



Cisco optical solution overview and update



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**Enable Your Network
Empower Your Business**

Cisco footprint in optical networking

- Market entrance in 1999 through Pirelli, Cerent and Monterey acquisition
- Cisco continues in investment into advanced optical technology
 - ✓ CoreOptics acquisition to obtain coherent optical technology (CP-QPSK) and MLSE
 - ✓ Massive investment Cisco ONS 15454 MSTP future functionality including 100 Gbps technology and beyond
- Flexible, zero-touch optical networking
 - ✓ Market leader in two degree and multi degree ROADM technology and packet optical transport
 - ✓ Support for omni-directional and colorless ROADM available
 - ✓ Automated optical control plane in the roadmap
- Tight integration with core routing, Metro Ethernet and TDM technology
 - ✓ IPoDWDM technology for close integration of core routing with Cisco ONS 15454 MSTP or 3rd party optical transport system
 - ✓ Xponder technology for Metro Ethernet integration
 - ✓ MSPP on the Blade for integrated TDM solution
- High quality planning and management tool
 - ✓ Comprehensive design and validation tool available to customers (Cisco Transport Planner)
 - ✓ Enhanced craft terminal for initial setup and deployment (Cisco Transport Controller)
 - ✓ Advanced management suite (Cisco Transport Manager)

Cisco ONS 15454 MSTP



Platform introduction and overview

Cisco ONS 15454 MSTP

Fully reconfigurable, intelligent DWDM platform

- **Carrier Class DWDM Transport**
 - Combines TDM, Ethernet, SAN and video services (fully integrated with Cisco ONS 15454 MSPP)
 - Originally introduced in 2003 as advanced metropolitan DWDM platform (broad services range, 800 km reach)
 - Through several releases evolves into platform covering all requirements for enterprise BC/DR solutions, metropolitan DWDM networks and LH applications (2300 km in release 9.2)
- **Flexible optical networking platform**
 - Cost effective Reconfigurable Optical Add/Drop Multiplexers (ROADM) with support for optical mesh
 - Full band Tunable 10G Lasers, modular client interfaces
 - Tight integration with IP core routers (IPoDWDM strategy)
- **Future proof extensible platform**
 - Up to 112 wavelengths available for the platform today
 - Support for 40 Gbps transport, 100 Gbps demonstrated in public
 - Further developed to extend the reach and functionality
 - High level of investment protection



Cisco ONS 15454 MSTP

Examples of installations in Central and Eastern Europe

•Hansapank Estonia

•KPSI – Regional
Government Poland



•Hungarian PTT National
backbone



•Czech Republic (NREN)

•Sloane Park Czech
Republic

•Elektro Maribor
Slovenia

•Slovanet Slovakia

•Energotel Slovakia



OSE (Greek Railways)
National Backbone

UMC – Mobile SP
National Backbone



UComLine - Ukrainian Challenger
National Backbone
KievStar - Mobile SP
National Backbone



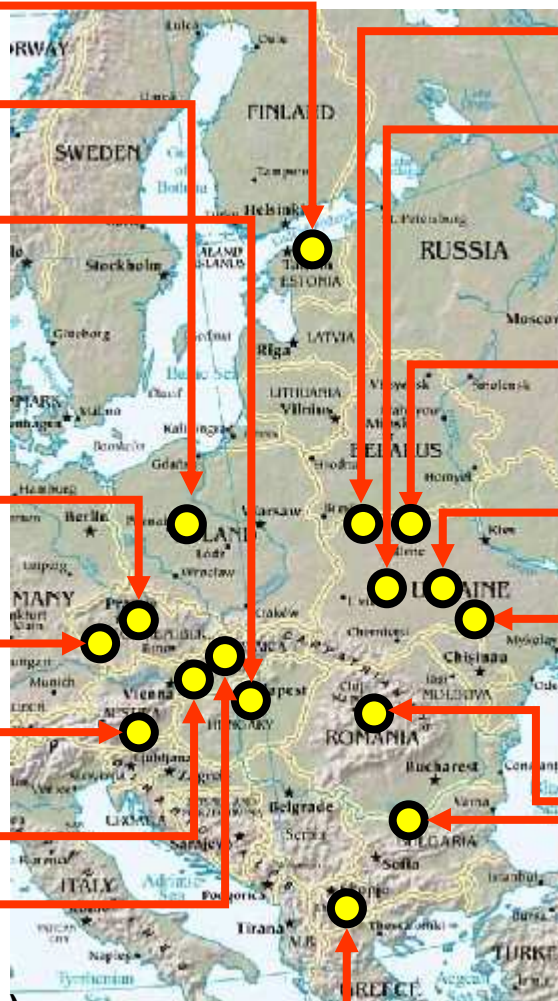
Datacom - Ukrainian Challenger
National Backbone

• UkrTelecom - Ukrainian PTT
National Backbone

• ComBridge - Romania



Bulgarian Telecom (BTC)
National Backbone

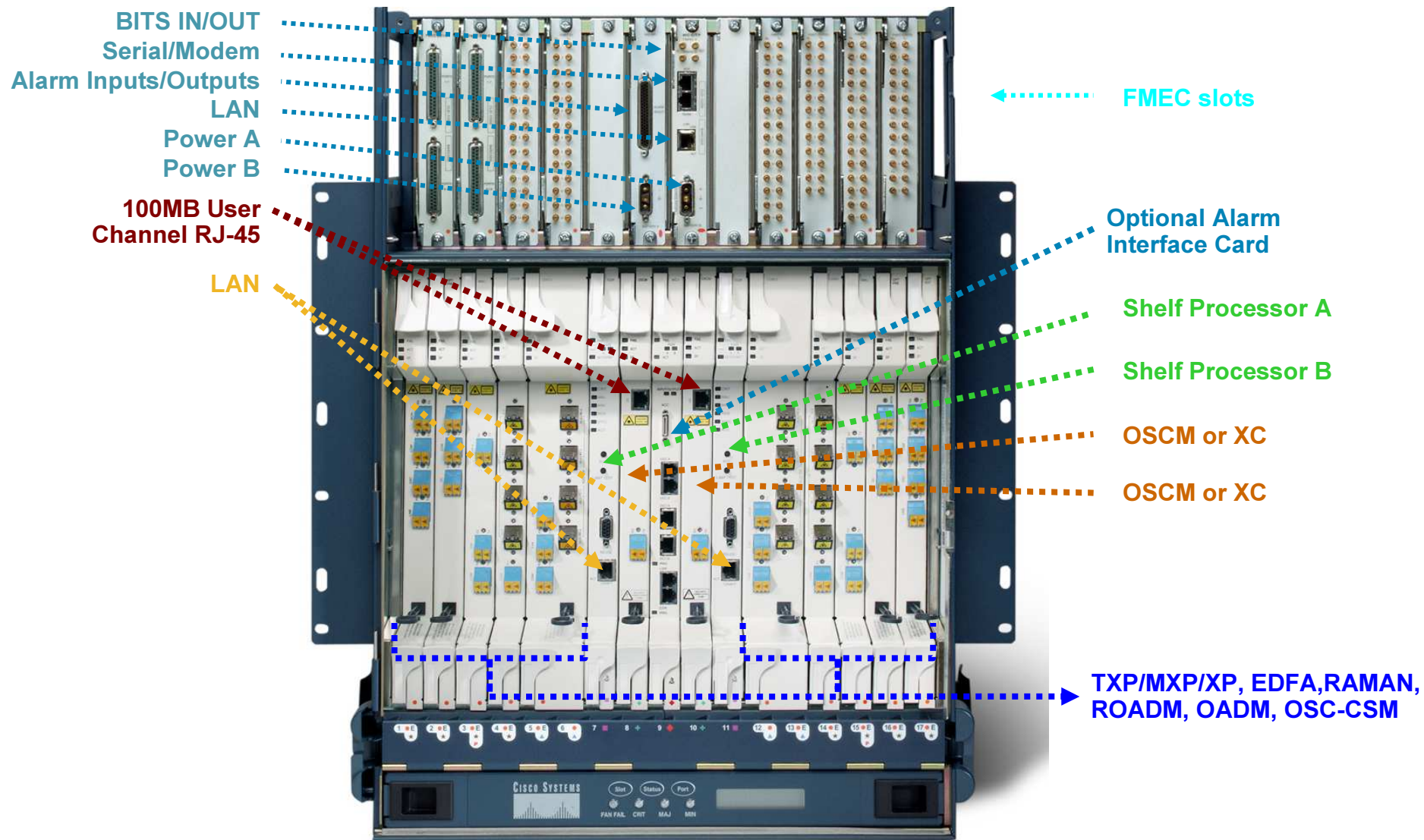


Cisco ONS 15454 MSTP



System performance, topologies and supported interfaces

Cisco ONS 15454 MSTP Chassis (ETSI) - M12



New smaller chassis - M6 and M2

New MSTP Chassis - R9.2

- MSTP Line card Backward Compatibility (SM-ROADM, OTU2-XP, 10G DME, Ethernet-XP, etc...)
- Improved Cooling
- Integrated OSC
- Integrated Multi-Shelf Management
- Integrated Database Back-Up
- Both ANSI & ETSI compliant
- Both AC & DC Power Options
- >50% Footprint Reduction

6 Slot ONS 15454 MSTP

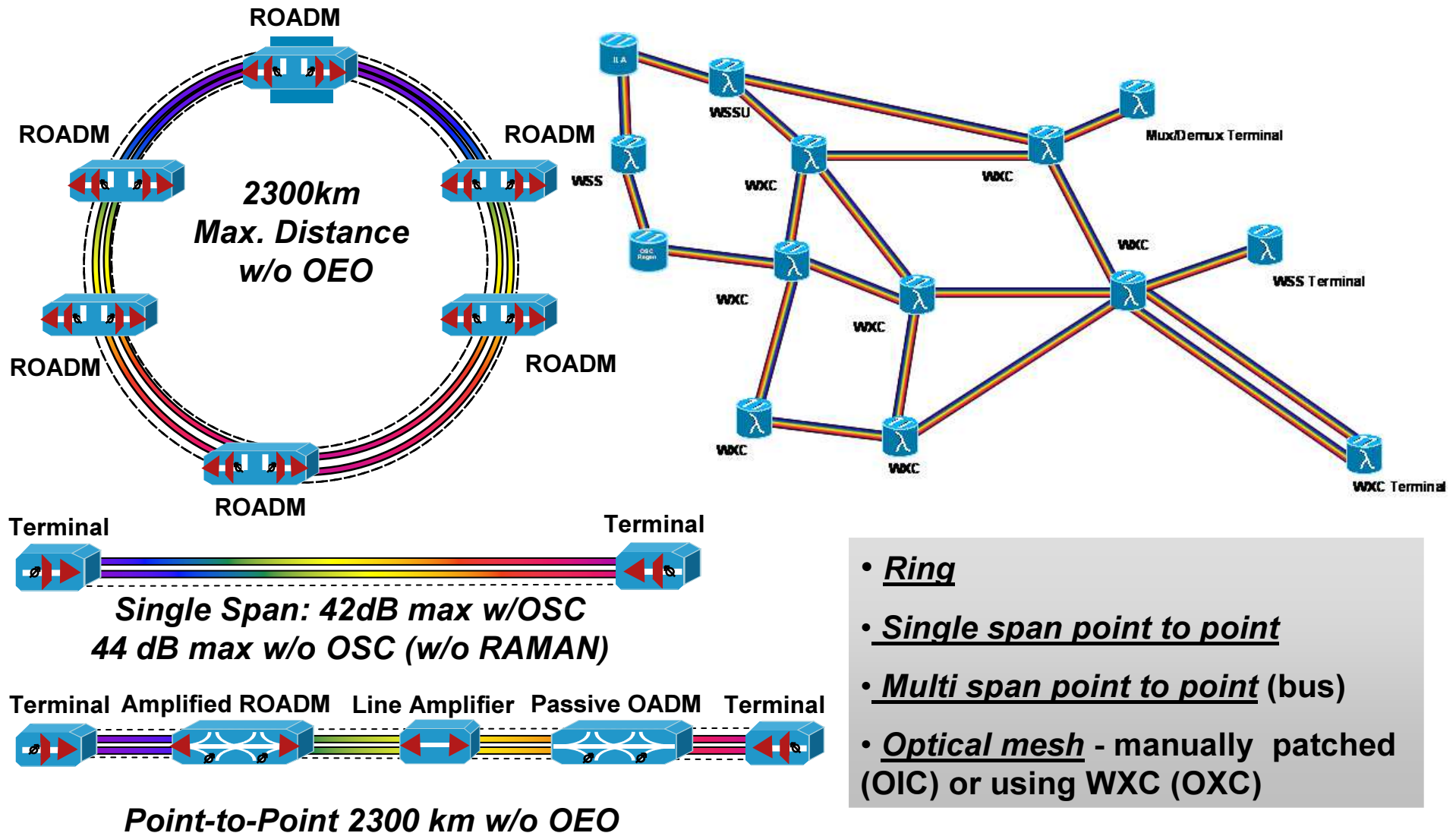


2 Slot ONS 15454 MSTP



Cisco ONS 15454 MSTP release 9.2:

Network Topologies (examples w/o RAMAN)



- Ring
- Single span point to point
- Multi span point to point (bus)
- Optical mesh - manually patched (OIC) or using WXC (OXC)

Cisco ONS 15454 MSTP - native client support

Wide range of telco and enterprise client interfaces

TDM

- STM-1
- STM-4
- STM-16
- STM-64
- STM-256
- OTU-2
- OTU-2e
- OTU-3
- E1
- E3

Data

- E
- FE
- GE
- 10 GE LAN PHY
- 10 GE WAN PHY
- 40 GE

Storage

- 1G FC/FICON
- 2G FC/FICON
- 4G FC/FICON
- 8G FC/FICON
- 10G FC/FICON
- ESCON
- ISC 1
- ISC 3
- Sysplex CLO
- Sysplex ETR
- STP
- 5G Infiniband

