Network Convergence: WiFi-7 and 50G-PON

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Network Convergence

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Network Convergence

The transformation of fragmented legacy networks into a unified, software-defined infrastructure that integrates access, transport, and service layers.

This shift enables service providers to deliver ***high-speed, low-latency connectivity*** using technologies like ***50G PON*** and ***Wi-Fi 7***—while dramatically improving operational efficiency.

Most importantly, it ensures a ***seamless, consistent experience*** for subscribers across all systems, applications and devices.

Experiences for the Whole Community

Game Changing Subscriber Experiences

Business Services	Small / Medium / Large Enterprise full 10G, 25G or more service	Enterprise specific PON and Network Slicing Remote health Data center connectivity
Aggregation Services	Mobile X-haul Mobile offload	Transport to MDUs Wi-Fi 7 access points
Broadband Services	Capacity for… Mutli-gig, 10Gbps, 25Gbps – *and beyond*	4K/8K Streaming AR/VR Metaverse

Business Driver - convergence of services to one network


WHAT LIES AHEAD

Today's Key Network Design Attributes...

... for scalable broadband network systems

1. Fiber Infrastructure

XGS for all new deployments
Migration from GPON to XGS

2. Indoor Deployments

Indoor ONT

Managed Wifi

3. Experience Subscriber

Outdoor Wifi

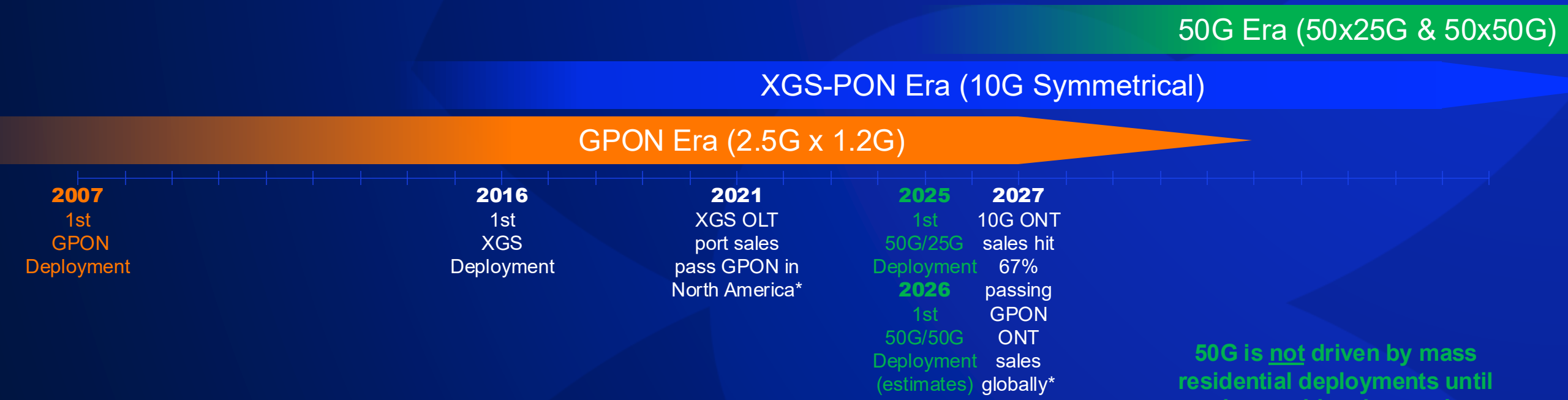
Lifestyle experiences

- ❑ Future Ready (Long lifecycle)
- ❑ Scalable
- ❑ Easy to operate, maintain & upgrade
- ❑ Support various deployment scenarios
- ❑ Highly available architecture

The network is built on the principles of longevity, modularity, and ease of maintenance

Standards Progression

Key Market Inflection Points



50G is not driven by mass residential deployments until volumes drive down price

10 Years
between next generation PON deployments

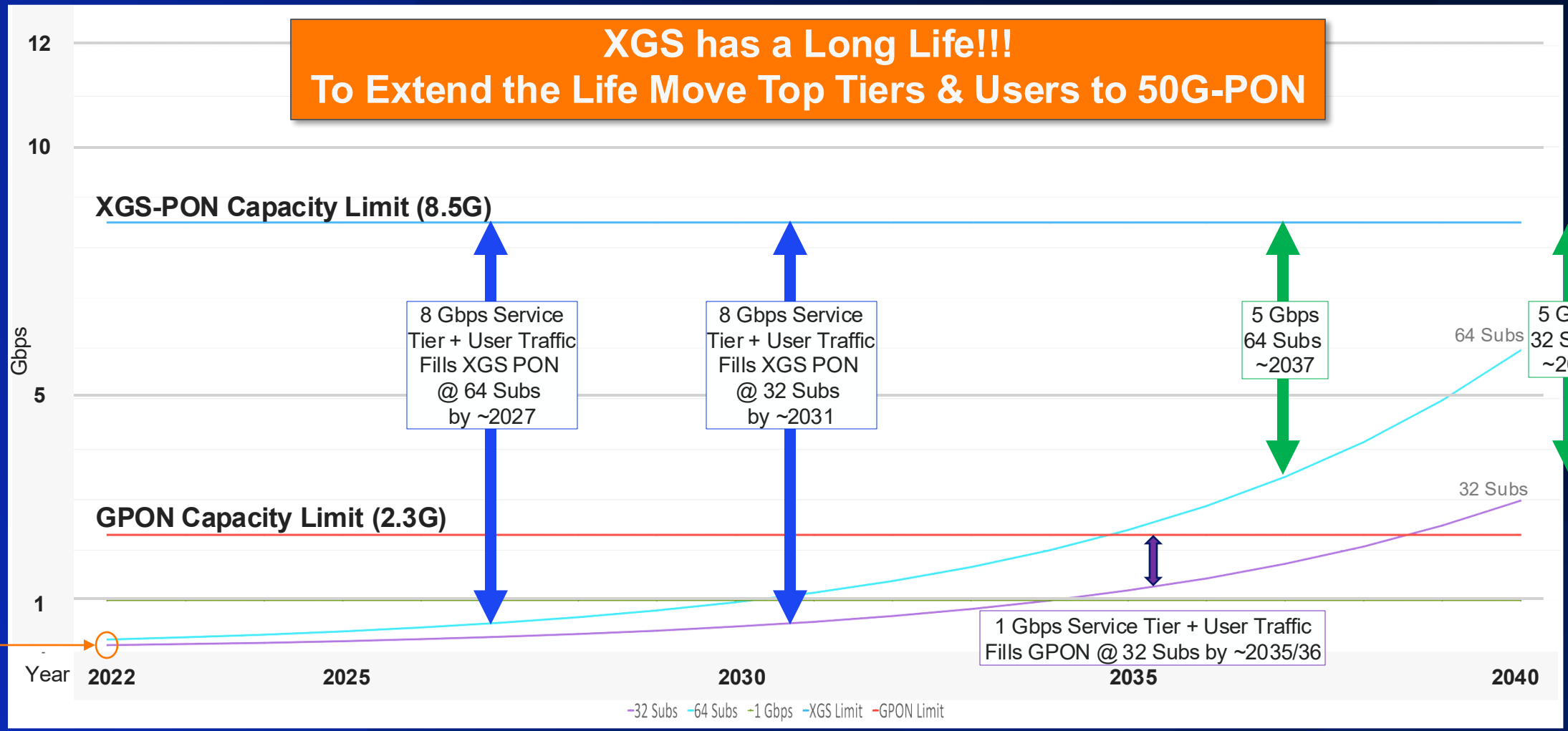
20 Years
For PON and ONT volume of new generation to surpass previous

