



Cybersecurity
Electronic and Communication Technologies
FTTx Technologies

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Backbones

Transport and Access Networks



MP4 Encoder

User Terminal

Wired/W'less Access Links

**(Fiber-Based)
Broadband Digital
Network**

high capacity,
long distance

Variety of Technology: even cellular network,
on Copper.



User Terminal



User Terminal

Wired/Wireless
Access Links

User Terminal



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FTTx Technologies

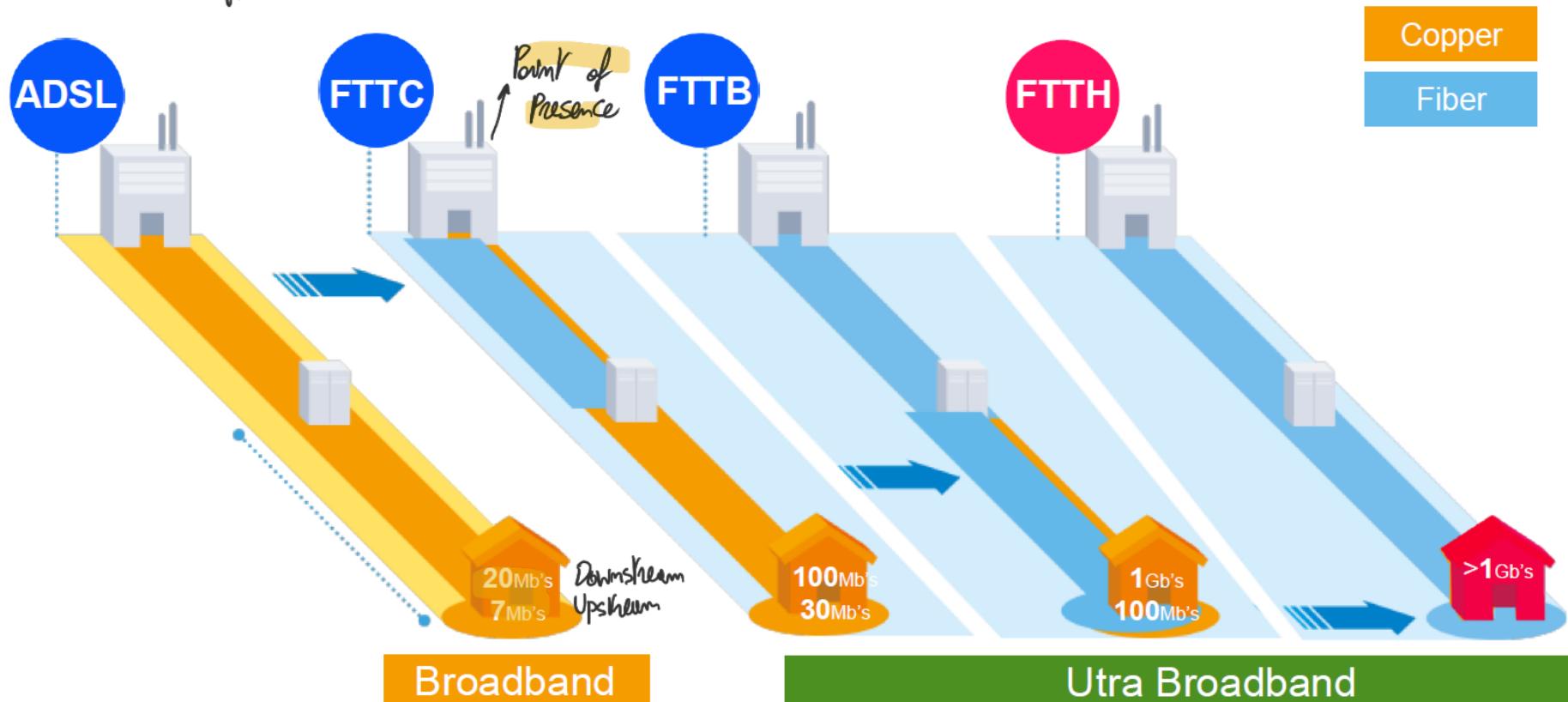


Access Network Technologies

Cybersecurity

Electronic and Communication Technologies

Many countries, xDSL. This means last mile using copper, by exploiting telephone cables. But telephone cables was designed to support analog comm. 50 years ago.



FTT cabinet

FTTC: between central office and end user there's a cabinet on the street with fiber.

