



ribbon

TECH FORUM 23



Apollo

Connecting the World with Light

Jonathan Homa – IP Optical Solutions Marketing

IP Wave Portfolio

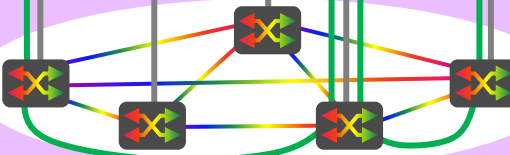
Muse
SDN Domain
Orchestrator



NPT
IP Routers



Apollo
Optical Networking
Systems

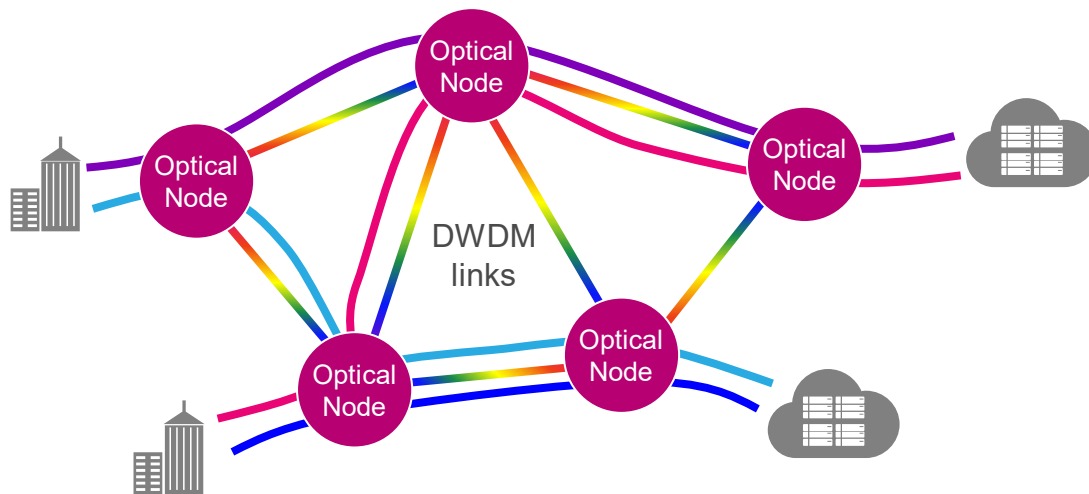


Ribbon
Professional
Services

Role of Optical Networks

Transport services transparently over wavelengths of light at a very low cost per bit

- **Transponders & muxponders** map services onto wavelengths
- **ROADMs** (reconfigurable optical add/drop multiplexers) route wavelengths over DWDM links
- **OTN switches** groom services traffic in about 30% of networks



DWDM (Dense Wavelength Division Multiplexing) links carry many wavelengths simultaneously

Apollo Optical Networking Portfolio

9400 Series High Density Applications



9408 Optical Transport

OLS (Roadmap)

Data center residency optimized with telco NEBS

9600 Series Modular Applications

Rich set of optical transmission and line system cards, usable across all platforms without engineering rules

