GPON

what is it | advantages | the future

barpa•space

line UP

framework

01

Investing in structured networks is an investment for the future. More and more internet users are searching for higher bandwidths and velocities.

Nowadays, we don't accept to wait minutes to receive one e-mail. As soon as we send the email we are already asking: did you receive it? Also, besides this, now even more than before we are searching for having a good relation cost-benefit of the installations.

These factors motivate the spread of fiber optic networks, that specific POL networks - Passive Optical LAN are local networks fully made of fiber optic with topology of point to multi-point in most of the cases.

Basically POL is an FTTx system for enterprise and private.

In this document we will present barpa solution which is settled in Plug N' Play, making the installation simplified.
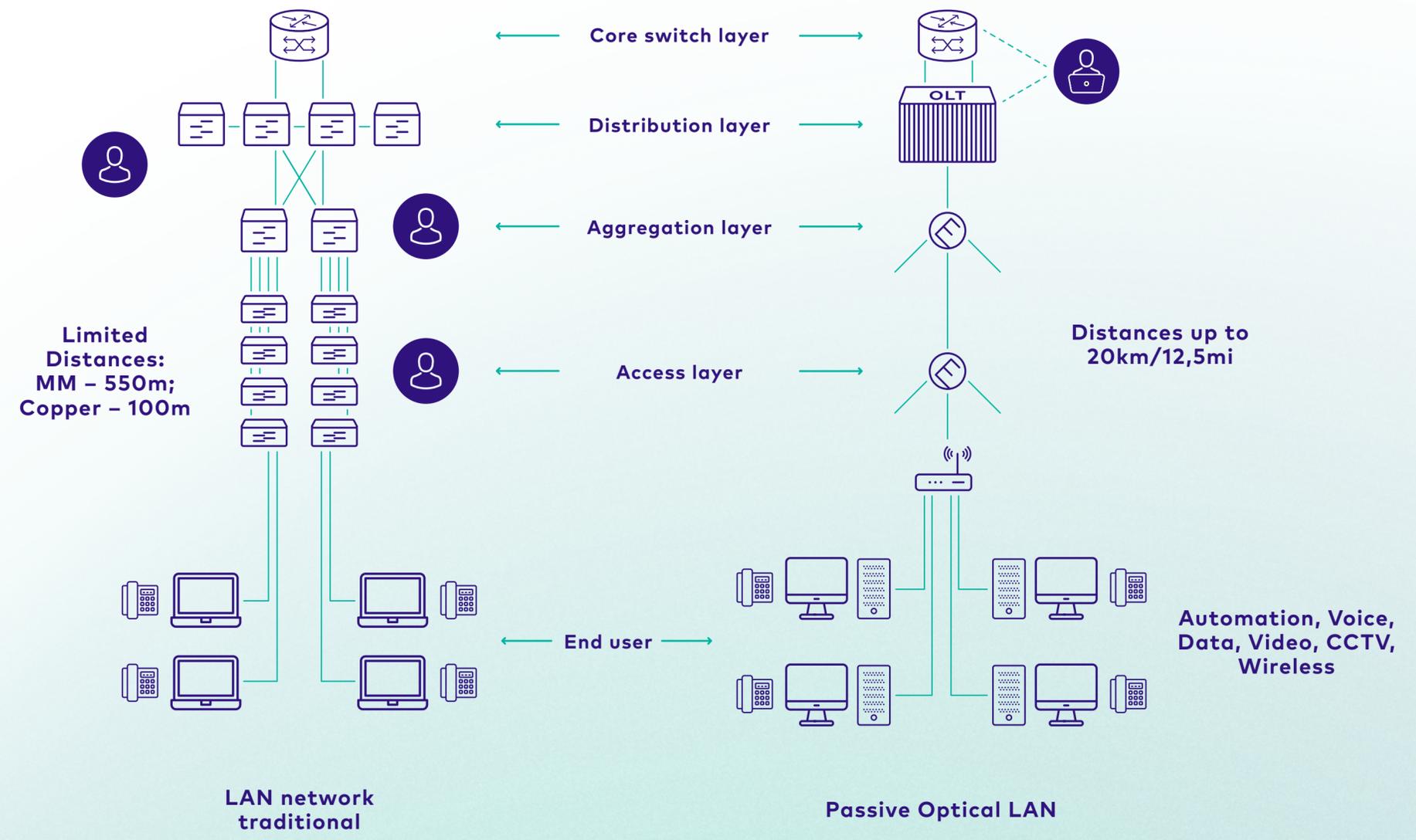
difference between traditional LAN and PON

Nomenclatures

OLT – Optical Line Terminal
ONT – Optical Network Terminal

In our POL solution, the Distribution Layer of the traditional LAN is replaced by the OLT, the copper network is replaced by fiber and the switches are replaced by optical splitters. ONT supplies the connected users (direct of wireless): services of data, voice and/or video.

