

Broadband Generation Roadmap & Access Network Technologies Evolution

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Fortune**

Why Broadband Is Crucial for Digital Infrastructure

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Broadband is a fundamental component of modern digital infrastructure. It enables high-speed connectivity that supports economic growth, government services, education, healthcare, and business operations.

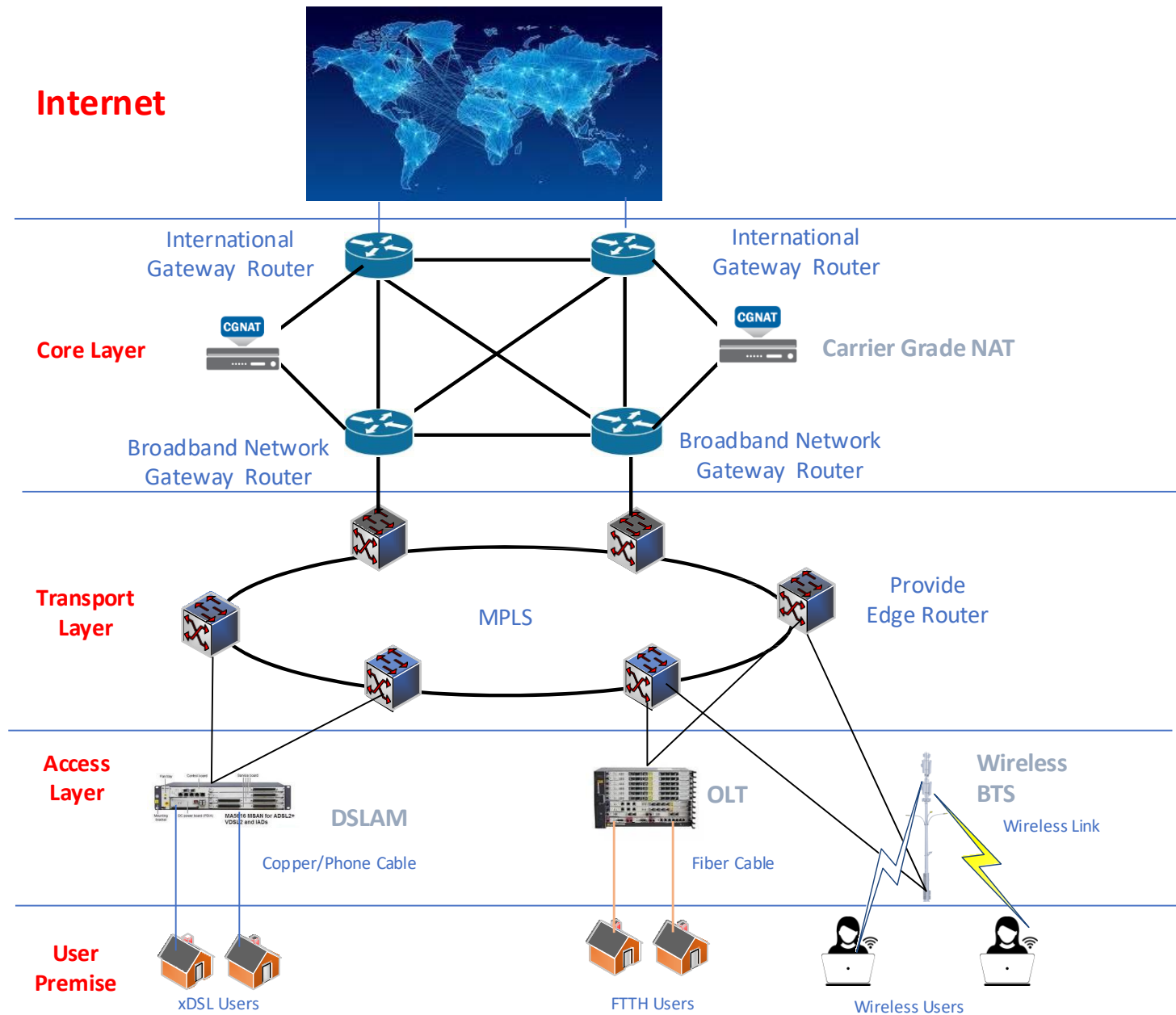
Reliable broadband allows:

- Digital economy activities such as e-commerce and fintech
- Online education and remote work
- Telemedicine and digital healthcare
- Cloud computing and smart technologies
- Government digital transformation

It also reduces the digital divide by connecting rural and underserved communities. In today's digital age, broadband is as essential as electricity or transportation infrastructure it forms the backbone of a connected, competitive, and inclusive society.