Telco and data center



9603



9608/D



9624

9900 Series OTN switching

Granular service control

Used in about 30% of solutions



**9901X
400G**



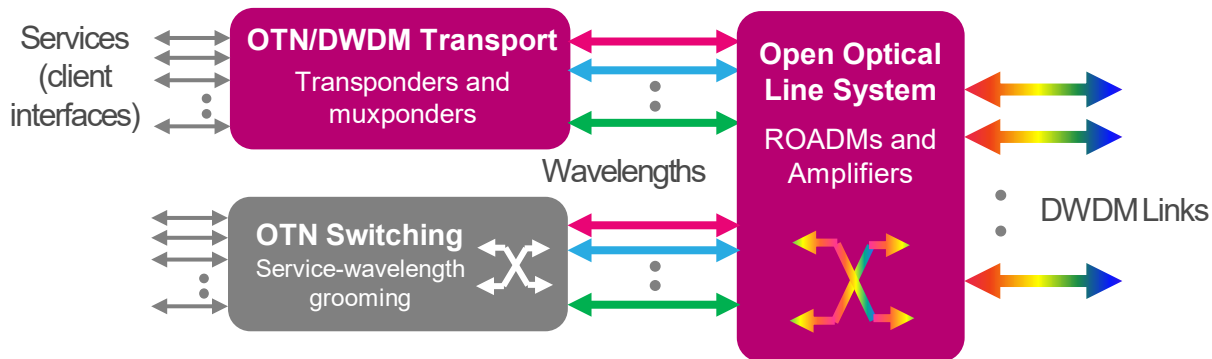
**9904X
2.8T**



**9914
5.6T**



**9932
16T**



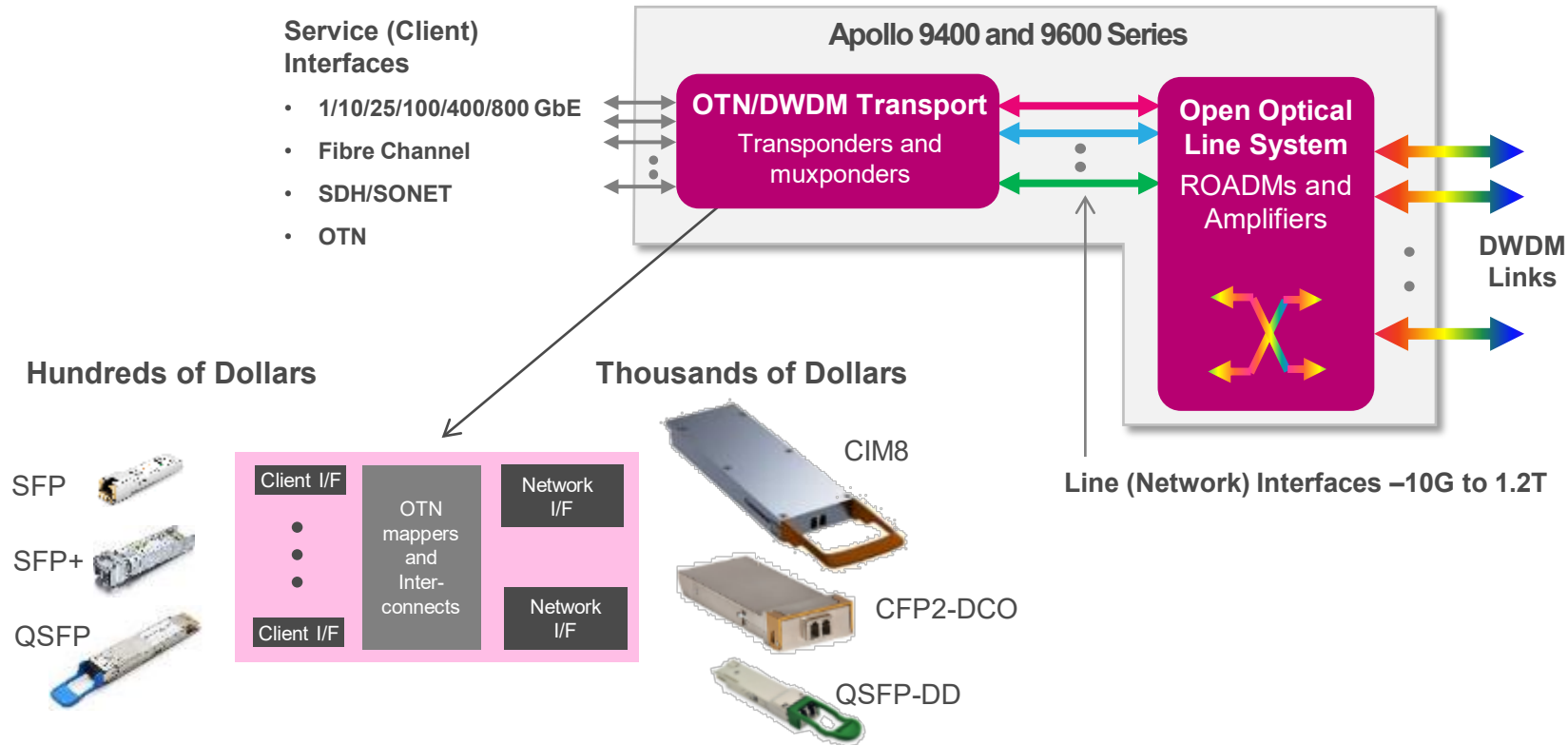
Apollo Capabilities

Capabilities	9400 High Density Transport	9600 Modular Transport	9900 OTN Switching
Service (client) interfaces	100/400GbE OTU4	1/10/25/100/400GbE SAN, TDM, OTN	1/10/100GbE SAN, TDM, OTN
Capacity-reach (performance) optimized line interfaces	5nm-140Gbaud 1200G	5nm-140Gbaud 800G	
Low power consumption optimized line interfaces	7nm-64Gbaud 400G	7nm-64Gbaud 400G	7nm-64Gbaud 400G
ROADMs	(Roadmap for 32 degree)	20 degree CDC-F	4-degree
OTN Switching		10G ADM; 400G ADM	400G to 16T
Dynamic Restoration		WSON	ASON
L1 optical encryption	Yes, including options for PQC and QKD key distribution		
Monitoring	Optical performance monitoring and OTDR for fiber health monitoring		

