Network Control Function
Virtualization for Transport SDN

Young Lee (Huawei),
Greg Bernstein (Grotto),
Ning So (Tata),
Luyuan Fang (Cisco),
Daniele Ceccarelli (Ericsson),
Diego Lopez (Telefonica),
Oscar Gonzalez de Dios (Telefonica)

SDN RG
IETF 88 Vancouver
Transport Network Control

• SDN concept has been applied for transport networks.
  – Separation of control plane functions from data planes by GMPLS/ASON control plane technology
    • Link Discovery (LMP)
    • Dissemination of Link/Resource Information (OSPF-TE)
    • Connection/Provisioning (RSVP-TE)
  – Global view of a network
    • TEDB, LSDB give the global domain view of a network
  – Logically centralized control
    • PCE for path computation; Stateful PCE for initiation of path provisioning (in cooperation with GMPLS signaling)

• There is little value of reinventing these network control protocols.
IETF Control Plane Architecture

**GMPLS Control Plane**
- Neighbor Discovery & Link/Resource discovery (LMP)
- Routing (OSPF-TE/ISIS-TE)
- Signaling (RSVP-TE)

**Transport Plane**

**CC:** Connection Control
**CCI:** Connection Control Interface
**NE:** Network Element
**NMI:** Network Management Interface

**Management Plane**

IETF 88, Vancouver
Is there a need to virtualize network control function?
- Why?
- How?
Client Control

• Supports various applications via various NB APIs (e.g., OpenStack, etc.)
• Various types of client to network
  – Data Center Operators
  – Virtual Network Providers
  – Contents Providers
  – Carriers of carrier
• Primary source for application service/connectivity requirements and location information (client end points).

But current GMPLS/PCE architecture does not support programmable interfaces for network virtualization
Virtual Network Control Layer

- Virtual Network Control separated from Physical network control
  - Open interfaces creation
  - Third party developer can develop VNC layer

- Virtual Network Control Layer provides virtual network control functions:
  - Virtual Service Creation
  - Virtual Path Computation
  - Virtual Topology Database Creation
  - Virtual Network Discovery
  - Topology Abstraction for Virtual Service
  - Virtual connection setup
Use-case A: application-specific topology abstraction and virtual control

- **Client A Controller**
- **Client B Controller**
- **Client C Controller**

**VNC**: Creates abstraction topology per application/client need

**PNC**: network topology
Use-case B1: Dynamic DCI in multi-domain network (Topology Request)

1. Topology Request: Endpoints list
2. Topology Request: Endpoints list, peering point
3. Abstracted Topology
4. E2E Abstracted Topology
Use-case B2: Dynamic DCI in multi-domain network (Connection Request)

1. Connect Request:1-6
2. V_Path Compute
3. Connect

Network 1
- DC1
- DC2
- PNC 1

Network 2
- DC3
- DC4
- PNC 2

Network 3
- DC5
- DC6
- PNC 3

DC Controller
VNC

IETF 88, Vancouver
Interfaces

1. **Application Layer**
2. **Client Control Layer**
   - Client-VNC Interface (CVI)
3. **Virtual Network Control Layer**
   - VNC-PNC interface (VPI)
4. **Physical Network Control Layer**
   - South Bound Interface (e.g., GMPLS CCI)

**SDN Client Control**

**SDN Network Control**

IETF 88, Vancouver
Control Workflows

1. VNS Instantiation (instance id, traffic matrix)
2. Path computation request
3. Path computation reply with updated topology
4. Abstracted topology
5. VNS Set-up Command
6. Network Provisioning Request
7. Network Provisioning Confirm
8. VNS Set-up Confirm

Client Control

VNS Control

Virtual Network Control

VNS Proxy

vPCE Agent

vConnection Agent

Physical Network Control

PCE

Network Provisioning
Work Items

• Which network control functions can be virtualized?
  – V-path computation
  – Abstraction topology database creation
  – V-connection
  – others??

• What is the right level of client control?

• How to represent abstracted topology?
  – Granularity level of topology abstraction
  – Information hiding without losing bottleneck link resource information
  – Modeling tool: JSON based, ...

• Who owns virtual network control?

• Related work on topology abstraction
  – ALTO topology Service [I-D.yang-alto-topology]& [I-D.lee-alto-app-net-info-exchange]
  – OGF NML: General framework for multi-layer network modeling in XML/RDF based on ITU-T G.800

• If you are interested in this work, more discussion will be held, 8:30-9:30pm, November 5 (today) @Plaza B