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The Role of NMS in Intelligent Optical Networks

Ann Von Lehmen
Telcordia Technologies
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Intelligent Optical Networking

- The technology itself is maturing……..
- Intelligence in the network layer is desirable
- The open question is how far, how fast with intelligence
- Adoption and deployment depends on the carrier business case
  - Operational costs savings vs revenue growth
  - Costs, timing of shifting to a new paradigm

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Operational Advantages of Intelligent Optical Networks ?

- Rapid provisioning
  - **Reduce service provisioning time and effort (point and click)**
  - **Equipment installation time accounts for majority of provisioning 'delay', so impact on overall provisioning times may be small**
  - **Cost associated with excess capacity vs. more rapid revenue flow**
- Dynamic provisioning/load balancing
  - **Automatic rearrangement of network resources to meet demand/relieve congestion**
  - **Essential for short term and time sensitive services**
  - **Assumes adequate network capacity at all locations**
  - **Effective congestion management requires integrated view of L2, L3 traffic and transport layer resources**

Operational Advantages of Intelligent Optical Networks?

- Automatic discovery: 'the network is the database'
  - **Provides a current view of network configuration and inventory**
  - **Removes the problem of database inaccuracy ($B)**
  - **Reduces the cost associated with retrieving inventory and synchronizing NMS databases**
  - **Missing piece: OXC-to-WDM connection mapping**
  - **Is link-level information available via OSPF enough?**
- Rapid restoration
  - **Automatic restoration of traffic in mesh-based networks**
  - **How fast is 'fast enough'**
- Fault detection, analysis, notification
  - **Reduces fault analysis and management at NMS level?**
  - **No uniform approach**

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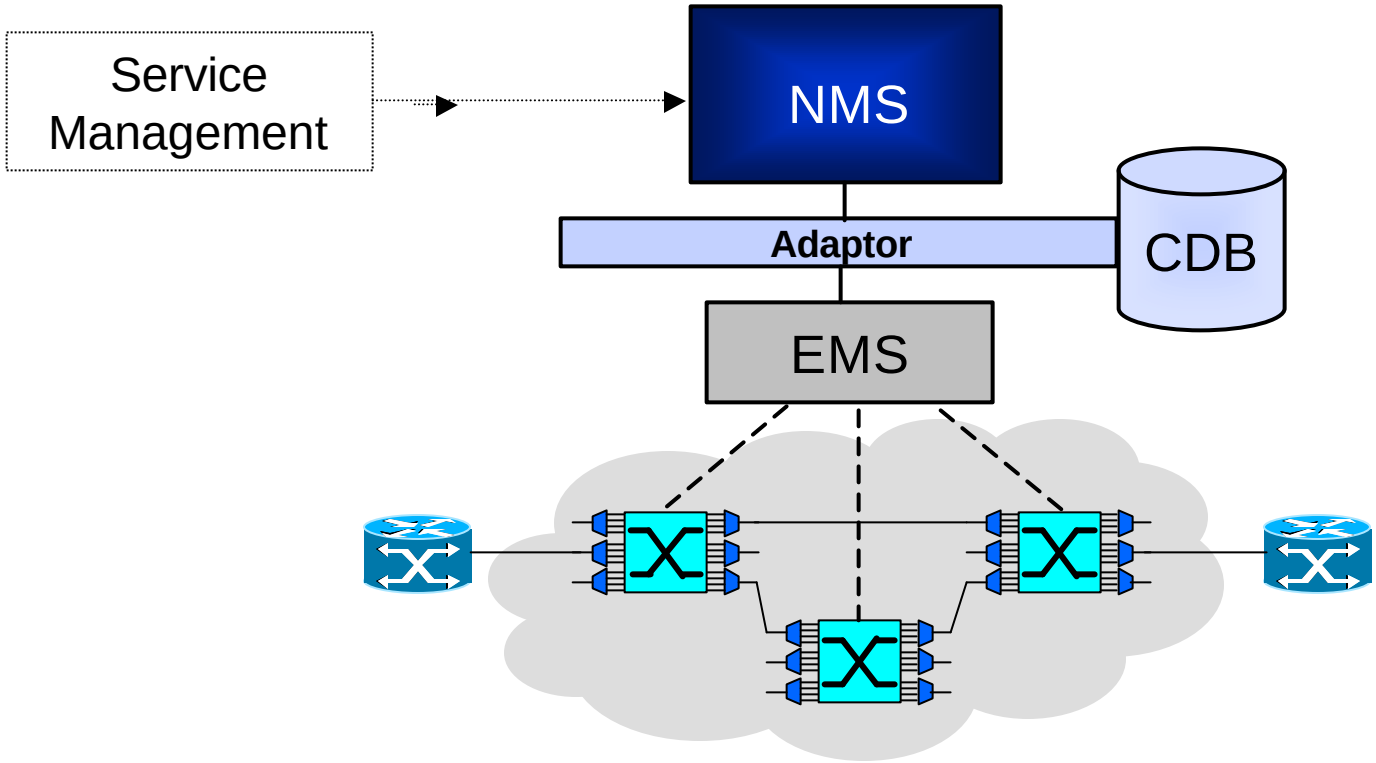
Connection Management in ION's

