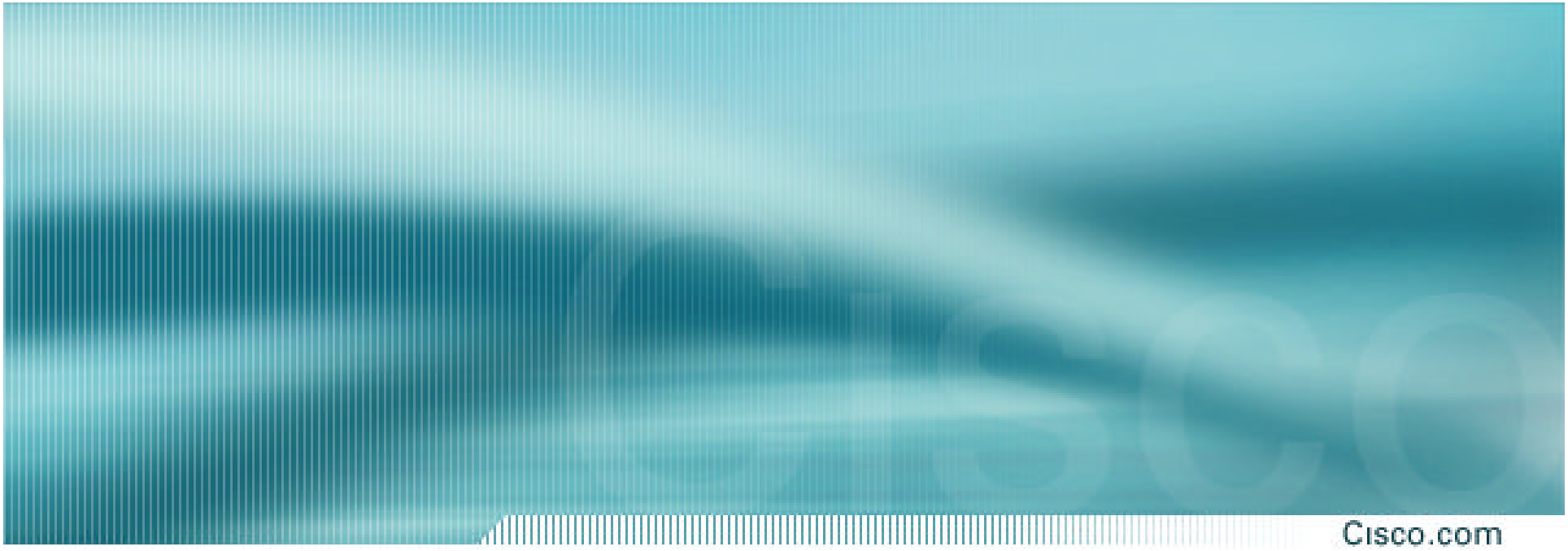

The Future of Optical Networking

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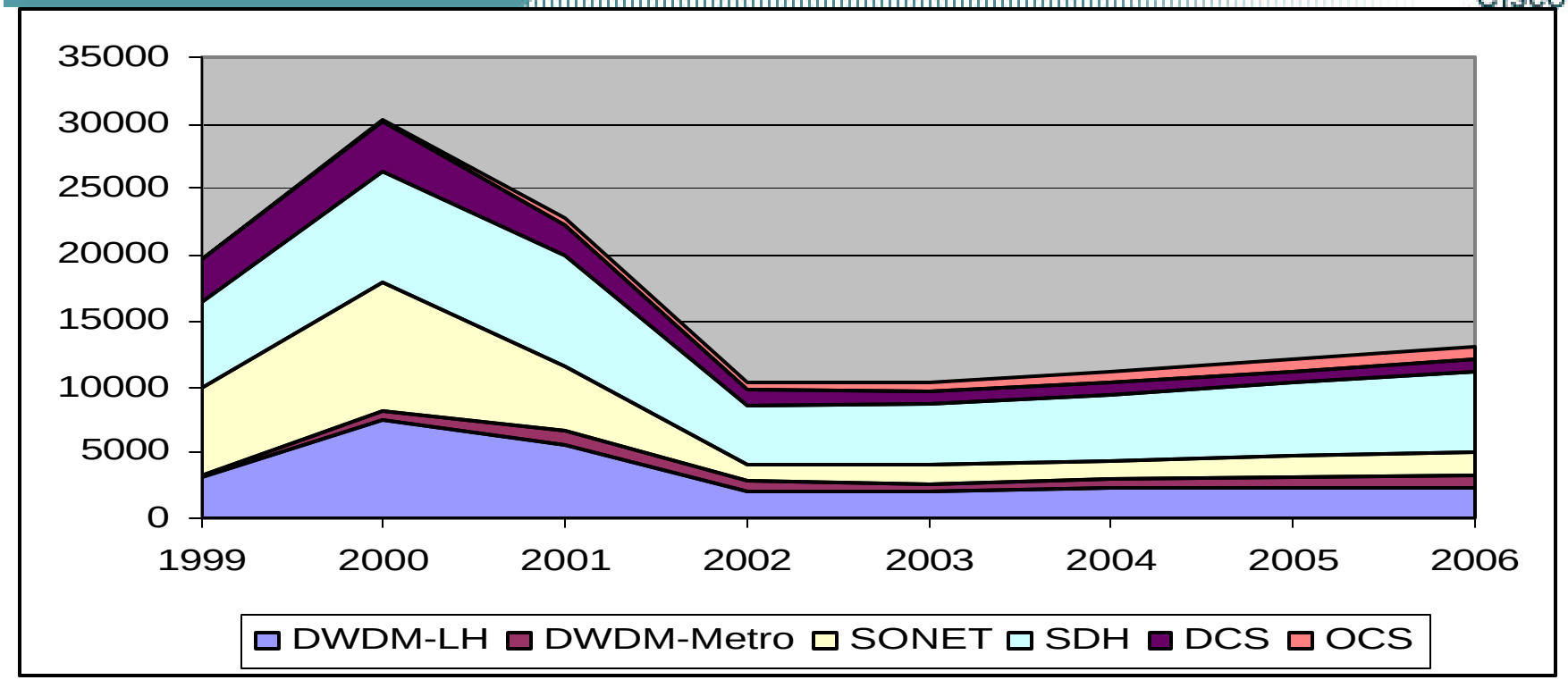
Acknowledgement: Ori Gerstel

