Datacenter Optical Infrastructure For The Enterprise

BRKDCT-2007

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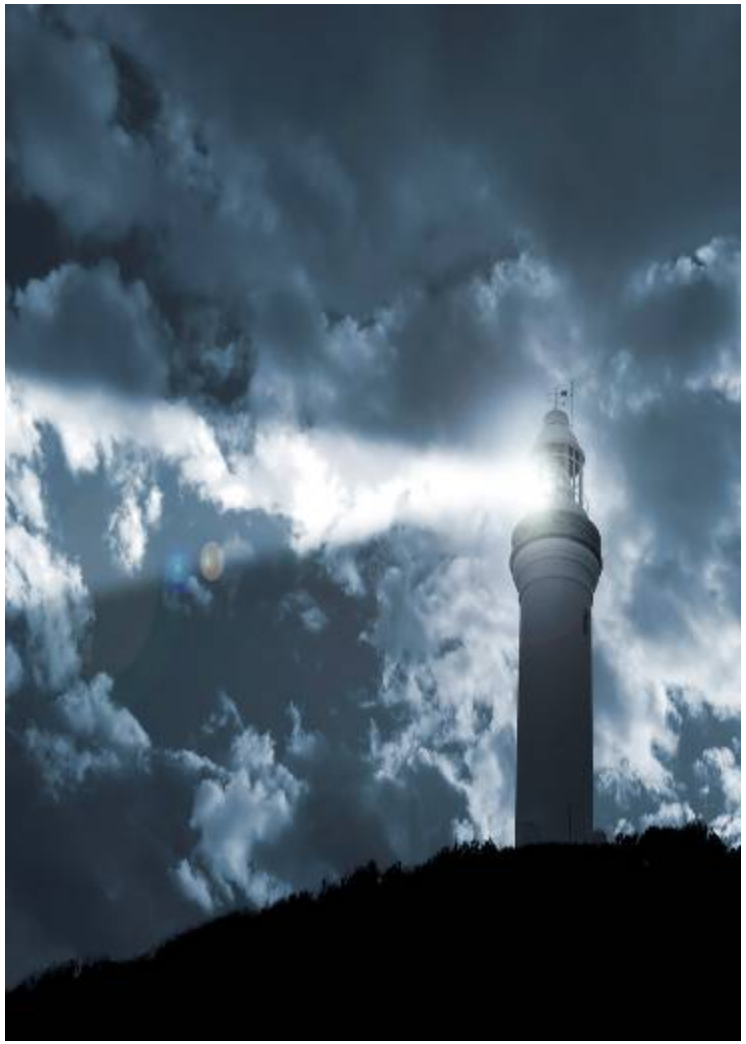
Cisco Networkers 2007

HOUSEKEEPING

- We value your feedback, don't forget to complete your online session evaluations after each session and complete the Overall Conference Evaluation which will be available online from Friday.
- Visit the World of Solutions on Level -01!
- Please remember this is a 'No Smoking' venue!
- Please switch off your mobile phones!
- Please remember to wear your badge at all times including the Party!
- Do you have a question? Feel free to ask them during the Q&A section or write your question on the Question form given to you and hand it to the Room Monitor when you see them holding up the Q&A sign.

Outline

- DC Interconnect At A Glance
- DC Back-end Interconnect Technologies
- Storage + Optical Synergies
- Case Studies

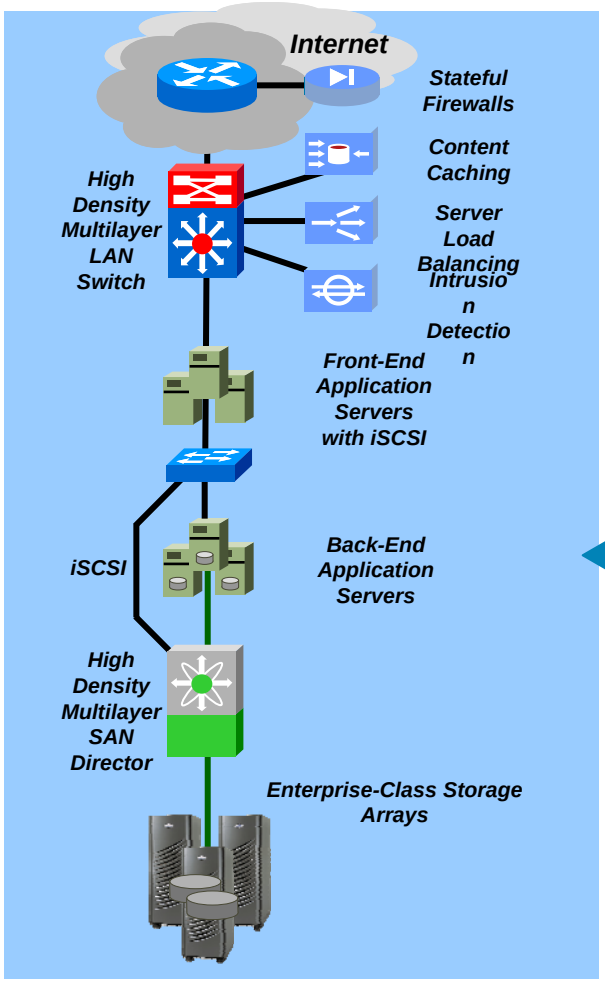


Business Reality
Driving Network Requirements

BUSINESS IMPERATIVES	IT MANDATES	MAN/WAN REQUIREMENTS
• Prepare for the worst—Protect business critical assets • Profitability—Reduce costs • Productivity—Do more with less	• Disaster Recovery • Distributed data centers • Collaborative apps • B2B applications • Web services • IP telephony • Consolidation • Content distribution	• High bandwidth • Highly available • Reduced complexity • Easily Manageable

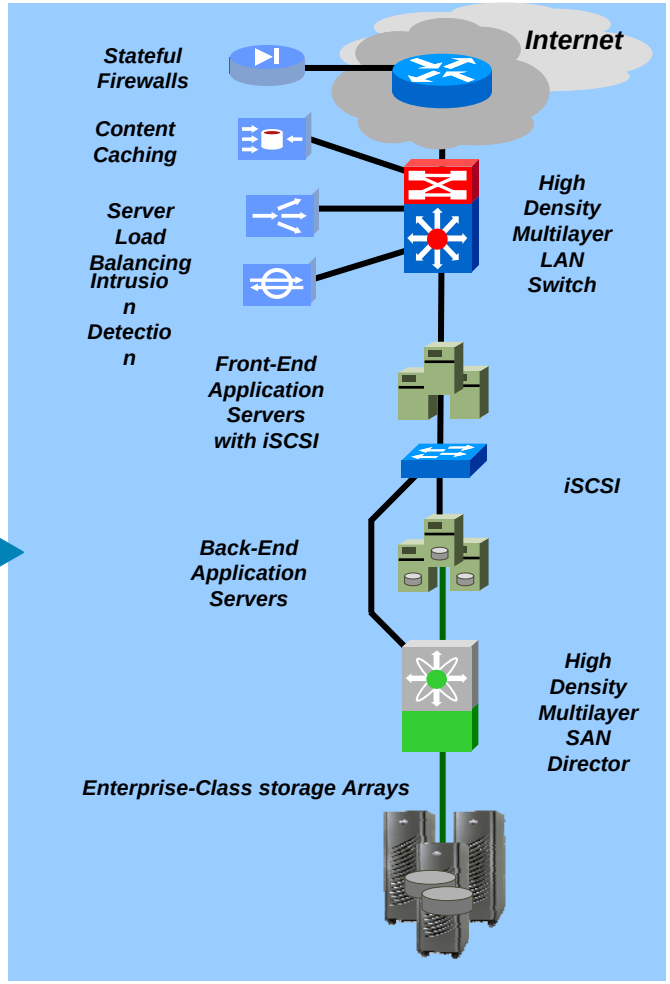
DC Interconnect

- Goal: Allow remote data center to appear as if it is local to the primary data center



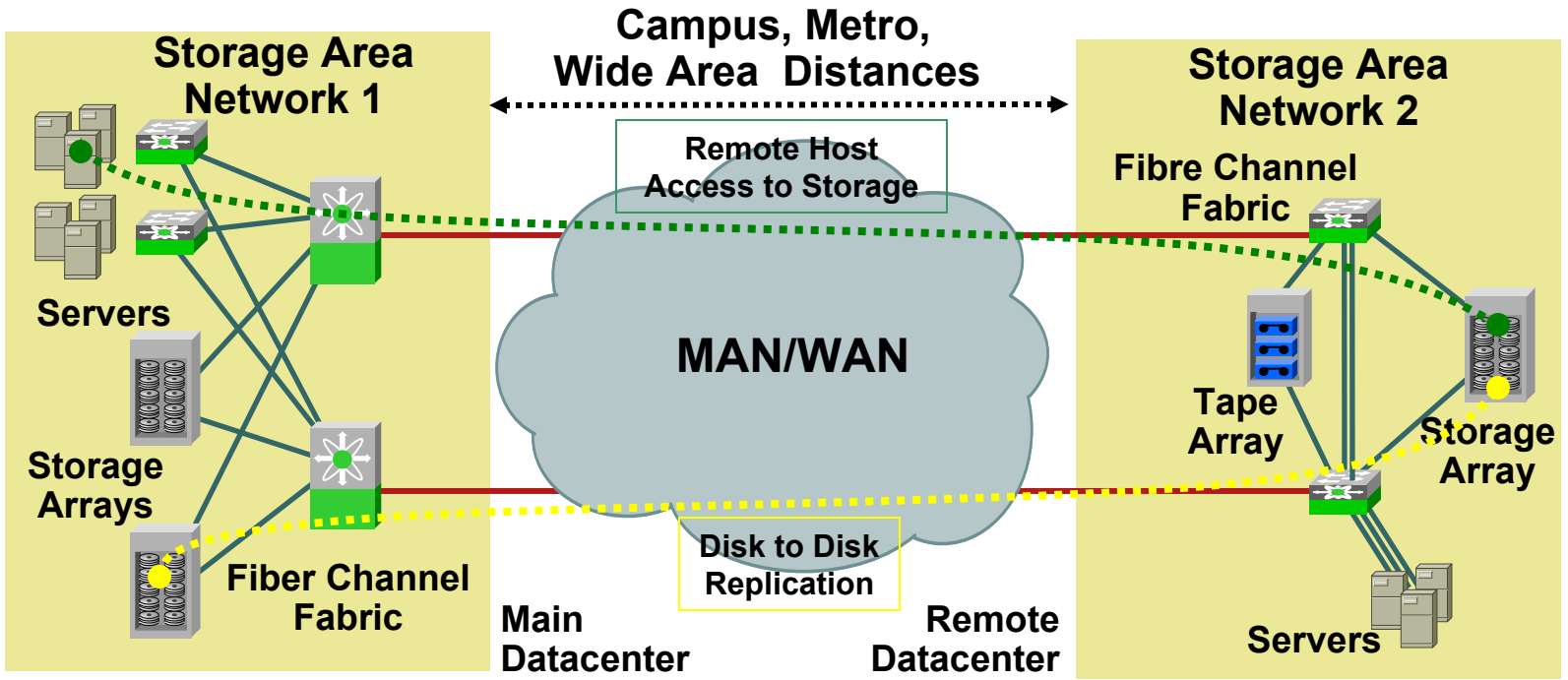
- Resilient network to extend local connections
  - LAN
  - VoIP
  - Video
  - Storage

- Many transport options available
- Ideally, same transport for all needs

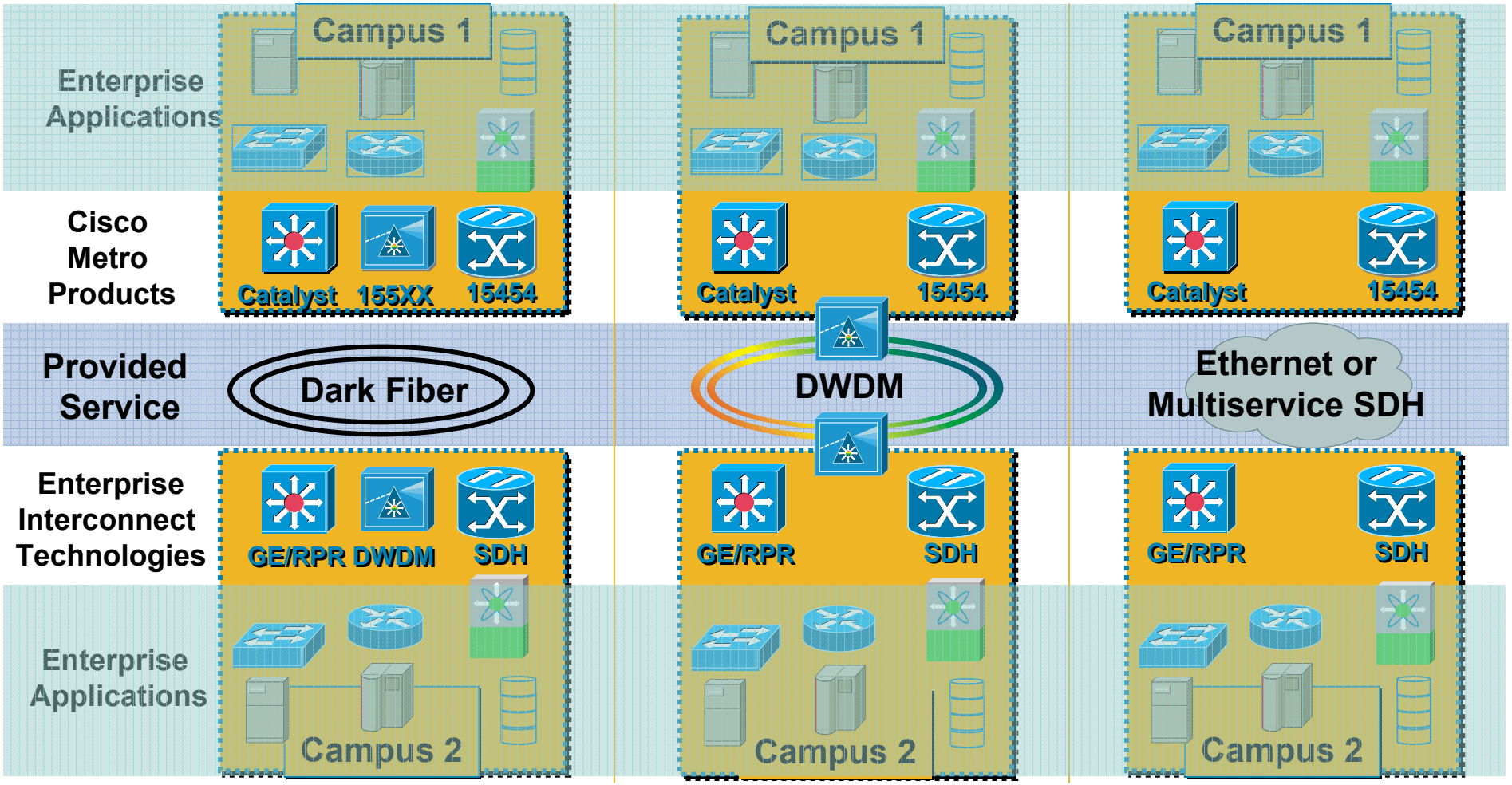


What Is SAN Extension?

- Extending Storage Area Network over metro or WAN distances
- Data Center back-end interconnect for business continuance or disaster recovery
- Connection bandwidth from 2 Mbps up to multiple 10Gbps
- Most stringent requirements (distance, latency, bandwidth…)



Different Approaches To DC Interconnect



"Do-It-Yourself" Dark Fiber

Lease Wavelengths or Managed Services from a Provider

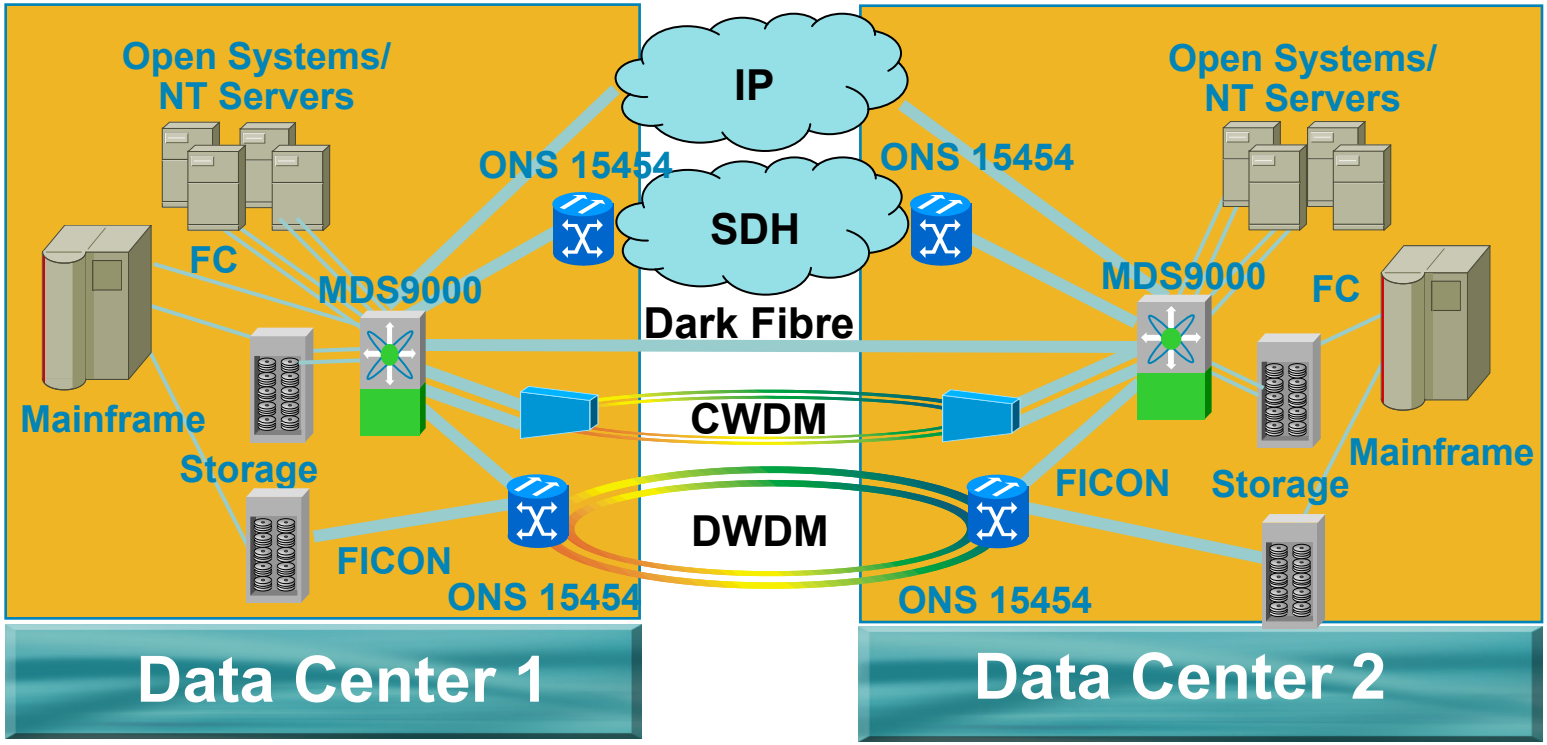
Purchase Services from a Provider

DC Back-end Interconnect Technologies

SAN Extension Connectivity Options

- Dark Fiber
- CWDM
- DWDM

- Fibre Channel over SONET/SDH
- Fibre Channel over IP (FCIP)
  - Carried over pure IP networks
  - Carried over optical



Considerations for Selecting The Appropriate Data Center Interconnect Technology

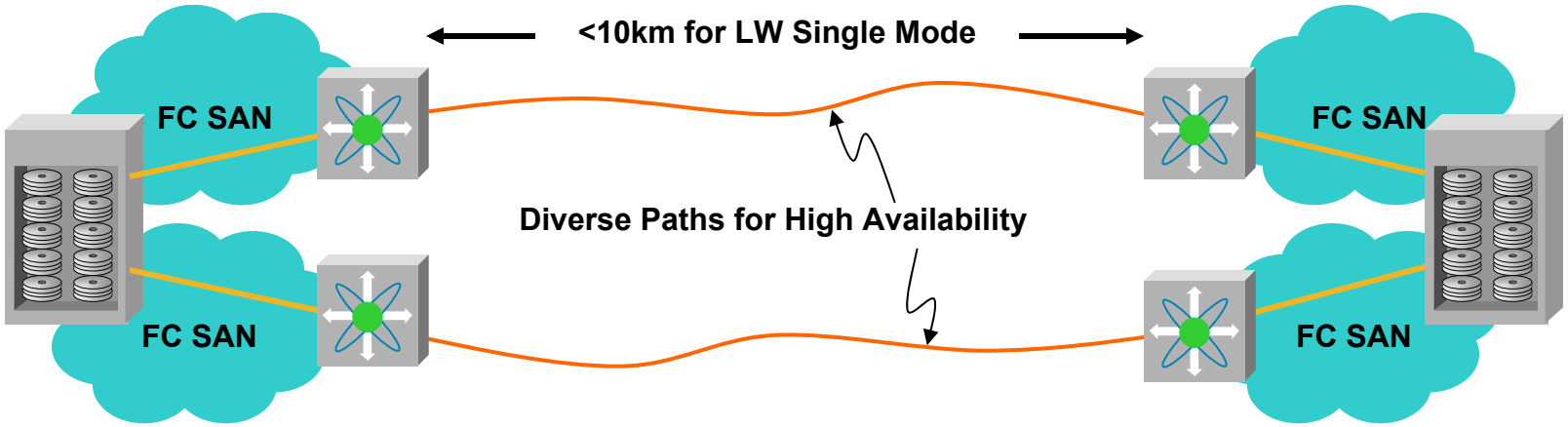
- Application Sensitivity to Delay
  - *synchronous vs. asynchronous*
- Distance Requirements
  - *propagation delays*
- Available connectivity at a Customer Site
- Bandwidth Requirements
  - *Present and future demand*
  - *Type and density required for applications*
  - *Growth factored in for most cost-effective option*
- Need for enahanced functionalities
  - *Compression, write and tape acceleration,*
  - *Data-in-transit encryption*
- Original Storage Manufacturer (OSM) certifications

DWDM provides high density, high bandwidth, low latency connectivity between Data Centers. Typical deployment is within Metro Regions and is ideal for synchronous apps.

