



Bandwidth Virtualization with Digital Optical Networks

Drew Perkins, CTO
dperkins@infinera.com
408-572-5308

Infinera Summary

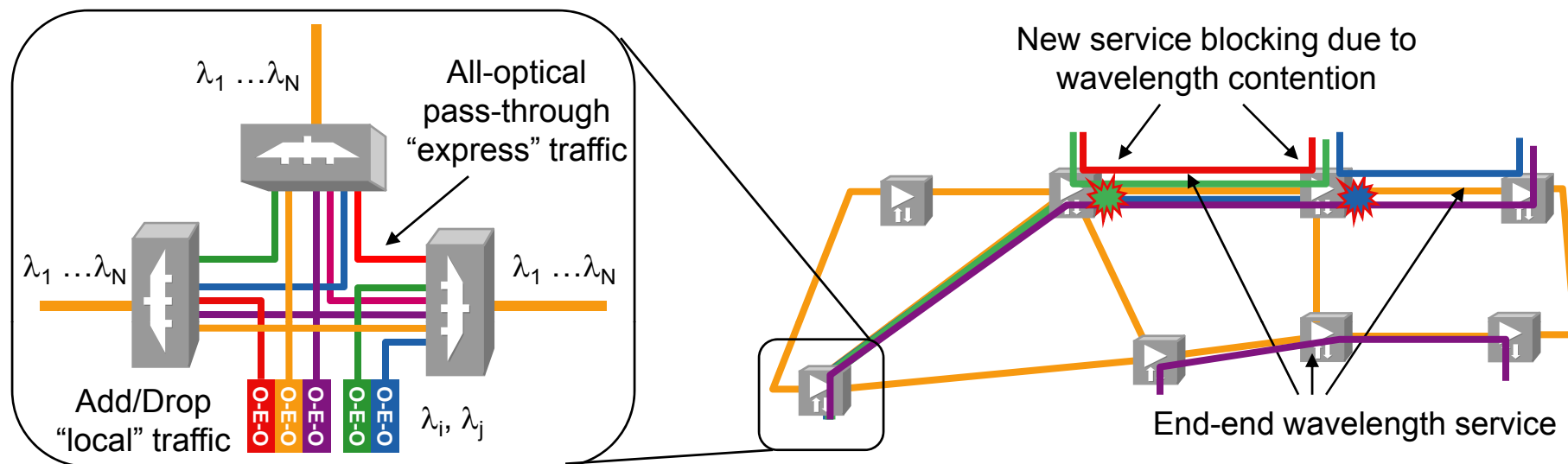
- Optical communications systems
- Core innovation:
Photonic Integrated Circuits
- A contrarian approach
 - “Digital Optical Networks”
 - PICs allow pervasive use of electronics in the optical layer to improve network economics and virtualize bandwidth
 - Infinera vertically integrates the PIC
- Rapidly winning footprint
 - Carriers, Cable operators, Internet content providers, Gov’t, R&E, and others
 - 1H07 sales: \$135.7M
 - 300% Y-Y growth vs. 1H06



Inside the Optical Network: Three Key Functions



All-Optical Networking with ROADMs



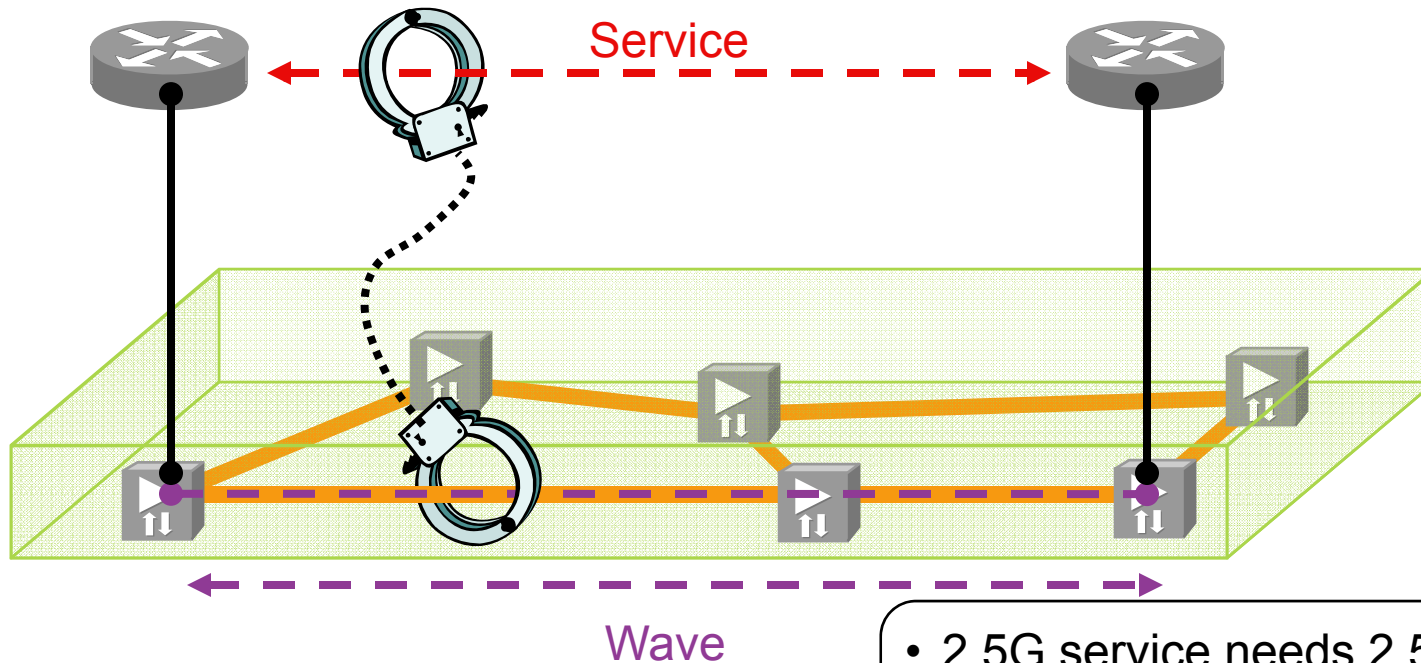
- All-optical wavelength switching using filters, ROADMs, WSS, etc.
- OEO only for local add/drop
- No sub-wavelength add/drop
- No wavelength inter-wavelength
- No digital PM or OAMP
- End-end services over wavelengths
- Wavelength contention and blocking
 - *Incremental* OEO for λ -conversion = hidden CapEx premium
- Service limited by wavelength path
 - Optical reach
 - Number of (R)OADM nodes passed
 - Fiber characteristics

