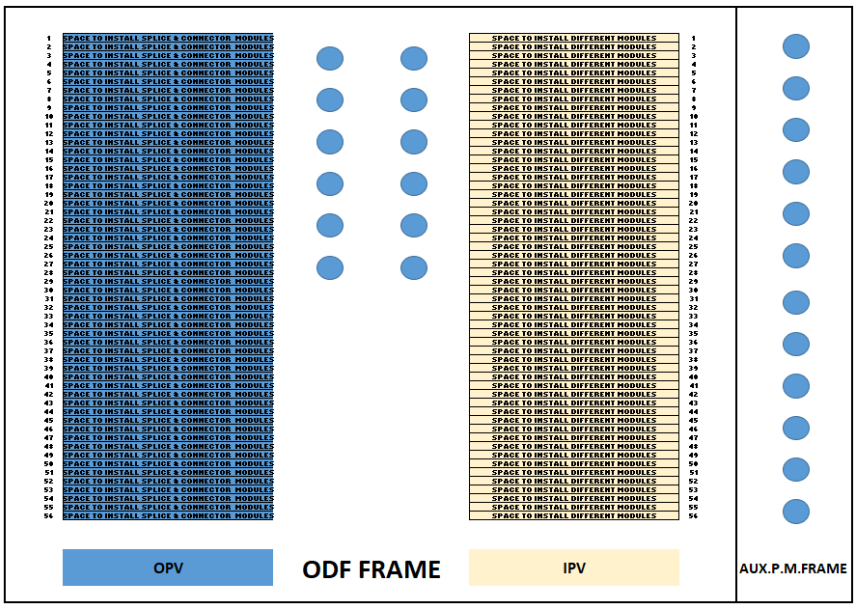


Figure 3. General scheme of the ODF (positions per vertical)

3.2 ODF PHYSICAL CONFIGURATION FOR HE-POPS (PLANT VIEW)

To manage properly the patchcords used to mirror the active equipment ports inside the ODF, an auxiliar patchcords management frame must be used installed at the right side of each ODF.

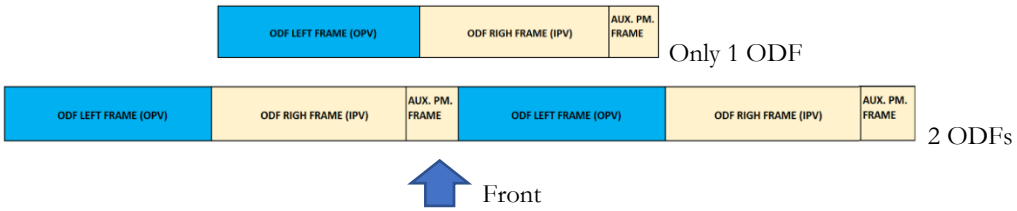


Figure 4. Plant view of the ODF frames configuration with the APMF installed.

