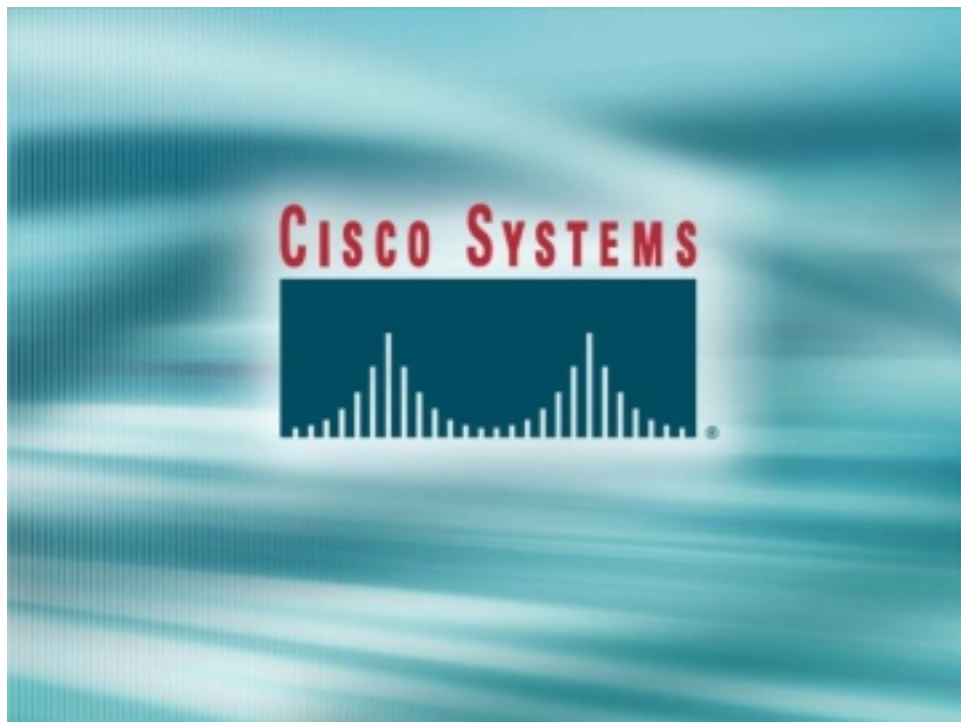
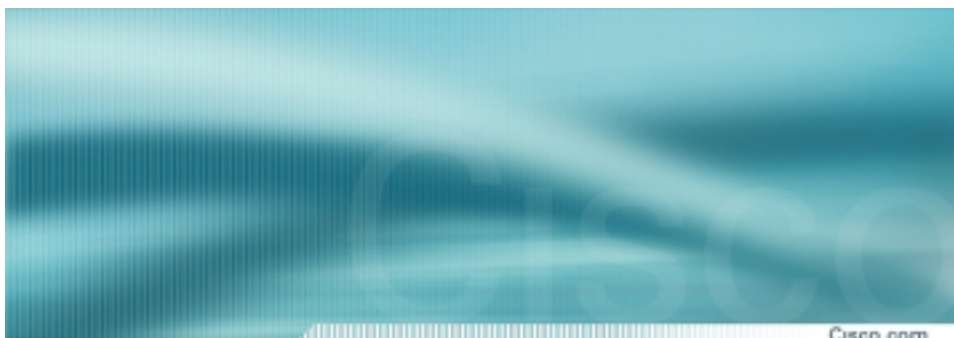




# IP + Optical Big Bang Seminar 2001





# Cisco DWDM System Launch

*Seung-Byoung Park,  
SE, Cisco Korea*

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3

## AGENDA



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- Introduction “DWDM”
- Core DWDM Overview
- Metro DWDM Overview
- Summary

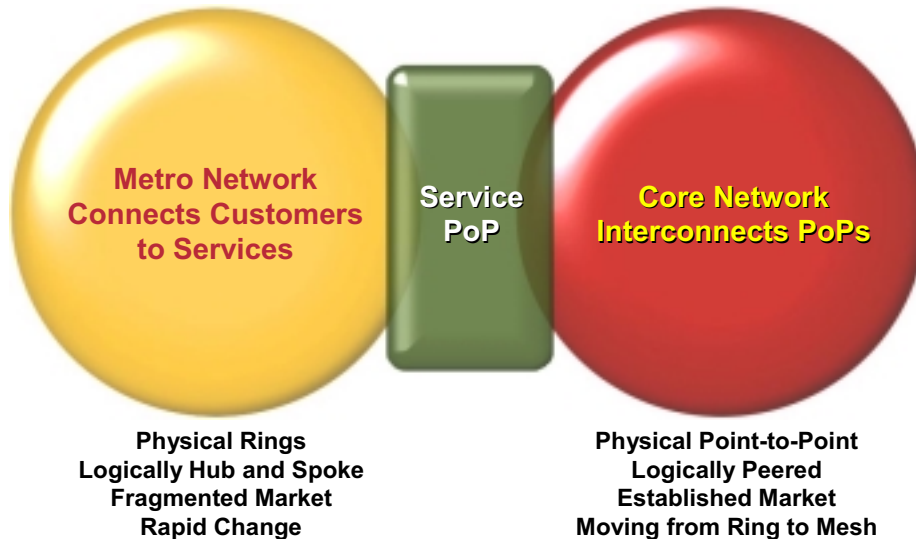


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## IP+Optical Metro and Core Architecture



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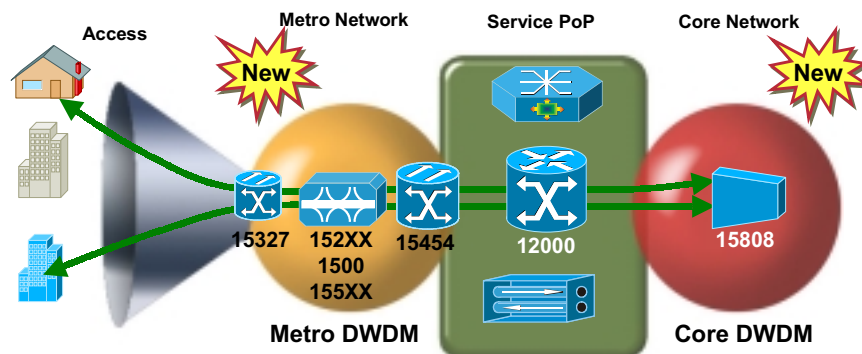
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## Transport Architecture Cisco Delivers All The Elements



Cisco delivers all the transport network elements  
with *best-of-breed AND end-to-end* solutions.