Core switch layer

Distribution layer

Aggregation layer

OLT

Access layer

Limited Distances:
MM – 550m;
Copper – 100m

Distances up to
20km/12,5mi

End user

Automation, Voice,
Data, Video, CCTV,
Wireless

LAN network traditional

Passive Optical LAN

understanding POL/PON networks and GPON

**PON networks are the umbrella of all fiber optic networks, we can divide in two type of applications:**

• For enterprises, hospitals, hotels, education, etc. - POL;
• For houses, apartments, small business – FTTx.

POL networks represent the passive structure and GPON represent the type of transport.

In one POL we can use Ethernet, GPON XGS-PON, NG-PON2, etc.

In this case we will apply the GPON technology to the FTTD system (Fiber to the Desktop) which is widely used in the commercial, educational to government areas.

According the standard ITU-T G.984 GPON Class B+, GPON are distributed by singlemode, simplex conectors and passive optical splitters. Using conectors with APC polish with the goal of having conections with precision and minimizing the attenuations or return loss.
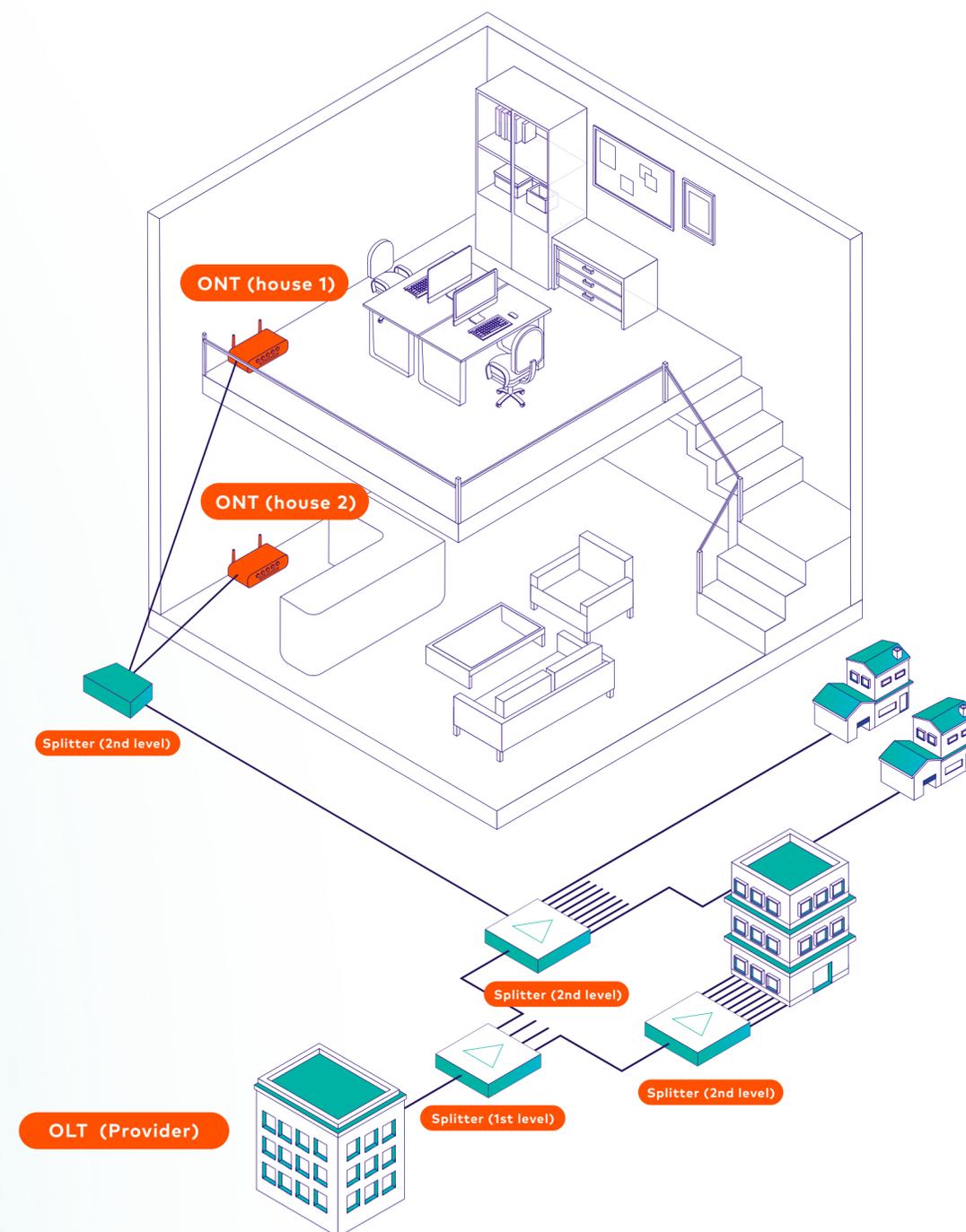
There are 4 main components: OLT, cabling and their products, optic splitters and ONT.