Typical Broadband Network

- DSLAM : Digital Subscriber Line Access Multiplexer
- OLT : Optical Line Terminal
- Wireless BTS : Wireless Based Transceiver Station
- MPLS : Multi Protocol Label Switching
- NAT : Network Address Translation



1. International Gateway Router (IGR)

Function:

The International Gateway Router connects the ISP's network to the **global internet and international upstream providers**.

How it works:

- It receives internet traffic from **international transit providers**.
- It uses **BGP (Border Gateway Protocol)** to exchange routing information with global networks.
- It decides the **best path for incoming and outgoing internet traffic**.
- Traffic coming from users passes through this router to reach websites or services on the internet.



Cisco ASR 9010

2. CGNAT (Carrier Grade NAT)

Function:

CGNAT allows many users to share a limited number of public IPv4 addresses.

Why it is needed:

IPv4 addresses are limited, so ISPs give customers private IP addresses and translate them to public IPs when accessing the internet.

How it works:

- User devices receive private IP addresses (for example 10.x.x.x).
- When users access the internet, CGNAT:
 - Translates the private IP to a public IP address.
 - Assigns a port number to identify each user session.
- Multiple users can share one public IP.



A10 Networks Thunder 3030S

3. Broadband Network Gateway (BNG)

Function:

The BNG is the main subscriber management router in the core network. It connects access networks (DSL, FTTH, Wireless) to the ISP backbone.

How it works:

- User traffic comes from the Access Layer (DSLAM, OLT, wireless base stations).
- Traffic passes through the MPLS transport network.
- The BNG performs:
 - User authentication (PPP, IPoE, RADIUS)
 - IP address assignment
 - Policy control
 - Traffic management (QoS)



Cisco ASR 9K series

Transport Layer Using MPLS (Layer 2.5)

In this architecture, the Transport Layer acts as the aggregation and backbone network. It uses MPLS (Multiprotocol Label Switching) to transport Layer-2 traffic from access nodes such as:

- OLT (FTTH access)
- DSLAM (xDSL access)
- Wireless Access Base Stations

to the BNG (Broadband Network Gateway) located in the Core Layer.

Because access networks operate mainly with Layer-2, the transport network must preserve this Layer-2 connectivity. MPLS enables this using Layer-2 VPN technologies.

The transport layer uses **MPLS L2VPN (pseudowire/xConnect)** to provide Layer-2 connectivity between access nodes and the BNG, enabling broadband protocols such as **PPPoE and IPoE** to operate correctly across the ISP backbone.

Layer-2 Service Delivery to BNG

The BNG requires Layer-2 connectivity because subscriber sessions use protocols like:

- PPPoE
- IPoE (DHCP)
- 802.1Q VLAN tagging

Therefore the transport network must deliver frames **without breaking Layer-2 structure**.

The process looks like this:

1. User traffic arrives at OLT / DSLAM
2. Frames are tagged with VLAN or QinQ
3. Access traffic goes to Provider Edge router
4. PE router encapsulates frames into MPLS pseudowire
5. MPLS network transports traffic
6. Remote PE delivers frames to BNG
7. BNG processes subscriber session

Fixed Broadband and Wireless Broadband In Access Network

1. Fixed Broadband Network (Wired Access)

Fixed broadband uses **physical cables** (copper or fiber) to deliver internet service to homes or offices. In your diagram, two main technologies are shown:

- xDSL (Copper/Phone Cable)
- FTTH (Fiber Cable)

These networks connect users to the ISP through access devices such as DSLAM or OLT.

2. Wireless Broadband Network

Wireless broadband provides internet access using **radio signals instead of physical cables**.

- Broadband Wireless Local Loop (BWLL)
- WiMax
- WiFi (Point to Point, Point to Multi-Points)

Broadband Generation Roadmap



BB3	BB4	BB5	BB5.5	BB6+
BASIC BROADBAND	FIBER EXPANSION	GIGABIT SOCIETY	DETERMINISTIC &	FULLY AUTONOMOUS
<ul style="list-style-type: none"> ✓ Copper to the Home ✓ Manual Operations 	<ul style="list-style-type: none"> ✓ Fiber to the Home (FTTH) ✓ Partial Automation 	<ul style="list-style-type: none"> ✓ Fiber to the Home ✓ Conditionally Autonomous 	<ul style="list-style-type: none"> ✓ Fiber to the Home ✓ Conditionally Autonomous 	<ul style="list-style-type: none"> ✓ Fiber to the Home ✓ Conditionally Autonomous