SONET/SDH provides dedicated sub-rate capabilities and can extend beyond metro regions. Typically when Dark fiber and DWDM is not available SP's are able to provide SONET/SDH connectivity

IP protocols are considered when the datacenter interconnect requirements are beyond metro and regional boundaries. FCIP solutions provide enhanced features like compression, encryption, write acceleration, ecc.

SAN Extension Over Dark Fibre

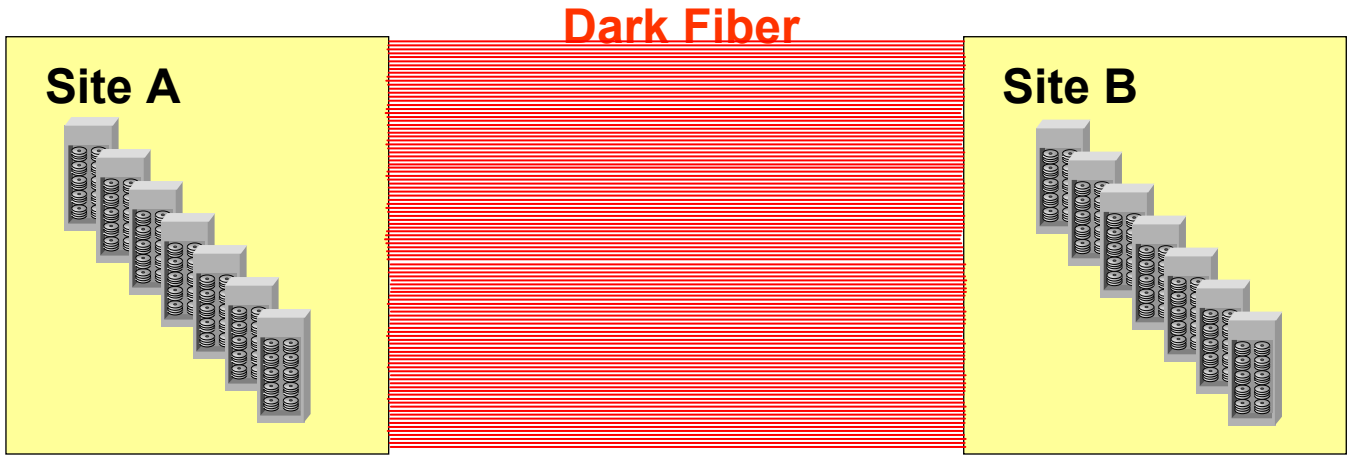


- Single 1 or 2 or 4 or 10 Gbps link per fibre pair
- Typically limited to less than 10Km
  - 9/125µm Single Mode Fiber Type
  - Transceiver LW (1310nm) 10km
  - Transceiver LW (1310nm) 4km (4G SFP only)
  - Colored Transceiver (CWDM/DWDM) up to 100km
- "Client Protection"—ULP (SAN or Application) responsible for failover protection

Considerations On Dark Fiber Solution

- What if I have to extend many channels?
- How many fibers do I need?
- How to go beyond 10Km?

ESCON	80	Protected
ETR	12	Unprotected
FICON	64	Protected
ISC	16	Unprotected
Gigabit Ethernet	32	Protected
FibreChannel	16	Protected
10 Gigabit Ethernet	2	Protected

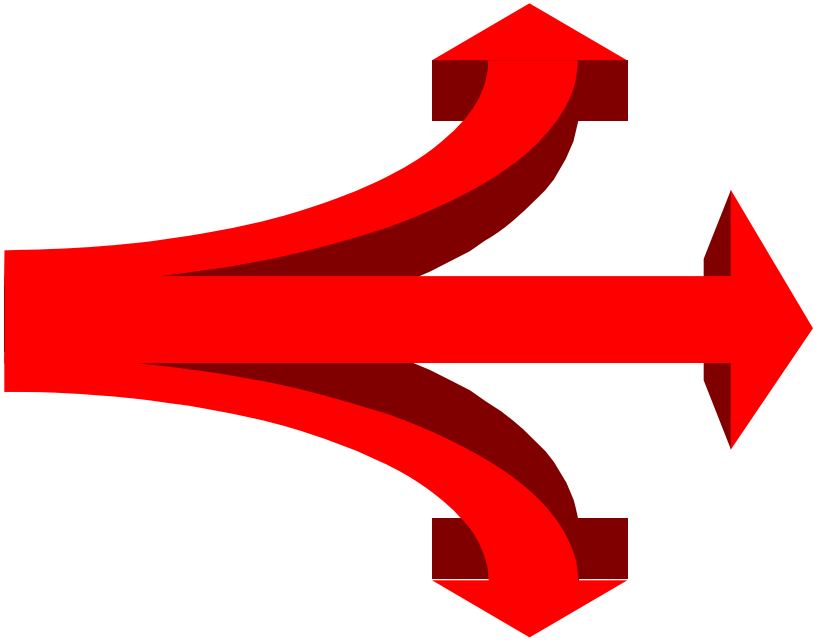


- 320 Gbps of capacity, 832 fibers, multiple cables
- Very expensive and …where do you get all those fibers?

Increasing Network Capacity Options

More Fibers (SDM)

Same bit rate, more fibers
Slow Time to Market
Expensive Engineering
Limited Rights of Way
Duct Exhaust



W D M

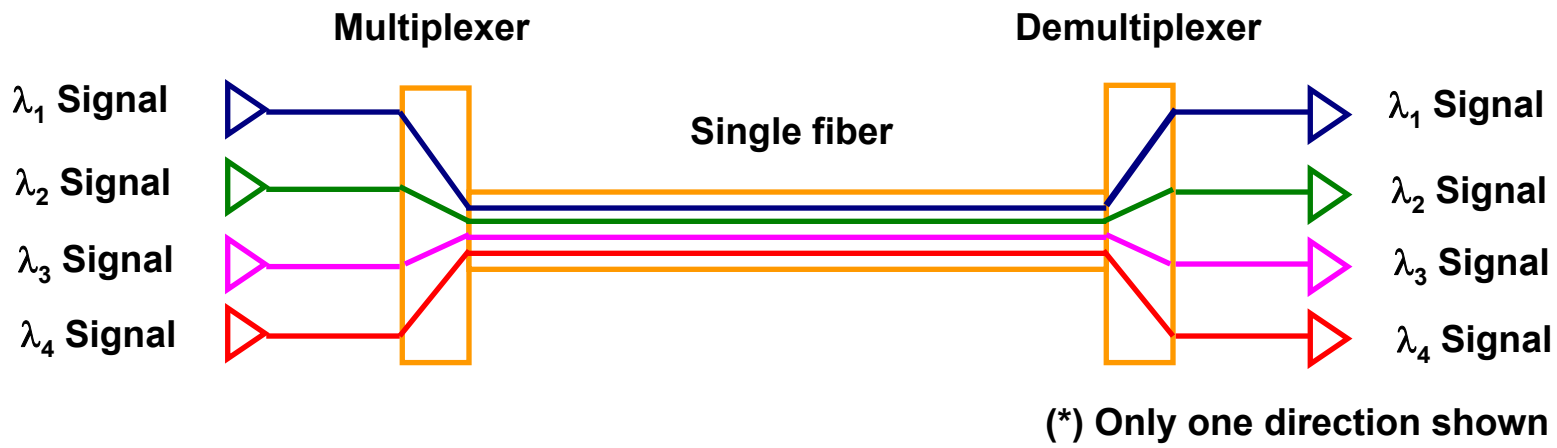
Same fiber & bit rate, more λs
Fiber Compatibility
Fiber Capacity Release
Fast Time to Market
Lower Cost of Ownership
Utilizes existing client equipment

Faster Electronics (TDM)

Higher bit rate, same fiber
Electronics more expensive
Challenging over long distance

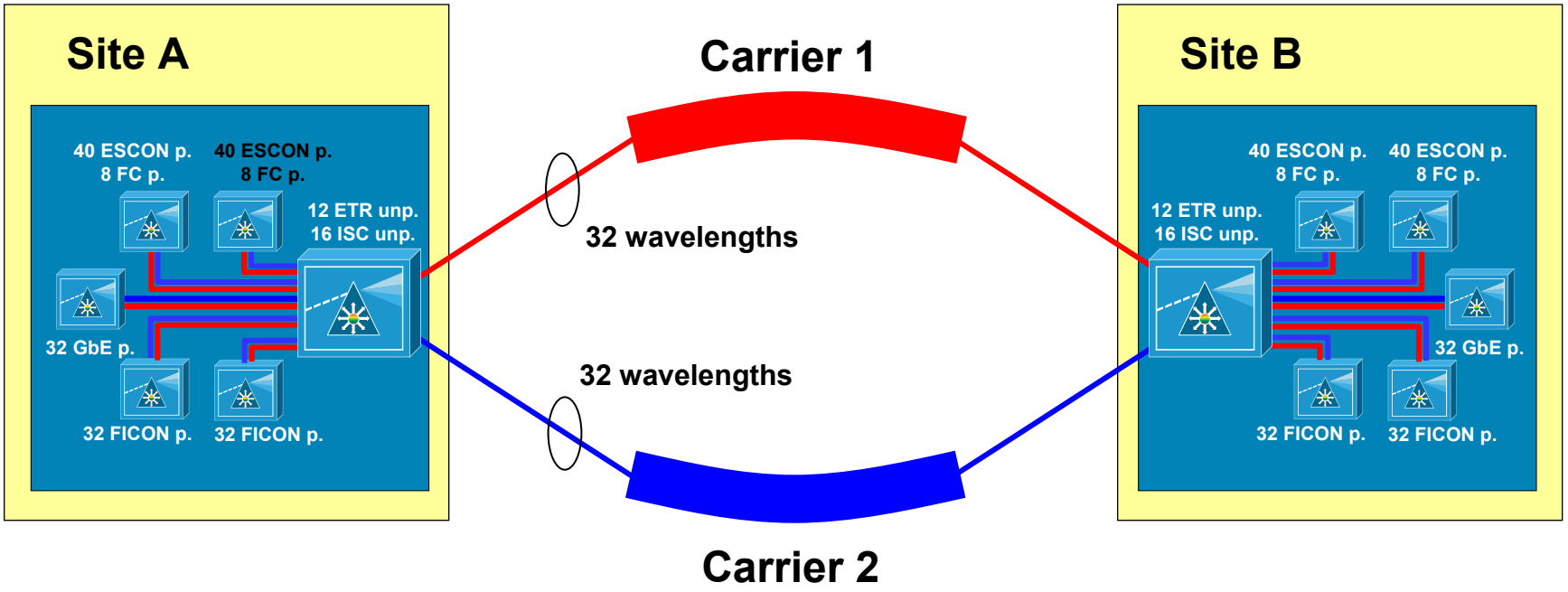
What is WDM all about?

Wavelength Division Multiplexing



The Bandwidth Multiplier

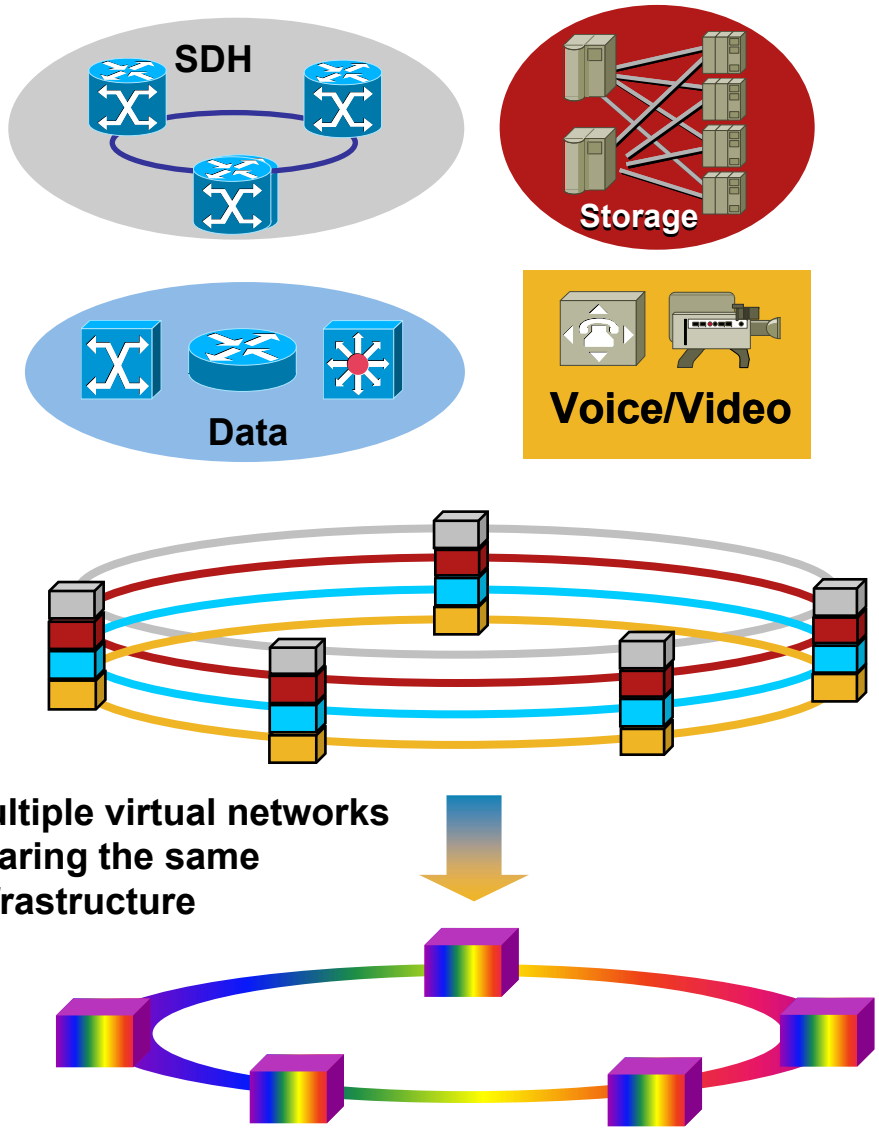
Metro DWDM Solution



- 320 Gbps worth of capacity
- 2 fiber pairs
- Optical protection
- Two carriers for better resiliency
- Reasonably priced

The Virtual Fiber Concept

- Flexible upgrade of network capacity
  - Plug&Play of new interfaces
- Multiservice transport over common fiber
  - bit rate transparent
  - protocol transparent
  - format transparent
- Highest security:
  - separation at the physical layer