Final section of copper is 300m instead of 1km. So with this evolved

tech, VDSL, you can reach better performances. Many towns use this.

But in some cases, you have FTTH: everybody has fiber. FTTB: fiber to the building; fiber comes to building and from base to the building, short section of copper cable. Two perform very similar, but FTTH is transparent to upgrades, because I have fiber.



Point-to-Point Architecture

End users



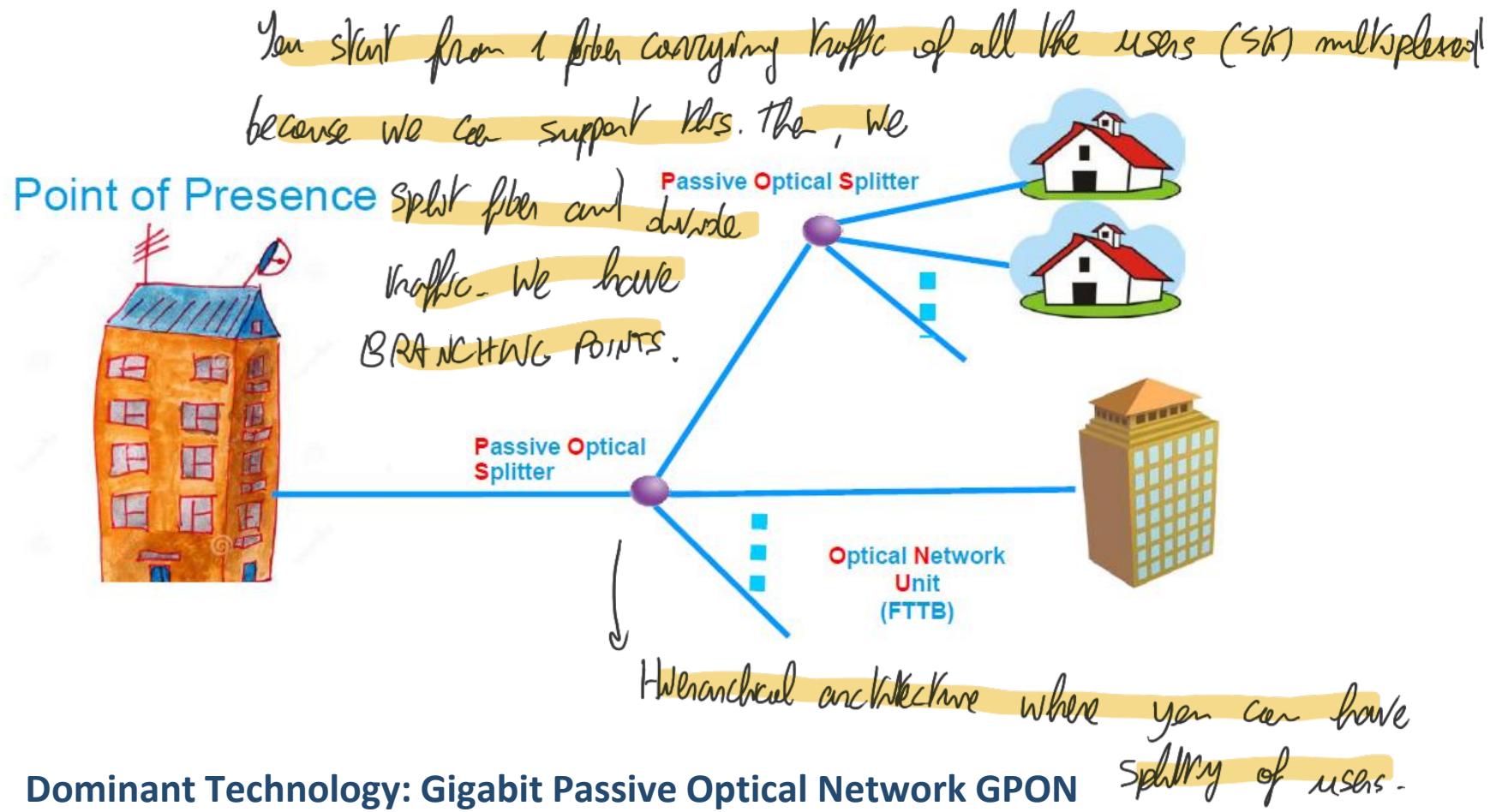
FTTH you have fibers in your apartment. If I have a central office that has to serve 5K users, I would need 5K individual fibers. Unfeasible.