30 Years
PON standards 4X plus capacity increase with each generation

* Source: Omdia research

Traffic Predictions and Max Service Tiers

Downstream Traffic with 20% Compound Annual Growth Rate (CAGR)



Traffic Projections Starting at 3.5 Mbps per Sub BHBD with 20% CAGR

Image started with 3.5 Mbps per Subscriber during peak busy hours in 2022 and a projection of the 20% CAGR until 2040. (Subs per port could also mean service group used in DOCSIS)
FCC Speed Performance Metrics: https://www.fcc.gov/reports-research/reports/measuring-broadband-america/measuring-fixed-broadband-twelfth-report

Traffic Predictions and Max Service Tiers

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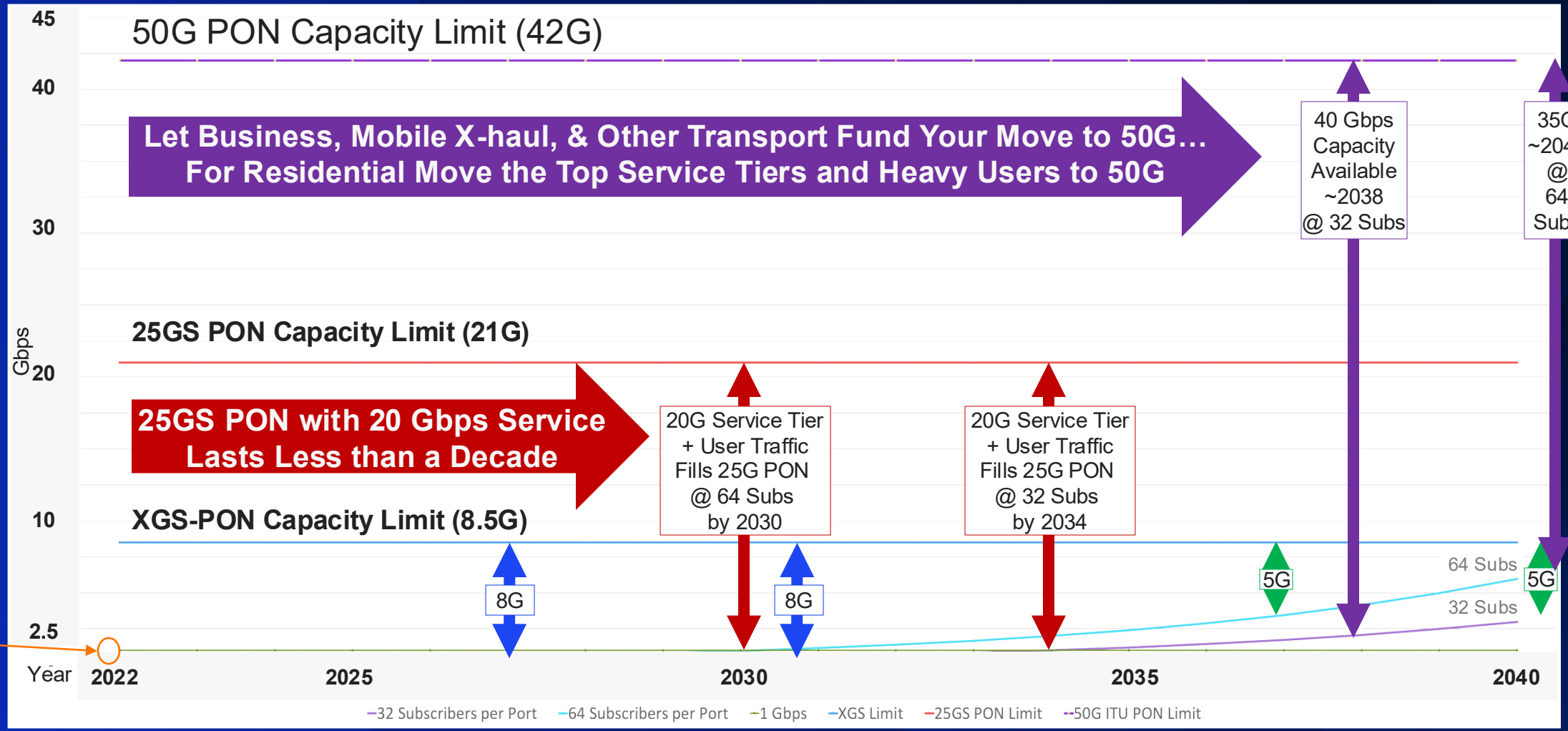