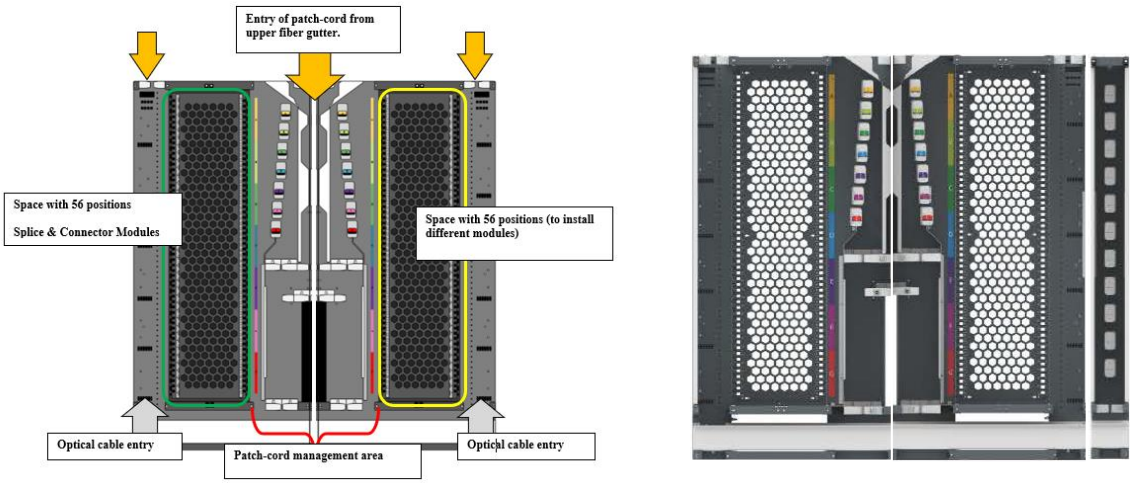
3.3 COMMSCOPE'S ODF DESCRIPTION

3.3.1 *FRAMES*

The ODF that could be used in the deployment from Commscope is the FACT ODF model. The dimensions of the main chassis of the ODF with 2 verticals installed are 2200mm (H) x 2100mm (W) x 300mm (D). It is formed by two sub-frames of 1050 mm wide each. If an auxiliar patch-cord management frame is added to the ODF, the dimension is increased in wide in 200 mm, going to 2300 mm.

To manage properly the patchcords used to mirror the active equipment ports inside the ODF, an auxiliar patchcords management frame must be used installed at the right side of the ODFs.

The next picture shows a front view of the FACT ODF from Commscope:



ODF simetrical units. with auxiliar patch-cord management frame

Figure 5. View of the (empty) ODF of Commscope

The frames are empty structures that has the space with the necessary means to fix the different modules. There are right-hand and left-hand modules. All the routes for the patching are signalized with colours.

3.3.2 *COMMSCOPE'S SPLICE AND CONNECTOR MODULES*

Commscope has several splice and connector modules in its FACT catalogue. The smallest module occupies only one position in the ODF frame.

There are 3 different models of "Splice and connector modules" that can be used for the fiber cable termination in the new splitting architecture: 48 fo, 96 fo and 192 fo. The basic module is the 48 fo capacity one. The other modules with more capacity are formed adding 48 fo splice and connector modules up to the capacity required. The module formed works as one block.

IMPORTANT: It is very important to consider, that all the splice and connector modules from CommScope have hand (left-hand or right-hand), depending in which vertical are going to be installed.

The following image is a real picture of a 96 splice and connector module (formed by 2 sub-modules of 48 fiber capacity).

Figure 6. Picture of a 96 fo splice and connector module and a CTU

Figure 7. Cable Termination Unit for splice and connector module of Commscope

Internally, the module, has 2 trays with space to store the fusion splices and the optical fibers, and the patch panel in which the pigtails are connected. Each tray has a capacity of 24 fibers and connectors.

IMPORTANT: Internally, each module has identified each port from the number 1 to 48.

3.3.3 *COMMSCOPE'S PATCH PANNEL MODULES*

For the urban architecture in which the OLT ports are going to be mirrored to the ODF, the use of patch-panel modules will be very important.

The capacity of this module is 48 adapters LC/APC, and it only occupies one position in the ODF frame.

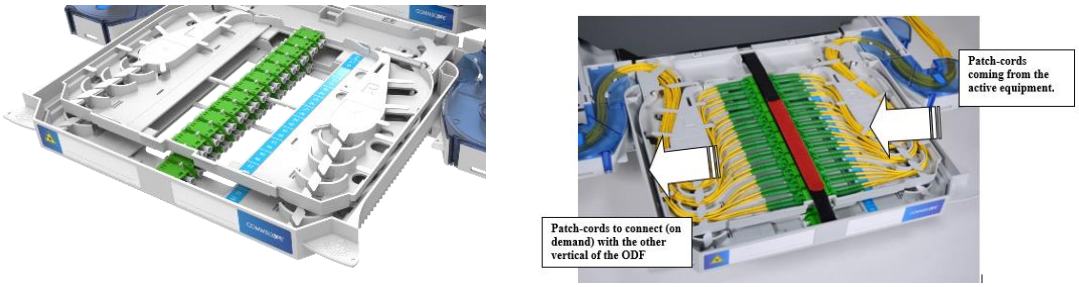


Figure 8. Detail of a patch panel module of 48 adapters (empty and full)