Point of Presence





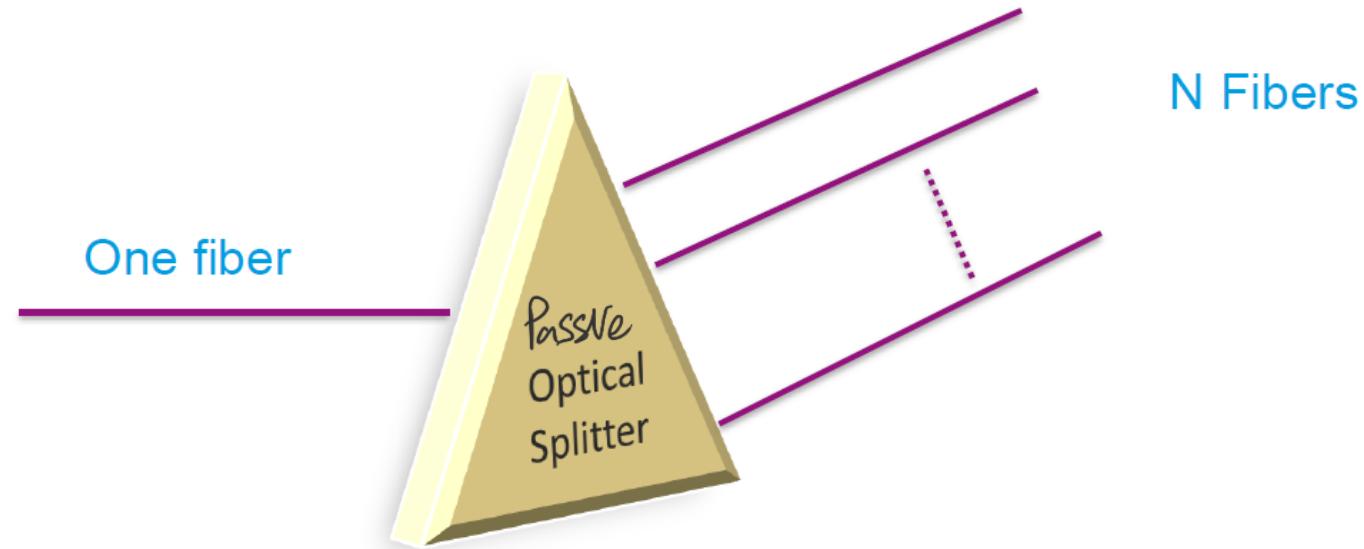
Point-to-Multipoint Architecture: Passive Optical Network





The (Passive) Optical Splitter

This done thanks to MWS;