50G PON: Reduces P2P Ethernet, Wins Billboard Speed Wars, and Extends the Life of XGS

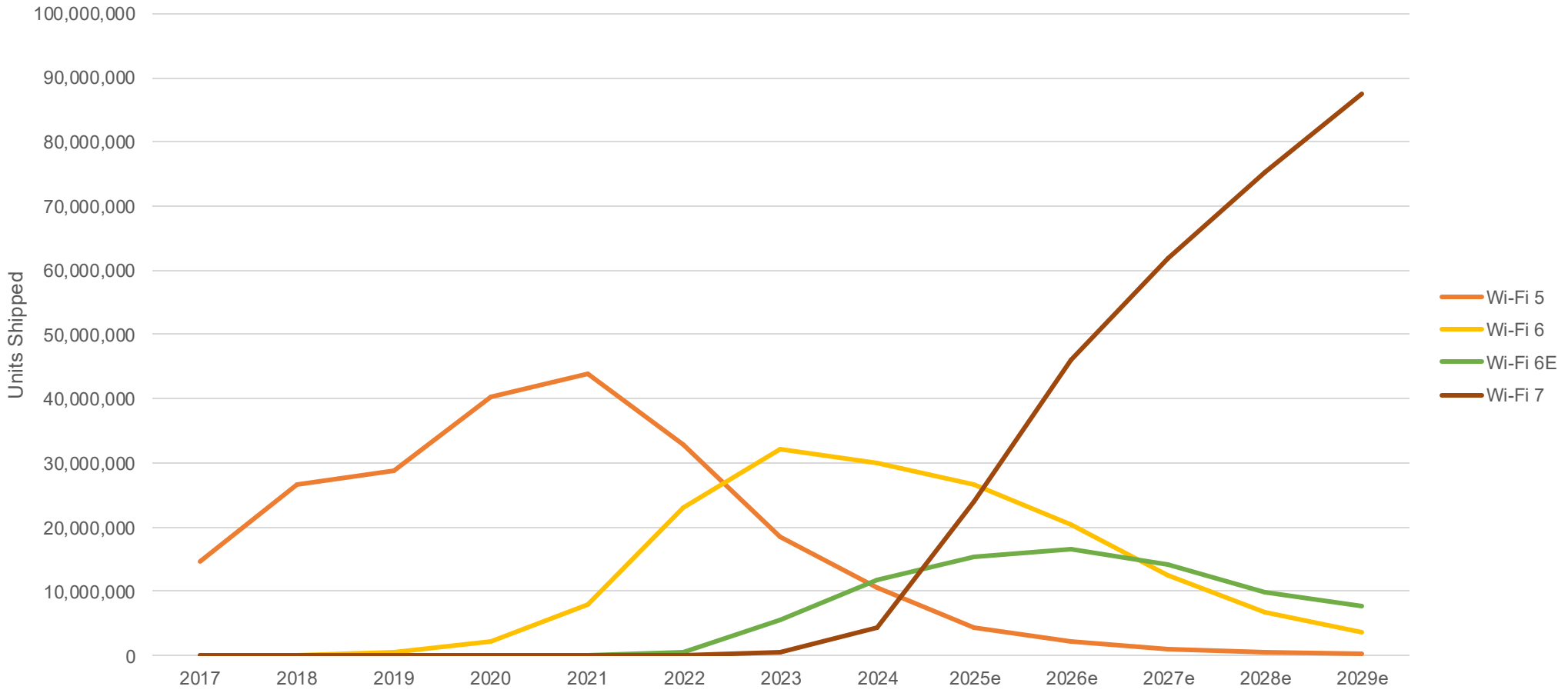
Wi-Fi 7

Wi-Fi Generation Duration

Standard	Version	Top Speed	Year
11be	Wi-Fi 7	46 Gbps	2024
11ax	Wi-Fi 6	9.6 Gbps	2019
11ac	Wi-Fi 5	3.5 Gbps	2014
11n	Wi-Fi 4	0.6 Gbps	2008
11g	Wi-Fi 3	0.05 Gbps	2003
11a	Wi-Fi 2	0.05 Gbps	1999
11b	Wi-Fi 1	0.01 Gbps	1997

- **Typical generation: 5 - 6 years**
- **Wi-Fi 7: from 2024/2025 to ~2029/2030**
- **Wi-Fi 7: will sustain high adoption rate due to advanced features**

Market Growth (Devices) by Technology



- Wi-Fi is the default communication technology: >25B devices
- Wi-Fi 6 continues due to performance and cost efficiency
- Wi-Fi 7 dominance starts in 2025

6Ghz Client Devices on the Rise
(~ 1200 Wi-Fi 7 certified devices (Mid 2025)

