

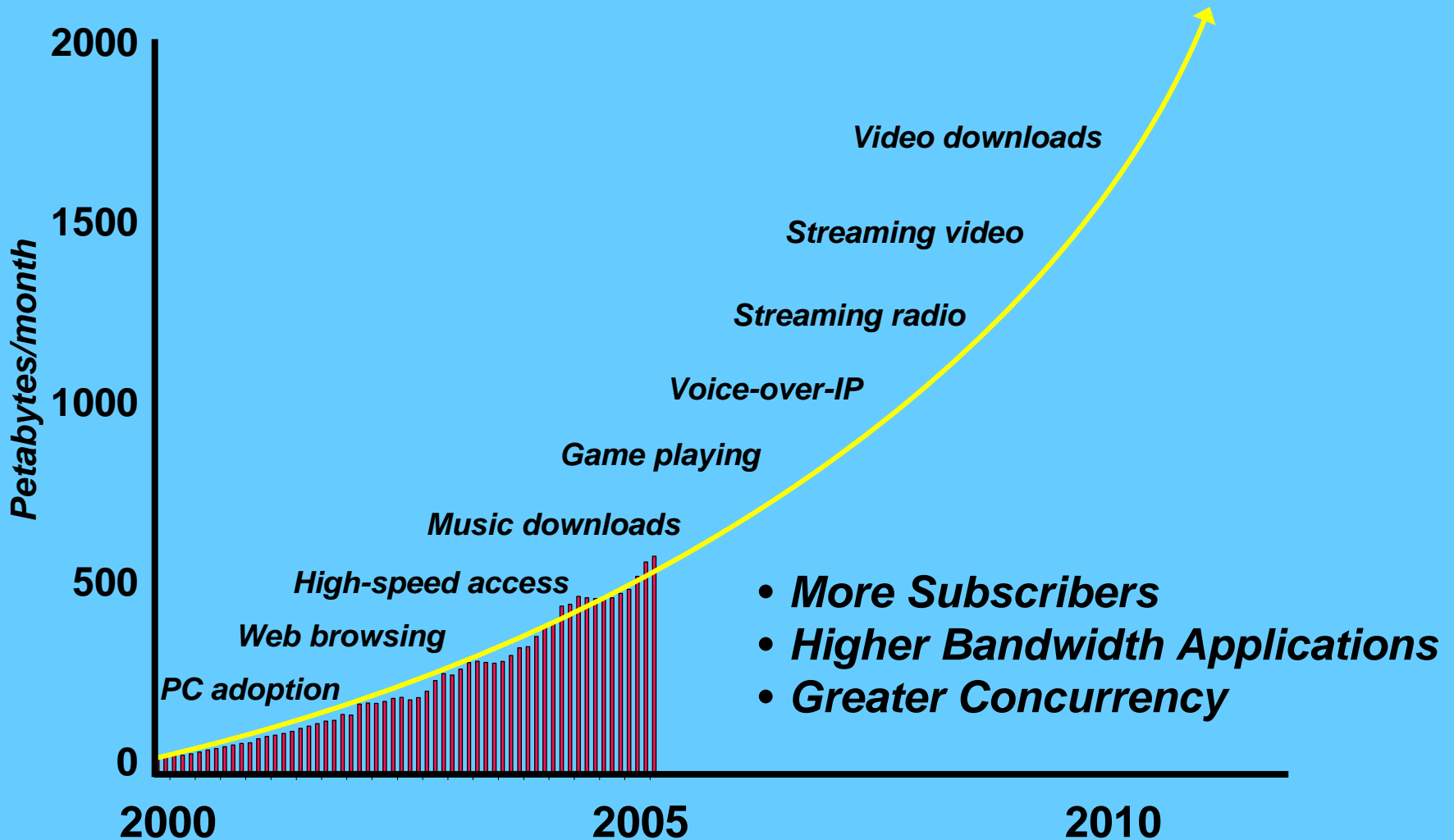
# Maximizing the Impact of Optical Technology

## OFC/NFOEC 2007



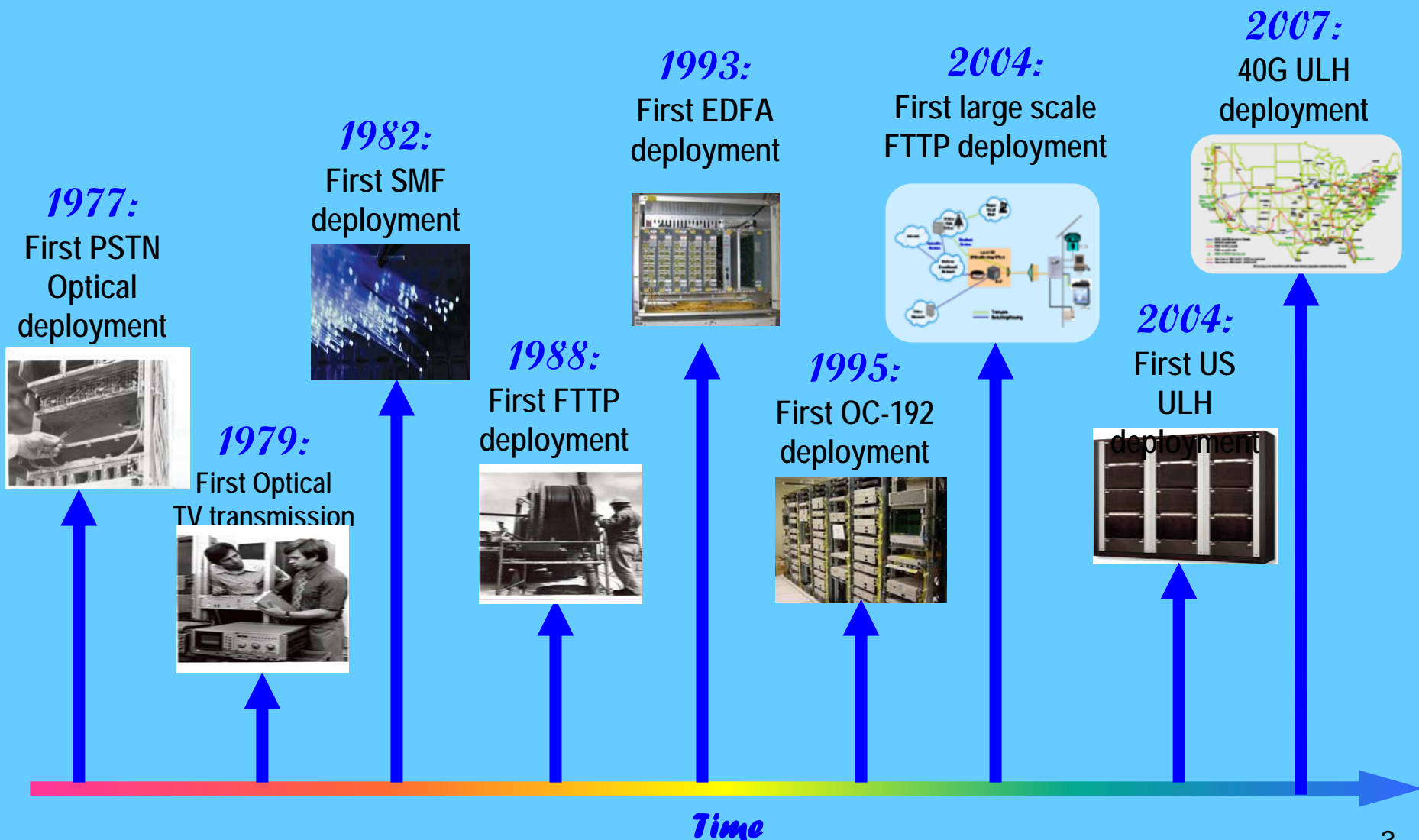
*Mark Wegleitner  
Senior VP – Technology, CTO  
Verizon  
March 27, 2007*