3.4 REICHLE AND DE MASSARI'S ODF DESCRIPTION

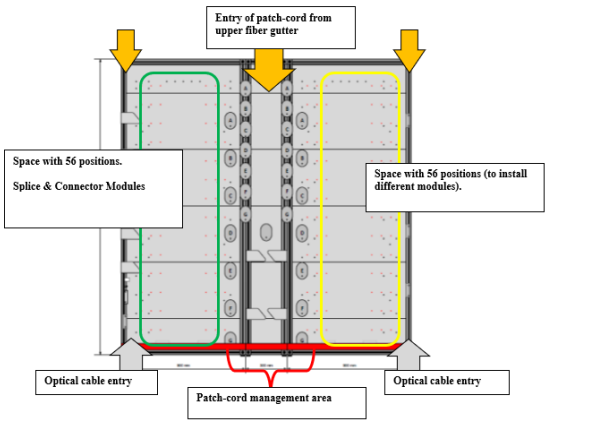
3.4.1 *FRAME*

The ODF that could be used in the deployment from Reichle and De Massari (R&M) is the PRIME ODF model.

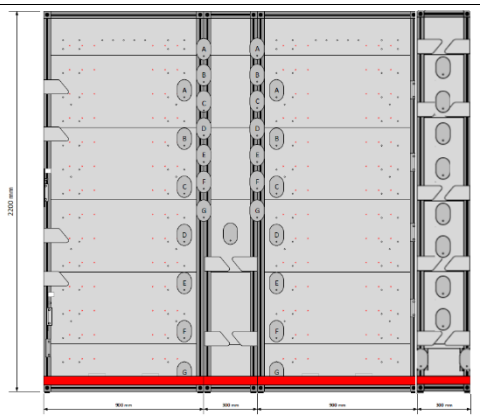
The dimensions of the ODF with 2 verticals installed are 2200mm (H) x 2100mm (W) x 300mm (D). It is formed by three sub-frames of 900 mm, 300 mm, and 900 mm wide each. If an auxiliar patch-cord management frame is added to the ODF, the dimension is increased in wide in 300 mm, going to 2400 mm.

To manage properly the patchcords used to mirror the active equipment ports inside the ODF, an auxiliar patchcords management frame must be used installed at the right side of the ODFs.

The next picture shows a front view of the PRIME ODF from R&M configured for this deployment:



ODF main frame.



Including an auxiliar patch-cord management frame

Figure 9. View of the (empty) ODF of R&M

The frames are empty structures that has the space with the necessary means to fix the different sub-racks in which could be possible to install different modules.

IMPORTANT: The R&M Prime ODF requires an additional element (a sub-rack) to install the different modules in the structure

3.4.2 *R&M'S SUB-RACK*

To install different modules on the Prime ODF of R&M it is necessary to install a sub-rack on it before. This sub-rack can be fixed directly to the back-panel of the ODF chassis and occupies 4 positions from the 56 positions available on it.

This sub-rack has internally 4 sliding rails on which up to 4 different modules can be installed.

Figure 10. Detail of the sub-rack of R&M

3.4.3 *R&M'S SPLICE AND CONNECTOR MODULE*

R&M has several splice and connector modules in its PRIME catalogue. All the models occupy only one position in the ODF frame (only one position inside the sub-rack).

The modules that are going to be used in the deployment have a capacity of 48 fibers. If more fibers are needed to terminate in the ODF, it is possible to achieve adding more modules to the ODF. The following image is a real picture of a 48 splice and connector module.

Figure 11. Picture of a "Splice and Connector" module of 48 fo from R&M.

Internally, the module, has 2 splice trays with space to store the fusion splices and the optical fibers. Each tray has a capacity of 24 fibers.

In the R&M ODF, the cables are not fixed directly to the splice and connectors modules. It is necessary to fix the cables to the ODF main structure (frame) and make a transition to corrugated tubes to guide the fibers to the splice and connectors modules. For this reason, there is no limit in the fiber count of the cables, since once make the transition, it is possible to guide the fibers by distributing them to different modules 48 by 48.