Video

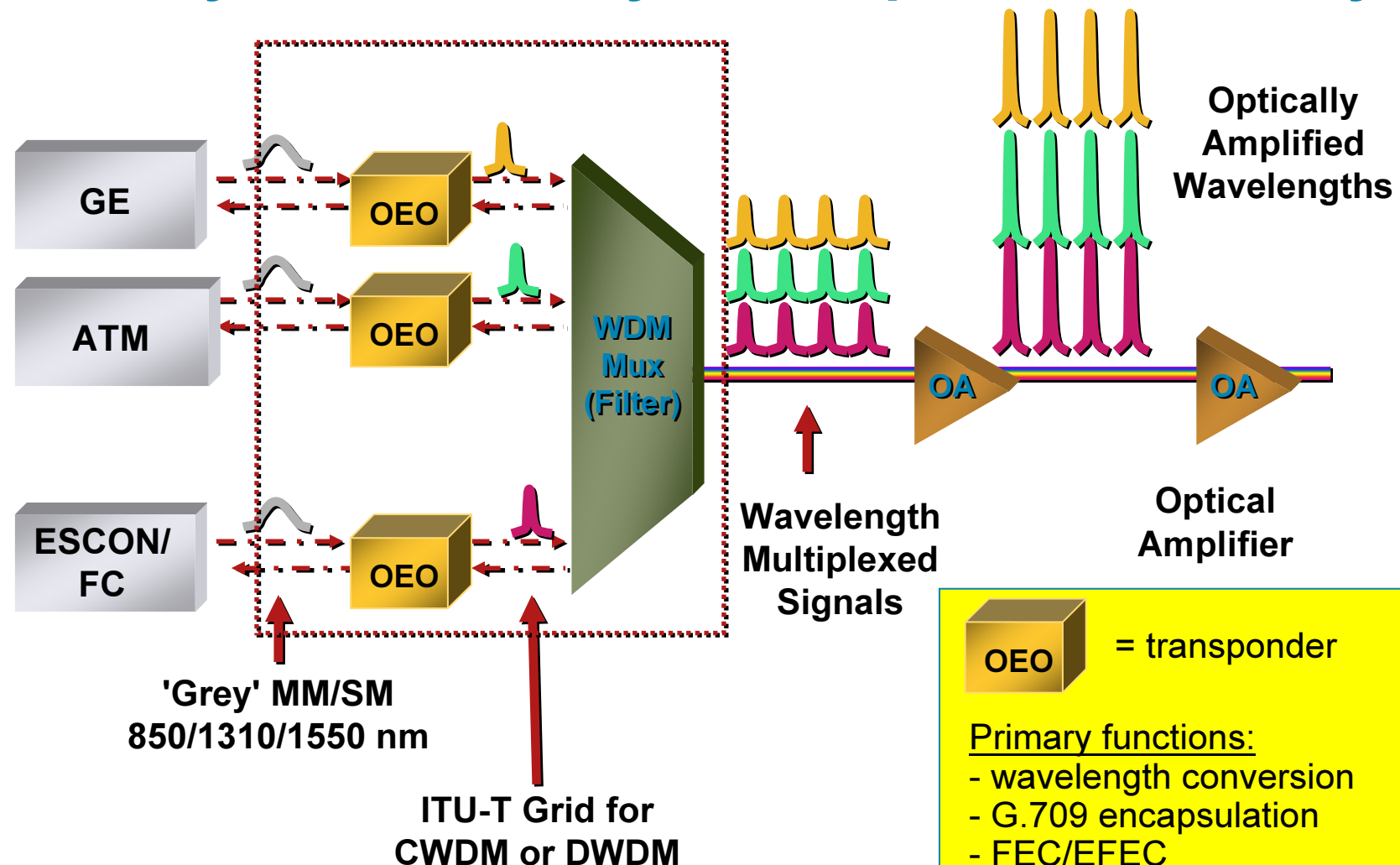
- DV-6000
- HDTV
- SDI
- D1 video
- DVB ASI

2R

- Any rate from 100 Mbps to 2.5 Gbps

- *BENEFIT: High flexibility in system deployment, most of applications covered*
- *BENEFIT: Broad range of potential service offerings*
- *BENEFIT: 40Gbps support allows for further bandwidth scaling*

WDM system anatomy – transponder based system



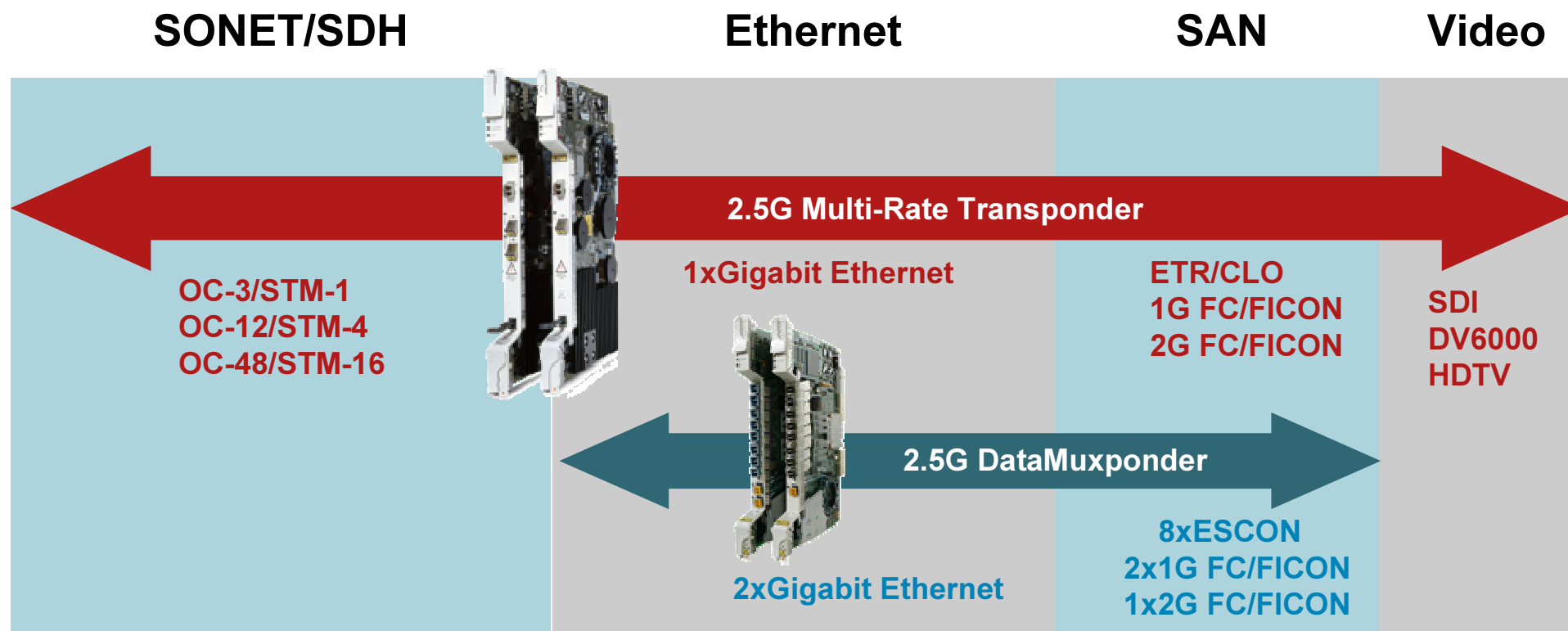
OEO = transponder

Primary functions:

- wavelength conversion
- G.709 encapsulation
- FEC/EFEC
- protocol monitoring
- service demarcation point
- OFC

Cisco ONS 15454 MSTP

2.5Gbps Service Cards



- Simple planning, sparing, and ordering with multi-rate, multiprotocol and pluggable optics
- Optical, G.709 and payload monitoring
- FEC support at 2.5Gbps transponder
- G.709 support, trunk lasers 400GHz tunable in 100GHz grid
- Client 1+1, Y-cable and splitter protection

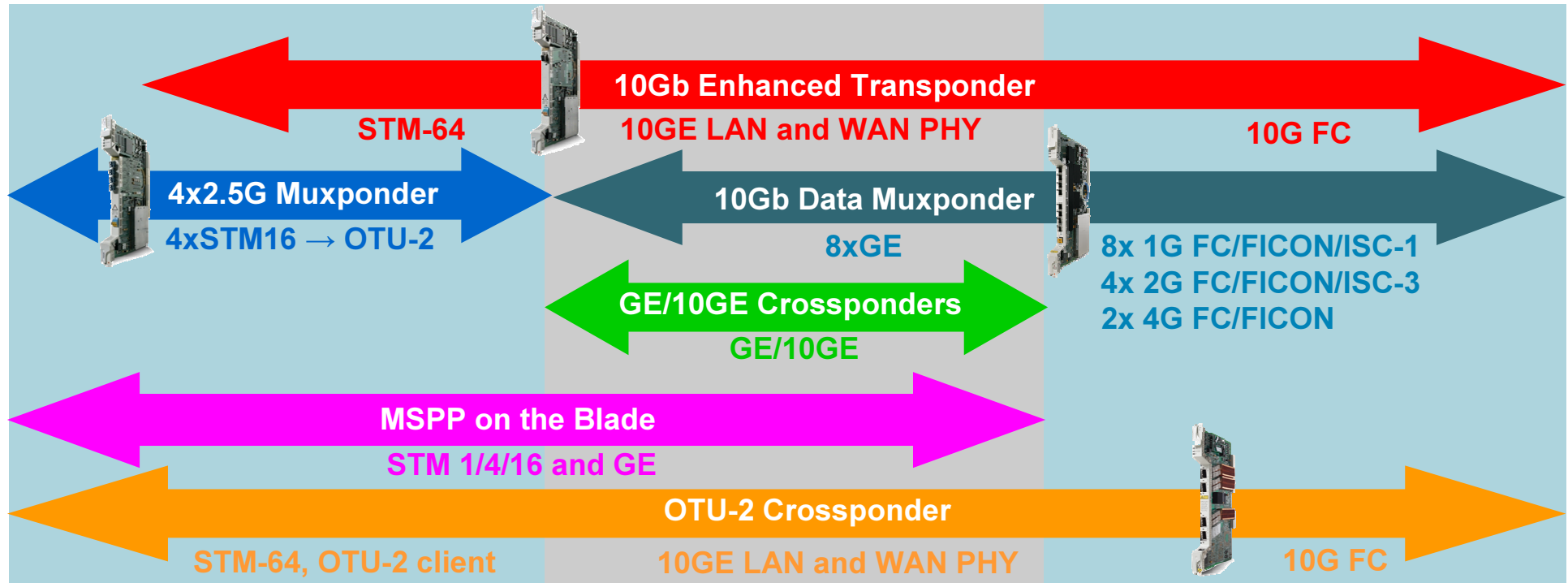
Cisco ONS 15454 MSTP

10Gbps Service Cards

SONET/SDH/OTN

Ethernet

SAN



- All 10G applications covered by 1 transponder,
- Aggregation cards reduce the cost of service delivery
- Full C-band or L-band tunability - 80 channels @ 50GHz spacing
- FEC and EFEC support (G.975, G.975.1), G.709 support
- Optical, G.709 and payload monitoring, Client 1+1, Y-cable protection and 'splitter' (XP)
- MLSE support for PMD challenged fiber

Pluggable client interfaces

Integrating flexible core with cost effective edge

Type/category	Example
Grey optics 850 nm SFP	1000BaseSX, MMF FC clients
Grey optics 1310 nm SFP	1000BaseLX, SDH SR/IR clients, FC SMF clients
Grey optics 1550 nm SFP	1000BaseZX, SDH LR clients
Grey optics 850 nm XFP	10GE, 10G FC
Grey optics 1310 nm XFP	10GBaseLR, 10G FC, STM-64
Grey optics 1550 nm XFP	10GBaseER/EW, STM-64 LR
CWDM client optics	GE, 1/2G FC, STM-16
DWDM client optics	GE, 1/2G FC, STM-16, 10GE, 10G FC, STM-64, OTU-2
Electrical client SFP	10/100/1000BaseT for GE Xponder



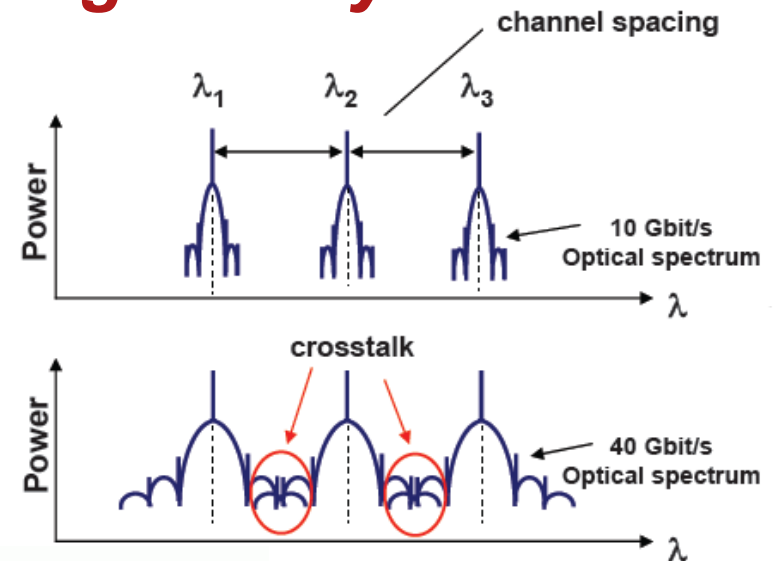
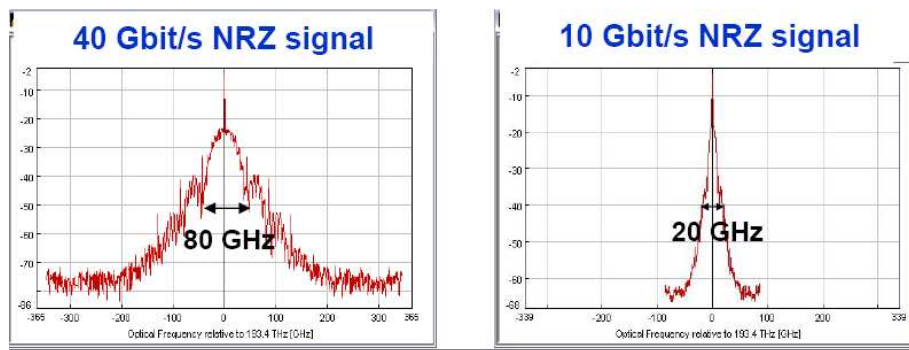
- *BENEFIT: Lower opex through common sparing with other Cisco products*
- *BENEFIT: Per port reach and rate selection*
- *BENEFIT: Tight integration of CWDM and DWDM from network perimeter*
- *BENEFIT: High transponder reusability for different services*

http://www.cisco.com/en/US/prod/collateral/optical/ps5724/ps2006/brochure_c02-452560.html