OLT – Optical Line Terminal

This equipment converts the "Ethernet world" to the "GPON world".
Acts like one bonding agent and it's typically in the Data Center
or in the Telecom room. It has one central processing unit, passive
optical network cards, a gateway router and voice gateway cards.
It can transmit data signals of 1490nm, this signal in each port can
transmit until 128 ONTs, depending of the OLT.

Cabling and their components

POL networks use the passive network to transmit signal. Since fiber
cables, copper cables, connectors, faceplates, cable trays, etc. All of
the fiber components need to count for the loss calculations.

Optical Splitters

In PON arquitecture we don't use switching equipment, instead we
use Optical Splitters that divides the signal from the OLT though one
fiber until 32 fibers which all of them connects to one ONT.

ONT – Optical Network Terminal:

This equipment is the turnarround between fiber optic and Ethernet
router. ONT convert the optical signals to electric signals, and
vice versa. This is, in a more standard way, near the user sockets.
It has multiple Ethernet entries to connect to IP devices such as:
telephones, access points, cameras, video components, etc.
Depending on the ONT manufacturer, it can give several diferente
characteristics, such as: PoE, redundancy, etc.
There are also ONT's that has F and BNC connectors for RF-Oberlay
and almost all of them includes Wifi. It can have from 1 to 8 RJ45
ports.

key advantages of barpa's POL solution

Plug N' Play system

o   Quick Installation;

o   Easy installation – reduce of specialized technicians

o   Quick and Easy Design;

o   Flexibility;

o   No optical fusions.

Reduce of Costs and Space

o   Capex (Initial Cost): between 40% and 60%*;

o   Opex (annual Cost): between 50% and 75%*;

o   Simplified Maintenance (less cables, less cabinets, centralized management network, failure reduction, etc.);

o   No secundary cabinets, no need of attenuators.

from 2018 BICSI conference

Highly secure and reliable

o   There are no Crosstalk in fiber optic;

o   With no electromagnetic influence (EMI/RFI);

o   In downstream we can considerer AES 128 encryption.

Energy Consumption Reduced – Green Arquitecture

o   Less energy consumed by the switching reduction, UPS, Air Conditioning, etc;

o   Less space used because there are a reduction of active equipments;

o   Reduction of the cable density. Allowing, in case of fire, be easier to act;

o   Adherence to sustainable initiatives – LEED® and STEP.

Offers Voice, Video and Data and other IP services

Scalable infrastructure designed for the future (10G, 40G, 100G)

Longer distances

Broadcast in various locations worldwide

Less quantity and dimmension of cable trays

High Badwidth

o   In GPON, downstream is 2,5Gbps and the upstream is 1,25Gbps. This is a significant improvement comparing to the traditional technologies. Besides this, this system uses one technology of dynamic bandwidth allocation.

POL applications

05

- **Offices**
- **Universities**
- **Hotels, Casinos, Museums**
- **Airports**
- **Industry**
- **Hospitals and Clinics**

