
P2P vs PON
What is the difference?
Find out more ›
NOKIA

P2P vs PON: what to choose?

Fiber-to-the-home (FTTH) broadband access solutions have been deployed in high volumes in every corner of the world, and they show no sign of stopping. They have played a pivotal role in the creation of sustainable digital societies, while providing an attractive business case for broadband infrastructure and service providers.

There are many flavors of FTTH and all of them contribute to meeting the objectives of diverse fiber players, such as national and international CSPs, regional operators, MSOs, governments, utilities, neutral hosts, etc.

The two main FTTH technology groups are passive optical networks (PON) and point-to-point (P2P). Here's what you need to know when choosing the right approach for your network.

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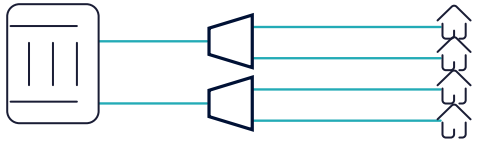
At a glance: P2P and PON compared

Ethernet P2P

P2P OLT

Topology	Eco-system	Cost	Bandwidth	Power	Evolution	Open access
Point-to-point	Limited deployments (mostly US and Europe). In decline.	More fibers, components and active equipment.	Symmetrical. Dedicated bandwidth 1G/1G 10G/10G 25G/25G	Uses more active equipment.	Today: 1G, 10G and 25G Next: 100G	Active or passive (from last distribution point or POP).

PON

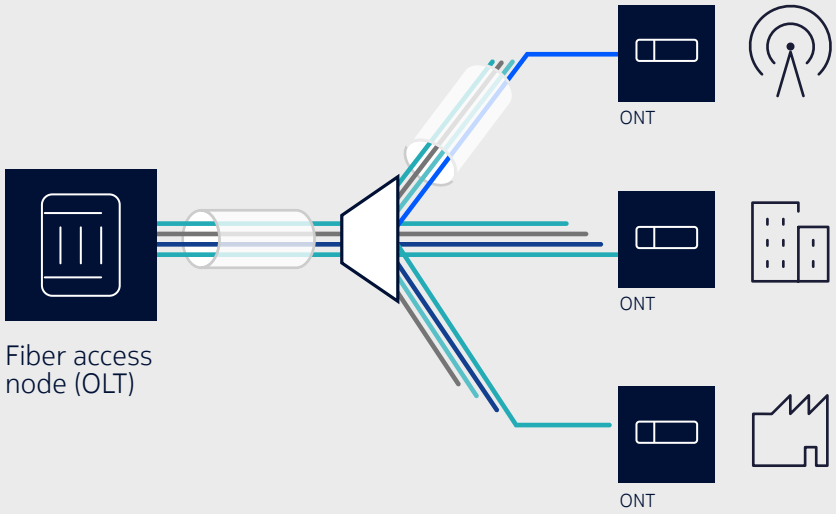


PON OLT Optical splitter

Topology	Eco-system	Cost	Bandwidth	Power	Evolution	Open access
Point-to-multi point	Accounts for 98% of all FTTH worldwide. Rich eco-system.	30% cheaper than P2P: - 30x smaller footprint - Shorter repair time.	Symmetrical or asymmetrical. Shared bandwidth 2.5G/1G 10G/10G 25G/10G 25G/25G	15x lower power consumption.	Today: 2.5G, 10G and 25G Next: 50G	Active or passive (from last splitter).