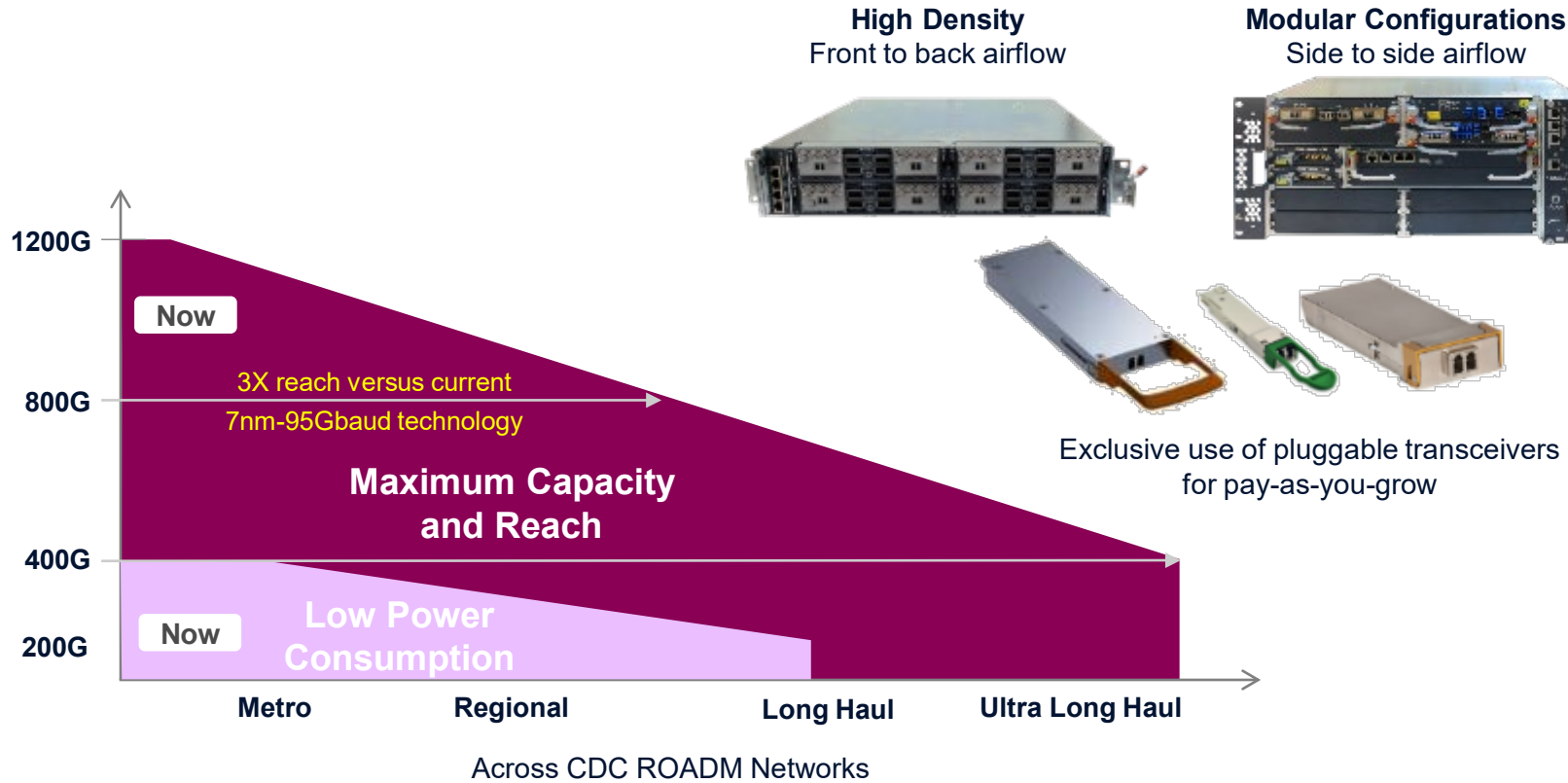


Two Types of Optical Transport Optimization for 100GbE and 400GbE Transport

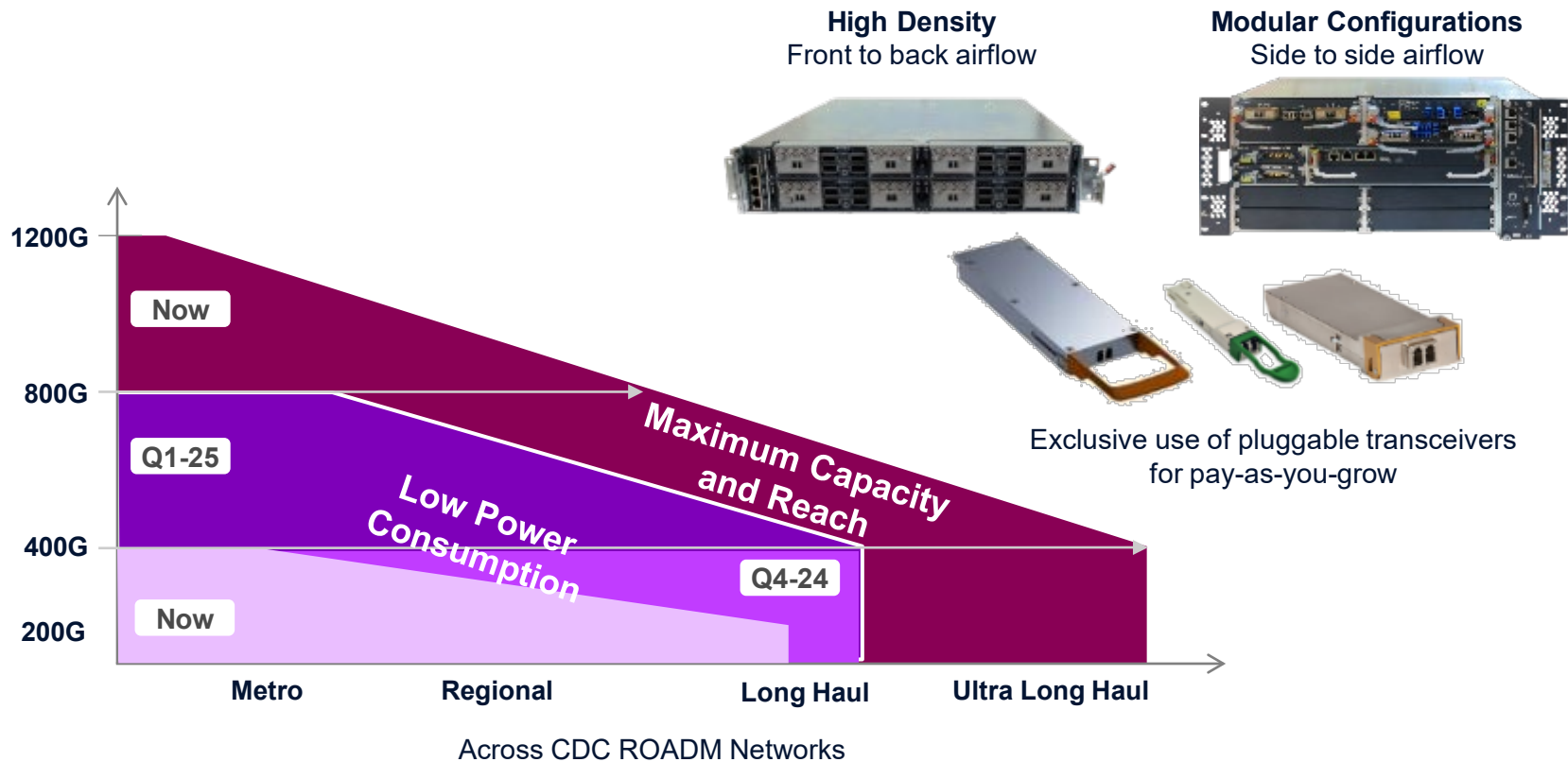
Pluggable Technologies



Suite of Solutions to Fulfill for All Optical Transport Needs



Suite of Solutions to Fulfill for All Optical Transport Needs



Complete Solution Framework for 100GbE and 400GbE Transport

Apollo 9408 High Density Applications



Data Center
600mm deep
F2B airflow

Apollo 9600 Series Modular Applications



Telco
300mm deep
L2R airflow



Capacity-Reach
(Performance)
Optimized



MPJ1200_2
with 2 x CIM8



5nm-140Gbaud
to 1.2T



TM800_2 with 2 x CIM8



5nm-140Gbaud
to 800G

Low Power
Consumption
Optimized



MPQ_8 with 8
x QSFP-DD

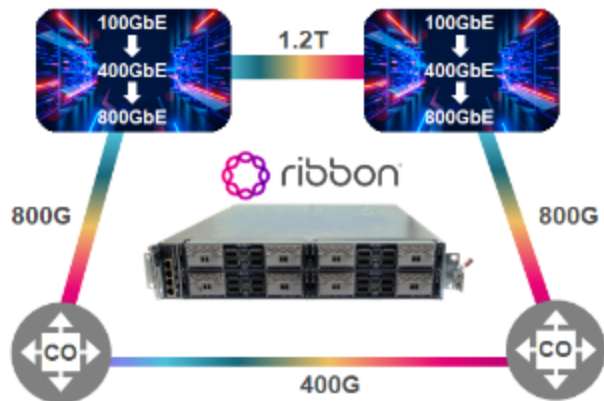
- 0dBm 400G Metro
- Future 800G Metro
- OpenROADM