Tipical ratio
1:4 1:16 or 1:32



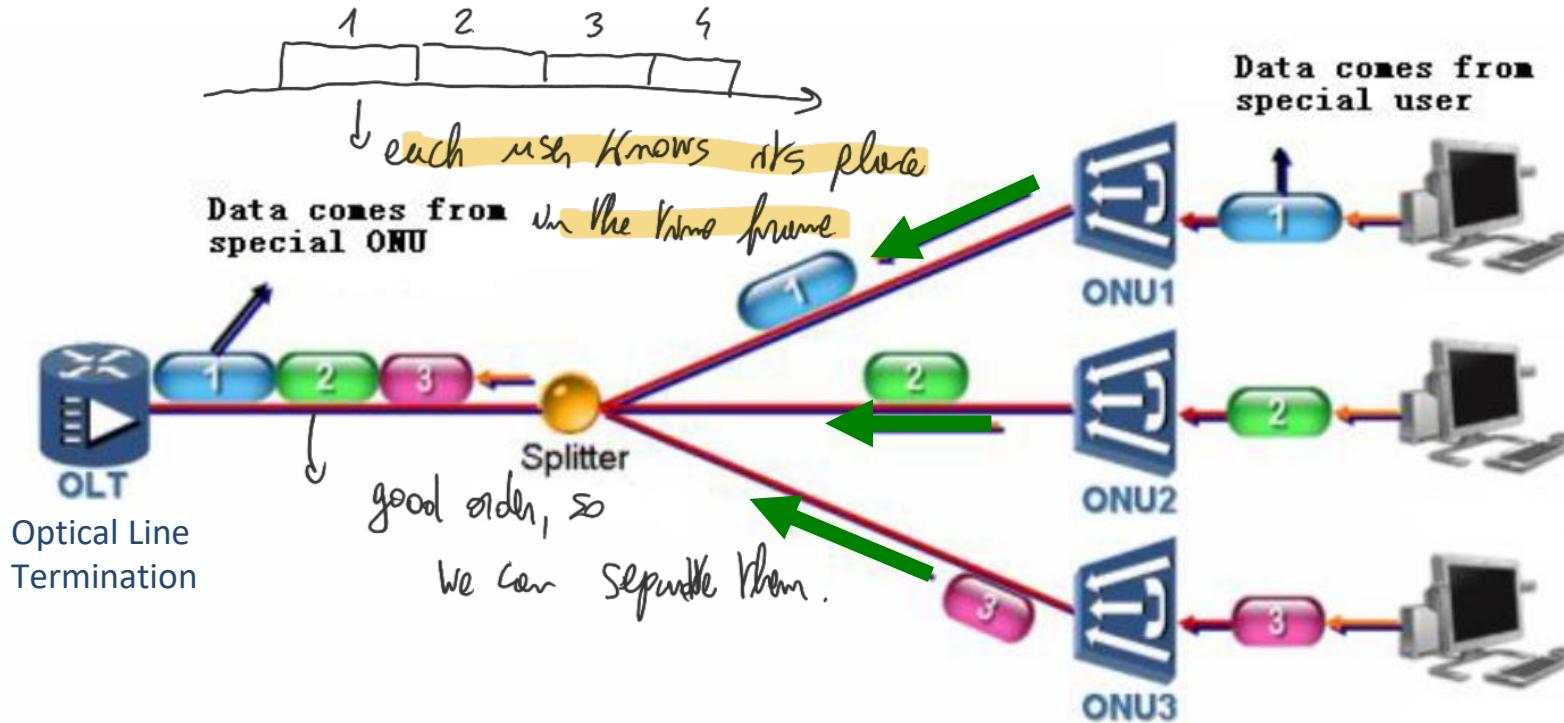
The (Passive) Optical Splitter



Pop! Col in input, since splitter is passive, you have in our Pop!
the same signal, just split.
 So attenuation is not negligible: for the length of the fiber yes, but we have
to keep splitting into account.

Upstream TDMA

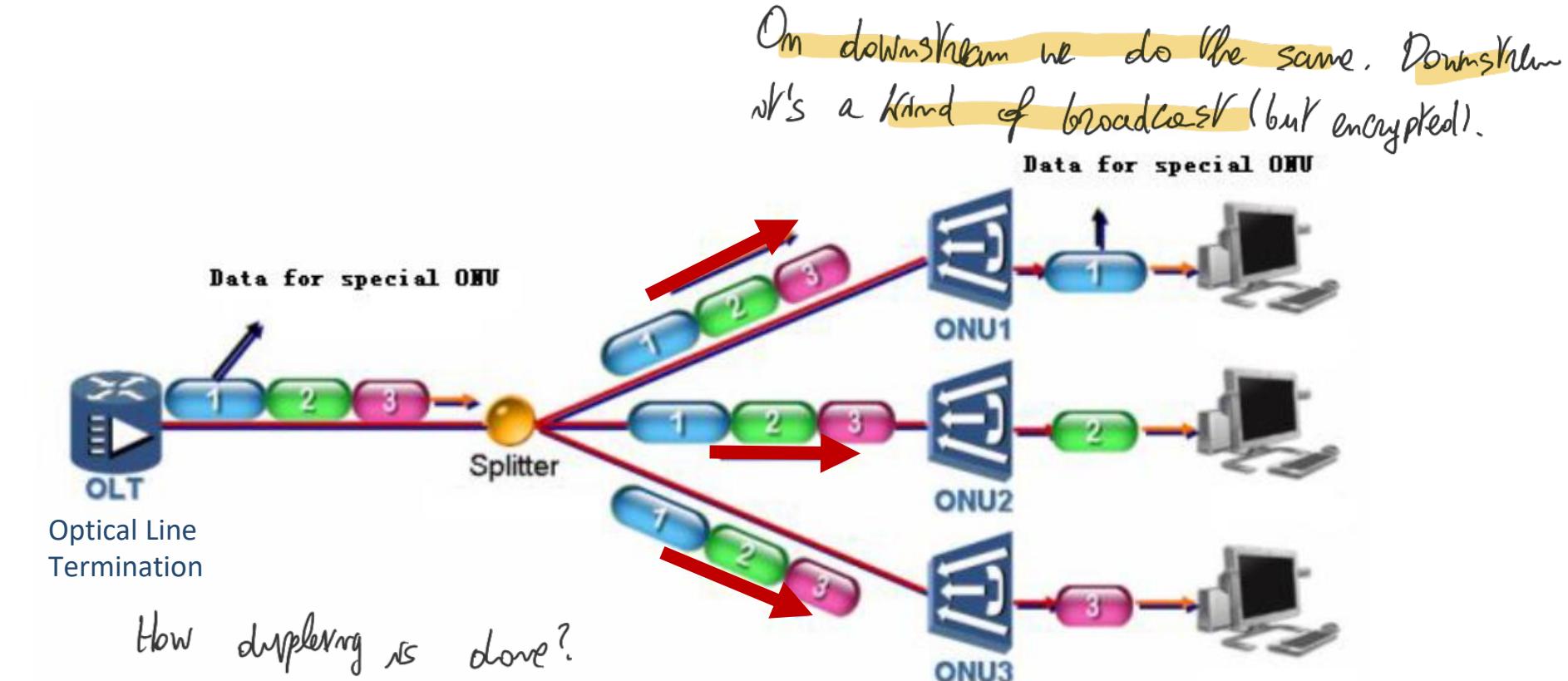
From end user to operator: each end user, with a certain synchrony, sends a packet.