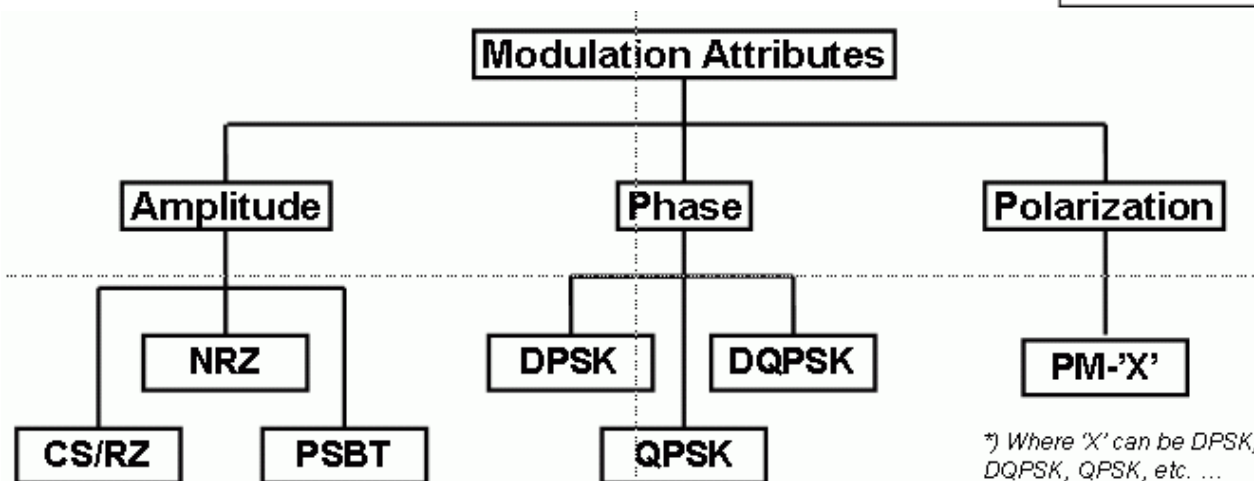
40Gbps transport

What is the market demand?

Compatibility with existing 10G systems.



New modulation formats are needed!



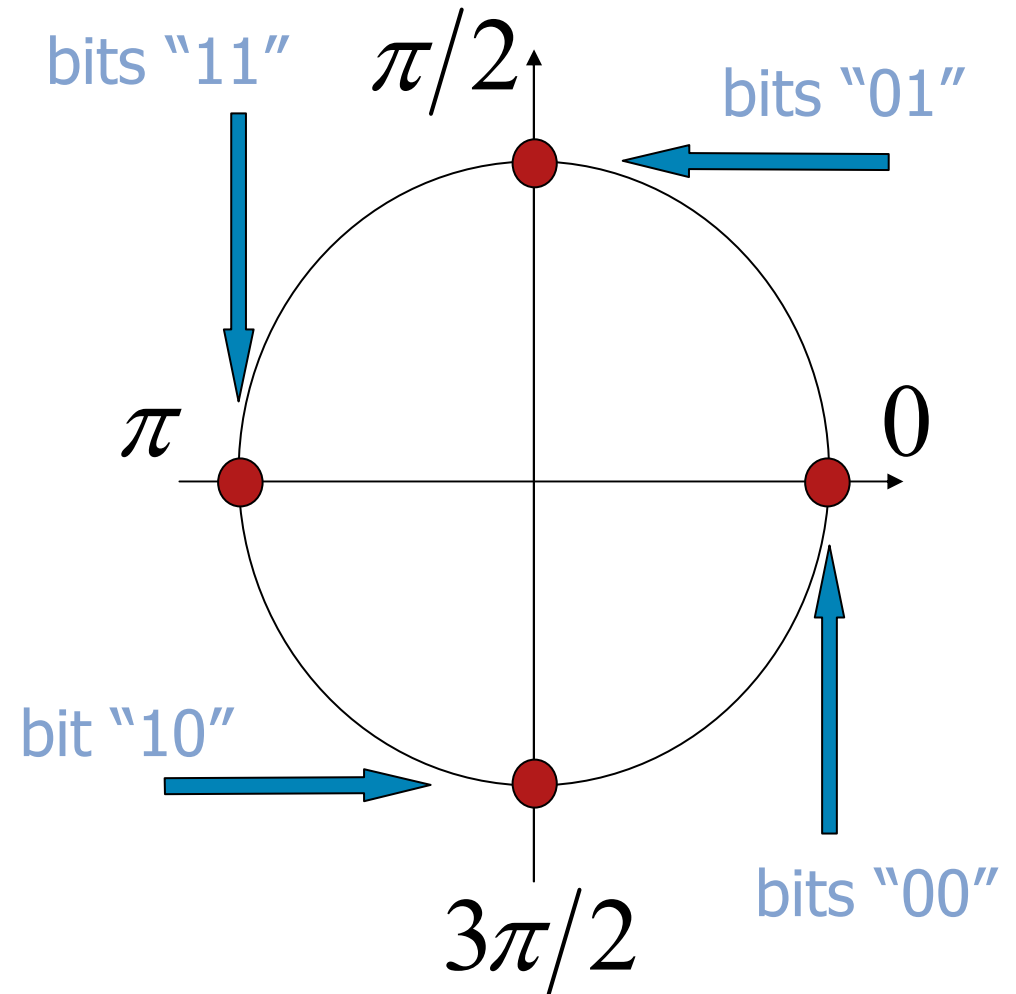
40Gbps transport

Technology options

Parameter	10G NRZ		ODB	DPSK	DQPSK	CP-DQPSK
Required OSNR B2B (dB)	5		13	8.5	8	4
Reach (km)	>2000		>500	>1000	>1000	>2000
50 GHz Compatible	Y		Y	Y	Y	Y
Chromatic Dispersion Robustness with 1 / 2 dB of OSNR margin (+/-ps/nm)	500/800		250	650	750	20,000
PMD Robustness with 1 / 2 dB of OSNR margin (ps)	10 / 14		2.5	2.5 / 3.5	5 / 8	> 25
Complexity	LOW		LOW	LOW	MEDIUM	HIGH

DQPSK – 4-Level Phase Modulation

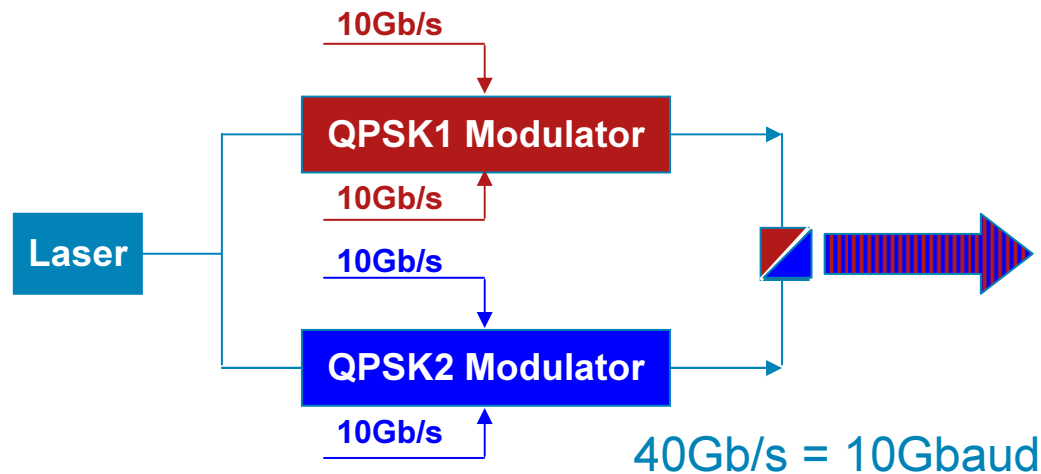
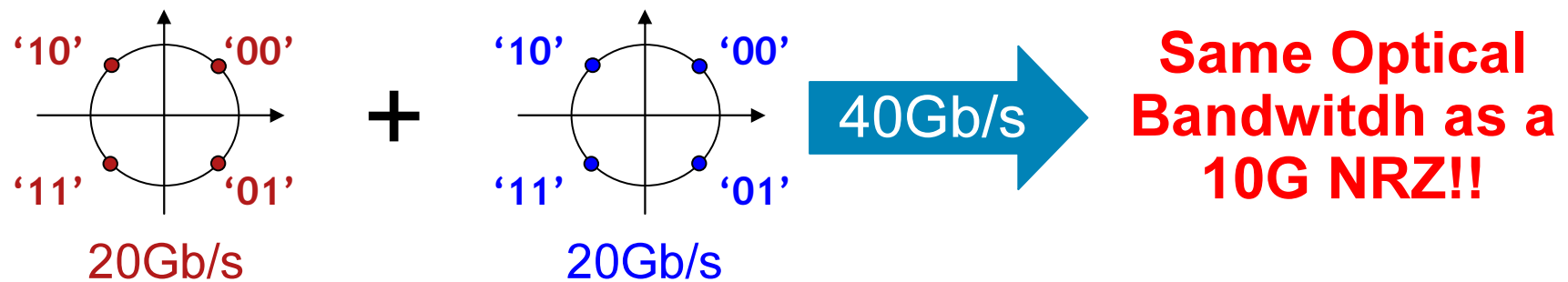
- Four “signal points” are used
- This way, each “phase”, or “signal point”, carries two bits



CP-DQPSK Solution

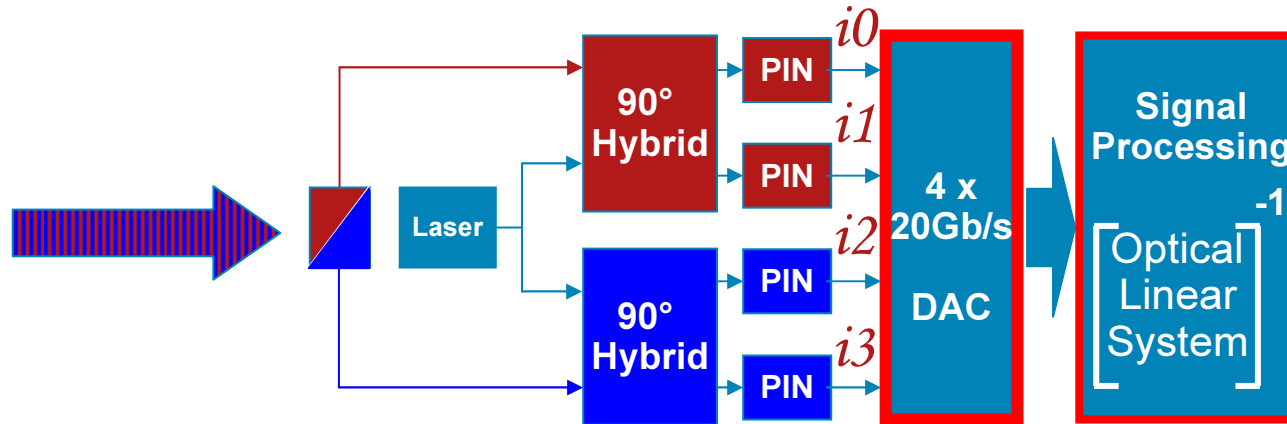
Dual Polarization DQPSK with Coherent Detection

Transmitter: Two QPSK signals are muxed in polarization



10Gbaud signal
propagate into
the fiber as a
10Gb/s signal

Coherent Detection and Post Processing



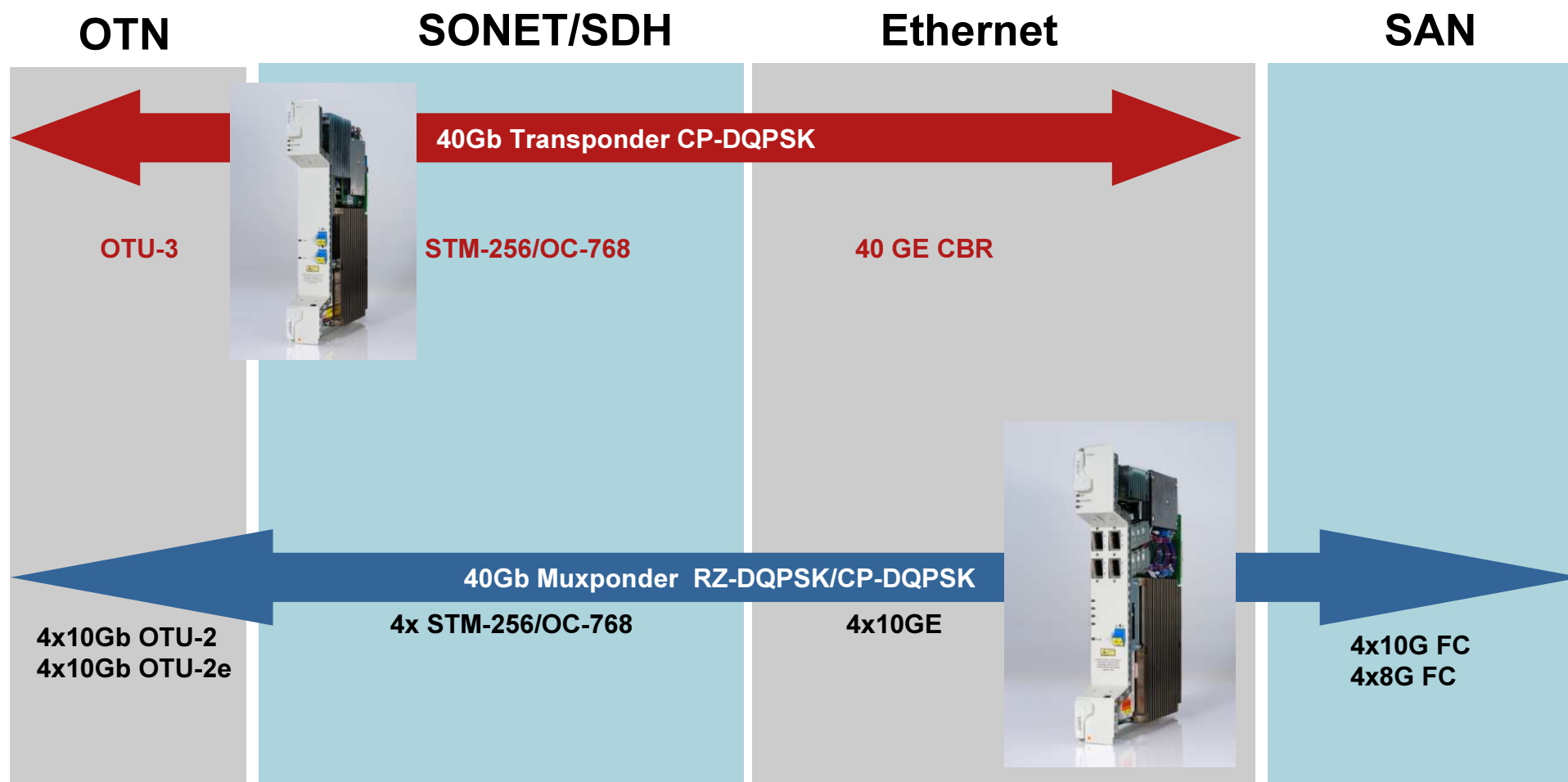
- RX Laser serves as Local Oscillator to provide a polarization and phase
- 90° Hybrid converts phase modulation in amplitude modulation
- Coherent receiver with Digital Signal Processing (DSP):
 - Synchronizes to carrier frequency and phase electronically
 - Recovers Polarization electronically
 - Compensates CD and PMD electronically