Apple
iPhone 16

SAMSUNG
Samsung Galaxy S24

Google
Pixel 6 and 6 Pro

ASUS
Zenphone 8

Apple
iPad Pro

Apple
Macbook Pro

hp
Spectre x360

RAZER
Razer Blade 14

SAMSUNG
Neo 8K TV

VIZIO
mQX Series

amazon
Fire Cube

NETGEAR
6E dongle

Key Wi-Fi 7 Features

Wider Channel Bandwith

4096 QAM

Multi-Link Operation

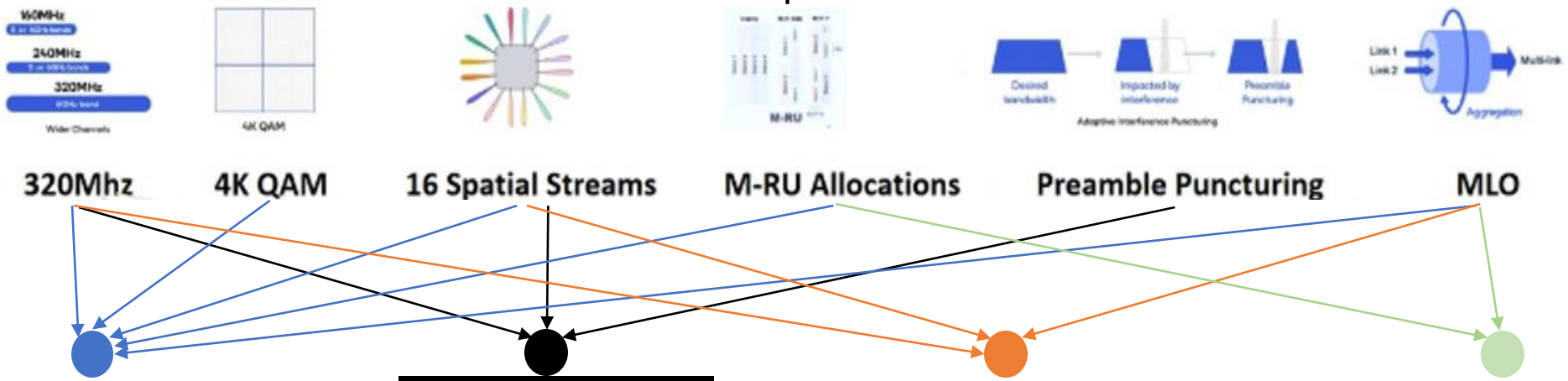
Automatic Frequency Coordination

16x16 MU-MIMO

Multi-RU Puncturing

The 6 Primary Improvements of Wi-Fi 7

When compared to 6e



Extremely High Throughput

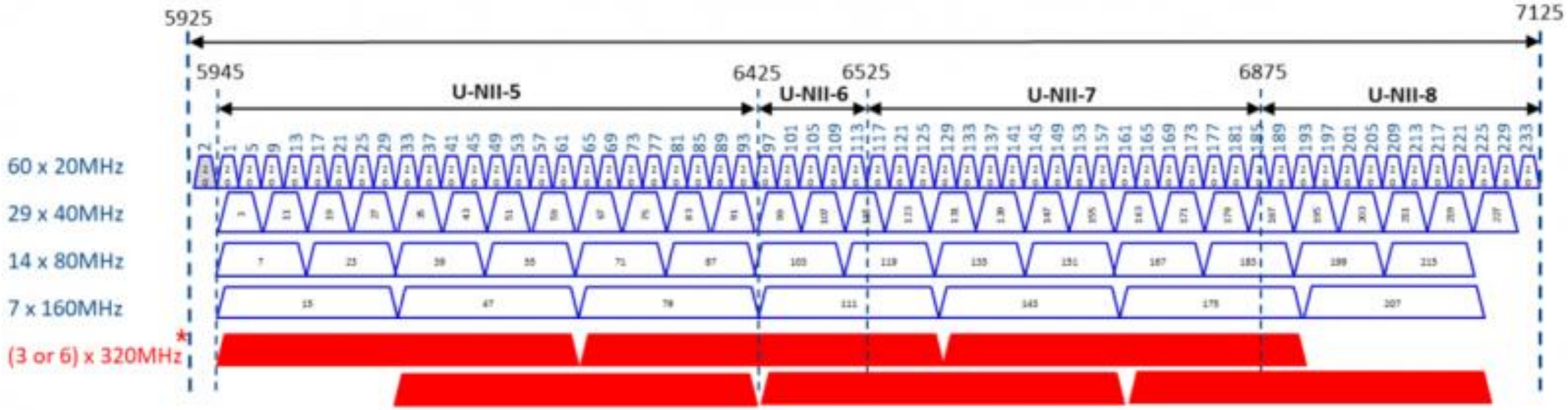
Extremely High Dense Deployments

Low Latency (<10ms)

High Reliability (>4 9s)

320MHz channel

- Dual stack 320MHz channel allowing greater utilization
- Less crowded 6GHz spectrum
- Single stream of 2.9 Gbps bandwidth



Wi-Fi 7 Advantages

	Wi-Fi 6 (11ax)	Wi-Fi 6E (6GHz)	Wi-Fi 7 (11be)	Benefits
Max Channel Width	160MHz (1 w/o DFS)	160MHz (7)	320MHz (3)	2X stream bandwidth
# of Streams	8	8	16	2X system bandwidth
QAM	1024	1024	4096	20% more bandwidth
Multi-RU	-	-	Yes	Improve utilization efficiency
Multi-Link Operation (MLO)	-	-	Yes	Improve utilization, lower latency
Multi-AP	-	-	Yes	
HARQ	-	-	Yes	Improve data accuracy
Max PHY Rate	9.6 Gbps	9.6 Gbps	46 Gbps	4.8X bandwidth
Max PHY Rate per stream	1.2 Gbps	1.2 Gbps	2.9 Gbps	2.4X bandwidth