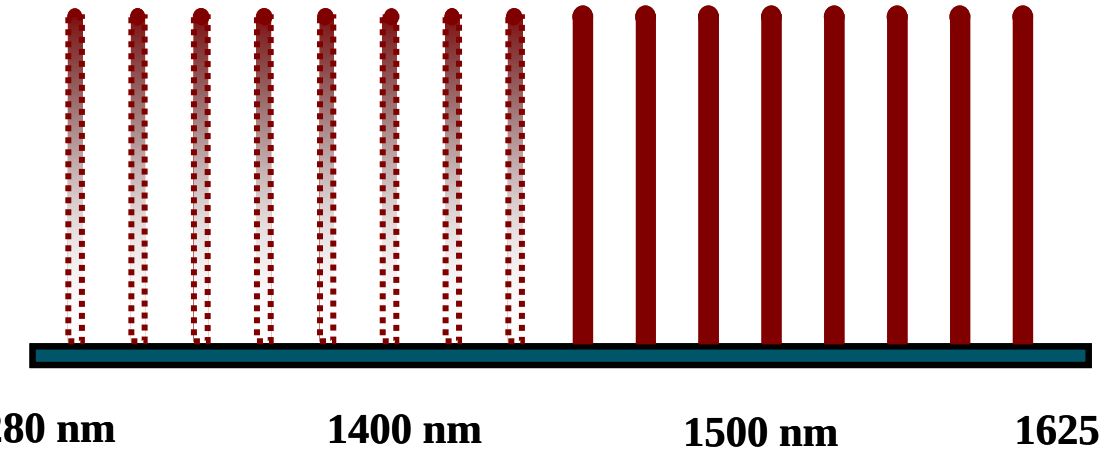
Channel Spacing Sets The Difference

D-WDM

Optimized for bandwidth

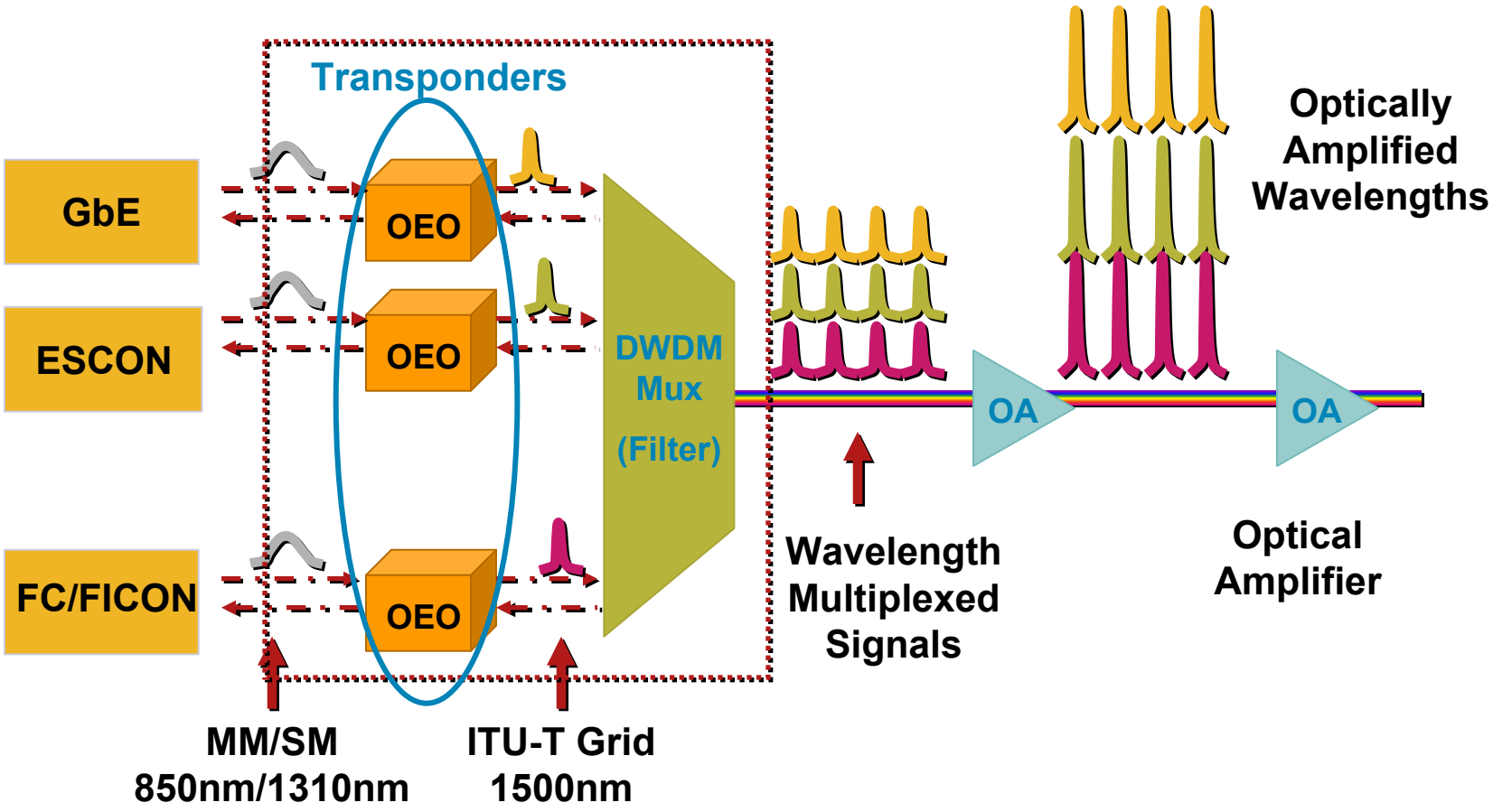
C-WDM

Optimized for low-cost

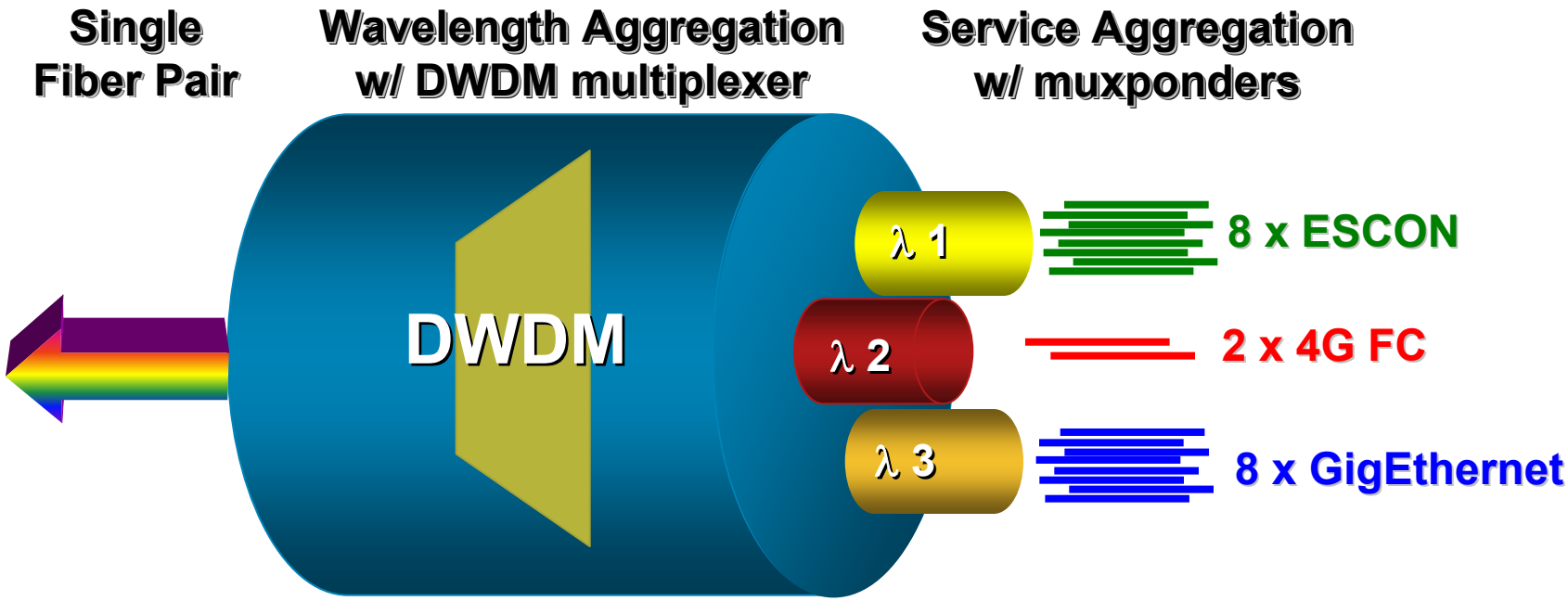


No amplification possible

DWDM Building Blocks



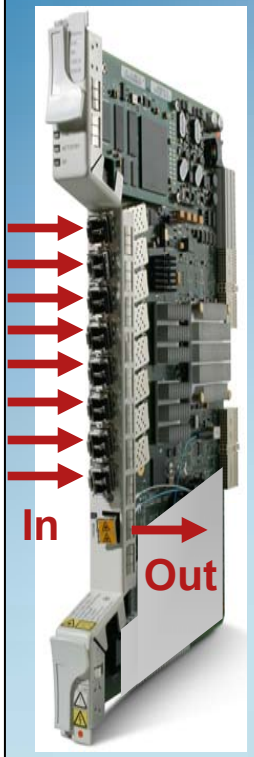
Double Service Aggregation



- Service Aggregation allows the electrical multiplexing of signals to maximize the carrying capacity of each wavelength
- DWDM is used to multiplex several of these wavelengths onto a single fiber pair
- Combination of Service Aggregation and DWDM multiplexing provides a scalable, high-density Metro Optical solution

Example: ONS15454 10Gbps Data Muxponder

10 Gbps Data Muxponder



- Trunk side: Tunability across Full C-band / L-band (80chs capable @ 50GHz each)
- Client side: Pluggable optics SFP
  - SM (@ 1310nm)
  - MM (@ 850nm)
- Data and Storage aggregation over 10Gbps wavelength:
  - 8x GE
  - 8x 1G FC / FICON / ISC-1
  - 4x 2G FC / FICON / ISC-3
  - 2x 4G FC
- SW Provisionable E-FEC / FEC / No FEC operating mode
- SONET/SDH framer with GFP-T encapsulation (G.7041 compliant)
- Buffer-to-Buffer Credit up to 1,400 Km
- Full Performance Monitoring Statistics
- E-Port, TE-port, F-Port, and N-Port support
- SAN Environment Certification

  EMC, HDS, IBM, HP, SUN

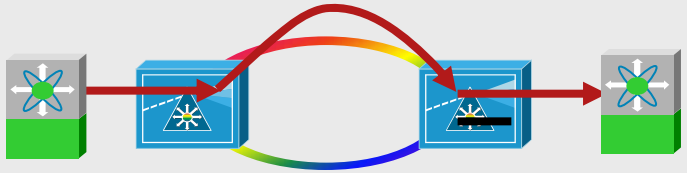
Cisco ONS 15454

Customer Benefit:

- Variety of data and storage services possible from one platform for lower investment to provision multiple services, highly manageable for ease of provisioning.
- Spares cost reduction

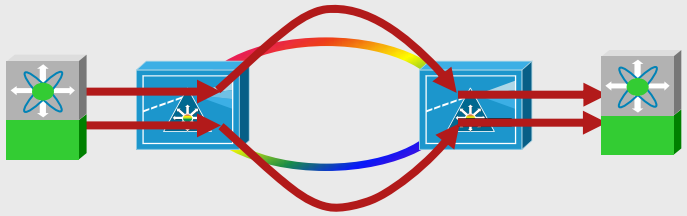
DWDM Protection Options for Storage (1)

Unprotected



- Single transponder required
- No protection
- May be used with redundant system for client protection

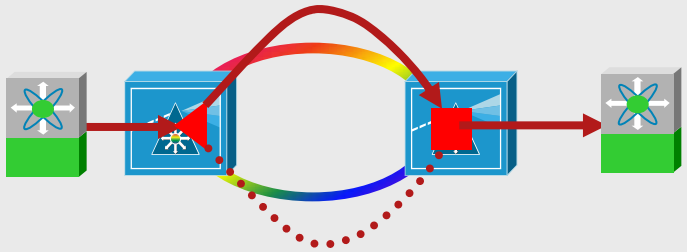
Client Protection



- Each service routed via diverse fibre route
- Client mechanism such as FSPF or port-channel used for resilience
- 50% capacity during fibre break

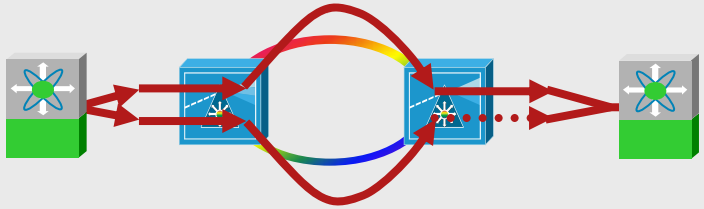
DWDM Protection Options for Storage (2)

Optical Splitter Protection



- Single transponder required (low cost)
- Protects against fibre failure
- Failover causes Loss of Light (and Fabric Change if only link)
- 100% capacity during fibre break

Linecard or Y-cable Protection

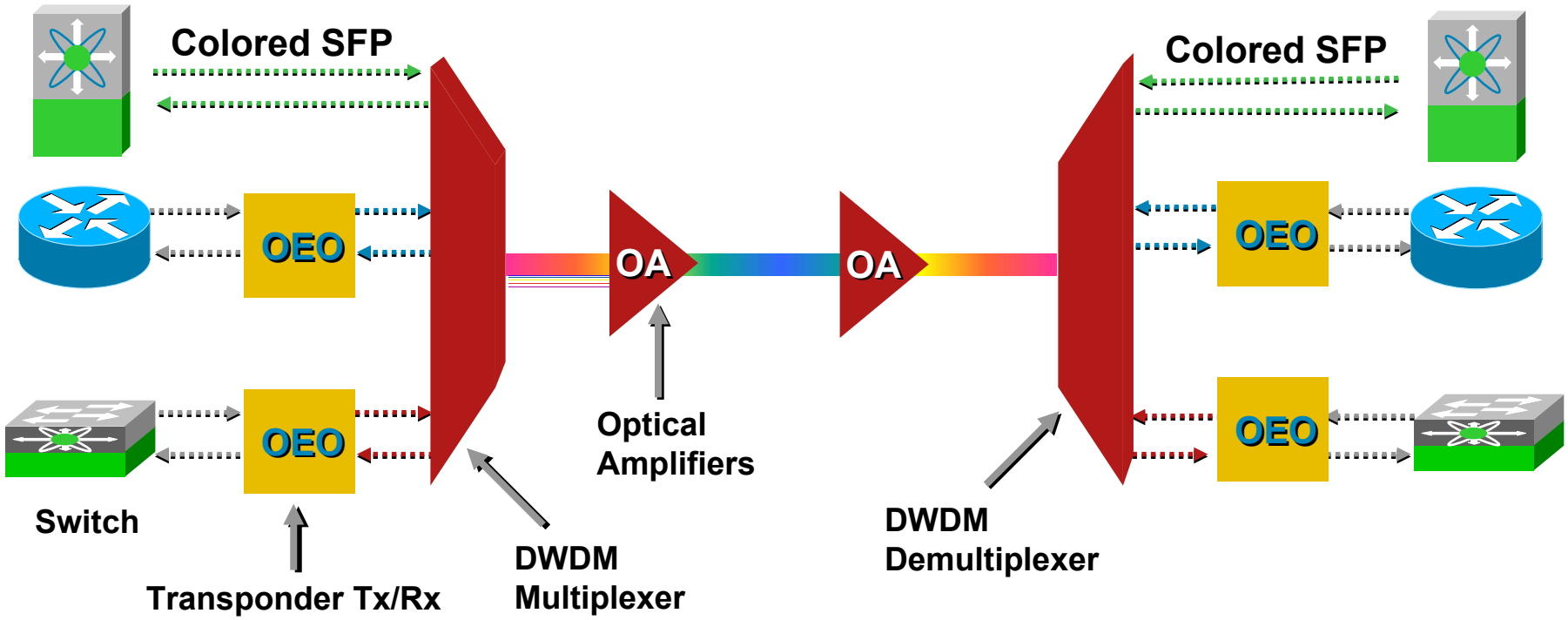


- Dual transponders required per service
- 100% capacity during fibre break OR laser failure

Delay And Storage Applications

- Storage applications can be very sensitive to delay
- Mostly relevant to synchronous applications
- Very critical for ESCON-based services
- Delay can significantly affect the overall application throughput
- Key parameter for SAN Extension design
- WDM technology is best compared to other SAN extension options (“speed of light” technology)
- For boosting application performance, overall system delay can be mitigated with advanced Write and Tape Acceleration features on state-of-the-art FC switching products (e.g. Cisco MDS9000)

Delay With DWDM Systems

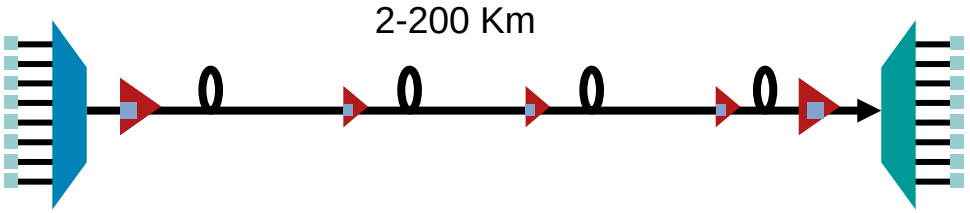


T_d = Transponder delay = 1- 24 μsec
F_d = Fiber delay = 5 μsec/Km
L_d = p2p link delay = 2 x T_d + D x F_d

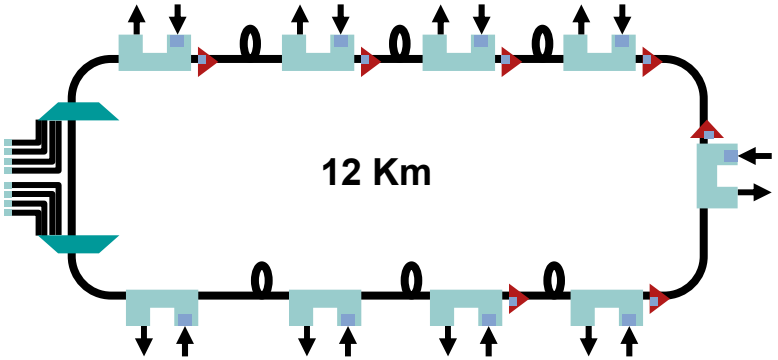
FEC
Muxponder
CRC check

Total delay is determined by fiber length

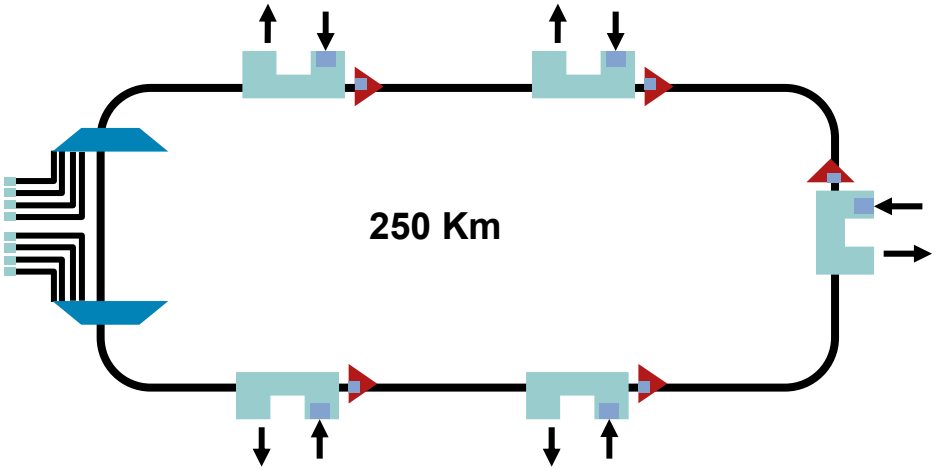
Common DWDM Architectures For DC Interconnect



Linear (Pt-Pt)



Campus Ring

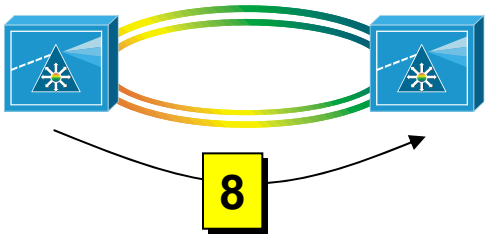


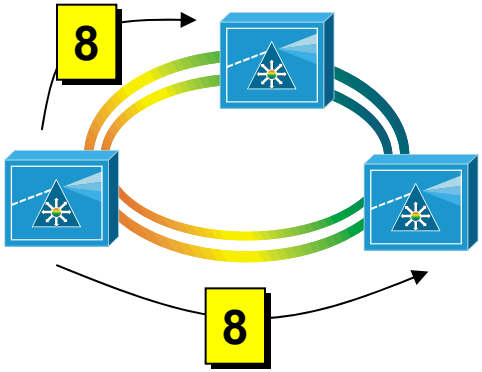
Metro Ring

Optical Technology Can Span Longer Distances

Why Rings & Enhanced Protection ?

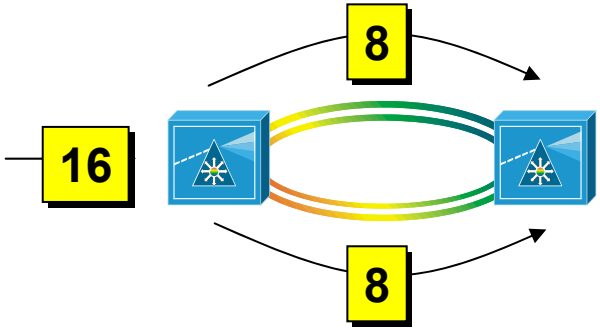
- In-Service Scalability – Many installations start with two, but grow to multiple sites

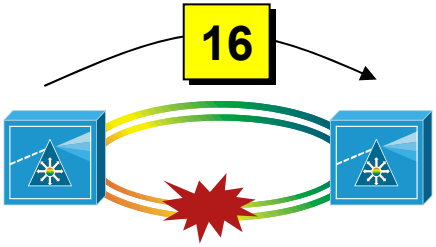




Grow without affecting service between first two sites

- Minimal hit to applications in case of fiber break – Ring allows to balance channels over alternative path (some applications need to re-sync even if switchover is < 50ms)