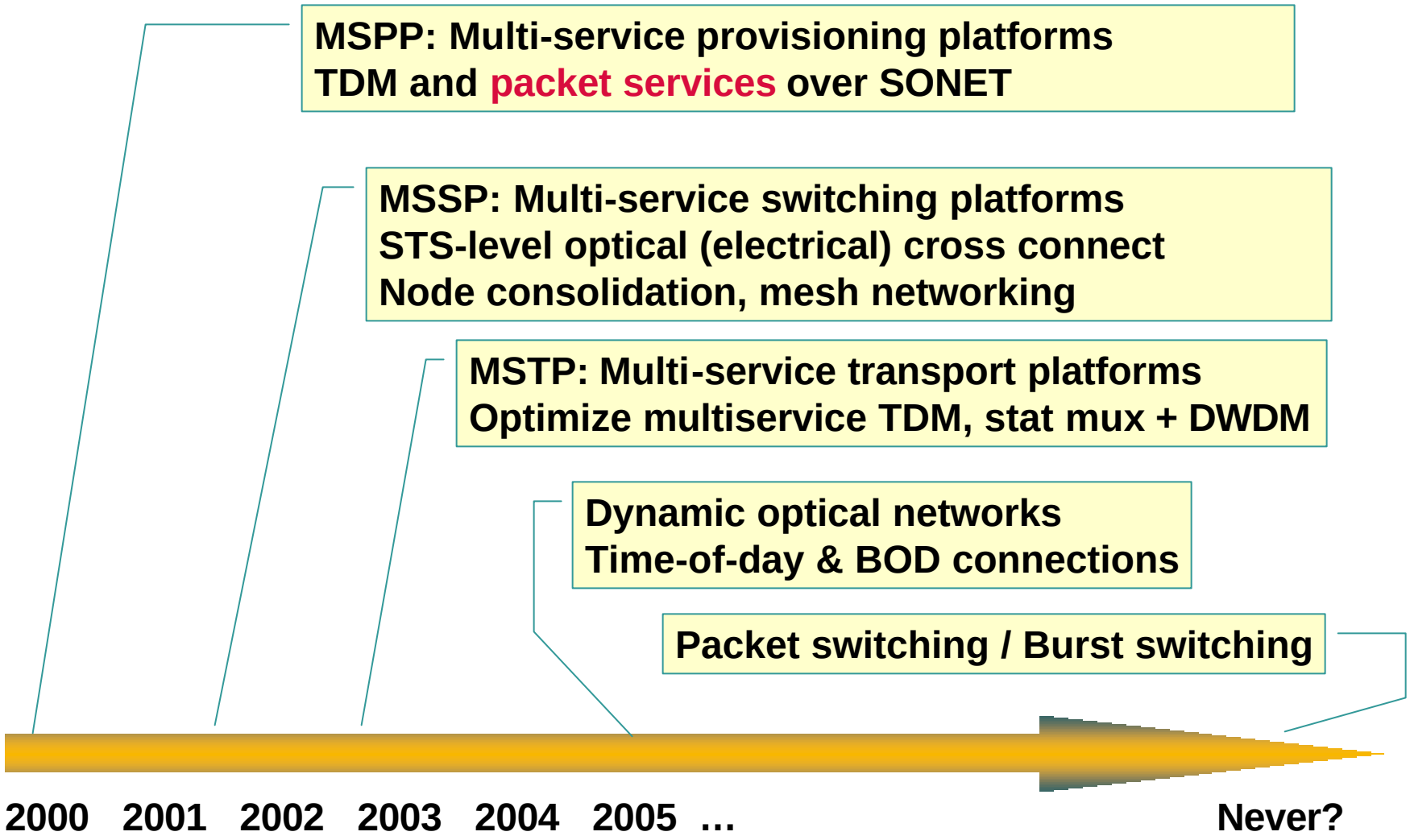
Optical Market Forecast (WW in $M)