Leroy Merlin

Fitness Up

Joaquim Chaves Laboratory

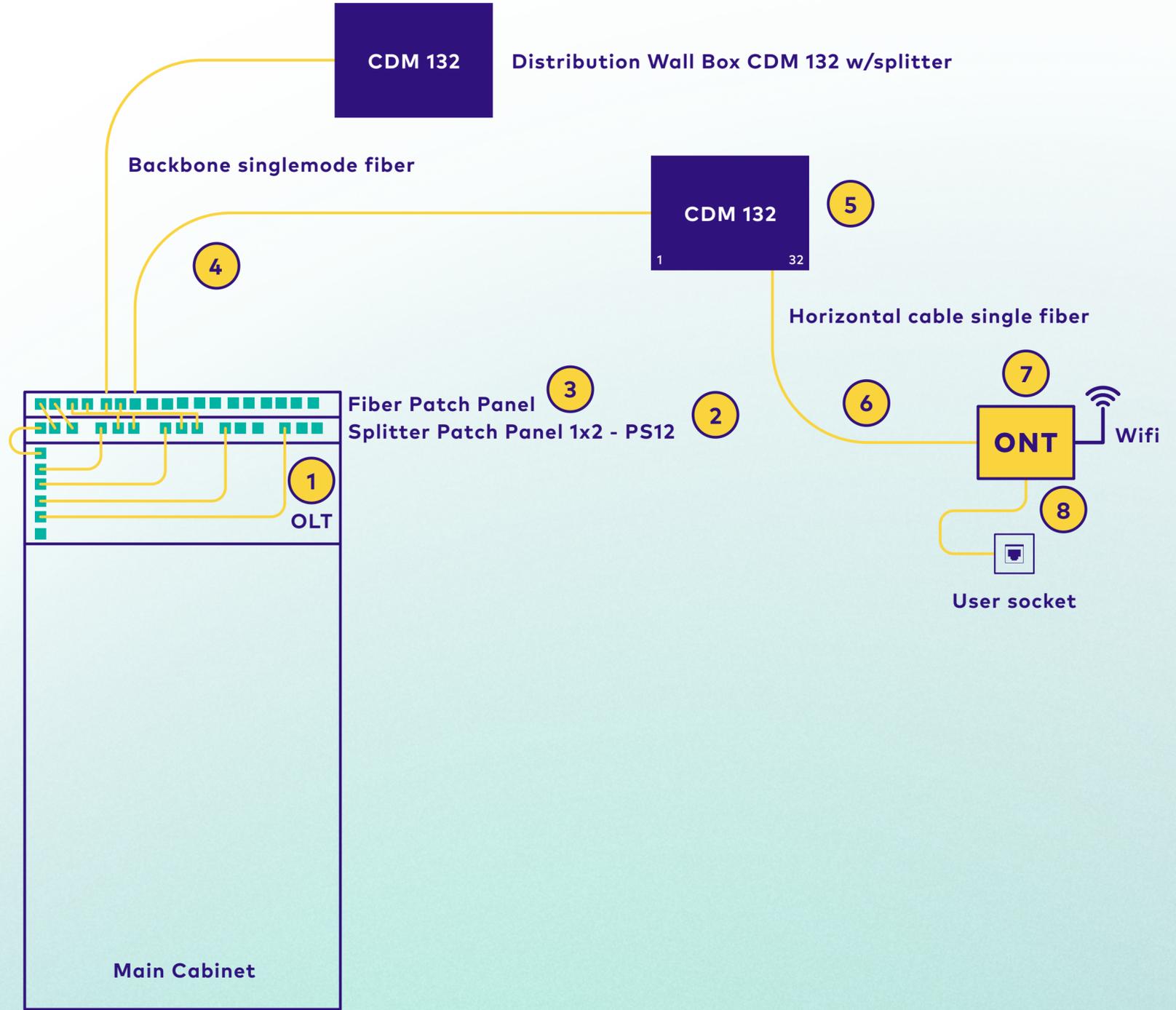Pestana Churchill Bay

barpa's GPON solution

When the I&D team of barpa was developing, it had one main goal to achieve: to be easier and simple to understand. We present to you one general image of our solution in one building:

1. Splitter Patch Panel

2. Splitter

3. Wall Distribution Box

4. Pre-Terminated Higgs Fiber Cables SC/APC-SC/APC 1F

5. Access Point

6. Box + Patch Cord

7. ONT

8. OLT

In a simplified way, the barpa solution consists of:

1. Patch Cord SC-SC/APC

2. Splitter Patch Panel – first level

3. Fiber Patch Panel - Optional

4. Backbone between main cabinet and Distribution Box

5. Distribution Box – second level

6. Cabling between Distribution box and ONT

7. ONT

8. Patch Cord Female-Male

CDM 132

Distribution Wall Box CDM 132 w/splitter

Backbone singlemode fiber

CDM 132

1   32

5

4

Horizontal cable single fiber

Fiber Patch Panel

Splitter Patch Panel 1x2 - PS12

3

2

6

7

ONT

Wifi

1

OLT

8

User socket

Main Cabinet

barpa's products of the GPON solution

Splitter Patch Panel

The barpa Splitter Patch Panel is one unit to hold PLC splitters.
Steel construction with Black Powder Coating.
Specially designed for GPON barpa solution. You can purchase this single product or you can customize per your needs (with splitters and adapters).

CODE	FOR SPLITTERS	MAX NUMBER OF SPLITTER	CONNECTOR
81503110210	1x2	8	SC Simplex
81503110410	1x4	5	SC Simplex
81503110810	1x8	3	SC Simplex

Fiber Patch Panel

barpa's Fiber Optic Patch Panel is a standard 19", It´s used to manage optical fiber terminations and splices up to 48 or 96 fibers in 1U of cabinet space. With a drawer design for easy access and adjustable in depth.

CODE	FOR ADAPTERS OF	CAPACITY (FIBERS
81501010101	SC Duplex/LC Quadriplex	48
81501010102	SC Simplex/LC Duplex	24

Wall Mounted Distribution Box

The barpa Wall Mounted Splitter Distribution box is a box that holds PLC splitters. Steel construction with Black Powder Coating. Specially designed for barpa's GPON solution. You can purchase this single product or you can customize per your needs (with splitters and adapters).

