

Revenue and Sustainability
The Intelligent Middle Mile

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# The Intelligent Middle Mile: Roadmap to Success

### Evolution of the Middle Mile

- More Complex Fiber Topologies
- Latency, Why it Matters

### Advanced Applications

- The Revenue Yield Problem
- Here Today, More Tomorrow
- Traffic Engineering and Management

### The Intelligent Middle Mile

- Solves the Revenue Yield Problem
- Empowers Investments in the Entire Network
- Built for the Long Term, Avoids the Forklift





# **Funding Realities**

Today: Historic Levels of Public Funding

- RDOF, BEAD, ReConnect, MMG, RUS...
- Little to No Opex Funding Available
- Unlikely to Repeat
- Revenue-Forward Networking
  - Capital Investment
  - Return on Investment
  - Improved Time to Revenue
  - Total Cost of Ownership
  - Extending the Life of Your Network



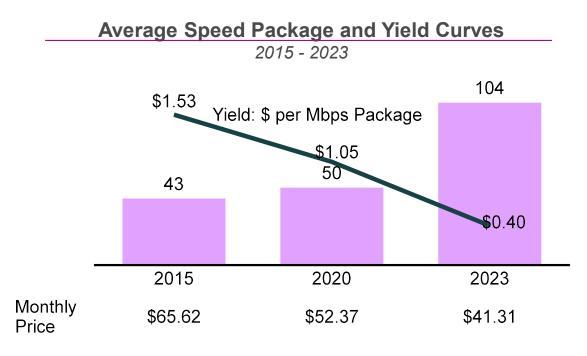


# The Yield Problem: Why More Bandwidth Isn't the Answer

Historically Customers have Migrated Speed Packages at a Moderate Rate

Yield (\$/ Mbps) has Declined Steadily as Industry Creates More Capacity

Acceleration of High
Capacity Gigabit is
Accelerating Yield Declines



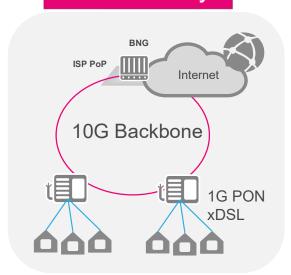
Source: U.S. Bureau of Labor Statistics; U.S. Telecom Pricing Report 2023; Packages for US Telecom "Consumer Choice" as part of Broadband Pricing Index study

#### Better Monetization is Essential to Reverse this Trend



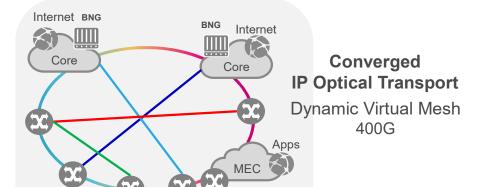
# **Fiber Topology Evolution and Adaptation**

### **Access Only**





### Access + Middle Mile



10/25G xPON

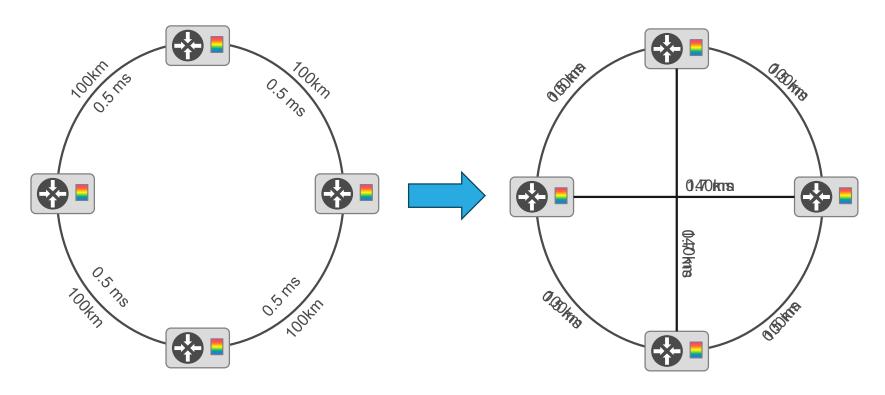
- G-PON and Other Legacy
- Access Devices Not Built for Advanced Applications
- Fixed Ring Capacity, Difficult and Expensive to Upgrade

