Architecture of Multi-Controller in SDN

Section W4J: SDN Transport and NFV
Overview of OFC

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## Overview of the section

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**Countries:**
- USA (W4J.1), China (W4J.3, W4J.4), Spain and Germany (W4J.5).

**Affiliations:**
- Network Operators: Verizon (W4J.1), China Telecom (W4J.4), Telefonica (W4J.5).
- Manufacturers: Fiberhome (W4J.3 and W4J.4), Huawei and ZTE (W4J.4), ADVA (W4J.5).
- Universities and Institutes: Tsinghua (W4J.3), BUPT (W4J.4), CTTC (W4J.5)
W4J.1-Overview

- **Contribution**
  - Introduce the reference architecture and five challenges of SDN.
W4J.1-SDN Architecture

**Orchestrator:**
The Orchestrator is positioned between the application plane and Management/Control Plane to control the facilities of Data Center and Transport Network (TN).
W4J.1-Challenges

- Operational simplicity (On-board new clients rapidly)
- Differentiated service delivery (Automate resource allocation on the fly)
- Scalability (Support X transactions per hours)
- Continuous Availability (Disaster avoidance/recovery)
- Legacy and multi-domain interworking.
W4J.3-Overview

• Contribution
  ▪ Introduce the two problems and their solutions of failed controllers.
W4J.3-Problems

- Problems
  - 1. **Unaware of failure control entity**: the statement of failed controller cannot be known by the other controllers.
  - 2. **Unable to release resource from influenced data plane**: the information of paths are stored in the controller, so that the paths cannot be torn down in the networks.
W4J.3-Solutions

- Problem 1: Timeout-event-driven failure verification and diffusion scheme.
- Problem 2: NMS (Network Management System) -agent resource releasing scheme.

Fig. 3 Timeout-event-driven failure verification and diffusion scheme
W4J.3-Results

Connection arrival rate per node: 0.2 min⁻¹, service rate per node: 0.1 min⁻¹
Average load per node: 2 Erlang, 1000 connections requests, 120 nodes

Fig. 4 Instantaneous actual load per node

Fig. 5 Instantaneous blocking probability (increment: 2 minutes)
W4J.4-Overview

Experimental Demonstration of Hierarchical Control over Multi-Domain OTN Networks Based on Extended Openflow Protocol

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• Contribution
  - Demonstrate a control mechanism for multi-domain optical network with commercial OTN equipment by using hierarchical SDN controller.
W4J.4-Architecture

- CC: connection controller
- RC: routing controller
- Parent controller has the information of each domain; domain controllers are used for setup and tear down paths.
W4J.4-Results

Figure 5 Network topology show on MDM APP

Figure 6 Sequence of connection setup messages

Figure 7 Extend Of packets captured with Wireshark
• Contribution
  ▪ Propose virtualize the SDN control function and move them to the cloud.
W4J.5-Architecture

• Orchestrator: both the cloud and network.
• SDN controller: network.
• vSDN Manager, Cloud Controller: cloud.
• Customer SDN Controller: one VON for custom.
W4J.5-Results

Fig. 2. a) Experimental network setup b) Wireshark capture at the NFV/SDH orchestrator when provisioning a virtual SDN-enabled optical network c) Performance evaluation in terms of setup delays d) Wireshark capture at a virtual SDN controller when provisioning of a flow.
Conclusions

• Issues for survivability of multiple controllers:
  ▪ Relationships of controllers.
  ▪ Locations of backup controllers.
  ▪ Location of path information storage, for instance, the information stored in parent controller or domain controller.
Thank you!