

Converged Management For A Converged Network

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Session Abstract

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The same forces that continue to drive convergence in the communications network are also driving convergence in the area of network management. This session describes converged network management in the context of traditional transport technologies (dense wavelength-division multiplexing [DWDM], Synchronous Optical Network [SONET], and Synchronous Digital Hierarchy [SDH]) and data (Ethernet, IP, and Multiprotocol Label Switching [MPLS]) from both the enterprise and service provider perspectives. Attendees will learn about (1) the advantages and disadvantages of converged network management, (2) the challenges associated with achieving converged network management and how to overcome them, and (3) potential converged network management solutions and how they may affect network administrators.

What Is A Converged Network?

Many Faces Of Convergence

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- The term *convergence* is used to refer to the deliberate integration of previously separate entities

Two or more things become one thing

- In the past *convergence* meant the integration of *voice* (circuit-oriented telephony) and *data* (packet-oriented data communications) onto a common network infrastructure

Since telephony evolved first, data service was forced to use the circuit-switched network

The key penalties of this were performance and cost

Convergence was seen as a way to eliminate both penalties through a network that was purpose-built and optimized for both voice and data services

- Today *convergence* can be used to refer to integration initiatives that are occurring at several different layers of the communications network model—from the Application Layer to the Physical Layer

From single log-in security and unified messaging to the TDM and Ethernet over SONET and WDM

Context For This Session

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- **This session will focus on the convergence that is occurring in the lower layers of the OSI 7-layer model**
- **The *voice* element has taken on the larger context of TDM-based transport technologies—T1/E1, T3/E3, OC-n/STM-n, and wavelengths**

Commonly referred to today as *Optical*

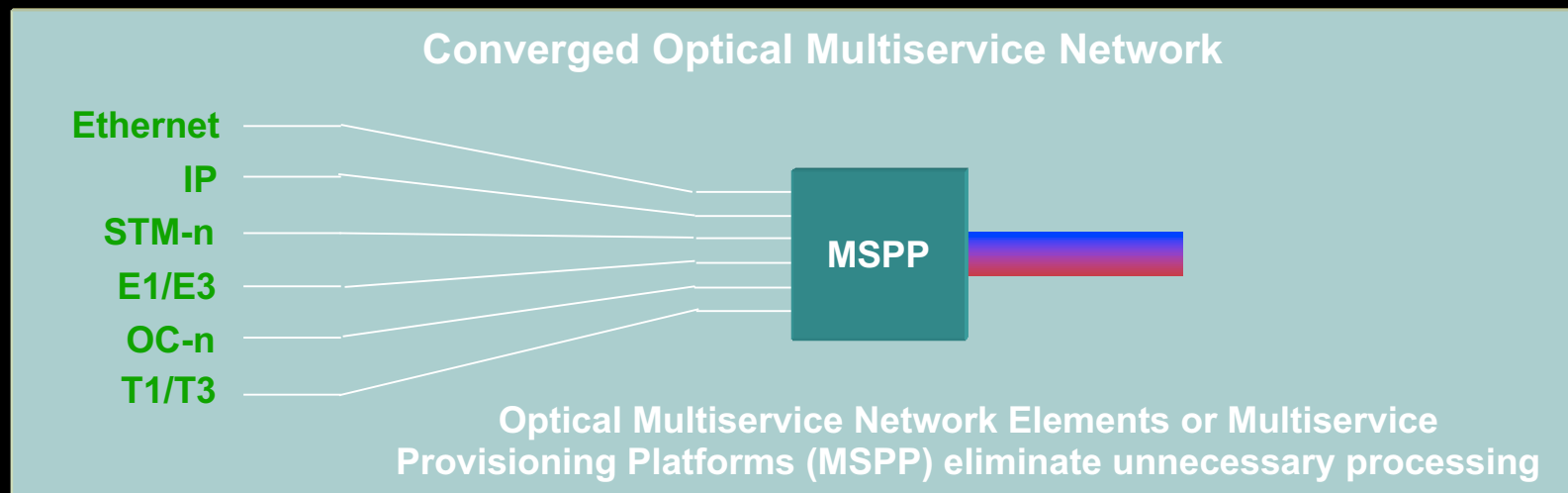
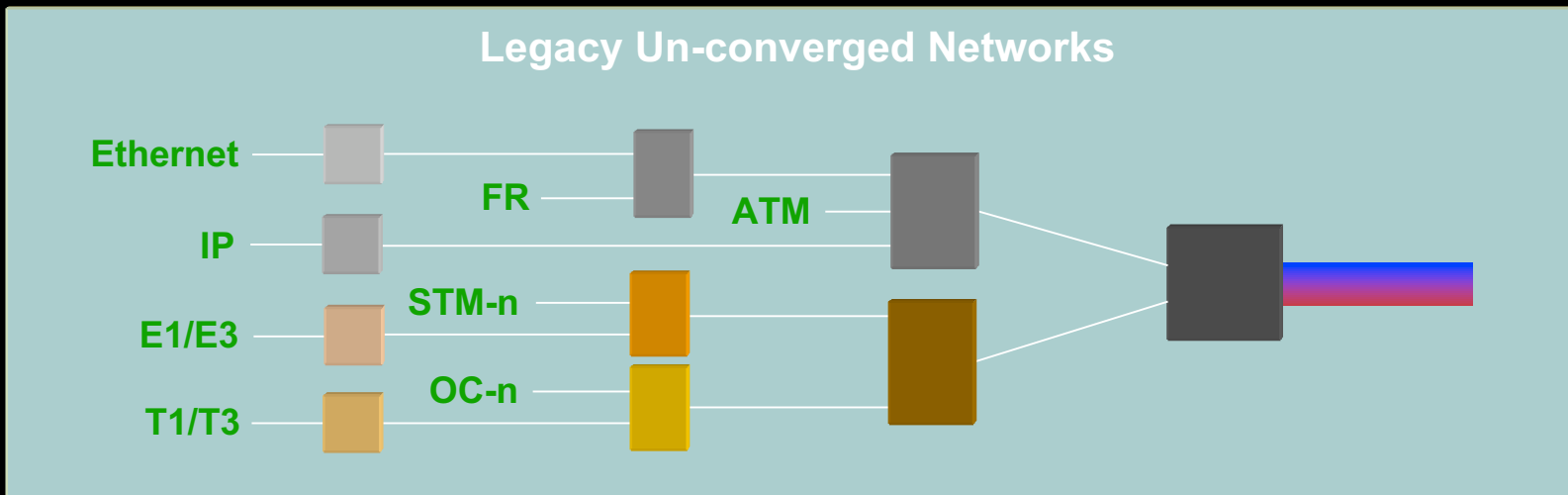
- **The *data* element has been partitioned into various packet-oriented technologies—IP/MPLS, FR/ATM, and Ethernet**