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# AGENDA



- Introduction “DWDM”
- **Core DWDM Overview**
- Metro DWDM Overview
- Conclusion

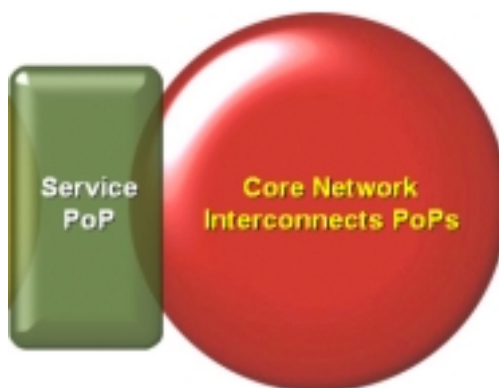


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## Role of Core DWDM



- Aggregate and Transport  $\lambda$ s between PoPs
- Minimize \$/bit – Capex
- Operational Efficiency – Opex
- Interface with all services
- Scale to meet demand

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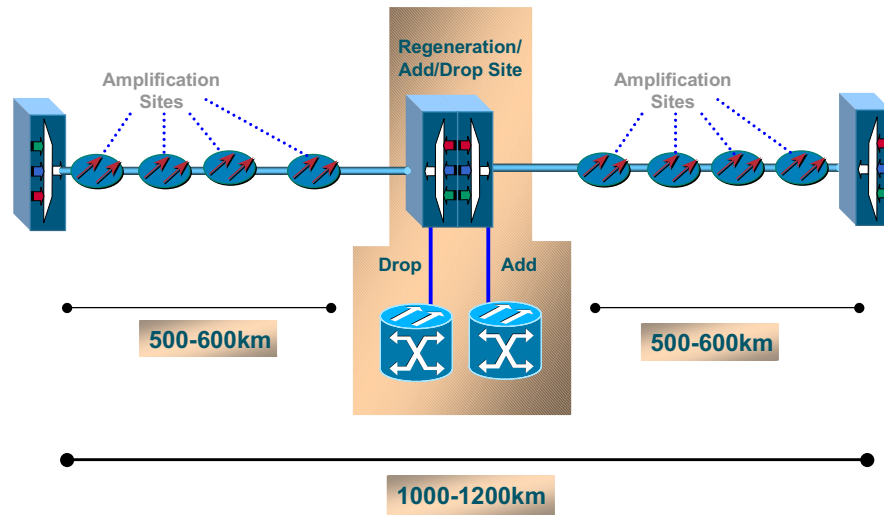
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## Requirements of core Transmission

### Long Haul DWDM



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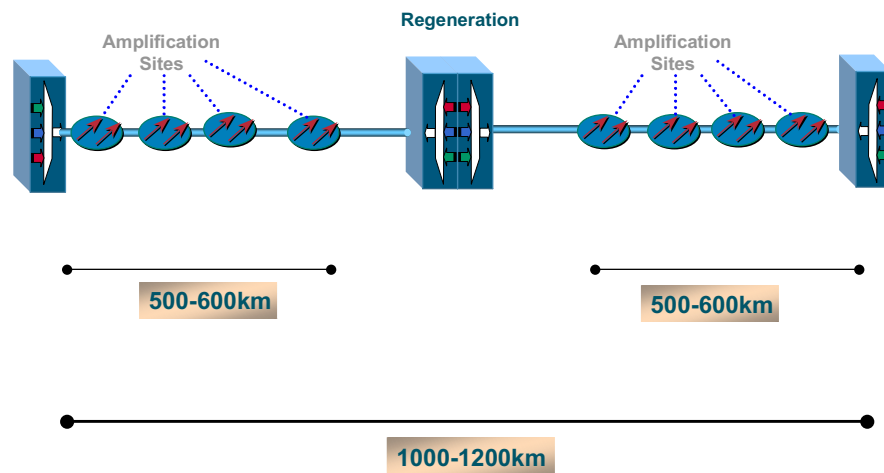
9

## Requirements of core Transmission

### Long Haul DWDM



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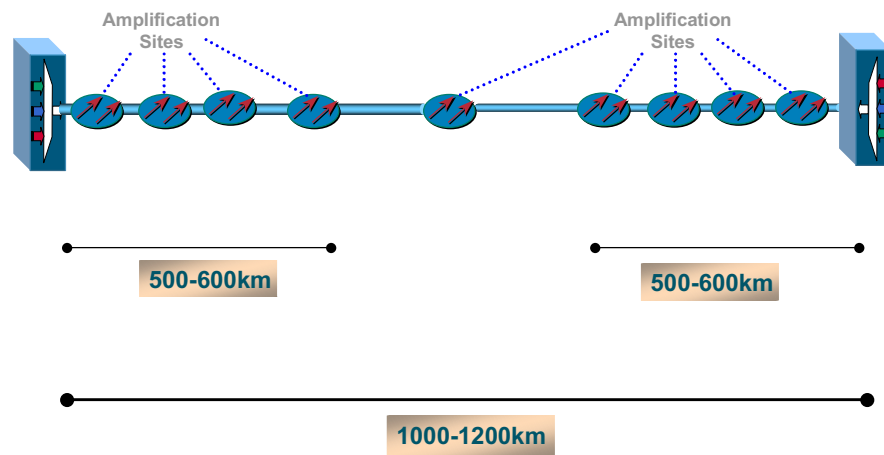
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## Requirements of core Transmission