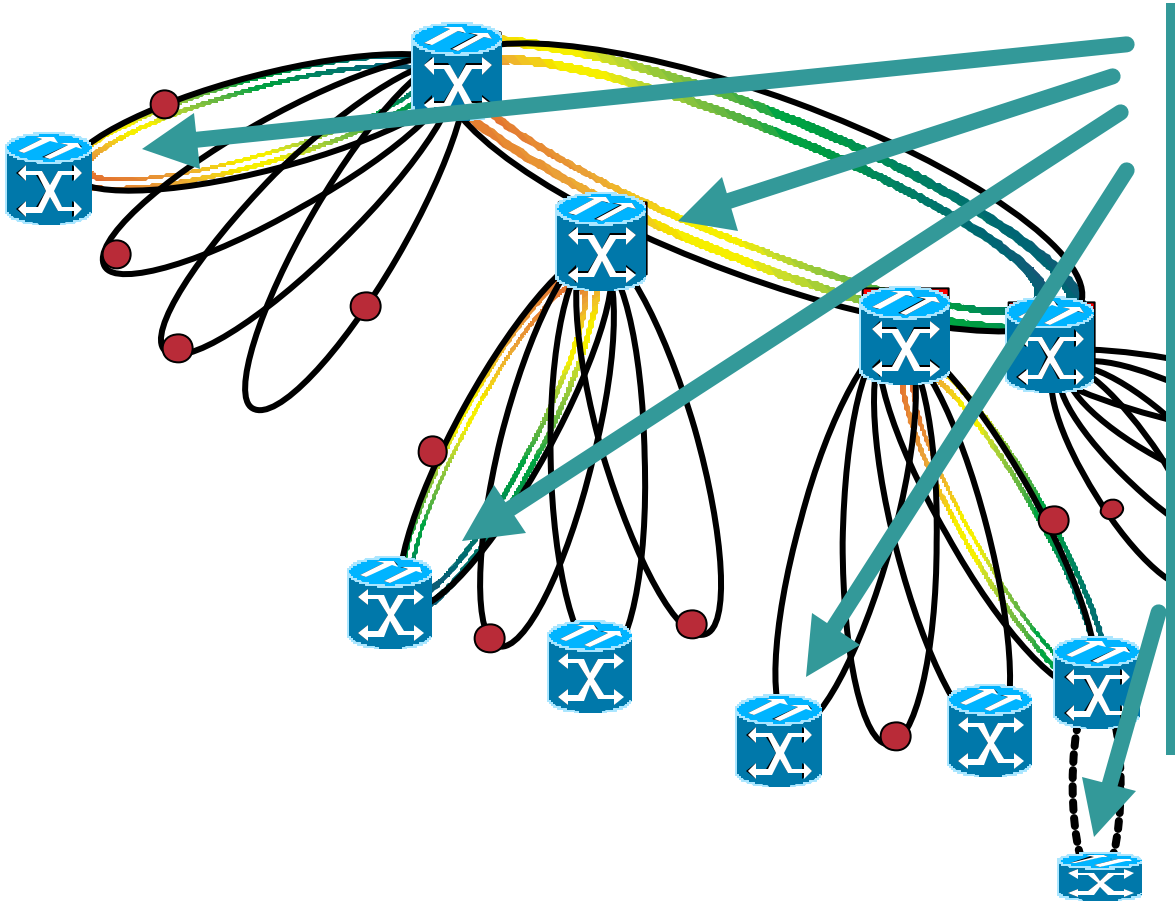
- **Post bubble growth is modest**
- **Capex driven by revenue; metro emphasis**
- **Bulk of spending still in SONET/SDH, not WDM**
- **Industry consolidation**

Technology Adoption in the Network

Cisco.com



MSPP – MSSP – MSTP: how do they fit in?