IMPORTANT: It is very important to consider, that all the splice and connector modules from R&M have hand (left-hand or right-hand), depending in which vertical are going to be installed.

3.4.4 *R&M'S PATCH PANNEL MODULES*

The patch panel module that is going to be used to do the mirroring of the OLT ports has a capacity of 48 LC/APC adapters. This module only occupies one position on the ODF frame. Can be feeded from both sides, but for the mirroring will be used the right side, and for the patching between verticals the left side.

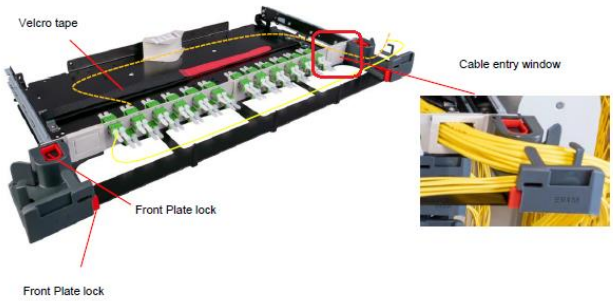


Figure 12. Detail of the patch-panel of R&M (Routing schemes)

This kind of modules have no hand and are valid for installation int both verticals (left or right), but in the UGG project, only will be installed in the right vertical (the internal plant vertical).

4. ODFS CONFIGURATIONS HEAD-END POPS (NEW ARCHITECTURE FOR URBAN AREAS)

The left vertical would be used to terminate the FTTH external plant network leaving the POP towards the Feeder Points that hang from the POP. Only "splice and connectors" modules would be installed for the termination of the fiber optic cables in this vertical.

The vertical located on the right, will be the "internal plant", and mainly will be filled with patch-panels to mirror the OLT ports inside the ODF. Also, can be used to terminate outside fiber cables in the top positions (for the termination of the backhaul fibers).

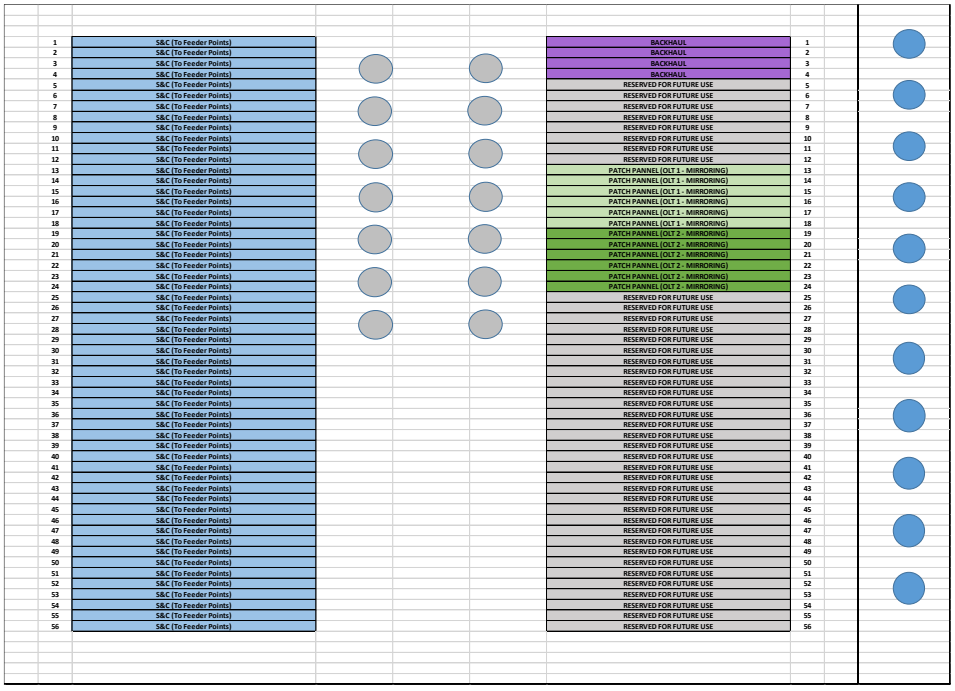
So, in the ODFs is possible to install the following modules:

- **Splice and connector modules.** This module can be installed in both vertical and it is used to finish optical fiber cables.