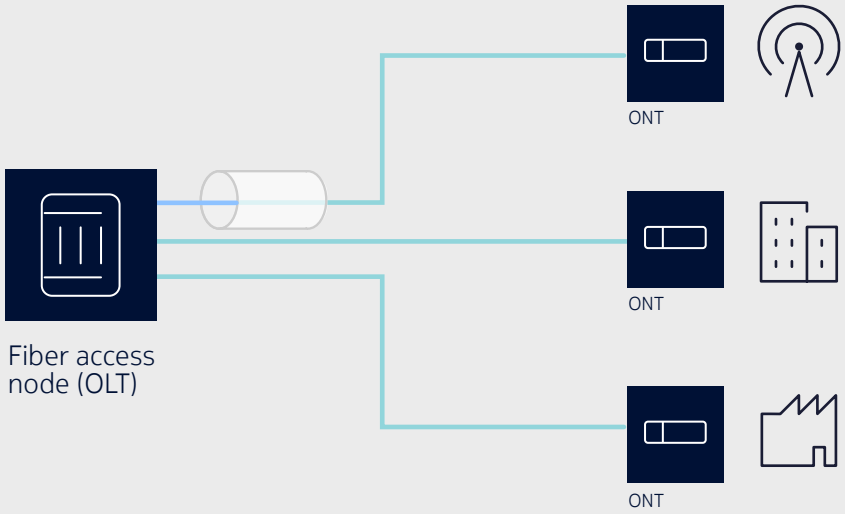
Topology

PON networks



- Point-to-multi point architecture.
- A single fiber fans out at the splitter location to connect an end-point.
- Flavors: EPON, GPON, XGS-PON, TWDM-PON, 25G PON, 50G, 100G.
- Each PON flavor operates on its own wavelength (color), so it is possible to have multiple flavors on a single fiber.
- Bandwidth increases are achieved by adjusting the equipment at both ends of a fiber and adding a wavelength that carries traffic at a faster transmission rate.

Point-to-point networks



- Point-to-point architecture.
- A dedicated fiber cable to each end-point.
- Flavors: 1G, 10G, 25G, 100G.
- A set of standardized wavelengths depending on whether a single or dual fiber is used.
- Bandwidth increases are achieved done by replacing the equipment at both ends of a fiber, so the P2P wavelength carries traffic at a faster transmission rate.

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Market landscape and eco-system

PON eco-system is richer

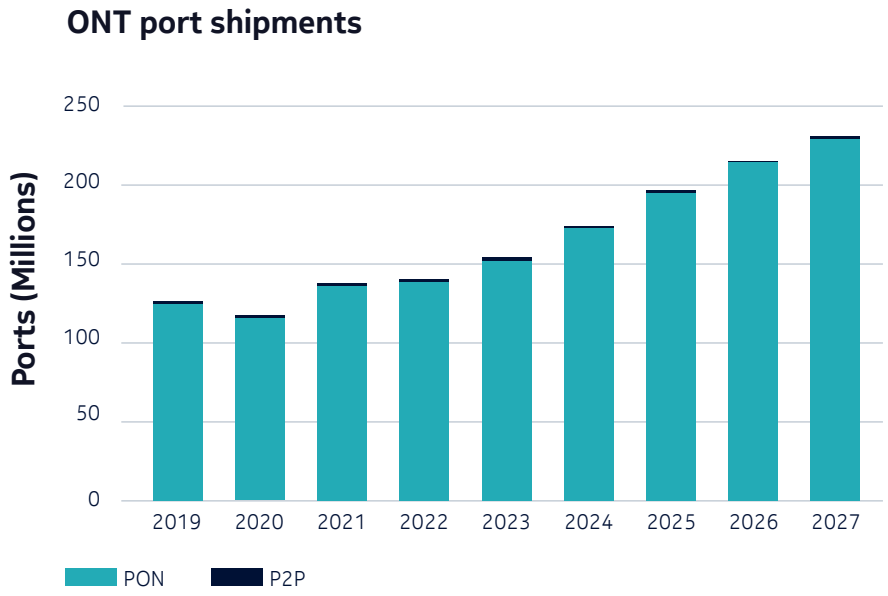
PON is much widely deployed than P2P, accounting for 98% of all FTTH shipments.

The PON eco-system is richer for consumer services, with more vendors competing, and offering a wider choice of solutions.

PON is the technology of choice worldwide for connecting consumers and small-medium businesses. With new high-capacity technologies, PON is increasingly being deployed for enterprises, mobile transport and smart cities.

P2P is deployed on a smaller scale for consumer and enterprise connectivity and mobile transport.

In an industry with frequent mergers and acquisitions, broadband providers should consider the impact of network architecture on their network value and attractiveness.



Source: Omdia, 2022

CAPEX comparison

PON is on average 30% more cost efficient

Outside plant cost:

In P2P there are typically more fibers to deploy, maintain and repair. However, operators can deploy P2P active equipment where the PON splitter would be, in which case there is no major difference between the number of cables in P2P and PON, but there will be more P2P active equipment in the outside plant that needs to be powered and maintained. In both cases the cost of outside plant for P2P is higher.

- P2P has 5x more cost for cabinets and PoPs.
- P2P has 25% more cost for civil works.
- PON has 2x longer reach and needs less CO sites.