	BB3	BB4	BB5	BB5.5	BB6
RESIDENTIAL SPEED	Up to 30Mbps	Up to 100Mbps	Up to 1Gbps	Up to 10Gbps	Up to 50Gbps*
ENTERPRISE SPEED	Up to 1Gbps	Up to 10Gbps	Up to 100Gbps	Up to 400–800Gbps	Up to 1.6–3.2Tbps
INTELLIGENCE	No automation	Partially autonomous (L2)	Conditionally autonomous (L3)	Highly autonomous (L4), fast provisioning times	Fully autonomous
RELIABILITY & LATENCY	99.9% / n/a	99.99% / 10ms	99.999% / 5ms consistent latency / low jitter	99.999% / 1ms latency (hard guarantee) / very low jitter	Deterministic reliability / <1ms latency (hard guarantee) / very low jitter
TRUSTWORTHY & GREEN	n/a	2x better per bit energy efficient	5x better per bit energy efficient	10x better per bit energy efficient, fast problem detection and response (minutes)	10x-plus better per bit energy efficient, very fast problem detection and response (seconds)
CONNECTIVITY	Copper to the home	Fiber to the home	Fiber to the room/desk, slicing in Gbps granularity	Fiber to the machine, fine granular (Mbps level) slices, 10 times IoT connections	Fiber sensors, 10 times more IoT terminals
SENSING CAPABILITY	n/a	n/a	n/a	Sensing for optimized O&M, application and computing awareness, AI	Fiber sensing for applications, application and computing awareness, AI

Broadband Generation Key Measurement

	BB3	BB4	BB5	BB5.5	BB6
Network Uptime	99.90%	99.99%	99.999%	99.999%	99.999%
Network Down Time (Yearly)	8.76 Hr	52 Min 33.6 Sec	5 Min 15.36 Sec	5 Min 15.36 Sec	5 Min 15.36 Sec
Residential Speed (Up to)	30 Mbps	100 Mbps	1 Gbps	10 Gbps	50 Gbps
Enterprise Speed (Up to)	1 Gbps	10 Gbps	100 Gbps	400-800 Gbps	1.6 – 3.2 Gbps

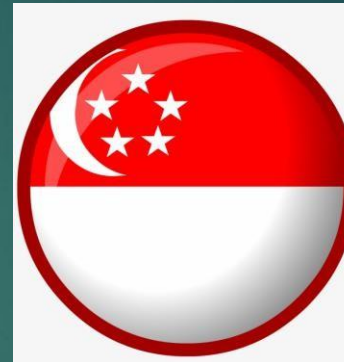
Where are we and neighbors countries?



Myanmar

<100 Mbps

Broadband 4th
Gen



Singapore

1000 Mbps
1 Gbps

Broadband 5th
Gen



Thailand

PC Show, Offer Download

FREE 1 year
Fibre Broadband
with Singtel TV!

Select from **180**
Channels

Singtel TV
Variety Pack

+ Fibre Broadband
1Gbps

Exclusive Bundle Benefits

- Free 1-year Fibre Broadband (1Gbps)
- Free Singtel TV Variety Pack (180 Channels)
- Free 1-year Singtel TV Variety Pack (180 Channels)

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Myanmar National Broadband Roadmap