- **Patch-Panel modules.** This module can be installed only in the "internal" plant vertical. These modules are used to mirror the ports of the active equipment's (OLTs).

4.1 ODF CONFIGURATION FOR HEADEND POP TYPE 5

The front-view configuration of the ODF for the Headend POP type 5 (only one ODF), will be as follow:



***Note: 2** OLTs maximum to be installed in a HE-POP Type 5*

Figure 13. Front view configuration of the ODF for the Headend POP type 5.

4.2 ODFS CONFIGURATION FOR HEADEND POP TYPE 1

The front-view configuration of the ODFs for the Headend POP type 1, will be as follow:

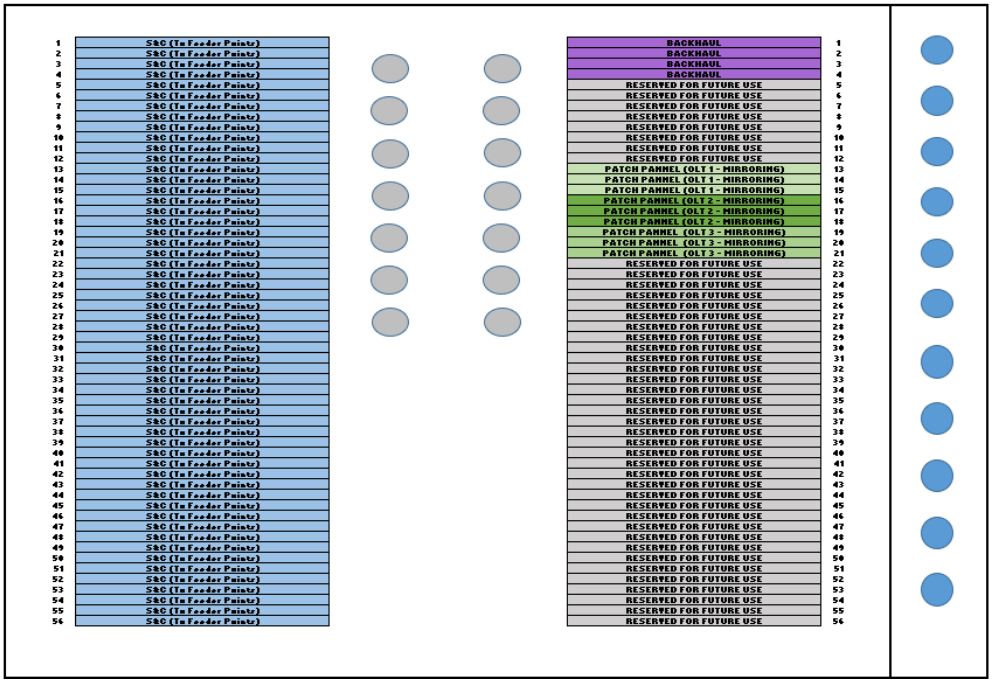


Figure 14. Front view configuration of the ODF1 for the Headend POP type 1.