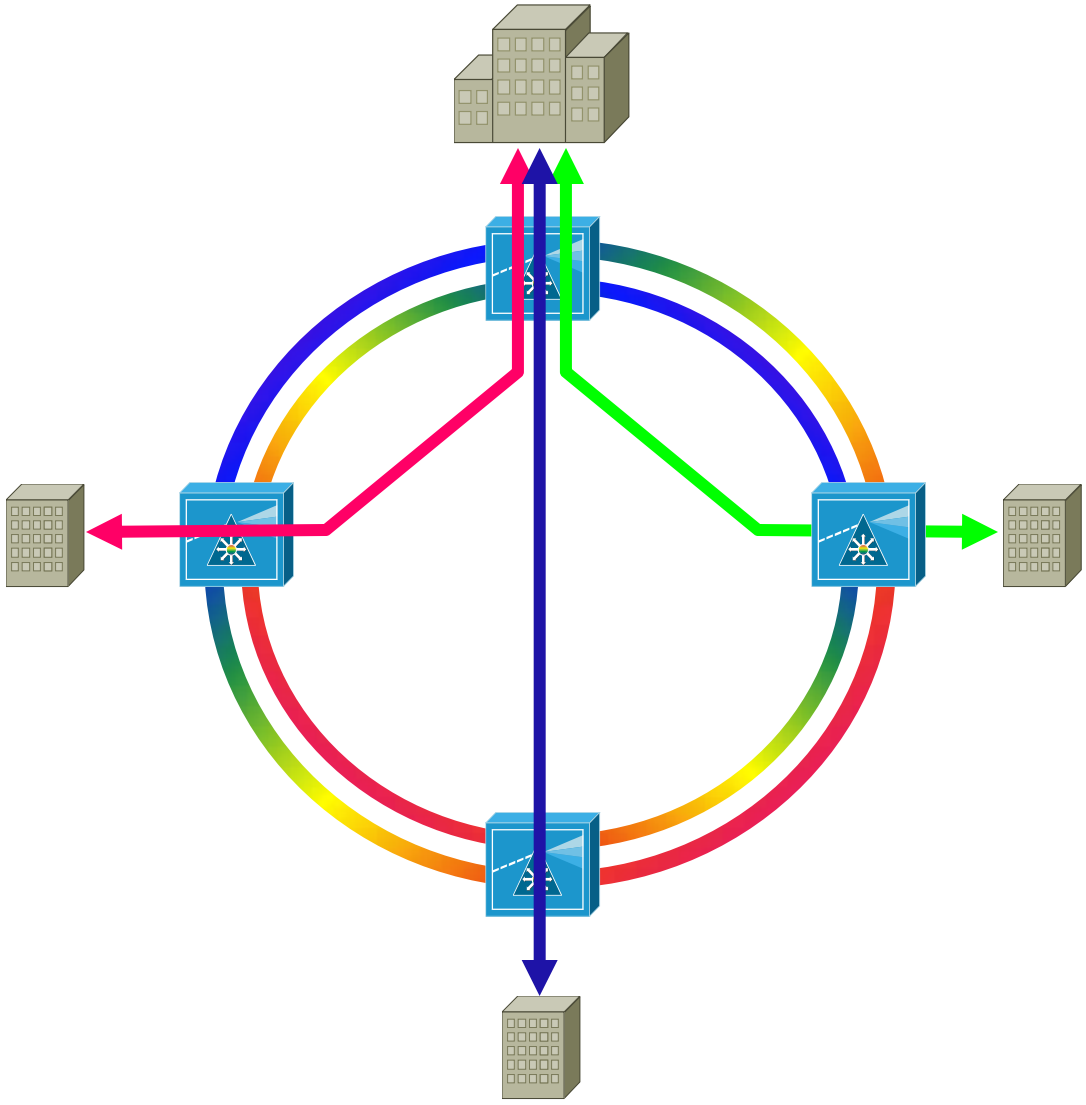




Only 8 rather than all 16 channels see the hit

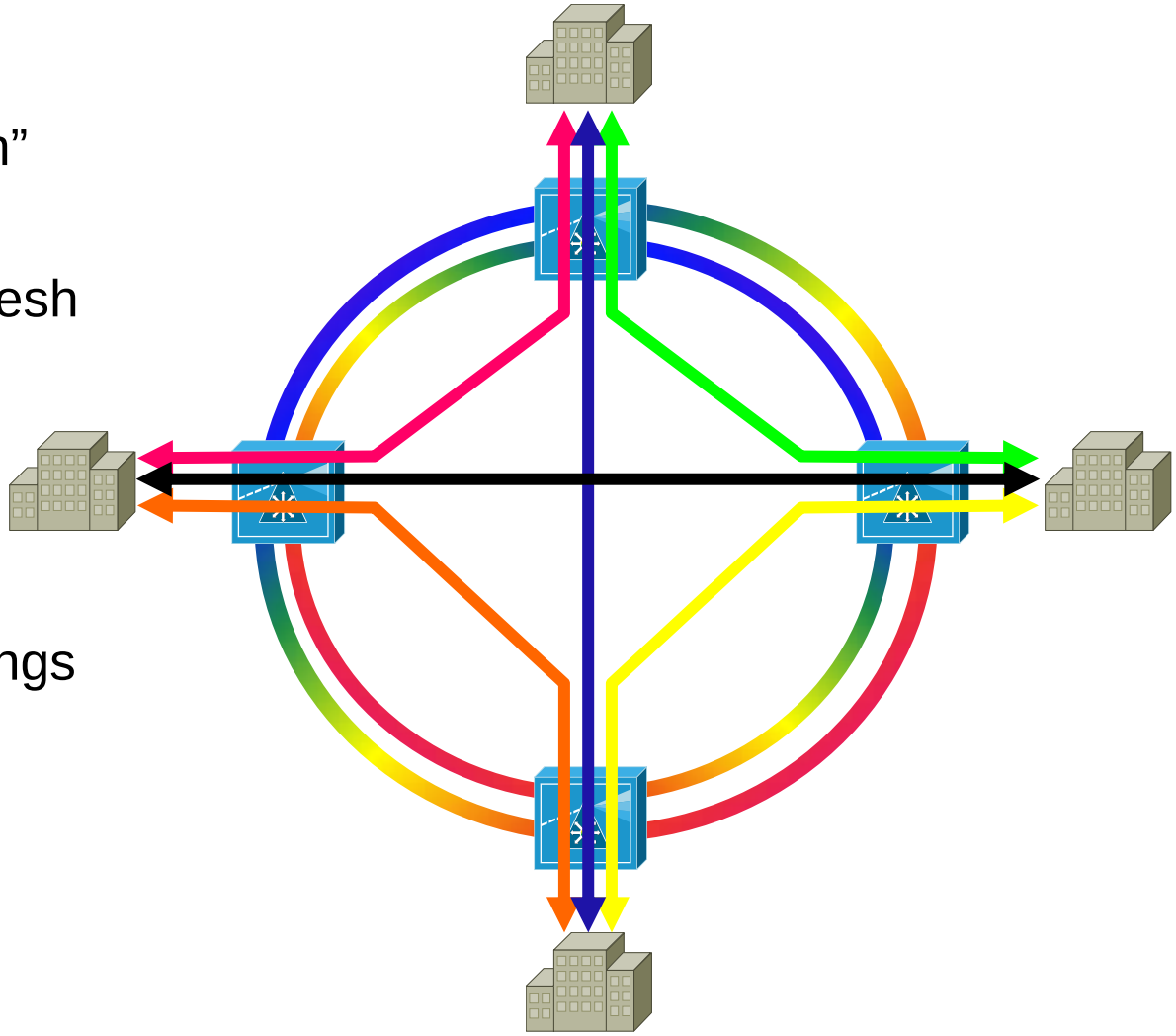
Hubbed-Ring Topology

- Hub node terminates all connections; spoke nodes “pass through” some wavelengths
- Physical ring, logical star
- Protection can be provided via multiple paths around ring
- Example: Connectivity between HQ and remote offices
- Example: Storage service provider



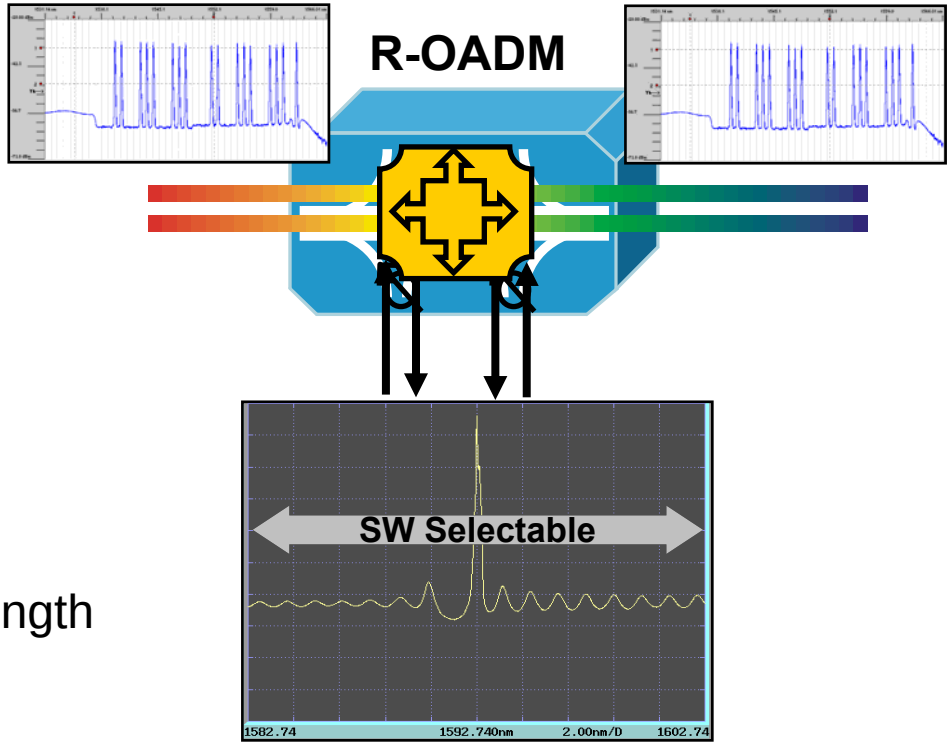
Meshed-Ring Topology

- All nodes “pass through” some wavelengths
- Physical ring, logical mesh
- Protection can be provided via multiple paths around ring
- Example: Connectivity between multiple buildings on a large campus
- Example: Metro service provider



From Fixed OADM To Reconfigurable OADM

- Optical add drop multiplexers
  - Efficient linear and DWDM rings
  - Minimized regeneration
  - Optimized DWDM ring architecture
- ROADM provides operational simplicity
  - No network reengineering for system growth
  - Nodes scalable from 1 to 32 wavelengths
- Investment protections
  - Single node type
  - Minimum spare
- Scaleable technology and wavelength path provisioning
  - Scalable wavelengths
  - Efficient optical layer protection



SDH Hierarchy

SDH, Synchronous Digital Hierarchy
ITU-T Recommendations G.707, G.708, G.709, early '90s

Signal	Bit Rate	Capacity
STM-1	155.52	63 E1s or 3 E3s
STM-4	622.08	252 E1s or 12 E3s
STM-16	2488.32	1008 E1s or 48 E3s
STM-64	9953.28	4032 E1s or 192 E3s

STM-n: Synchronous Transport Module level n

PDH Signal	Bit Rate
E0	64 kbps
E1	2.048 Mbps
E3	34 Mbps
E4	140 Mbps

SONET is the US counterpart of SDH

Next Generation SDH: Enablers

- GFP (ITU-T G.7041)

  Generic framing procedure for multiplexing of multiple client signals into a single payload

  GFP-F (for Ethernet) and GFP-T (for Fibre Channel)

- VCAT (ITU-T G.707)

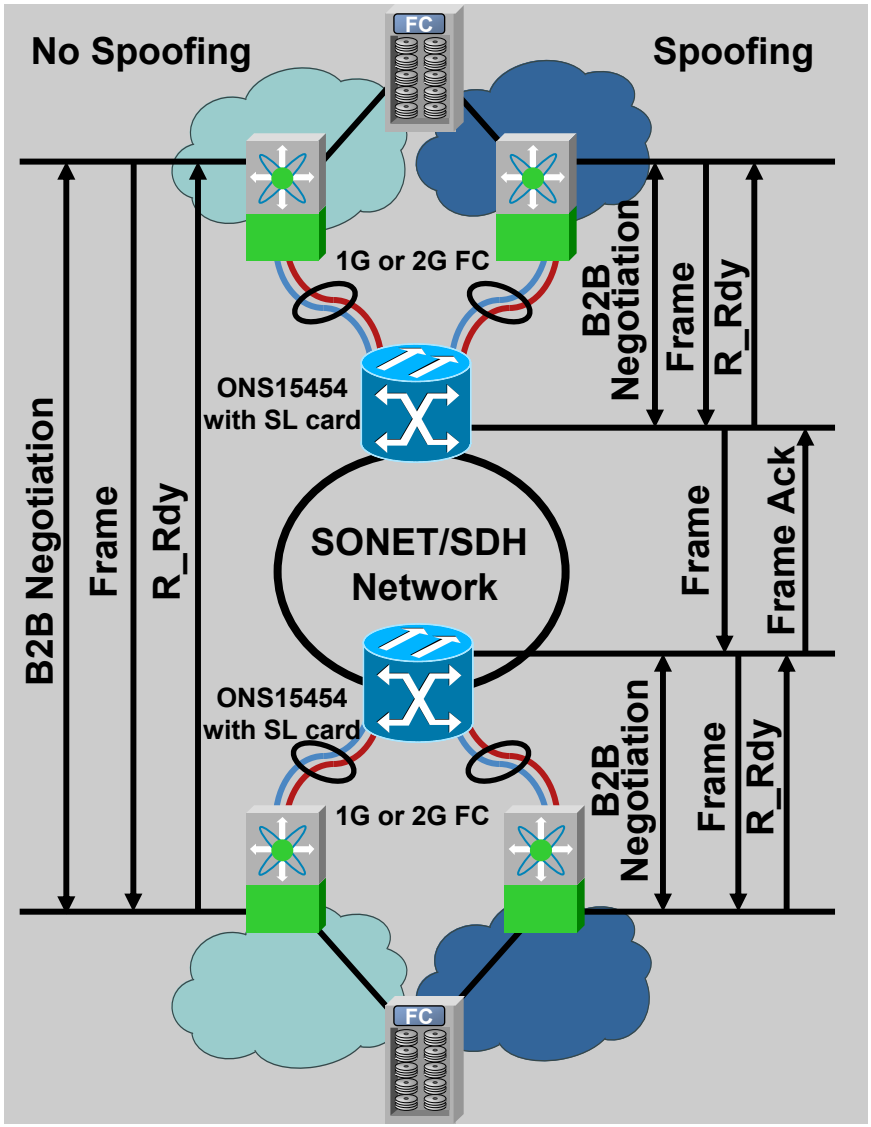
  Virtual concatenation is a method of creating a payload made up of 2 or more containers transported through a network independently

- LCAS (ITU-T G.7042)

  A mechanism for dynamically adjusting the size of a virtually concatenated channel

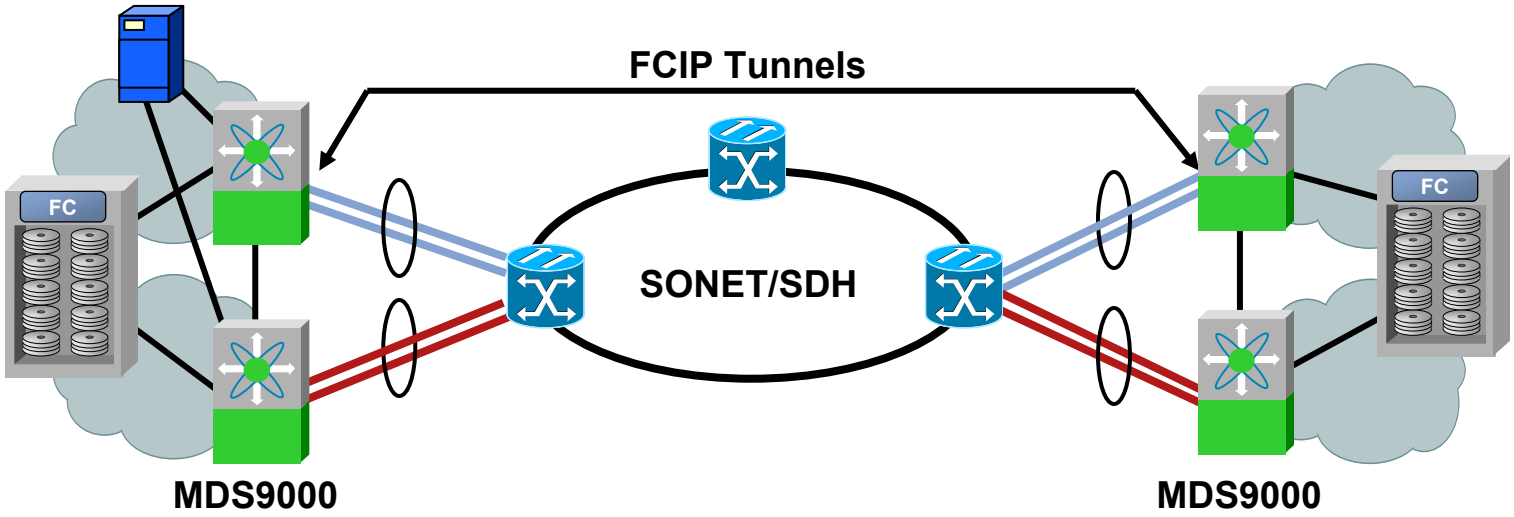
Next Generation SDH extends transport capabilities beyond legacy voice traffic (e.g. Data, Storage,…)

Fibre Channel over SONET/SDH



- SONET/SDH prevalent in Service Provider Networks and some Enterprise networks
  - FC over SONET/SDH follows same distance rules as other optical technologies
    - → BB_Credits required
  - ONS15454 with SL-Series card supports BB_Credit Spoofing
    - Up to 1200km@2G FC/FICON
    - Up to 2400km@1G FC/FICON
- Outage in SONET/SDH network will not cause loss of light
  - recovers in <50ms
  - may cause some loss of BB_Credit from in flight traffic
    - MDS9000 will recover lost BB_Credits
- Leverage GFP, VCAT, LCAS for efficient standardized mapping of storage protocols over SONET/SDH networks

FCIP SAN Extension over SONET/SDH



- FCIP is a tunneling technology to extend a SAN across a WAN
- FCIP encapsulates FC frames into an IP payload
- With FCIP, recommended MTU is 3000 bytes; SONET/SDH network must be capable of supporting this MTU
- Multiple high availability options: Etherchannel, PortChannel, SONET/SDH layer protection mechanisms

The Cisco Advantage
Multi-technology SAN Extension Capability

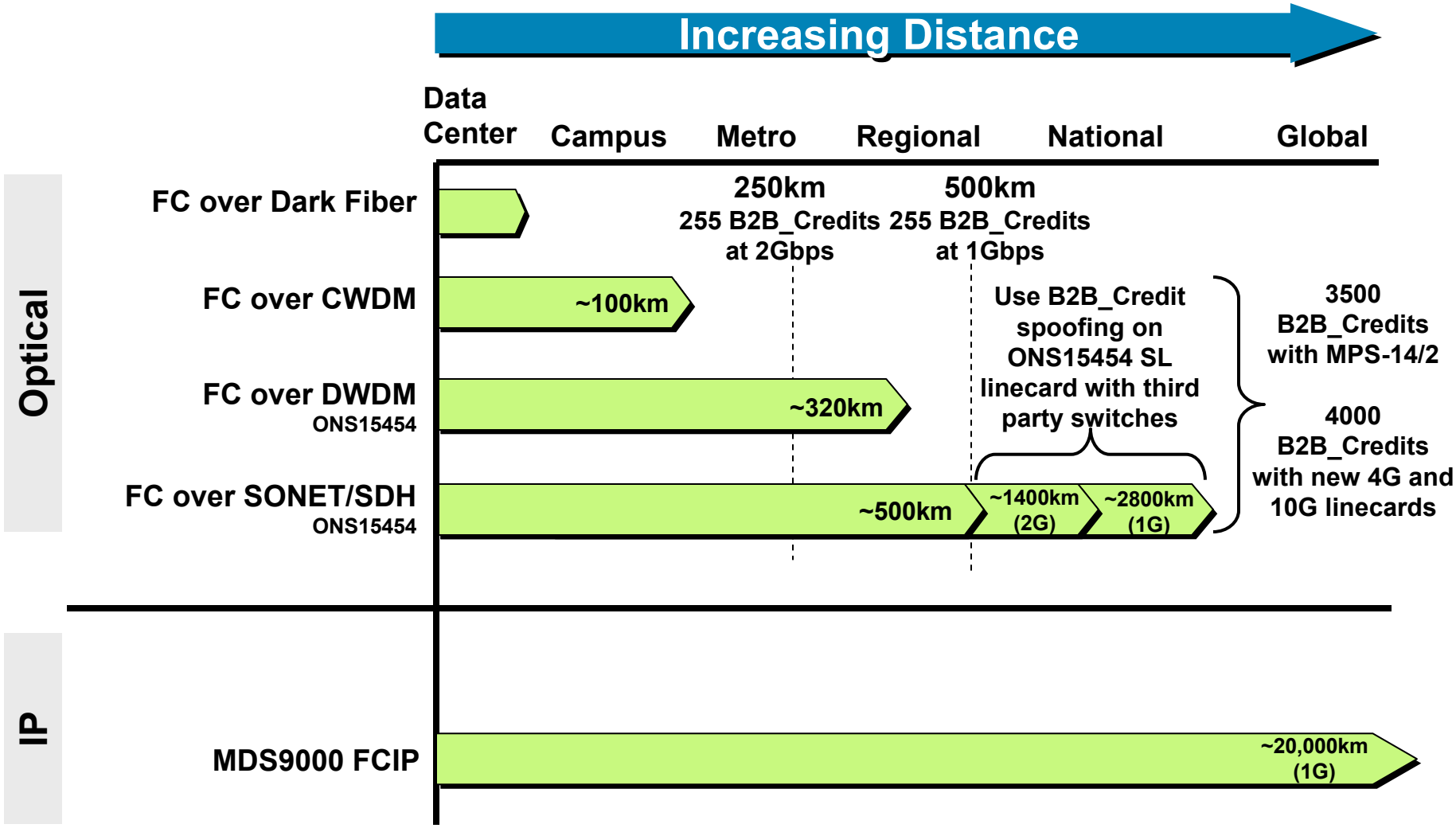
- FC/FICON over CWDM/DWDM
  - MDS 9000 – integrated CWDM
  - MDS 9000 – integrated DWDM

- FC/FICON over SONET/SDH
  - ONS 15454 MSPP with SL card
- FCIP over SONET/SDH
  - ONS 15454 MSPP with CE card
- FC/FICON over DWDM
  - ONS 15454 MSTP