Key Benefits:

- ~3dB better noise tolerance vs. conventional (~2x distance)
- Can compensate huge amounts of dispersion (>200x more than conventional)
- Usable for 40Gbps and 100Gbps, can scale to higher speeds

Cisco ONS 15454 MSTP

40 Gbps Service Cards



Journey towards 100Gbps

- 100GE commercial availability expected ~ 2010
- 100G DWDM interface expected within following 12 months
- Initial deployment will be limited to Core IP backbone network
- Customer can anticipate the deployment for other applications only if pricing will provide better trade off respect 40G
- Same requirements for interoperability with existing systems built for 10G transmission
- Standardization effort in IEEE and ITU-T

Cisco ONS 15454 - 100Gbps program

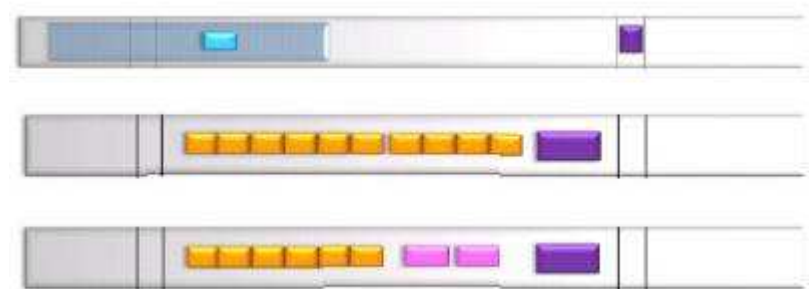
- CP-DQPSK Modulation, 50,000ps/nm CD robustness, 30ps PMD robustness
- 100Gbps transmission will leverage on 3 cards that can be differently combined:

100GE/OTU-4 Full C band tunable Line Card

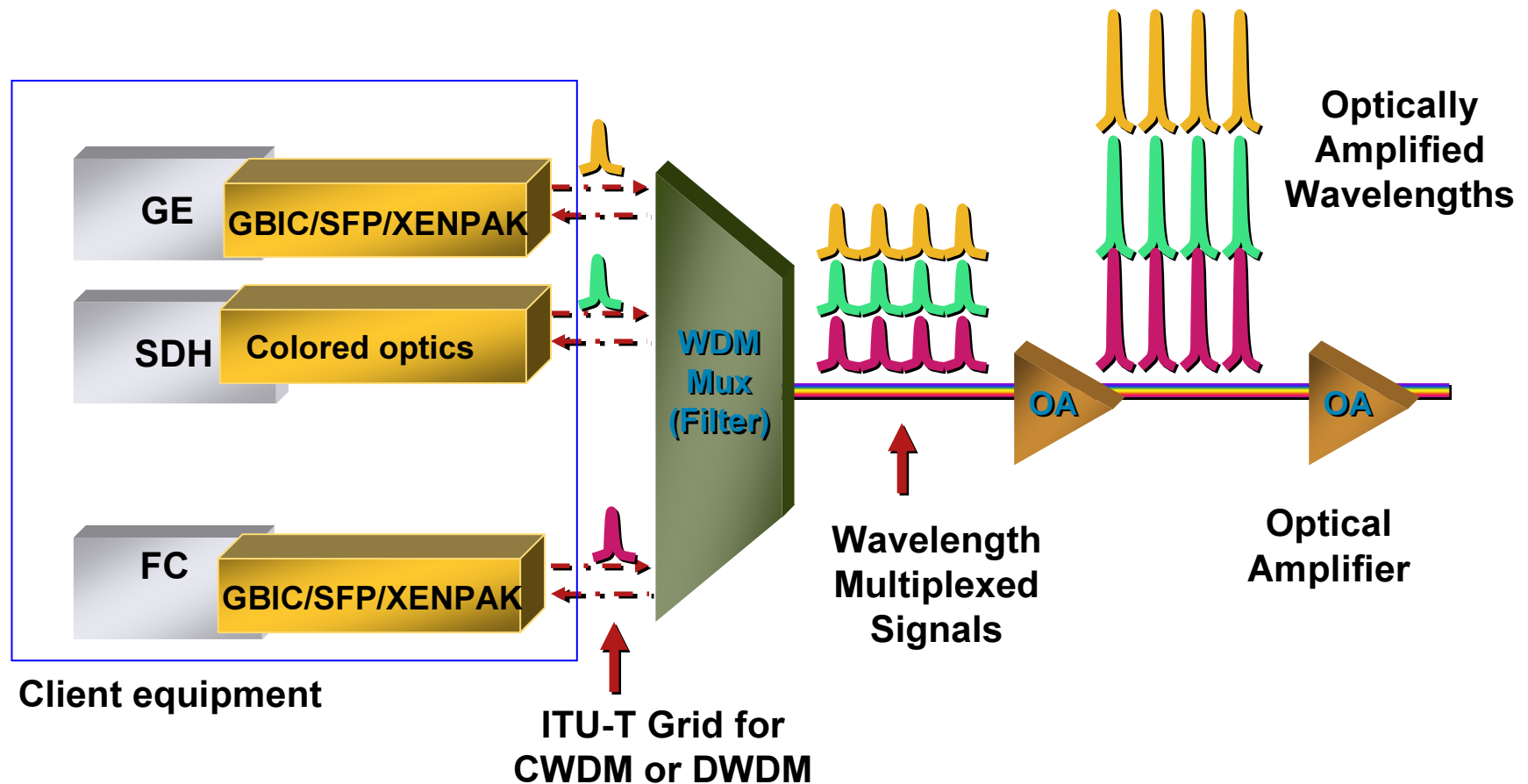
10x10G Client Line Card

Mixed 40G/10G Client Line Card

- Common development between DWDM Optical team (ONS), ASR and CRS
- The 3 units can be placed in M2 or M6 and chassis



WDM system anatomy – colored client signals



Cisco ONS 15454MSTP multivendor interoperability

Alien wavelength support

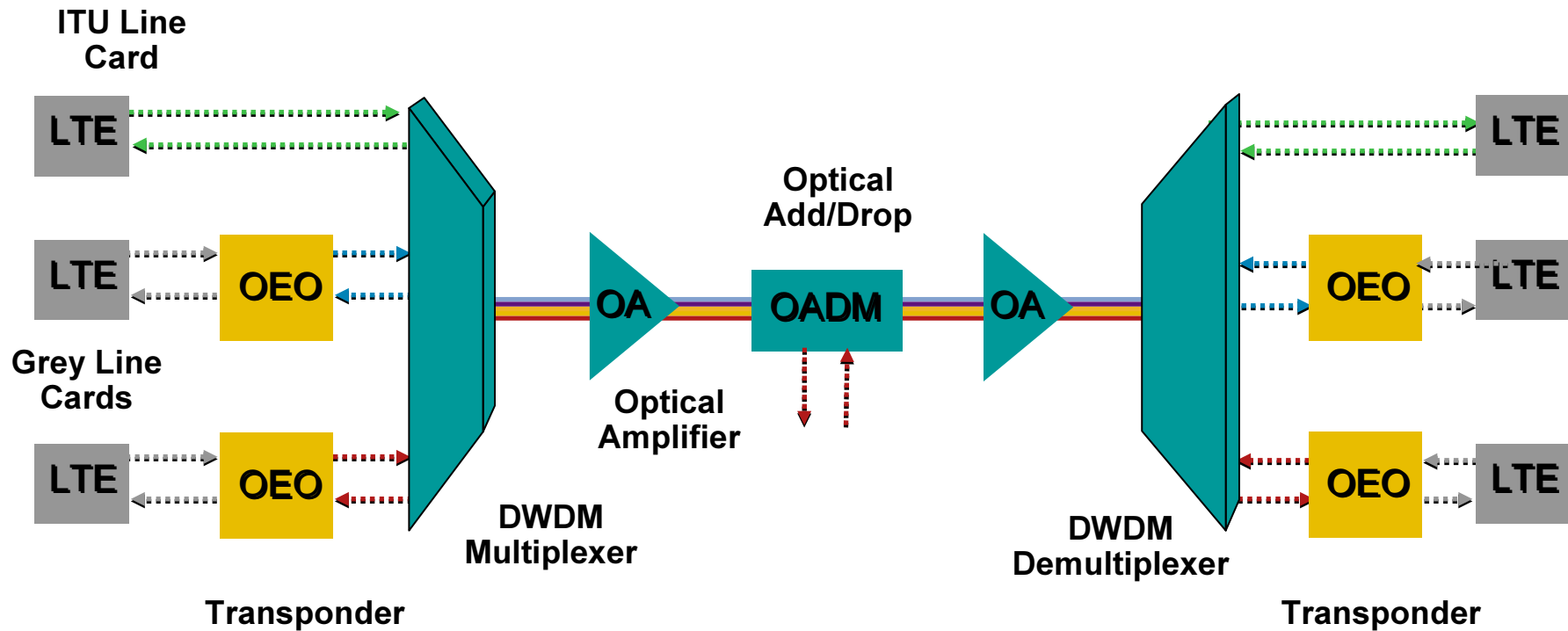
Available options:

- **Colored pluggables:**
 - DWDM XENPAK, X2, XFP
 - DWDM GBIC, SFP
- DWDM line cards (e.g. from MSPP)
- IPoverDWDM interfaces
- Generic signal (e.g. from 3rd party)

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. Sensitivity Back-to-Back
4. TX Optical Output Power Range: Pmin ÷ Pmax [dBm]
5. TX Wavelength Stability: [±pm]
6. Chromatic Dispersion Robustness
7. Scale Factors: F-PPL, F-POL, F-OSNRPL, F-OSNROL
8. Gaussian X-Talk-penalties
9. Single-interfering X-Talk penalties

- *BENEFIT: High degree of interoperability with 3rd party equipment*
- *BENEFIT: Lower cost per channel where transponder is not needed*

Cisco ONS 15454 MSTP - support for both options



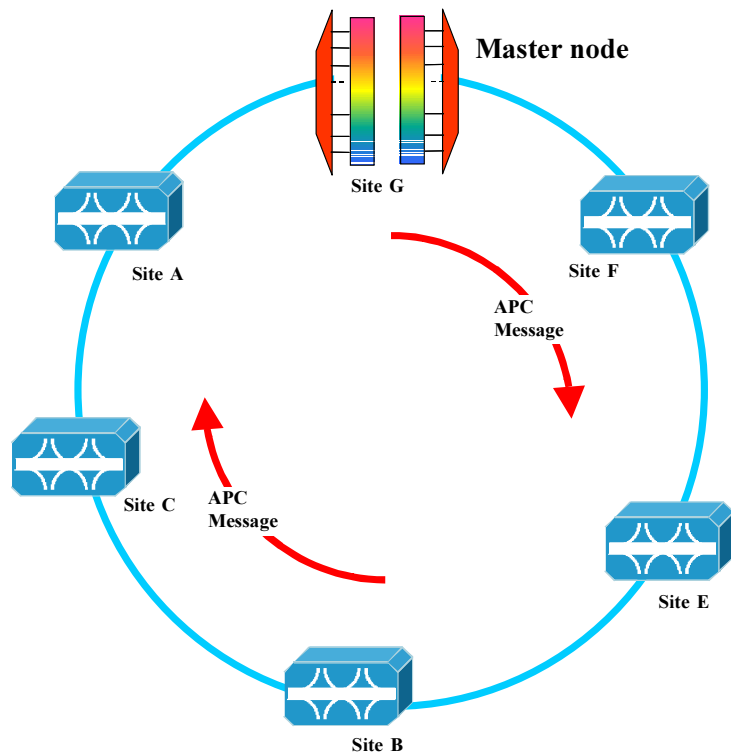
Advanced monitoring functionalities

Monitoring of multiple levels of communication

- Optical parameters
 - signal levels
 - laser bias
- OTN
 - G.709
 - FEC/EFEC statistics
- Payload specific
 - RMON like information for ethernet
 - 8B/10B, running disparity for FC
 - SDH specific
 - others (ESCON, ...)