TM400_2 with 2 x CFP2-DCO



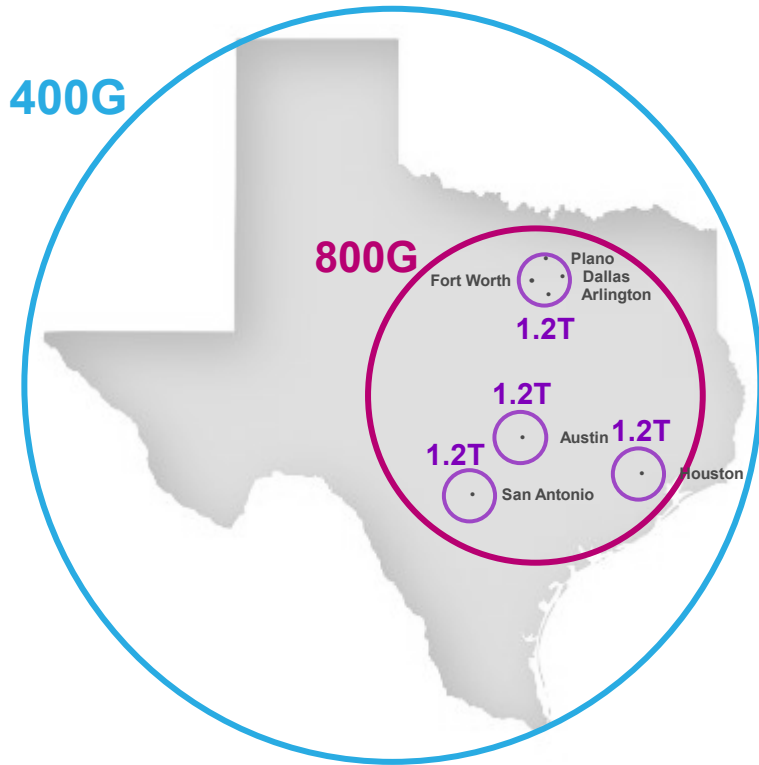
- 0dBm 400G Metro
- Future 400G LH
- OpenROADM

Nx400G Lanes for Transporting 100GbE/400GbE Traffic



Ribbon “breaks down” data center walls with optical network transport of 100GbE, 400GbE and future 800GbE traffic with industry best:

- 1.2T Short Haul (DCI)
- 800G Metro-Regional
- 400G Long Haul



Apollo Alien Wavelengths – Overlay Solution

Proven Operation
over Multiple OLS

Tens to Thousands
of Kilometers

Pluggability for
Pay-as-You-Grow

OpenConfig or
EMS Control



Working over major Optical Line Systems

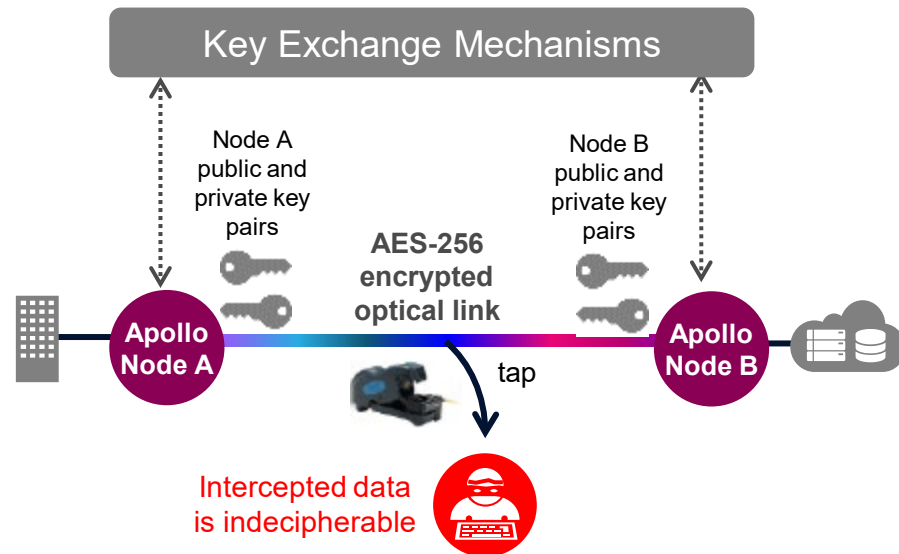
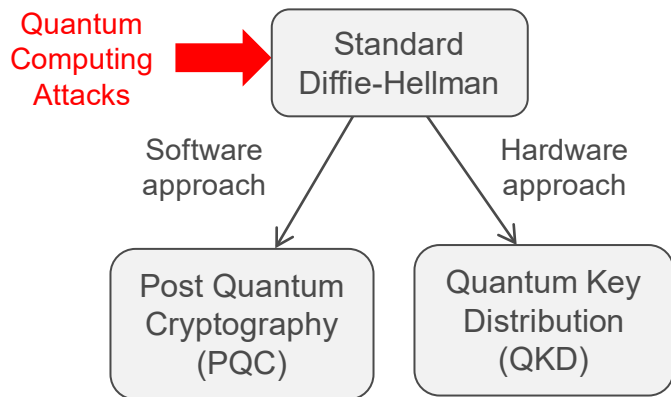
- Adva
- Ciena
- Cisco
- Ericsson
- Fujitsu
- Huawei
- Infinera
- Nokia



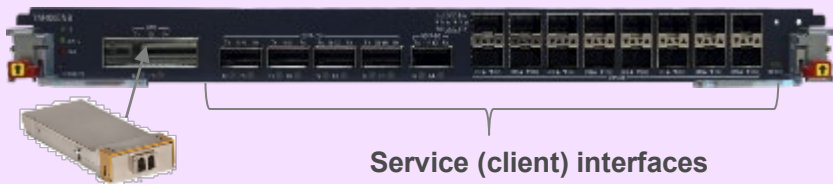
Layer 1 Optical Encryption

Future Proof Layer 1 Optical Encryption

- Protects against data interception via fiber tapping with no added overhead or latency
- Non-crackable AES-256 encoding
- New key exchange mechanisms to deal with threat posed by quantum computing