# Traffic Growth

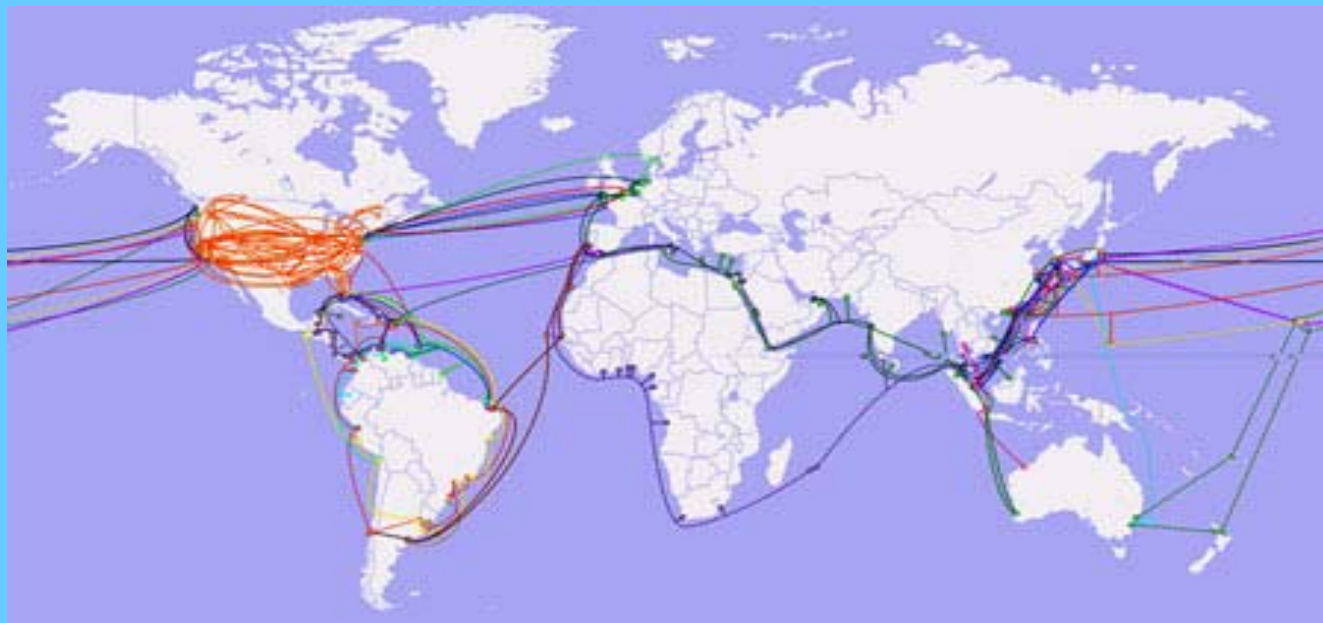


Source: Ovum-RHK

# Verizon Optical Technology Thrusts



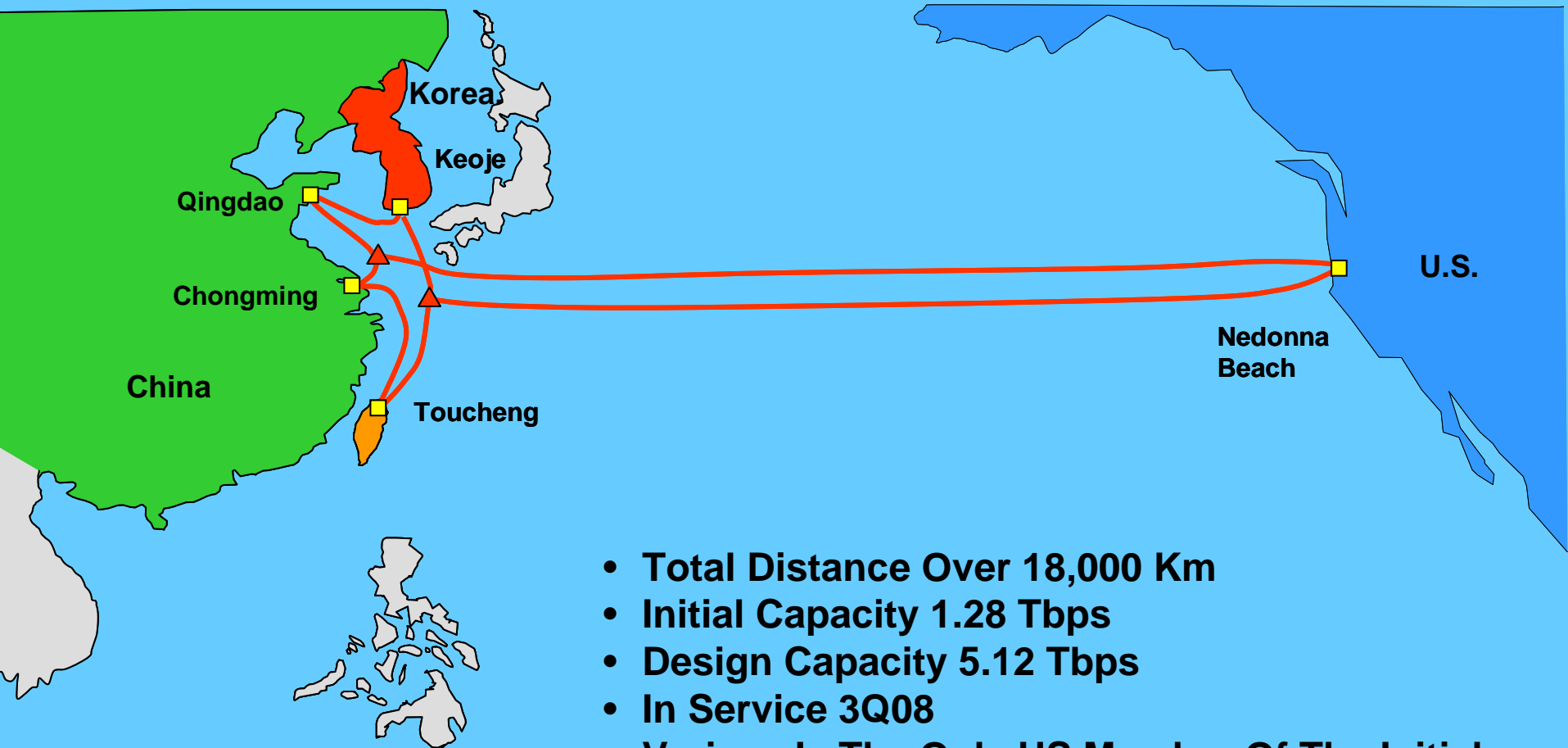
# The Verizon Global Network



- 6 Continents
- 150+ Countries
- 2700 Cities
- 4500 PoPs
- 446K Route Miles
- 130K Enterprise Customer Relationships

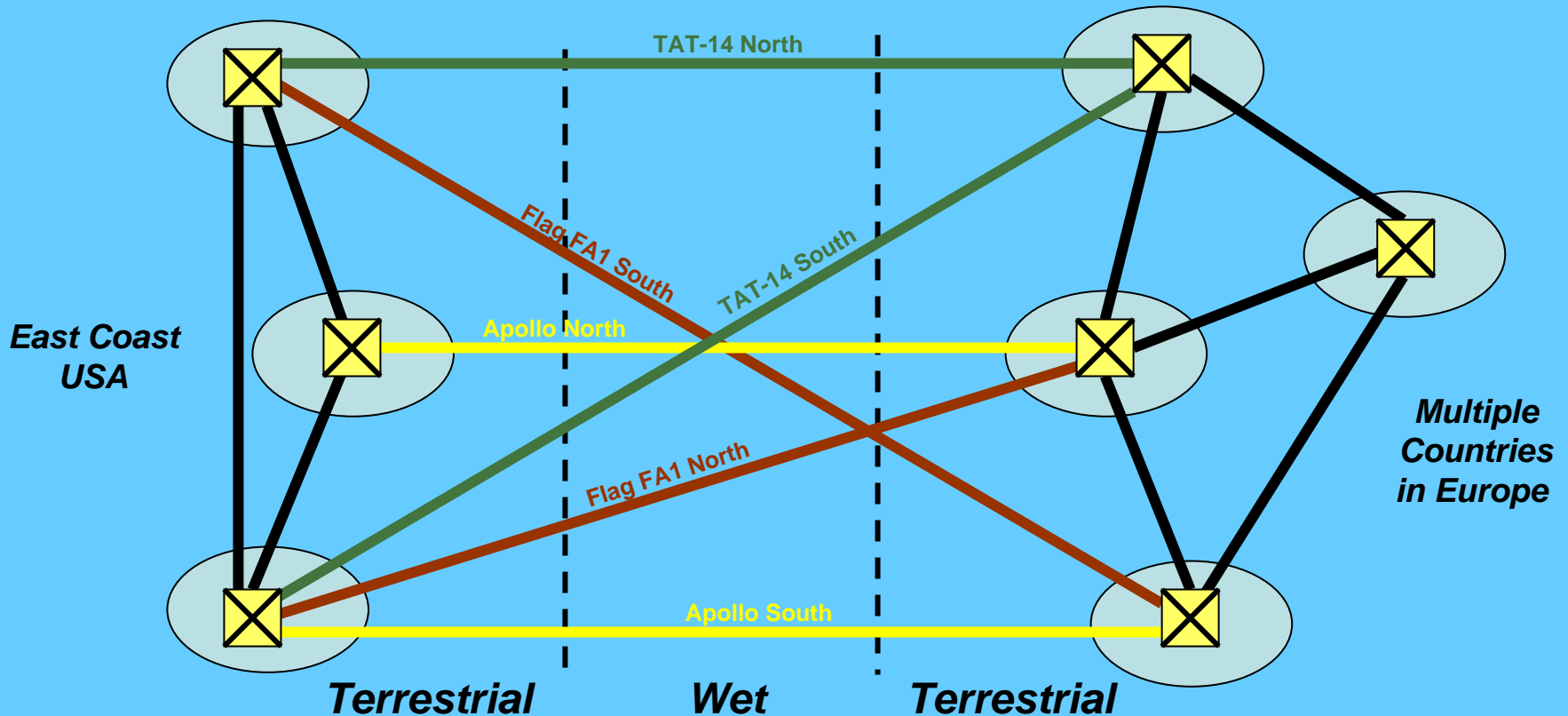
**One of the Largest Wholly Owned  
Facilities-Based Networks in the World**