No UNI



- NMS configures control-plane parameters
- NMS categorizes connection type:
  1) NMS routing, control-plane set-up
  2) control-plane routing and set-up
- NMS triggers set-up via EMS
- EMS provides update to NMS/CDB with data on connections
- NMS provides hooks for customer service mgt. (e.g., for optical VPNs)

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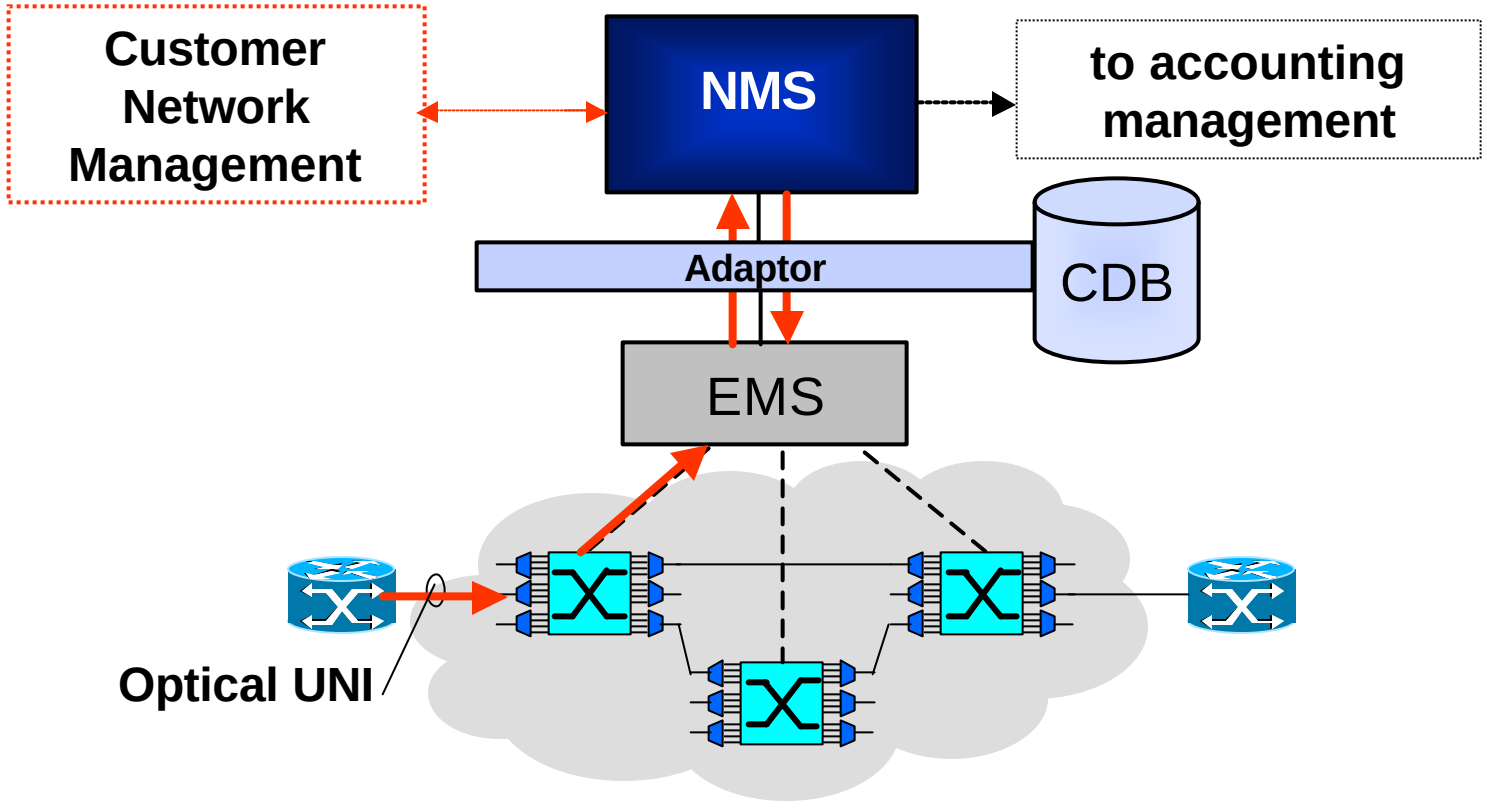
Connection Management with Optical UNI