Central office cost:

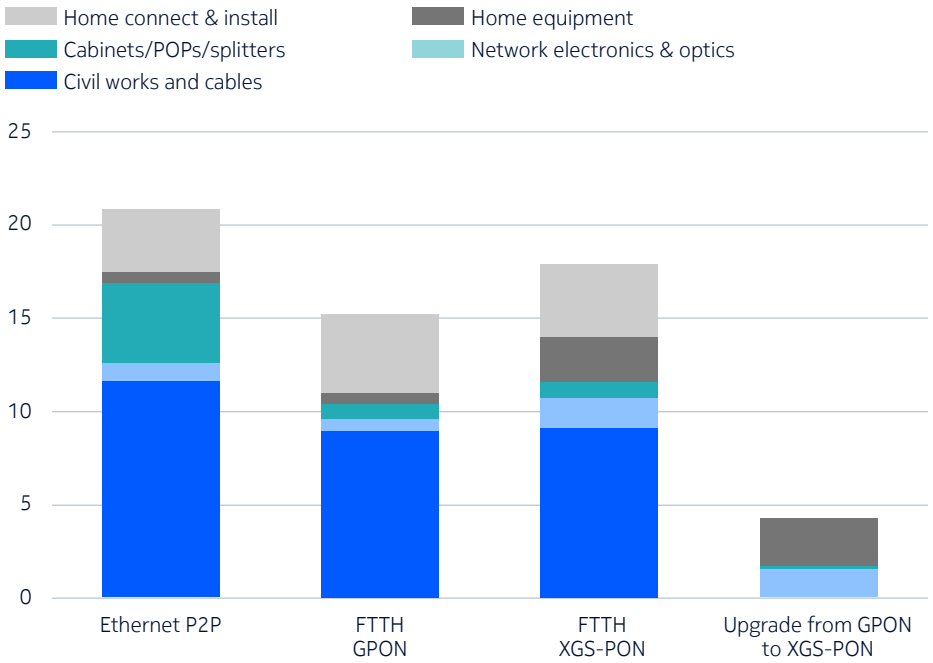
PON uses less equipment. To illustrate, one P2P port can connect one user, but one PON port can connect 32, 64 or 128 users.

PON has huge volumes and a rich eco-system, which drives down the average market price.

Customer premises cost:

Home equipment and connection costs are similar.

Relative CAPEX per subscriber (2500 HH/km²)

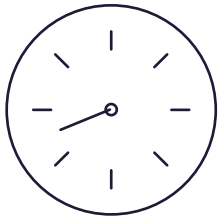


Bandwidth per user

PON and P2P at par

P2P has a dedicated connection to each user, while PON shares the total available bandwidth among multiple users. However, various bandwidth management techniques in PON, based on statistical multiplexing and dynamic bandwidth allocation, ensure the same level of bandwidth and customer experience.

However, PON has a higher overhead, so the maximum achievable rate needs to account for it.

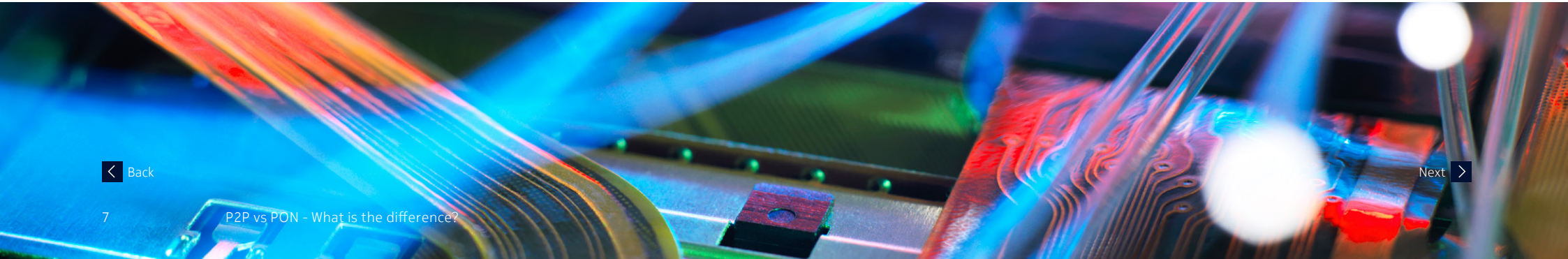


PON

- Symmetrical or asymmetrical options.
- Total bandwidth on a PON (2.5G/10/25G) is shared by multiple users (typically 32 or 64).
- Bandwidth management techniques ensures fair and accurate bandwidth allocation to each subscriber.
- Each user can burst to maximum bandwidth if needed.
- Peak bandwidth for a user is up to the total PON bandwidth.