- FC/FICON over IP
  - MDS 9000 – integrated FC, FICON over IP

DC Back-end Interconnect

Distance Summary with MDS9000 SAN Switch



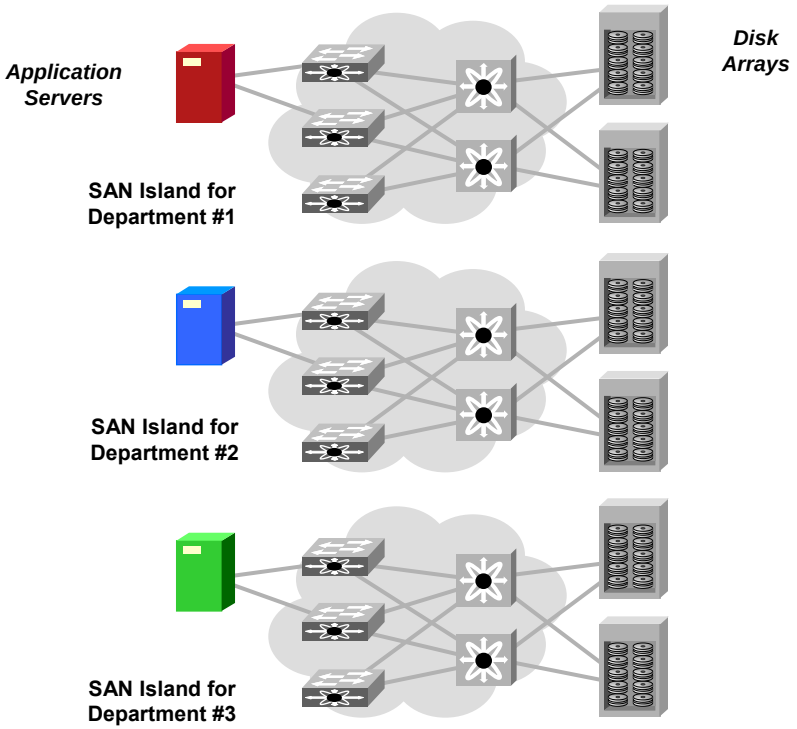
Storage + Optical Synergies

Looking For Synergies

- Consolidation & High Availability: VSANs & PortChannels
- Quick Failover: Port Tracking and Port Squelching
- Going The Distance: Buffer to Buffer Credits Spoofing
- Deeper Optical Integration: colored transceivers

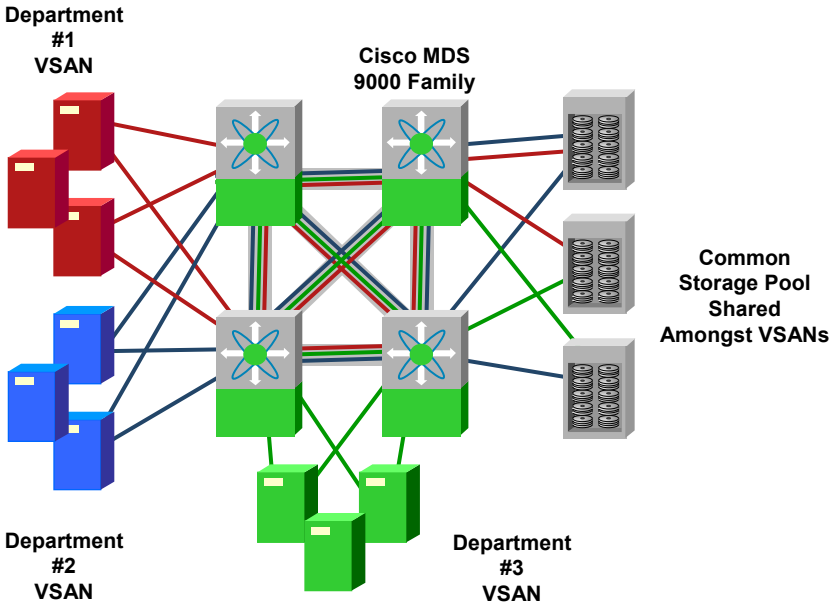
From SAN Islands to Virtual SANs

Application/Department based SAN Islands



- Separate Physical Fabrics
- Ports are Over-Provisioned
- Many Switches to manage

Consolidated Fabric w/ VSANs



- Common Redundant Infrastructure
- Ports Provisioned Non-Disruptively
- Few Switches to manage

EISLs and TE_Ports (VSAN Trunking)

The Virtual SANs feature consists of:

1. Hardware-based frame tagging of traffic belonging to different VSANs

   Add 8 bytes to FC frame size

2. Creation of independent partition of Fibre Channel services for each VSAN:

   Zone server, name server, management server, principle switch election, etc.

No change to end nodes (hosts, disks, etc)

Multiple VSANs can be carried over the same physical link (VSAN trunking):

1. The Trunking E_Port (TE_Port)

   Negotiated between MDS 9000 switches – default

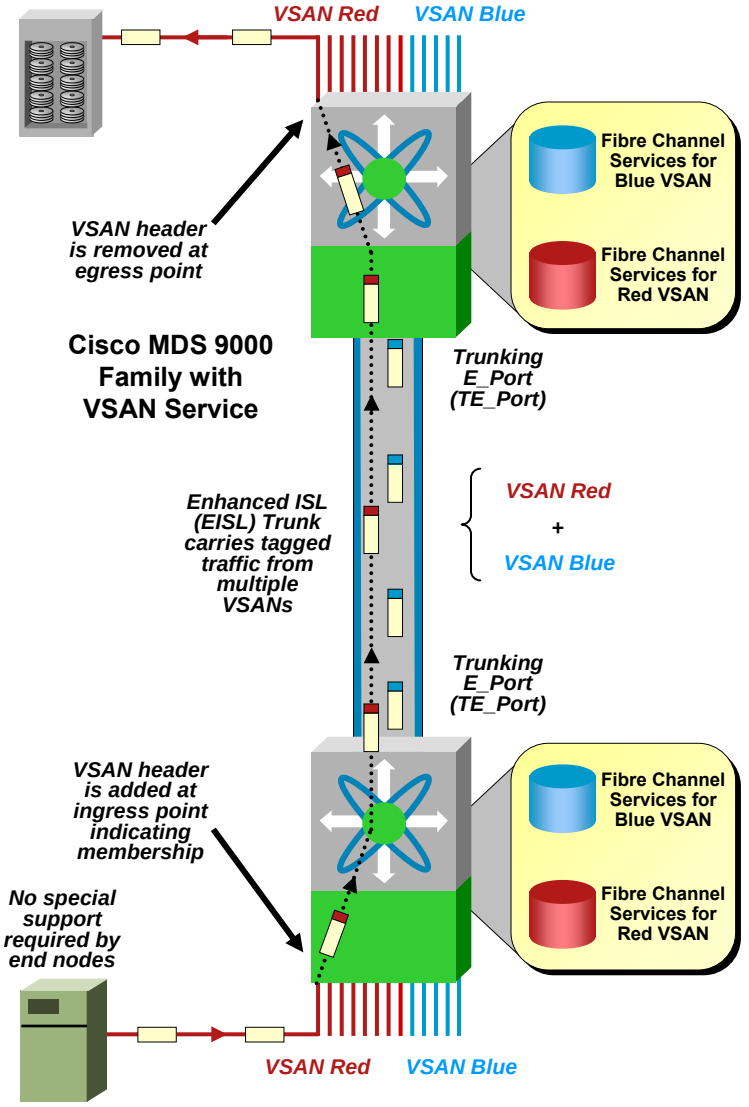
   Carries tagged frames from multiple VSANs

2. The Enhanced ISL (EISL) link

   The resultant link created by two connected TE_Ports

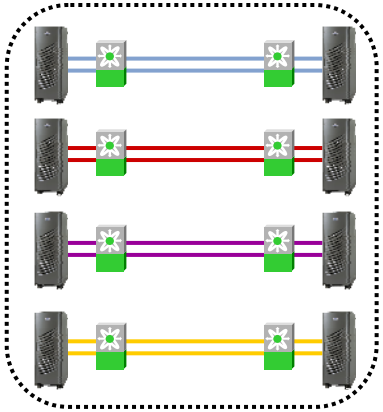
   Superset of ISL functionality

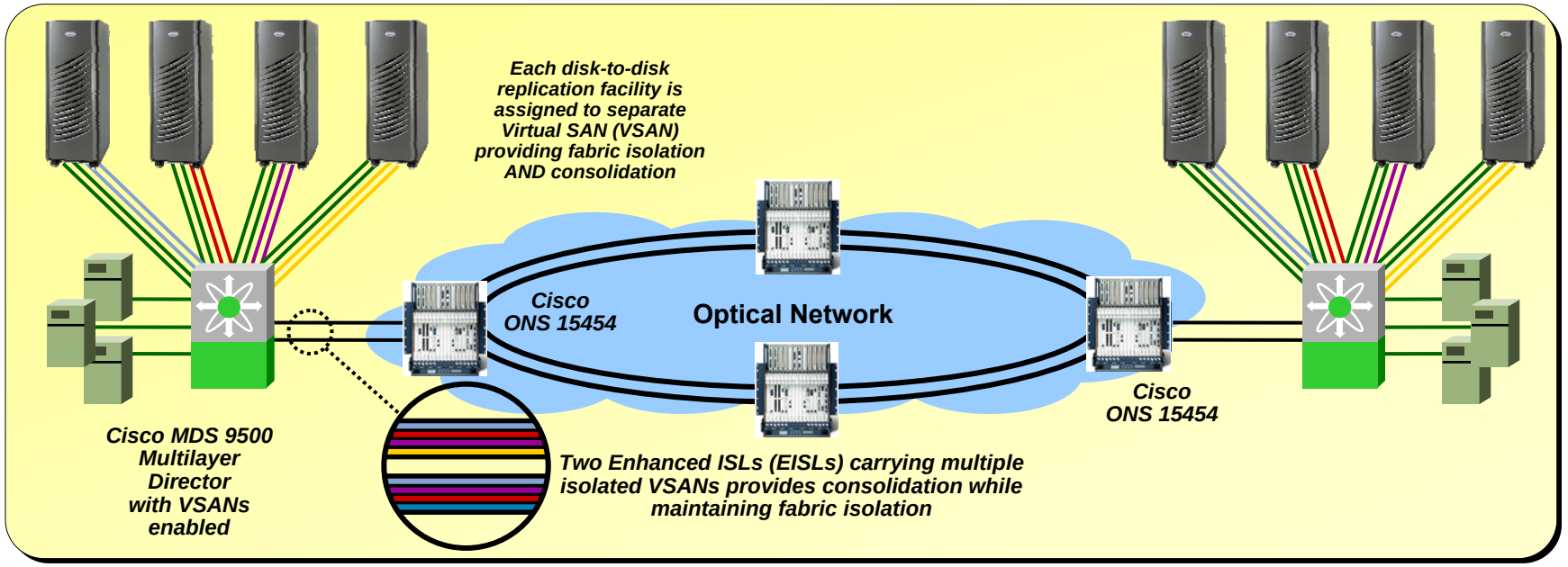
   Can be extended over distance (DWDM, FCIP, etc)



ONS15454: VSAN-Proof Optical Transport

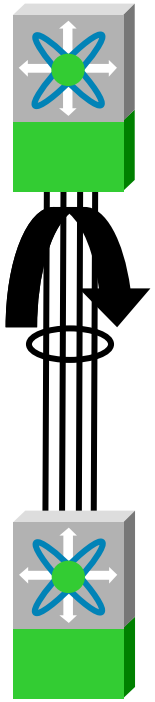
- **Cisco MDS 9000 Family VSAN Feature enables consolidation of services onto fewer wavelengths**
- Strict isolation still maintained to isolate connections
- ONS15454 ASICs designed for VSAN support
- High availability architectures can be used





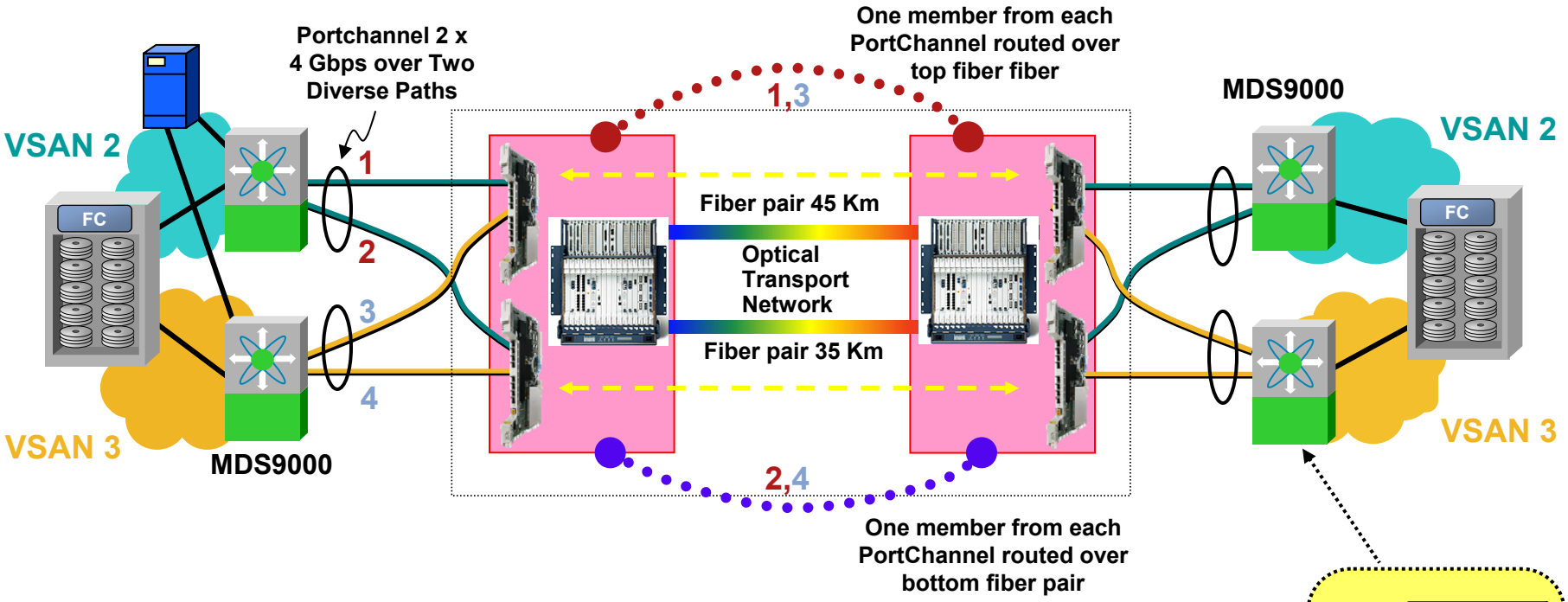
ISL PortChanneling

- A PortChannel is a logical bundling of identical links
- A PortChannel provides:
  - higher aggregated bandwidth with load balancing
  - higher availability
  - quicker recovery
- Treated as one logical ISL by upper layer protocols (FSPF)
- Can use up to 16 links in a PortChannel (160Gbps max)
- Can be formed from any ports on any linecard – HA enabled
- Exchange-based in-order load balancing
  - Source/Destination FC_IDs
  - Source/Destination FC_ID and Exchange ID (OX_ID)
- Much faster recovery than FSPF-based balancing
- Non-disruptive addition/removal of portchannel members
- Support for VSAN Trunking
- Free of charge with Cisco MDS9000

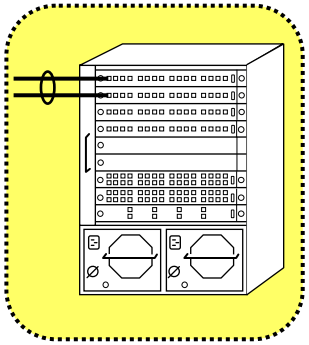


4x2=8 Gbps
PortChannel

High Availability Design: PortChannels and Optical Transport



- PortChannels support unequal length routes
- PortChannels offer active/active load balancing
  - Optical protection is active/standby
- Resilience to failures (fiber cut, transponder or FC port down)
  - 2-member Portchannel—diverse paths
  - Portchannel appears as single logical link
  - Load balance by Src/Dst/OXid (or Src/Dst) - unidirectional per VSAN
  - VSAN trunking over Portchannel for enhanced security
  - Fiber cut will halve transported capacity but not alter Fabric topology—no FSPF change
- Optical Protection options also available: Client 1+1, splitter, Y-cable

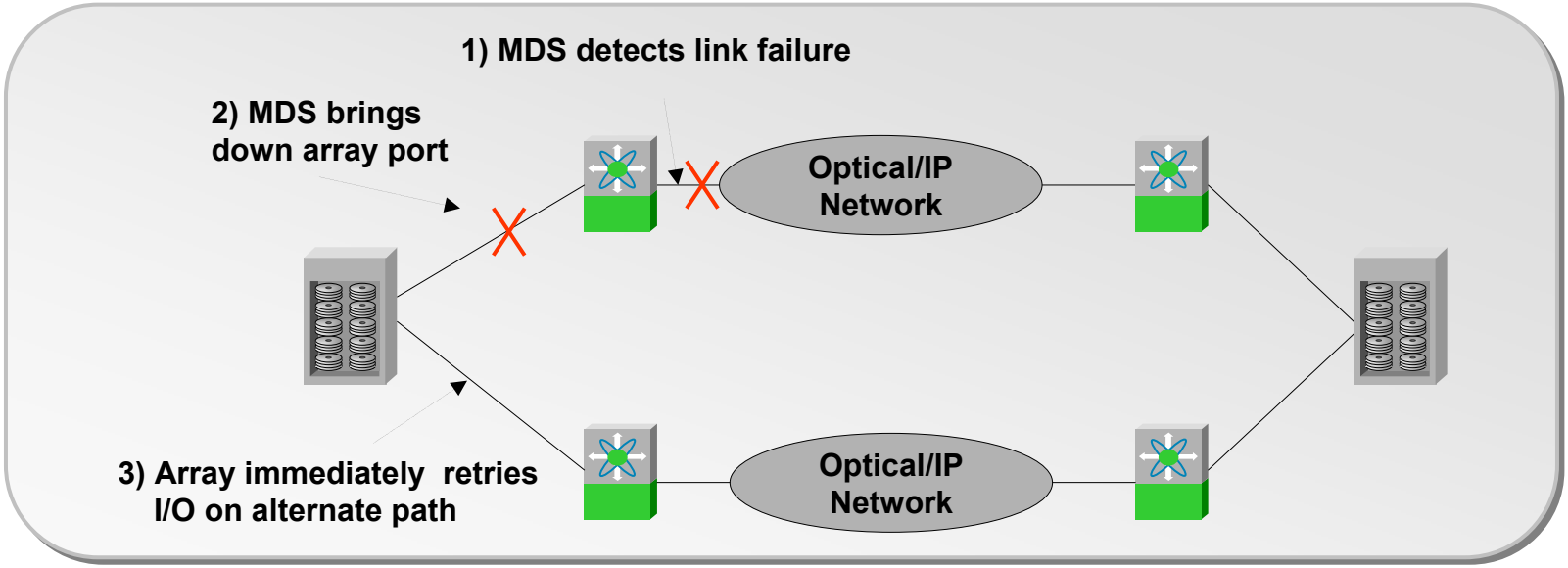


PortChannels are built from ports on different switching modules for higher availability