Automatic Power Control

The tool for keeping the network operational and stable



- Keep either power or gain constant on each amplifier
- Avoid BER or non linear effect
- APC automatically starts when network detects needs for a gain correction
- No human intervention required
- Correct amplifier power/gain
 - whenever the # of channels changes
 - to compensate ageing effects
 - To compensate changing in operating conditions (e.g. temperature increase)

BENEFIT: Automatic reaction of network to fast and slow changes in the network

Cisco ONS 15454 MSTP



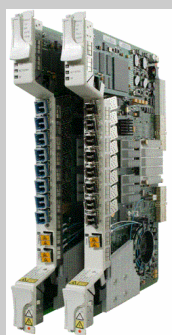
Muxponding, crossponding and MSPP integration

Flexible muxponding

Effective use of bandwidth by Cisco ONS 15454 MSTP

2.5G DM

- 8 ports
- GE
- 1/2G FC
- 1/2G FICON
- ESCON
- signal mix supported



10G DME(X)

- 8 ports
- GE
- 1/2/4G FC
- 1/2/4G FICON
- ISC-1, ISC-3
- signal mix supported



40G MXP

- 4 ports
- 10GE
- 8/10G FC
- 8/10G FICON
- STM-64
- OTU-2, OTU-2e
- signal mix supported



4xSTM-16 ->OTU2 Muxponder

- 4 ports
- STM-16 clients
- ODU1 into OTU2



- *BENEFIT: Better lambda capacity utilization*
- *BENEFIT: Higher service density and flexibility*

Ethernet enabled DWDM

Solution components - GE/10GE XP/XPE

GE crossponder

- 20x GE ports (UNI)
- 2x 10GE ports (NNI)



10GE crossponder

- 2x 10GE ports (UNI)
- 2x 10GE ports (NNI)



Features

- Smart optical ring protection based on G.709 overhead (sub 50 ms)
- Configurable as muxponder, transponder, 10GE regenerator and in L2 switch mode
- SFP for GE ports
- XFP for 10GE ports (DWDM or 'grey')
- Can interoperate with IPoDWDM card in routers
- Enhanced version available in release 9



Cisco ONS 15454 MSTP flexible optical networking

MSP on the blade

HW features

- 16 SFP Based Client (Grey and CWDM optics available)
- Support of OC-3/OC-12/OC-48 and GE client signals
- 1 Trunks XFP Based supporting E-FEC/FEC and G.709
- 2 SR XFP supporting redundancy connection with protection board and Pass-through Traffic
- GFP-F Mapping

SW features

- OTN PM on Trunk
- A to Z Circuit provisioning (STS layer)
- SONET PM (B1, B2 on Trunk and aggregate) and Alarm Management (Line, Section and Path)
- Ethernet RMON statistics
- UPSR Protection on Trunk
- 1+1 APS on Client



- *BENEFIT: Better lambda capacity utilization*
- *BENEFIT: Higher service density and flexibility*
- *BENEFIT: Compact MSP integration*

Cisco ONS 15454 MSTP



Reconfigurable OADM

Reconfigurable optical add/drop multiplexers

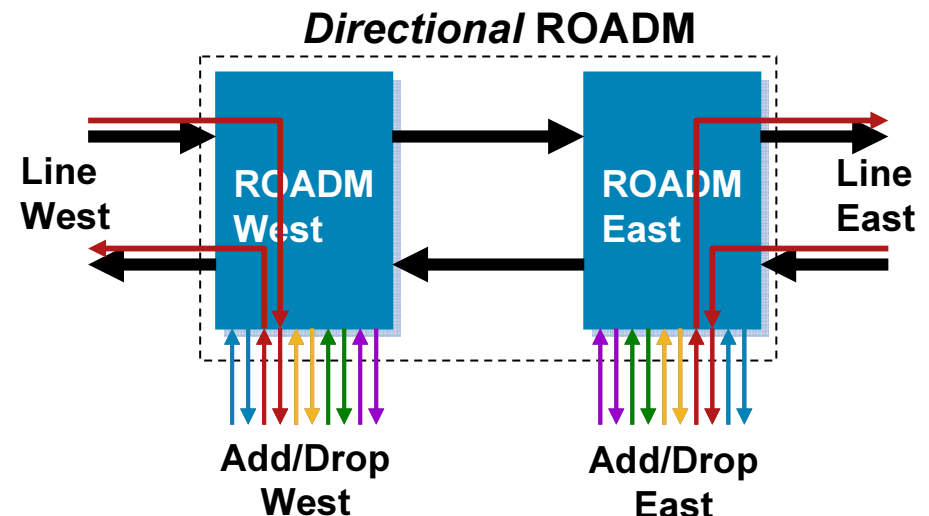
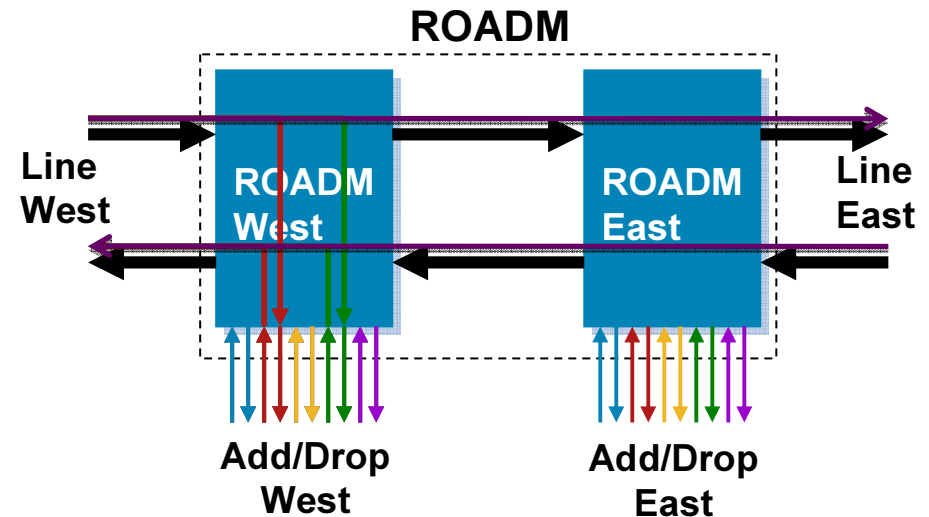
Evolution steps

- Basic implementation
 - 2° ROADM
 - Multidegree ROADM (optical mesh)
- Enhanced functionality
 - Omnidirectional
 - Colourless
 - DWDM aware control plane
- Integration and space/power efficiency
 - Single module ROADM

Increasing flexibility of optical networks

What is a ROADM?

- ROADM (Reconfigurable Optical Add & Drop Multiplexer) is an optical Network Element able to Add/Drop or Pass through any wavelength composing the DWDM spectrum
 - A ROADM is typically composed by 2 line interfaces and 2 Add/Drop interfaces
- Typical ROADM implementations have Add/Drop interfaces dedicated to a direction
 - As a side-effect, if it is required to reconfigure the connection to drop the channel from a different side the new channel is sent to a different physical port: this would require to manually change the cabling of any connected client equipment



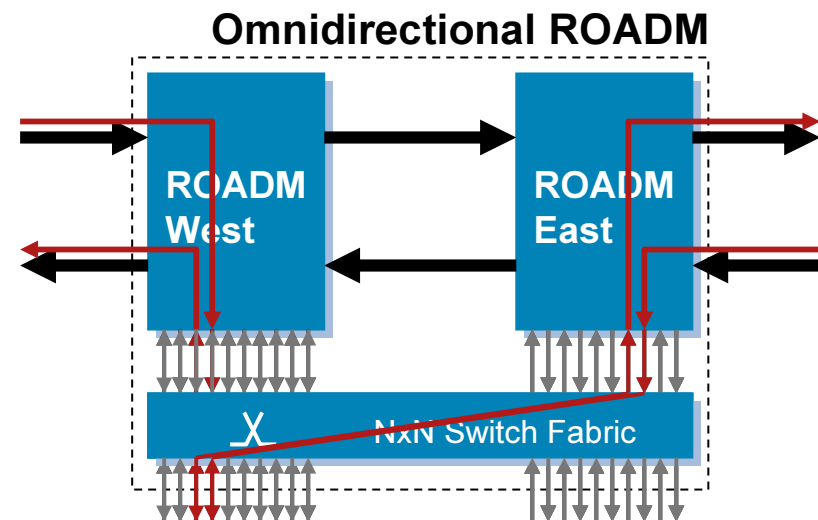
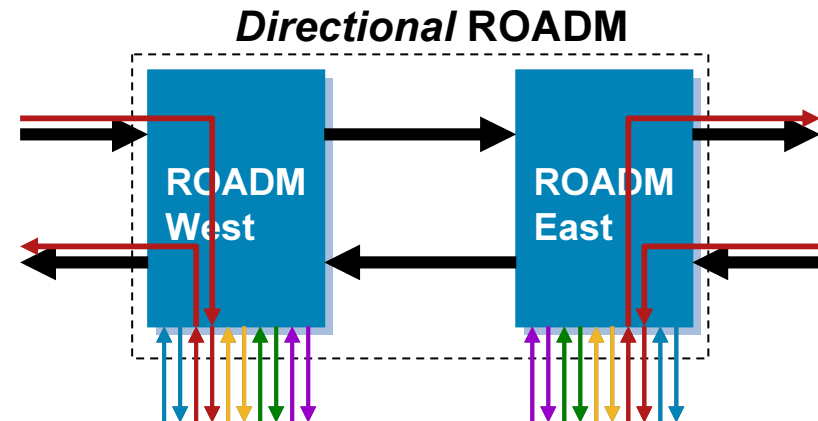
What is an Omnidirectional ROADM?

Omnidirectional ROADM functionalities can, again, be understood comparing it with a *Directional* ROADM

- A *Directional* ROADM always add/drop a given wavelength from/to a given Line Side: channel #1 is always dropped from West Side
- If it is required to reconfigure the connection to drop the channel from a different side the new channel is sent to a different physical port: this would require to manually change the cabling of any connected client equipment

A Omnidirectional ROADM, on the contrary, can be reconfigured to drop ANY wavelength from ANY Line Side:

- For instance we can start dropping the red wavelength from the West Side
- and reconfigure the ROADM to drop the red wavelength from the East Side on the same port
- No re-cabling is required



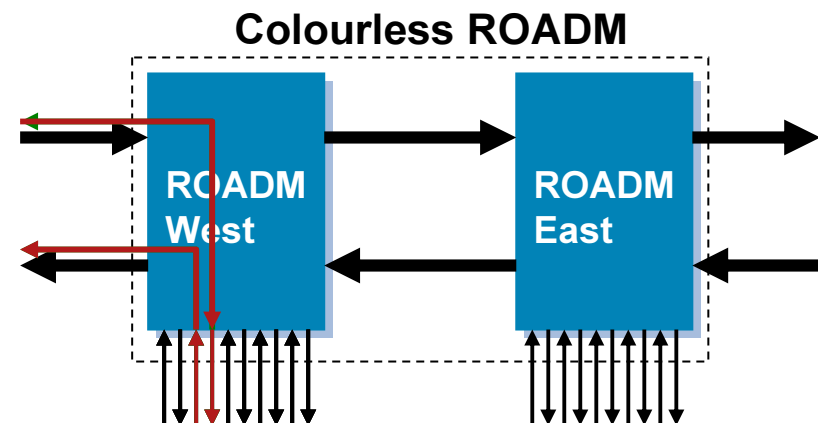
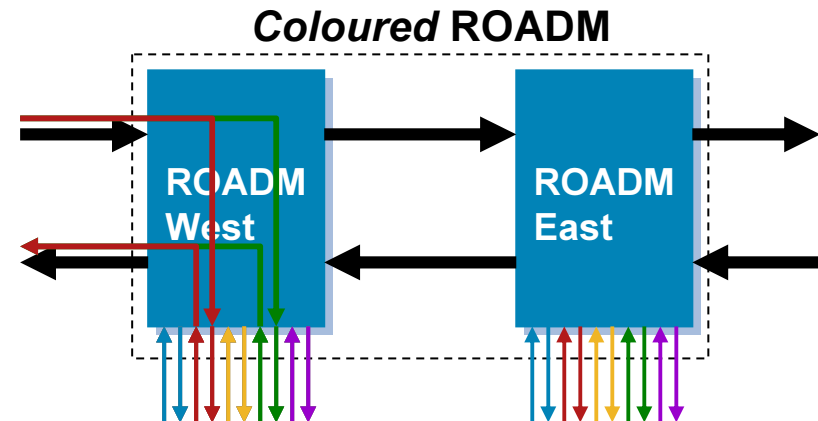
What is a Colourless ROADM?

Colourless ROADM functionalities can be understood comparing it with a Coloured ROADM

- A *Coloured* ROADM always add/drop a given wavelength from/to a given port: channel #1 is always dropped on port #1
- If it is required to reconfigure the connection to drop a different wavelength (i.e. channel) the new channel is sent to a different physical port: this would require to manually change the cabling of any connected client equipment

A colourless ROADM, on the contrary, can be reconfigured to drop ANY wavelength on ANY port:

- For instance we can start dropping the green wavelength
- and reconfigure the ROADM to drop the red one on the same port
- No re-cabling is required

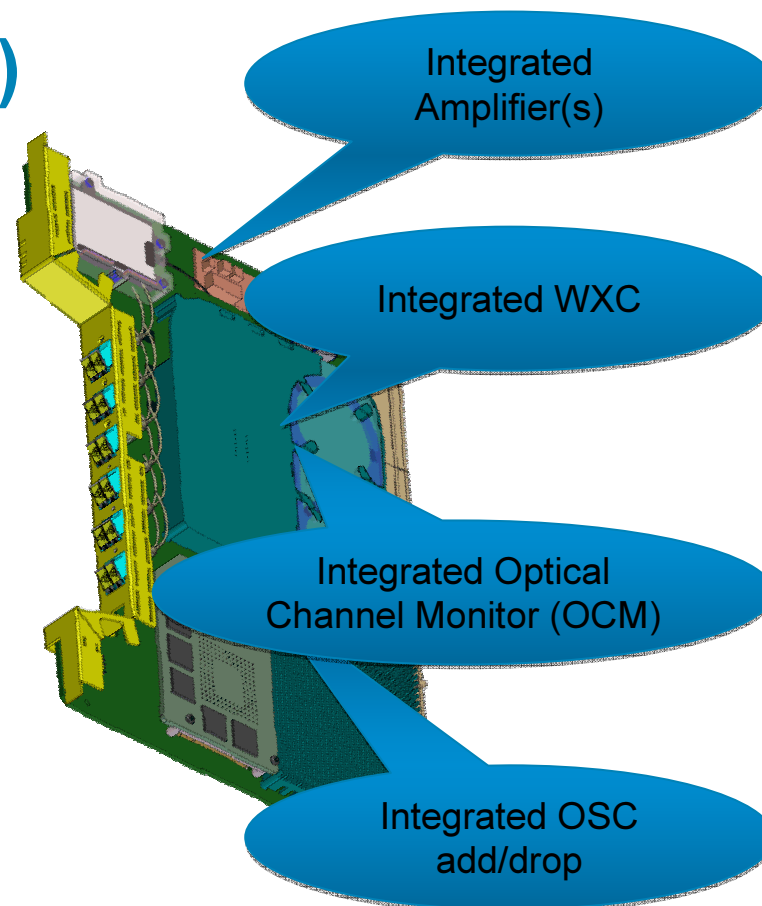


Single Module ROADM (SMR)