### Extended / Ultra Long Haul DWDM

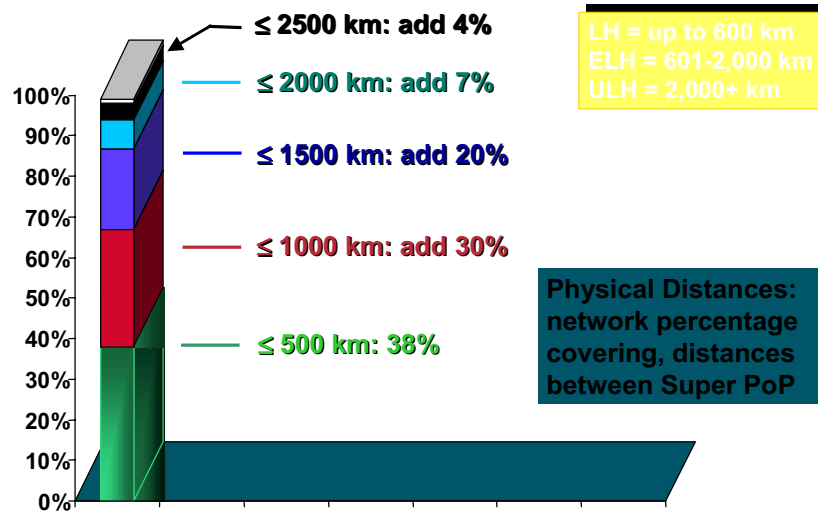


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## LH / ELH / ULH



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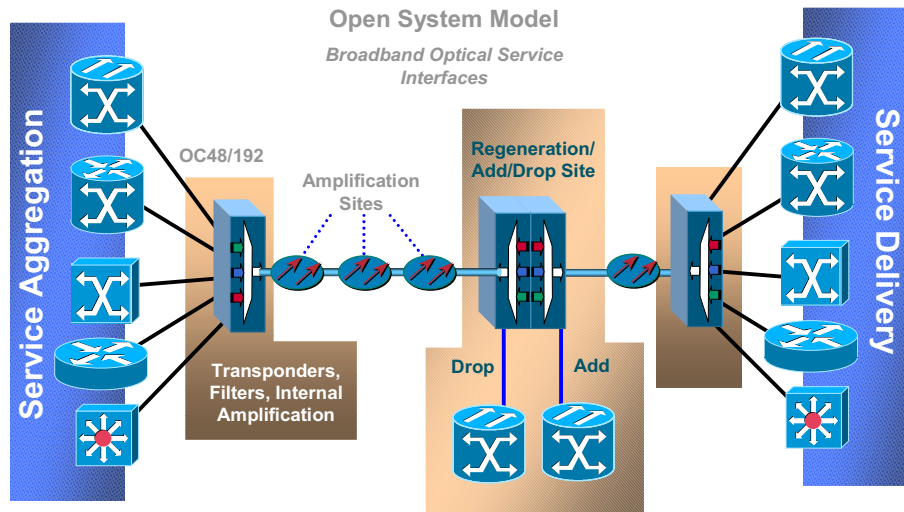
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## Requirements of core Transmission

### Long Haul DWDM



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## Requirements of core Transmission

### DWDM Interfaces



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- STM-16 STM 64 Clients
  - Flexible design accommodates any traffic mix
  - Open architecture accommodates a variety of SONET/SDH equipment, IP routers and ATM switches
- Muxponder
- VSR Interface
- Tunable Lasers
- Gig E Transponder
- B1 Monitoring
- OOB FEC (10E-15)

## VSR(Very Short Reach) interface



Cisco.com

**VSR is a technology  
pioneered by  
Cisco Systems**

### What it is:

- First 10 Gbps interface providing a low-cost solution optimized for intra-POP interconnection (less than 300m) between routers, switches, and DWDM
- Standard (VSR-1) approved by the Optical Internetworking Forum (OIF) in Jan. 2001

### What it brings to our customers:

- VSR accelerates deployments of 10Gbps links in scaling Internet Points of Presence by dramatically lowering intra-POP connectivity costs by as much as **50% or more**

“Innovation is a key differentiator for Cogent, it allows us to deliver the cutting-edge services our customers demand - and with VSR we can guarantee non-oversubscription and outstanding price points even more efficiently than before.”

— Dave Schaeffer, CEO Cogent Communications

(August 1<sup>st</sup>, 2001)

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## Requirements of core Transmission Summary



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- **A Platform** to deliver LH transmission of 80+ channels @ 10Gb/s.
- **A Platform** to deliver ELH / ULH to reduce the Regeneration requirements.
- **A Platform** to be interoperable with legacy systems and have flexible interconnections.
- A fully integrated NMS system for all platforms end to end.
- Reliable history in DWDM for 2.5 and 10G systems.
- End to End SDH/SONET capability.
- IP plus Optical capability.

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## ONS15800/1 Platform



- **Dense WDM system**
  - Scales to 64 x 10Gb/s
  - Split band EDFA architecture
  - 600 km spans, power balancing
- **Transport of STM4 STM-16 and STM-64**
  - Supports interfaces from Sonet, IP, ATM
- **Used by Major Customers in the world**
- **3,000 OC-192 channels deployed**
- **Currently operating over seven different fiber types**
- **Introducing single slot transponders**



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## Cisco ONS 15808 Release 1.0



- **Architecture to scale beyond 300 channels**
- **80 channels initial in C band**
- **L band ready**
- **50 GHz channel spacing**
- **2.5Gb/s and 10Gb/s support**
- **OOB Forward Error Correction (FEC): 10E-15**
- **8 channel OADM**
- **Auto Power Provisioning**
- **25 GHz ready**
- **Inter-Office DWDM characterization**
- **CTM Rel 3.0 management**



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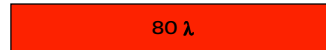
18

# Cisco ONS 15808 Basic Architecture



Cisco.com

## Two amplifier bands 50 GHz channel spacing



LH 80 x 2.5 or 10Gb/s



LH 80 x 2.5/10Gb/s + ELH 40 x 2.5/10Gb/s



LH 160 x 2.5Gb/s / 10Gb/s

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# ONS 15808 Release 2.0



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- +40 channels in L band
- 20 channel OADM
- >1600 km Raman assisted transmission
- 50 GHz channel spacing
- 2.5Gb/s and 10Gb/s support
- CTM management

- 4:1 STM 16 Muxponder
- VSR Interface
- Tunable lasers
- Gig E Transponder

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## ONS15808 Future Direction



### Release 3.0

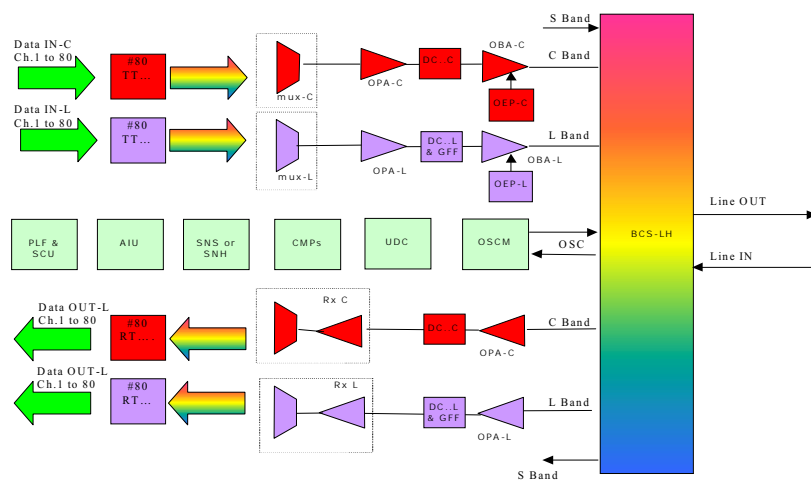
- 10 GigE Interface
- 40 Gbps Muxponder
- Enhanced OOB-FEC
- Installation, Commissioning, Operation & Maintenance Automation

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## Terminal Site Configuration