MSPP

Multiservice Provisioning Platform

DS-1 to OC-192 TDM

10/100Mb and GbE

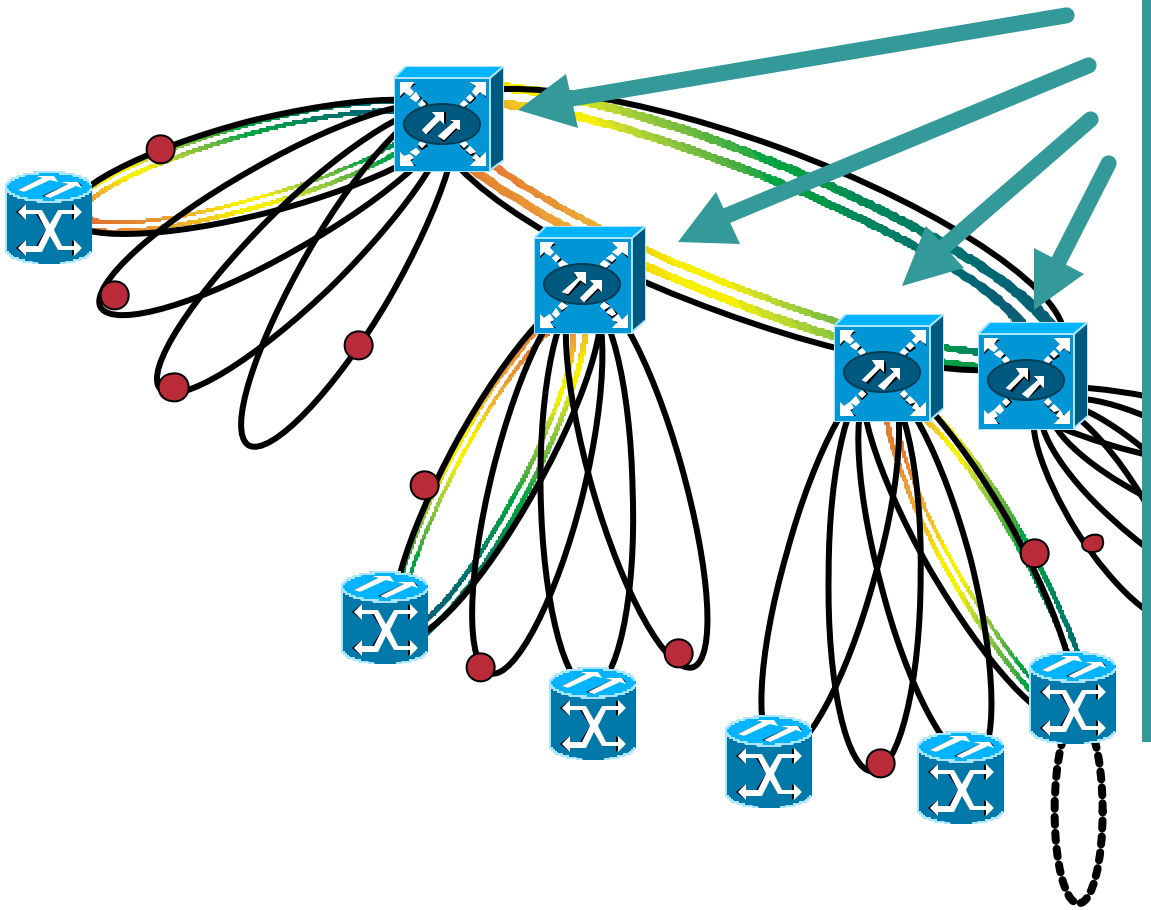
Integrated ITU optics

Access MSPP

DS-1 to OC-48 TDM

10/100Mb and GbE

MSPP – MSSP – MSTP: how do they fit in?