- XGS-PON, 10G/25G+
- Lower Latency
- Intelligent Transport
- Middle Mile Scales Easily to Terabits



# **Evolving Fiber Architectures – Latency**

Shorter Fiber Routes Allow Lower Latency Services



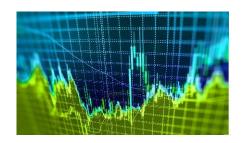
The Majority of Latency Incurred in a Broadband Network is Signal Travel Time.



# **Evolving Fiber Architectures – Latency**

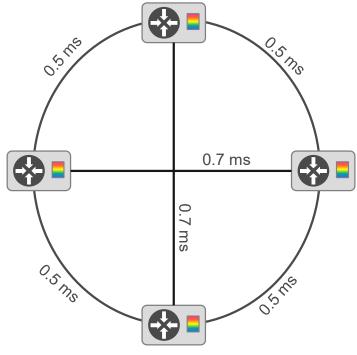
Fiber 'Shortcuts' Aren't New, but...

Rapid-Decision L3 Protocols Allow Full Utilization of Complex Topologies, Enhancing Service Quality.





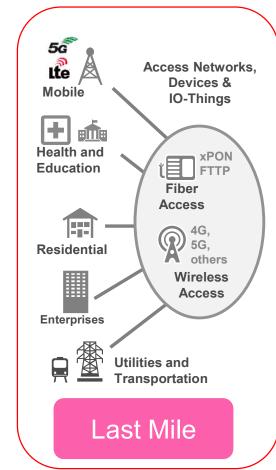


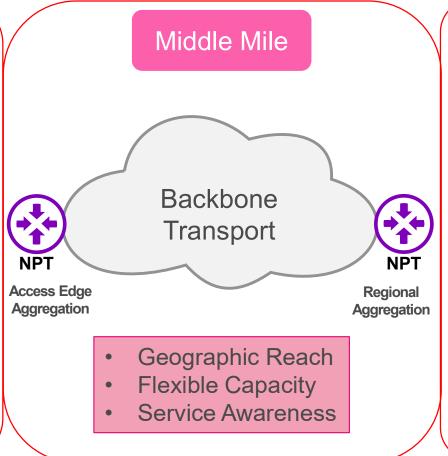


A 1-Millisecond Advantage ... Can be Worth \$100 Million a Year to a major brokerage firm.



### What is the 'Middle-Mile'?

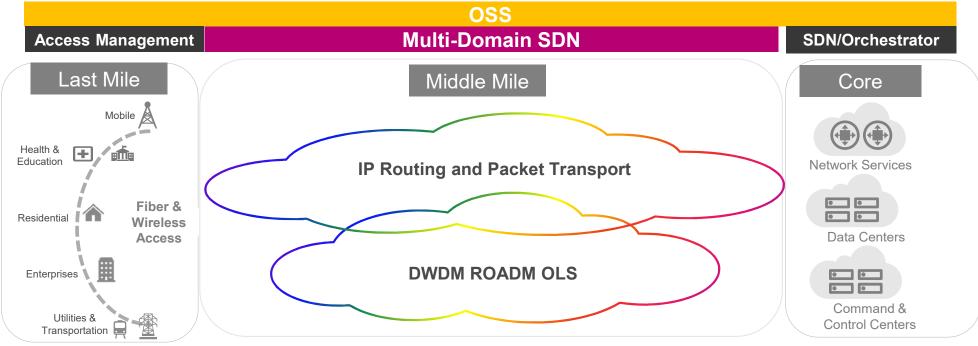








# **Definition: The Intelligent Middle Mile**



- Connects Last Mile with Core Services and Applications
- · Combines IP and Optical Networking
- From 10s to 1000s of Kilometers
- Reliable, Secure, and Meets Service Performance and SLA Requirements