TM400ENB: 400G Multiservice Encryption Muxponder



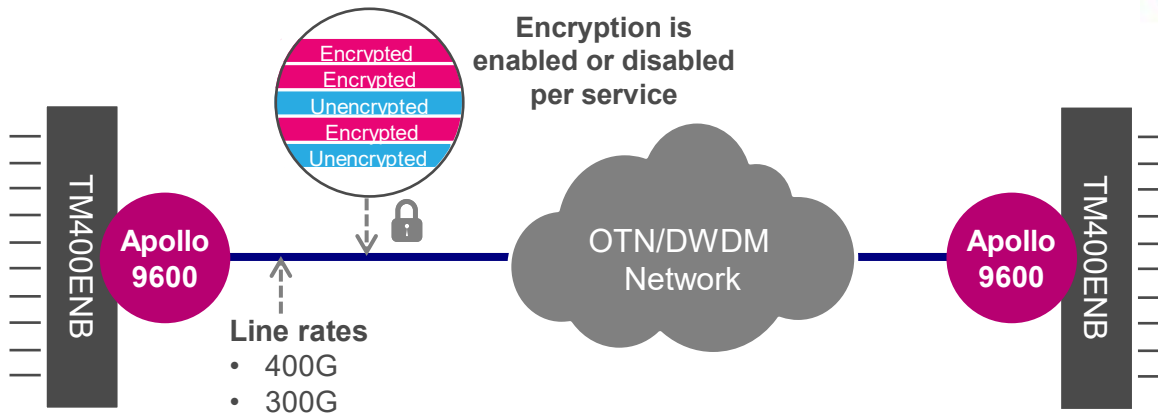
400GZR+ CFP2-DCO

- Delivers 400G capacity multiservice encryption within Apollo's Layer 1 Optical Encryption Solution Framework
- Provides FIPS 140-3 compliancy against physical tampering
- CC EAL4+ compliancy



Multiservice mix

- 10/25/100/400 GbE
- FC 16/32/64
- OTU2/OTU2e
- OTU4





OTN Switching

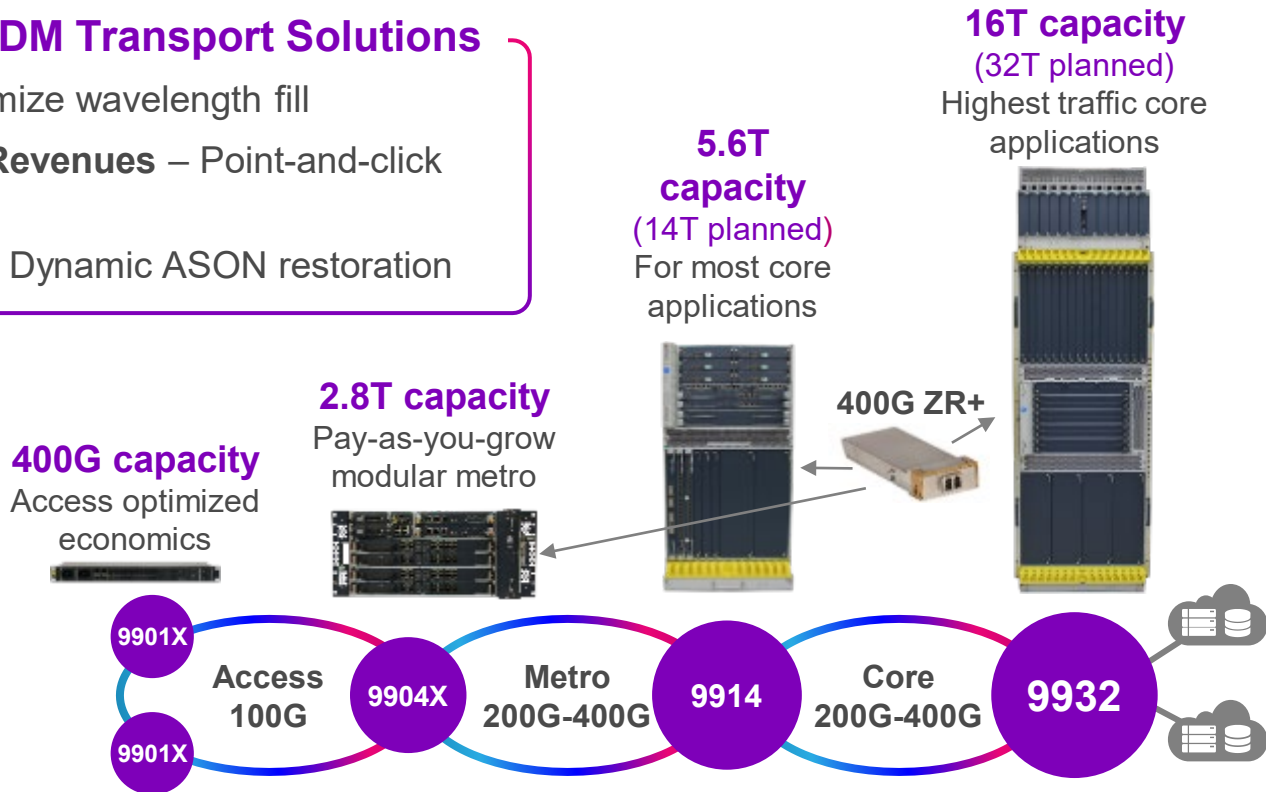
Apollo 9900 Series – Access to Core OTN Switching

Elevates OTN/DWDM Transport Solutions

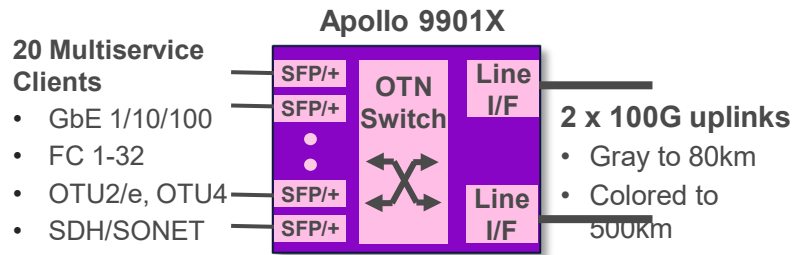
- **Lower Capex** – Optimize wavelength fill
- **Lower Opex/Rapid Revenues** – Point-and-click service provisioning
- **Higher Availability** – Dynamic ASON restoration