# Trans-Pacific Express



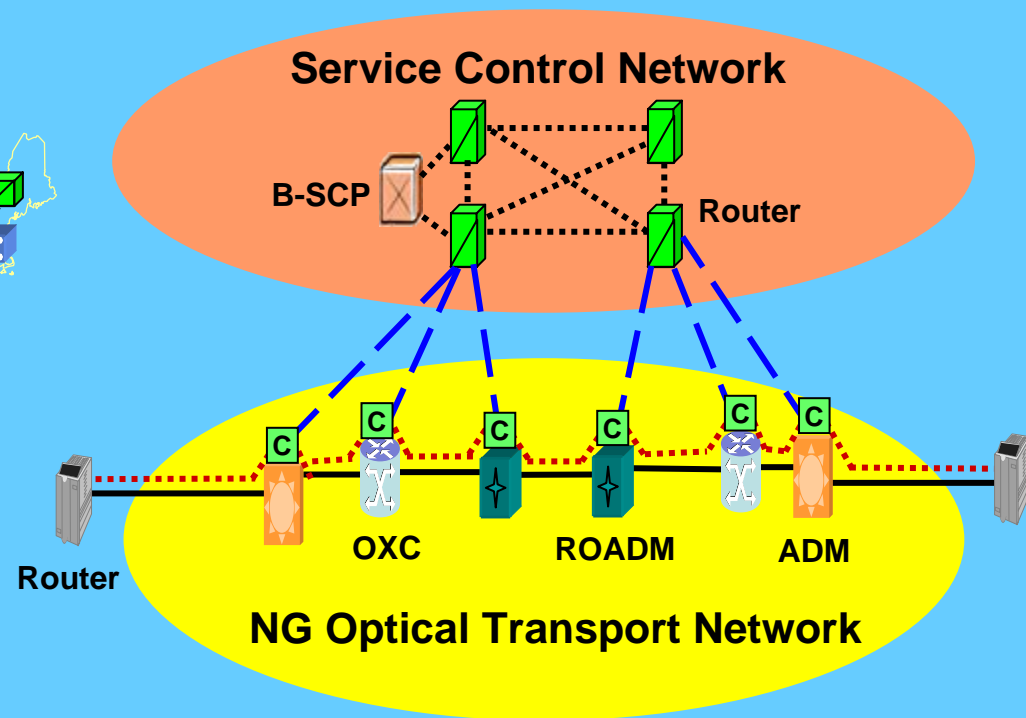
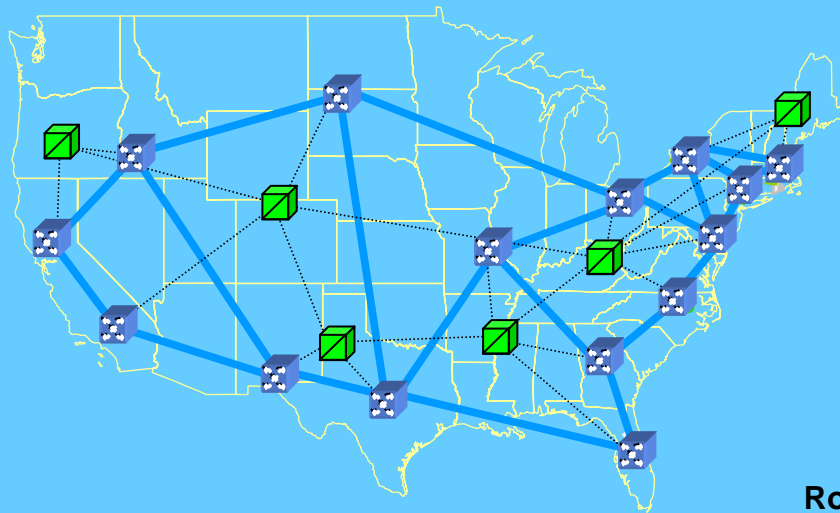
- Total Distance Over 18,000 Km
- Initial Capacity 1.28 Tbps
- Design Capacity 5.12 Tbps
- In Service 3Q08
- Verizon Is The Only US Member Of The Initial Consortium

# Atlantic Mesh Network



- Multiple Diverse Paths On Land And Across The Sea
- New Routes And More Capacity Being Added In 2007
- Automated, Control Plane Based Restoration Of Faults