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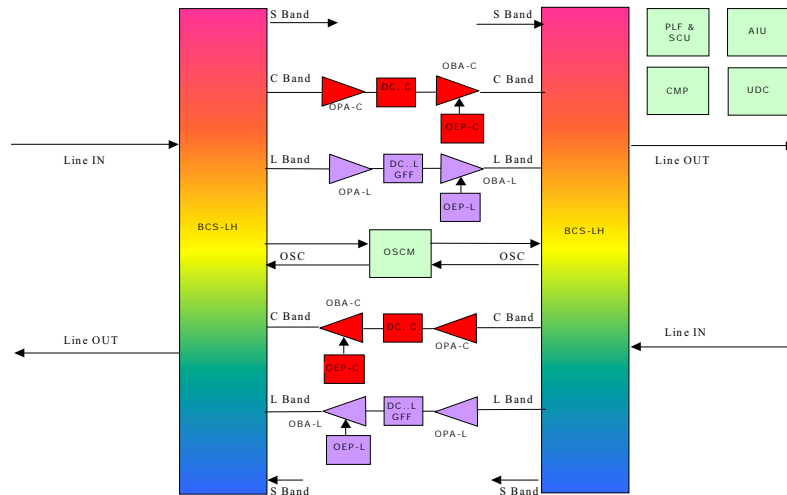
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# Line Amplifier Configuration



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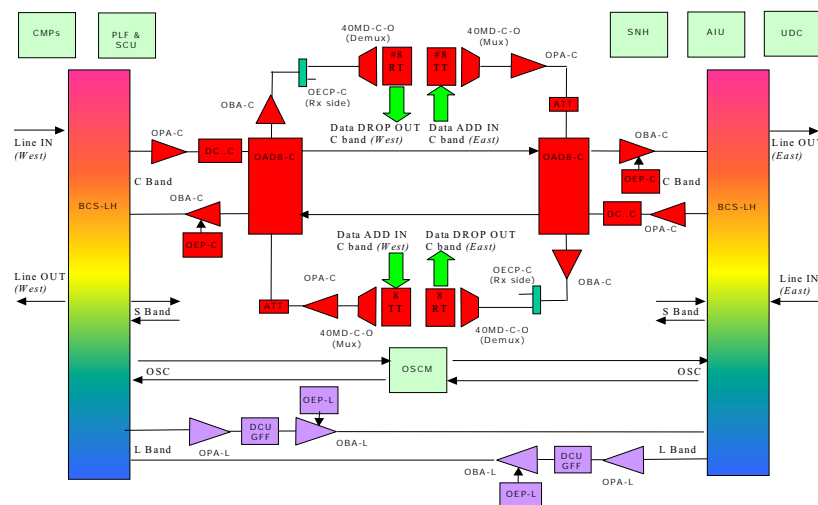
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# OADM Configuration



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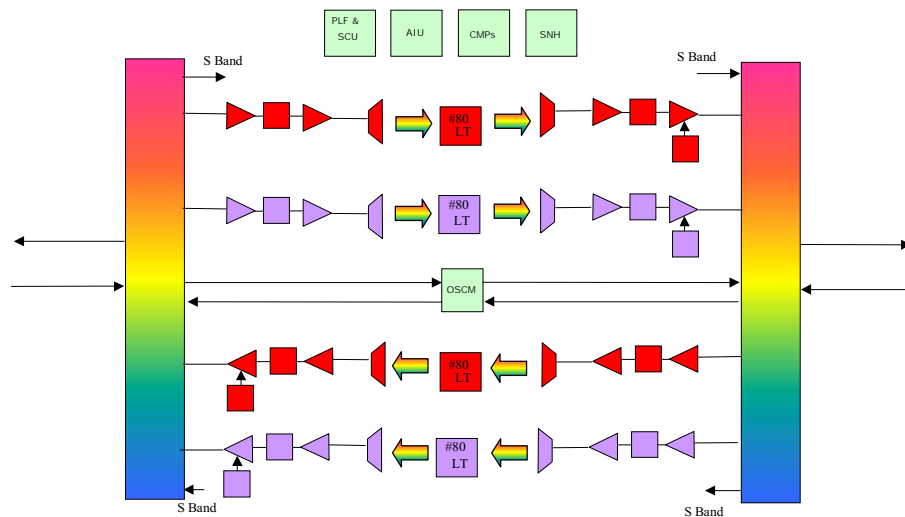
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# Regenerator Configuration



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## AGENDA



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- Introduction "DWDM"
- Core DWDM Overview
- **Metro DWDM Overview**
- Summary



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## Role of Metro DWDM



- Transport  $\lambda$ s between Enterprise
- Minimize \$/bit – Capex
- Operational Efficiency – Opex
- Interface for variable services
  - ESCON, FICON, FC, GDPS
  - SDH/SONET signal
  - GE, 10GE
- Scale to meet demand

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## Cisco Metro DWDM Portfolio



$\lambda$   
To The  
Build

• lowest first cost  $\lambda$  to building solution  
• OC/STM-n, GE, bit-rate independent

**ONS 15454 and ONS 15216**

**New-Generation Multi-Service DWDM**

- Service Density + DWDM
- DS1, DS3, GE, OC-N Mux,
- $\lambda$  Services: 200MB – 10G
- Plug and Play Multi-service
- Regional Networks (Mesh, Ring)
- RBOC & IXC Applications (OSMINE, NEBS3,...)



**ONS 15201 + 15252**

- Ring based Application
- Dense ESCON, FC, GE
- EMC, IBM
- Transparent, bit-rate independent interfaces



**ONS 15540 ESP**

**Metro 1500**

- Optimized PTP DWDM
- Lowest cost
- IBM, EMC
- ESCON, FC, GE
- OC/STM-n



**New**



SONET

Extended-Service

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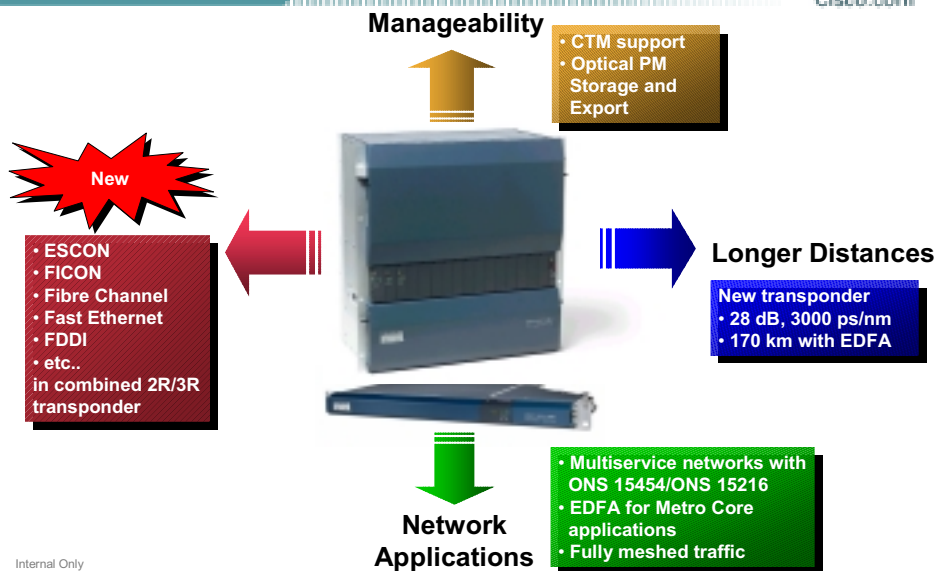
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## Cisco ONS 15252