Achieving Maximum Wi-Fi 7 Performance

Calix Testbed Configuration

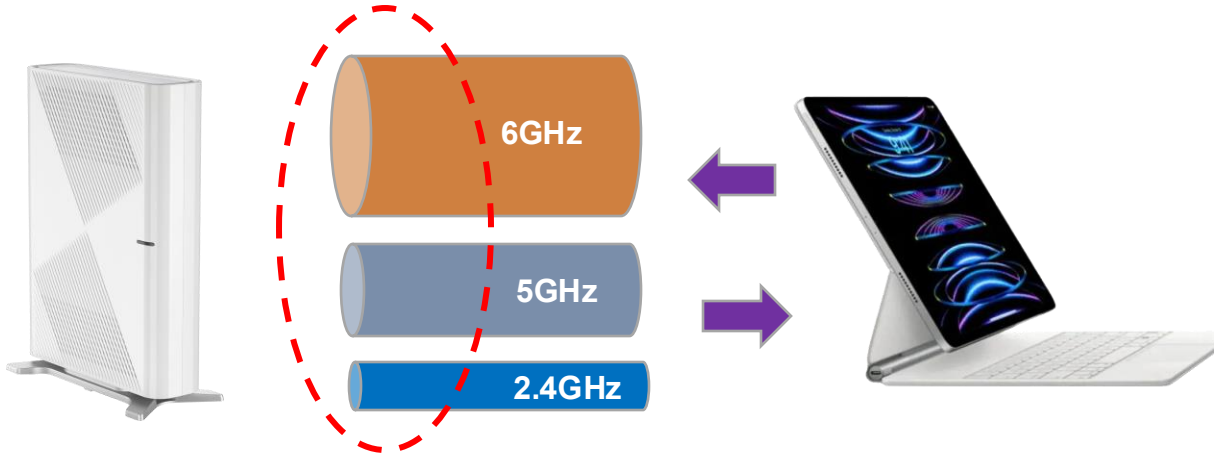
- Wi-Fi 7 System (GigaSpire 7u10t)
- 10GE Connection to ONT
- 6 GHz Band
- Tested in Optimal Conditions

Device	Wi-Fi Standard	320 MHz Channel	DL (Gbps)	UL (Gbps)
Samsung S24 Ultra	Wi-Fi 7	Y	3.58	3.55
iPhone 16 Pro	Wi-Fi 7	N	1.54	1.77
Pixel 8	Wi-Fi 7	N	2.02	1.50
iPhone 15 Pro	Wi-Fi 6e	N/A	1.56	1.62
Pixel 6a	Wi-Fi 6e	N/A	1.68	1.74



MLO: Multi-Link Operation

- Aggregate different spectrum and channel for greater BW networking
- Can be simultaneous transmit and receive
- Can be simultaneous transmit on one link and receive on another link



All Wi-Fi 7 Systems are Not Created Equally

- The devil in the details
  - 320 MHz Channel Width is *optional*
  - 4K QAM is *optional*
  - 6GHz Frequency is *optional*
    - WPA3 is required if 6GHz is supported
    - AFC is required if Standard Power on 6GHz
- Calix systems hold Wi-Fi 7 certifications from the Wi-Fi Alliance

WiFi-7 Key Take Aways

1. **WiFi Standards lifecycle approximately 5 years**

2. **WiFi 7 has distinct advantages that are driving its market adoption; Device Driven**

3. **Not all WiFi-7 solutions are created equally! Invest in the best solution for your deployment needs**

Wi-Fi 7 Use Cases

Residential Wi-Fi 7

PERFORMANCE RESPONSE TIME

Immersive real-time experiences without the wires

- Graceful evolution from single gig to multi-gig to 10G
- Over the air, per stream speeds of 2.9Gbps
- Improved streaming experience through better data compression

Business Wi-Fi 7

PERFORMANCE | CAPACITY | RESPONSE TIME | AVAILABILITY

Business

Differentiated experience and boosted application performance for customers and employees

- Maximizes bandwidth utilization to maintain fairness to all wireless connections
- Increased availability and performance for accessing local and cloud business applications
- Increased connection capacity

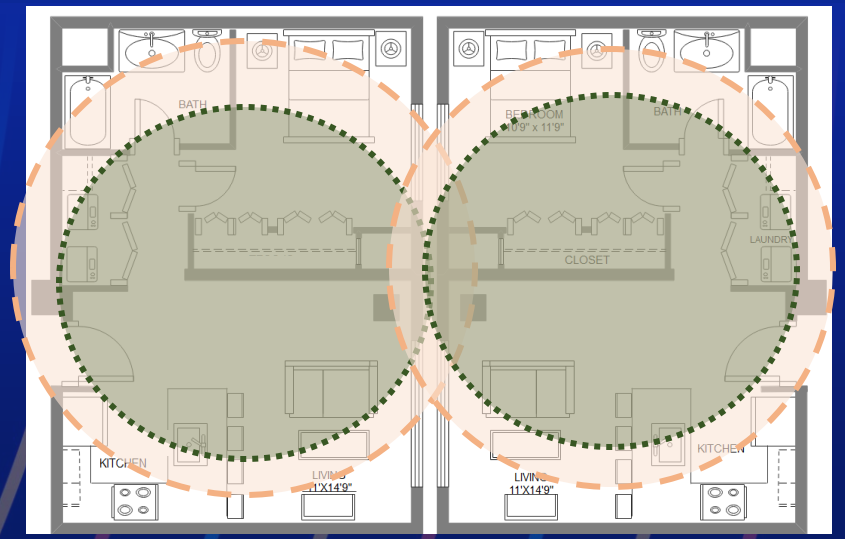
MDU/MTU Wi-Fi 7

PERFORMANCE AVAILABILITY

Bandwidth sharing, fairness, and security for an improved experience

Interference present on 2.4 and 5GHz

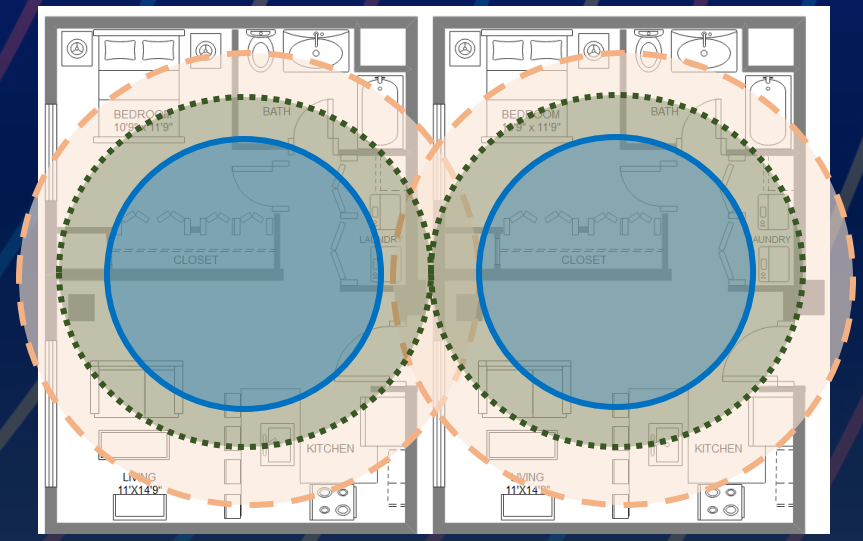
- Need high power to cover the apartment
- Experiences overlap interference
- If antenna power is reduced, some areas are not covered