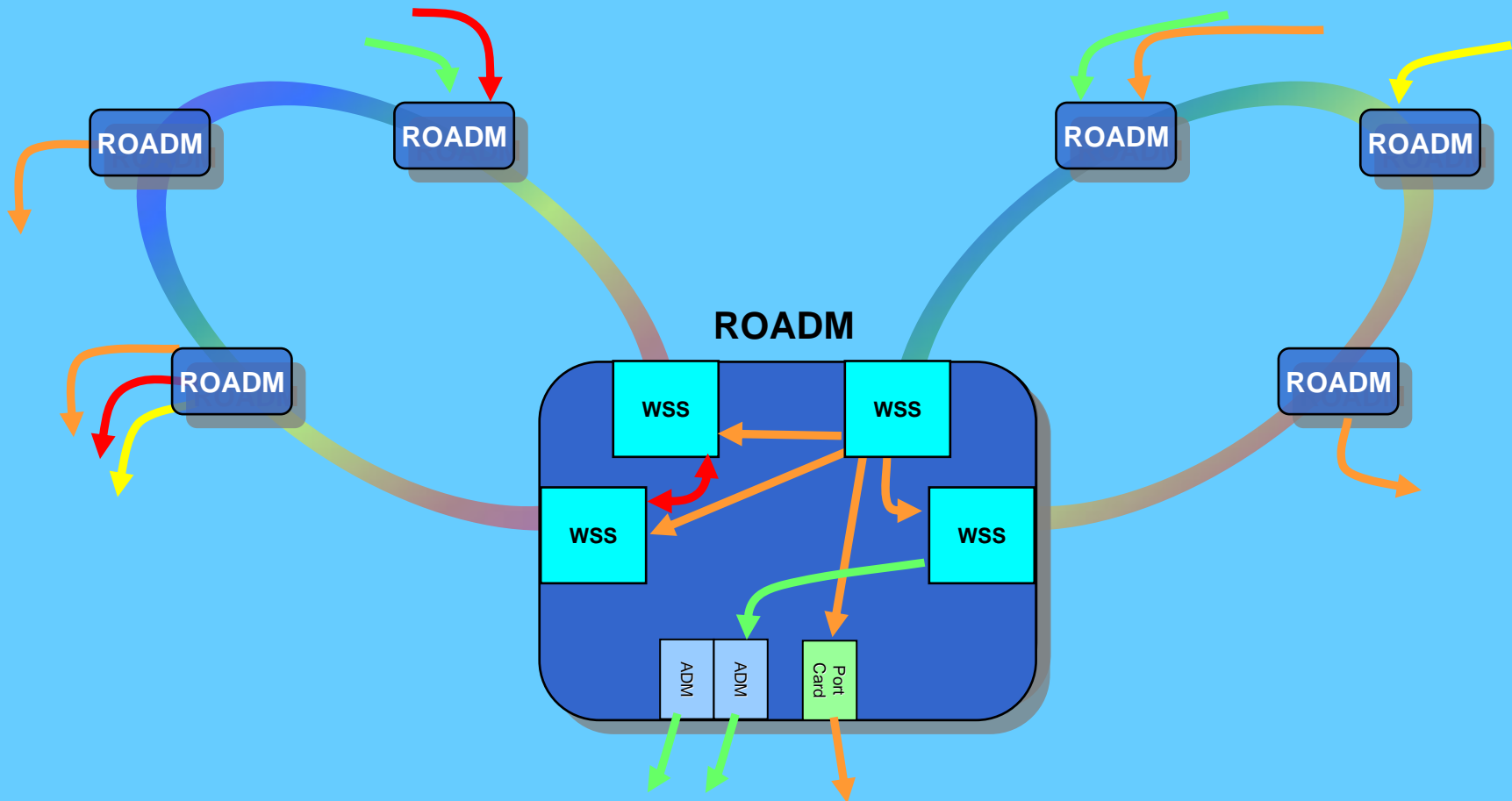
# Control Plane Based Network



- **Dynamic Service Provisioning and Maintenance**
  - Self-Inventory
  - Self-Assignment
  - Self-Configuration
  - Self-Healing

**A Fully Automated  
End-To-End Network**

# Multi-Degree ROADM

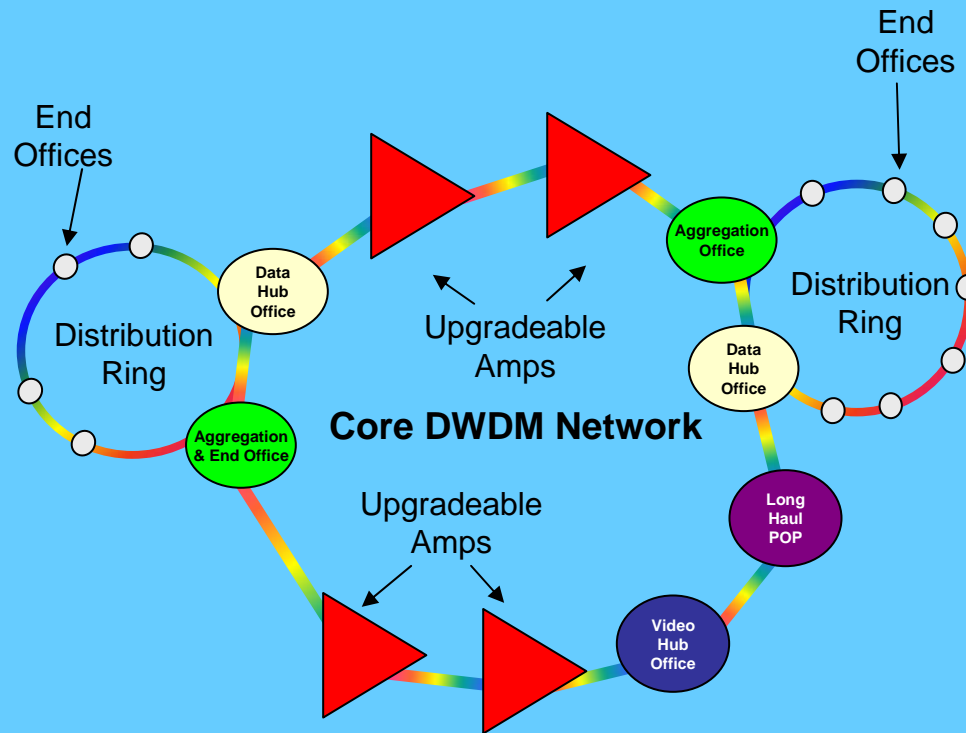


## Wavelength Selective Switch (WSS)

- Supports Up To 8 Fiber Degrees
- Switches Wavelengths Under Software Control
- Improves Reach By Providing Per Wavelength Power Equalization

