Architecture of Multi-Controller in SDN

Section W4J: SDN Transport and NFV
Overview of OFC

Chen Ma

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Overview of the section

ID	Title	Authors	Affiliations

Countries:

USA (W4J.1), China (W4J.3, W4J.4), Spain and Germany (W4J.5).

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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

SDN Transport Architecture and Challenges

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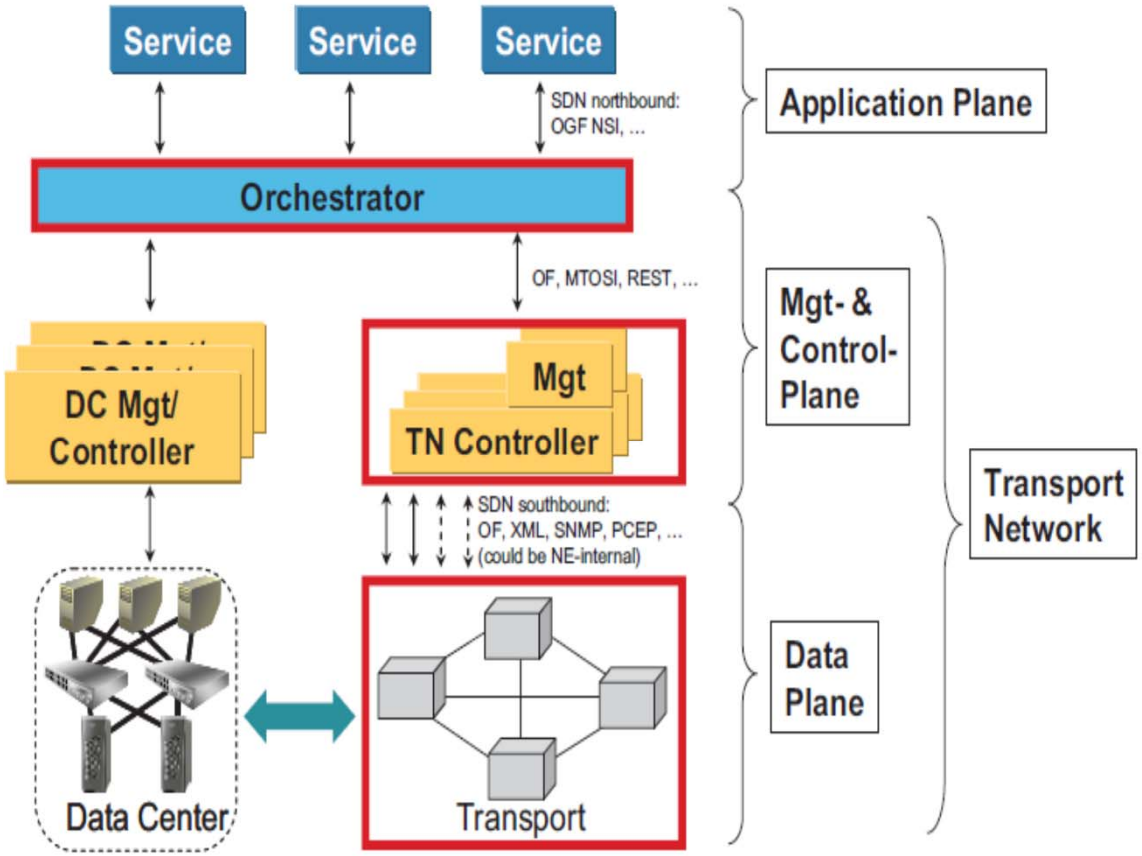
- **Contribution**
  - Introduce the reference architecture and five challenges of SDN.

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

Consideration of Control Entity Failure in Distributed Controlled Multi-domain Multi-vendor Optical Networks

Wangyang Liu[1,2], Nan Hua[1,2], Xiaoping Zheng[1,2], Bingkun Zhou[1,2], Xiaohui Chen[3,4]
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- **Contribution**
  - Introduce the two problems and their solutions of failed controllers.

W4J.3-Problems

- Problems
  - 1. **Unware 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.