MSSP

Multiservice Switching Platform

320 Gb/s to Multi Tb/s

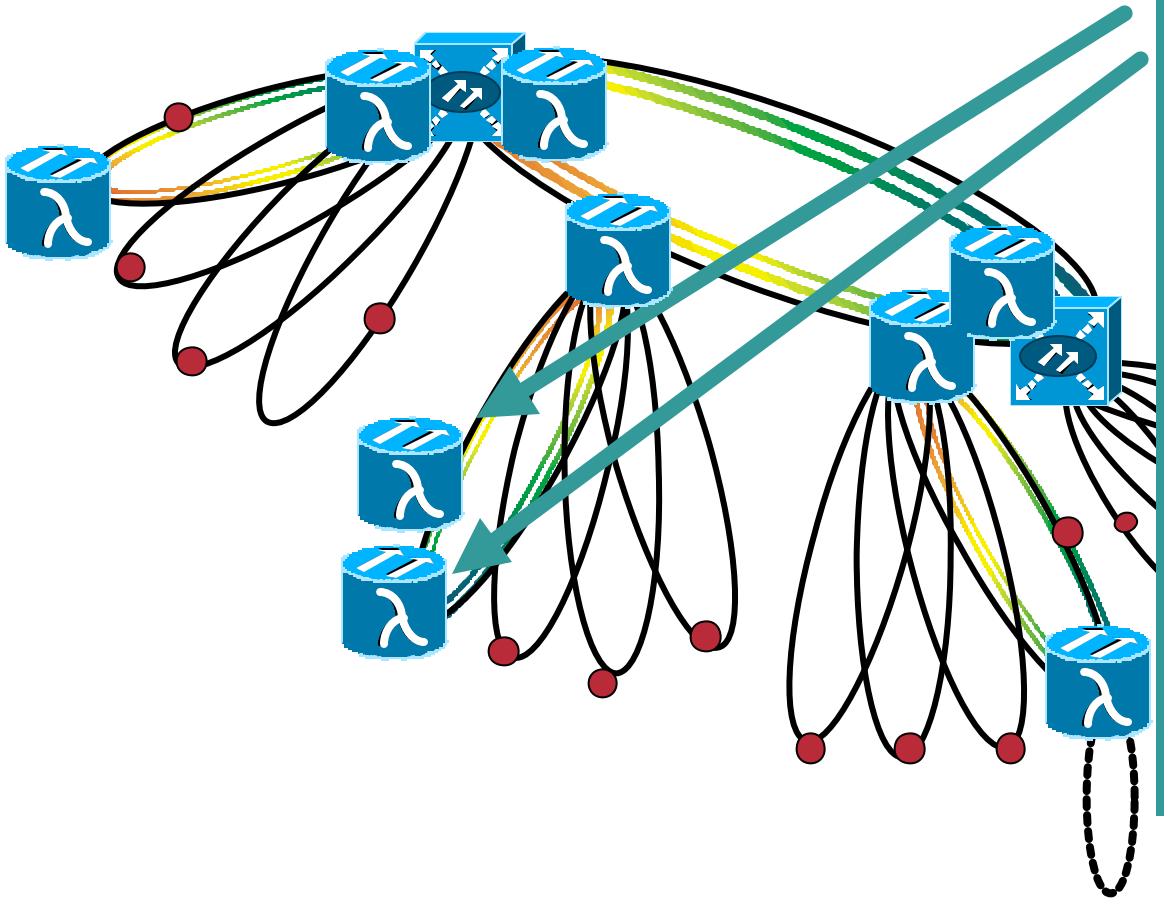
DS3 to OC-192 TDM

Non-blocking VC-4 / STS-1 Cross-connect Matrix

ITU Optics

1Gb/s & 10Gb/s Ethernet

MSPP – MSSP – MSTP: how do they fit in?