- NMS provides admission-control and policy-management functions for O-UNI connection requests; also provides hooks into billing
  - Policy management (may be centralized or distributed)
- NMS triggers connection set-up

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End-to-end Connection Management

- Connection spans multiple subnetworks
- No UNI at either end
  - NS-Sig-NS
  - Sig-Sig-Sig with no E-NNI between subnets
  - Sig-Sig-Sig with E-NNI between one pair of subnets
  - Sig-Sig-Sig with E-NNI between all subnets
- UNI at one end
  - Sig-Sig-NS
- UNI at both ends
  - Sig-NS-Sig
  - Sig-Sig-Sig No E-NNI
  - Sig-Sig-Sig E-NNI between one pair of subnets
  - Sig-Sig-Sig with E-NNI between all subnets

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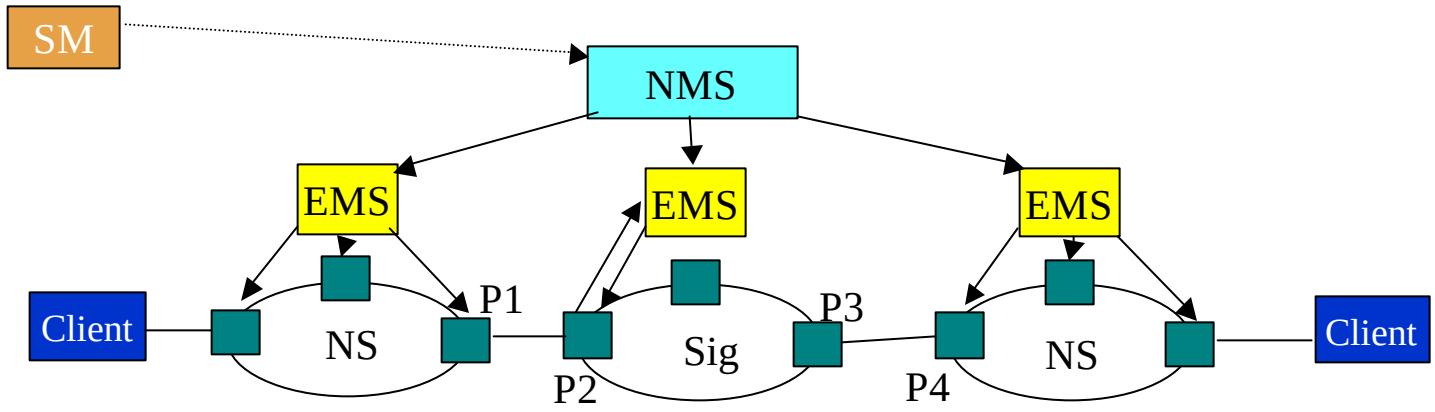
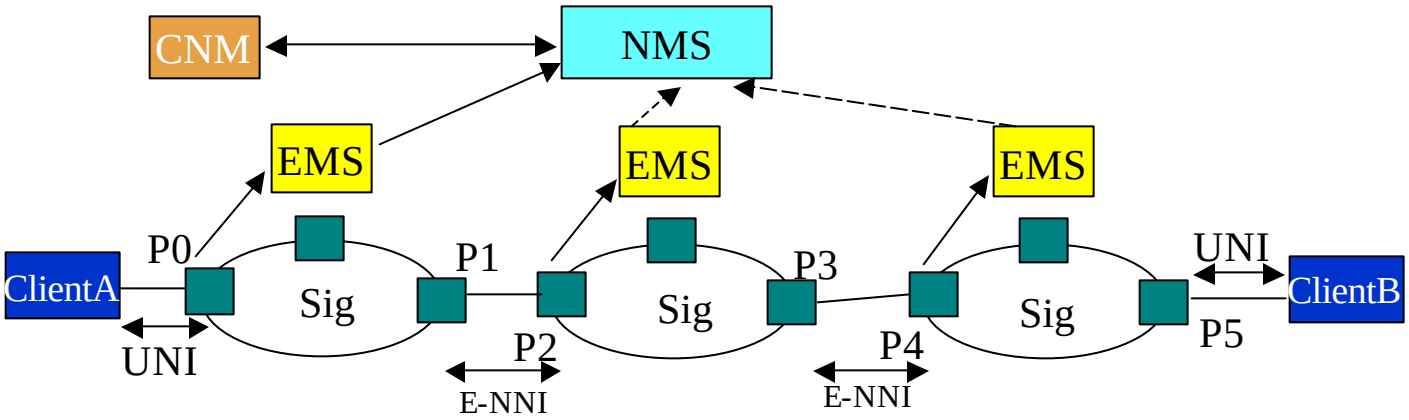
No UNI, no NNI, NS-Sig-NS