CODE	CONNECTOR
81602050320	SC Simplex

Mini Type PLC Splitter

Especially applicable to PON (EPON, GPON, BPON, FTTX, etc.) to connect the MDF (main distribution frame) and the terminal equipment and to branch the optical signal.

CODE	1XN	CONNECTOR
81441111102	1x2	SC/APC
81441111104	1x4	SC/APC
81441111108	1x8	SC/APC
81441111116	1x16	SC/APC
81441111132	1x32	SC/APC

Wall Terminator Box

With a good dust-proof design, fits 2 adapters with a
lock structure for protection.
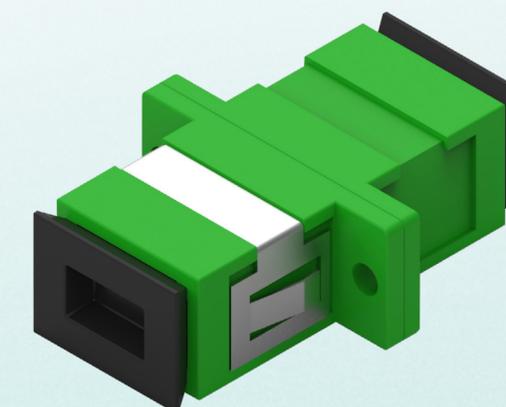
CODE

81601010020
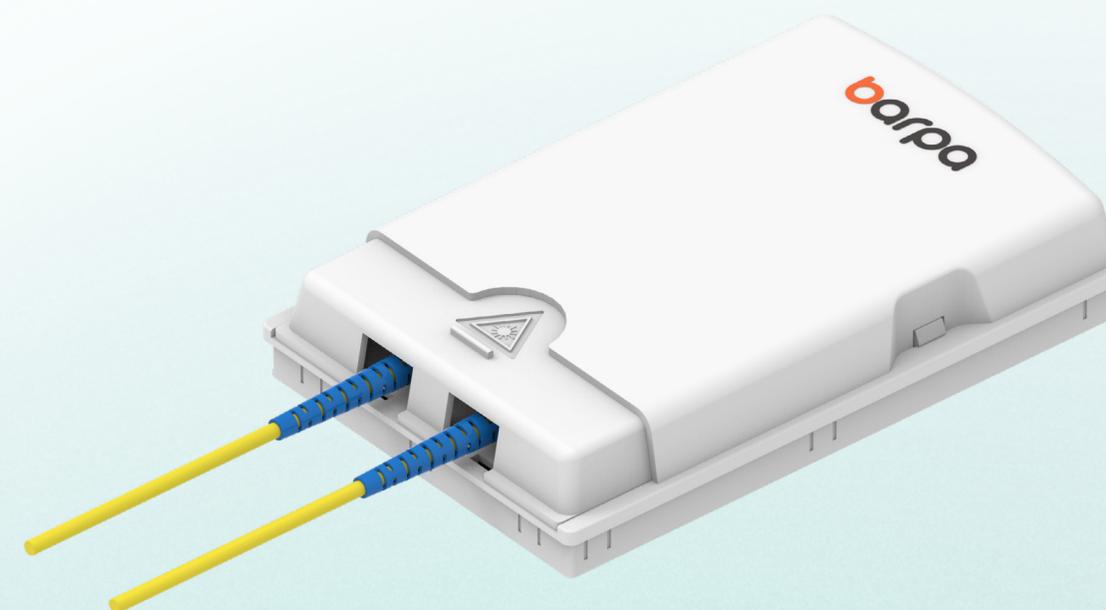
Adapters

barpa adapters have high yield with a precise alignment and low insertion and return loss.

CODE	CATEGORY	CONNECTOR	TYPE	FLANGE
81411091050	OS2	SC/APC	Simplex	With
81411111050	OS2	SC/APC	Simplex	Without

Pre-Terminated Fiber Cables
Tailor Made by Higgs

What makes the GPON solution of barpa really Plug N'Play is the option of using our Tailor Made services. Several configurations are possible according to the project requirements. This solution has countless advantages, we present some to you:

o   Cost reduction of Installation;

o   100% tested and with traceability;

o   Cable waste reduction;

o   Guaranteed laboratory production quality;

o   Eliminates the need to make fusion splices.