ROADMs limited by all-optical implementation

Conventional DWDM Couples Services to Waves

The service is coupled to the wave, and *inherits the associated problems*

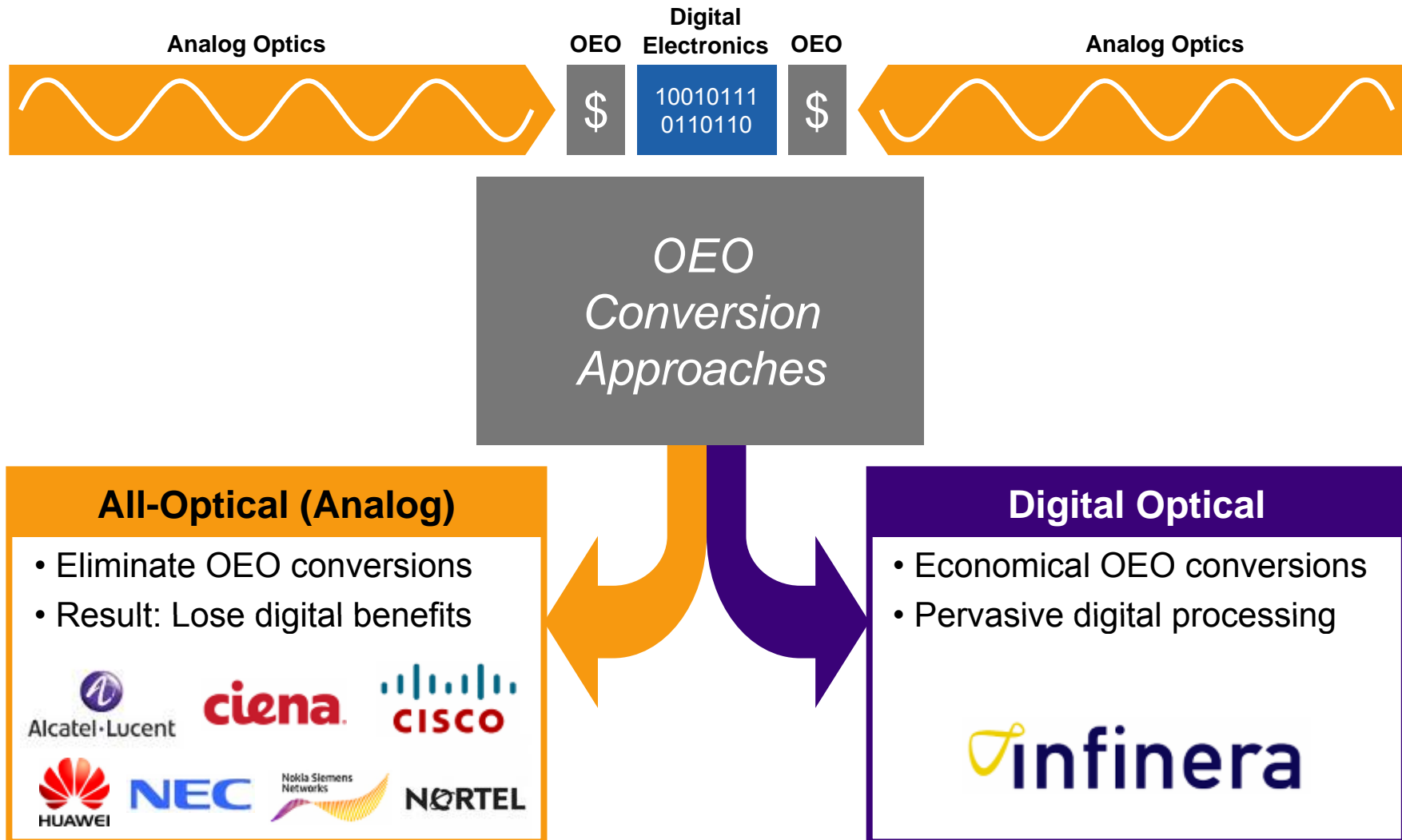
Can the network handle the datarate? Wave blocking? Dispersion? Optical power? Regen? Protection? etc.