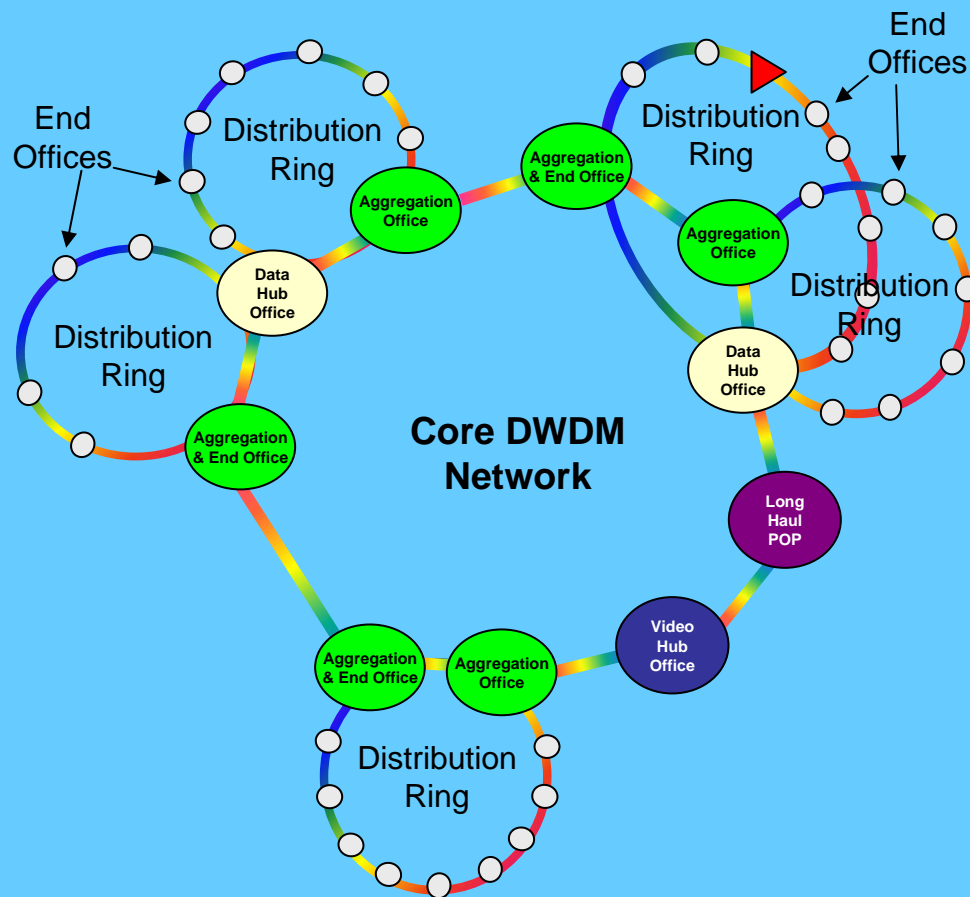


# Regional Network Infrastructure



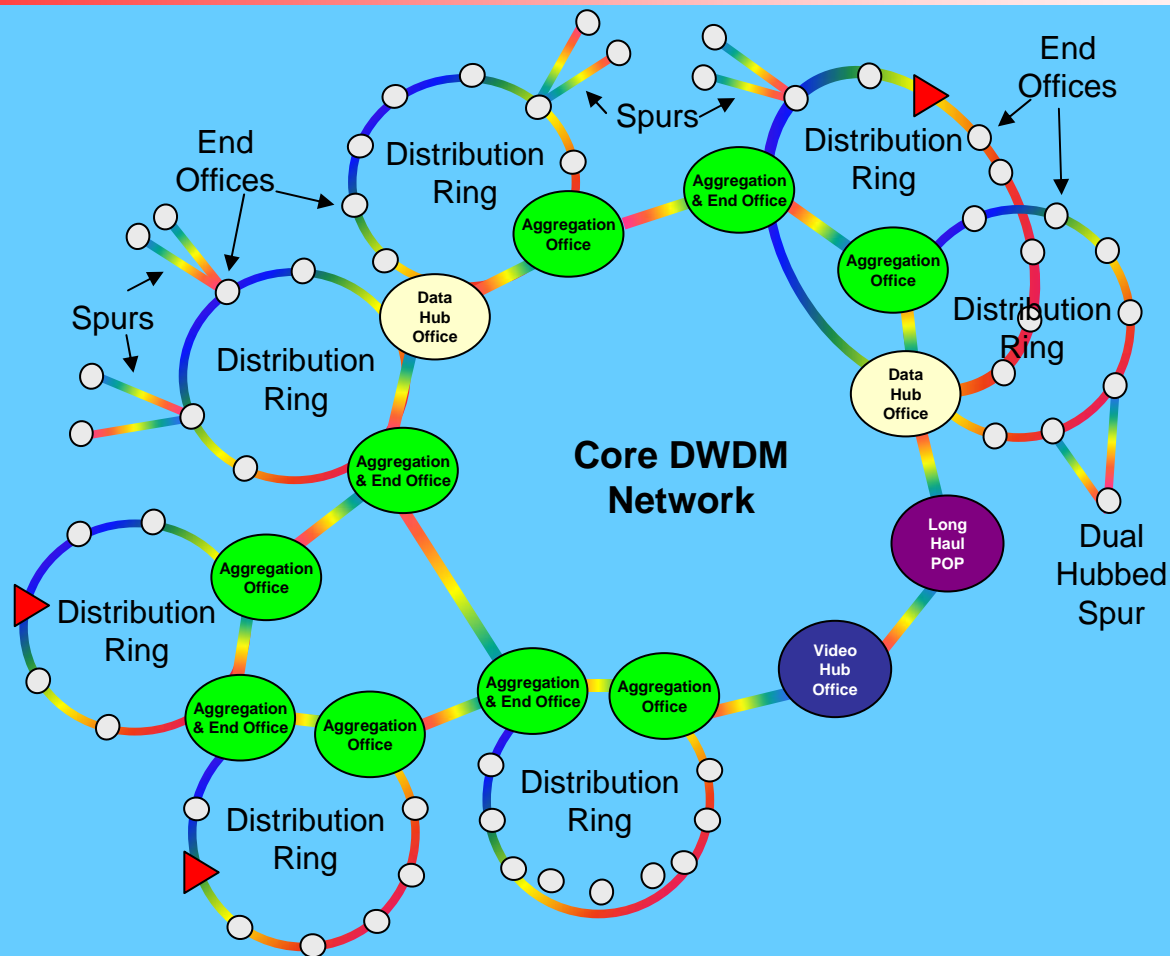
- End Offices Start With Unidirectional Video Broadcast And Combined VOD/Data
- Support An Architecture That Incrementally Scales Based On Demand
- Amplifiers Pre-Positioned For Node Upgrade

# Regional Network Infrastructure



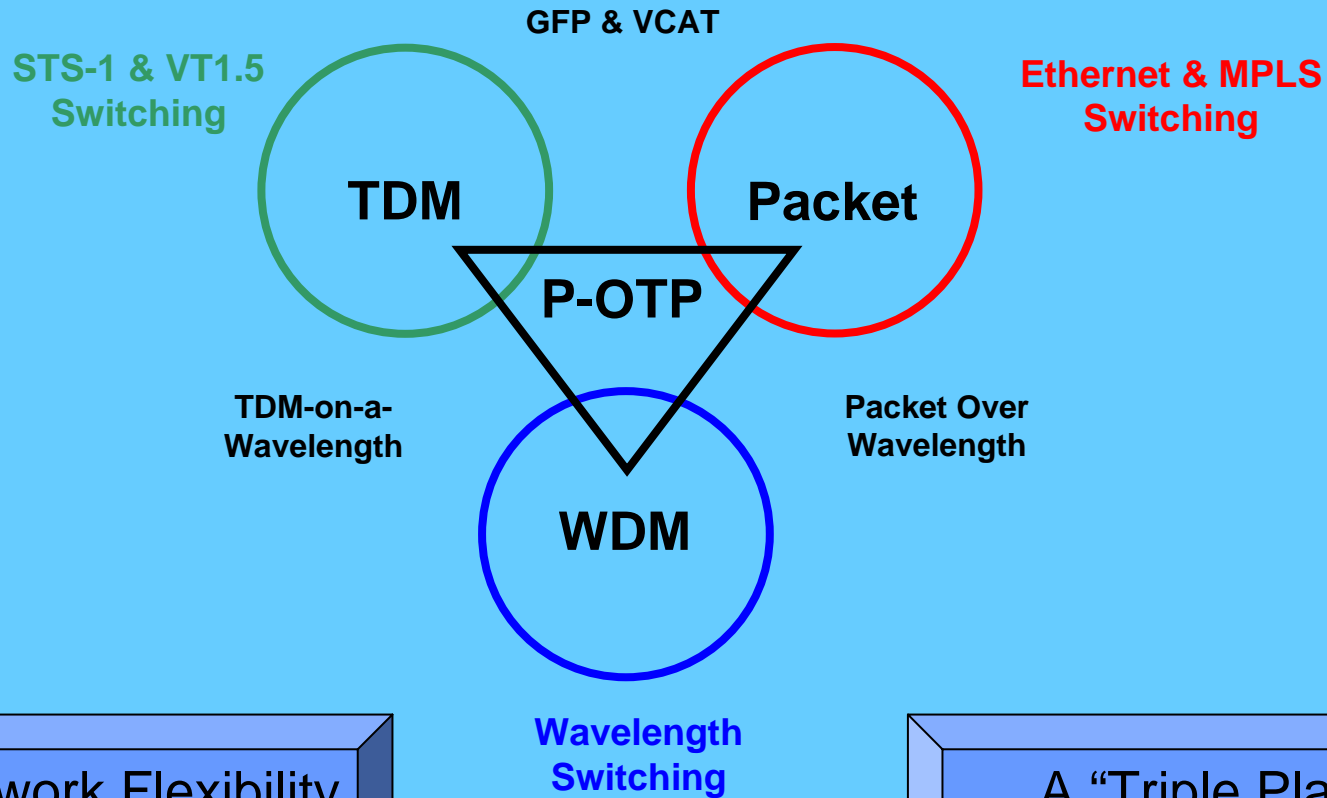
- Amplifiers Upgraded To Support Additional Aggregation Offices and Distribution Rings
- WSS Enables Easy Node Degree Increase

# Regional Network Infrastructure



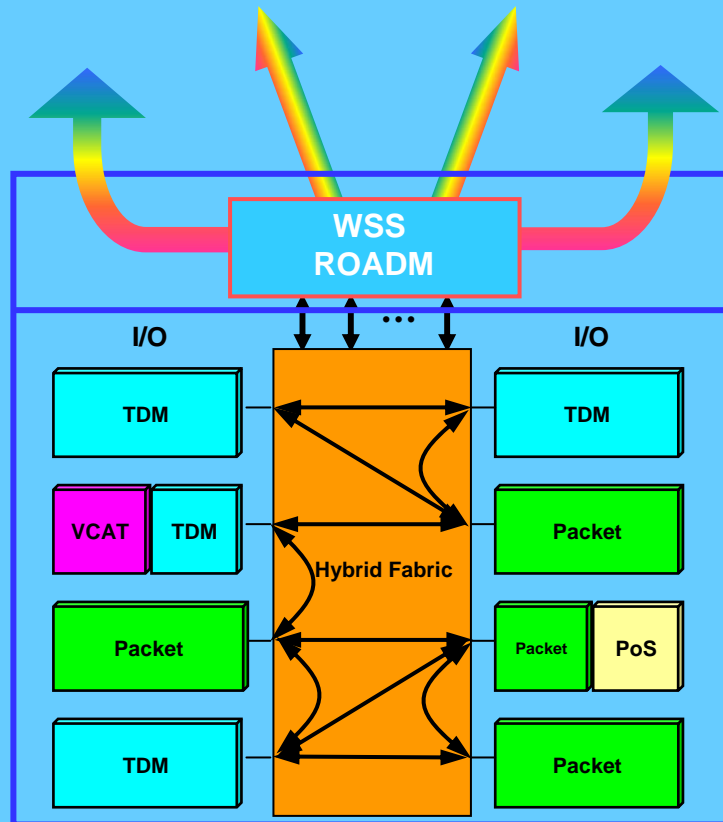
- **Core Structure Further Extended With Additional Aggregation Offices**
- **Spurs To Support Additional End Offices**
- **Common Network To Support FiOS, IOF, And Enterprise Service Infrastructure**