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**Broadband 4th
Gen**



**Broadband 5th
Gen**

**Speed:
<100 Mbps**

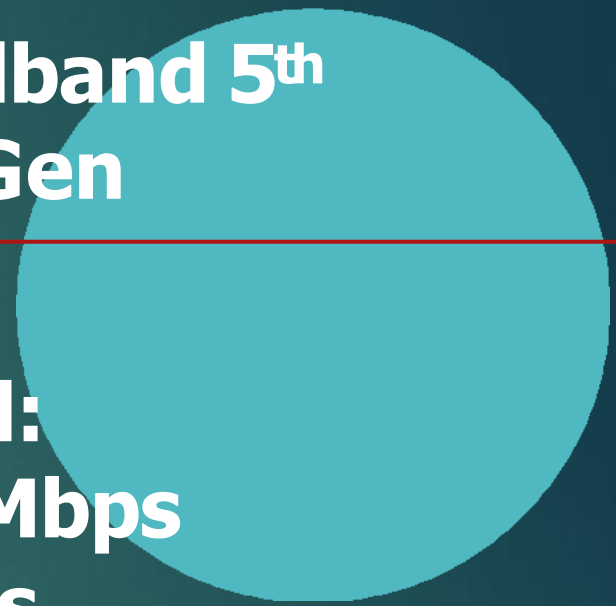


**Speed:
1000 Mbps
1 Gbps**

**Uptime < 98%
Downtime
Yearly
(175 Hrs 12 min)**



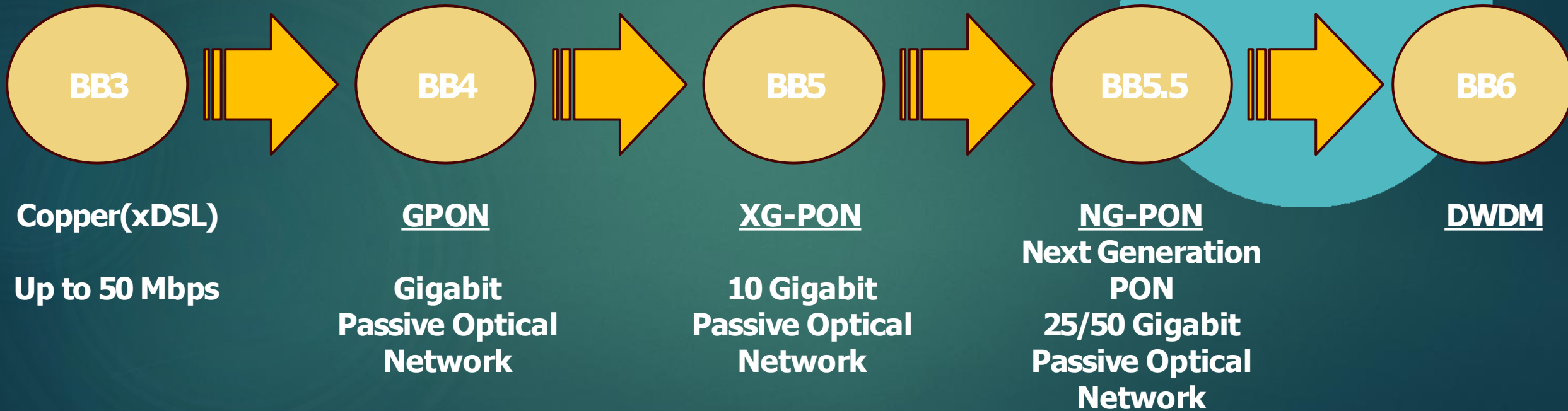
**Uptime 99.999%
Downtime Yearly
(5 Min 15.36 Sec)**