P2P

- Symmetrical bandwidth.
- Total bandwidth on each interface is for a single user.
- QoS manager in the access node handles overbooking in the switching matrix and on uplink interfaces.



OPEX comparison

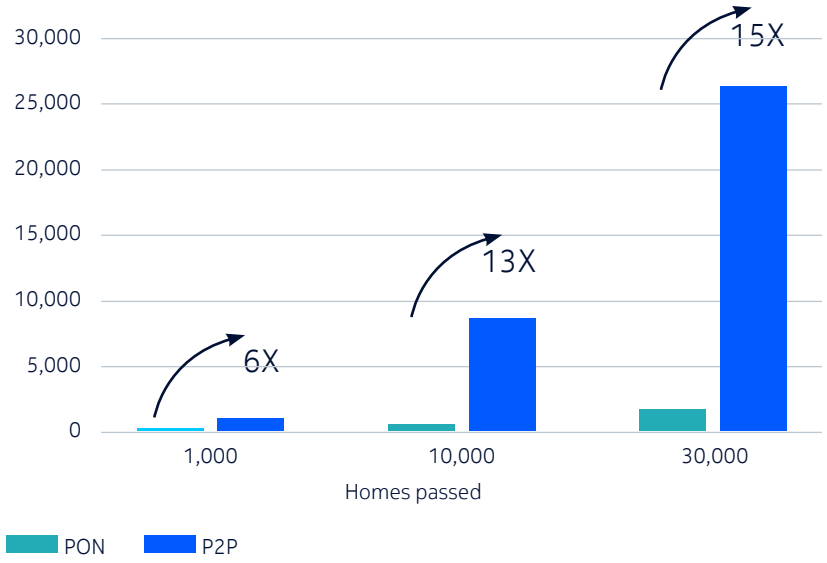
PON is more energy efficient

PON uses less equipment and needs less energy to power the equipment.

PON has a smaller footprint in the telecom central office and needs less energy to cool the room.

The power consumption difference becomes significant with large deployments.

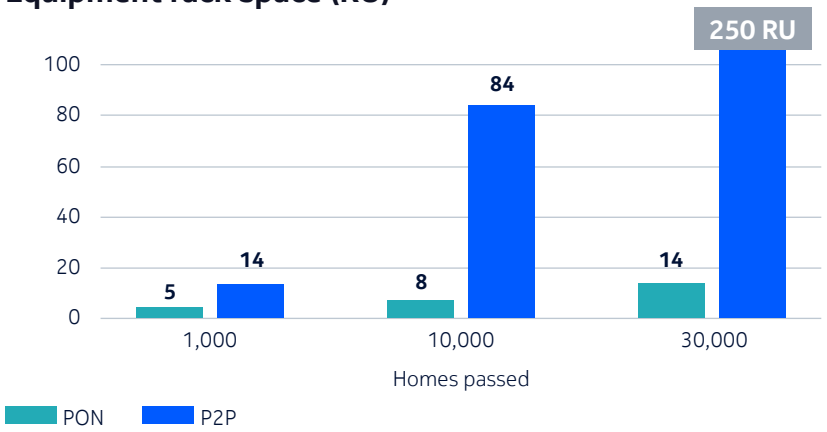
Power consumption (W)



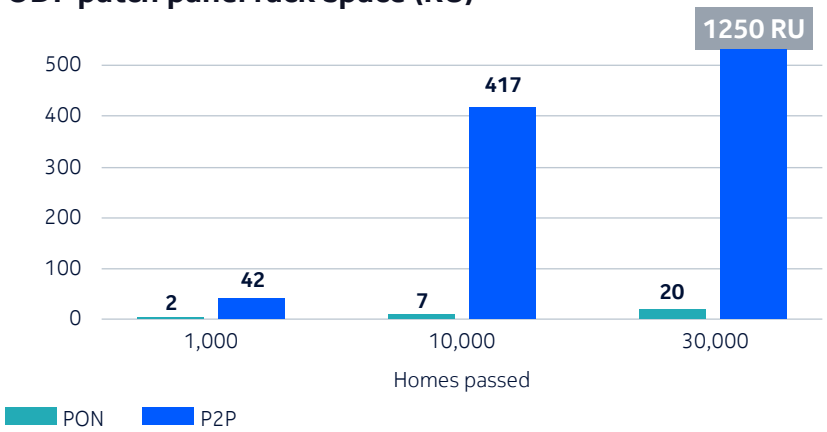
OPEX comparison

PON requires less rack space

Equipment rack space (RU)



ODF patch panel rack space (RU)



With a single rack PON can serve **30,000 homes**.