Commonly referred to today as *IP*

- **This area of convergence is also referred to as *IP+Optical* or *Optical Multiservice* networking**

Convergence—A Physical Perspective

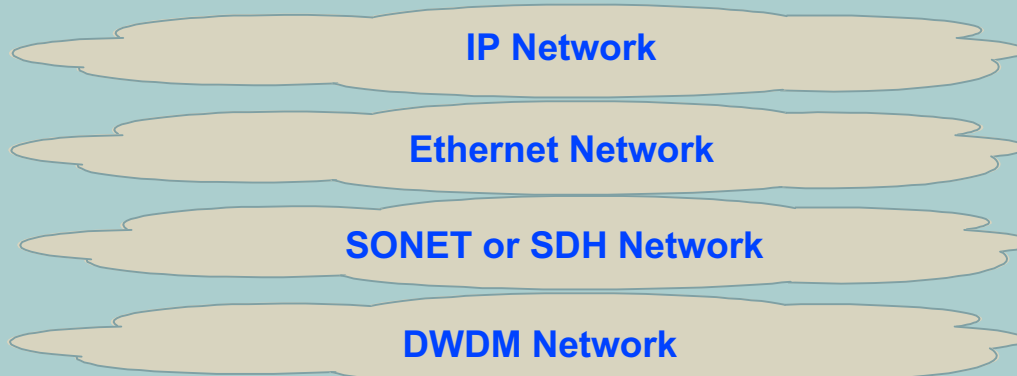
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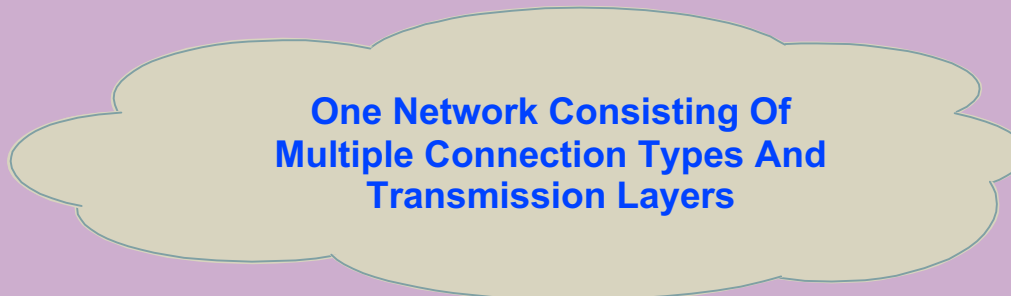
Convergence—A Logical Perspective

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Observer Views Multiple Distinct Networks



Observer Views One Network



- Regardless of the actual physical structure of a network, the operator may *view* it as multiple distinct networks or a single network
- The way a network is viewed, correlates to the way it is operated and managed

Why Pursue Convergence?

