Requirements & Technologies for Transport SDN

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Outline

• Transport SDN
  • Trends and business drivers

• OIF Role and Structure

• Transport SDN Architecture & Requirements

• Summary
Trends

• Carrier environment has evolved and changed
  • All IP services
  • Changing traffic patterns
  • Need for new business models
• Network standardization environment has changed and there is increasing emphasis on
  • Virtualized environment -
    • Separation of HW and SW
    • Separation of transport and control functions
    • Software implementation of network functions
  • Standard (COTS) hardware
  • Application aware routing
  • Programmable optical networks
• New forums – ONF, NFV, OGF, OpenDaylight, …
• SDN – an approach for optimizing networking
Business Drivers

• Protection and restoration options

• Multi-layer control

• Potential of having one logical controller over multiple domains

• Application aware networking
Orchestration - One main Aspect of SDN
What is the OIF?

• Since 1998 OIF has brought together industry groups from the data and optical worlds

• Mission: To foster the development and deployment of interoperable products and services for data switching and routing using optical networking technologies

• Our 100+ member companies represent the entire industry ecosystem:
  • Carriers and network users
  • Component and systems vendors
  • Testing and software companies
Where we fit

IETF
GMPLS Protocols
ASON Architecture & Requirements
ITU-T
ITU-T
Interop Testing
OTN/Optical Interfaces

ONF
Transport SDN

NFV

ONF
100G Interfaces
Ethernet Alliance

TMF
CP management

MEF
Ethernet Services

IEEE
100G Interfaces
Infiniband Trade Assn

ONF
100G Interfaces

TMF

MEF

OIF OPTICAL INTERNETWORKING FORUM

OIF OPTICAL INTERNETWORKING FORUM
How OIF is organized

- Board of Directors
- Technical Committee
  - Carrier WG
  - Networking & Operations WG
  - Physical & Link Layer WG
  - Interop WG
- Implementation Agreements
- Interop Demonstrations
- Implementation Agreements

*PLUG: Physical Layer User Group*
OIF Carrier WG

- **Requirements on Transport Networks in SDN**
- **Architectures - Transport SDN**
  - Document is based on contributions of major carriers worldwide
  - Comprises requirements on Transport SDN
    - Orchestrator (transport network relevant part)
    - Control and management planes
    - Data plane
  - Being used as guidance within OIF but also communicated to other SDO and forums
SDN Reference Architecture
Components of Transport SDN

- Application Plane
  - Orchestrator
    - SDN northbound: OGF NSI, ...
    - OF, MTOSI, REST, ...
  - Mgt- & Control-Plane
    - Mgt
    - TN Controller
      - SDN southbound: OF, XML, SNMP, PCEP, ...
        (could be NE-internal)
  - Transport Network
    - Data Plane

- Transport
- Data Center
- Service
**SDN Architecture - Standardization**

**Mature**
- ITU-T, IETF, OIF
- ASON / GMPLS (G.8080 / G.771x,...)

**New**
- ONF
- OpenFlow Switch Spec. 1.4.0
- OF Config. & Mgt Protocol 1.1

Diagram:
- MP – EMS/NMS
- Control Plane
- L1/L2 Transport NEs

- MP – CLI/GUI
- OF – Controller
- OF Packet Switches

**OIF Optical Internetworking Forum**
General Requirements

- Requirements are not aimed at a particular (set) of protocols, HW and SW implementations
  - Packet & circuit switching
  - Centralized & distributed control instances
  - Allow multiple protocols
  - Modular SW and HW (COTS)
  - Decoupling of network layers

- Guarantee interoperability among different vendor implementations, carrier network domains, data center functions, ...
  - Well defined interfaces for increasing level of interoperability
Requirements on Communication between Transport SDN Components

- Transport SDN components:
  - Orchestrator
  - Control and management planes
  - Data plane

- Message exchanges must be supported by data communication capabilities that meet operator needs of resilience, scalability, performance, and security.

- A dedicated data communications network is assumed.