 = ROADM or WSS

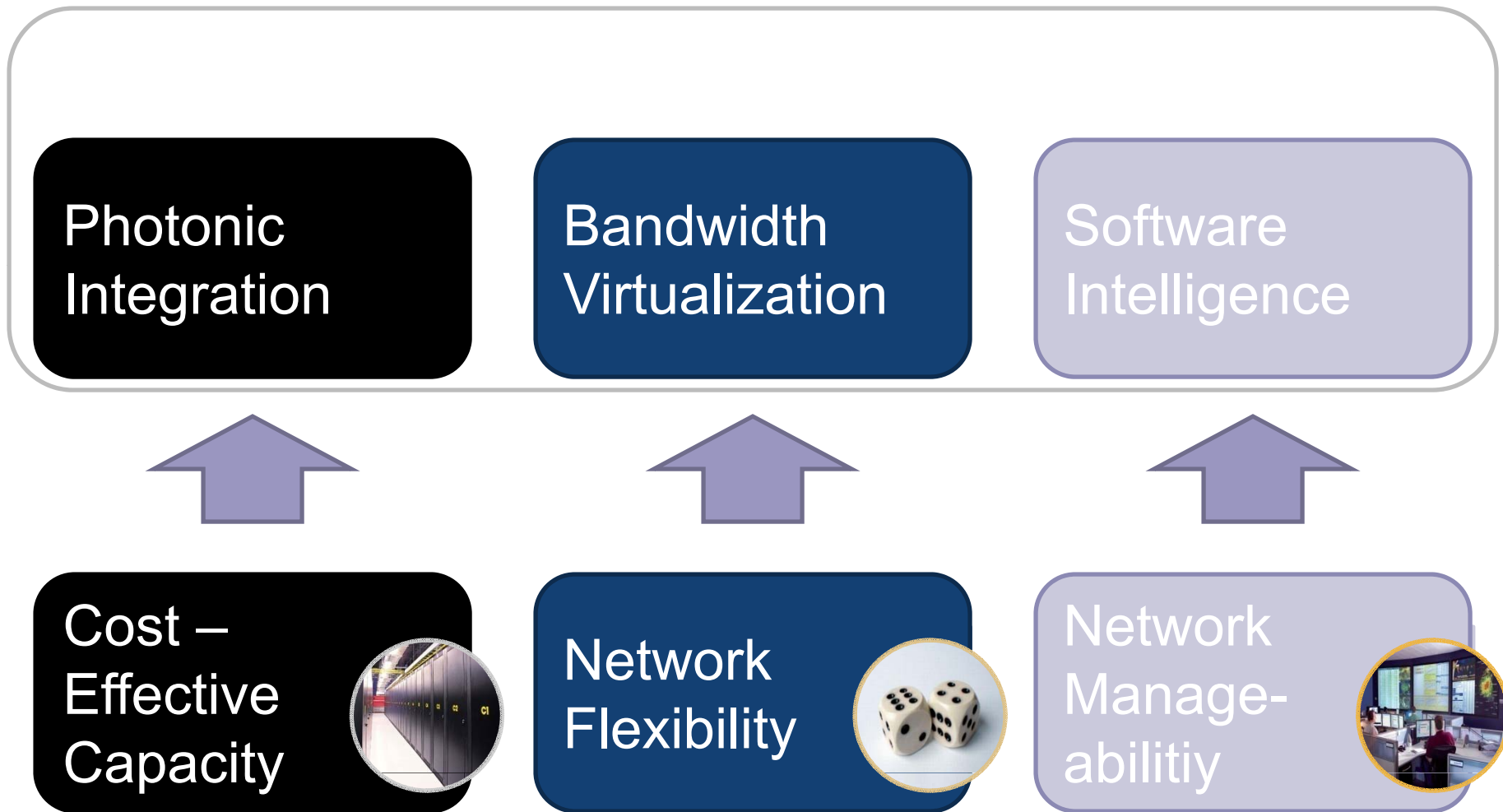
- 2.5G service needs 2.5G wave
- 10G service needs 10G wave
- 100G service needs...???