Efficiency, Flexibility, Simplicity

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- **Converged network exhibits fewer signal processing steps**
More efficient conversion/de-conversion of data to be transmitted
- **Converged network has fewer network element types**
Fewer points of failure increases network reliability and availability
Fewer intra-site interconnections of various different types of traffic
- **Converged network is more flexible as circuit packs can be placed where needed to add or grow service**
- **Converged network has fewer network elements**
- **Fewer network elements means simpler networks**
Emphasis on aggregation to transport to de-aggregation
Multi-technology complexity pushed to the network edge
- **Physical convergence tends to make the network simpler, more efficient, and more flexible**

Reduced Capital Expenditure

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- **Data and signal processing efficiencies lead to reduced network element cost**
- **Fewer network elements lead to lower network cost**
- **Fewer network element types lowers the cost of spares and initial training programs**
- **Physical convergence tends to reduce the CapEx for new network builds and network expansions**

Reduced Operations Expenditure

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- Fewer network elements leads to lower field staffing levels
- Fewer equipment types to master means less training and knowledge required to operate and maintain the network
- However, residual technology areas must still be handled appropriately
 - Opportunity to converge the network logically
 - Knowledge silos could be eliminated through cross-training programs
- Operations and maintenance staff could be right-sized to a critical mass of cross-trained personnel
- Operations and maintenance tools—network management systems—are critical enablers of logical convergence
- **Physical convergence tends to produce some *natural* OpEx savings**
- **Logical convergence holds the key to significantly more OpEx savings**

Challenges To Physical Convergence

Building A Multiservice NE

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- **This is a challenge for the equipment supplier**
- **Create multi-disciplinary design and development teams**
 - Get Ethernet and IP hardware and software engineers to work with SONET and WDM hardware and software engineers**
 - Overcome cultural differences and mutual misconceptions**
 - Such a synergistic culture is typically incubated at startup companies**
- **Optimize TDM and packet processing in a common chassis**
 - Convince staunch TDM-heads that, “it’s a TDM box”**
 - Convince staunch data-heads that, “it’s a data box”**
- **Squeeze processing cost out with new multi-function components, e.g. ASICs**
- **In short: A converged product development team**

State Of Physical Convergence

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- Many multiservice network elements have been built—mostly by startups
- Large equipment vendors have acquired the best of breed
- Multiservice Provisioning Platform (MSPP) is now a well-defined product category being tracked by industry analysts
- Many Enterprises and Service Providers have purchased and installed MSPPs
- **We're in good shape here; network renewal is in process**

Exploring Converged Management

Management Is A *Generic* Process

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- **Fault Management**
 - Receive, display, and store alarms and events
 - Correlate alarms to service/customer impacts and network root cause
- **Configuration Management**
 - Discover the inventory of what is installed in the network
 - Configure slots for cards based on desired services
 - Configure cards for protection relationships or not
 - Configure physical (PTP) or logical (CTP) ports to support service profiles
 - Create, modify, view, delete connections
 - Download software, backup NE configuration
- **Accounting Management**
 - Collect, store, and forward usage data to support billing
- **Performance Management**
 - Collect, store, and forward data to characterize the integrity of transmission
 - Determine when connections fail to meet committed integrity thresholds
- **Security Management**
 - Control access to management functions
 - Control access to network logical resources

A Network Is All About Connections

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- The function of the network is to provide connections between edge points
- The use of these connections is the *service*
- In general, DWDM, SONET, SDH, Ethernet, and IP are all *connection* technologies
- The relevant information and the attendant operations and management work-flows are quite similar in nature
 - Set up, monitor, assess, modify, restore, tear down a connection
- What is different is the precise meaning of the information and this may be relevant fewer management persons, e.g. Tier 3 support

Management Convergence

- Management convergence is about finding and using the common denominator of management information and management functions
- There is no fundamental impediment to management software convergence
- Today, it is possible to build management software that can

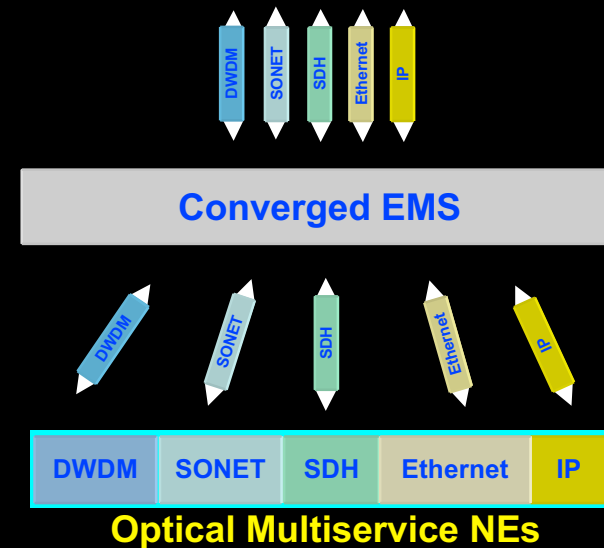
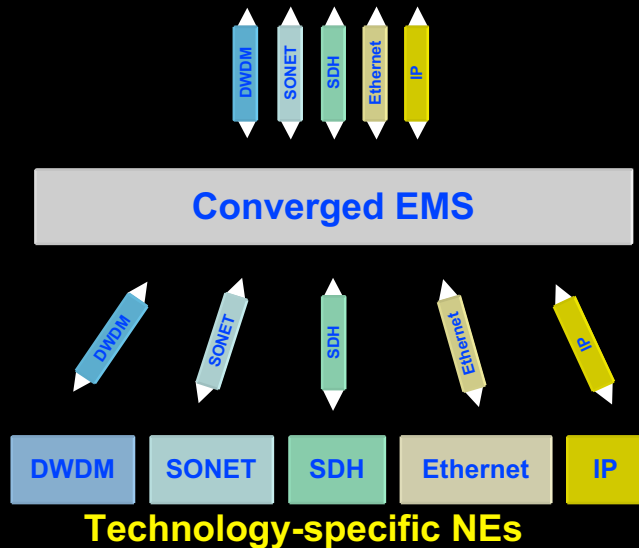
Communicate concurrently to different types of network elements or other management systems to receive/collect information updates, and to push command and control messages to change the network

Provide uniform processing of analogous information, e.g. alarms for DWDM, SONET, or Ethernet objects are processed in the same manner

Provide common information display vehicles, e.g. common alarm windows, common inventory displays, common performance data tables, etc.