# Convergence



- Network Flexibility
- Service Flexibility
- Lower Cost

A "Triple Play"  
In Transport  
Technology



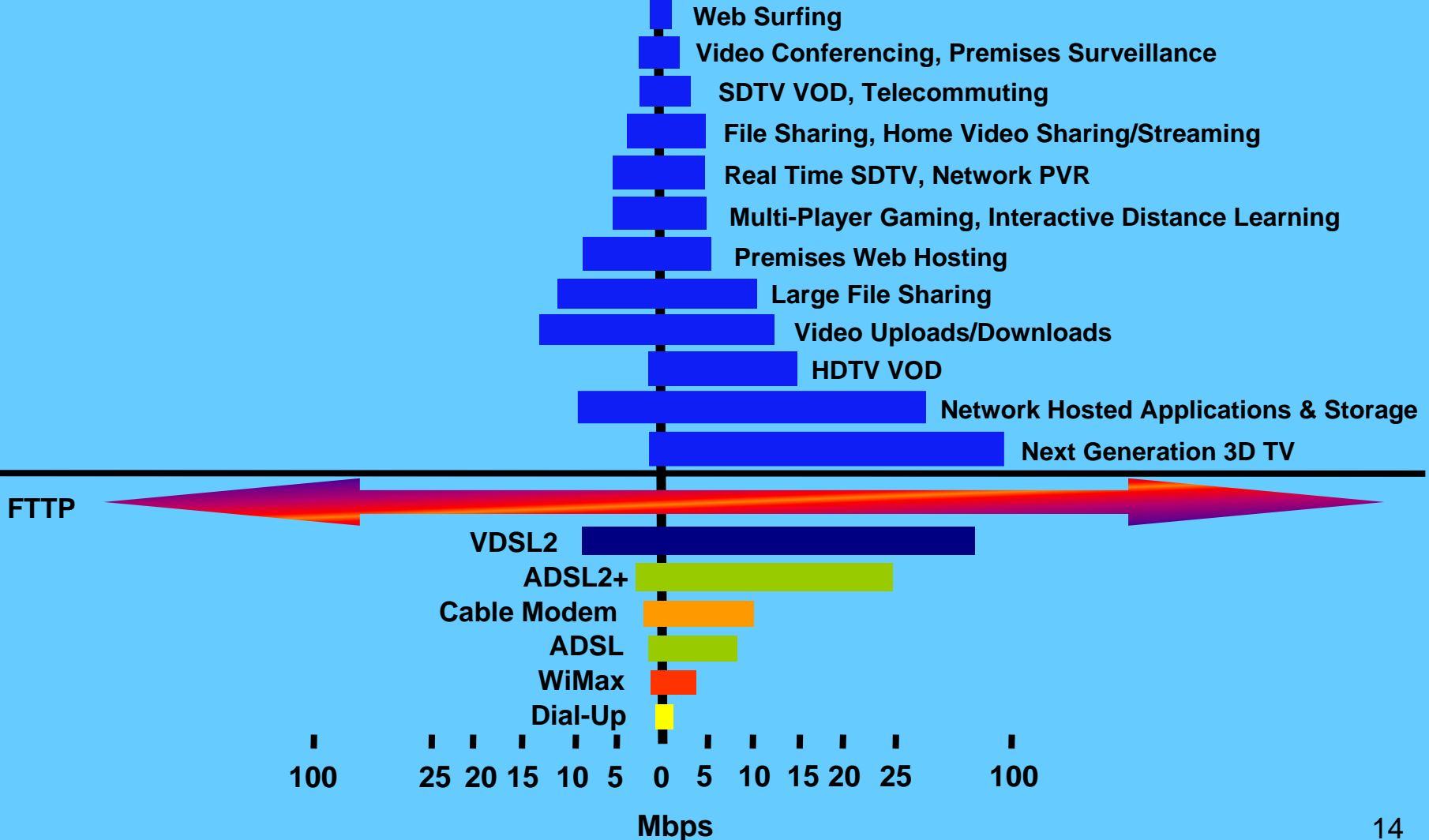
- Single Network Element
- Hybrid Fabric To Support Mix Of TDM And Packet Switching
- WSS Based ROADM To Support Multi-Degree Connectivity
- Fully Automated Control Plane