Multi-service:

- L1 GbE 1/10/40/100
- L2 GbE 10/100
- Fibre Channel 1-32
- OTU2/2e
- SDH/SONET

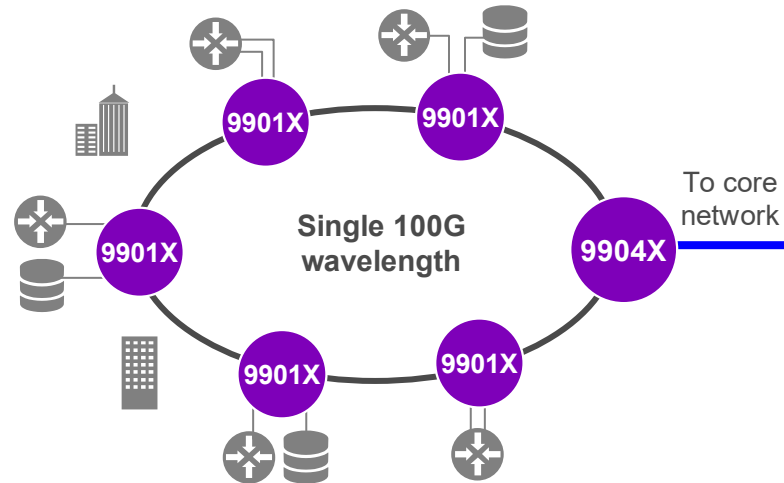


9901X Access OTN Switch



Economical 1U OTN ADM/100G demarcation

- Proves in over about four P2P DWDM muxponder connections
- L1 optical encryption
- Pluggable AC/DC redundant power units
- OpenROADM and OpenConfig compliant
- Auxiliary XFP ports for OTDR or EDFA



Delivering Effortless Service Aggregation

- Point-and-click service provisioning with no network engineering
- All services mapped to a single wavelength
- Any-to-any OTN connectivity
- Advanced protection



Optical Health

Network Health Analysis

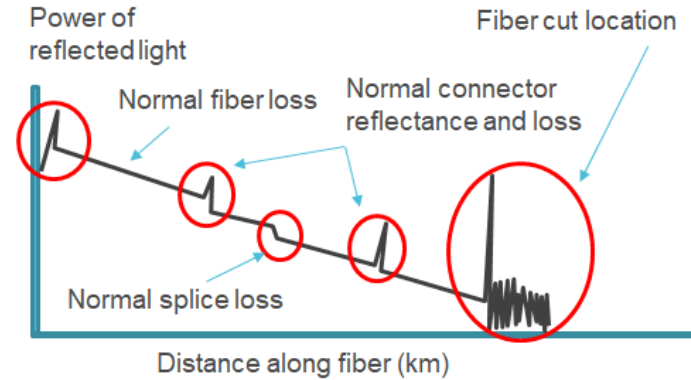
Signal Health

Monitor Optical Channels



Fiber Health

Enhanced OTDR Monitoring



- Detect and address degradations before they become failures
- Rapidly locate and dispatch repair crews to failures



Applying Apollo to Customer Networks

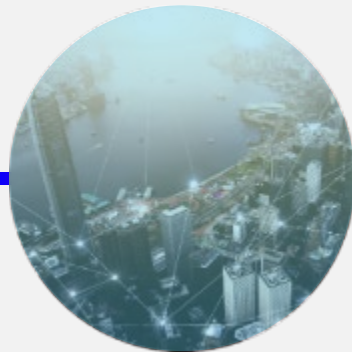
Optical Network for All Network Operator Types

Service Providers

- Telco
- Broadband
- Cellular
- MSO/Cable
- Carrier-of-carrier

Private Networks

- Critical infrastructures like utilities, transportation
- Research and education networks
- Defense networks
- Enterprises
- Cloud



Applying Apollo Optical Solutions

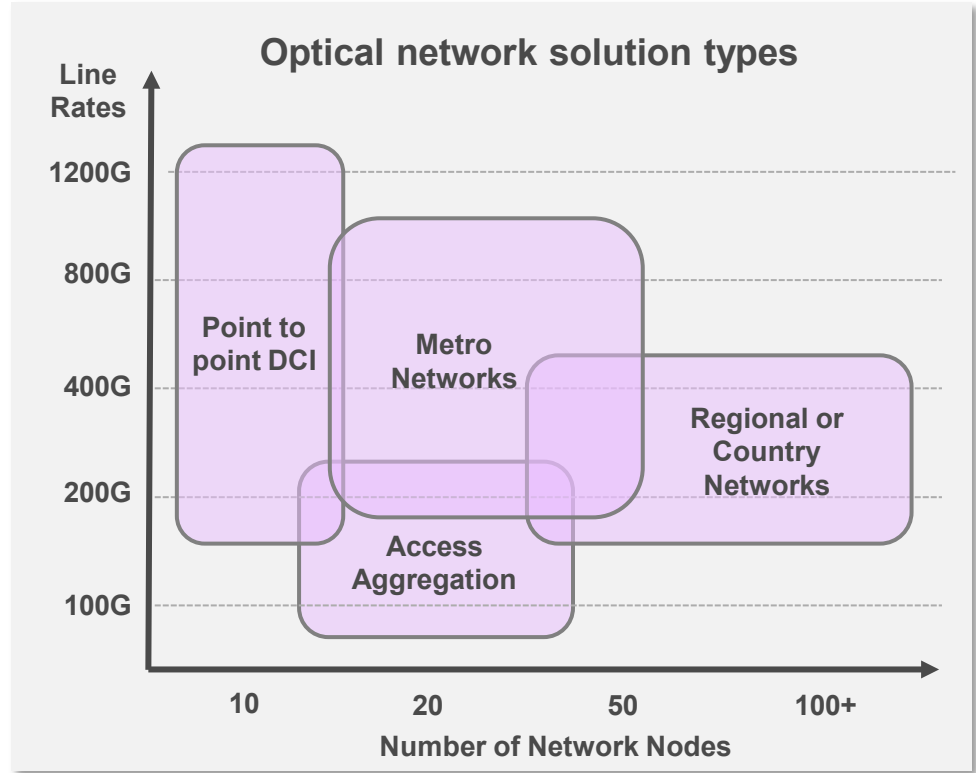
Service Providers

- Telco
- Broadband
- Cellular
- MSO/Cable
- Carrier-of-carrier

Private Networks

- Critical infrastructures like utilities, transportation
- Research and education
- Defense
- Enterprises
- Cloud