Provide common work-flow GUIs to configure slots, cards, physical ports, logical ports, and connections

...



Management Convergence Options

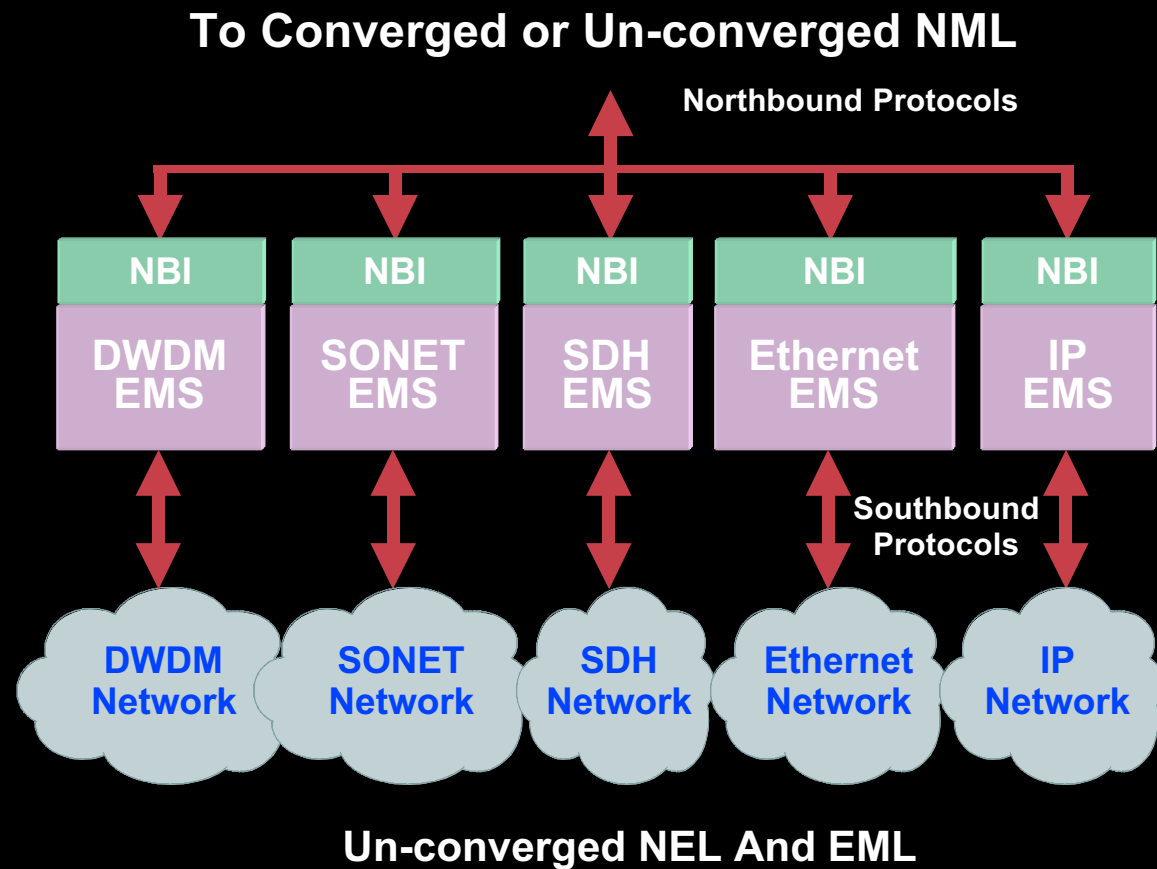
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- Since management is about the collection, processing, storage, display, and forwarding of FCAPS information, then management convergence is
 - Independent of network element convergence
 - Flexible in its implementation at the EML, NML, or both
- Converged NEL, EML, NML, ...
- **Un-converged NEL**, converged EML, converged NML, ...
- **Un-converged NEL**, **un-converged EML**, converged NML, ...
- **Un-converged NEL**, converged EML, **un-converged NML**, ...
- **Maximal convergence leads to maximum CapEx and OpEx savings**

NEL = Network Element Layer; EML = TMN Element Management Layer; NML = TMN Network Management Layer

Un-converged EML

- This is an un-converged network made up of technology-specific network elements from one or more vendors
- Multiple EMSs—one for each technology
- Convergence may or may not occur at the NML
- Multiple EMSs mean multiple CapEx and OpEx instances for each