Looking For Synergies

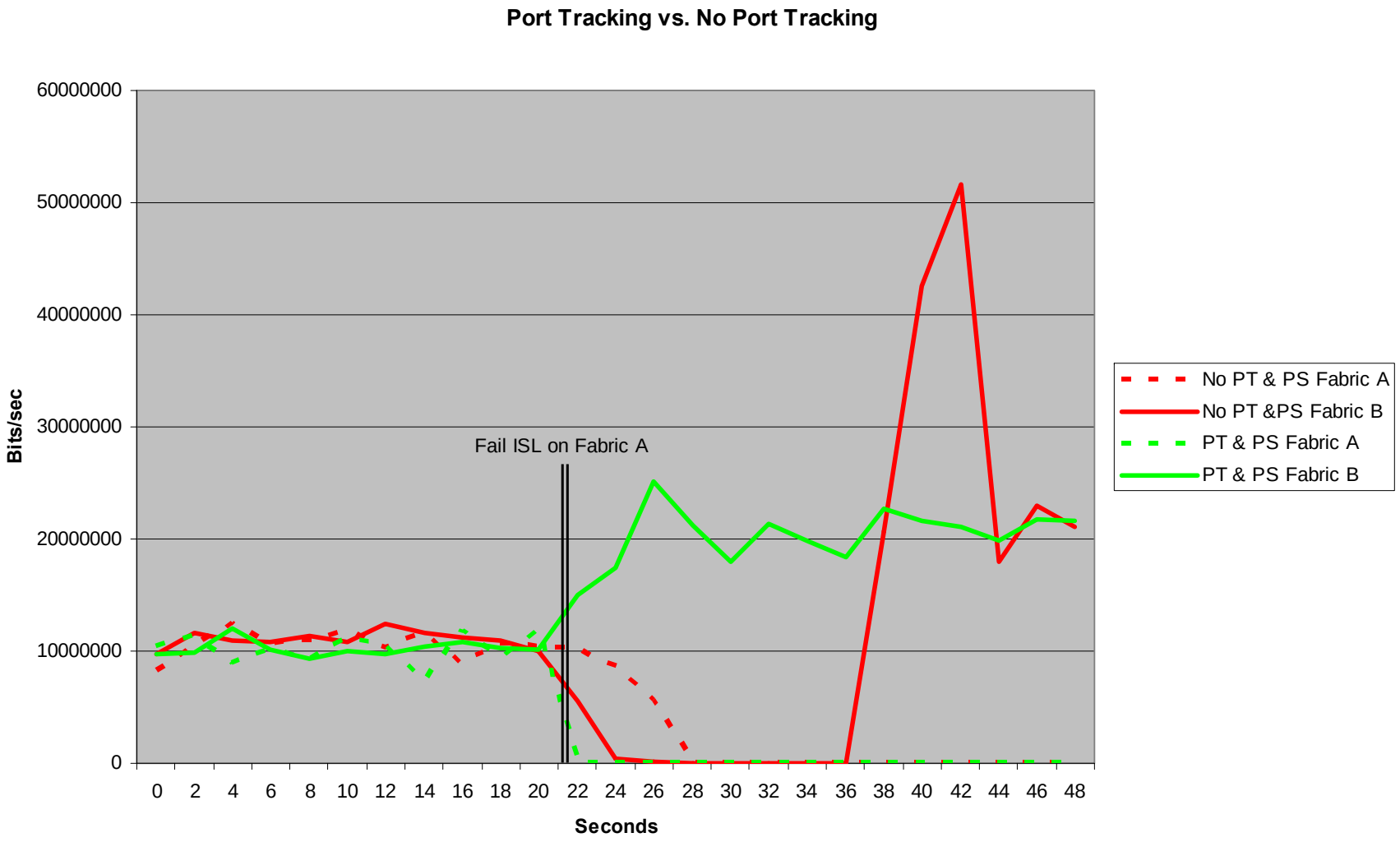
- Consolidation & High Availability: VSANs & PortChannels
- Quick Failover: Port Tracking and Port Squelching
- Going The Distance: Buffer to Buffer Credits Spoofing
- Deeper Optical Integration: colored transceivers

Port Tracking:
Improving SAN Extension Solutions



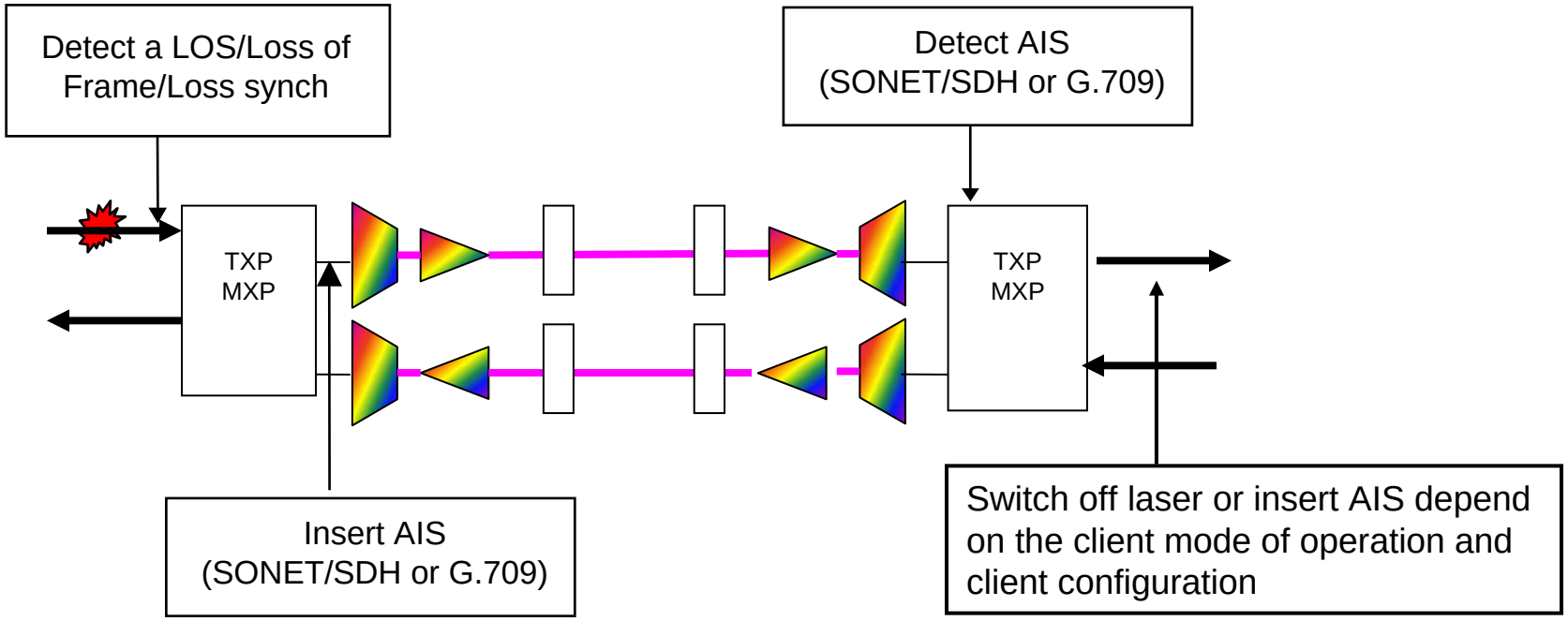
- For a failure of direct link to array, recovery can be immediate
- For a failure of remote link (e.g. ISL), arrays recover via SCSI I/O timeouts. However, this can take several seconds or longer (depends on TOV, RSCN, replication software…)
- PortTrack feature in SAN OS 2.0 and above addresses this by monitoring the WAN/MAN link and if it detects a failure, it will bring down the corresponding link directly connected to the array
- After detecting a directly connected link failure, the array will re-direct the I/O to another link without waiting for the SCSI I/O to timeout
- Same apply to recovery for host-disk connectivity (with Multipath software onboard)

Example of Port Tracking Benefit

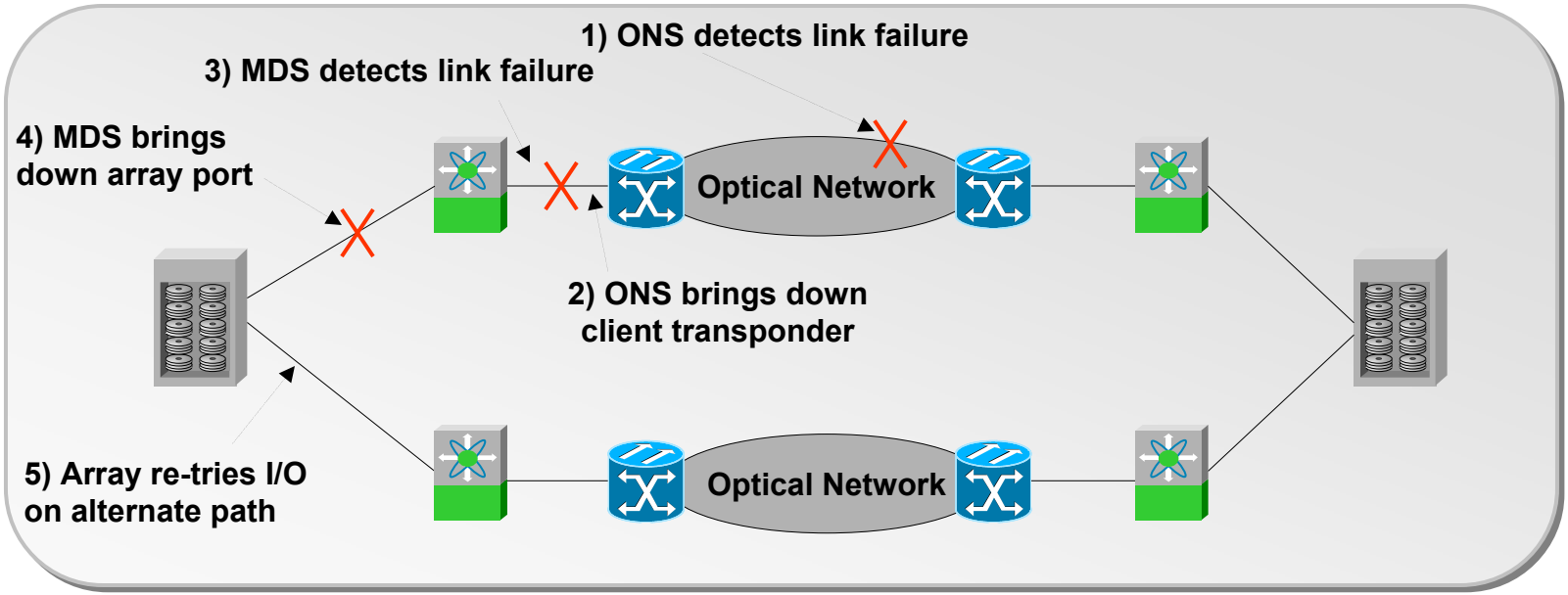


ONS15454: Squelching Mechanism

- **Squelching mechanism is configurable per port**
- **Option to make remote port to send AIS or shut down**
- **Squelching (shut down) is supported for FC/GE signals on all transponder/muxponder when used in 3R mode**
- **Quick activation (msec)**



Port Tracking and ONS15454 Squelching



- The MDS port tracking feature can be used in conjunction with ONS15454 port squelching feature to further track failures in the network, improving the ability to detect failed paths
- Squelching mechanism and port-tracking offer end to end path failure detection and speed up failover

Looking For Synergies

- Consolidation & High Availability: VSANs & PortChannels
- Quick Failover: Port Tracking and Port Squelching
- Going The Distance: Buffer to Buffer Credits Spoofing
- Deeper Optical Integration: colored transceivers

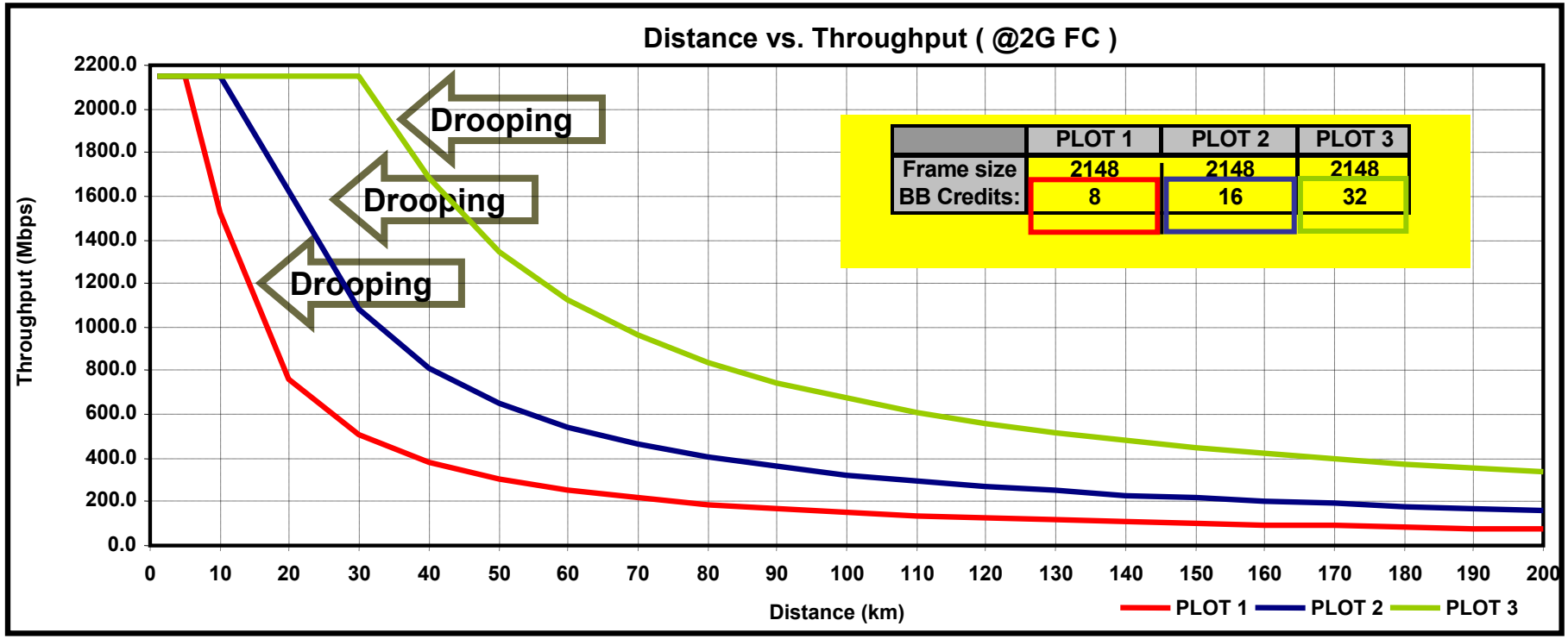
FC over Optical: Distance Limitations

Can I extend the distance at pleasure with optical?

- Power budget limitations
  - Power, sensitivity, BER, OSNR, dispersion
- Application limitations
  - Sync vs. async
- Protocol limitations
  - Buffer to Buffer credits

FiberChannel Flow Control and Drooping

- Buffer to Buffer Credits are the Flow Control mechanism of FC
- Near end system must wait for R_RDY's to continue data transmission
- Full throughput cannot be supported beyond a distance based on the buffer capacity (drooping effect)
- Optical systems can provide Buffer to Buffer Credits Spoofing



How many B2B Credits Do I Need?

- 1G FC: 1 B2B for 2km at max frame size
- 2G FC: 1 B2B for 1 km at max frame size
- 4G FC: 2 B2B for 1 km at max frame size
- 10G FC: 6 B2B for 1 km at max frame size

Example: 64 B2B credits available per port
4G FC speed
Maximum distance of 32 Km with maximum frame size

$$\frac{64}{2}\frac{credits}{\frac{credits}{km}@4Gbps} \approx 32\ Km$$

Why B2B Credits Spoofing on Optical Systems?

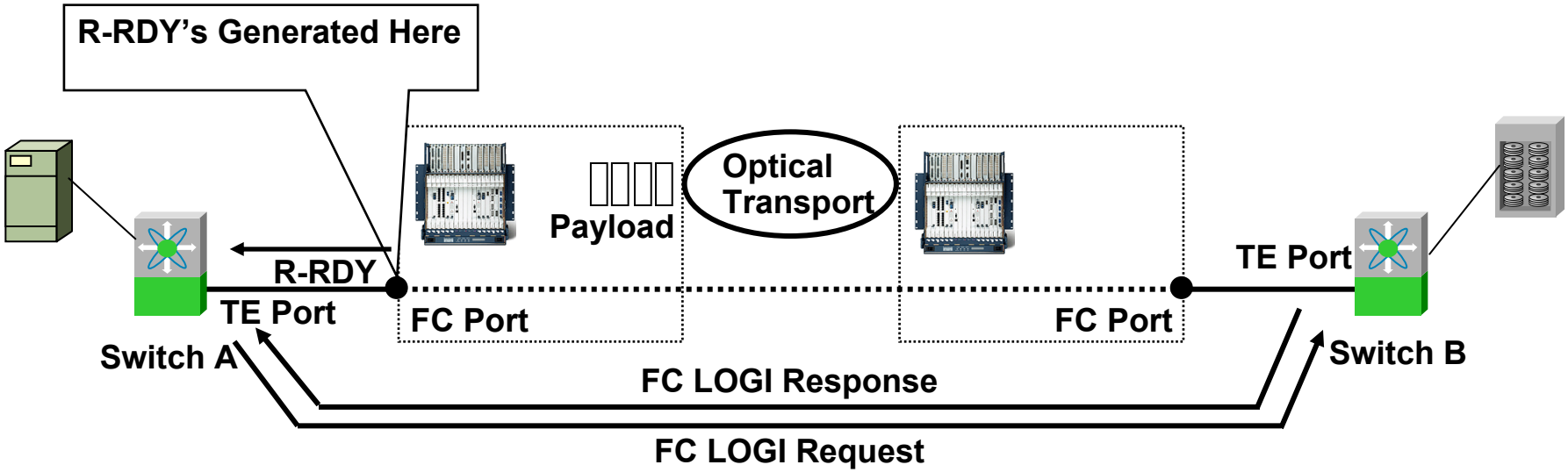
Problem:

- Old switches typically have a limited number of buffer to buffer credits (32-64)
- New switches may provide more buffer to buffer credits but a licence fee is required

Solution:

- Use Buffer to Buffer Credits Spoofing on Cisco ONS15454

SAN Extension with BB Credits Spoofing



- B2B Credits spoofing is a layer 1 technology (only flow control and error monitoring frames get manipulated)
- Layer 2 FC protocol is NOT terminated at the optical node
- End systems interoperate through solution transparently
  - E port on switch A talks to E port on switch B
  - Example: FC LOGI procedure
- Allows for greatly extended distances with maximum FC throughput
- Specific extended distance depends on linecard and bit rate

Looking For Synergies

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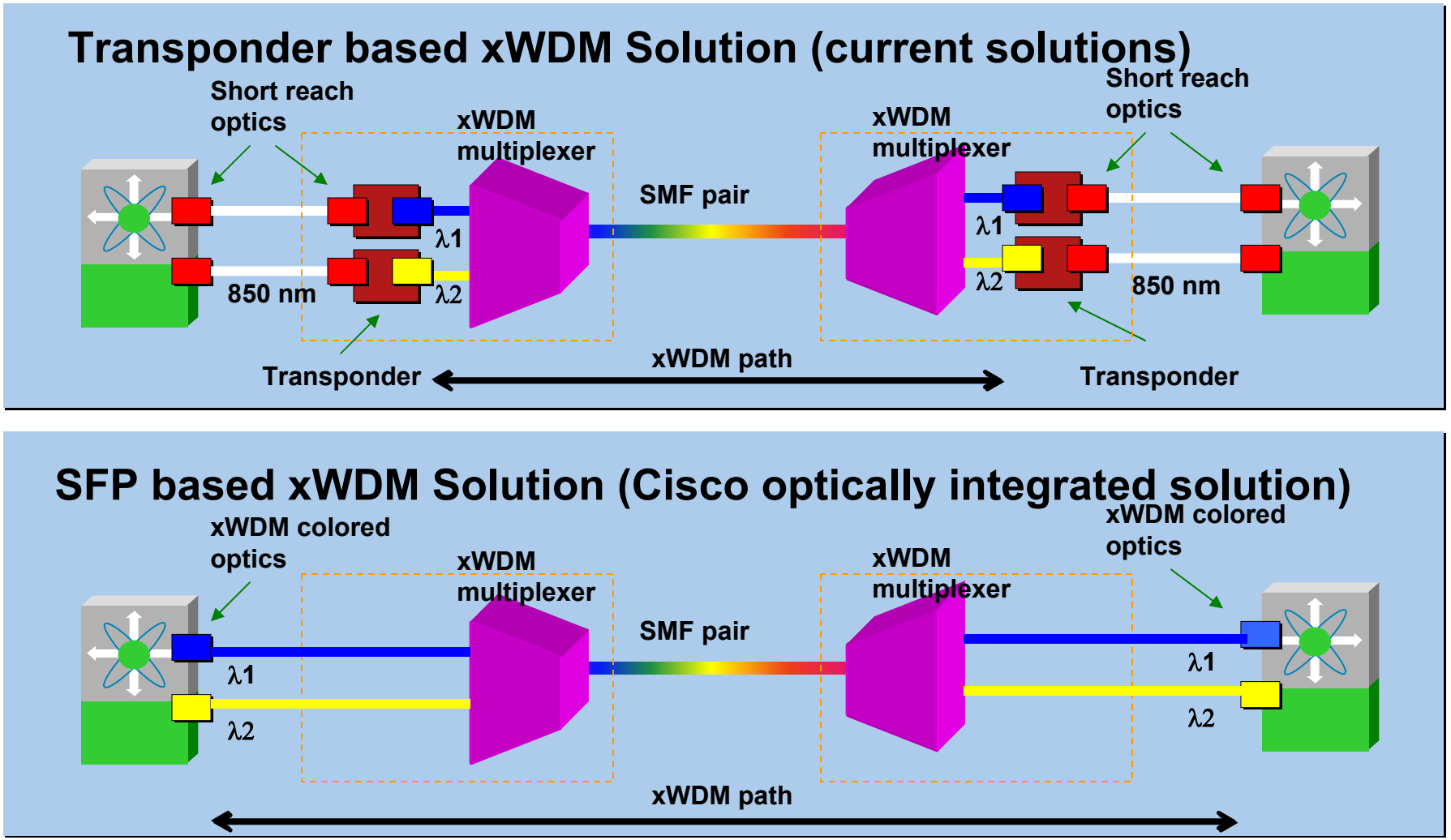
Transponder vs. Integrated SFP Solutions



Gigabit Ethernet Colored Transceivers

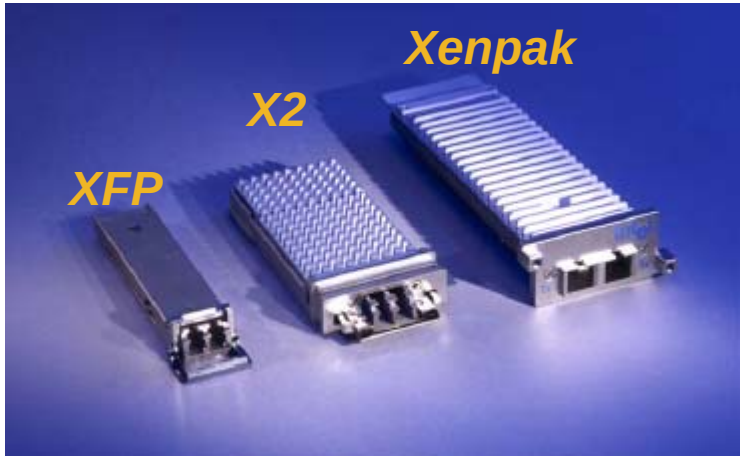
- Gigabit Interface Converter, a.k.a. GBIC: it is an industry-wide standard (or Multi-Source Agreement—MSA) for Fibre Channel and Gigabit Ethernet transceivers.
  (GBIC specification document: ftp://ftp.seagate.com/sff/SFF-8053.PDF)

- Small Form Factor Pluggable, a.k.a. SFP: it is another standard MSA to support a large number of applications including Gigabit Ethernet (SFP specification document: ftp://ftp.seagate.com/sff/INF-8074.PDF).