■ Next Generation ROADM Technology

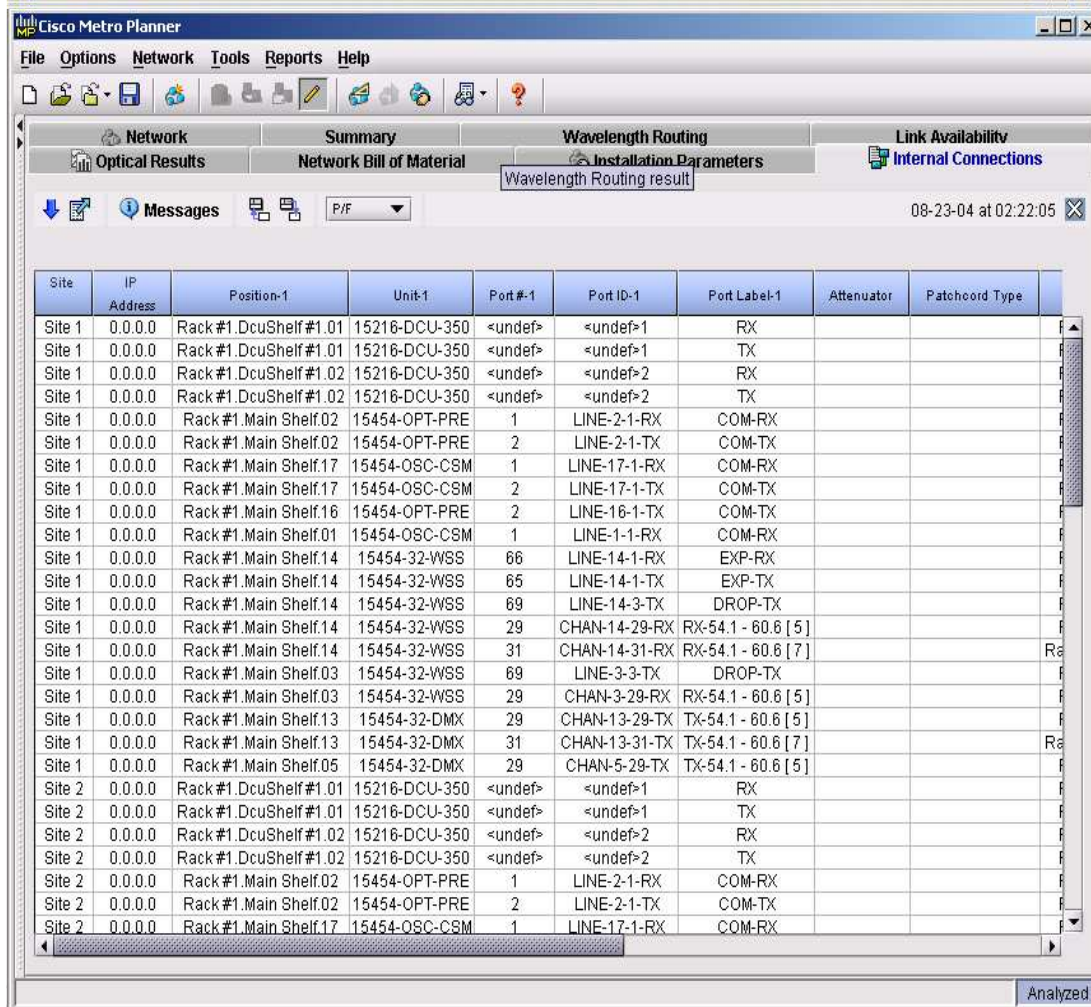
- Hyper Integration:
 - Booster
 - Preamplifier
 - Wavelength crossconnect
 - OSC add/drop
 - Integrated Optical Channel Monitoring
- Consumes ~40% less Power
- Address terminal, 2⁰, 3⁰ and 4⁰ ROADM applications
- 15454-40-SMR1-C=
 - 40chs Degree-2 ROADM with integrated Pre-Amplifier.
- 15454-40-SMR2-C=
 - 40chs Degree-4 ROADM with integrated Booster & Pre Amplifier

■ Attractive pricing with PAYG bundles



Cisco ONS 15454 MSTP:

Comprehensive design tool - Cisco Transport Planner



The screenshot shows the Cisco Metro Planner interface with the 'Wavelength Routing result' tab selected. The table displays the following data:

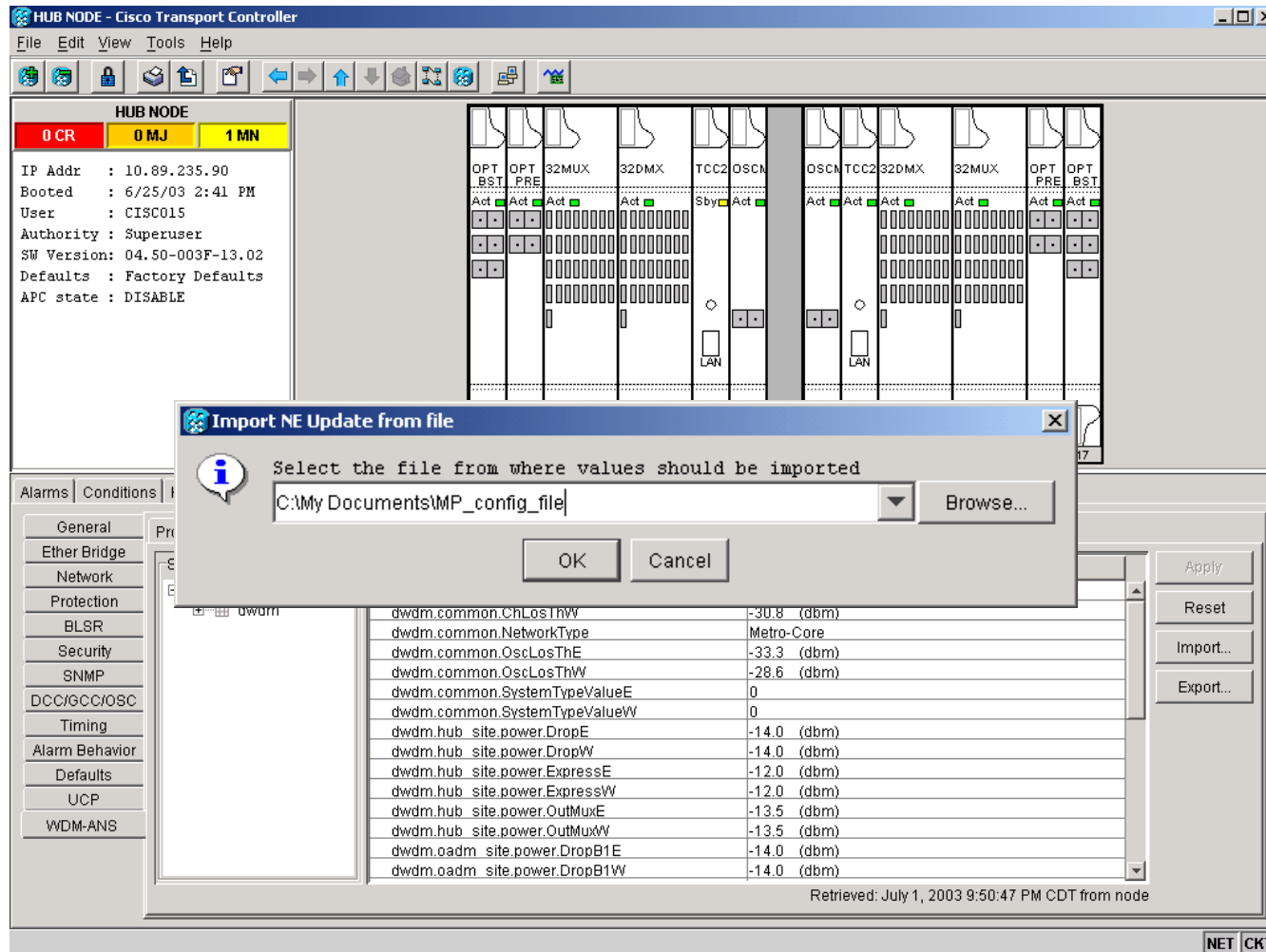
Site	IP Address	Position-1	Unit-1	Port#-1	Port ID-1	Port Label-1	Attenuator	Patchcord Type
Site 1	0.0.0.0	Rack #1.DcuShelf #1.01	15216-DCU-350	<undef>	<undef>1	RX		
Site 1	0.0.0.0	Rack #1.DcuShelf #1.01	15216-DCU-350	<undef>	<undef>1	TX		
Site 1	0.0.0.0	Rack #1.DcuShelf #1.02	15216-DCU-350	<undef>	<undef>2	RX		
Site 1	0.0.0.0	Rack #1.DcuShelf #1.02	15216-DCU-350	<undef>	<undef>2	TX		
Site 1	0.0.0.0	Rack #1.Main Shelf.02	15454-OPT-PRE	1	LINE-2-1-RX	COM-RX		
Site 1	0.0.0.0	Rack #1.Main Shelf.02	15454-OPT-PRE	2	LINE-2-1-TX	COM-TX		
Site 1	0.0.0.0	Rack #1.Main Shelf.17	15454-OSC-CSM	1	LINE-17-1-RX	COM-RX		
Site 1	0.0.0.0	Rack #1.Main Shelf.17	15454-OSC-CSM	2	LINE-17-1-TX	COM-TX		
Site 1	0.0.0.0	Rack #1.Main Shelf.16	15454-OPT-PRE	2	LINE-16-1-TX	COM-TX		
Site 1	0.0.0.0	Rack #1.Main Shelf.01	15454-OSC-CSM	1	LINE-1-1-RX	COM-RX		
Site 1	0.0.0.0	Rack #1.Main Shelf.14	15454-32-WSS	66	LINE-14-1-RX	EXP-RX		
Site 1	0.0.0.0	Rack #1.Main Shelf.14	15454-32-WSS	65	LINE-14-1-TX	EXP-TX		
Site 1	0.0.0.0	Rack #1.Main Shelf.14	15454-32-WSS	69	LINE-14-3-TX	DROP-TX		
Site 1	0.0.0.0	Rack #1.Main Shelf.14	15454-32-WSS	29	CHAN-14-29-RX	RX-54.1 - 60.6 [5]		
Site 1	0.0.0.0	Rack #1.Main Shelf.14	15454-32-WSS	31	CHAN-14-31-RX	RX-54.1 - 60.6 [7]		
Site 1	0.0.0.0	Rack #1.Main Shelf.03	15454-32-WSS	69	LINE-3-3-TX	DROP-TX		
Site 1	0.0.0.0	Rack #1.Main Shelf.03	15454-32-WSS	29	CHAN-3-29-RX	RX-54.1 - 60.6 [5]		
Site 1	0.0.0.0	Rack #1.Main Shelf.13	15454-32-DMX	29	CHAN-13-29-TX	TX-54.1 - 60.6 [5]		
Site 1	0.0.0.0	Rack #1.Main Shelf.13	15454-32-DMX	31	CHAN-13-31-TX	TX-54.1 - 60.6 [7]		
Site 1	0.0.0.0	Rack #1.Main Shelf.05	15454-32-DMX	29	CHAN-5-29-TX	TX-54.1 - 60.6 [5]		
Site 2	0.0.0.0	Rack #1.DcuShelf #1.01	15216-DCU-350	<undef>	<undef>1	RX		
Site 2	0.0.0.0	Rack #1.DcuShelf #1.01	15216-DCU-350	<undef>	<undef>1	TX		
Site 2	0.0.0.0	Rack #1.DcuShelf #1.02	15216-DCU-350	<undef>	<undef>2	RX		
Site 2	0.0.0.0	Rack #1.DcuShelf #1.02	15216-DCU-350	<undef>	<undef>2	TX		
Site 2	0.0.0.0	Rack #1.Main Shelf.02	15454-OPT-PRE	1	LINE-2-1-RX	COM-RX		
Site 2	0.0.0.0	Rack #1.Main Shelf.02	15454-OPT-PRE	2	LINE-2-1-TX	COM-TX		
Site 2	0.0.0.0	Rack #1.Main Shelf.17	15454-OSC-CSM	1	LINE-17-1-RX	COM-RX		

- GUI-based Network Design Entry
- Traffic requirements:
 - Any-to-Any Demand provided by ROADM
 - Point-to-point demands
- Comprehensive Analysis checks for:
 - wavelength routing and selection
 - optical budget and OSNR
 - CD, PMD, amplifier tilt etc.
- Smooth Transition from Design to Implementation
 - Bill of Materials
 - Rack Diagrams
 - Step-by-Step Interconnect

BENEFIT: Fast and comprehensive network design

Cisco ONS 15454 MSTP flexible optical networking

Automatic Node Setup



BENEFIT: Fast network deployment and setup

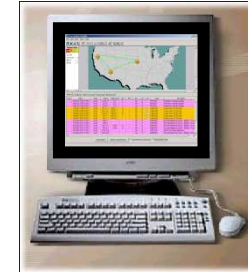
Cisco ONS 15454 MSTP:

Management Applications Options

- ***Cisco Transport Controller (CTC)***

- Installation and setup

- Full node/ring management capability



- ***Cisco Transport Manager (CTM)***

- EMS/NMS layer applications for advanced optical management

- CORBA/TL1 and SNMP NBI available for OOS integration



- ***Cisco Transport Planner***

- Network design

- Network modelling

- Computer-aided installation: from network design straight to installation



- ***OSMINE completed***

- TIRKS, NMA and TEMS

Cisco Transport Controller Views & Navigation

The image displays four distinct views of the Cisco Transport Controller software interface:

- Multi-Shelf or Node/NE View:** This view shows a summary of the ROADM 15, including its IP address (10.89.204.15), user (CISCO15), and various status indicators (0 CR, 0 MJ, 0 MN). It also displays a rack diagram with multiple shelves (Shelf 1, Shelf 4) and a table of ports and wavelengths.
- Shelf View*:** This view provides a detailed look at a specific shelf (ROADM 15, Shelf 1), showing slot details (Slot 1: OPT-BST, Slot 2: OPT-FPE, etc.) and a corresponding rack diagram.
- Network View:** This view shows a map-based representation of the network topology, with nodes labeled ROADM 25, ROADM 23, ROADM 15, MESH 17, and OMN 11 connected by lines representing network links.
- Card View:** This view shows a detailed configuration for a specific card (ROADM 15 Shelf 1, Slot 1 OPT-BST), including service state (IS-NR) and port details (Port 1: 00S-AU, AINS, Port 2: 00S-AU, AINS, etc.).