In a GPON Network, upstream and downstream data packets are transmitted in wavelengths in the 1290-1330nm (typ. 1310) and 1480-1500nm (typ. 1490) ranges respectively.



Downstream TDM Multiplexing (Broadcast)



In a GPON Network, upstream and **downstream** data packets are transmitted in wavelengths in the 1290-1330nm (typ. 1310) and 1480-1500nm (typ. **1490**) ranges respectively.

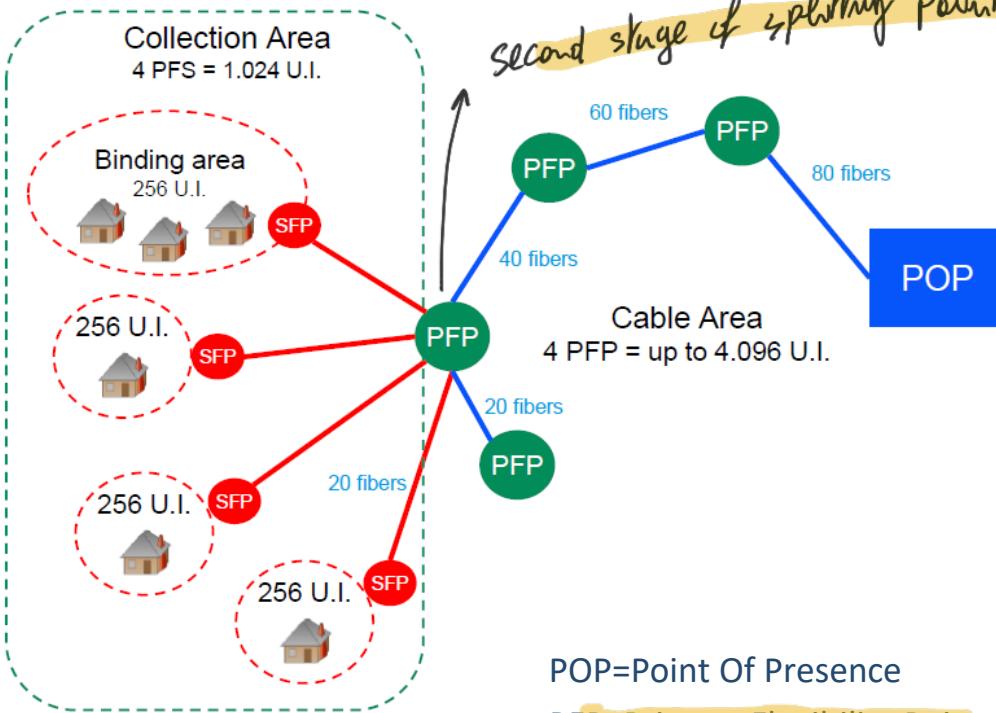
This is wavelength

division multiplexing.



So we have 2 channels on the same fiber and this is called
Wavelength division multiplexing.

Sample Network Architecture: OPEN FIBER's Gigabit PON



2 branching points

second stage of splitting point you can serve up to 256 U.I.s

Definitions

- **Cable Area:** House-Holds area served by the same cable.
- **Collection Area:** House-Holds area served by the same Primary Flexibility Point.
- **Binding area:** House-Holds area served by the same Secondary Flexibility Point.