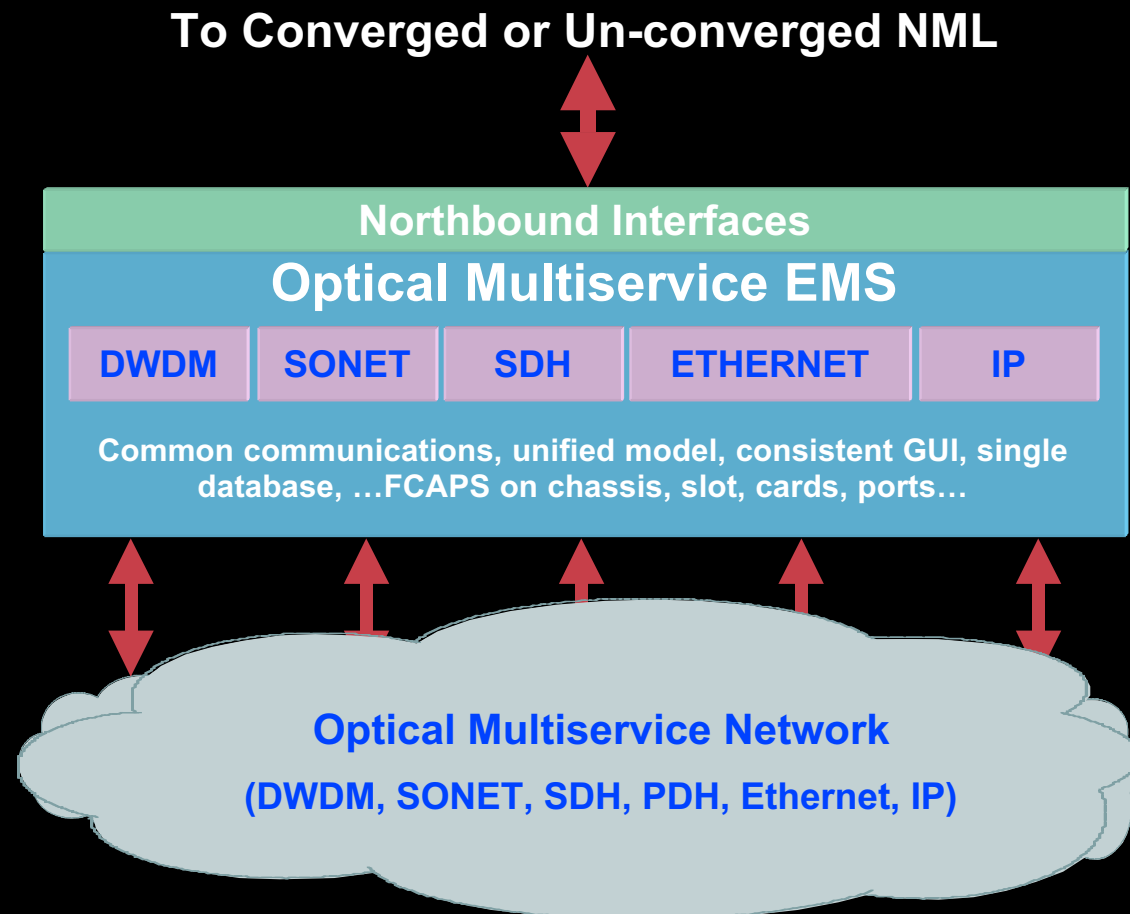


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Converged EML

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- A single converged Optical Multiservice EMS for *integrated* management of all technologies
- Vendor-specific
- A single EMS means one instance of CapEx and OpEx per vendor
- Convergence may or may not occur at the NML
- CapEx/OpEx benefit is effected even in the absence of a true multiservice network