* If the top-level node view is a single shelf (not multi-shelf) this is referred to as Node/NE View

Cisco Transport Controller

Alarms Pane

Cisco Transport Controller

File Edit View Tools Help

Network Scope: All

Summary Network Explorer

Network View

2 CR 6 MJ 45 MN

Alarms Conditions History Circuits Provisioning Maintenance

New	Date	Node	Object	Eqpt Type	Shelf	Slot	Port	Path Width	Sev	ST	SA	Description	Cond
	11/23/06 07:32:49 UTC	ncp55	FAN-1						CR	R	✓	Mismatch Of Equipment And Attributes	MEA
	05/02/01 18:07:13 IST	ncp53	SLOT-7	TCC		7			CR	R	✓	Primary Non-Volatile Backup Memory Failure	BKUPMEMP
	04/06/01 13:47:39 UTC	ncp56	SYNC-NE						MJ	R	✓	Primary Synchronization Reference Failure	SYNCPRI
	11/23/06 07:32:46 UTC	ncp55	SYNC-NE						MJ	R	✓	Primary Synchronization Reference Failure	SYNCPRI
	04/01/01 19:38:02 IST	ncp54	SYNC-NE						MJ	R	✓	Primary Synchronization Reference Failure	SYNCPRI
	05/02/01 10:42:43 IST	ncp53	SYNC-NE						MJ	R	✓	Primary Synchronization Reference Failure	SYNCPRI
	11/05/09 09:51:05 IST	ncp51	SYNC-NE						MJ	R	✓	Primary Synchronization Reference Failure	SYNCPRI
	06/13/09 14:53:13 IST	ncp52	SYNC-NE						MJ	R	✓	Primary Synchronization Reference Failure	SYNCPRI
✓	05/25/09 02:37:20 UTC	ncp56	SYSTEM						MN	C		Loss of connection between node and CTC	DISCONNECTED
	04/06/01 13:47:28 UTC	ncp56	SLOT-7	TCC		7			MN	R		Protection Unit Not Available	PROTNA
	04/06/01 13:47:39 UTC	ncp56	BITS-1						MN	R		Loss Of Signal	LOS
	04/06/01 13:47:39 UTC	ncp56	BITS-2						MN	R		Loss Of Signal	LOS
	04/06/01 13:47:39 UTC	ncp56	SYNC-NE						MN	R		Secondary Synchronization Reference Failure	SYNCSEC
	04/06/01 13:48:12 UTC	ncp56	PWR-B						MN	R		Battery Failure	BAT-FAIL
	04/06/01 13:49:29 UTC	ncp56	SLOT-10	XC10G		10			MN	R		Protection Unit Not Available	PROTNA
	04/06/01 13:56:07 UTC	ncp56	FAC-16-1	OC48		16	1		MN	R		SDCC Termination Failure	EOC
	04/06/01 13:56:07 UTC	ncp56	FAC-16-1	OC48		16	1		MN	R		Loss Of Signal	LOS
✓	05/25/09 02:37:34 UTC	ncp55	SYSTEM						MN	C		Loss of connection between node and CTC	DISCONNECTED
	11/23/06 07:32:35 UTC	ncp55	SLOT-7	TCC		7			MN	R		Protection Unit Not Available	PROTNA
	11/23/06 07:32:46 UTC	ncp55	BITS-1						MN	R		Loss Of Signal	LOS
	11/23/06 07:32:46 UTC	ncp55	BITS-2						MN	R		Loss Of Signal	LOS

Synchronize Filter... Delete Cleared Alarms ☐ AutoDelete Cleared Alarms

Help

NET CKT

WDM Span Check (Non-Raman link)

The screenshot displays the ROADM 23 - Cisco Transport Controller interface. The left sidebar shows a tree view with 'Database' expanded, containing 'Network', 'OSI', 'Protection', 'Software', 'Diagnostic', 'Audit', and 'DWDM'. The 'DWDM' section is selected. The main window shows the 'Alarms' tab, which is highlighted with a red arrow. The 'Alarms' tab displays a table of alarms, with one alarm highlighted in yellow: '1931 1931 02/23/09 12:58:27 CST LINE-1-1-3-RX OPT-BST 1 5 MN R SPANLEN-OUT-OF-RANGE Span Length Out of Range'. Below the table, there are buttons for 'Retrieve Span Loss values', 'Reset', 'Apply', and 'Help'. The top of the interface shows the 'Summary' tab with 'ROADM 23' status: '0 CR', '0 MJ', '0 MN'. The 'Network Explorer' tab shows a diagram of 'Rack 1' with 'Shelf 1' and various slots.

ROADM 23 - Cisco Transport Controller

File Edit View Tools Help

Summary Network Explorer

ROADM 23

0 CR 0 MJ 0 MN

Node Addr : 10.89.204.23
IPv6 Address : unknown
Booted : 2/6/09 5:38 PM
User : CISCO15
Authority : Superuser
SW Version: 09.00-008I-17.17
Defaults : Factory Defaults
APC state : Side A - Enabled
Side B - Enabled

Rack 1

Shelf 1

Alarms Conditions History Circuits Provisioning Inventory Maintenance

Database Network OSI Protection Software Diagnostic Audit DWDM

APC WDM Span Check ROADM Power Monitoring Mesh Patch Panel Internal Patchcords Automatic Node Turn-Up All Facilities

Side	Measured By	Min Exp. Span Loss (dB)	Max Exp. Span Loss (dB)	Meas. Span Loss (dB)	Resolution (dB)
A	CHANNEL	10.0	25.0	33.3	2.5
B	CHANNEL	10.0	25.0	18.9	1.5

Alarms Conditions History Circuits Provisioning Inventory Maintenance

Num	Ref	New	Date	Object	Eqpt Type	Slot	Port	Sev	ST	SA	Cond	Description	D
1931	1931		02/23/09 12:58:27 CST	LINE-1-1-3-RX	OPT-BST	1	5	MN	R		SPANLEN-OUT-OF-RANGE	Span Length Out of Range	D

Retrieve Span Loss values Reset Apply Help

NET CKT

Circuit Provisioning / 1

2. OCHCC example... from Circuit Attributes user can choose protocol type, data rate, wavelength, protection option, and the final service state of the circuit and interface ports... then Click Next...

1. From Network, NE, Shelf, or Card view > Circuits tab click the Create button to bring up the Circuit Types window... Select a circuit type and click Next to bring up the Circuit Attributes window...

Circuit Attributes

Circuit Name: OCHCC #1
Type: OCHCC
Size: SONET
OC-192
OCHNC Wavelength: 1530.33 nm
C Band
Odd
☒ Bidirectional for OCHNC only
☐ Protection for OCHCC Splitter or PSM protection only
State: IS
☒ Apply to OCHCC ports IS Enable interface
<Back Next> Finish Cancel Help

Circuits	Circuit Name	OCHNC Wlen	State	Type	Dir	State
GE-XP ROADM13 to ROADM15 55.75		1555.75 nm	IS	OCHTRAIL	2-way	DISCOVER
GE-XP Omni 11 to ROADM13 40.56nm		1540.56 nm	IS	OCHTRAIL	2-way	DISCOVER
OCHTRAIL_OMNI 27_21		1560.61 nm	IS	OCHTRAIL	2-way	DISCOVER
GE-XP ROADM15 to Omni17 61.4nm		1561.42 nm	IS	OCHTRAIL	2-way	DISCOVER
OCHTRAIL_OMNI 11_89		1530.33 nm	IS	OCHTRAIL	2-way	DISCOVER
ADM10G-East		1535.82 nm	IS	OCHTRAIL	2-way	DISCOVER
ADM10G-West		1535.82 nm	IS	OCHTRAIL	2-way	DISCOVER
OMNI Demo OC192		1530.33 nm	IS	OCHCC	2-way	DISCOVER
test		1560.61 nm	IS	OCHCC	2-way	DISCOVER
CRS-1 PLIM 40G		1559.79 nm	IS	OCHNC	2-way	DISCOVERED

Circuit Provisioning / 2

Circuit Creation

Circuit Attributes

Name: OCHCC #1
Type: OCHCC
Size: SONET/OC-192

Source
Node: OMNI 11

Destination
Node: OMNI 27

Slot: slot 17 (TXP_...)
Port: 1 (Client)

In: s1/p5/A
Out: s1/p6/A

Source
OMNI 11/s1/pClient-1

<Back Next> Finish Cancel Help

3. Choose Source and Destination: The circuit attributes chosen previously act as a filter... only nodes with cards having the selected attributes will be available as sources and destinations. If there is more than one card in the node with the selected attributes they will all be available as choices...

Indicates the entry/exit points of the circuit to/from the node, based on interface slot/port chosen.

4. Choose trunk attributes (if different from current). These changes cannot be made on the interface if the trunk port is in IS state...

Circuit Creation

Circuit Attributes

Name: <auto-assigned>
Type: OCHCC
Size: SONET/OC-192
Direction: 2-way
State: IS
Apply to OCHCC ports: False

Source
OMNI 27/s1/pClient-1

Trunk Setting

Current Values

	Service State	ITU-T G.709...	FEC	SF BER	SD BER	Mapping
Source	OOS-MA,DSBLD	Enable	Enhanced	1E-5	1E-7	Synch
Destination	OOS-MA,DSBLD	Enable	Enhanced	1E-5	1E-7	Synch

Provisioning Values

ITU-T G.709 OTN: Enable FEC: Enhanced SD BER: 1E-7

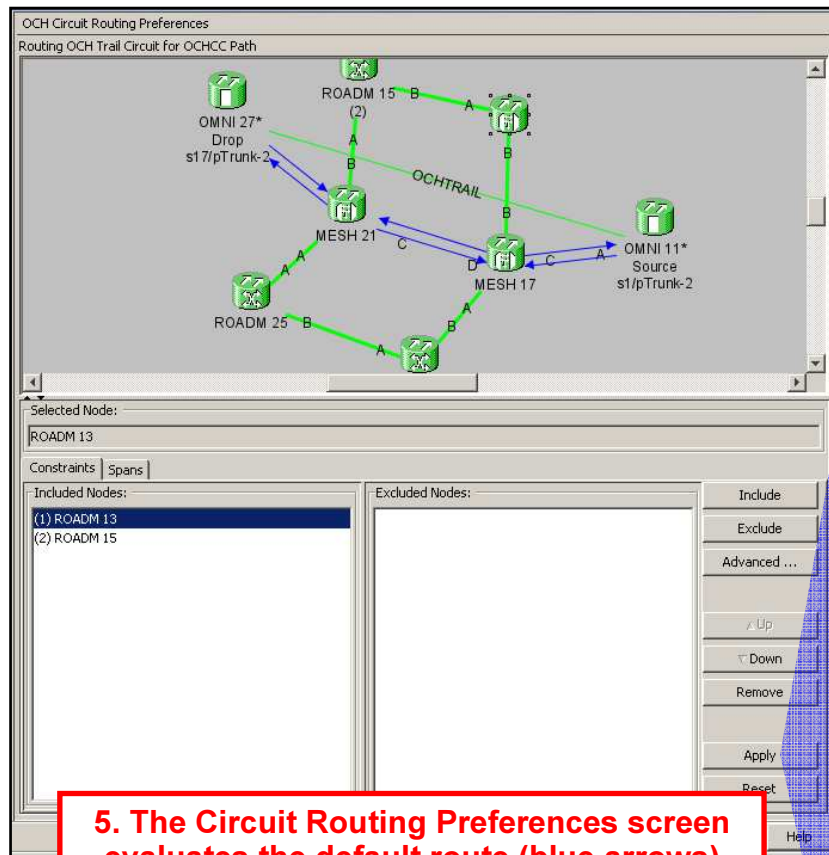
Mapping: Synch

Protection

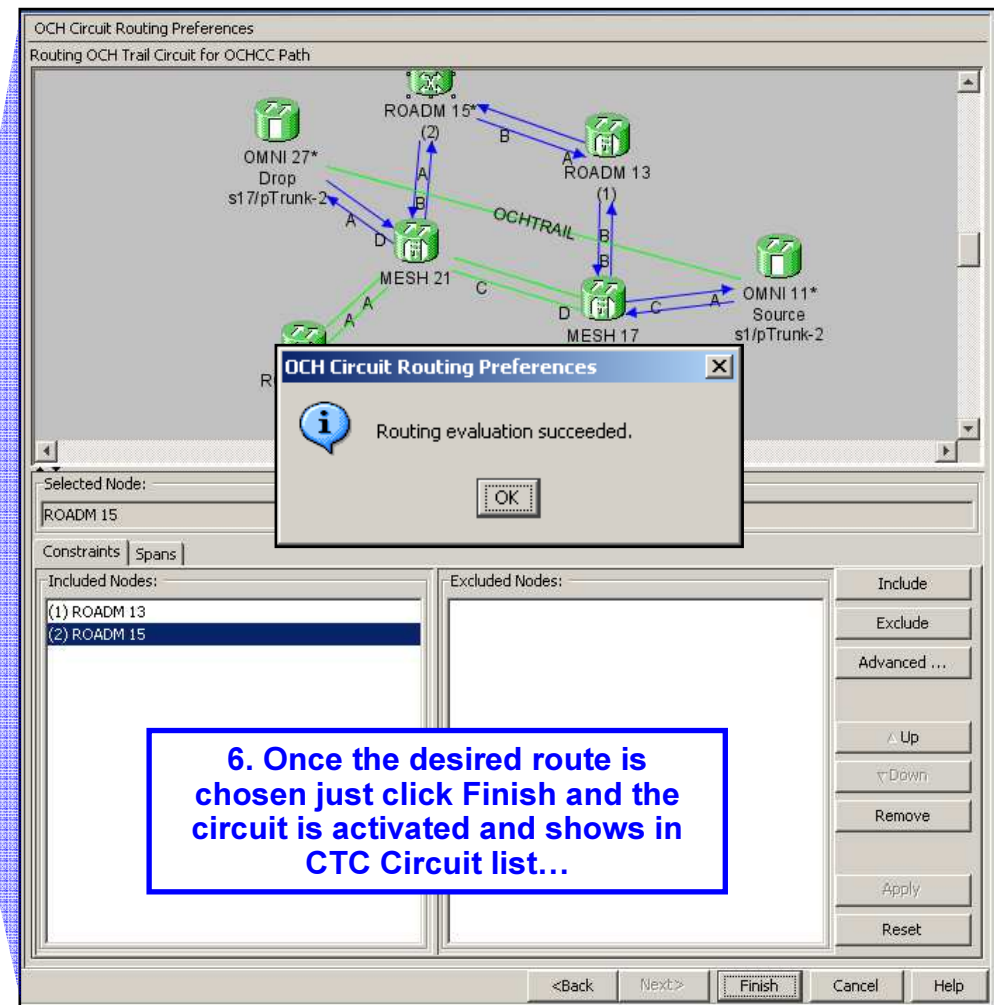
☐ Revertive Reversion Time (min): 5.0 enable/set revert time for protection