With a single rack P2P can serve **1,000 homes**.

The difference in floor space **increases with the deployment size**.

From 1RU
PON serves **>1000** users
P2P serves **36** users.

For 30K users, **PON needs >40x less space**.

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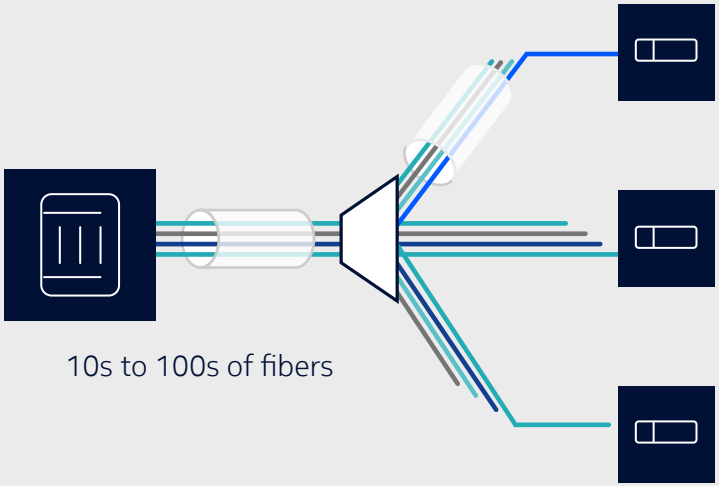
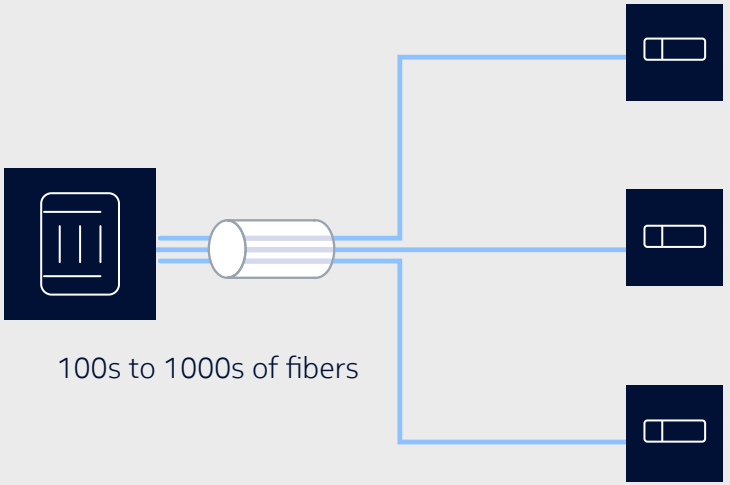
OPEX comparison

Fiber plant maintenance

PON point-to-multi-point



Ethernet point-to-point



With fewer feeder cables, repair times for cable faults and cuts are much shorter with PON.

P2P fault isolation is simpler. A more advanced method (OTDR) is needed for PON.