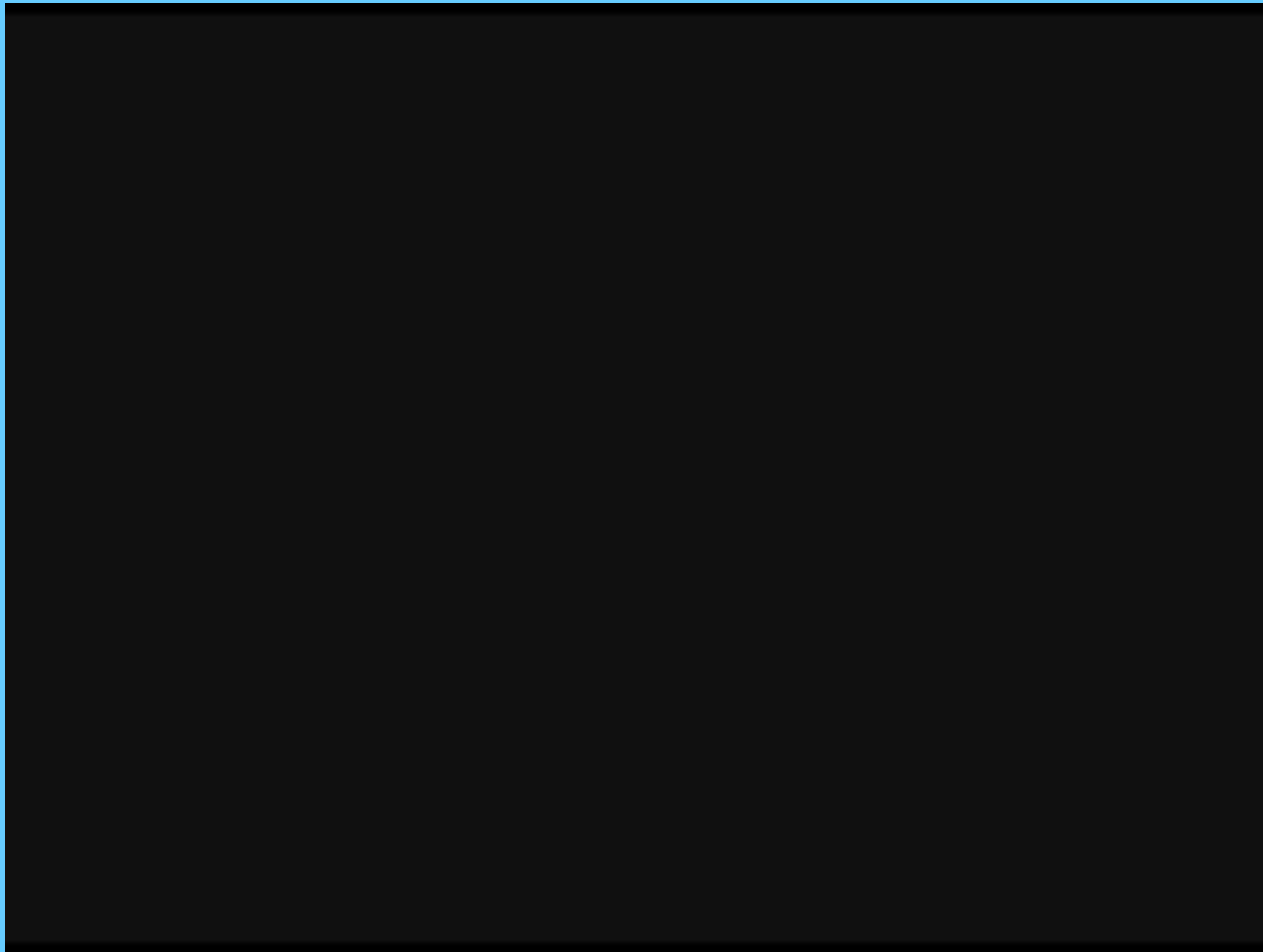
# Applications and Media Bandwidth



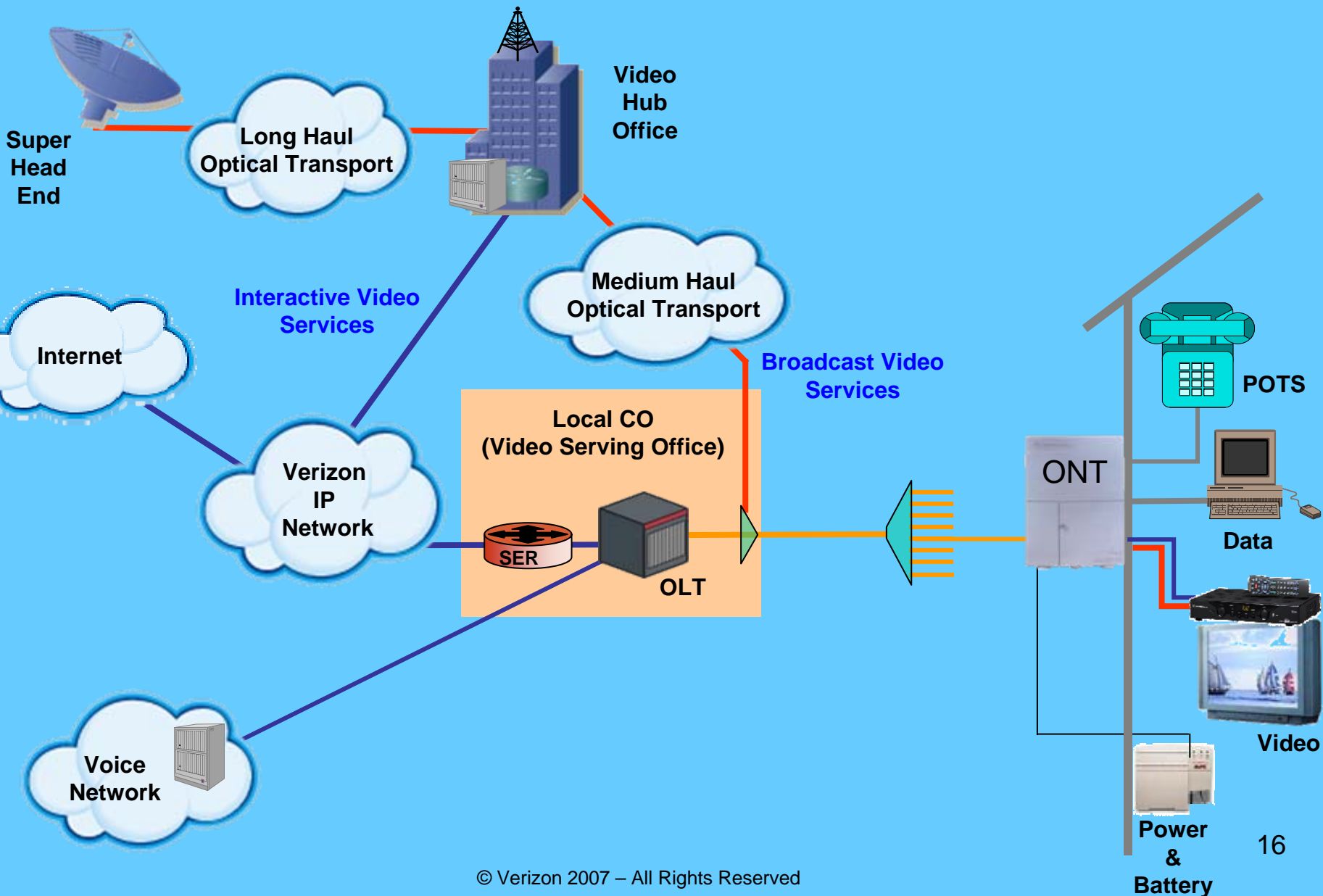
Upstream

Downstream



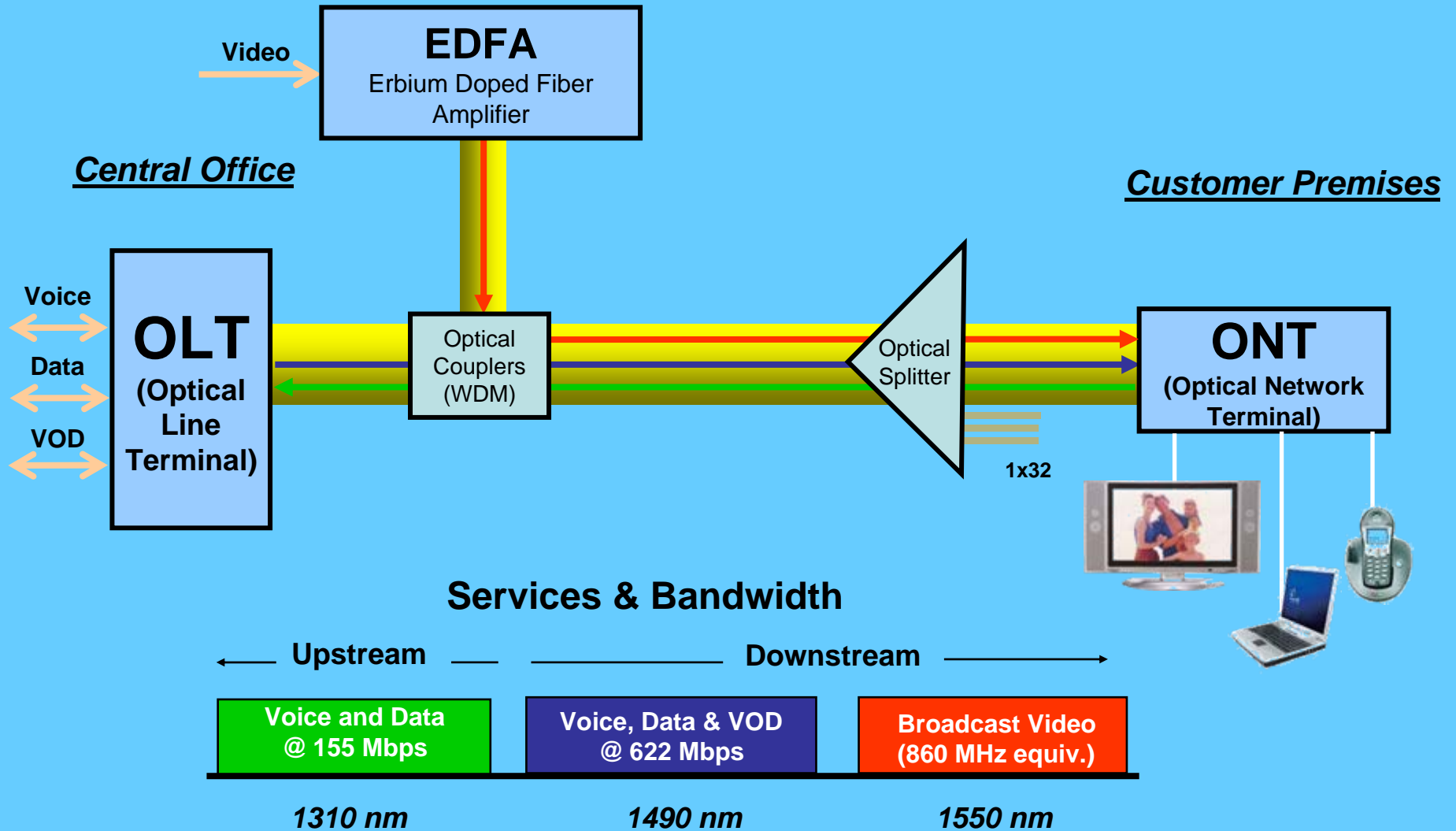


# Simplified FTTP Architecture

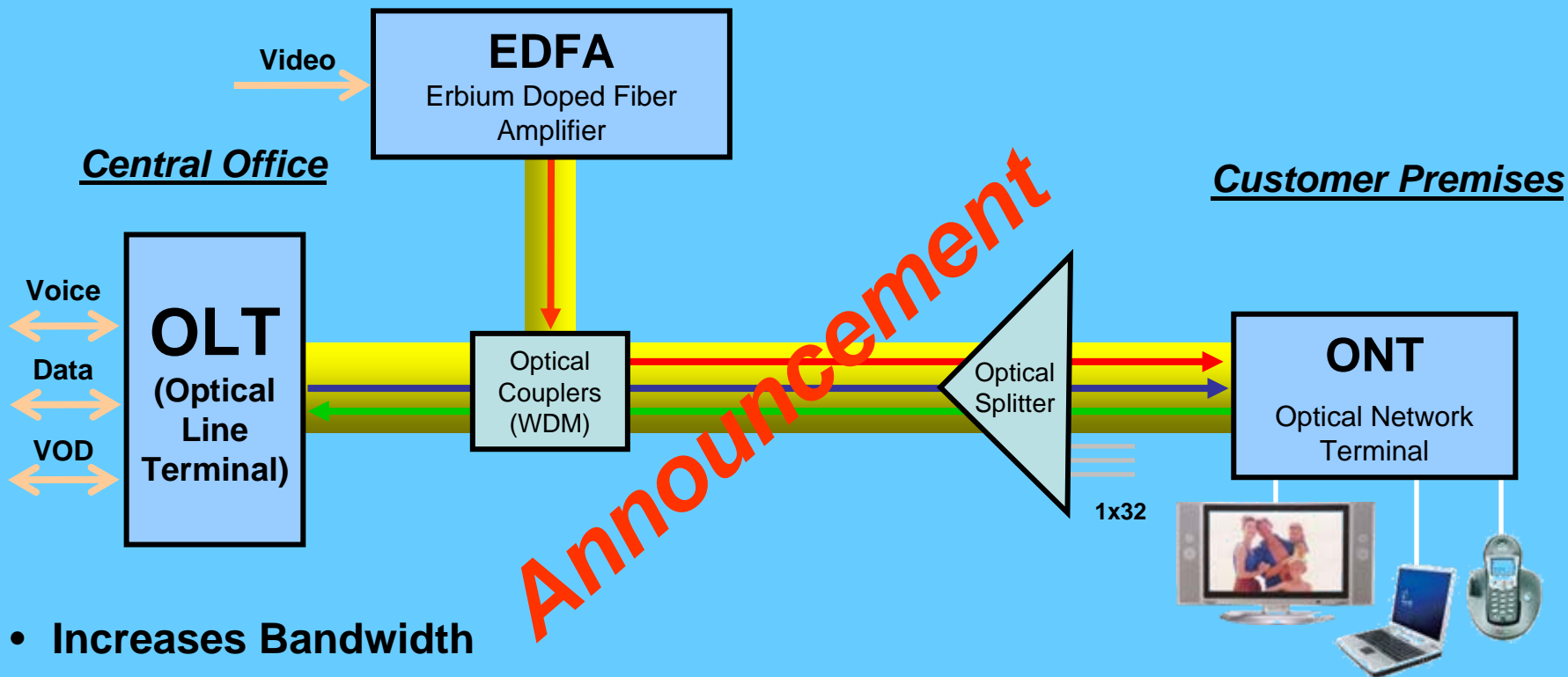




# FTTP BPON

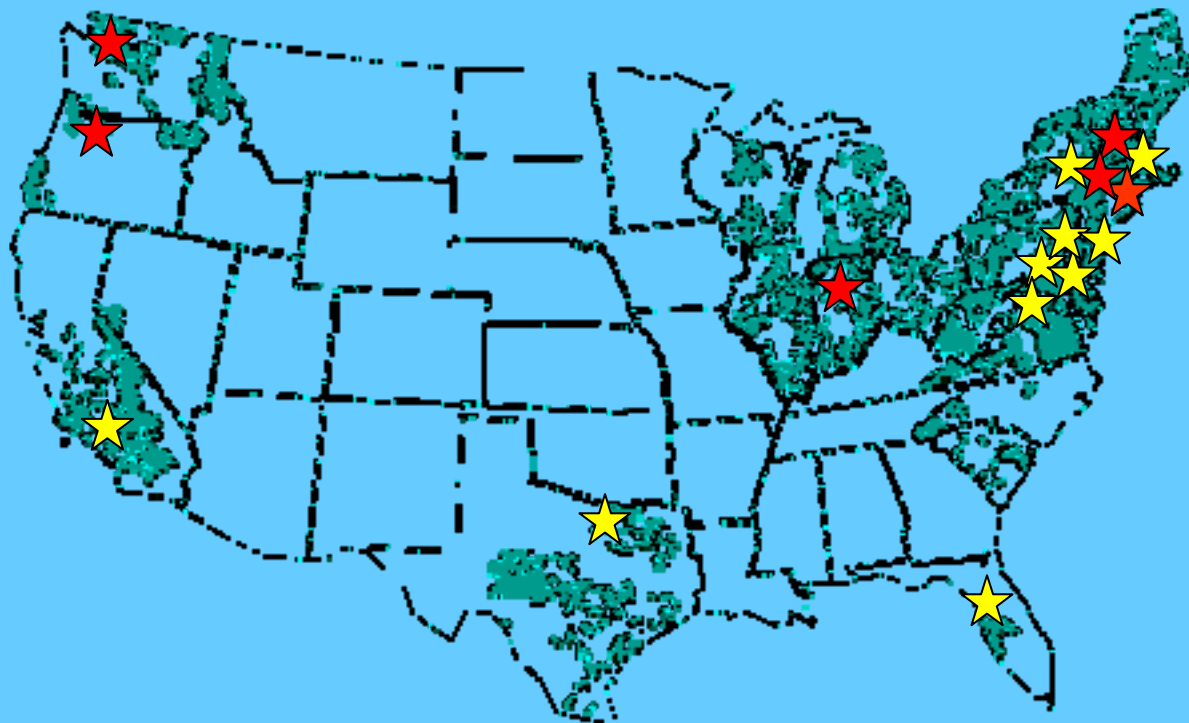


# FTTP GPON



- **Increases Bandwidth**
  - 2.4 Gbps/1.2 Gbps
- **Initial Deployments Include A Third Wavelength To Maintain Service Package and Accelerate Deployment**
- **Expanded Bandwidth Enables Full IPTV Implementation Later**

# Verizon's FTTP Deployment



- Over 6M Homes Passed To Date
- Target Is 18M By 2011 (3M / Year)
- GPON And More HDTV In 2007
- Same Infrastructure For SMB Markets

- **Support Residential, Enterprise/Government, Wholesale, And Internal Requirements**
- **Remain “X”able**
  - Accessible (Protocol Agnostic, Defined Interfaces)
  - Predictable (Throughput, Latency, ...)
  - Scalable (Rate Adaptive/Adjustable Port)
  - Reliable/Survivable (Protected – Nodal, Port, Link, Route, Service, ...)
- **Become Dynamic**
  - Control Plane Enabled
  - Topology, Element And Capacity Aware
  - Routing, Bandwidth Allocation, And Protection/Restoration Functional

- **More Capacity (Speed and Wavelengths)**