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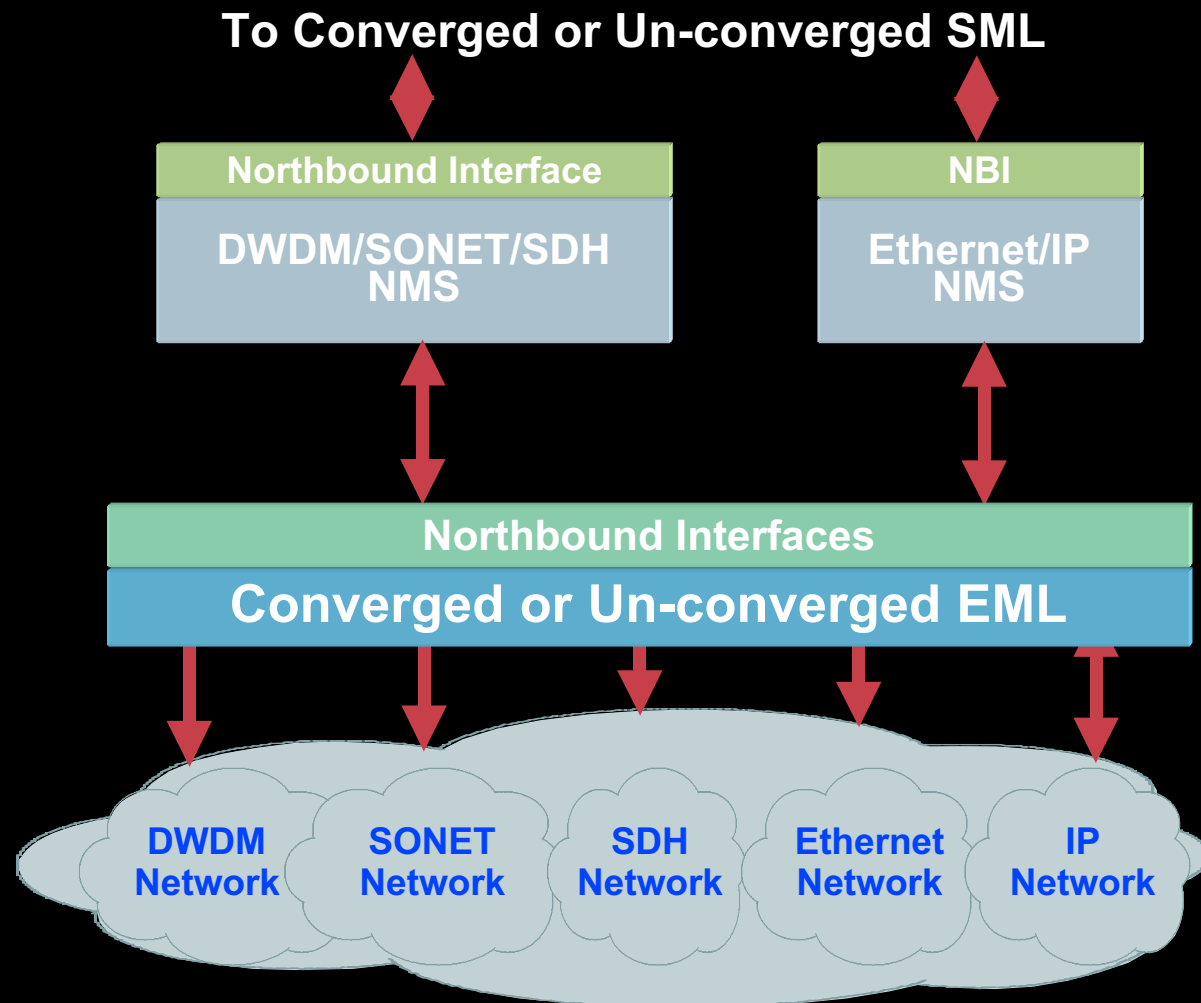
Un-converged NML

Northbound Protocols

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- Two NMSs—one for *transport* and *data* respectively
- Often multivendor
- Convergence may or may not occur at the EML and NEL
- Two or more NMSs means multiple CapEx and OpEx instances for each

Converged or Un-converged NEL



NEL = Network Element Layer; EML = TMN Element Management Layer; NML = TMN Network Management Layer