Both CWDM and DWDM Versions Exist

10 Gig Ethernet Colored Transceivers

Three main types of 10GbE Pluggable MSAs:

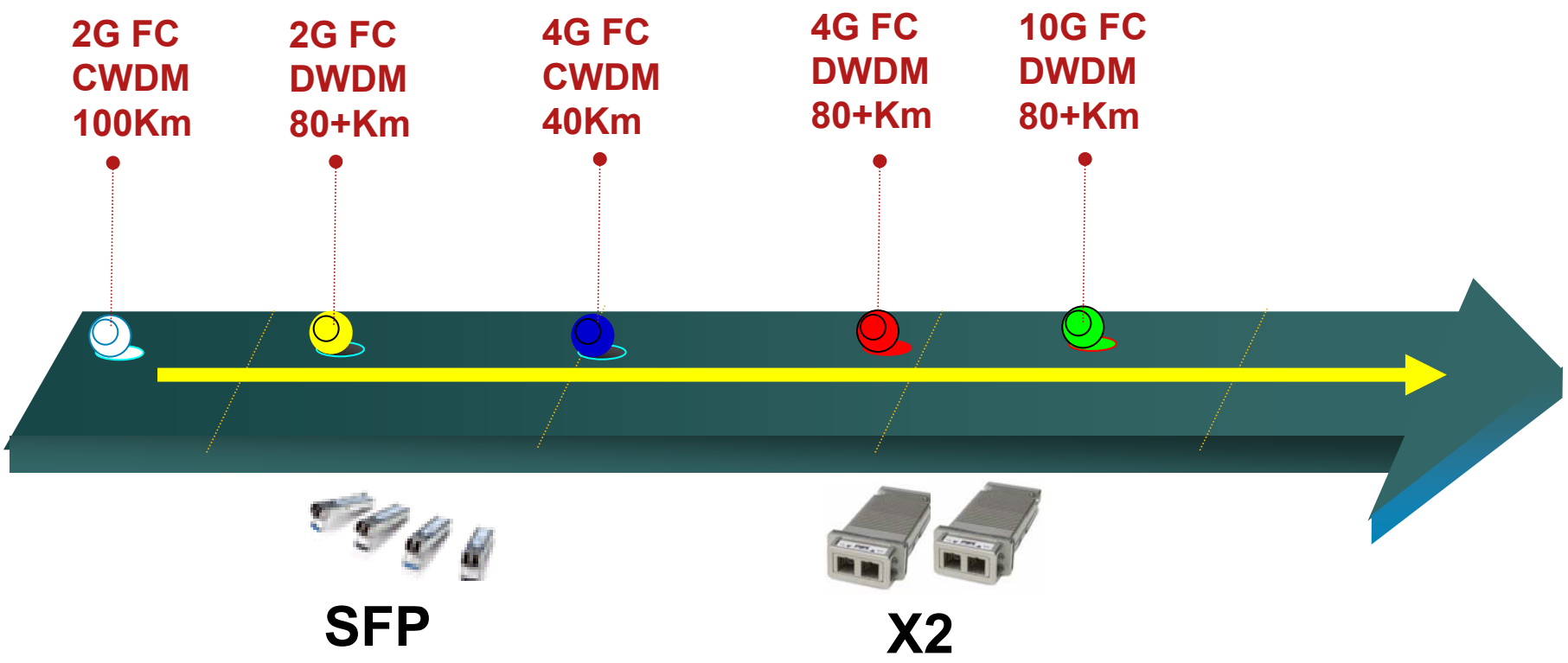


- Xenpak (www.xenpak.org)
- X2 (www.x2msa.org)
- XFP (www.xfpmsa.org)

Supporting Platforms	Catalyst 6500	Catalyst 4500	Catalyst 3xxx	Next Gen. 10G Routers
Xenpak	√		√	
X2		√		
XFP				√

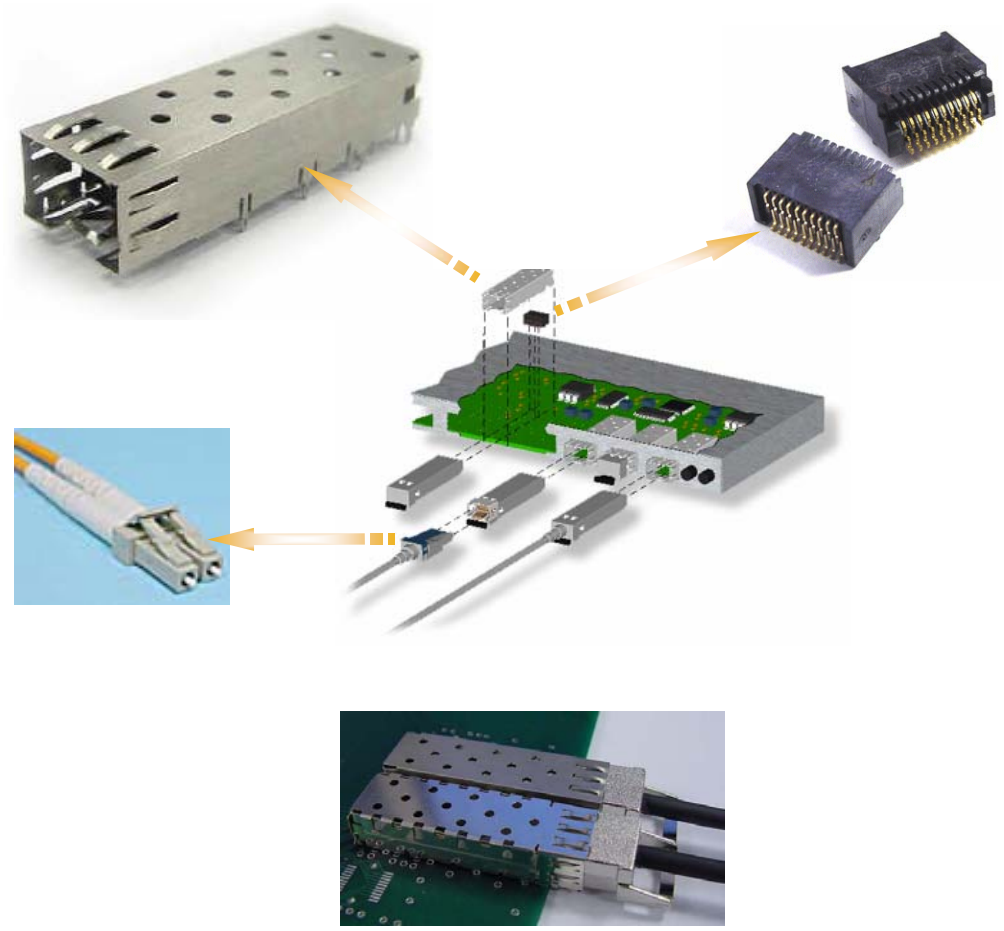
Only DWDM Version Available/Planned

Fibre Channel Colored Transceivers



Colored Transceivers Popularity is Growing
Mix & Match Colored Transceivers and Transponders

Not All Pluggables Are Born Equal



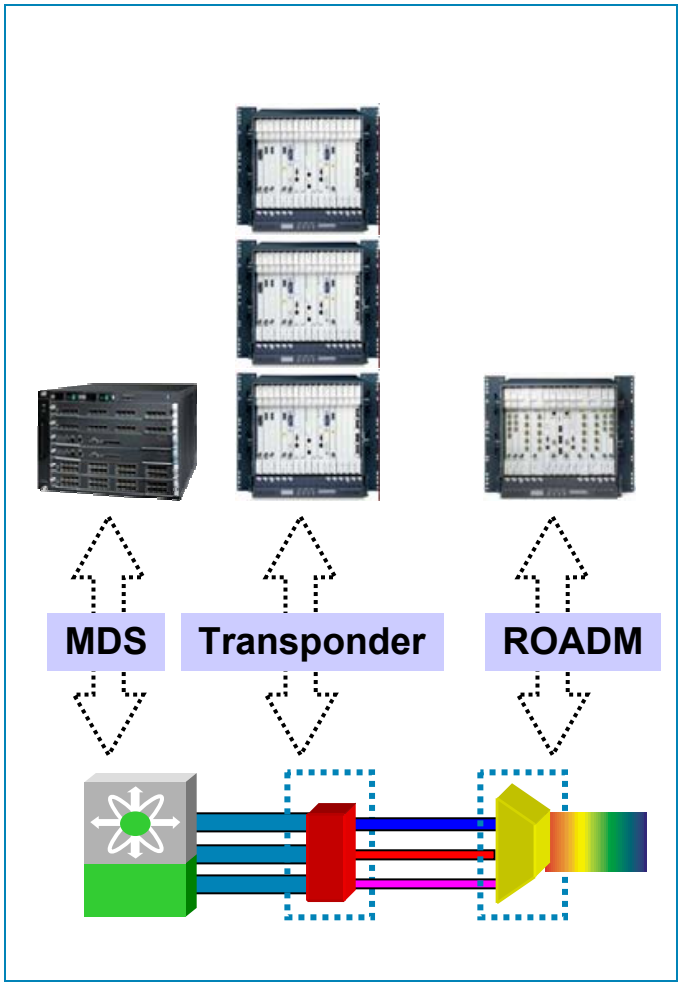
- Colored pluggables are more demanding than popular grey pluggables
  - Higher consumption
  - Higher heat dissipation
  - EMI challenges
- First to market does not mean best
  - Reliability (MTBF)
  - Testing (EMI, ESD, laser safety, software)
  - Optical Performance

Digital Optical Monitoring (DOM)

- Digital monitoring is a multi-source agreement SFF-8472 (ftp://ftp.seagate.com/sff/SFF-8472.PDF) intended to define a digital interface to access real-time transceivers operating parameters such as:
  - Optical TX power
  - Optical RX power
  - Laser current
  - Temperature
  - Voltage
- DOM makes troubleshooting easier
- In Cisco products DOM is accessible via CLI interface or SNMP
- Support for DOM is product specific

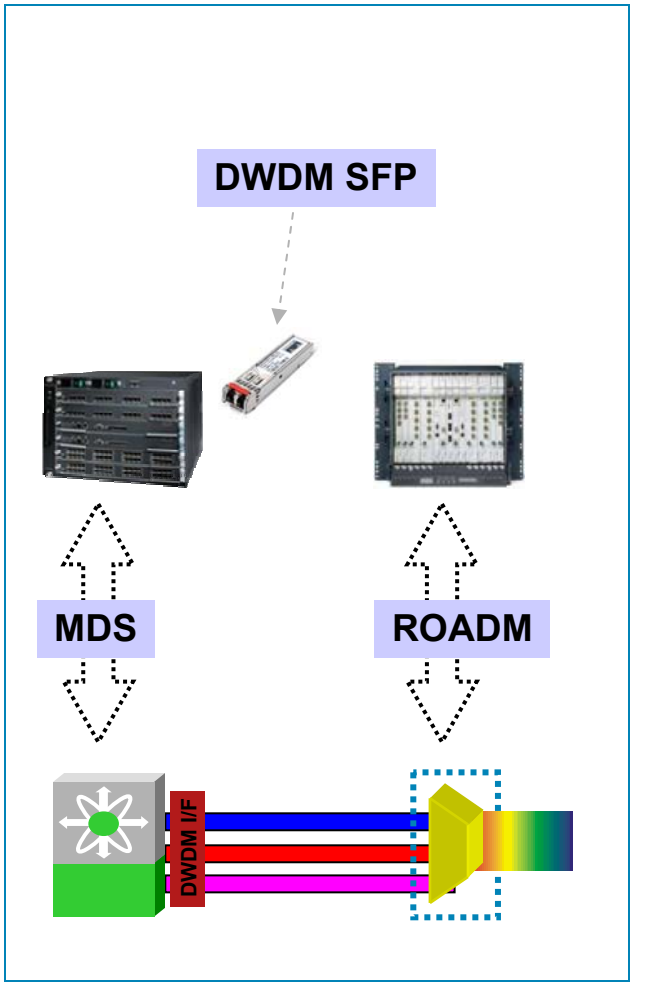
MDS9000 with Integrated DWDM Optics

FC and DWDM - Today



- Lower CapEx
  - Up to 66% less lasers
- Lower OpEx -improved efficiency
  - Fewer shelves, less rack space, less power, simplified management
- Enhanced resiliency
  - Fewer active components, fewer points of failure

FC and DWDM - MDS w/ Integrated DWDM Optics



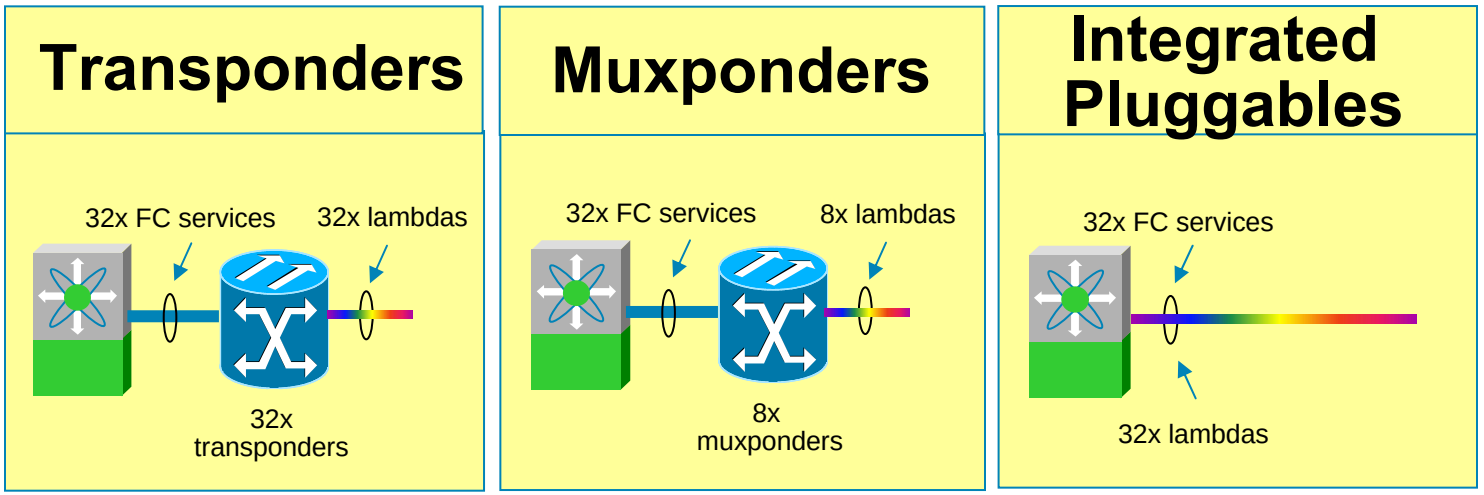
Colored Pluggable Transceivers On Stage

- Pros
  - Reduce network cost and complexity
  - Client-integrated managements of colored interfaces (DOM)
  - Lower latency
  - Reduce spare parts
  - Increase overall reliability (less components)
  - Reduce footprint, power consumption, cooling
  - Flexible deployment (interchangeable pluggables)
  - Well perceived approach from all enterprises
- Cons
  - Blurred demarcation point between enterprise/SP network
  - Lower optical budget and CD robustness
  - Lower service density on the fiber (no muxponding)
  - No per channel splitter protection
  - Lack of tunability

Pluggable SFP

Transponder

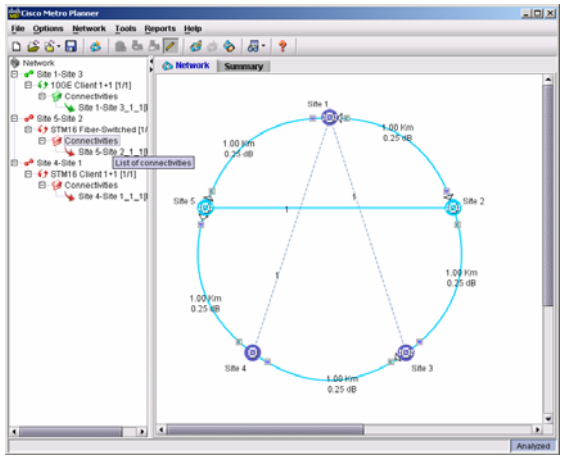
Let's Compare (Example)



Chassis	3	1	0 (100% off)
Power Consumption	1184 W	464 W	32 W (97% off)
Cost/service	19,000$	13,500$	6,000$ (68% off)

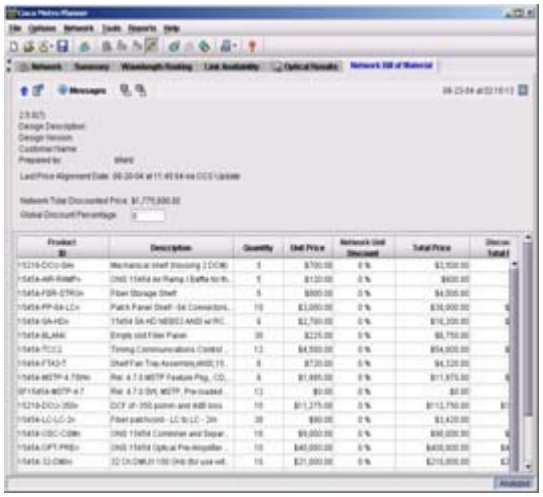
(*) 2G FC services assumed

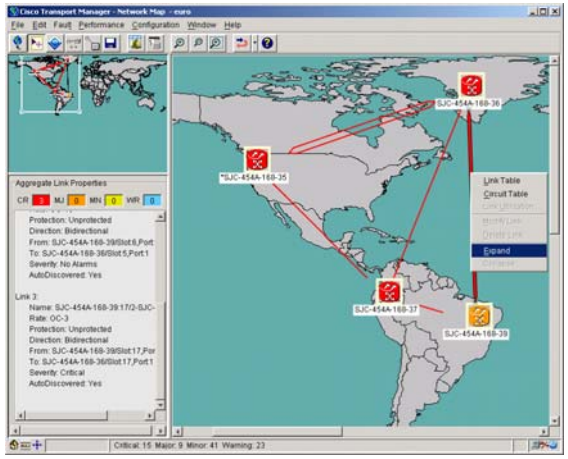
Operational Tools Streamline Deployment Cycle