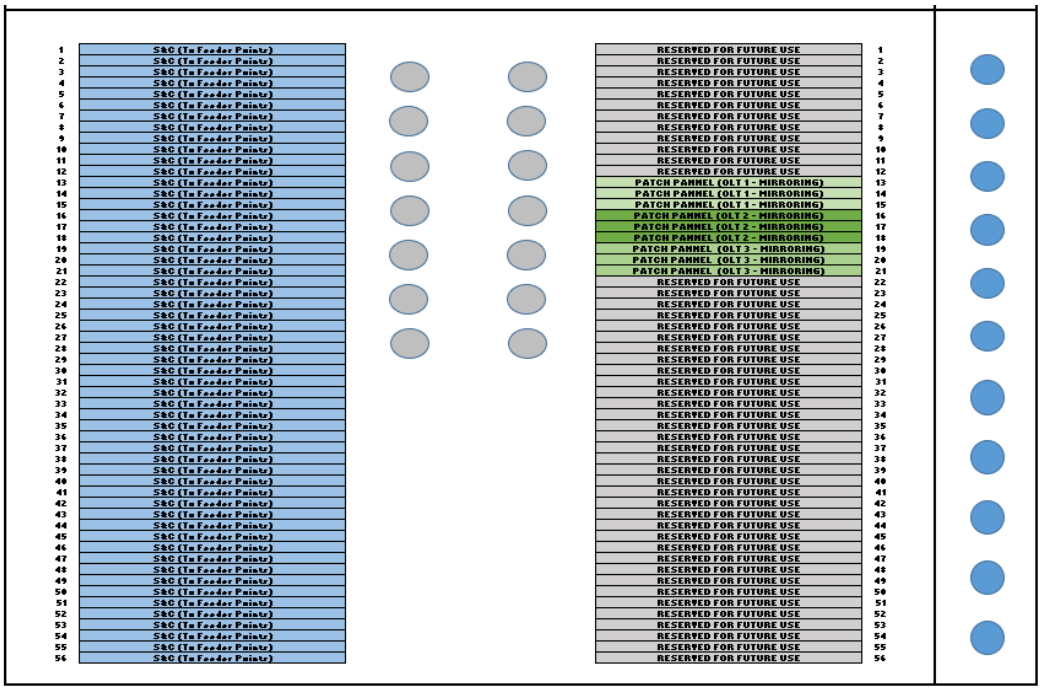


Figure 15. Front view configuration of the ODF2 for the Headend POP type 1.

4.3 IPV-OLT CONNECTIONS FOR HEADEND POP TYPE 5

The active equipment in a HeadEnd POP will be only connected to ODF's IPV:

- The L2AGG switch (for an Aggregation HeadEnd POP) to the S&C modules reserved for the Backhaul links:
    - IPV1 module position 1: for connections with SWD. If it is needed.
    - IPV1 module position 2: for backhaul inter-cluster links with L2AGG switches of different clusters, must be balanced between next available ODF racks (this is for redundant links with other switches in different clusters, if needed).
    - IPV1 module position 3: for intra-cluster switches connections: subtended or redundancy links (this is for redundant links with other L2AGG switches in the same cluster, if needed).
    - Remaining IPV's module positions in sequence order: for downlinking the OLTs hanging from this L2AGG switch.
- OLTs
    - For uplink connections
        - In Aggregation Headend POPs, direct patchcords connections of each OLT with the collocated L2AGG switch, so ODF won't be used for this purpose.
        - In Active Headend POPs (one OLT, without L2AGG switch), remote connection will use the IPV1 module position 1
    - For GPON ports connections:
        - **For the first OLT**: **there will be 6 PP module positions assigned**, from position 13 to position 18, corresponding to 256 GPON ports plus 32 reserved fiber positions in the PP module on position 18.
        - **For the second OLT there will be 6 PP module positions assigned**, from position 19 to position 24, corresponding to 256 GPON ports plus 32 reserved fiber positions in the PP module on position 24.

    Anyway, in all the OLTs (at least initially), 64 (4x16) GPON ports will not be connected to the IPV, taking them on reserve for future uses. So, a maximum of 192 (12 line cards x 16 ports/line card) GPON ports will be connected initially to the IPV, using the allocated PP modules in sequence both in OLT line card and port (starting with first line card and first port) and in PP modules (starting with first PP module and first fiber position).

    The positions reserved to install patch-panels in the ODF for each OLT are maintained independently if there are installed 1 or 2 OLTs.