Several cabinet options depending on your needs:
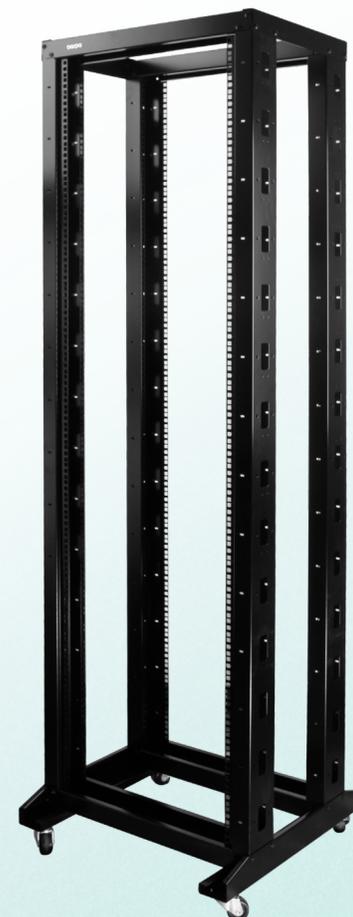
Server Cabinet

- Cetus 1
- 1300kg
- 24U to 47U

Floor Cabinet

- Norma 1 / 2 / 3 / 4
- 800kg
- 15U to 47U

Open Rack

- Pyxis 1
- 250kg
- 29U to 47U

Wall Cabinet

- Crux 1
- 80kg
- 6U to 22U
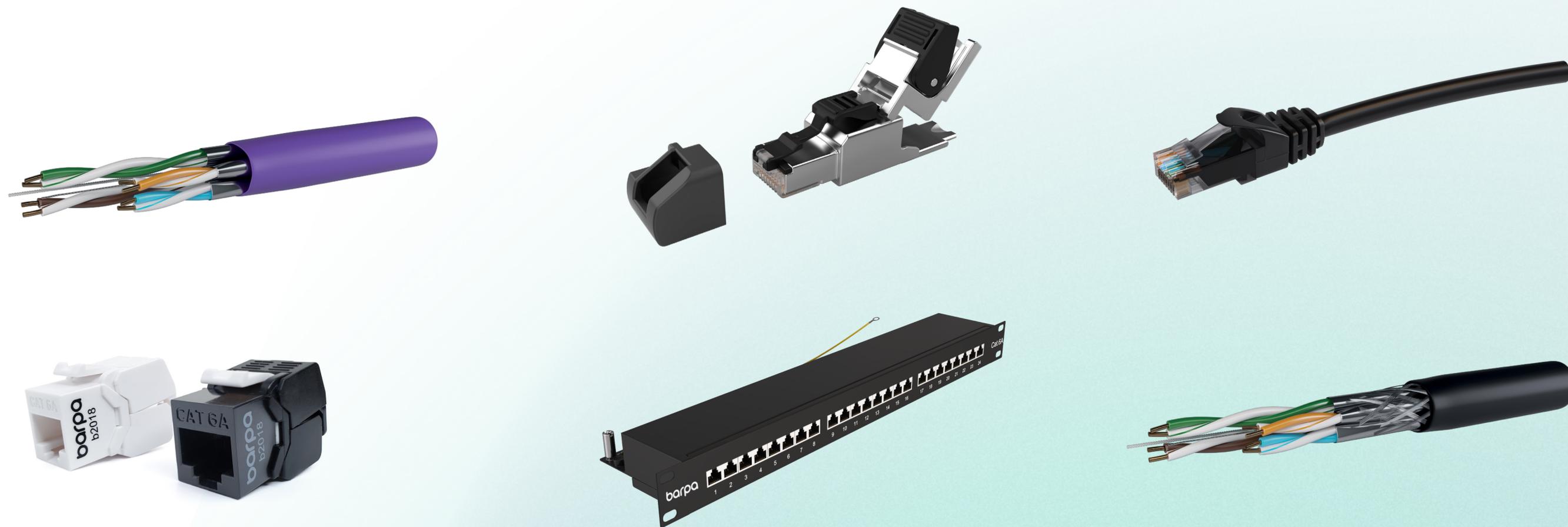
Wall Cabinet

- Crux 2
- 2U to 7U

Copper – Cable, Patch Cords, Panels,Keystones, Plug RJ45

Several options for the end of the network, interconection to the equipments.

Loss Calculations of Channel and Link

POLs are tested the same way as the traditional fiber optic networks. All the cabling must be tested considering standards of IEC, ANSI e EN. Calculating channel attenuation include all the passive components (cable, connectors, patch cords, fusion splices, adapters and splitters).