Customer optical networking needs typically can be mapped into **four types** of optical networks



Applying Apollo Optical Solutions

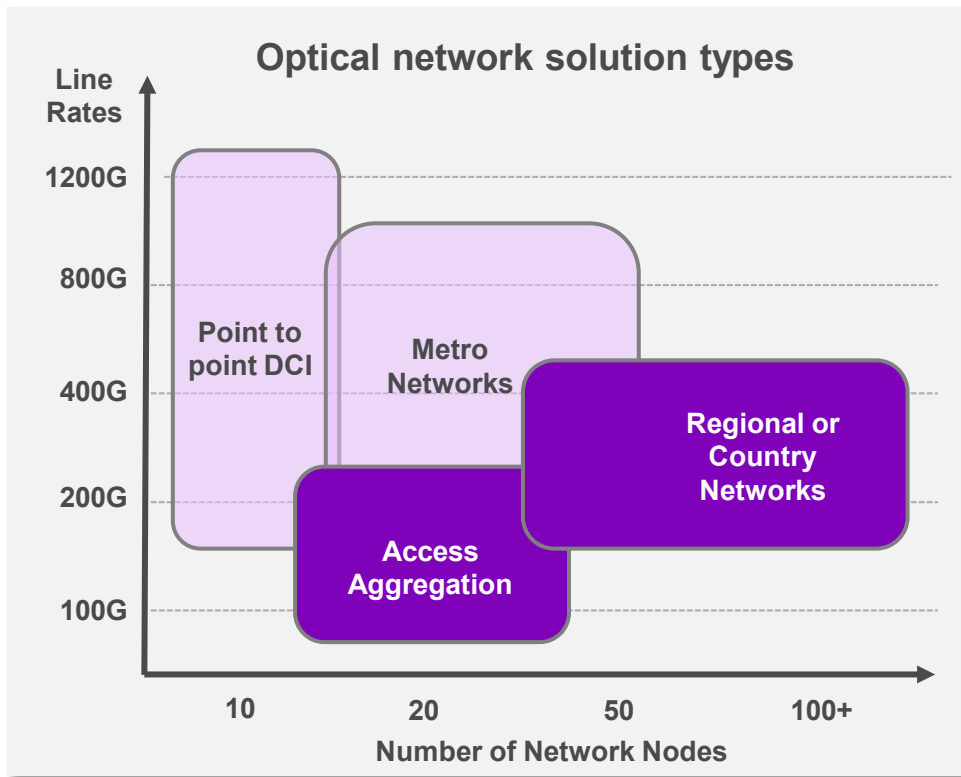
Service Providers

- Telco
- Broadband
- Cellular
- MSO/Cable
- Carrier-of-carrier




Private Networks

- Critical infrastructures like utilities, transportation
- Research and education
- Defense
- Enterprises
- Cloud

Customer optical networking needs typically can be mapped into **four types** of optical networks

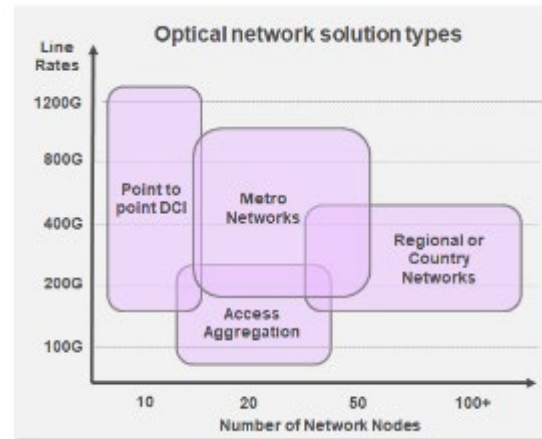


Applying the Apollo Portfolio

OTN/DWDM Transport		OTN Switching	
9400 Series High Capacity Applications	9600 Series Tailored Applications	9900 Series Scalable OTN switching	
 OT9400 OLS9408 (2024)	<ul style="list-style-type: none">Rich set of optical transmission and line system cards, usable across all platforms without engineering rulesTelco and data center  9603 9608/D 9624	<ul style="list-style-type: none">Optimize wavelength fillPoint-and-click provisioningDynamic ASON restoration  9901X 9904X 9914 9932 400G 2.8T 5.6T 16T	



The Apollo portfolio can be optimized for each solution type



Apollo Solutions Building Blocks Summary

Solution Type	OTN/DWDM Transport		Optical Line Systems	OTN Switching
	Capacity-Reach Optimized	Power Consumption Optimized		
	9400 Series – High density solutions 9600 Series – Modular solutions			9900 Series
Access Aggregation		200G: CMR200 TM200EN 10G: AoC10C TR10_12R		9901X
Point to point DCI	1.2T: MPJ1200_2 800G: TM800_2	400G: MPQ_8 TM400_2 TM400ENB/R		
Metro Networks	400G: TM800	200G: TR200_2	EDFA & Raman amplifiers 4 - 20 degree ROADMs with multiple CDC-F options	9904X
Regional/LH Networks	400G: MPJ1200_2 TM800_2 200G: TM800		OTDR cards	9914 9932



Use Cases

Auto Manufacturer Private Optical Network

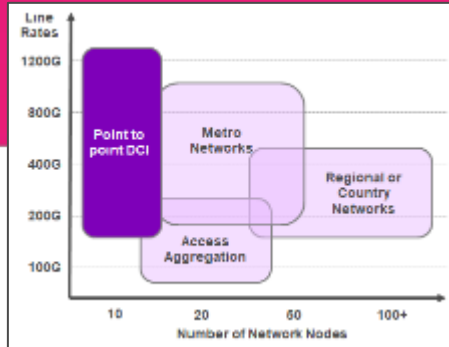
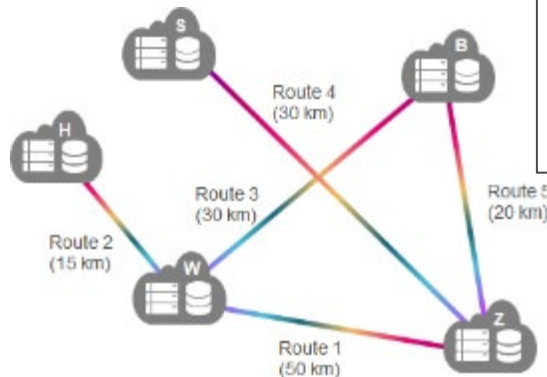
Needed to implement multiservice private data center networking over dark fibers