Access Network Technologies Evolution



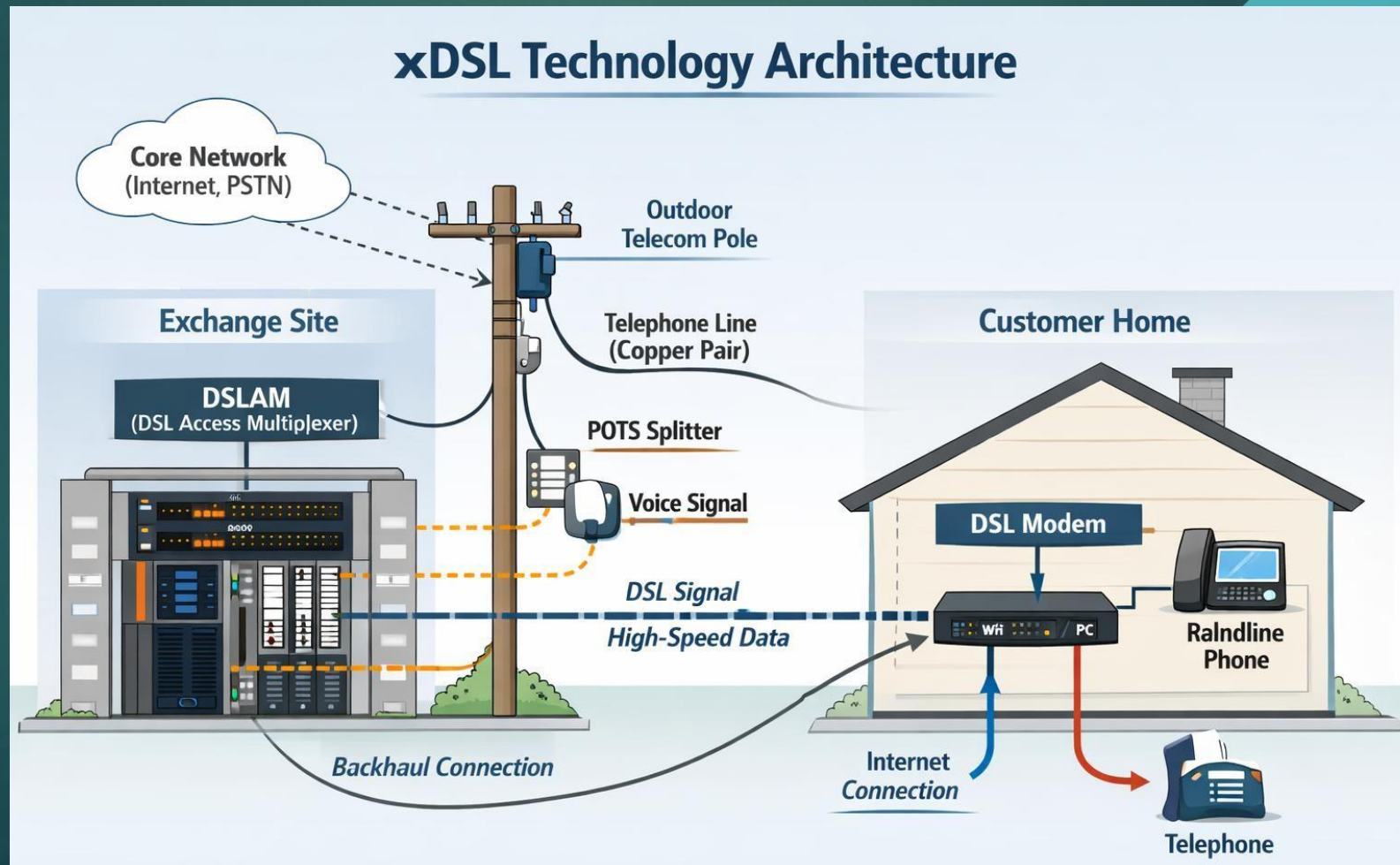
Evolution of Access Network Technologies Across Broadband Generations










xDSL Technology Architecture (BB3 Gen)

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xDSL (Digital Subscriber Line) is a family of technologies that provides digital data transmission over traditional copper telephone lines while allowing simultaneous voice (POTS) service.



xDSL Technology (Broadband 3rd Gen)

DSL Type	↓ Download Speed	↑ Upload Speed	📍 Max Distance	Typical Use Case
 ADSL	↓ Up to 8 Mbps	↑ Up to 1 Mbps	~ 5 km	Basic home internet
 ADSL2	↓ Up to 12 Mbps	↑ Up to 1.5 Mbps	~ 3.5 km	Improved residential
 ADSL2+	↓ Up to 24 Mbps	↑ Up to 3 Mbps	~ 3 km	Streaming, SME
 VDSL	↓ Up to 52 Mbps	↑ Up to 16 Mbps	~ 1.2 km	IPTV, HD streaming
 VDSL2	↓ Up to 100 Mbps	↑ Up to 100 Mbps	~ 300–800 m	High-speed broadband
 SDSL	↓ Up to 2.3 Mbps	↓ Up to 2.3 Mbps	~ 3 km	Business symmetric use
 HDSL	↓ Up to 2 Mbps	↑ Up to 2 Mbps	~ 3.5 km	T1/E1 replacement

xPON (Passive Optical Network) Technology (Broadband 4th - 5.5th Gen)

xPON (Passive Optical Network) is a family of fiber-based access technologies used to deliver high-speed broadband services from a service provider's central office to multiple customer premises using passive optical components.

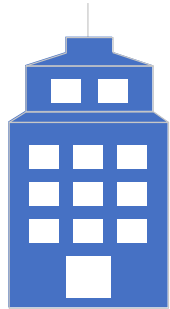
The "x" represents different generations of PON technologies such as:

- **GPON** (Gigabit PON)
- **XG-PON** (10G downstream)
- **XGS-PON** (10G symmetric)
- **25G-PON / 50G-PON** (Next-generation PON)

xPON (Passive Optical Network) Technology Architecture (Broadband 4th - 5.5th Gen)



**OLT
Optical
Line
Terminal**



**Central Office/
Exchange Location**

Distribution Feeder Optical Fiber Cable



1:16 Splitter in
Fiber Access Terminal (FAT)
(Or)
Subscriber Node (SN)
2nd Level Splitting