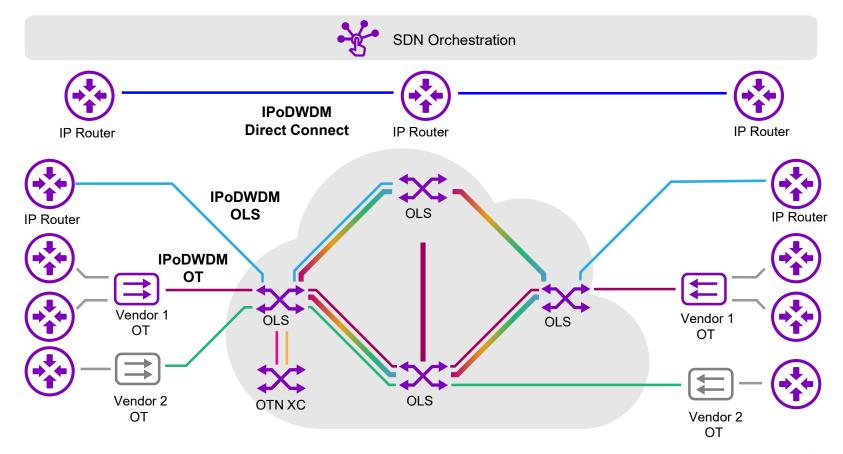
# **Evolving Network Architectures – Coherent Routing**

#### **MULTI-LAYER DOMAIN CONTROL** Coherent **OLS** ZR/ZR+ Routing (optional) without OT ZR+ ZR/ZR+ **OpenROADM** Coherent **Proprietary Routing with** ОТ 📒 OT **OLS** book-ended OT Gray

Cost Effective and Flexible Architecture

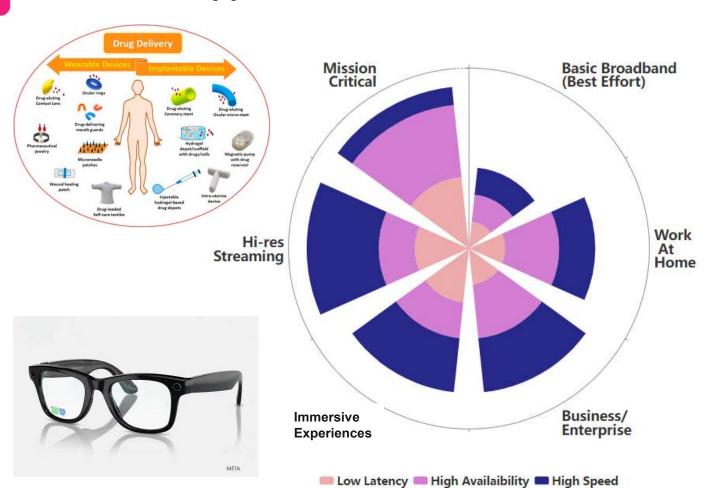


# **Using DWDM to Carry Ethernet**





# **Advanced Applications and Revenue**









# Traffic Engineering is Critical to Happy and Loyal Customers

### **Streaming Entertainment**

- High Bandwidth, "Best Effort"
- Latency: tolerant
- Minor Packet Loss: tolerant