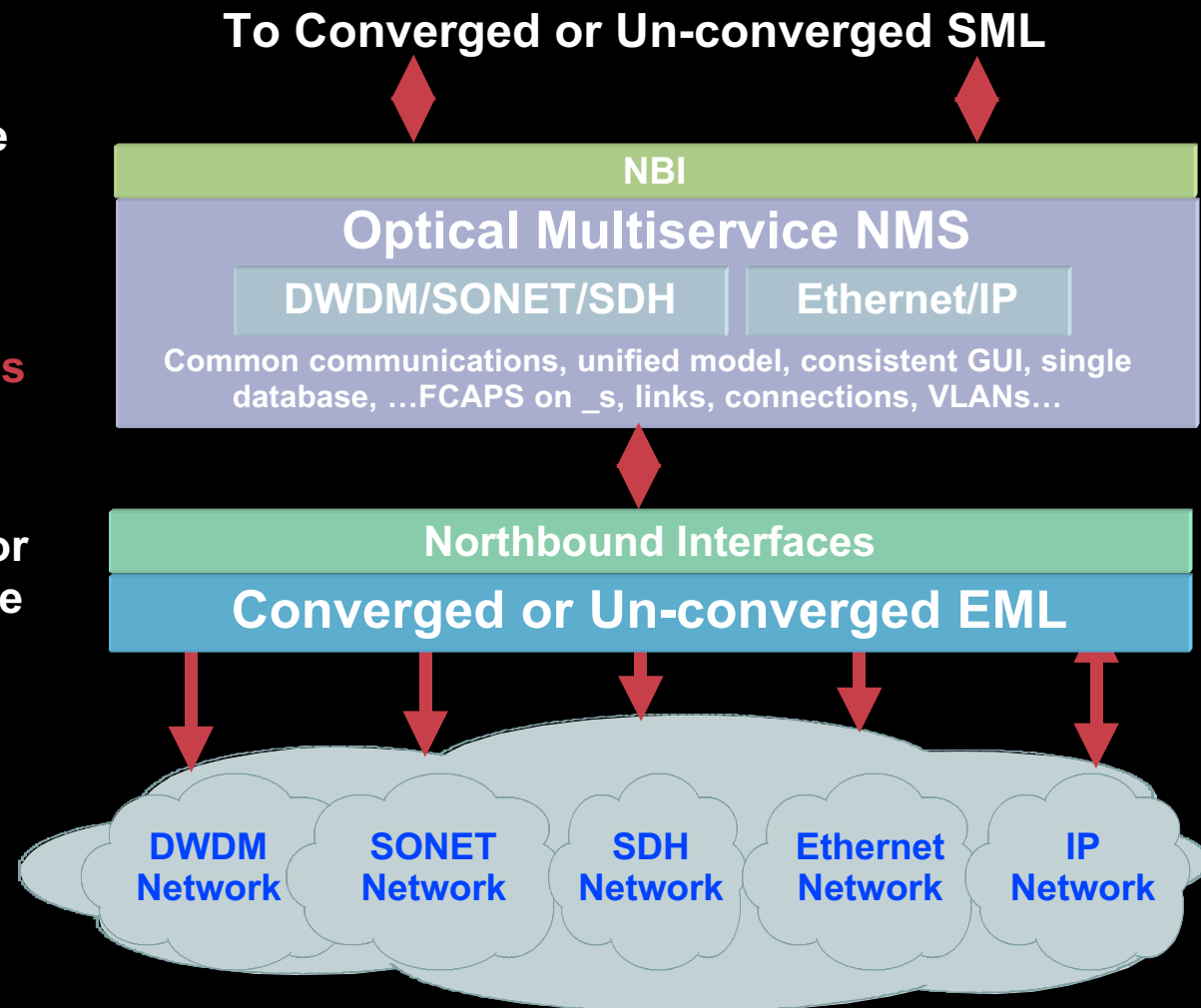
Converged NML

Northbound Protocols

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- A single converged Optical Multiservice NMS for *integrated* management of all technologies
- A single NMS means one instance of NM CapEx and OpEx
- Convergence may or may not occur at the EML or NEL

Converged or Un-converged NEL



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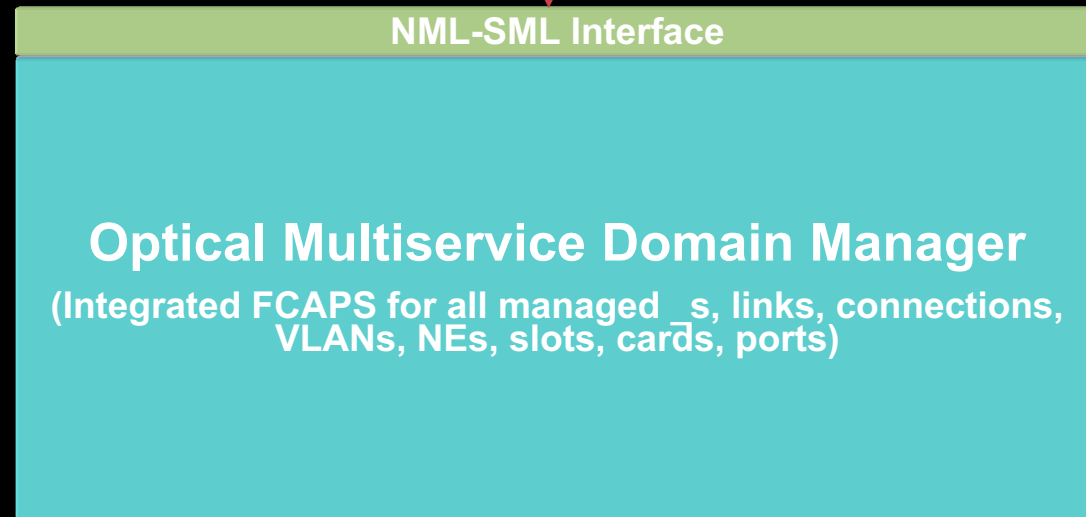
Converged Single-Vendor Network

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Converged
Optical
Multiservice
NMS