Planning SAN Extension over DWDM w/Cisco MetroPlanner

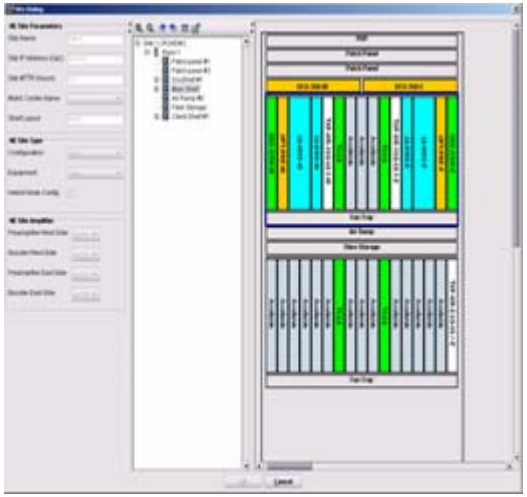
Creates Accurate BOM



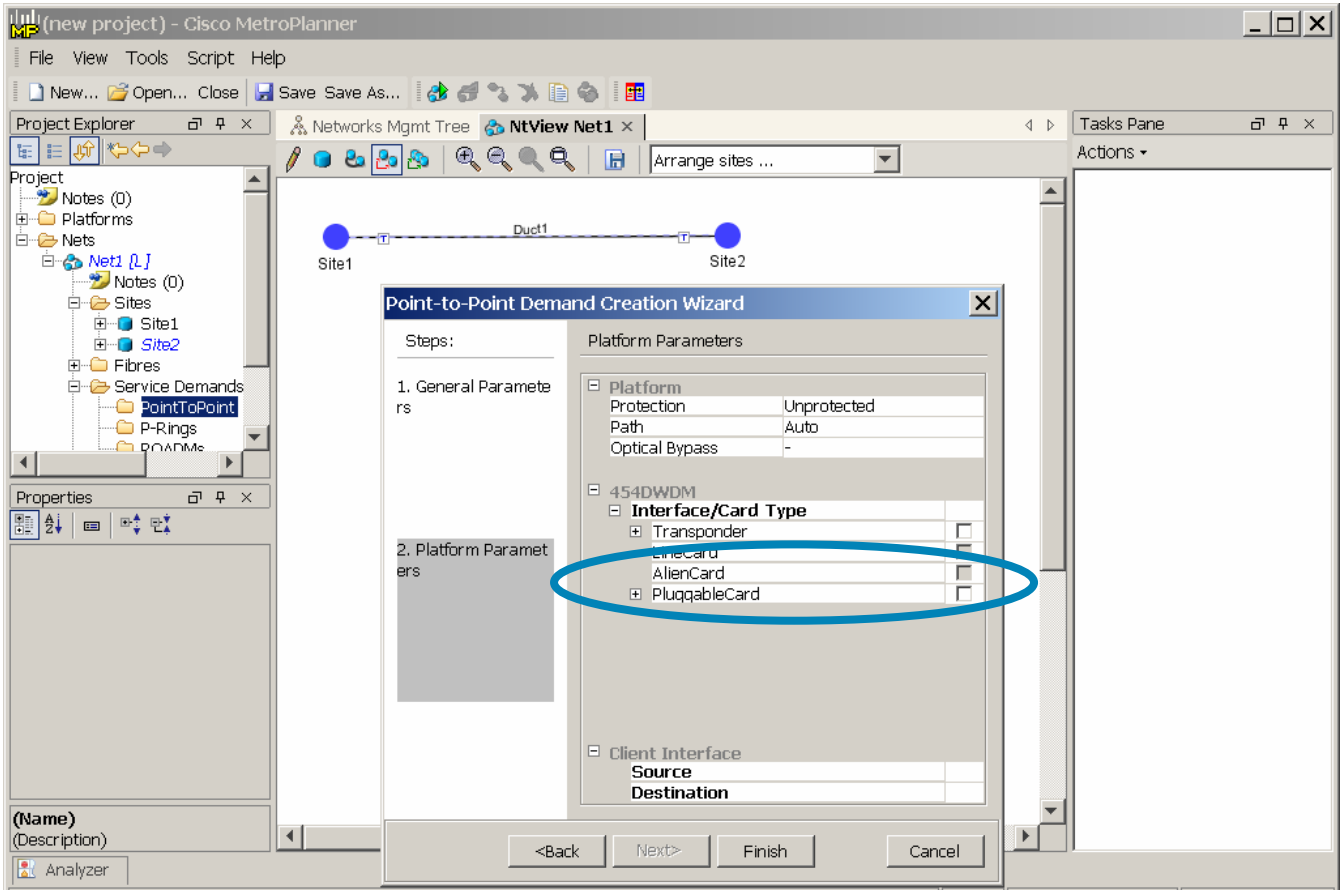


Integrated Element Management

Facilitated Deployment with Nodal Layout



Cisco MetroPlanner Design Tool: Embedded Support For Colored Transceivers

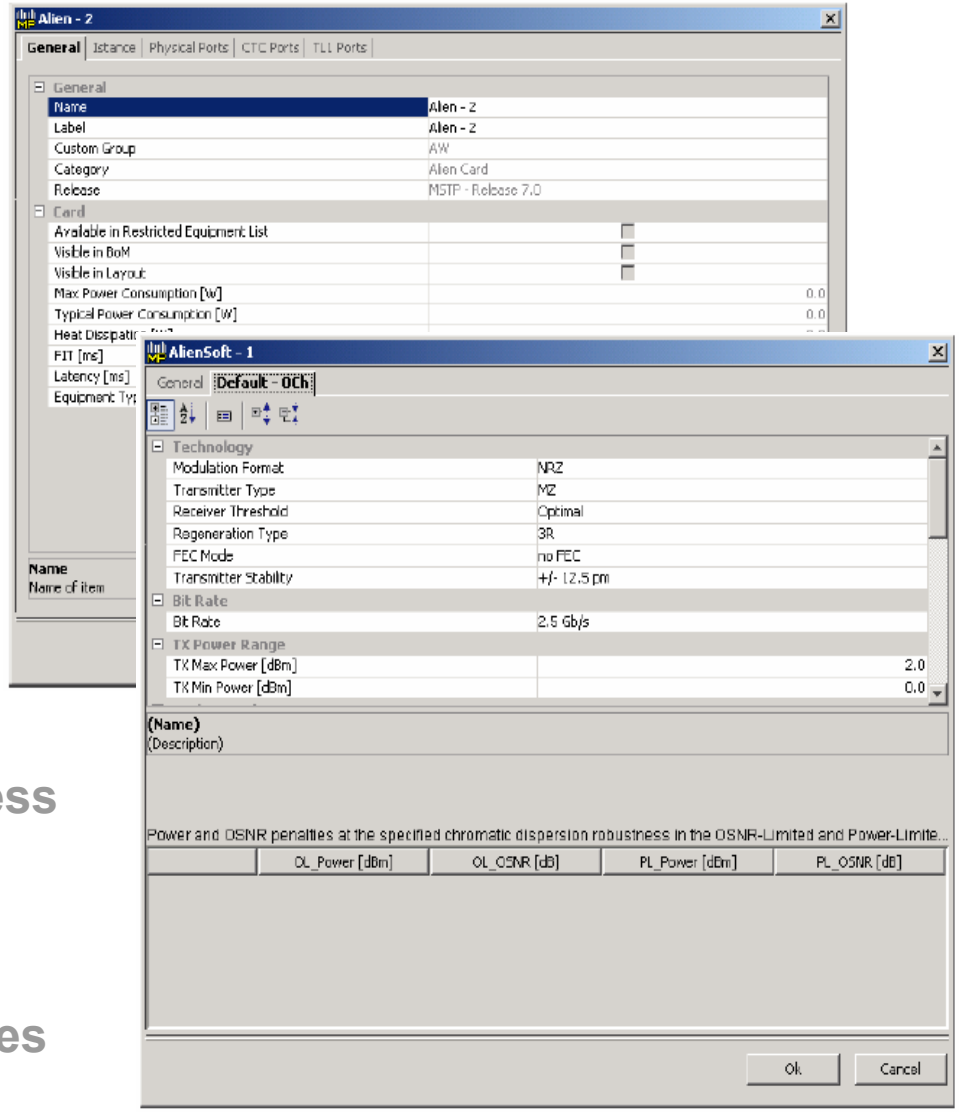


Cisco MetroPlanner can design and validate DC Interconnect solutions over DWDM with both transponders/muxponders and client-integrated colored transceivers

Alien Wavelength Parameters

1. **Technology:**
   Transmitter characteristics:
   - **Modulation format: NRZ / ODB**
   - **Transmitter type: MZ / DML / EML**

   Receiver characteristics:
   - **Receiver Threshold: Opt / Avg**
   - **no-FEC / FEC / E-FEC**
   - **2R / 3R**
2. **Bit Rate**
3. **TX Output Power Range:**
   Pmin ÷ Pmax [dBm]
4. **TX Wavelength Stability: [±pm]**
5. **Sensitivity Back-to-Back**
6. **Chromatic Dispersion Robustness**
7. **Scale Factors for Penalty:**
   F-PPL, F-POL, F-OSNRPL, F-OSNROL
8. **Gaussian X-Talk-penalties**
9. **Single-interfering X-Talk penalties**

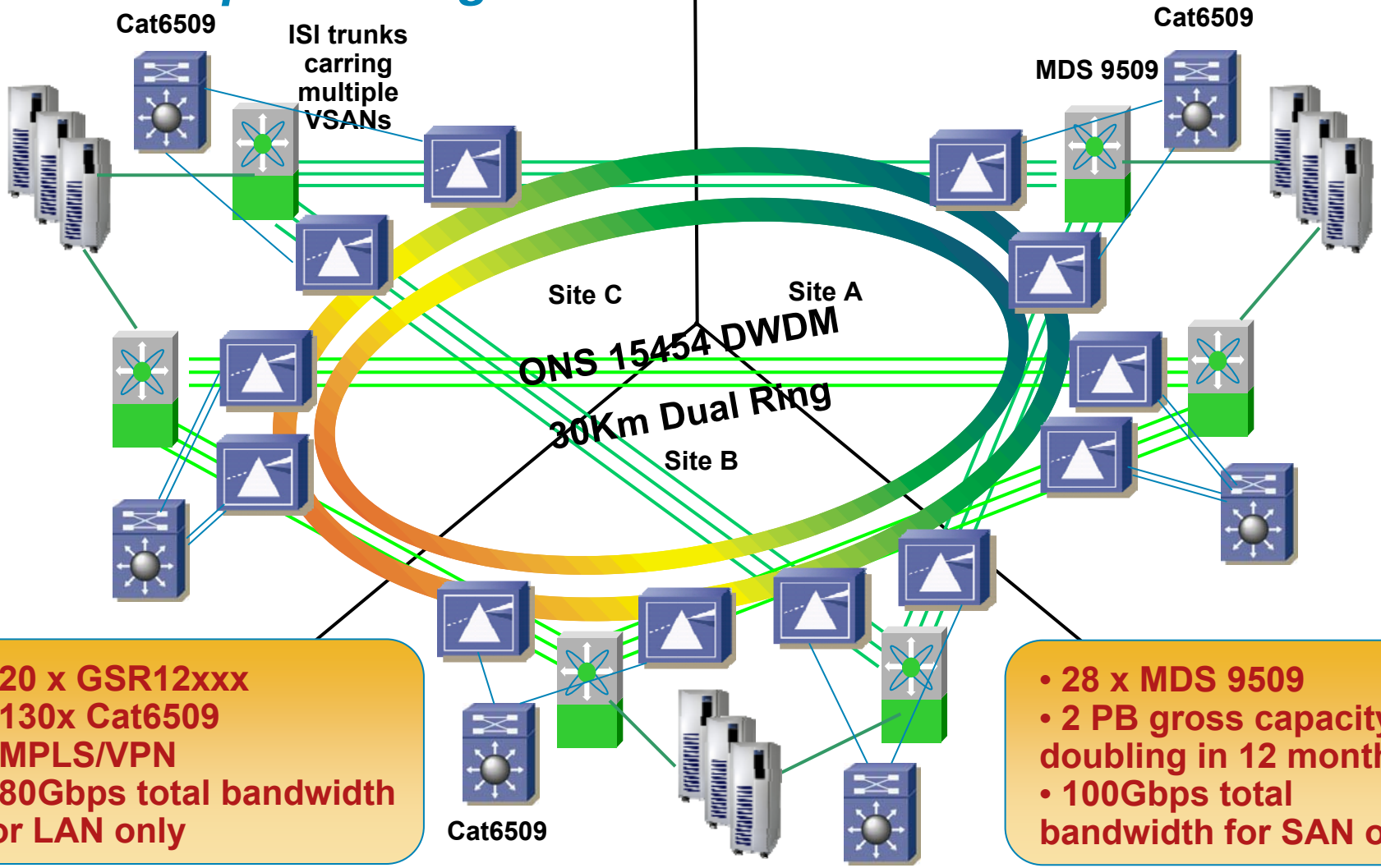


(*) Mandatory item in black

Case Studies

Case Study: Intra-city SAN/LAN Transport

Dual Optical Ring for FC and Ethernet



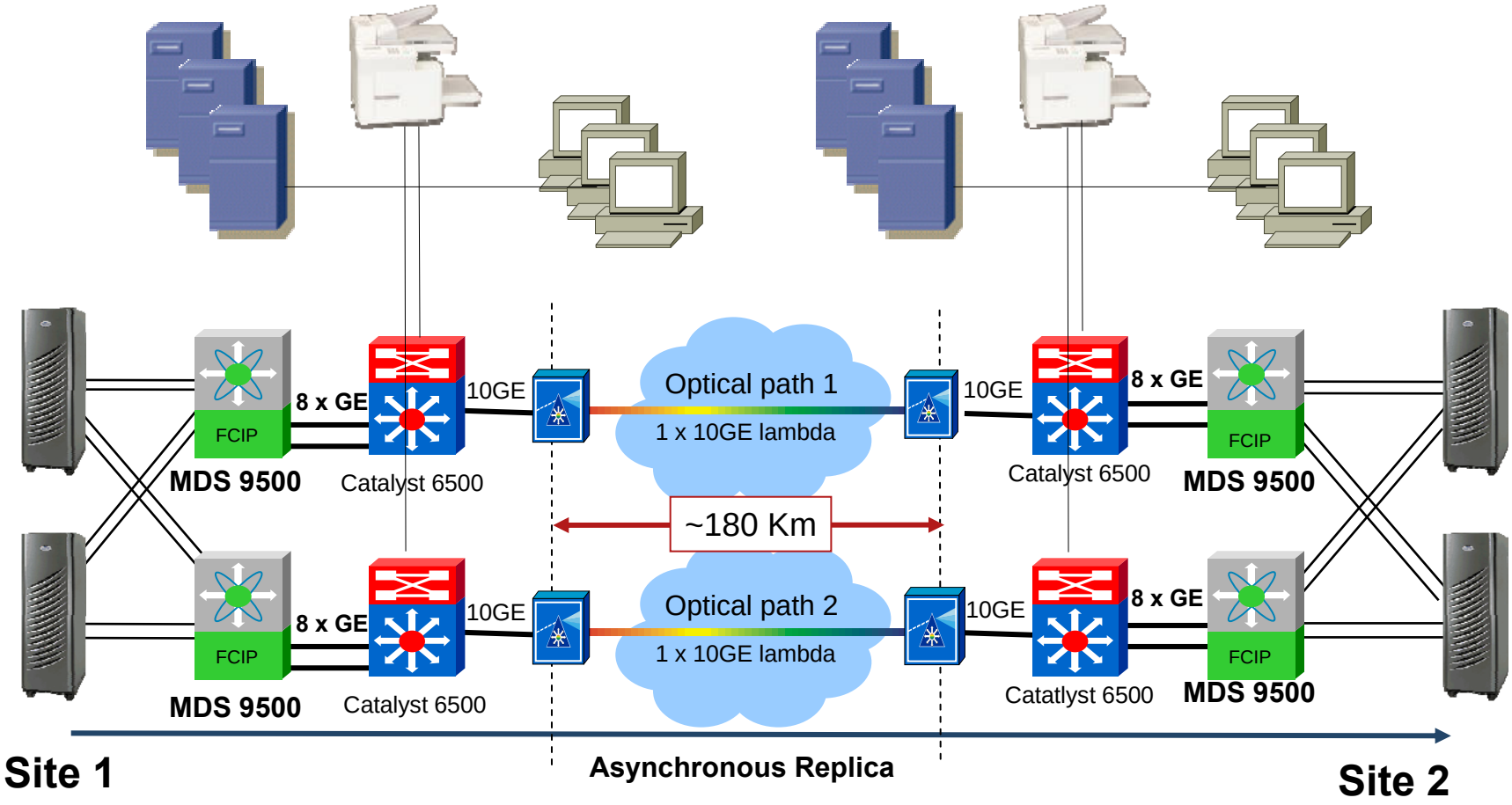
- 20 x GSR12xxx
- 130x Cat6509
- MPLS/VPN
- 80Gbps total bandwidth for LAN only

- 28 x MDS 9509
- 2 PB gross capacity, doubling in 12 months
- 100Gbps total bandwidth for SAN only

Do-It-Yourself Approach

Case Study: FCIP and LAN over Metro DWDM

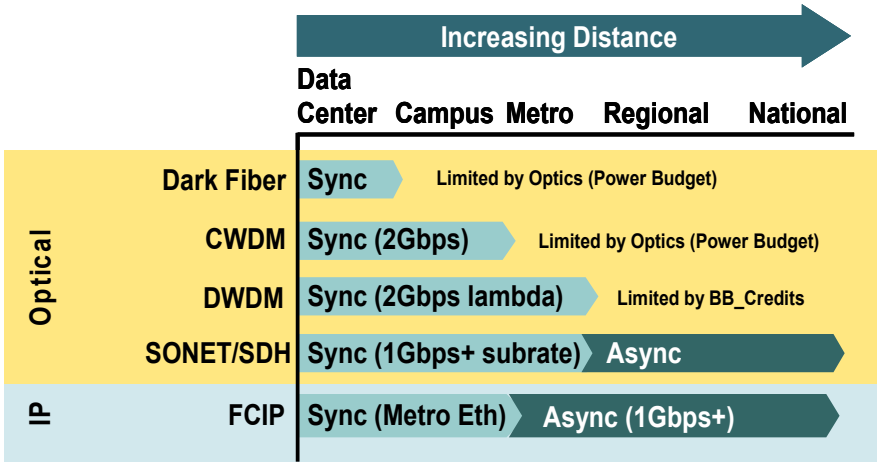
Dual P2P Optical Link for 10G Ethernet



Managed Service Approach

Summary

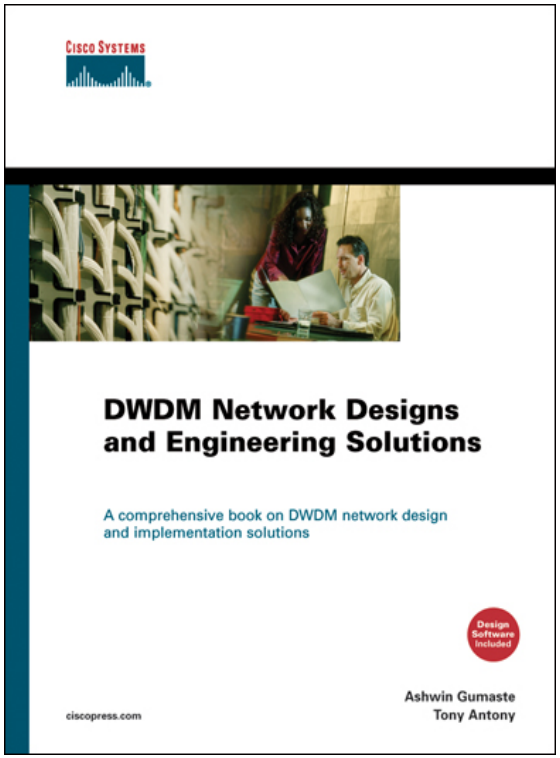
- Many transport alternatives for DC Interconnect
  - Dark Fiber
  - DWDM, CWDM
  - SONET/SDH
  - IP
- Requirements and Budget will drive technology
  - Sync / Async Replication
  - Distances
  - Line price and availability
- Optical is best for highly scalable, multiservice, highly available solutions
- An integrated Storage + Optical solution can provide extra benefits
- Whatever the technology chosen, Cisco has a solution



Recommended Reading

Optical Network Design and Implementation
ISBN: 1-58705-105-2

Storage Networking Protocol Fundamentals
ISBN: 1-58705-160-5



Available on-site at the Cisco Company Store

Meet the Experts
Data Centre

- Victor Moreno
  Technical Leader

Datacenter Optical Infrastructure For The Enterprise

- As storage capacity requirements skyrocket and compulsory regulatory compliance begins to impact the ability to transact business, datacenter infrastructure needs to be extended to remote sites to deliver business continuity and disaster recovery options. Optical transport solutions provide the answer while satisfying the stringent requirements of high-end implementations.
- This session will review various SAN extension options and demonstrate the benefits of deploying optical technologies. Dark fiber, CWDM, DWDM, SDH and FCIP will be covered. In addition, the interaction with vital storage networking capabilities such as Virtual Storage Area Networks (VSANs), PortChannels, Buffer-Credits and more will be discussed.