- NMS computes end-end path: Identifies points P1, P2, P3, and P4 and routing in the two NS domains.
  - Needs routing info from Sig domain
- NMS/EMS establishes connections in NS domains
- NMS/EMS signals to P2 for connection to P3
- Signaling domain sends connection details to EMS (sent by P2)

UNI, Sig-Sig-Sig (E-NNI, E-NNI), UNI



- ClientA UNI signals to P0 for path to ClientB
- P0/CNM provide admission control
  - does admission depend on availability of routes?
- UNI signaling to P0 triggers P0 to do inter-domain routing, which determines P1, P2, P3, and P4.
  - Does NMS provide any guidance on which subnetworks should be involved?
- P0 does I-NNI signaling to set up connection to P1
- P1 does E-NNI signaling to P2, which then routes and sets up connection to P3 using I-NNI.
- P3 does E-NNI signaling to P4, which then routes and sets up connection to P5 using I-NNI, and P5 does UNI signaling to Client.
- Each domain sends connection setup information to EMS, which update NMS, and P0 sends end-to-end connection info to NMS.

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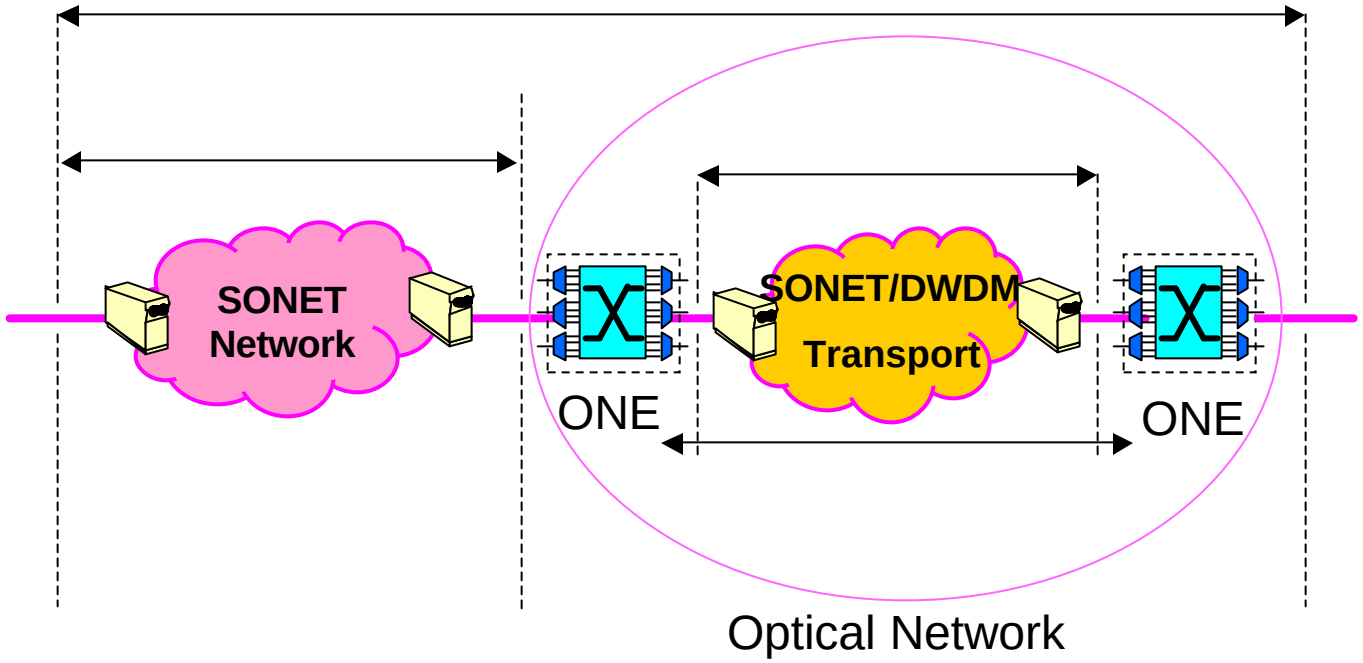
End-to-end Optical "Circuit"

- Involves multiple technologies
- Involves transport and switching *within* ION subnets
- OXC-xport link mapping not currently part of autodiscovery



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Role of the NMS

Management of independent vendor control planes/subnets

- facilitate carrier's use of network intelligence

End-end connection/service management

- with/without NNI and UNI
- interworking of legacy and intelligent optical systems
- multiple technologies

Policy management and control of 3rd-party access

- admission control for optical UNI
- resource partitioning among services and users

Handling of complex restoration events

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NMS/EMS Issues

- Division of functionality
  - NMS routing, control-plane set-up vs. control-plane routing and set-up