Converged
Optical
Multiservice
EMS



Scalable
Optical
Multiservice
Network

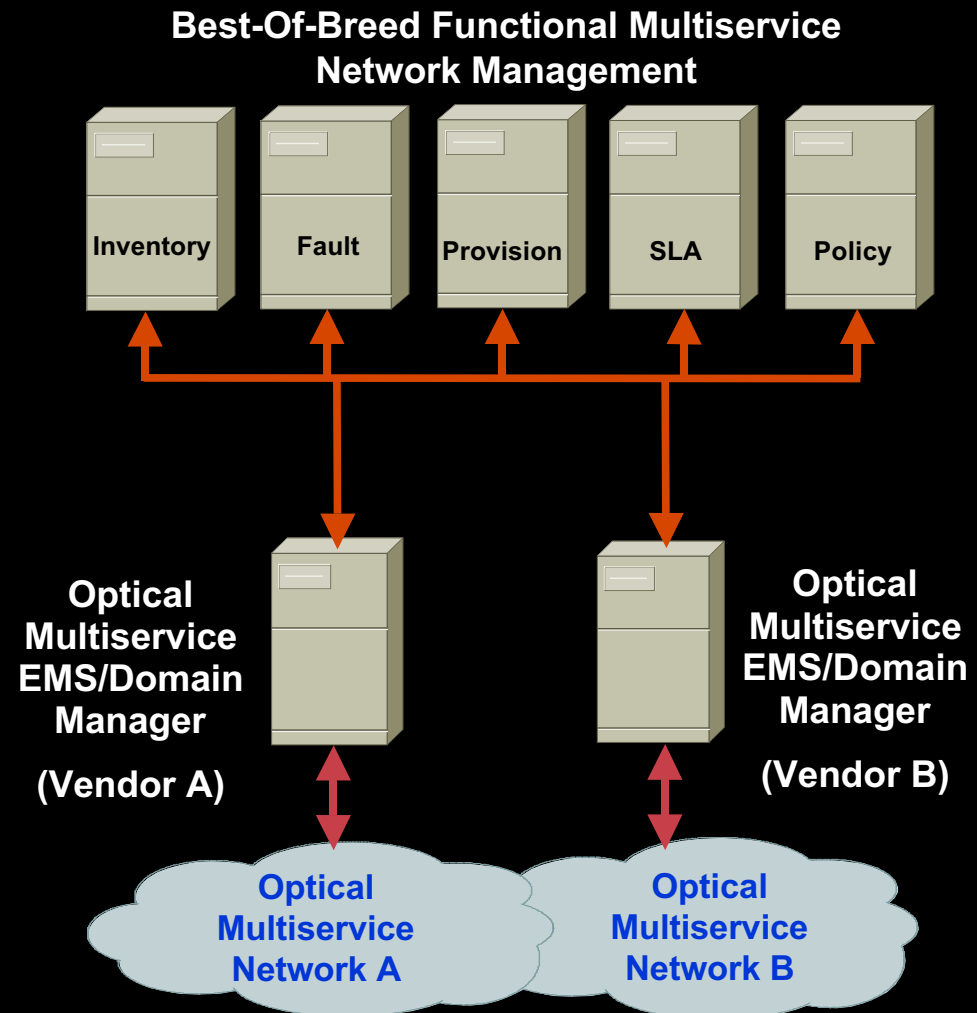


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Multivendor Best-Of-Breed NML

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- The NML is composed of multivendor NMSs dedicated to specific FCAPS functions
- Each NMS is converged and executes its function for all technologies
- Convergence may or may not occur at the EML or NEL



NEL = Network Element Layer; EML = TMN Element Management Layer; NML = TMN Network Management Layer

Challenges To Logical Convergence

Build A Multiservice EMS/NMS

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- **Start with a converged product development team—multi-disciplinary design and development teams**

Cross-train design and development teams on Ethernet/IP and DWDM/SONET/SDH or provide pools of expertise on each

Cross-train design and development teams on SNMP, TL1, and CORBA or provide pools of expertise on each

- **Create a common information model that accommodates all technologies**
- **Create persistent storage for this model in a single database**
- **Design and develop common handling of DWDM, SONET, SDH, Ethernet, and IP alarms and events**
- **Design and develop common handling of DWDM, SONET, SDH, Ethernet, and IP performance data**
- **Implement technology-specific logic when necessary to normalize information and functions**
- **Conceal technology-specific nuances as much as possible to create uniform work-flow driven GUIs for connection provisioning at L1 through L3**

If you can drive a car, then you can drive a van, an SUV, a bus, ...

Converge Personnel And Processes

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- **A converged management tool needs to be used by a converged operations and maintenance staff**

Who will sit in front of the GUI of an optical multiservice EMS or NMS?

Who will install and turn up a device that is both a SONET ADM and an Ethernet Switch in one chassis?

Who will troubleshoot problems with a OC-3 leased line and an 100 Mb/s Fast Ethernet leased line?

Will operations staff be intimidated by powerful multiservice management tools?

- **Are there structural or legal obstacles?**

Do FCC regulations permit operations convergence?

Do unions permit operations convergence?

These may be the biggest impediment to the benefits of convergence at some companies

- **Enterprises are less constrained than Service Providers in the pursuit of operations convergence**

Eliminate Operations Silos

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- **Operations silos are largely historical**
The rapid growth of Internet technology is a relatively recent phenomenon
- **Cross-training is the key to converged operations**
The Internet Generation can't tell the difference
Adopt cross-training as an IT or Operations policy
Cross-training programs can expose new hires to both transport and data knowledge
- **Cultural legacy may persist on both sides**
It's too late to learn this data stuff; can't teach an old dog new tricks
Bring "crusty" SONET guys and Internet "geeks" into the same shop
Mix in younger "eager beavers" to be mentored by both
- **Regulatory constraints must be observed**
Same SP company cannot legally offer data and transport services
Impact on North American ILECs mostly

In Conclusion

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- **The convergence evolution has grown beyond just *voice* and *data*; today it includes DWDM, SONET/SDH, Ethernet, and IP/MPLS**
- **Equipment vendors achieve development efficiencies as they produce converged optical multiservice equipment platforms**
- **These efficiencies pass on as CapEx savings to both Service Providers and Enterprises as they build converged optical multiservice networks**
- **The network is in the eye of the beholder; if one still perceives multiple networks, then one operates and manages multiple networks**
- **Additional CapEx and OpEx benefits of convergence lie in the savings associated with operating the converged optical multiservice network as a single network**
- **These benefits are not achievable without a converged optical multiservice management solution**
- **Management convergence can be implemented at the EML or NML independently, or at both; maximal convergence leads to maximum benefits**
- **Equipment vendors and ISVs can provide tools to fit every implementation preference**
- **Ultimately, the most impactful impediments to these CapEx and OpEx benefits may be organizational and/or regulatory**

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