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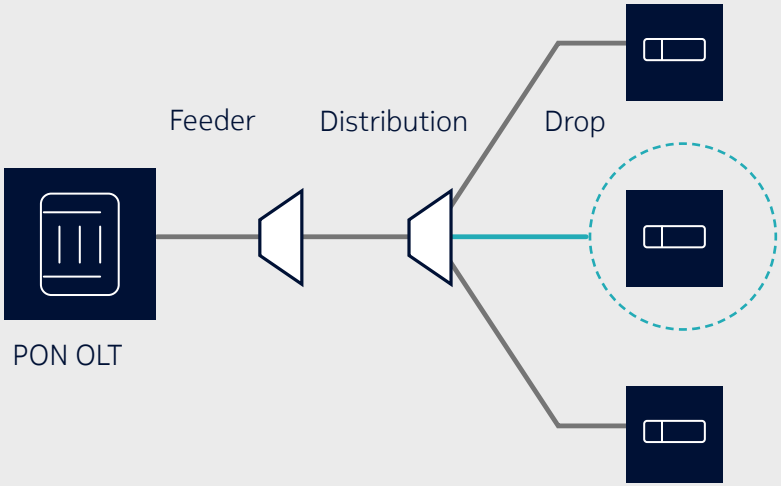
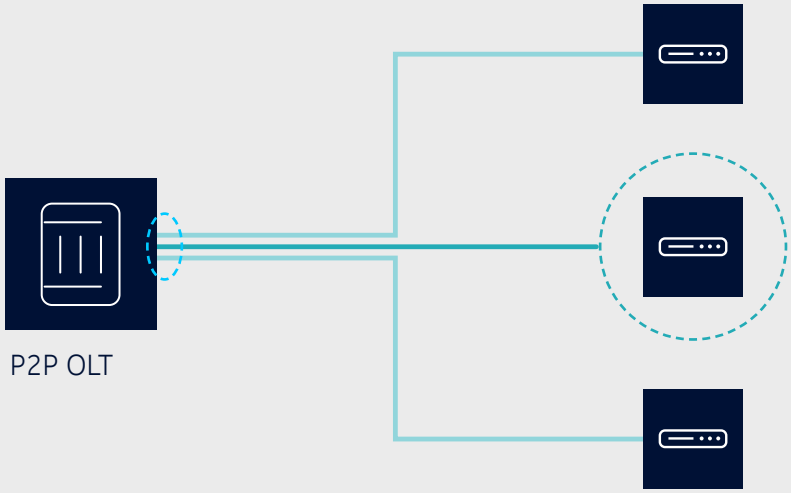
Pay-as-you grow with PON

Add unplanned users more efficiently with PON's flexible network architecture





With PON architecture:

- Fiber is already available until the last splitter, so only last drop needs to be built
- No need for a new port in the OLT.

With a P2P architecture:

- If no spare cables are available, a new cable needs to be deployed from the active node to the user premises
- A new port in the OLT is needed

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Security

PON and P2P at par

Fiber broadband is increasingly being used for mission-critical services, where security is the key requirement for business customers.

P2P has a dedicated fiber connection, so there is less concern about the data security.

PON is a shared medium with multiple users sharing the same pipe. Is a user's traffic secure? PON standards have implemented advanced protocols that ensure mission critical security:

- Isolation of traffic for each user, so other users on a PON can not access data that is not intended for them.
- Data traffic for each user is encrypted. The encryption key is only known by the OLT and that user ONT.
- Strict user activation procedures prevent unauthorized devices connecting to a PON.
- Message integrity validation ensures a malicious user can not tamper with the control message.

Read more:

Nokia: Security for PON Business Services

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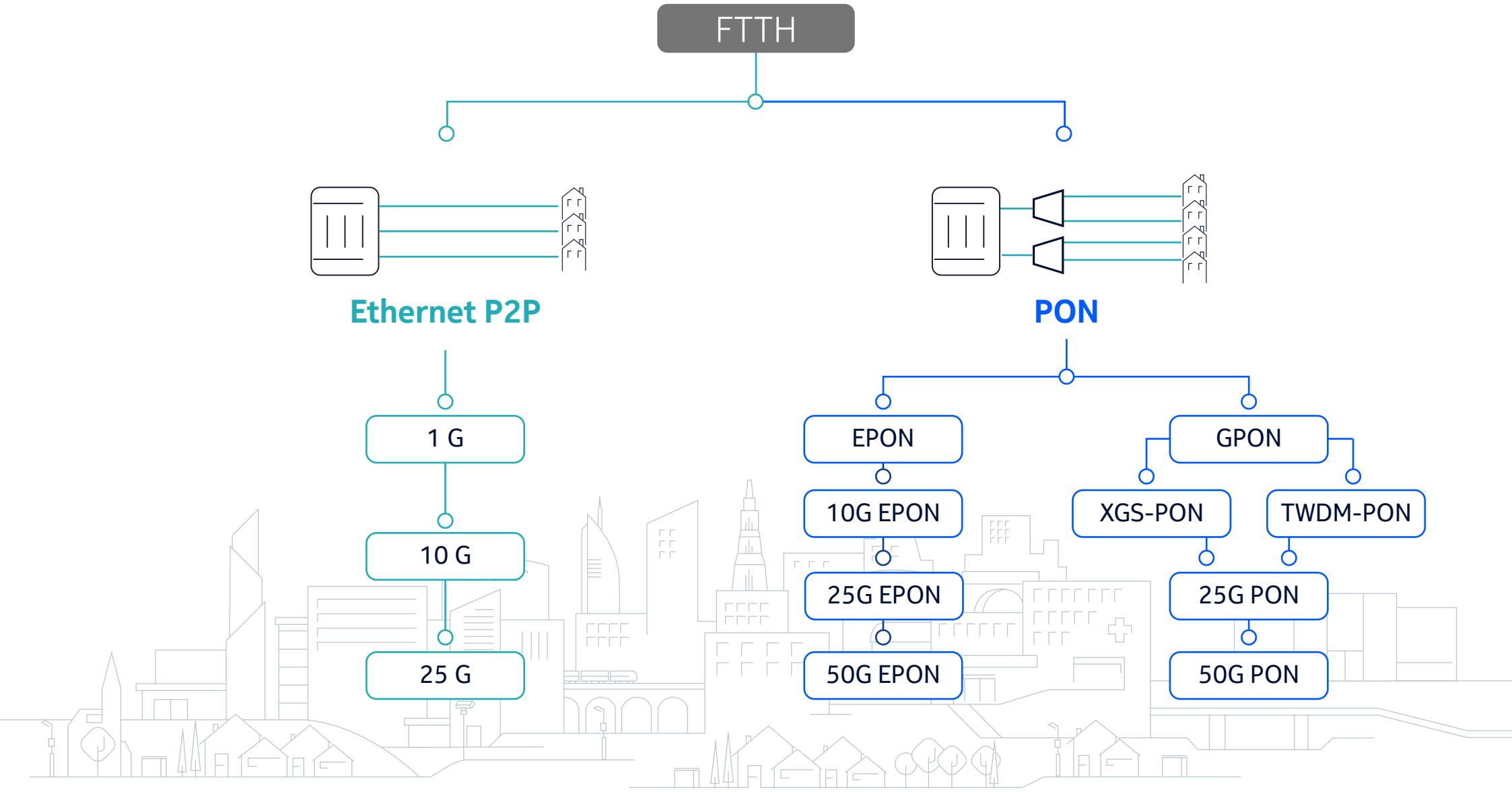
Evolution



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Conclusion

Both P2P and PON are deployed and have their merits. Each operator should evaluate the best approach based on their service strategy and business priorities. For delivering massive broadband connectivity to consumers, businesses, smart cities and mobile cell sites, the PON business case is better. P2P is better suited for low density applications.

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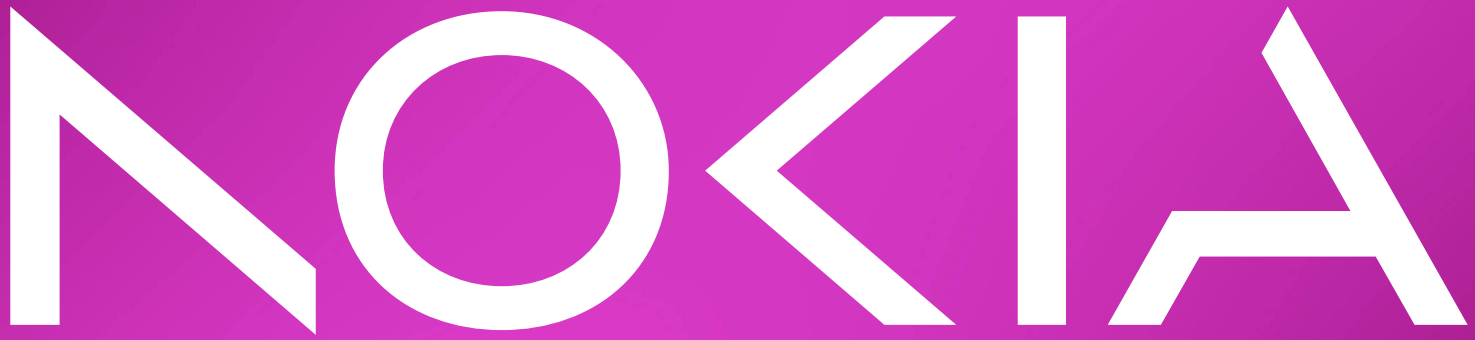

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As a B2B technology innovation leader, we are pioneering the future where networks meet cloud to realize the full potential of digital in every industry.

Through networks that sense, think and act, we work with our customers and partners to create the digital services and applications of the future.