Why Ribbon

Met many customer requirements:

- **Multiservice:** Ethernet and Fibre Channel
- **Low latency** for synchronous data replication
- Routes doubling for **redundancy** against failures
- Selective Layer 1 **Optical Encryption** on Fibre Channel Links
- **Fiber health** monitoring with OTDR

Worked closely with channel partner and SP who supplied dark fiber



All routes doubled for protection

Services		Routes				
		#1	#2	#3	#4	#5
SAN	32G FC	4				
	16G FC	24				
LAN	100 GbE	5				
	10 Gb	5	1	1	1	1
	1 GbE	6	1	1	1	1

Viaero Wireless

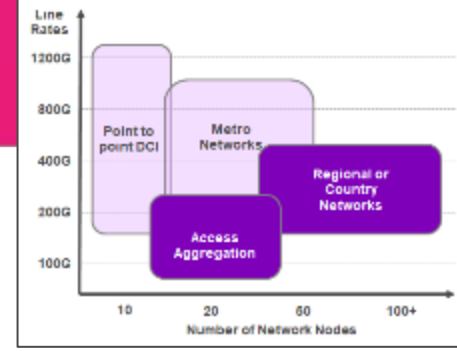
USA Mobile Network Operator

Mobile network operator with over 1M customers needed to migrate from microwave to fiber, to increase capacity and facilitate selling mobile backhaul services to other MNOs like AT&T, VZ and T-Mobile.

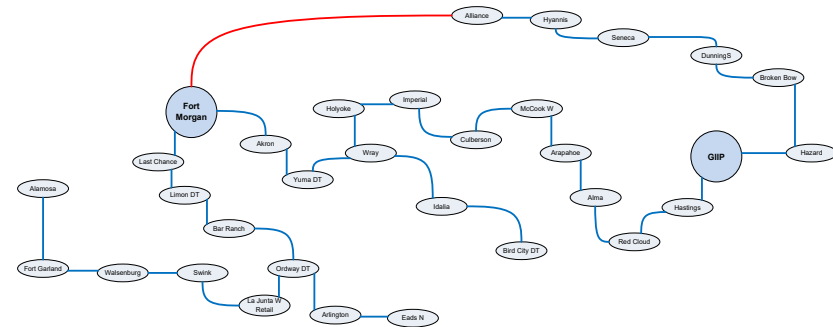
Why Ribbon

Integrated IP Optical multilayer solution managed through a **single pane of glass**

- 1G and 10G services aggregation with MPLS backhaul transport
- 200G DWDM optical backbone easily scalable to 400G, with ROADMs at each site
- Integrated optical performance monitoring
- Fiber health management with OTDR



10th largest MNO in USA by area, covering Colorado, Kansas, Nebraska, and Wyoming



Electric Power Utility Network Modernization

Needed to modernize its IP Optical network to support much higher bandwidths required by internal operations

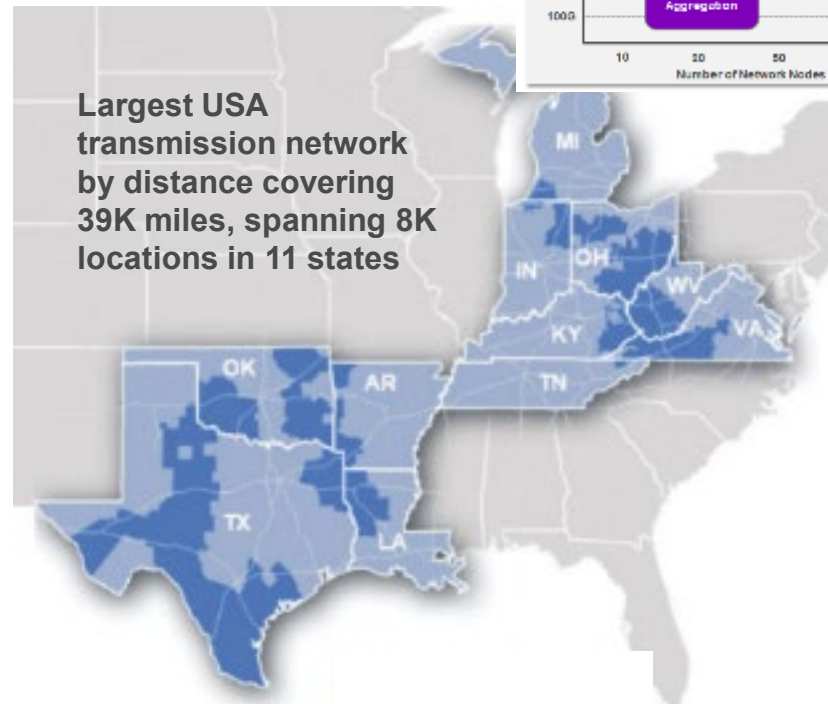
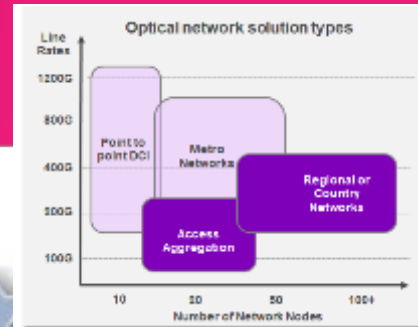
Why Ribbon

Multilayer End-to-End Solution

- Multiple NPT platform types for layer 2 & 3 OT/IT and SCADA services
- OTN switching for dynamic restoration
- 400G DWDM transport smoothly evolvable to 800G

Most cost effective 5 years TCO

White gloves services and commitments for service SLA



Apollo – Connecting the World with Light



Powerful

10G to 1.2T



Modular

Precisely meets customer needs



Intelligent

Advanced SDN features



Open

Multivendor solutions



ribbon

TECH FORUM 23