Cisco.com



## ONS15200 Overview



Cisco.com



ONS15252/201

- ONS15252 for hub / gateway deployment. Terminates up to 16 channels in a 12RU 19" sub-rack
- ONS15201 for customer prem. / PoP deployment. Terminates a single channel in 1RU
- High node and channel counts and long distances achieved without optical amplifiers
- Flexible to fibre architecture, traffic types, and traffic patterns
- Multiple protection options
- Comprehensive management

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## ONS 15201



- 19" shelf, 1 RU high
- Dimensions: 44 x 432 x 273 mm (h.w.d)
- -48V DC power feed (dual feed option)

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## ONS 15252



- 19" shelf, 12 RU high
- Shelf dimensions: 533 x 483 x 275 mm (h x w x d)
- -48V DC feed (dual feed option)
- Terminates 16 channels (shelves may be concatenated)

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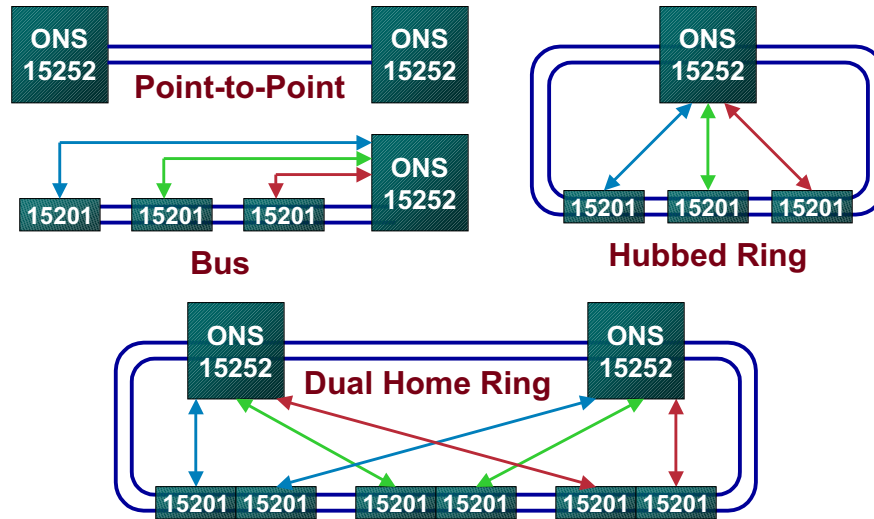
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## Network Architectures



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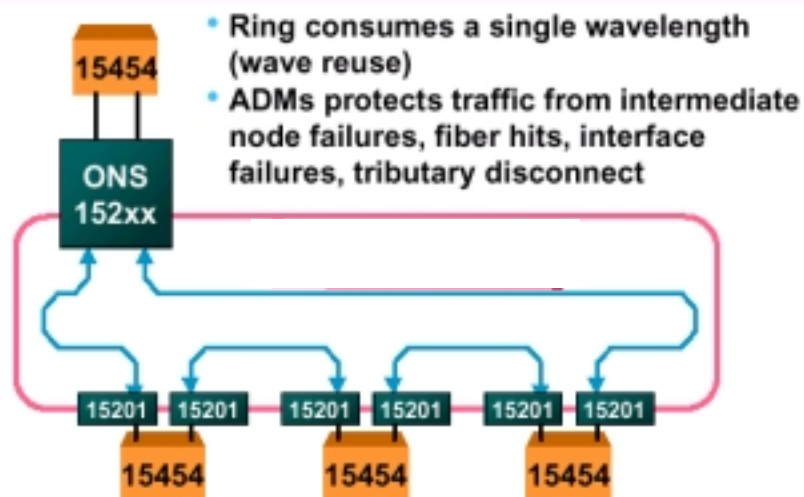
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## SDH ring architecture



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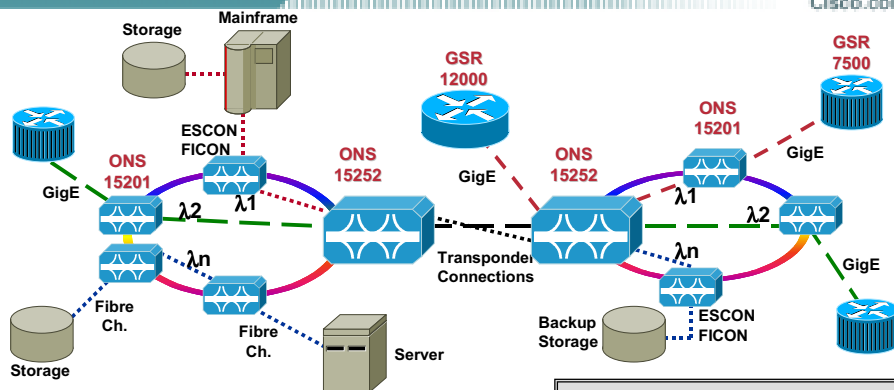


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## Any Data Service on Any Wavelength



**ESCON & FICON for mainframes**  
**Fibre Channel for storage**  
**GigE for TLS, VPN & Internet**

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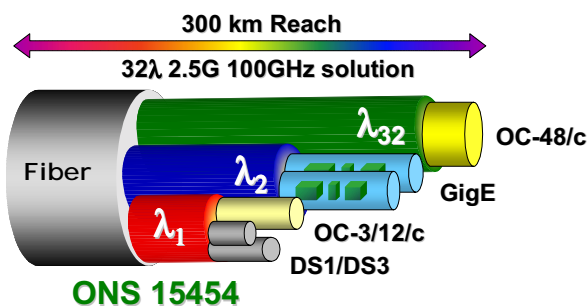
Service Interface	Bit Rate
100-FX Ethernet	100 Mbps
FDDI	125 Mbps
ESCON	200 Mbps
D1 Video	270 Mbps
Fibre Channel	1.06 Gbps
FICON	1.06 Gbps
Gigabit Ethernet	1.25Gbps

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## ONS 15216 DWDM Filter



Cisco.com



**ONS 15216 (R2.1)**



- 32λ 100GHz DWDM Solution

**ONS 15454**  
 Available now



37λ OC-48 ITU Optics

- 4 Slots per shelf
- 26 dB, 5400 ps/nm
- Backwards compatible with 200 GHz filters

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## Cisco ONS 15216 Release 2.1

### 32 Channel 100GHz DWDM Solution



16λ Red Terminal



16λ Blue Terminal



1λ OADM – 32 versions



2λ OADM – 16 versions



4λ OADM – 8 versions

- Uni-dir mux/demux
- Red band base
- Blue band expansion
- 2 paths (east/west)
- Automatic VOA
- TL1 managed

