Open, Hierarchical SDN Control Systems: Ecosystem Progress

Chris Janz, Technical VP

Next-Generation Optical Networks, Nice 2016
"Network Infrastructure is our most important platform, it is our core competitiveness to engage in Internet business."

- Sun Zhengyi in SoftBank
The provisioning of planned inter-DC services takes several days to weeks.

Burst services such as big data analysis and cloud computing bring heavy IDC workloads, resulting in unpredictable service quality deterioration.

Service faults should be quickly located. The KPI for level-1 fault recovery must be less than 2 hours.

The global DC traffic in 2019 is predicted to rise to 10.4 ZB, at the CAGR of 25%.

Source: Cisco, Baidu, Tencent
Inter-IDC operations underpin almost all Baidu services.

All inter-IDC traffic is forwarded by the super IDC, resulting in IDC load imbalances and a requirement for excess transport capacity.

**Challenge**

**Transport-SDN IDC Network**

- **App**: Service departments such as Baidu finance and video can provision services online, simplifying operations.
- **Bandwidth calendaring**: Bandwidth can be added or deleted at planned times for planned IDC operations.
- **Load balancing**: Bypass function based on OTN cross-connection improves global network efficiency.
Deployed T-SDN Solutions (Huawei)
① **E2E Service Provisioning**

Value: days/hours down to minutes/seconds for service provisioning with SRLG management between IP & optical.

② **Multi-Layer Traffic Optimization**

Value: avoid local traffic congestion, reduce CAPEX.

③ **Multi-Layer Protection & Restoration**

Value: protection auto-negotiation across IP & optical, reduce CAPEX.

④ **OAM Synergy, Fast Troubleshooting**

Value: unified control, fast service troubleshooting, reduce OPEX.
Maturing SDN Global Architecture: Open, Multivendor, Flexible

Evolved OSS/BSS, CSO, etc.

OPEN-O

NBI: Intent, Abstract Topology/Tunnel

Service Composition
Cross-Domain Composition
“Narrow Waist”
Network Resource
Real-Time Control

NBI: IP/MPLS Link/Tunnel

Legacy/Proprietary Domain Controllers, SBIs
Controller Hierarchy/Federation
Standard Transport (TE) NBI Abstractions
Open Source Hierarchical Controllers, Orchestrators
Clear Orchestration/Control Demarcation

Arbitrary SBIs

OPEN-O

Orchestration

IP Control Federation
IP+Optical Control Synergy
Hierarchical SDN Controller (IP + Optical)
Transport Control Federation

IP Controller (Vendor A)
IP Controller (Vendor B)
Transport Domain Controller (Vendor C)
Transport Domain Controller (Vendor D)
Hierarchical SDN Controller

NBI: IP Controller
NBI: Transport Controller
NBI: Standards-Based Abstract Topology/Tunnel

Evolved OSS/BSS, CSO, etc.

NFV
ONF T-APIS:
- Topology Service
- Connectivity Request/Retrieval
- Path Computation Request/Retrieval

Transport domain controllers, Transport equipment domains

Global topology capture & display

E2E service provisioning (rich constraint menus)

High-performance restoration (multiple approaches)

ONOS and standard T-APIs support workable multi-vendor, multi-domain T-SDN on an open system basis

https://www.youtube.com/watch?v=jcmXgXVEeCk
Hierarchical Controller
Domain Controller A
Domain Controller B
Domain Controller C
Domain Controller D
Domain Controller E

- Potentially unlimited number of levels of hierarchical controllers
- Parent-child and lateral confederation among hierarchical controllers
- Standard N-S and E-W interfaces based on IETF YANG models

IETF Drafts: Hierarchical Control Framework
- ACTN Requirements: draft-ietf-teas-actn-requirements
- ACTN Framework: draft-ceccarelli-teas-actn-framework

IETF Drafts: Topology
- Network Topology: draft-ietf-i2rs-yang-network-topo
- Abstract TE Topology: draft-ietf-teas-yang-te-topo
- OTN TE Topology: draft-zhang-ccamp-l1-topo-yang
- WDM Topology: draft-ietf-ccamp-wson-yang

IETF Drafts: Tunnel
- TE Tunnel: draft-ietf-teas-yang-te
- Transport tunnel: draft-zhang-ccamp-transport-ctrlnorth-yang

ONOS Hummingbird & “I” releases:
- Critical–mass for PoC demo support: “I” release (11/16)

In parallel – OSSDN Breckenridge:
- PAL for ONF T-API support NB
Evolved T-SDN Architecture (Huawei)

- Application layer: BoD, Automation, Planning, OVPN, Third-party app
- Orchestration layer: Cross-stratum orchestration
- Application model
- Policy management
- RESTful API
- RESTful/RestConf/YANG

Traditional NMS
- BSS/OSS
- EMS/NMS

Super Controller
- RESTful/RestConf/YANG

Other-Party Domain Controller
- Path computing
- Service configuration
- Restoration
- Resource management

SBI (PCEP)
- Metro
- Regional

IDC
- Enterprise
- OVPN

EMS/NMS
- Automation
- Planning
- OVPN
- Third-party app

EMS/NMS
- Automation
- Planning
- OVPN
- Third-party app