The protocol ITU-T G.984 determine the minimum and maximum attenuation allowed of the channel to a maximum length. The next table shows the values of ITU-T G.984 Class B+/C+.
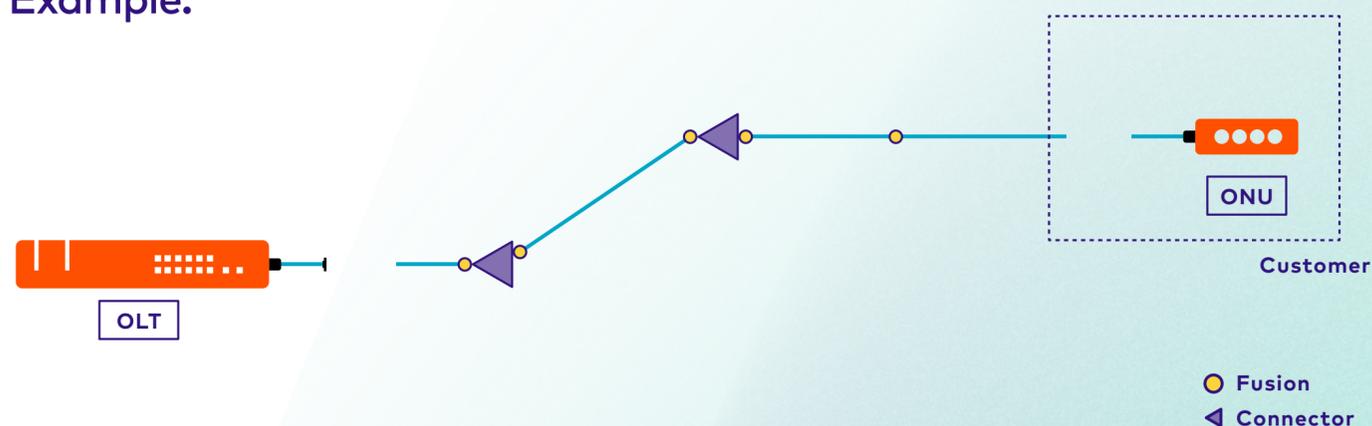
GPON CLASS B+ (ITU-T G.984)	UPSTREAM @ 1310NM	DOWNSTREAM @ 1490NM
Channel Attenuation (Min)	13dB	13dB
Channel Attenuation (Max)	28dB	28dB
Maximum Supported Distance	20Kms	

GPON CLASS C+ (ITU-T G.984)	UPSTREAM @ 1310NM	DOWNSTREAM @ 1490NM
Channel Attenuation (Min)	17dB	17dB
Channel Attenuation (Max)	32dB	32dB
Maximum Supported Distance	60Kms	

From ITU-T G.984

Example:

OLT

ONU

Customer

○ Fusion
◁ Connector

The attenuation calculation of POL channel depend on several factors:

- Length of the connection (Kms);

- Specifications of the used equipments (OLT and ONT);

- Topology used (splitters+connectors);

- Safety margin (for future expanse or maintenance).

The fiber loss will depend of the length. We will define the window of 1310nm (Upstream) for the calculations because it is what represents an higher attenuation:

FIBER TYPE (CATEGORY)	SINGLEMODE OS2 G657A2	
	Attenuation	Transmission Window
	0,38 dB/Km	1310nm
	0,23 dB/Km	1550nm

To analyze physical topology that must be used, it is necessary to quantify the losses of the passive components to be used. The following table shows the loss values of the different components:

CONNECTOR ATTENUATION	dB	0,3
SPLICE ATTENUATION	dB	0,05
MECHANIC ATTENUATION	dB	0,3
SPLITTERS PLC		
1X2	dB	≤ 4,1
1X4	dB	≤ 7,4
1X8	dB	≤ 10,5
1X16	dB	≤ 13,8
1X32	dB	≤ 17,1

|		TOTAL ATTENUATION	
CONNECTION LENGTH (METERS)	100	0,038	dB
NR. OF CONNECTOR	2	0,6	dB
NR. OF FUSIONS	0	0	dB
NR. OF MECHANIC FUSIONS	0	0	dB
NR. OF PLC SPLITTERS			
1X2	1	4,1	dB
1X4	0	0	dB
1X8	0	0	dB
1X16	0	0	dB
1X32	1	17,1	dB
		21,838	dB
SAFETY MARGIN (MINIMUM RECOMMENDED 2DB)		6,162	dB

future technologies

08

POL Evolution

The direction of the evolution of POLs in the area of telecommunications is a point of high interest to the community. A positive aspect of the GPON network is that it is possible to migrate to XG-PON, XGS-PON networks, as the physical structure is the same.

In the table we can see the main differences.

|	GPON	xGPON	XGS-PON	NG-PON2
TRANSMISSION SPEED	Asymmetric Downstream: 2,5 Gbps Upstream: 1,25 Gpbs	Asymmetric Downstream: 10 Gbps Upstream: 2,5 Gpbs	Asymmetric Downstream: 10 Gbps Upstream: 10 Gpbs	Symmetric Downstream: 4x10 Gbps Upstream: 4x10 Gpbs
WAVELENGTH	Downstream: 1490nm Upstream: 1310nm	Downstream: 1577nm Upstream: 1270nm	Downstream: 1577nm Upstream: 1270nm	Downstream: 1596-1603nm Upstream: 1525-1544nm
DISTANCES	Until 20 Km	Until 60 Km	Until 60 Km	Until 40 Km
PORT CAPACITY PON	Up to 128 users	Up to 256 users	Up to 256 users	Up to 128 users