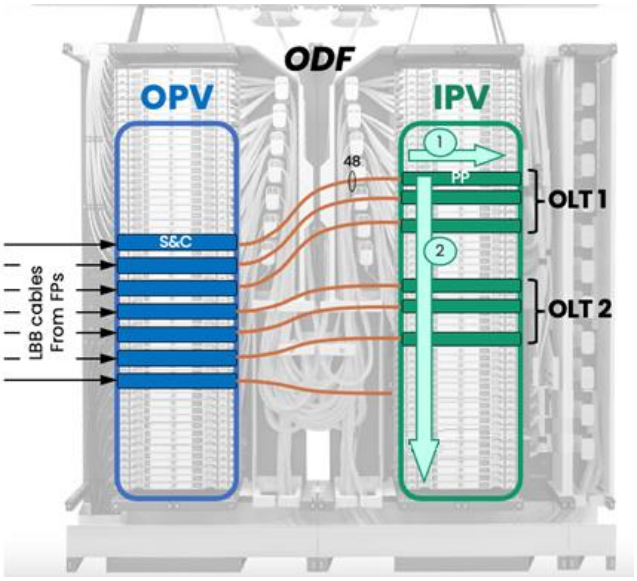


Figure 16. Scheme of OLT mirroring in the POP type 5 (with one ODF)

4.4 IPV-OLT CONNECTIONS FOR HEADEND POP TYPE 1

The active equipment in a HeadEnd POP will be only connected to ODF's IPV:

- The L2AGG switch to the S&C modules reserved for the Backhaul links:
    - IPV1 module position 1: for connections with SWD. If it is needed.
    - IPV1 module position 2: for backhaul inter-cluster links with L2AGG switches of different clusters, must be balanced between next available ODF racks (this is for redundant links with other switches in different clusters, if needed).
    - IPV2 module position 1: for intra-cluster switches connections: subtended or redundancy links (this is for redundant links with other L2AGG switches in the same cluster, if needed).
    - Remaining IPV's module positions in sequence order: for downlinking the OLTs hanging from this L2AGG switch.
- OLTs
    - For uplink connections: direct patchcords connections of each OLT with the collocated L2AGG switch, so ODF won't be used for this purpose.
    - For GPON ports connections:
    - All the OLTs will have their ports mirrored to both ODFs and distributed in the same proportion (50%/50% of OLT ports mirrored in each ODF). There will be 6 PP module positions distributed in 3 PP module positions assigned in the IPV vertical of each ODF for each OLT.
        - **For the first OLT the reserved positions in both verticals IPV1 and IPV2 will be the positions from 13 to 15.** These positions can do the mirroring of the corresponding to 256 GPON ports (128 ports in IPV1 and 128 ports in IPV2) plus 32 reserved mirroring ports (16 mirroring ports in each IPV in the position 15).
        - **For the second OLT the reserved positions in both verticals IPV1 and IPV2 will be the positions from 16 to 18.** These positions can do the mirroring of the corresponding to 256 GPON ports (128 ports in IPV1 and 128 ports in IPV2) plus 32 reserved mirroring ports (16 mirroring ports in each IPV in the position 18).
        - **For the third OLT the reserved positions in both verticals IPV1 and IPV2 will be the positions from 19 to 21.** These positions can do the mirroring of the corresponding to 256 GPON ports (128 ports in IPV1 and 128 ports in IPV2) plus 32 reserved mirroring ports (16 mirroring ports in each IPV in the position 21).

      Anyway, in all the OLTs (at least initially), 64 (4x16) GPON ports will not be connected to both IPVs, taking them on reserve for future uses. So, a maximum of 192 (12 line cards x 16 ports/line card) GPON ports will be connected initially to both IPV, using the allocated PP modules in sequence both in OLT line card and port (starting with first line

card and first port) and in PP modules (starting with first PP module and first fiber position)