**Note:** Photos shown for illustrative purpose only.

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## 15216-DWDM8-RED / BLUE



15216 DWDM (Red unit shown)

- 200 GHz Spacing, 18 Wavelengths
- Low Insertion Loss
  - 4.5 dB Per Mux Including Connectors
- Ultra Compact 1 RU
- In Service Upgrade from Red to Blue Filter
- Reduced Cost by Eliminating Transponders

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## 15216-OADM1 (1 Channel, 2 Path OADM)



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15216 OADM (1channel add/drop)

- 200 GHz Spacing
- Low Insertion Loss

**Pass Through Loss –1.8 dB max**

**Drop Loss –2.5 dB max**

- Ultra Compact 1 RU
- Variable Optical Attenuation (Add Ports)
- Monitor Ports at Outputs

Channel	ITU#	Wavelength(nm)
1	21	1560.61
2	23	1558.98
3	25	1557.36
4	27	1555.75
5	29	1554.13
6	31	1552.52
7	33	1550.92
8	35	1549.32
9	37	1547.72
10	43	1542.94
11	45	1541.35
12	47	1539.77
13	49	1538.19
14	51	1536.61
15	53	1535.04
16	55	1533.47
17	57	1531.9
18	59	1530.33

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## 15216-OADM2(2 Channel, 2 Path OADM)



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15216 OADM (2 channels add/drop)

- 200 GHz Spacing
- Low Insertion Loss

**Pass Through Loss –2.0 dB**

**Drop Loss –2.6 dB max**

- Ultra Compact 1 RU
- Variable Optical Attenuation
- Monitor Ports at Outputs

Pair	ITU#	Wavelength(nm)
1	23	1558.98
	25	1557.36
2	27	1555.75
	29	1554.13
3	31	1552.52
	33	1550.92
4	35	1549.32
	37	1547.72
5	43	1542.94
	45	1541.35
6	47	1539.77
	49	1538.19
7	51	1536.61
	53	1535.04
8	55	1533.47
	57	1531.9

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## 15216-EDFA



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15216 Metro C-band EDFA

- C-Band EDFA for Metro / Regional DWDM
- Total Output Power 17 dBm
- Automatic Gain Control Loop
- Integrated GFF w/ Constant 23 dB gain per Channel
- Low Noise Figure < 6.0 dB
- Ultra Compact 1 RU
- Monitor Port at Output

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## 15216-OPM(Optical Performance Monitor)



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- End to End Monitoring of Optical Signals
  - Center Wavelength
  - Power Levels per Wavelength
  - Optical Signal to Noise Ratio (OSNR)
- Alarm Reporting, Historical Data Storage & Collection
- Under 100 ms Sampling Period
- Compact 2 RU
- Two Monitor Port Inputs

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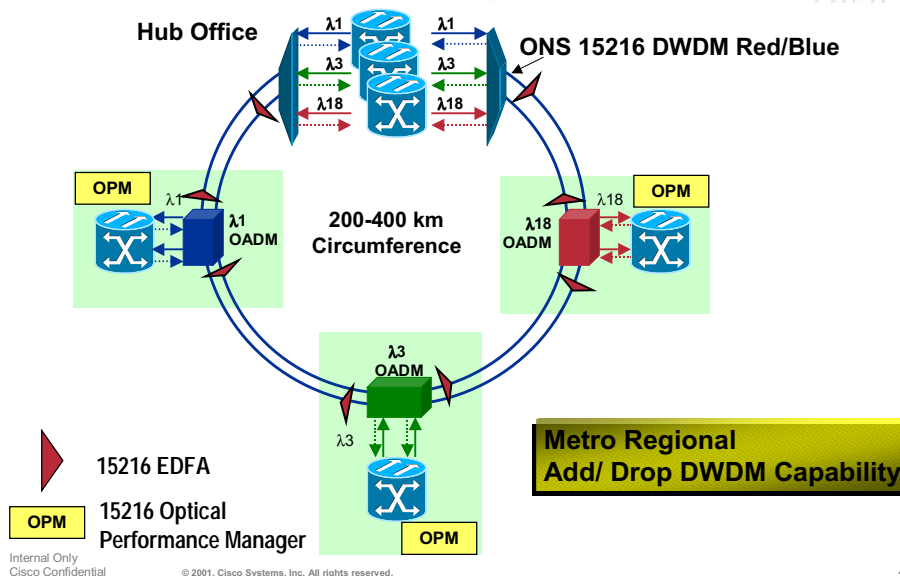
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## Applications- Metro Regional Multi-Service Ring DWDM



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## Cisco Metro 1500



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- Lowest Price
- Max. 32 channel system
- Point-to-Point and Point-to-MultiPoint
- Up to 2.5Gbps for SDH/SONET, ESCON, FICON, Fibre Channel, GE, IBM Coupling Link/channel
- 1+1 line protection
- Best SAN solution for Bank&Security with PTP configuration

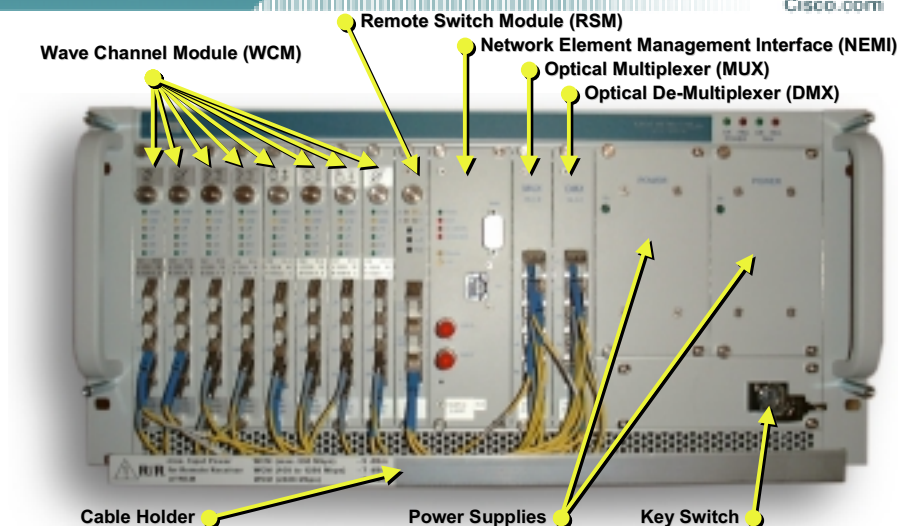


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# 1500 Chassis Configuration