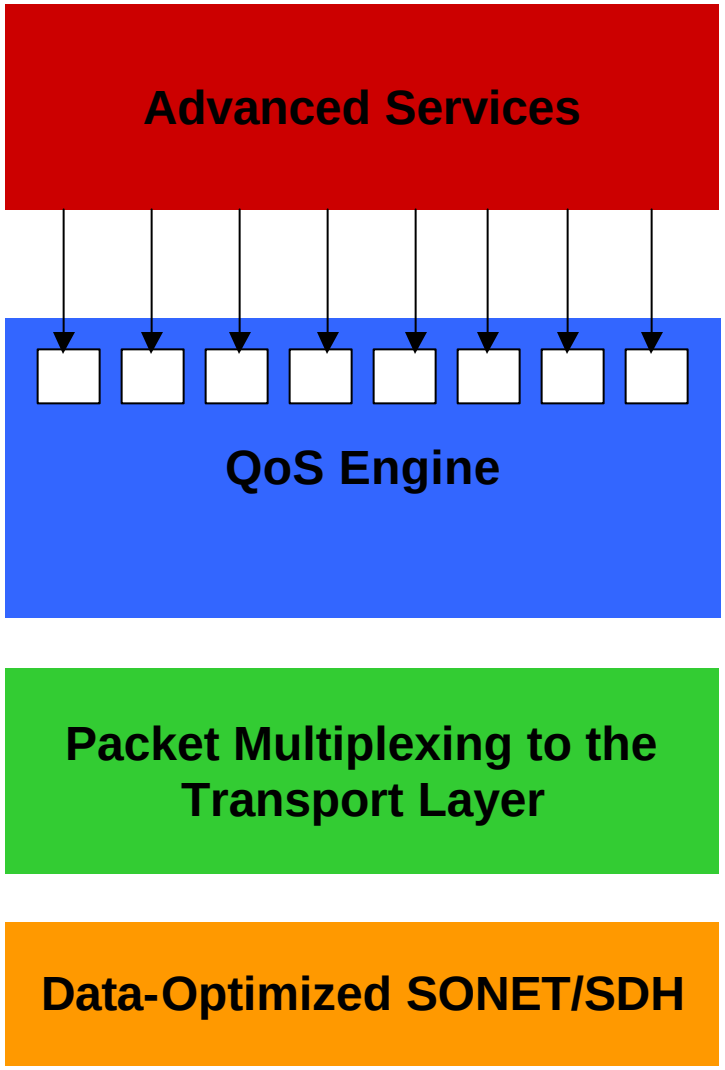


MSTP

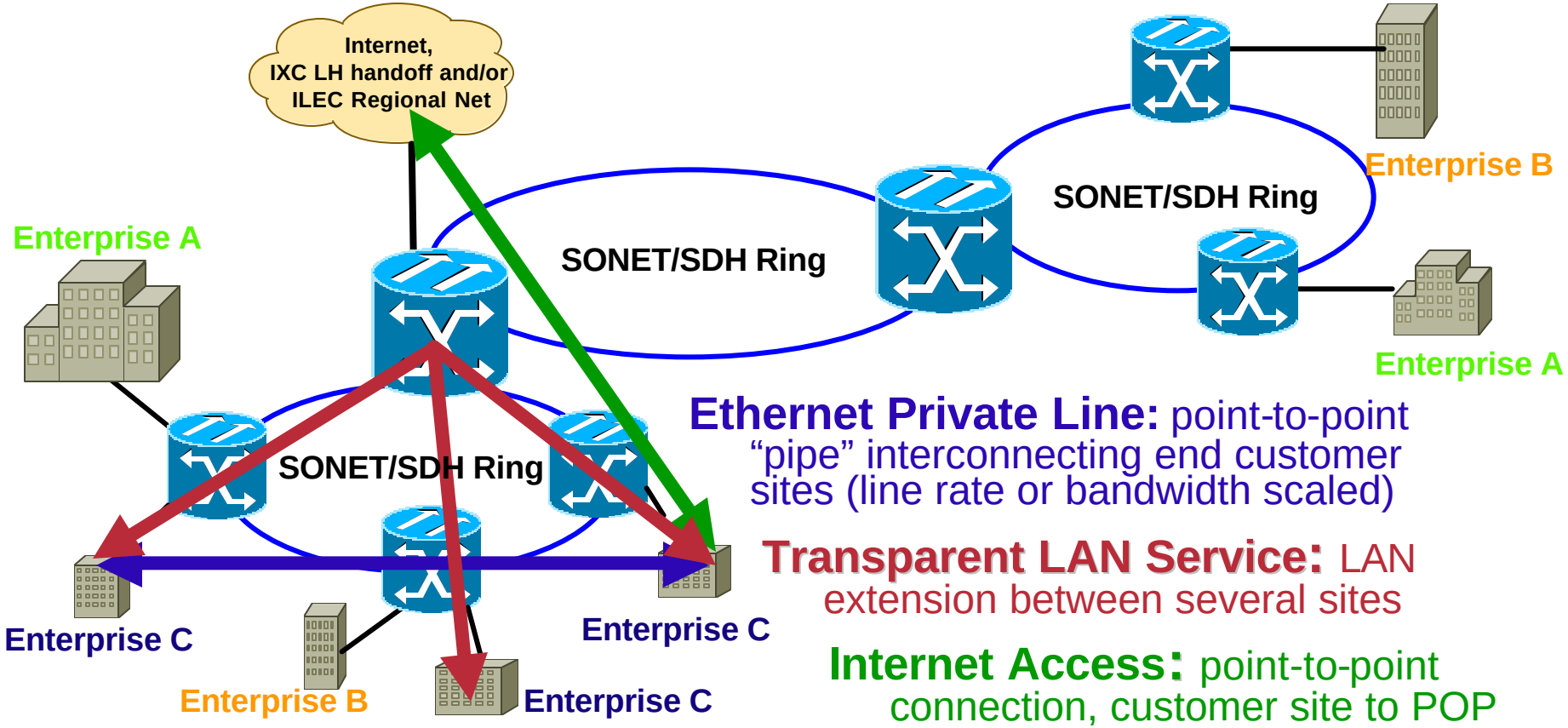
- DWDM with MSPP software intelligence
- Access through regional reach (100s of km)
- Flexible OADMs
- Robust, carrier-class DWDM
- λ Services
- 10GigE, GigE, ESCON, Fiber Channel, SDH/SONET 150M to 10G

Innovations for Multiservice over SONET/SDH Service Delivery

- Deploying advanced services is key to profitability
- Ethernet, Video, VoIP, and SAN Interconnect key service needs
- QoS is necessary for advanced services and providing SLAs
- Cisco IOS provides advanced per-packet, per port QoS
- Packet Multiplexing is crucial for network efficiency and scale
- Cisco technology innovations (MPLS, RPR, EoS) enable this
- SONET/SDH will need to become more efficient
- GFP, CCAT, VCAT, and LCAS all offer incremental improvements