- The DCN being used for SDN purposes does not need to be identical with an existing (legacy) DCN/SCN already in operation.
SDN Reference Architecture

Orchestrator

Application Plane

Mgt- & Control-Plane

Transport Network

Data Plane

Service

SDN northbound: OGF NSI, …

OF, MTOSI, REST, …

SDN southbound:
OF, XML, SNMP, PCEP, …
(could be NE-internal)

DC Mgt/Controller

TN Controller

Data Center

Transport

OIF OPTICAL INTERNETWORKING FORUM
Requirements on Orchestrator

- The Orchestrator is responsible for the coordination and management of SDN services
- It coordinates data center and transport network actions
- It requests transport network service primitives from the control and management plane
- It represents the transport network to the Application Plane using virtualization and abstraction
- The Orchestrator needs to provide structured, extensible, flexible, well defined interfaces
  - To the application plane (northbound API)
  - To the TN control and MP (southbound)
  - To the DC control and Mgt. systems (southbound)
  - Between SDN controllers (hierarchical/federated)
**SDN Reference Architecture**

**Management & Control Plane**

- **Orchestrator**
  - SDN northbound: OGF NSI, ...
  - OF, MTOSI, REST, ...

- **Mgt- & Control-Plane**
  - Mgt
  - TN Controller

- **Transport Network**
  - Data Plane

- **Service**

- **DC Mgt/Controller**

- **Data Center**

- **Transport**

- **SDN southbound**: OF, XML, SNMP, PCEP, ...
  - (could be NE-internal)

**SDN southbound**

**SDN northbound**

**Application Plane**
Requirements on Control Plane

- The Control Plane (CP) supports connection management, discovery mechanisms, resilience functions, dissemination, and abstraction functions
  - OIF Carrier WG Guideline Document on “Control Plane Requirements for Multi-Domain Optical TN”
- The CP needs to operate in a network functions virtualization environment
- The CP needs to support virtual networks in a multi-layer transport network context
- The CP requires
  - Northbound interfaces to the Orchestrator
  - Southbound interface(s) for communication to the DP
  - Interfaces for communication with the Management Plane
- The CP shall not be restricted to a specific protocol suite
Requirements on Management Plane

- The Management Plane (MP) is responsible for the support of all aspects of network and network element management. These functions are not specific to SDN.
- The MP provides fault, configuration, accounting, performance, security management (FCAPS).
- The MP needs to support:
  - Southbound interfaces to the Data Plane
  - Northbound interfaces to the Orchestrator:
    - Provision of abstract network state, resource availability, network utilization
    - Requests from Orchestrator
- The MP needs to support virtual networks in a multi-layer TN context
- The MP needs to support interfaces for communication with the Control Plane
SDN Reference Architecture
Data Plane

Application Plane

Mgt- & Control-Plane

Transport Network

Data Plane

Orchestrator

Service
Service

SDN northbound:
OGF NSI, ...

OF, MTOSI, REST, ...

SDN southbound:
OF, XML, SNMP, PCEP, ...
(could be NE-internal)

Data Plane

Transport

DC Mgt/
Controller

TN Controller

Data Center

Service

OGF NSI, ...
Requirements on Data Plane

• Many existing Data Plane (DP) standards and specifications are needed as a basis for interoperable implementations of SDN architectures
• The DP requires northbound interfaces to the Control Plane and the Management Plane to support:
  • Provision of physical parameters, network state, resource availability, network utilization information
  • Requests from Management Plane and Control Plane
• The DP should support a variety of resilience mechanisms (Protections and/or restoration)
• The DP needs to support network slicing in a multi-layer transport network context using:
  • Dedicated DP resources per service
  • Sharable resources among services
The Vision - Seamless Interworking

- On-demand services are provisioned, based on ASON/GMPLS control plane functions
  - Multi-domain
  - Multi-layer
  - Multi-technology

→ OIF control plane follows ASON multi-domain architecture and allows UNI, E-NNI protocol separate from domain operation
→ Interworking with SDN domains is ensured

Domains can use Network Management, SDN or distributed control plane internally

Domains can use different technologies internally
Summary

- **SDN has great promise to improve transport control**
  - Programmability
    - Ability to deliver new behaviors not (yet) considered by standards, vendors, ...
  - Simplified multi-layer control
  - Common behaviors in heterogeneous NE deployments
  - Application awareness
- **OIF is providing guidance to accelerate deployment**
  - Carrier requirements
  - Framework document
  - Use cases and architecture
  - Demonstrations
Thank you for your kind attention!

Carrier Requirements Document
www.oiforum.com

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