Infinera's Contrarian Approach to OEO

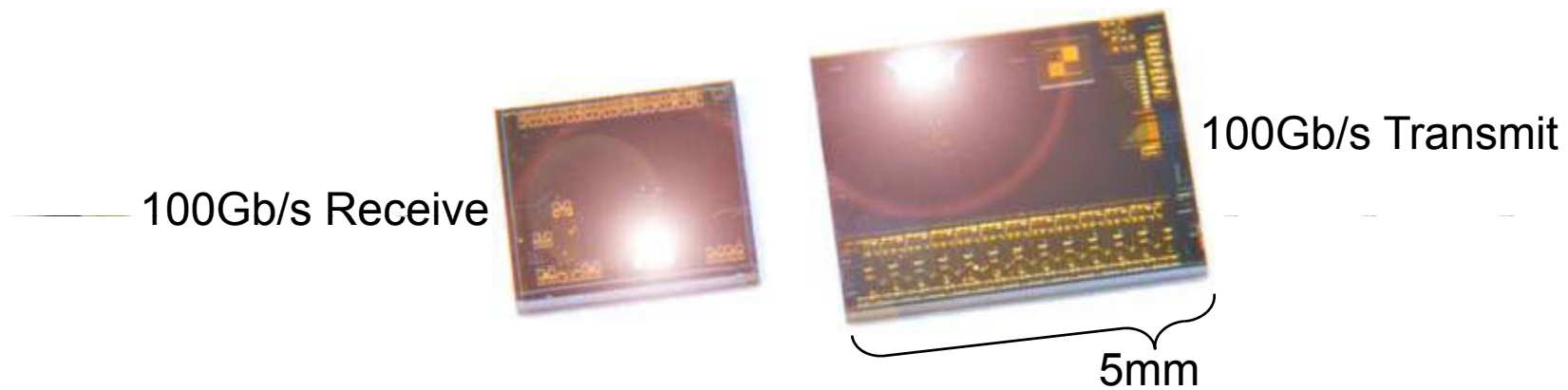


GENI Concerns

Digital Optical Network Solutions

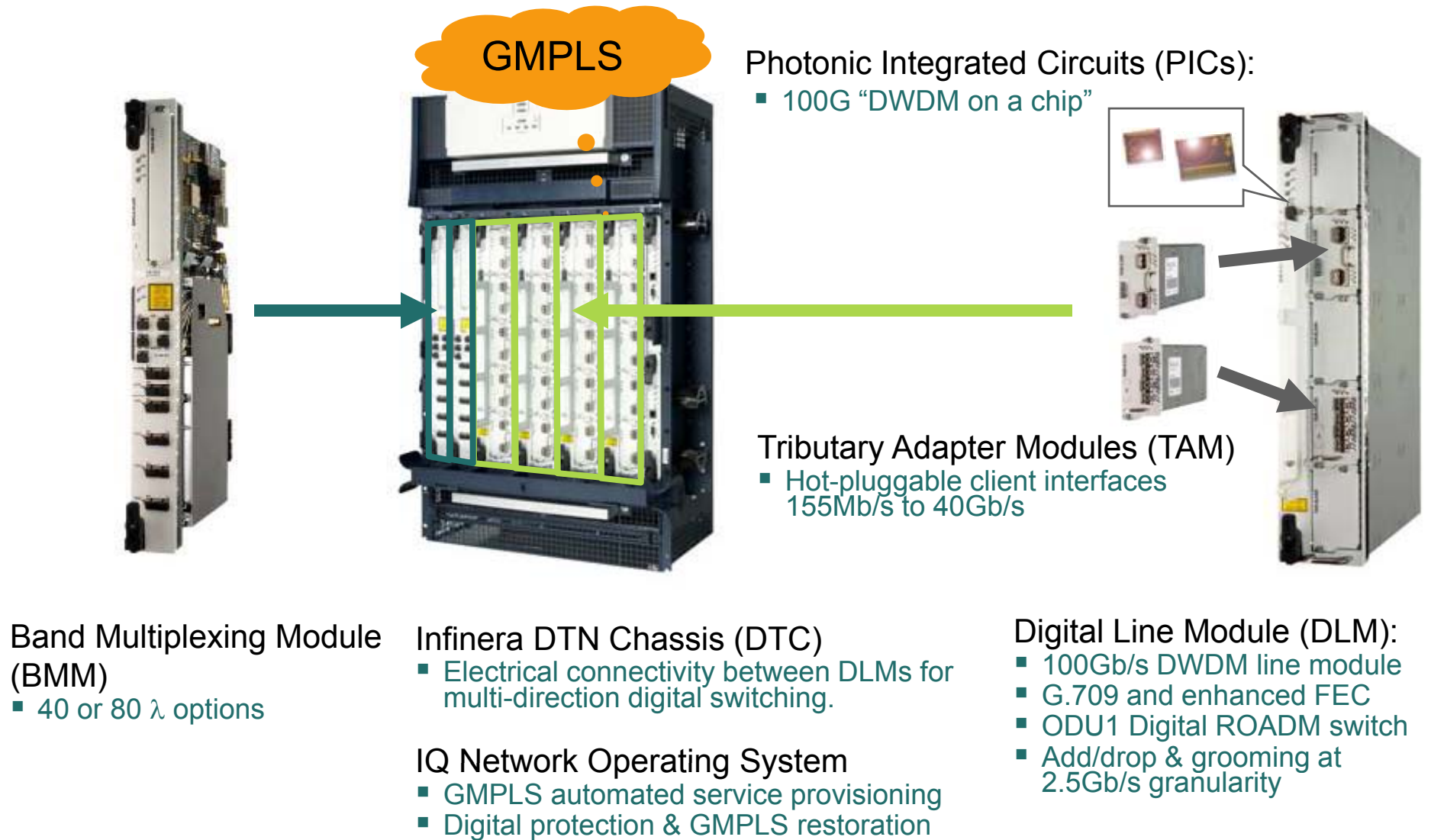


How to Reduce OEO Costs? Photonic Integration



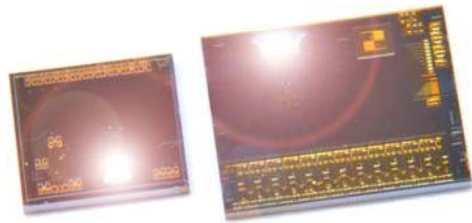
- Improves cost, space, power, reliability
- Makes digital processing economical