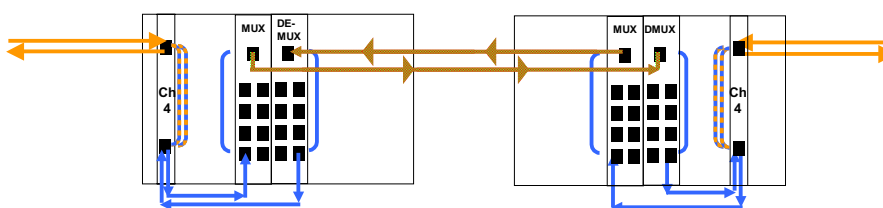


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# Metro 1500 DWDM Operation



- 1) CPE input from std SM/MM laser into channel specific line card
- 2) Remap from std MM/SM  $\lambda$  to DWDM  $\lambda$ , e.g. channel 4
- 3) Transfer from line card to MUX via short external jumper
- 4) Aggregation of all  $\lambda$ s on MUX inputs into a single output connection
- 5) Output from MUX over dark fiber into DMUX, (Up to 100KM)
- 6) Separation of  $\lambda$ s into discrete paths by precision comb filter
- 7) Transfer of channel specific  $\lambda$  from DMUX to line card
- 8) Remap from DWDM  $\lambda$  to std MM or SM  $\lambda$  for connection to CPE

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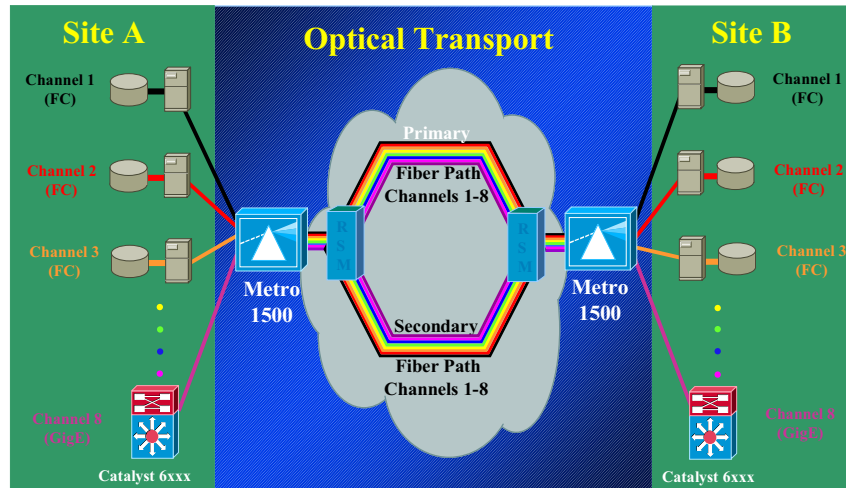
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## Mirroring System with DWDM



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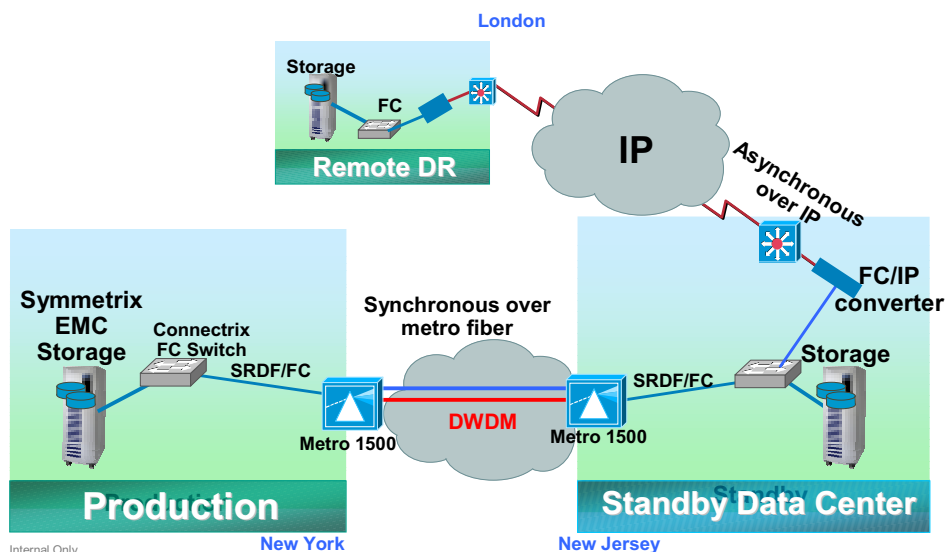
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## Disaster Recovery with EMC



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## Cisco ONS 15540



- Ring based Metro DWDM
- 32 lambdas/fiber; 96/rack
- **Transparent** and **switched** modes
- **10GE**, GE, ESCON, FICON, FC and SDH/SONET support
- 2.5 G and **10 G wavelength**
- Pt-Pt, ring and mesh networks
- High Availability Options
- NEBS

### ONS 15540



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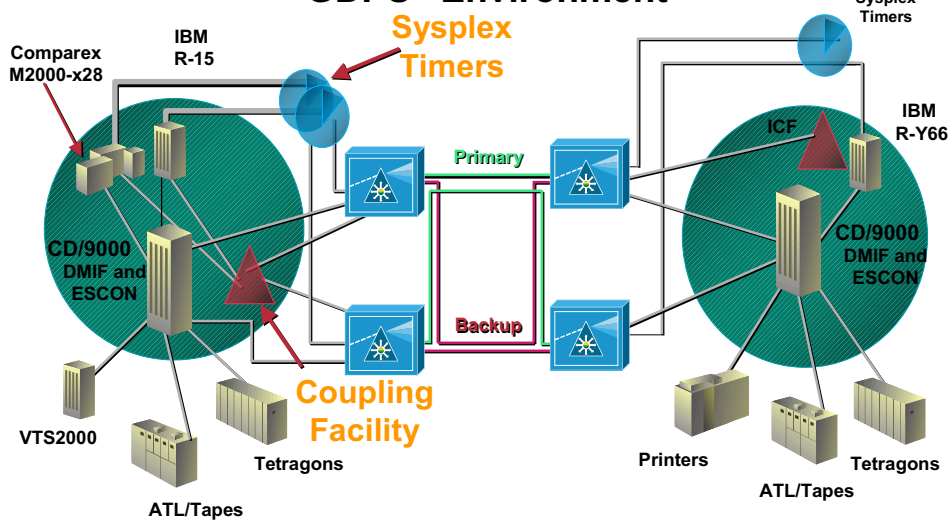
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## IBM Environment



### "GDPS" Environment



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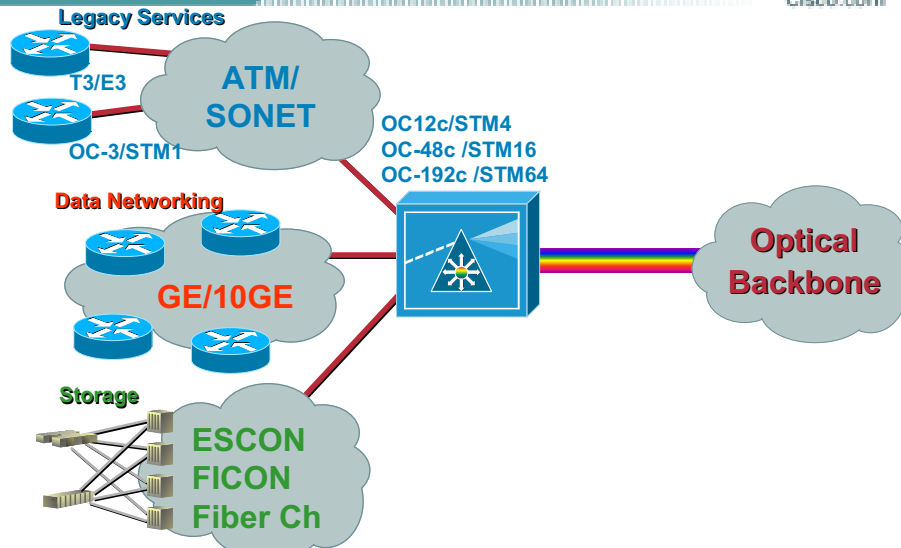
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## Multi-Services Integration