1:4 Splitter in
Distribution CB
(Or)
Optical Distribution Box (DN)
1st Level Splitting



**FTTx
PORT**



1:16 Splitter

Access Feeder Optical Fiber Cable



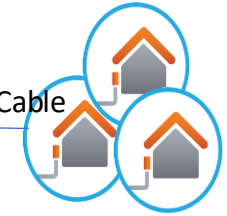
Last Mile Drop Cable



16 Subscribers Home



Last Mile Drop Cable



16 Subscribers Home



Last Mile Drop Cable



16 Subscribers Home



Last Mile Drop Cable



16 Subscribers Home

GPON Parameters for Broadband 4th Generation (BB4)

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Standard & Technology

- **Standard:** ITU-T G.984.x
- **Access Type:** Passive Optical Network (PON)
- **Topology:** Point-to-Multipoint (P2MP)
- **Medium:** Single-mode fiber (SMF)

GPON Line Rate

- | | |
|--------------|------------|
| • Downstream | 2.488 Gbps |
| • Upstream | 1.244 Gbps |

Service Capability

- 50 – 100 Mbps typical plan
- Triple-Play support (Internet + IPTV + VoIP)

XG-PON Parameters for Broadband 5th Generation (BB5)

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Standard & Technology

- **Standard:** ITU-TG.987.x
- **Technology:** 10G Passive Optical Network
- **Topology:** Point-to-Multipoint (P2MP)
- **Medium:** Single-mode fiber (SMF)
- **Coexistence:** Can operate with GPON on same ODN

XG-PON Line Rate

- | | |
|--------------|----------|
| • Downstream | 10 Gbps |
| • Upstream | 2.5 Gbps |

Service Capability

- 500 Mbps – 1 Gbps plans
- 4K/8K IPTV support
- Low latency gaming (<5 ms access side)

NG-PON Parameters for Broadband 5.5th Generation (BB5.5)

Standard & Technology

XGS-PON	ITU-T G.9807.1
25G-PON	ITU-T G.9804 (emerging)
Topology	Point-to-Multipoint (P2MP)
Medium	Single-mode fiber (SMF)
Coexistence	With GPON & XG-PON on same ODN

NG-PON Line Rate

25G-PON (Advanced BB5.5 / Early BB6)

- Downstream 25 Gbps
- Upstream 25 Gbps

Service Capability

- 2.5G / 5G / 10G plans
- 8K streaming
- Cloud gaming
- AR/VR applications
- Smart home IoT density

The Critical Role of Infrastructure Stability in Broadband 5th Generation

Modern, Minimum Environmental Impact Underground Micro-Duct System



Micro-Trenching Machine



Fiber Duct



Micro-Duct



Fiber Cable Blowing

Advantages of Underground Fiber Network

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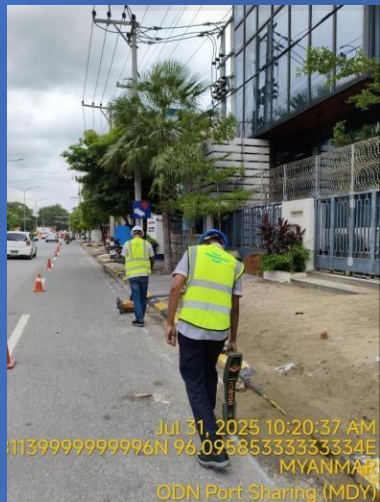
- **High Reliability:** Protected from weather conditions such as storms, heavy rain, and strong winds, making it more stable than overhead cables.
- **Longer Lifespan:** Underground installation ensures durability and extended service life.
- **Low Risk of Damage:** Less exposure to accidents like vehicle collisions, falling trees, or vandalism.
- **Reduced Maintenance Cost:** Requires minimal repairs and maintenance after installation, lowering long-term expenses.
- **Urban Compatibility:** Keeps cities clean and organized since no overhead wires obstruct views or clash with urban infrastructure.
- **High-Speed Connectivity:** Fiber technology provides stable and high-bandwidth internet for both residential and business users.
- **Future-Proof:** Easier to upgrade and expand for next-generation technologies without major reworks.

End to End Underground Optical Distribution Network for BB5

(Before)



(After)



Advancing Toward 5th Generation Broadband Networks



High Bandwidth : 1 Gbps / Home
High Reliability : 99.999% Up time
: 5 Min 15.36 Sec
Down time / Year
Ultra-Low Latency : <5 Mili Second

THANK YOU FOR YOUR TIME.

We look forward to your valuable insights and questions.