Infinera DTN Overview



Photonic Integration and Digital Optical Networks

Photonic Integrated Circuits

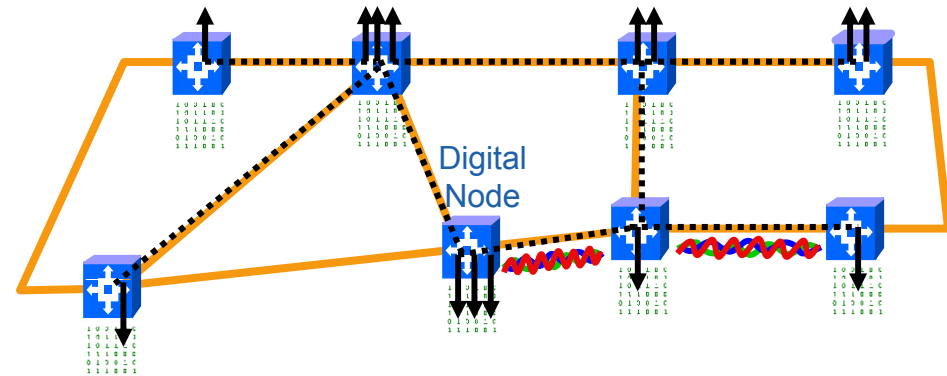


100Gb/s Receive

100Gb/s Transmit



Digital Optical Networks



Don't Eliminate
OEO...Make it
Cheaper

Photonic
Integrated
Circuits

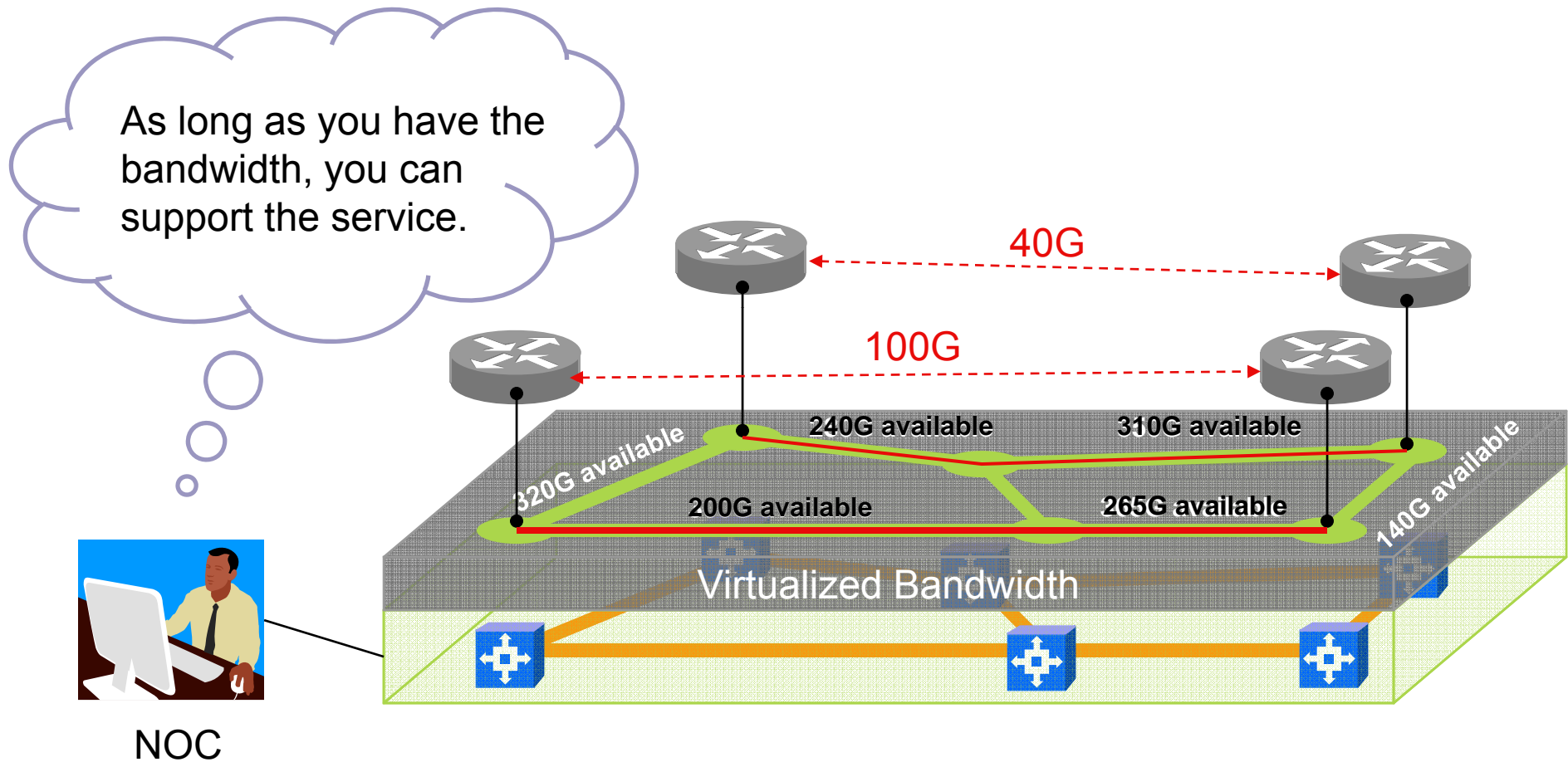
Direct Benefits:

- Lower cost OEO
- Lower power
- Higher density
- More reliable
- Fewer line cards
- Simpler system design

Strategic Benefits:

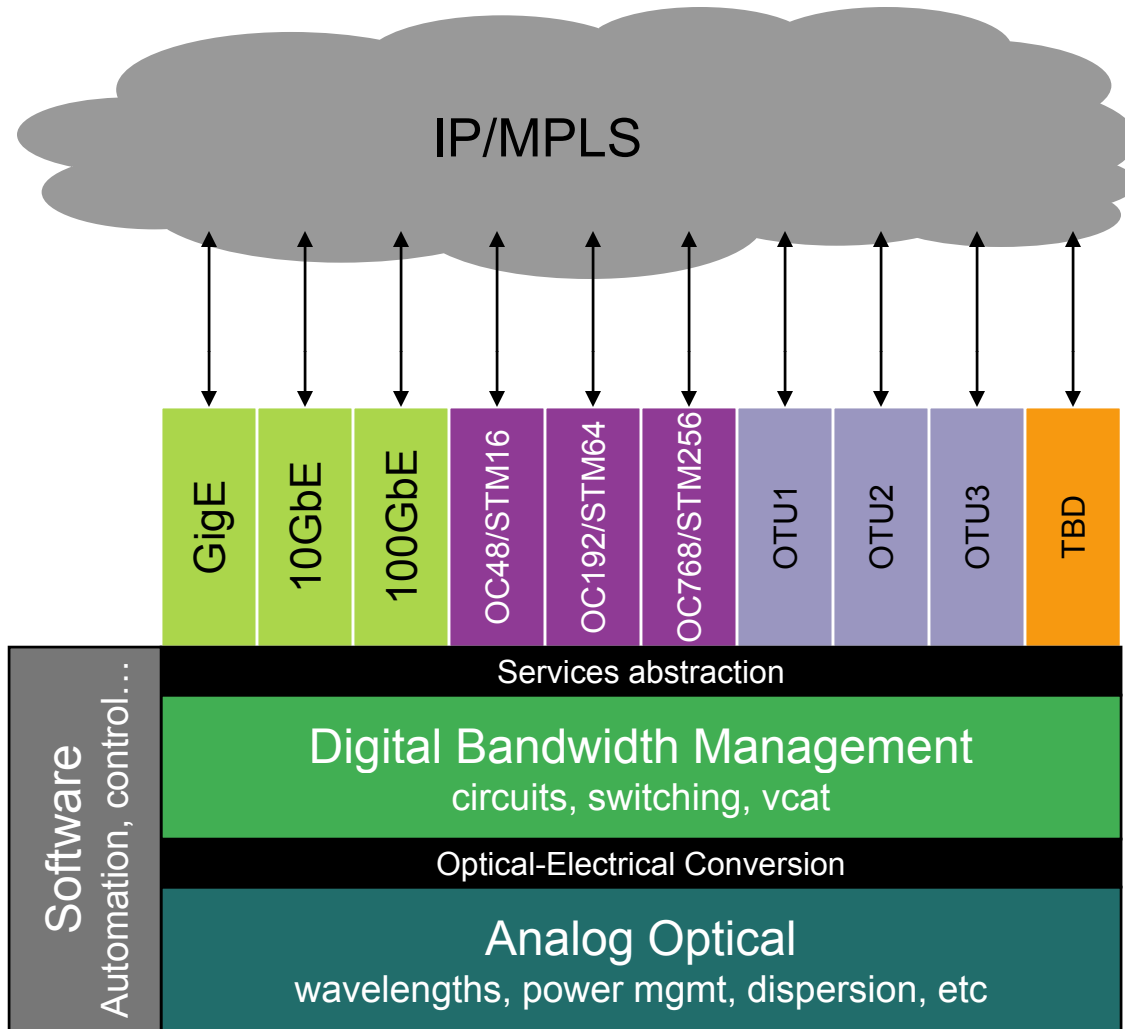
- Maximize service access
- Digital feature richness at every node
- Software intelligence
- Simplify operations
- Increase flexibility