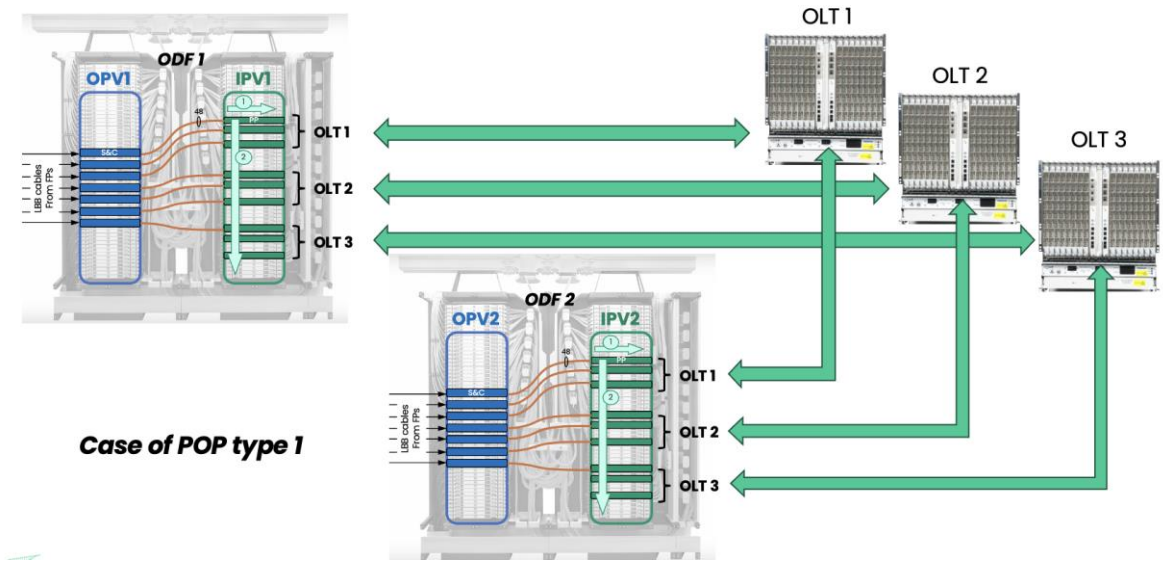


Figure 17. Scheme of OLT mirroring in the POP type 1 (with two ODFs)

4.5 PATCH-CORDS ROUTES FOR OLT PORTS MIRRORING INTO THE ODFS

The patch-cords used to mirror the GPON ports of the OLTs to the Patch-panel modules installed in the IPV of the ODF will be installed through the upper gutters (yellow ones) available in the POPs buildings.

The installation must be done in an ordered manner, avoiding curvatures or twist cables and the length of all the patch-cords must be selected conveniently.

The entrance of these patchcords to the ODF will be done from the right side of the ODF frame (the entrance of the right).

The entrance of the mirror patch-cords to each patch-panel module will be done from the right side of the module and will be connected to the ports from the right side (in the Commscope ODF) or from the back (in the R&M ODF).

The overlength of each patch-cord must be guided and managed conveniently in the auxiliar patch-cord management frame attached to the right side of each ODF.

The next picture shows the path that must follow the patchcords used to do the port mirroring of the OLTs:

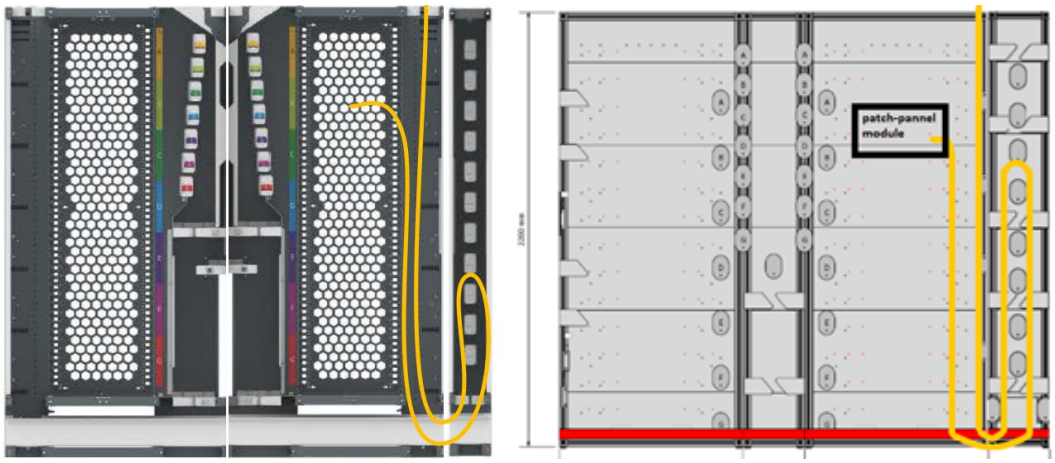


Figure 18. Scheme routes for the patch-cords for the OLT port mirroring