Data Transport Evolution

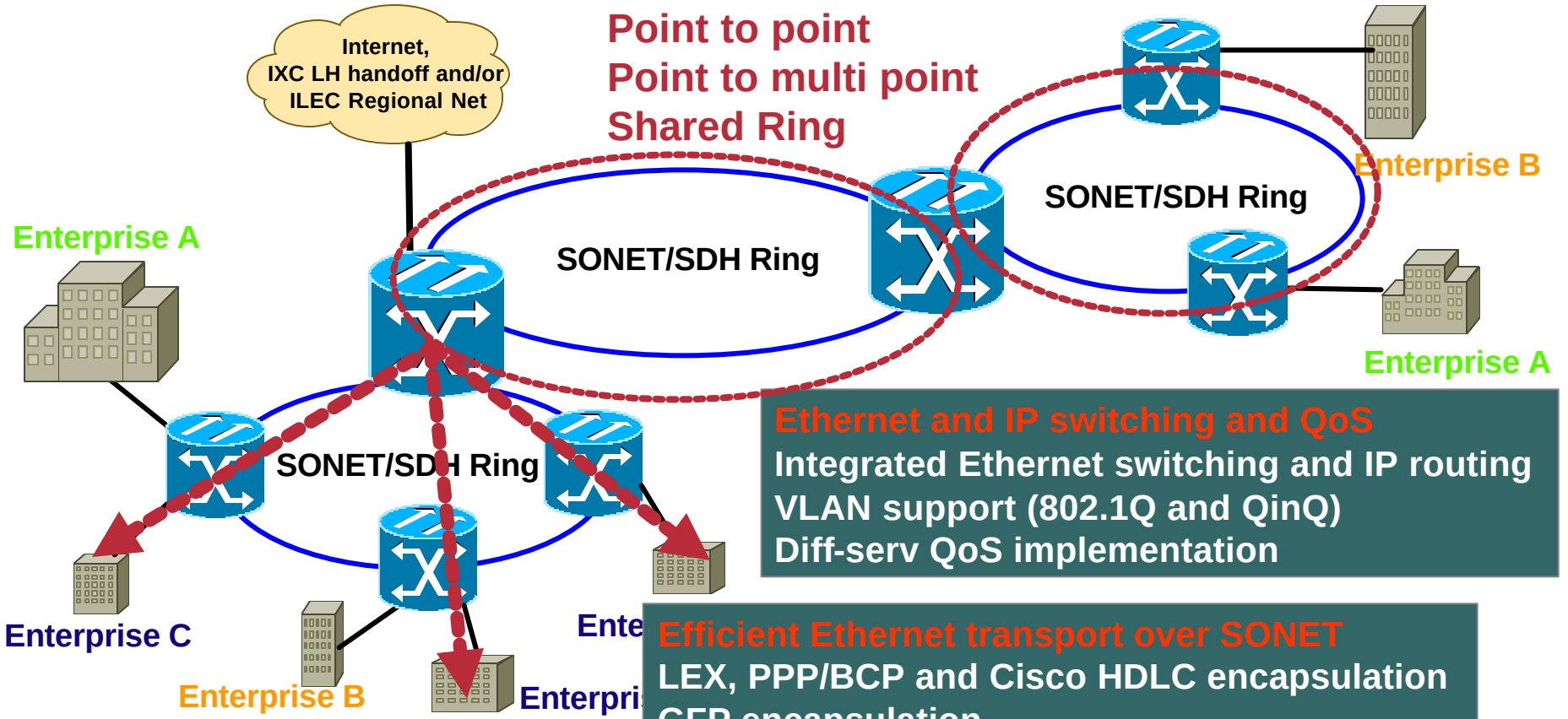


Ethernet Private Line: point-to-point "pipe" interconnecting end customer sites (line rate or bandwidth scaled)

Transparent LAN Service: LAN extension between several sites

Internet Access: point-to-point connection, customer site to POP

Data Transport Evolution



Ethernet and IP switching and QoS
Integrated Ethernet switching and IP routing
VLAN support (802.1Q and QinQ)
Diff-serv QoS implementation

Efficient Ethernet transport over SONET
LEX, PPP/BCP and Cisco HDLC encapsulation
GFP encapsulation
HO-VCAT and LO-VCAT with LCAS
RPR

What about the Near Future?