Decoupling Transport Services from Waves



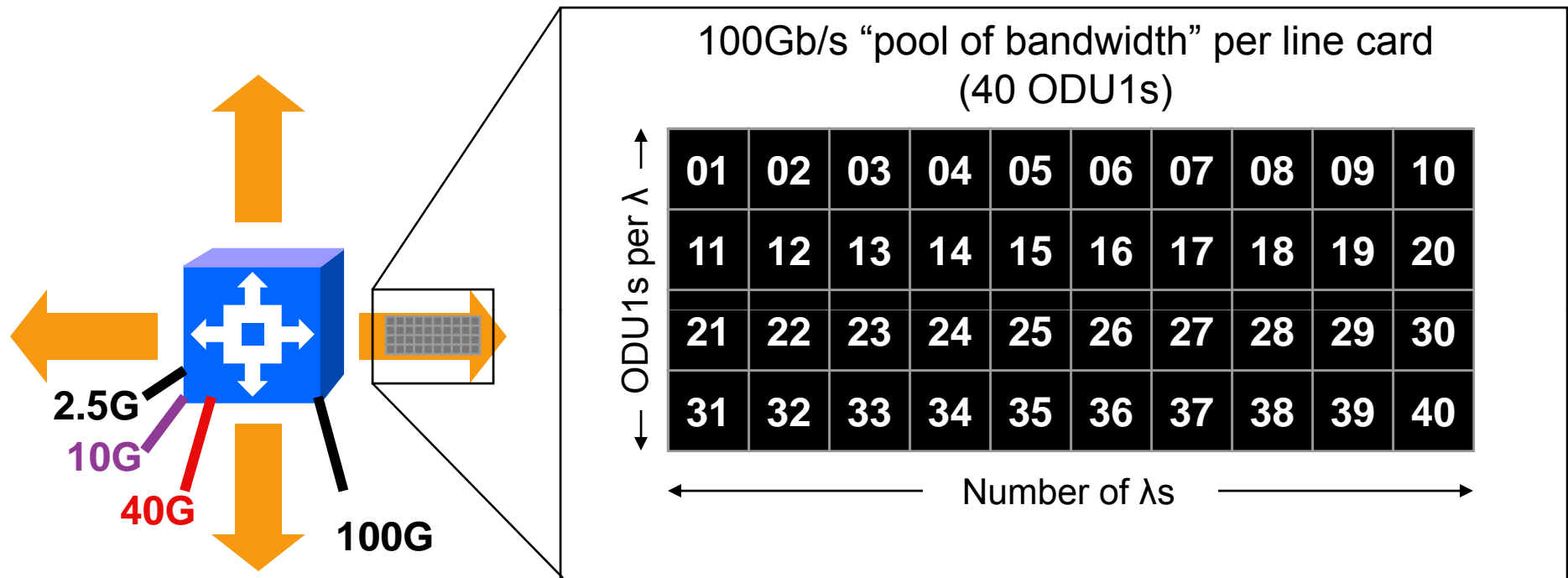
All sites are connected; GMPLS enables Operational simplicity

Open Service Architecture



- “Services” not “Wavelengths”
- Decouple the transport infrastructure from the services
 - Sub-lambda
 - Lambda
 - Super-lambda
 - Ethernet (GigE → 100GbE), SDH/SONET, OTN