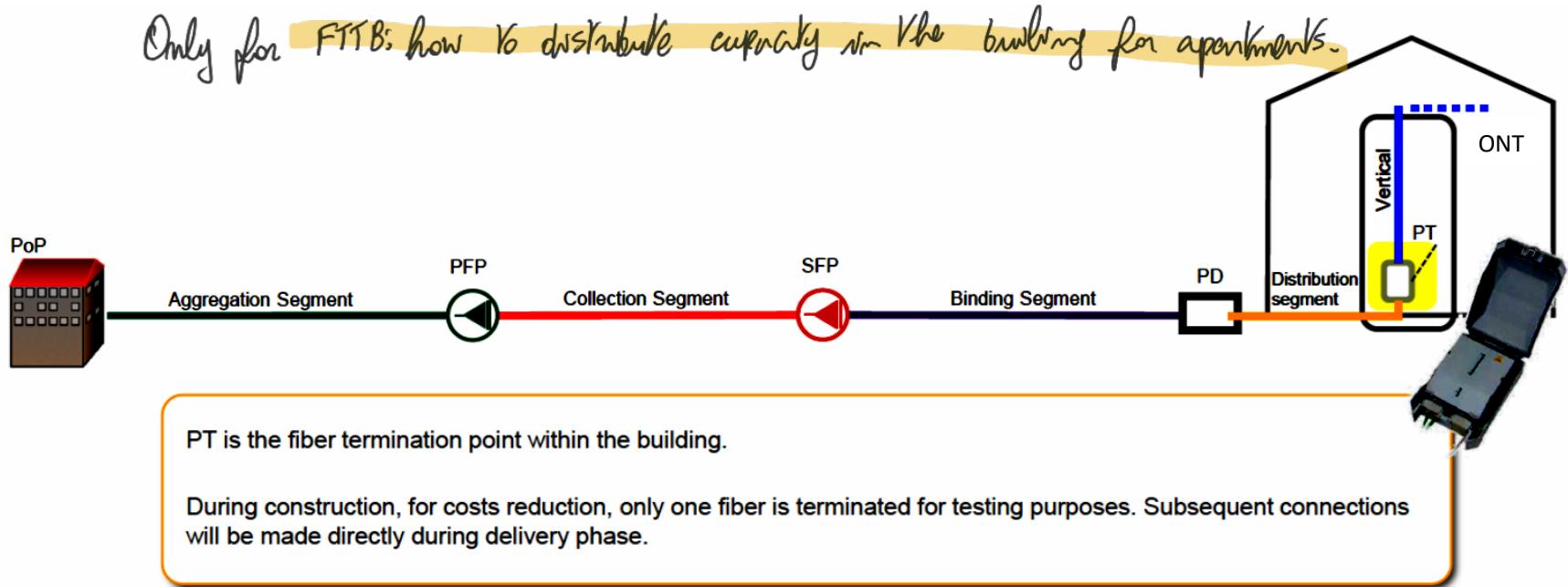
POP=Point Of Presence

PFP=Primary Flexibility Point = location where you have a few splitting of fibers

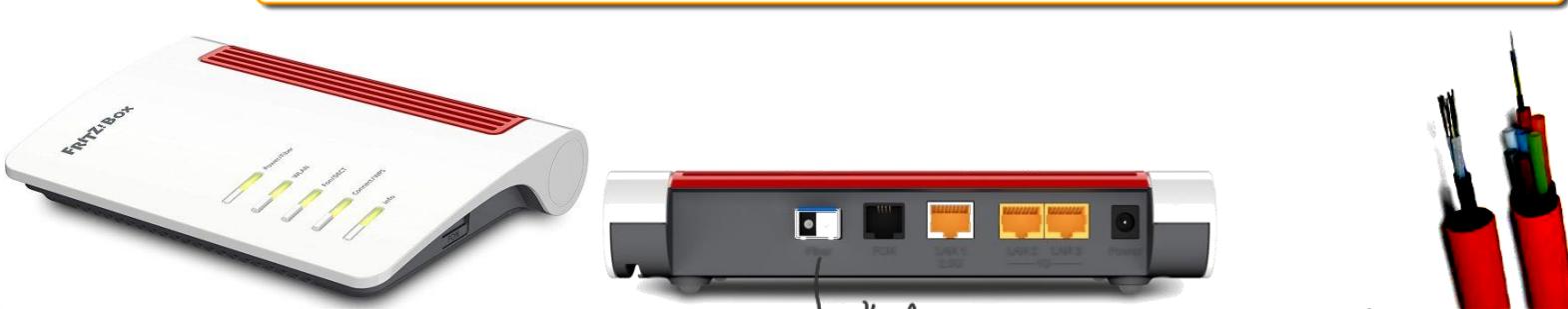
SFP=Secondary Flexibility Point

U.I.=Unità Immobiliare (Residential Unit)