- **Greater End User Access Bandwidth**
- **Common Control Standards**
- **Easier Fiber Administration In Central Office And Outside Plant**
- **Fiber In the Premises for Higher Bandwidth and Ease of Installation**
- **Higher Functional Integration (To Reduce Cost)**
- **Bandwidth On Demand Capability**
- **Multi-Vendor Supply**
- **Maintenance Of Reach And ITU Spacing At Higher Speeds**
- **Routing Flexibility**

- **Beyond GPON: 10GPON And/Or WDM PON**
- **Low Loss/Bend Insensitive Fibers**
- **Mechanized Optical Patch Panels For Central Office, CEV And FDH Applications**
- **GMPLS Control Plane Standards For SONET And DWDM**
- **More Wavelengths Per Fiber**
- **Higher Bit Rates: 40G/100G**
- **Alien Wavelength**
- **Advanced Modulation Techniques For 40/100 Gbps**
- **Dynamic Colorless Mesh Networking**
- **Optical Packet Switching**

## Verizon is . . .

- **Focused On Optical As Key To The Future**
- **Widely Deploying Optical Technology Supporting A Variety Of Applications**
- **Pushing The Status Quo To Insure Support For Future Growth/Scale**
- **Looking To Leverage Optical Investment For New Applications And Services**
- **Taking Advantage Of Next Generation Optical To Lower Costs And Achieve Greater Performance**