### **Business Connectivity**

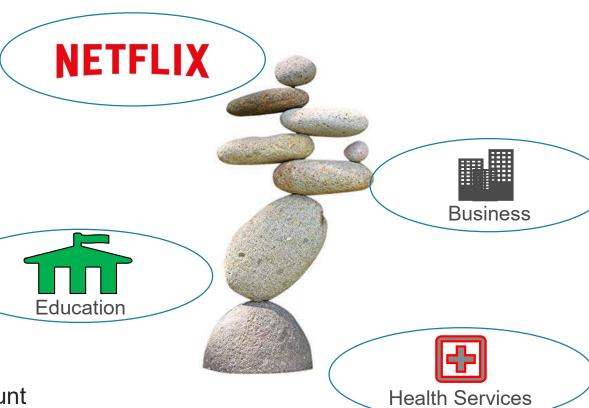
Reliability is Essential

#### **Education**

• Security, Controlled Access

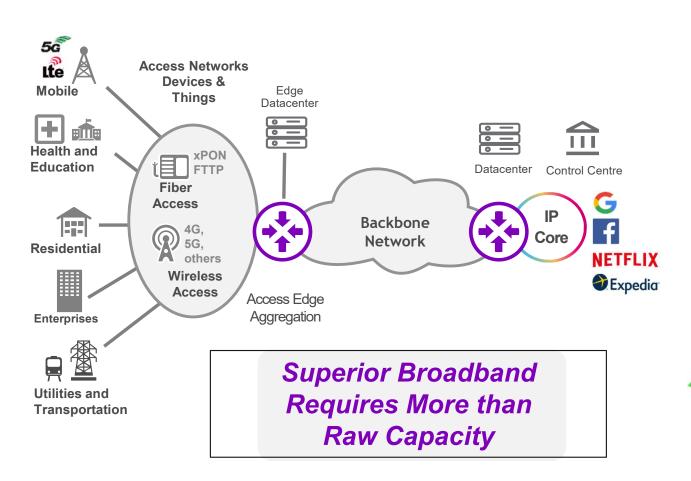
### Telehealth, Telemedicine

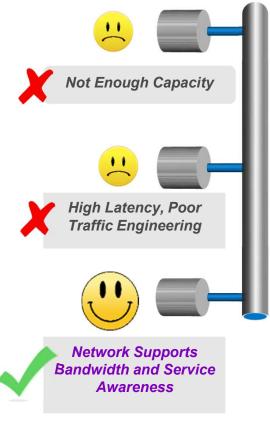
Encryption, Privacy are Paramount





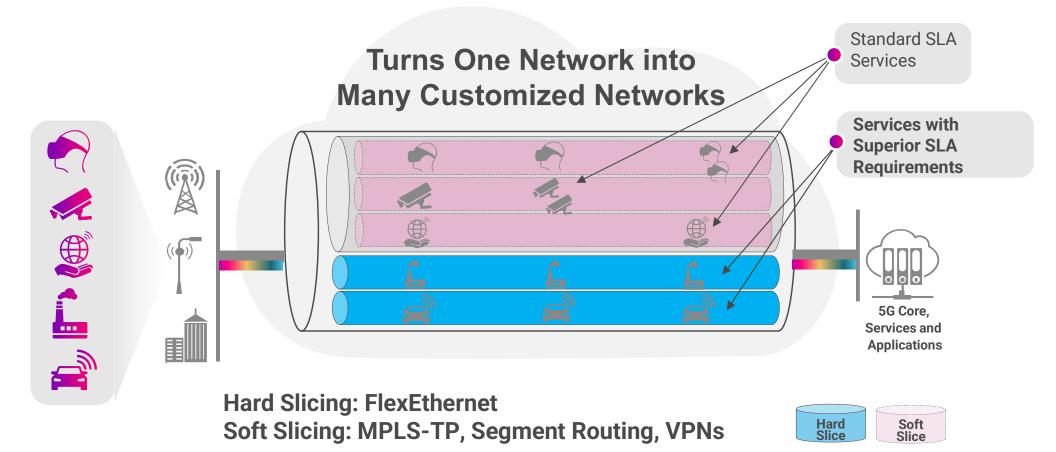
# **Network Scalability – More Than Just Capacity**