The Vertical Segment/Termination Point (PT)



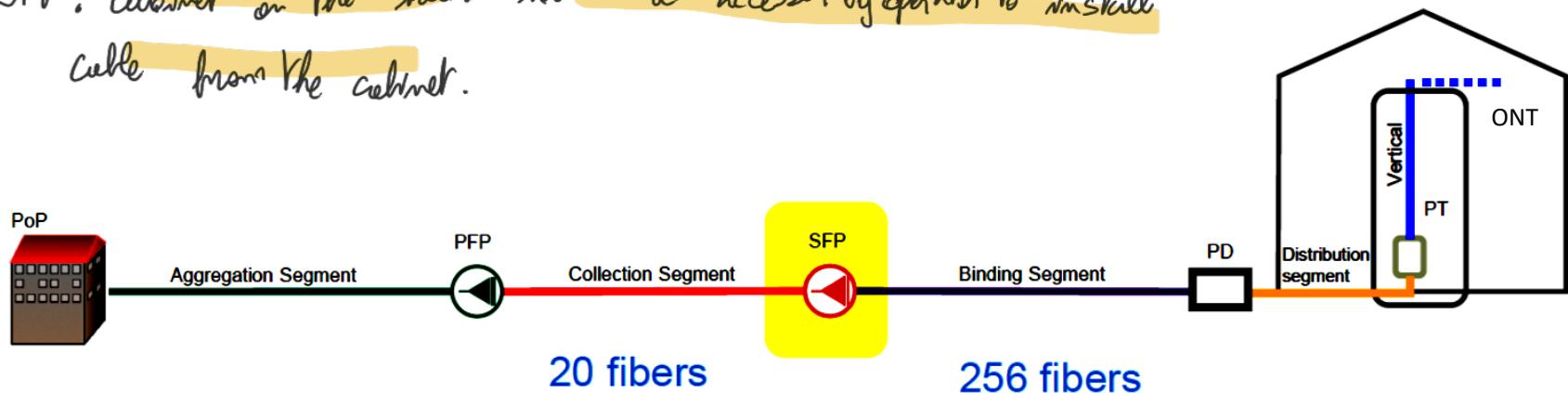
The Vertical segment is realized, where possible, simultaneously during construction of the network.



The SFP



2FP: Cabinet on the street. It has to be accessed by operator to install cable from the cabinet.



In the Open Fiber network the SFP usually is an outdoor cabinet with 20 splitters 1:16 inside. This is due to the needed flexibility to easily provide a dedicated GPON to at least 5 different OLOs. The cabinet is also engineered to host:

- splitters for GPON connections.
- ODF for permutation.
- Area to perform junctions toward households.
- Area to perform junctions toward business buildings with P2P architecture.