  - Explicit routing capability in NMS vs in subnetwork
    - congestion management
    - survivability
  - NMS connection mangement DB--how much info
  - NMS polling vs EMS updates
  - Policy management/admission control centralized vs. distributed
  - Fault management: EMS capabilities vary widely

- NMS/EMS interfaces
  - Must be enabled to support intelligent optical networks

MTNM Scenarios for UNI & NNI

- A Preliminary list of questions
  - What are the *Control Plane parameters* that require configuration?
  - How does a *UNI set-up request* get passed from EMS to NMS?
  - How does EMS identify failed *SNCs* or *Topological Links* to NMS?
  - How does NMS *query* EMS for above information?
  - How does EMS represent an *end-to-end call path*?
  - How can *dynamic source reroute and M:N shared path protection* or pre-planned be addressed by MTNM?
- Additional work needed:
  - Analyze additional & more detailed scenarios
  - Compare with MTNM use cases (TMF 513, TMF 608)
  - Provide detailed requirements and use cases to TMF MTNM team
- **New contribution to OIF OAM&P group**

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Myth vs Reality?

- Roll-out of intelligent optical networks in large scale networks will be paced by:
  - carrier economics, standards development
  - NE/EMS development
  - meeting service requirements?
  - resolution of NMS/EMS division of functionality for ION's
  - updates to existing standards for NMS/EMS interfaces
  - support for other management functions (eg billing and policy management) are in place
  - end-to-end service and network management capabilities

- However ……..
  - The full vision need not be realized in a single step, or at all!
  - Implementation of limited capabilities may have significant value and low barriers to deployment
  - Extremely attractive to greenfield (or 'cap and grow') deployments
    - Deployment will lead standards

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Thank you!

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