Topic	When?	Why?
Electrical mesh protection	2002-2004	Reduced bandwidth makes sense, but complicated to get right
Optical control plane/ GMPLS	2005-	Initial application for scalability, reduced network mgt cost Future application for dynamic services
Flexible OADMs	2003-	Flexible initially, ROADMs later
Photonic switching	2006-	Electrical switching good enough Incorporated into ROADMs

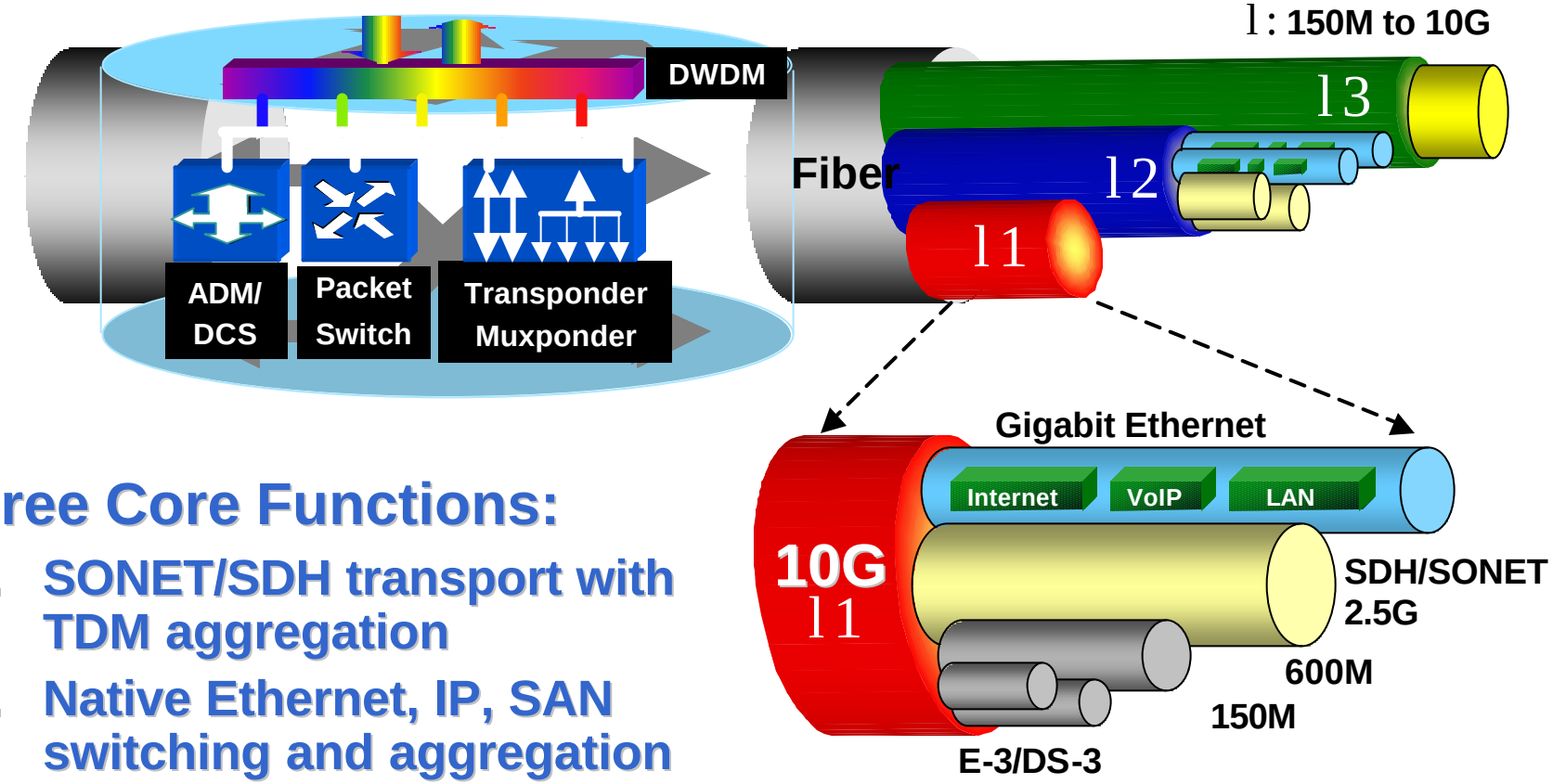
What about the Far Future?

Topic	When?	Why?
All-optical mesh protection	Far out	Complicated and requires advances in optical technology
Burst switching	Far out	Not as challenging as packet switching, but must be justified over simple optical bypass + sophisticated electrical routers
Packet switching	Never?	Too many challenges with ns-level optics and sophisticated logic at this layer
Interoperability at the optical layer	Never?	Too complicated. Single-vendor islands are good enough

Other potential topics for discussion (let me know which ones to expand upon)

- Why stat muxing should be part of the transport layer? (interesting for the infocom crowd) – we have good slides on this
- The future of ULH, 40G and up
- How everything changes if OEOs become real cheap – AON may go away or become a band level solution
- Photonic switching (from 1000 port OOO to OADM w varying levels of agility)
- Fully automated photonic layer (pre-deployment issue)

MSTP Architecture



Three Core Functions:

1. SONET/SDH transport with TDM aggregation
2. Native Ethernet, IP, SAN switching and aggregation
3. Intelligent DWDM with wavelength services

Streamlines CapEx