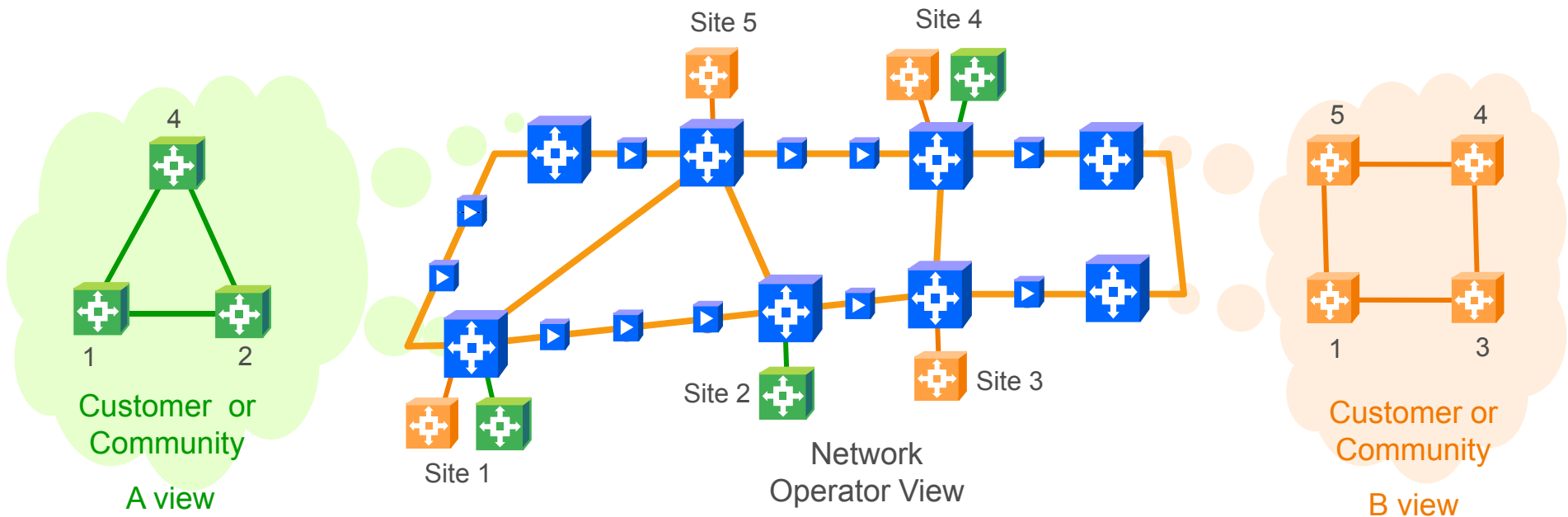
Digital Bandwidth Management w/ GMPLS



- Enables fractional services (e.g., Fractional 100 GbE)
- GMPLS fully automates bandwidth management

Layer1 VPN - Overview

Multiple virtual transport networks on a shared physical network



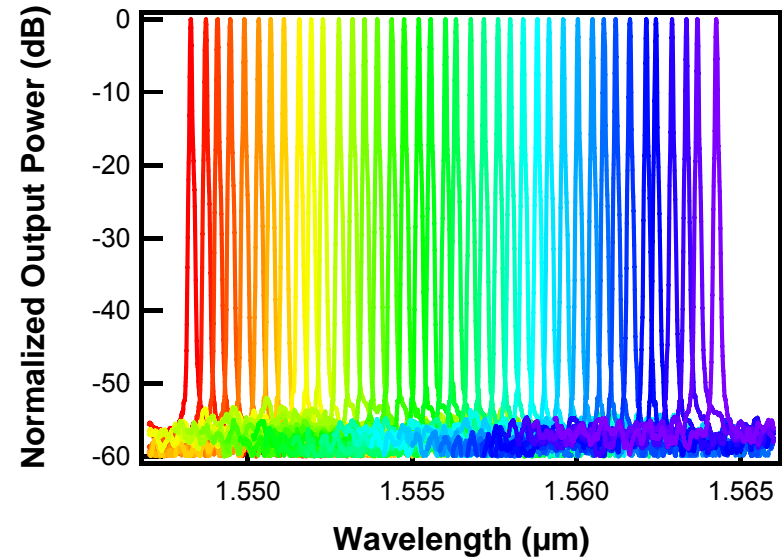
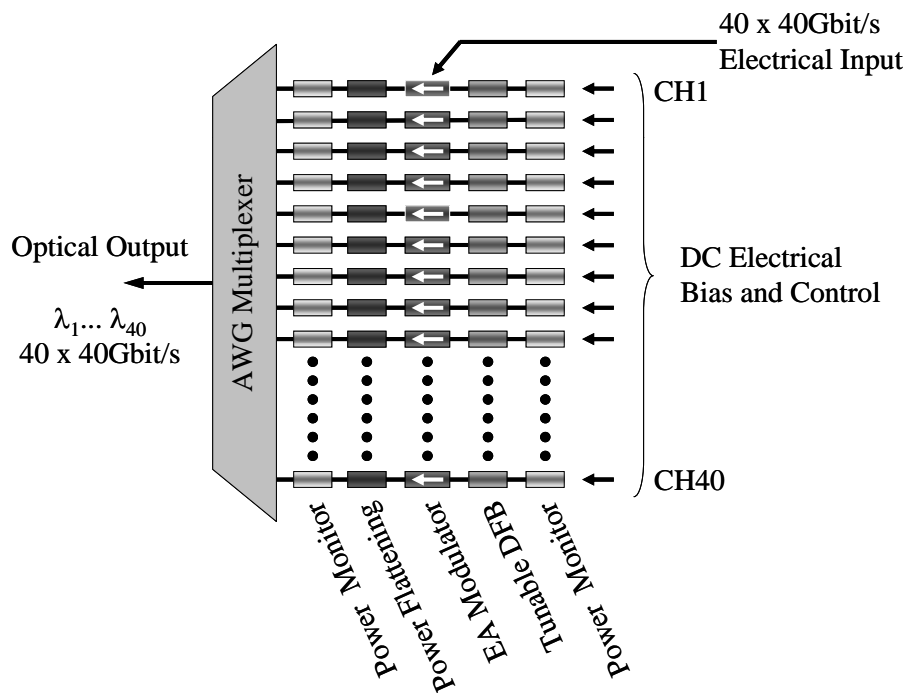
L1VPN - Characteristics