Problem today

Wi-Fi 7 reduces interference and enhances QOS

- 6GHz high power backhaul – no interference
- Lower power on 2.4 and 5GHz to reduce interference



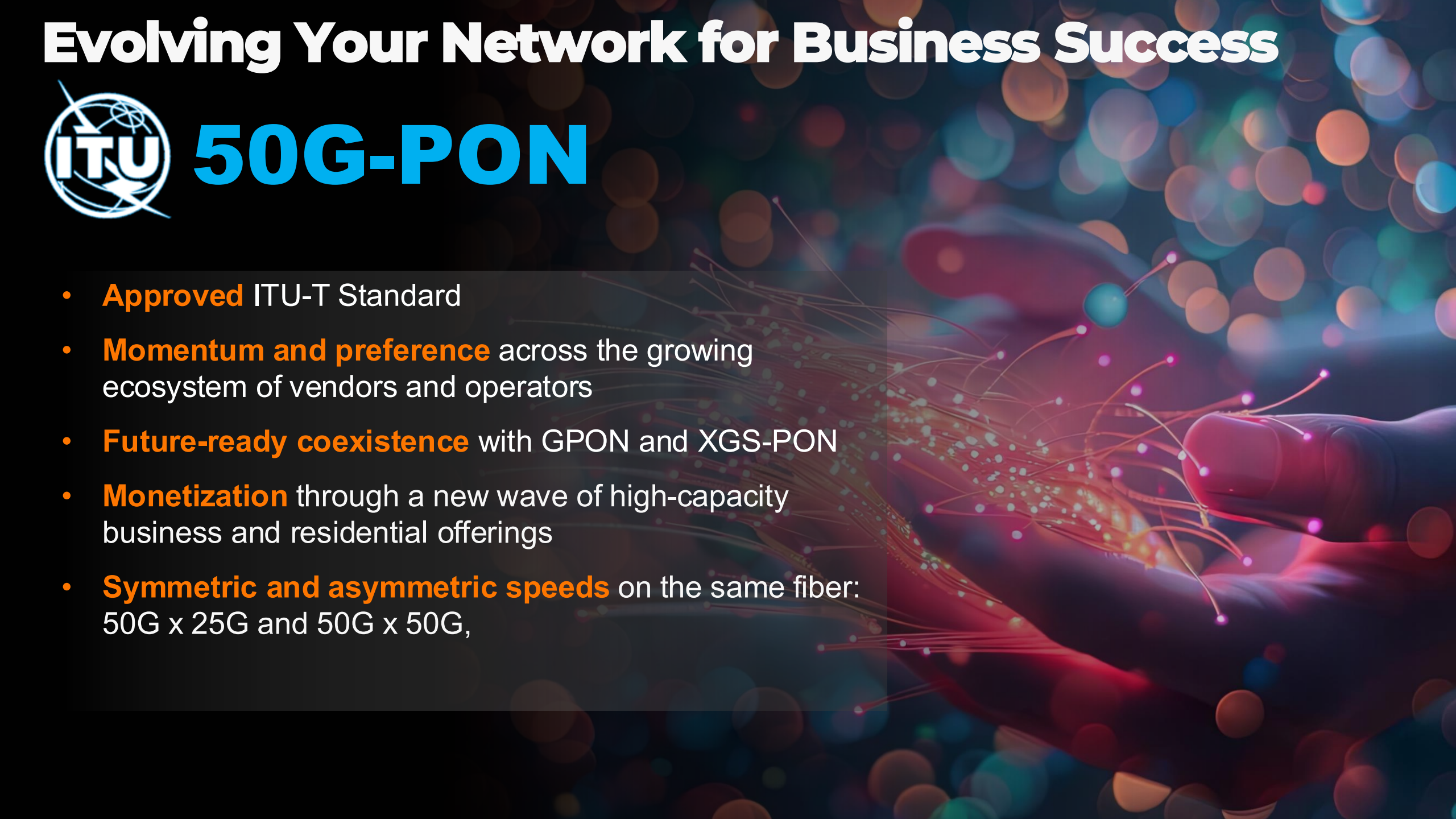
Improved performance / Less Congestion

50G-PON

Evolving Your Network for Business Success

50G-PON

- **Approved** ITU-T Standard
- **Momentum and preference** across the growing ecosystem of vendors and operators
- **Future-ready coexistence** with GPON and XGS-PON
- **Monetization** through a new wave of high-capacity business and residential offerings
- **Symmetric and asymmetric speeds** on the same fiber: 50G x 25G and 50G x 50G,