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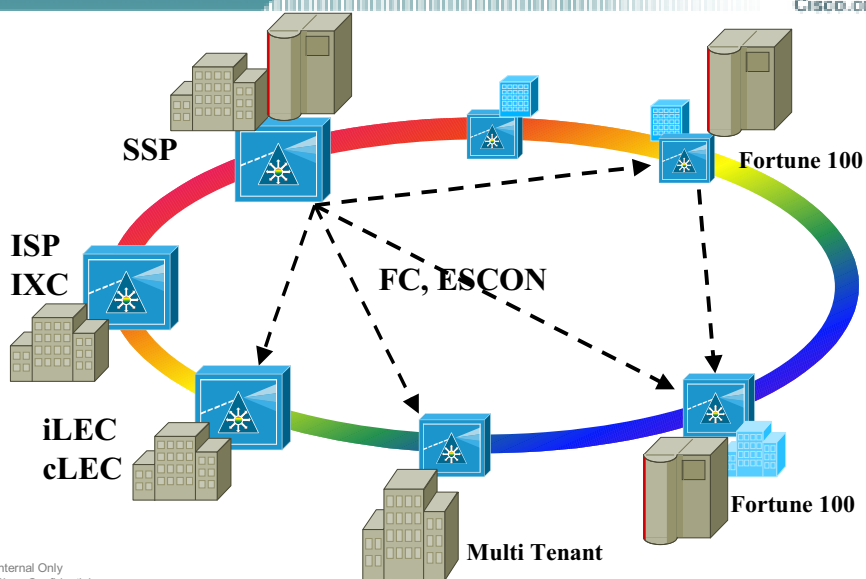
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## NG(Next Generation) Storage Delivery



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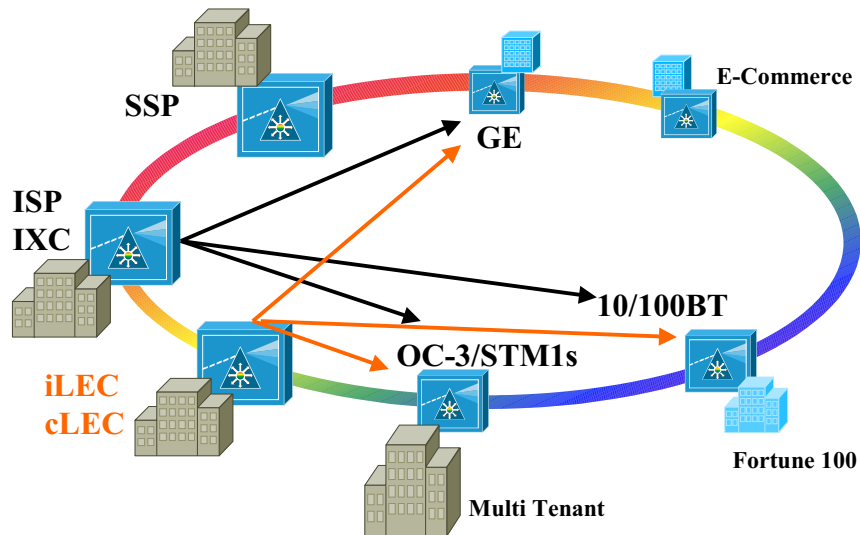


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## NG Ethernet and SONET/SDH Delivery

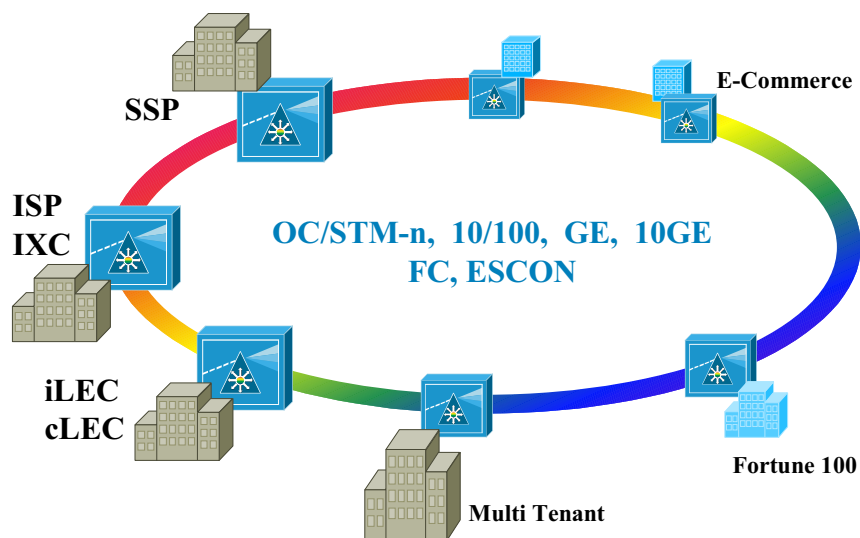


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## NG Extended Services Delivery



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# AGENDA



- Introduction “DWDM”
- Core DWDM Overview
- Metro DWDM Overview
- **Summary**



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## Cisco DWDM Solutions Summary (Core DWDM)



### • Core DWDM

#### □ ELH/ULH DWDM (ONS 15808)

- ✓ Distance : ELH/ULH support
- ✓ Interface : SDH/SONET, GE/10GE
- ✓ Feature : Muxponder, VSR, Tunable Laser
- ✓ Quality : B1 monitoring, OOB-FEC



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## Cisco DWDM Solutions

### Summary (Metro DWDM)



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- **Metro DWDM**

- ❑ Lambda Service DWDM (ONS 15200)
  - ✓ Optimized 1 or 2 lambda service
  - ✓ Variable interface : SDH/SONET, GE, ESCON, FICON
- ❑ PTP SAN DWDM (Metro 1500)
  - ✓ Optimized PTP application with Low price
  - ✓ Variable interface : SDH/SONET, GE, ESCON, FICON
- ❑ Ring DWDM (ONS 15540)
  - ✓ Optimized Ring application
  - ✓ Interface : SDH/SONET, GE/10GE
  - ✓ High Port Density : 96 lambda/rack



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