<Back Next> Finish Cancel Help

Circuit Provisioning / 3



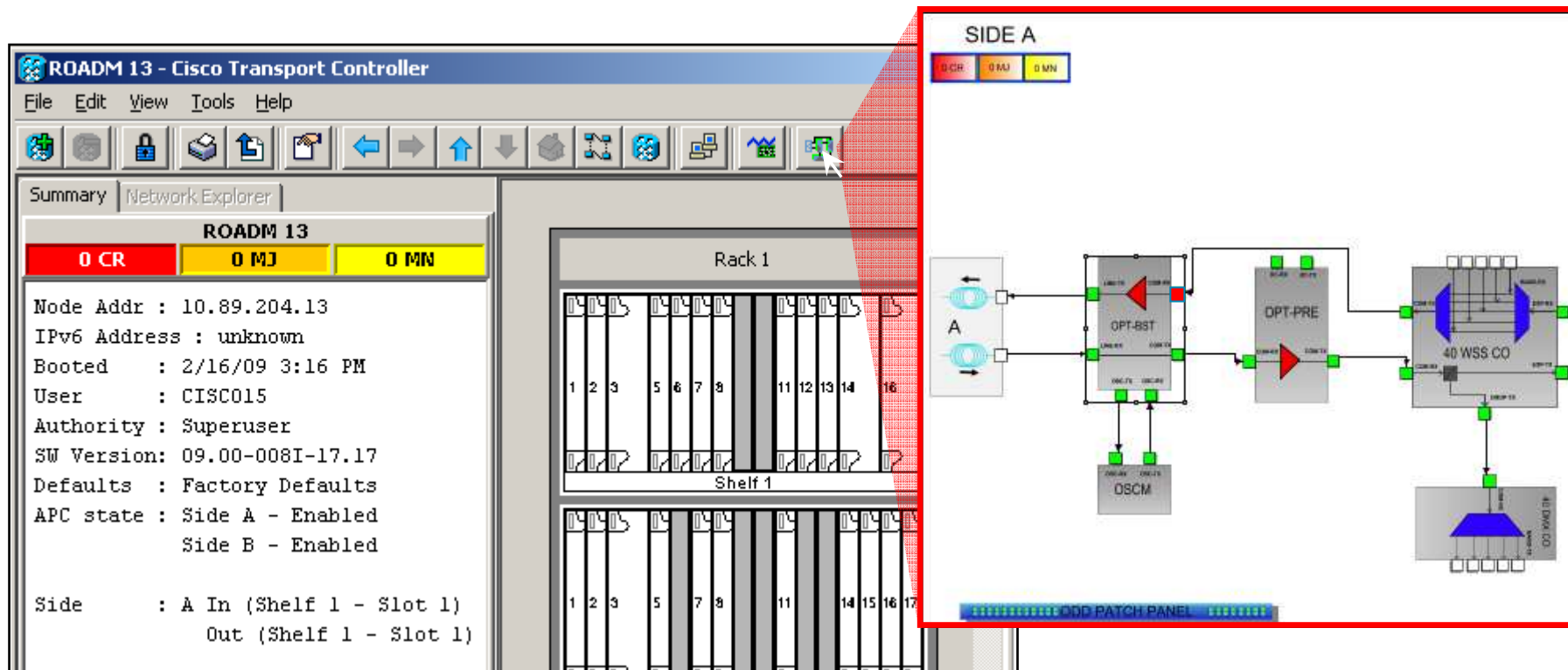
5. The Circuit Routing Preferences screen evaluates the default route (blue arrows) through the network based on the chosen source and destination and allows the user to choose an alternate route (mesh only) by including or excluding nodes. Once nodes are chosen the changes must be applied (Apply) and CTC will attempt to evaluate a new route...



6. Once the desired route is chosen just click Finish and the circuit is activated and shows in CTC Circuit list...

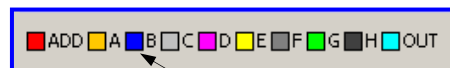
DWDM Functional View

- Available since 8.5
- Displays logical port connections between Amp, Filter, and OSC units for all available optical sides, based on internal connections list
- Useful for understanding optical signal flow
- Show TX/RX power on a connection
- Rearrange card and link objects



ROADM Power Monitoring

- Available since release 4.7. Accessed in NE View > *Maintenance* > *DWDM* > *ROADM Power Monitoring*
- In ROADM and Mesh nodes using 32/40-WSS or 40-WXC it provides capability to monitor the DWDM signal presence and equalization for each optical side separately
- Also available for TERM sites (later releases) and Dynamic Gain Equalization sites
- Color-coded to identify signal origin / optical side
- Color key for **multi-degree** indicates the cross-connected optical side...

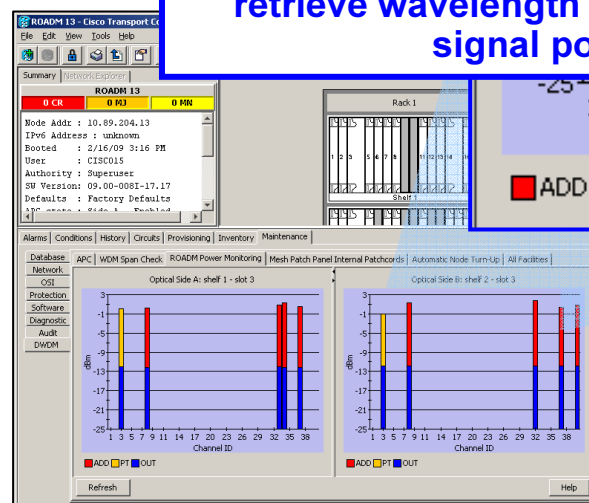
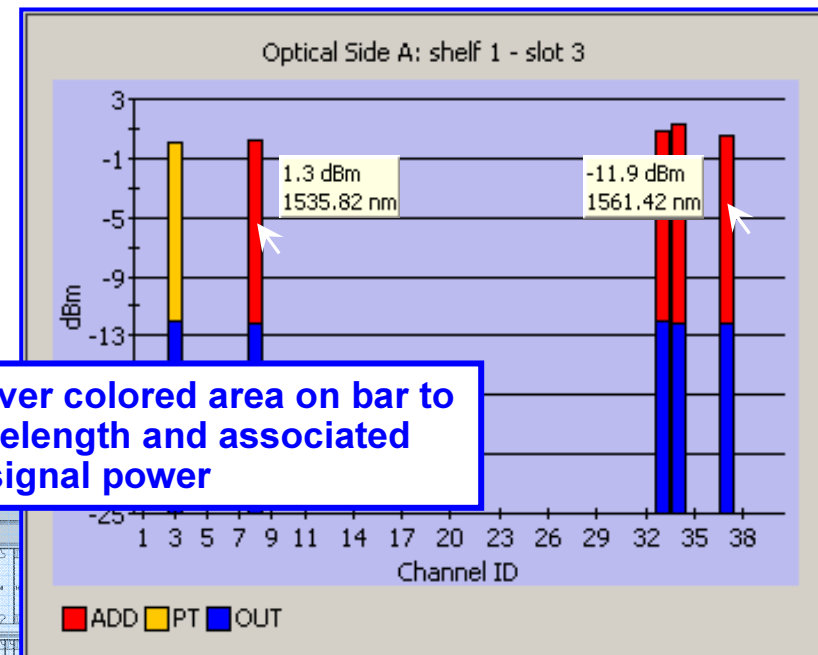


A signal shown on optical side A graph which is cross-connected from side B would show a bar with top part in blue as shown (multi-degree only)



Place cursor over colored area on bar to retrieve wavelength and associated signal power

2-degree ROADM example



- Pass-through Wavelength Power
- Added Wavelength Power
- Output Wavelength Equalization

Performance Monitoring (PM) / Filters, Amps, OSC units

For DWDM filters, amplifiers, and OSC units an 8-hour (15 min intervals) / 2-day (1 day intervals) optical power history showing min/max/average power (dBm) for the period is available for each port on the card. This is available in Card View > Performance. All PM history can be exported in excel or html format.

15 min period

Param	Curr	Prev	Prev-1	Prev-2	Prev-3	Prev-4	Prev-5	Prev-6	Prev-7	Pi
Optical Pwr (Min)	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-3.2	-3.9	
Optical Pwr (Avg)	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.8	
Optical Pwr (Max)	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	

Directions: ☒ Near End ☐ Far End

Intervals: ☒ 15 min ☐ 1 day

Port: Refresh Auto-refresh: Baseline Clear... Help

15-minute, near-end registers for all ports

Select a port to monitor on the card, then Refresh

For DWDM filters, amplifiers, and OSC units real-time power values are available in Card View > Provisioning.

Real-time dBm values

Port	Port Name	Power	Admin State	Service State	Active Channels	AINS So
1 (COM-RX)		-2.6	IS	IS-NR	4	00:00 (H:M)
2 (COM-TX)		-14.4	IS	IS-NR	4	00:00 (H:M)
3 (OSC-RX)		N/A	IS,AINS	OOS-AU,AINS	0	00:00 (H:M)
4 (OSC-TX)		-49.5	IS,AINS	OOS-AU,AINS	0	00:00 (H:M)
5 (LINE-RX)		-14.5	IS	IS-NR	4	00:00 (H:M)

Parameters Optics Thresholds

Apply Reset Help

Performance Monitoring (PM) / Interfaces (TXP, MXP, etc)

Real-time values for each port can be viewed from **Current Values** tab

15 min period

The screenshot displays the Performance Monitoring (PM) interface for a specific port. The interface is divided into several sections:

- Current Values Tab:** This tab shows real-time values for various parameters. The parameters are listed in a table with columns for Curr, Prev, Prev-1, Prev-2, Prev-3, Prev-4, Prev-5, Prev-6, Prev-7, and Prev-8. The parameters include Laser Bias (Min, %), Laser Bias (Avg, %), Laser Bias (Max, %), RX Optical Pwr (Min, dBm), RX Optical Pwr (Avg, dBm), RX Optical Pwr (Max, dBm), TX Optical Pwr (Min, dBm), TX Optical Pwr (Avg, dBm), and TX Optical Pwr (Max, dBm).
- Utilization Tab:** This tab shows utilization statistics for the port. It includes a table with columns for Param, Port 1-1 (TEN_GE), and Port 3-1 (Trunk). The parameters include Time Last Cleared, ifInOctets, rxTotalPkts, ifInMulticastPkts, ifInBroadcastPkts, ifInErrors, dot3StatsFCSErrors, etherStatsUndersizePkts, etherStatsFragments, etherStatsPkts64Octets, etherStatsPkts65to127Octets, and etherStatsPkts128to255Octets.
- History Tab:** This tab shows historical data for the port. It includes a table with columns for Param, Curr, Prev, Prev-1, Prev-2, Prev-3, Prev-4, Prev-5, Prev-6, Prev-7, and Prev-8. The parameters include BBE-SM, ES-SM, SES-SM, UAS-SM, FC-SM, ESR-SM, and CRC-SM.

The interface also includes a "Directions" section with radio buttons for "Near End" and "Far End", and a "15-minute, near-end" label. The "Statistics at March 1" label is also present. The "Refresh" button is located at the bottom of the interface. The "Auto-refresh" section shows a dropdown menu set to "15 Seconds". The "Baseline", "Clear...", and "Help" buttons are also present.

Database Backup and Restore

The screenshot displays the Term29 - Cisco Transport Controller interface. The main window shows a network diagram with various components like CR, MJ, MN, MXP, TXP, DMX, TCC2, TCC240, WSS, CO, AMP, OPT, and RAMP. The user is identified as CISC015. Two dialog boxes are overlaid: a 'Backup Database' dialog and a 'Restore Database' dialog. The 'Backup Database' dialog is highlighted with a red border and contains a text box with the path 'C:\Documents and Settings\sdimmy\Desktop\Site1' and a 'Browse...' button. The 'Restore Database' dialog is highlighted with a blue border and contains a text box with the same path, a 'Browse...' button, and a checked checkbox labeled 'Complete Database(System and Provisioning)'. Both dialogs have 'OK' and 'Cancel' buttons. A red arrow points from the 'Backup...' button in the main interface to the 'Backup Database' dialog. A blue arrow points from the 'Restore...' button in the main interface to the 'Restore Database' dialog. The main interface also has a 'Database' section with buttons for 'Backup...' and 'Restore...'. A table at the bottom left lists various database components: Overhead XConnect, Diagnostic, Timing, Audit, Test Access, DWDM, Database, Network, OSI, Protection, and Software.

Use the database backup utility to back up all provisioning on the node...

Use the database restore utility to restore shelf, card, port, and circuit provisioning. The "Complete Database" option restores settings such as node name and IP settings, otherwise these are not restored...

The database can also be restored to default using a special re-initialization utility on the Cisco ONS 15454 System Software CD. This will undo all provisioning and cross-connects on the node.

Q & A