Why 50G-PON
Convergence, Capacity, Cost Efficiency

Highest Capacity at Lowest Cost per Bit

PON capacity supporting high sub count, service tiers and traffic growth rates

50G-PON Access Convergence

Convergence of networks and services

Lower OpEx Solution

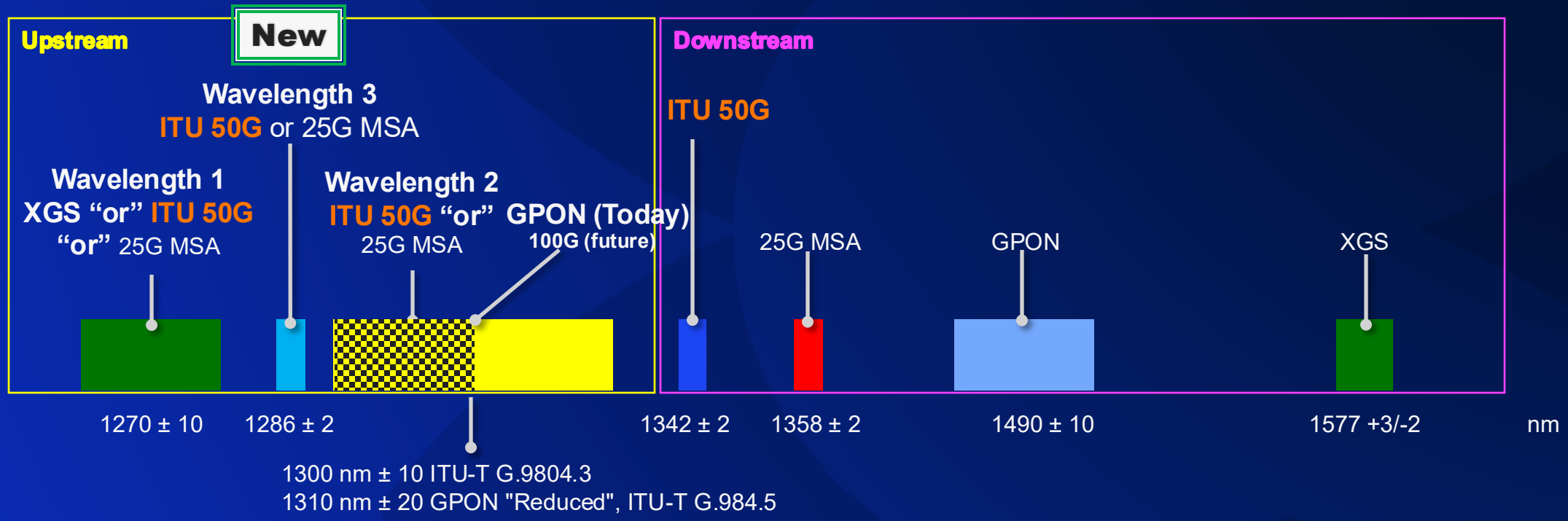
High-capacity per port using less space and power per Gigabit

Future Ready – PON Slicing

Programmability of slices of capacity, QoS, and latency for groups of subscribers

One Last PON wavelength remains. Choose Wisely.

- Many service providers utilize GPON and XGS-PON on the same fiber
- New standard Upstream Wavelength placed between the GPON & XGS band
- Choosing 25G MSA complicates the eventual upgrade to ITU 50G-PON



Invest in ITU 50G-PON today for a future-ready network with limitless service possibilities.

Next Generation PON Planning

Very Challenging

Starting Point 1

GPON or EPON Deployed
XGS or 10EPON Deployed
25GS-PON Skip
50G PON Planned
- 1286± 2 Upstream & 1342± 2 Downstream

100G PON Planned (GPON/EPON Reclamation)

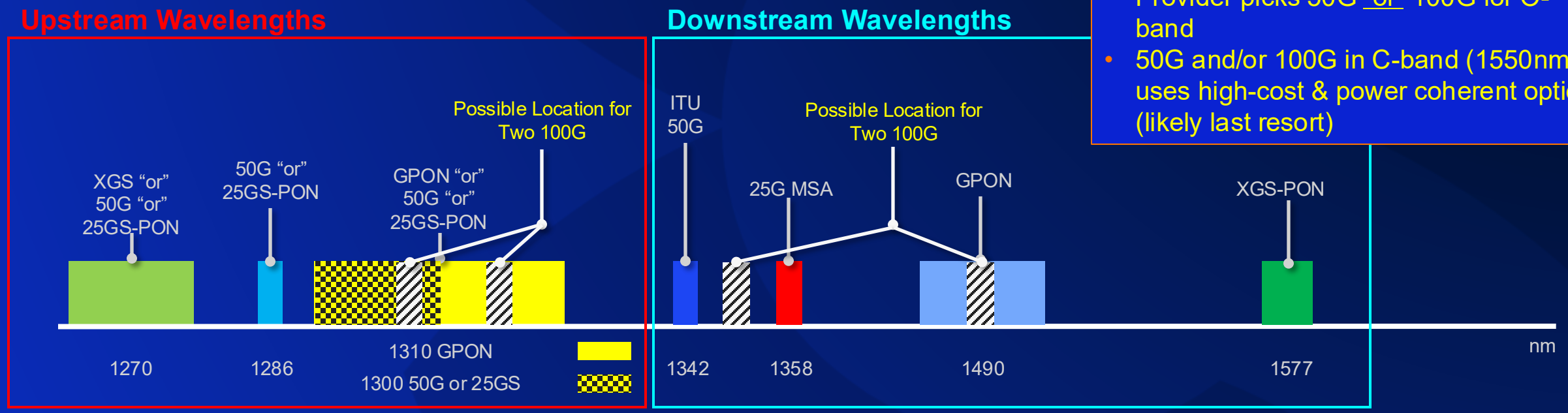
Starting Point 2

XGS or 10EPON Deployed
25GS-PON Skip
50G PON Planned
- 1286± 2 Upstream & 1342± 2 Downstream