OLO=Optical Local Operator

The SFP

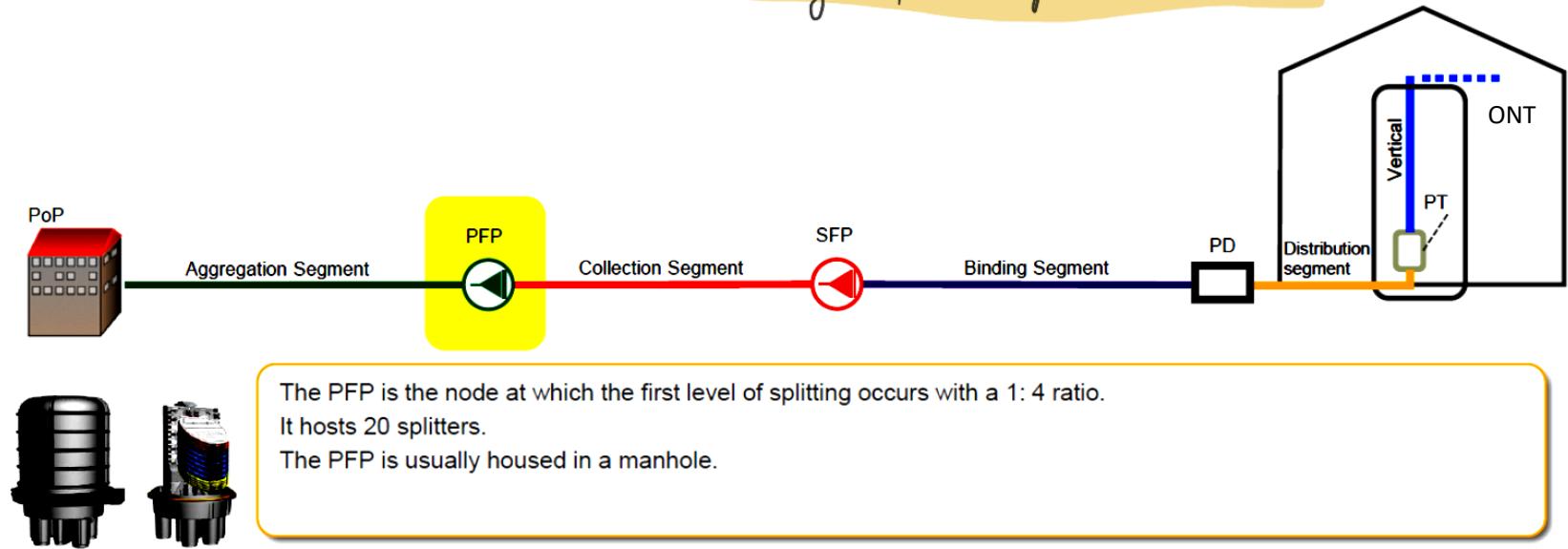


The PFP



PFP not accessible: from there after you installed it once

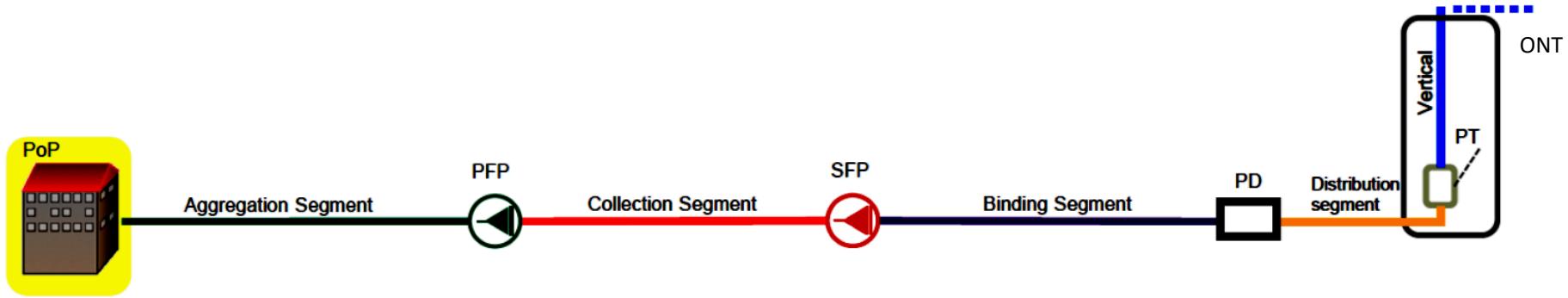
You never need it again, unless for maintenance.



The PFP



The PoP



The Open Fiber POP is able to connect around 70,000 HouseHolds. There are two different type of POP:

- Outdoor, made using shelters or cabinets on concrete platforms.
- Indoor, set up in special rooms.

The Open Fiber POP includes two segregated areas:

- An area reserved for Open Fiber personnel, which contains optical distribution frames and active transport equipment
- An area dedicated to the housing of OLO devices (OLT)



Future Evolution of G.PON

With FTTH in place, you just need to change the box at the home and at the office.

- The infrastructure will NOT change Even with FTTB is fine as well what you get.
- Slowly, multichannel WDM will be introduced

Gigabit passive optical network

GPON → **XG-GPON** → **XGS-PON** → **NG-PON2**

Downstream
2,5 Gbit/s
Upstream
1,25 Gbit/s

Downstream
10 Gbit/s
Upstream
2,5 Gbit/s

Downstream
10 Gbit/s
Upstream
10 Gbit/s

Downstream
40 Gbit/s
Upstream
10 Gbit/s

↓ next step is symmetrical.



Future Evolution of G.PON

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