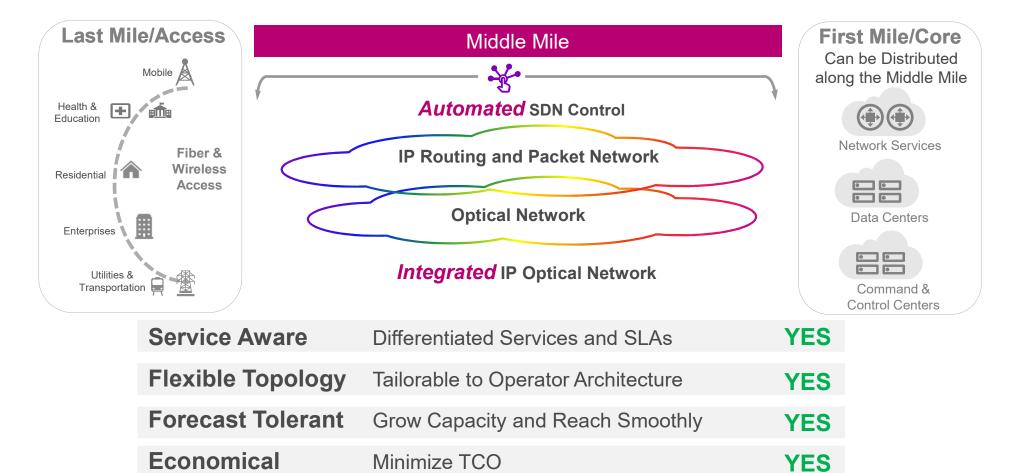


# Traffic Engineering Example: Transport Network Slicing





# **Intelligent Middle Mile Approach**





# **In Summary**

- Public Investment is CapEx Only so Spend Wisely!
- Cost-Improved Technology Advances
  - Advanced Service Handling Routers
  - Coherent Routing with 400G Optics
- Traffic Engineering Enables Enhanced Service Offerings
- Intelligent Middle Mile Design is Key to Sustainability and Revenue Growth



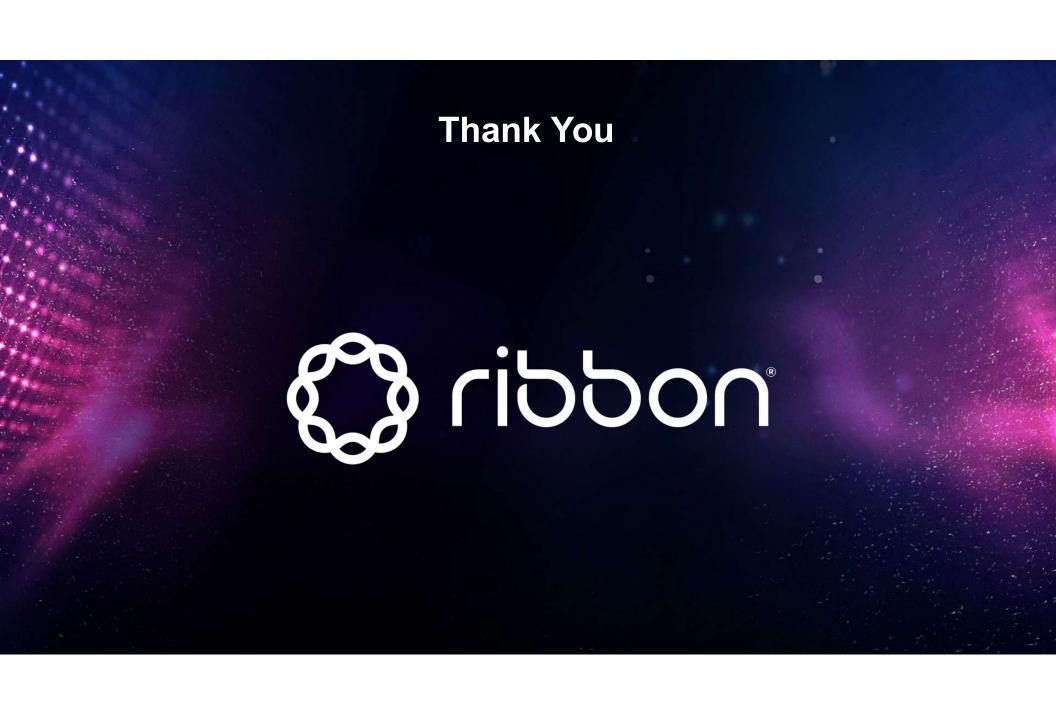


# **Contact Information**



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