- Data plane isolation from other customers
- Management and control plane separation
- User-controlled circuit provisioning

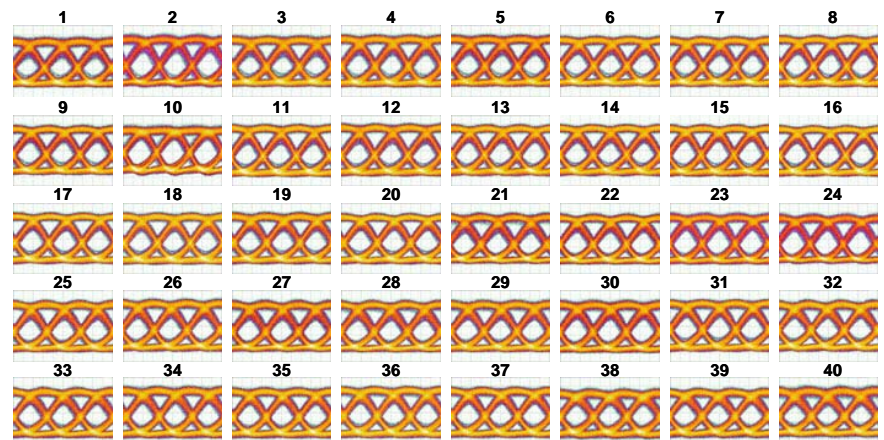
Key Applications

- Alternative to separate networks
- Separate administrative domains within user community

PIC Allow Scaling Beyond 100G: 1.6Tbit/s DWDM Large-Scale PIC Transmitter

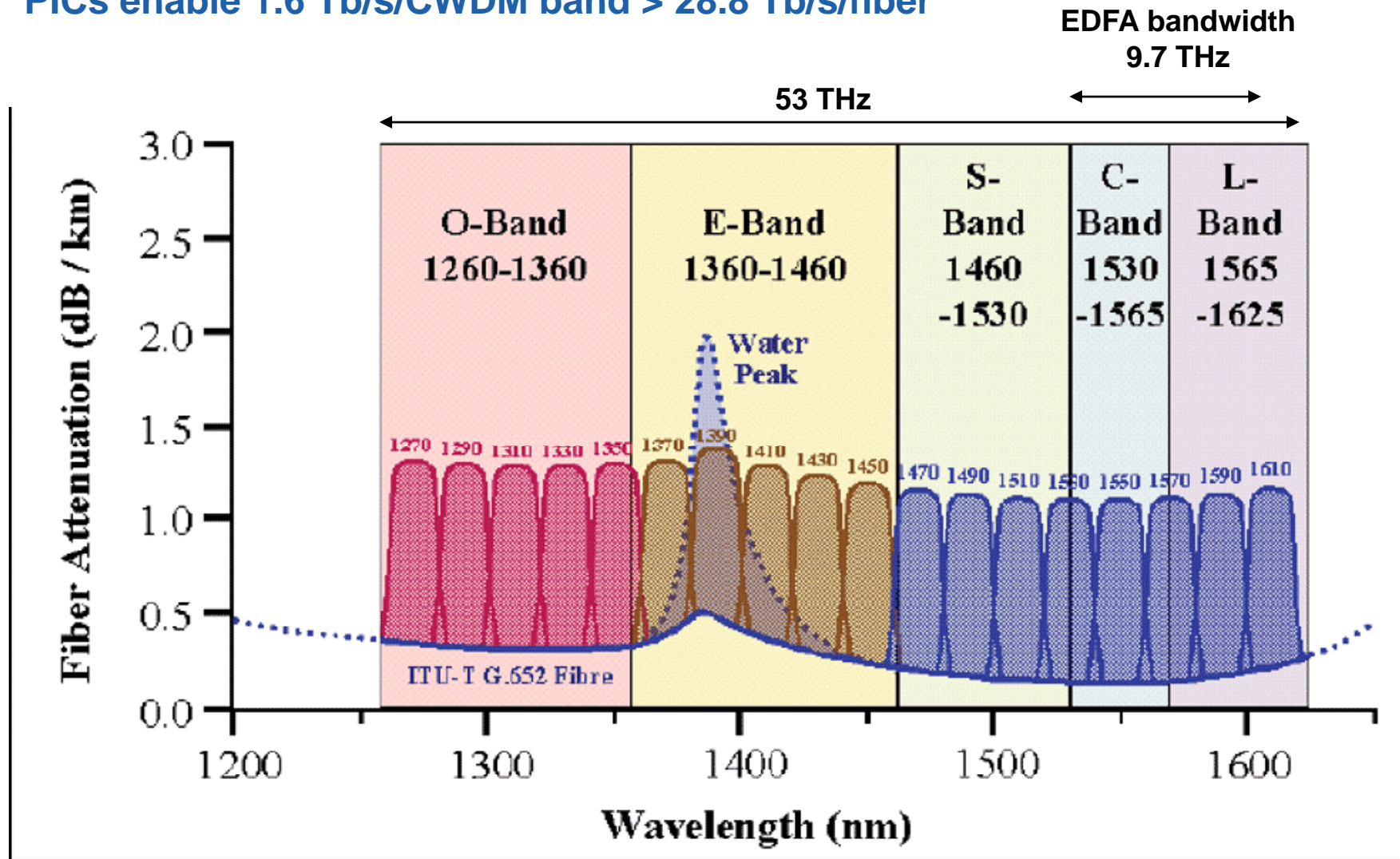


...40 channels x 40 Gb/s



PICs Enable Ultra High Capacity Networks

PICs enable 1.6 Tb/s/CWDM band > 28.8 Tb/s/fiber





Thank you!

Drew Perkins, CTO
dperkins@infinera.com
408-572-5308