At the Upstream and Downstream wavelength level, the scheme is as follows:
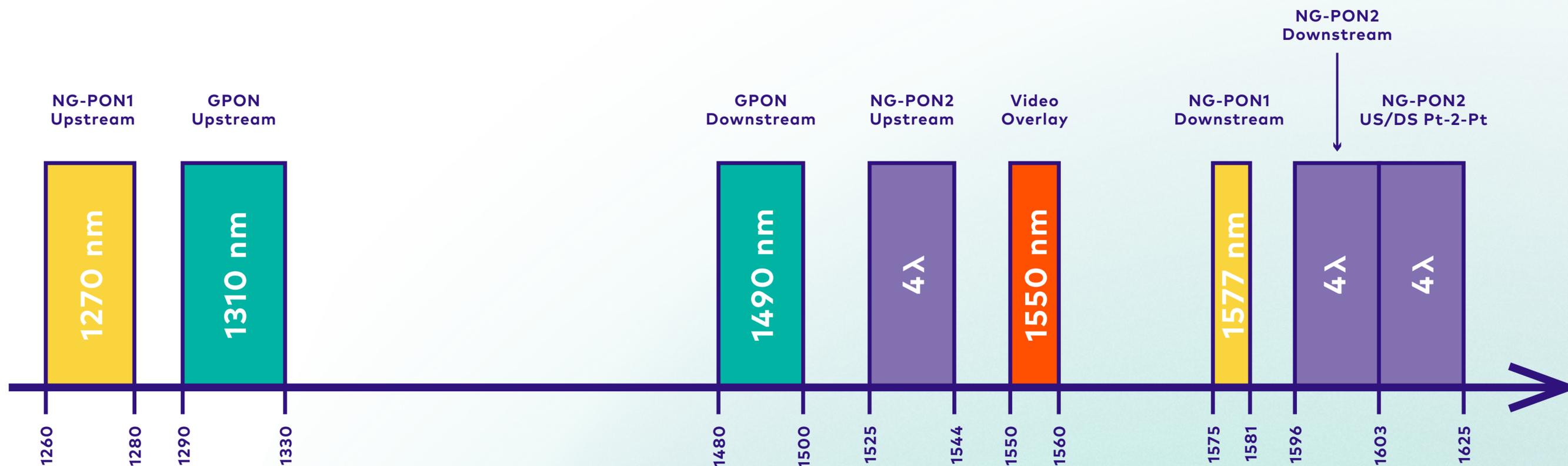
conclusion

Conclusion

POLs and GPON networks are increasing importance in the market due to all their advantages: flexibility, cost reduction, etc. At barpa we present a totally plug n'play solution in order to bring added value to the installer and user. Although we cannot apply it in any scenario, this architecture is here to stay and they provide very interesting solutions in terms of bandwidth, security, flexibility and the scability for the future.
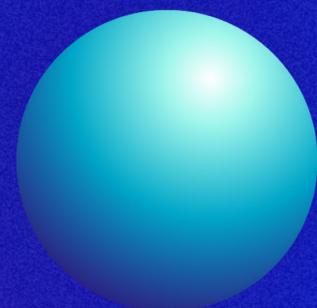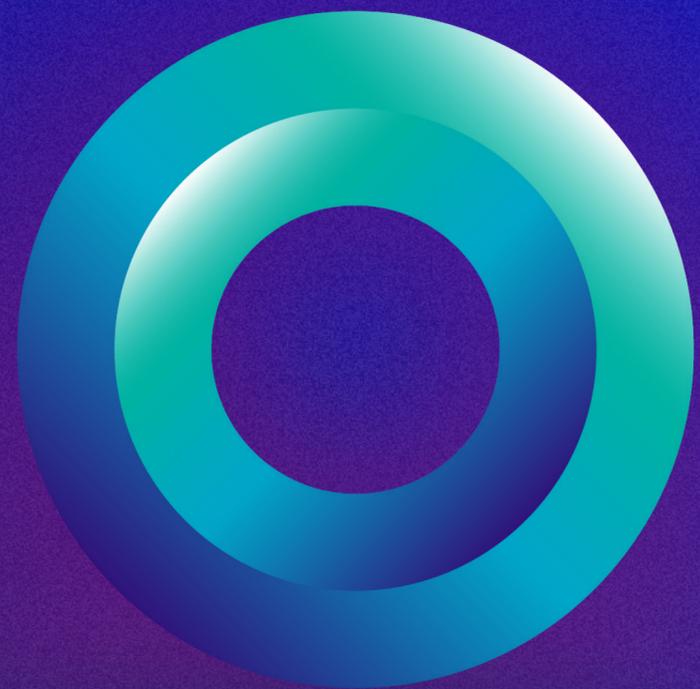
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