100G PON Planned
- Using ITU VHSP wavelengths in GPON / O-band

Starting Point 3

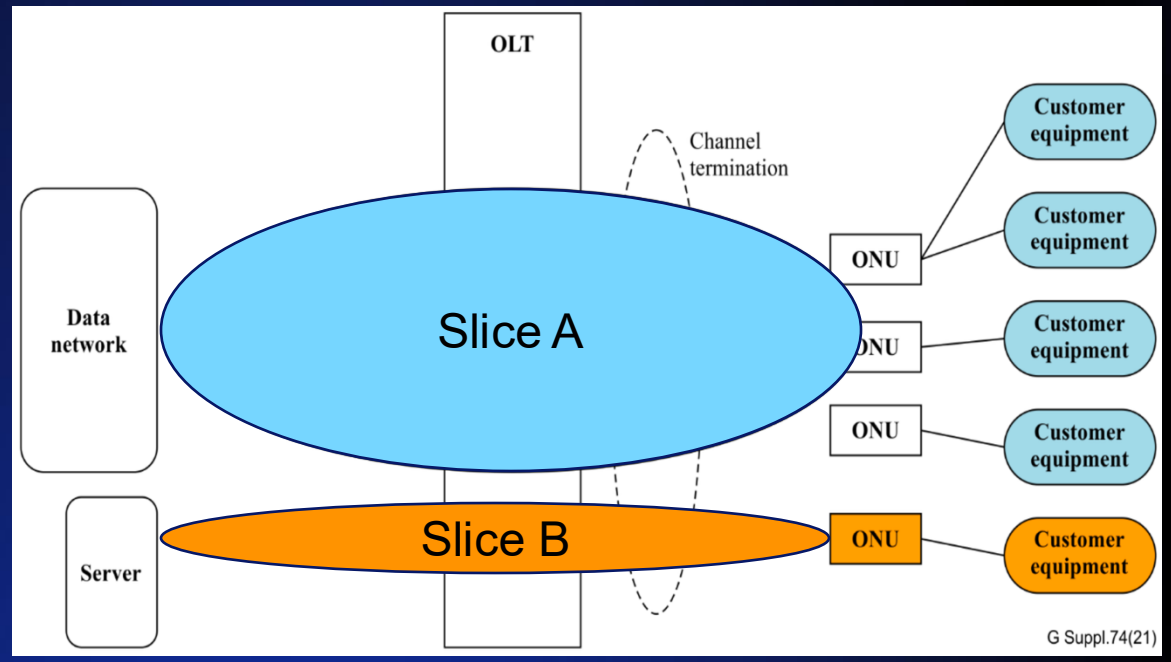
GPON or EPON Deployed
XGS or 10EPON Deployed
25GS-PON Deployed 1286 Up & 1358 Down
- Path to 50G or 100G is challenging
- All cost-effective wavelengths are used
- Requires GPON/EPON reclamation for lower cost O-band 50G "or" 100G PON
- Provider picks 50G "or" 100G for O-band
- 50G and/or 100G in C-band (1550nm) uses high-cost & power coherent optics (likely last resort)



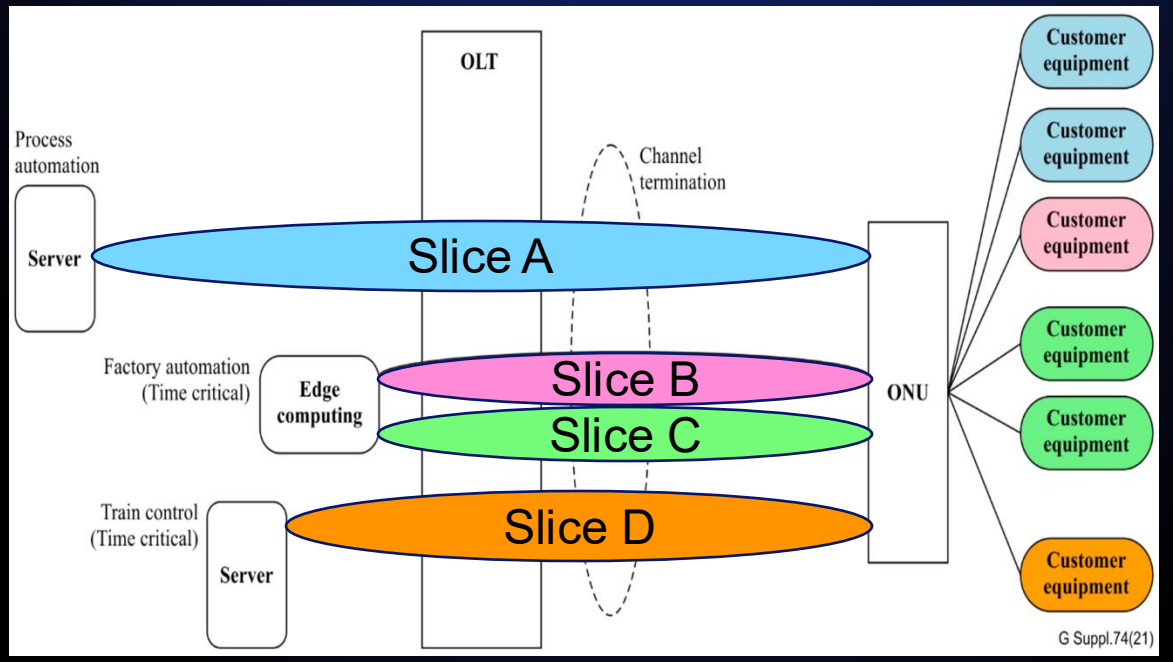
Recommendation: Plan to use 50G PON "and" 100G PON as these are emerging

What is PON Slicing?

- Allocating a portion of PON capacity to a group of users
- Each slice and the members in a slice can have configurable bandwidth and latency properties
- Unused guaranteed bandwidth (CIR) may be shared within each slice and among all slices
- Each slice has a DBA (Dynamic Bandwidth Assignment) managed by a hierarchical traffic scheduler



ONU Dedicated to a Single Slice



One ONU Carrying Multiple Slices

Calix 50G-PON Ecosystem Timeline

50G-PON TRIALS

COMMERCIAL 50G-PON SOLUTION

Calix OLT and ONT

SmartLife™ CalixCloud® Intelligent Access™ Unlimited Subscriber™ Success

The Right Approach to Delivering 50G-PON Next Generation Experiences

- Seamless and fast integration
- Same footprint, same Intelligent Access investment you have today
- Enhanced operational efficiencies and business opportunities
- Managed the same way you do today

50G PON Key Take Aways

1. **Standards are key to long term deployment success**

2. **50G PON with Network Slicing enhances Network Convergence strategies**

3. **50G PON is emerging now, widely adopted in the years to come**

Calix

Thank You