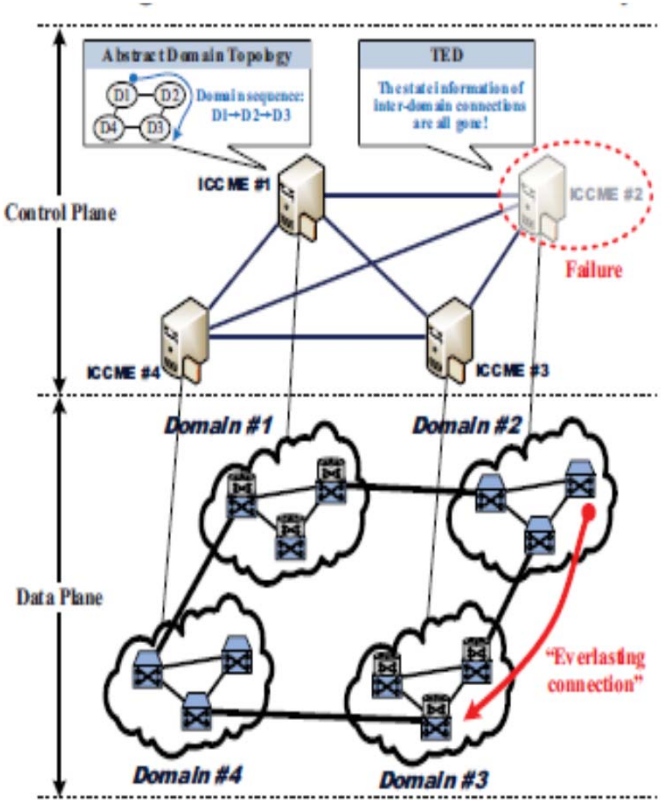

Fig. 2 Problem statement

W4J.3-Solutions

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

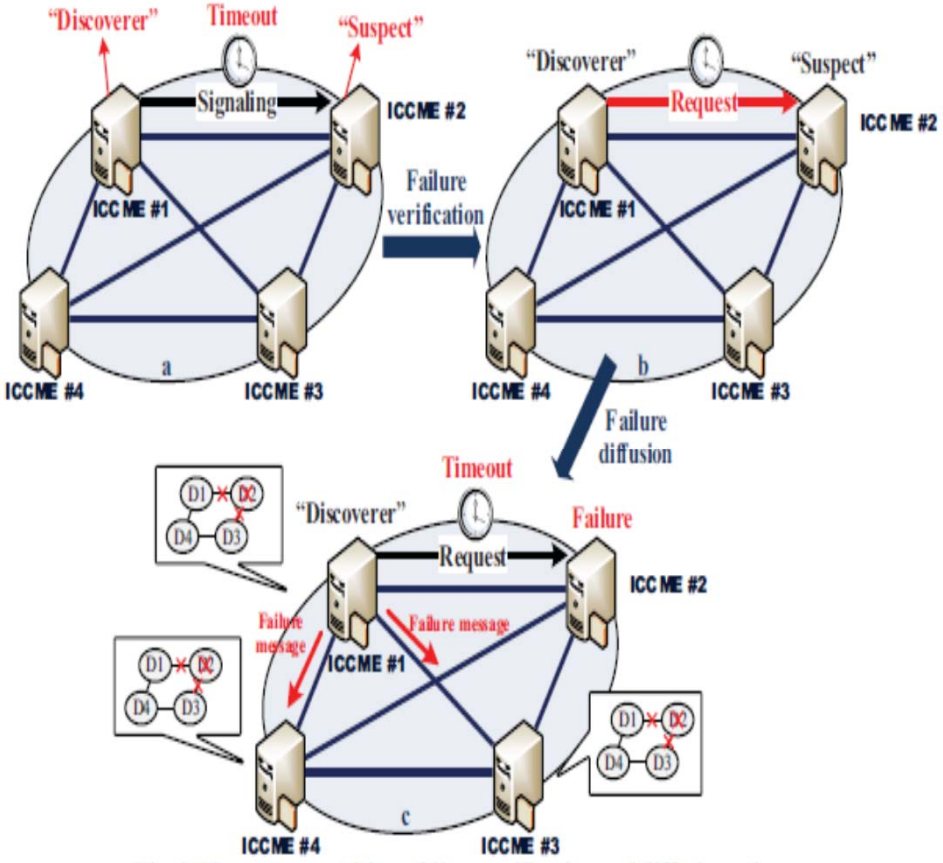

Fig. 3 Timeout-event-driven failure verification and diffusion scheme

W4J.3-Results

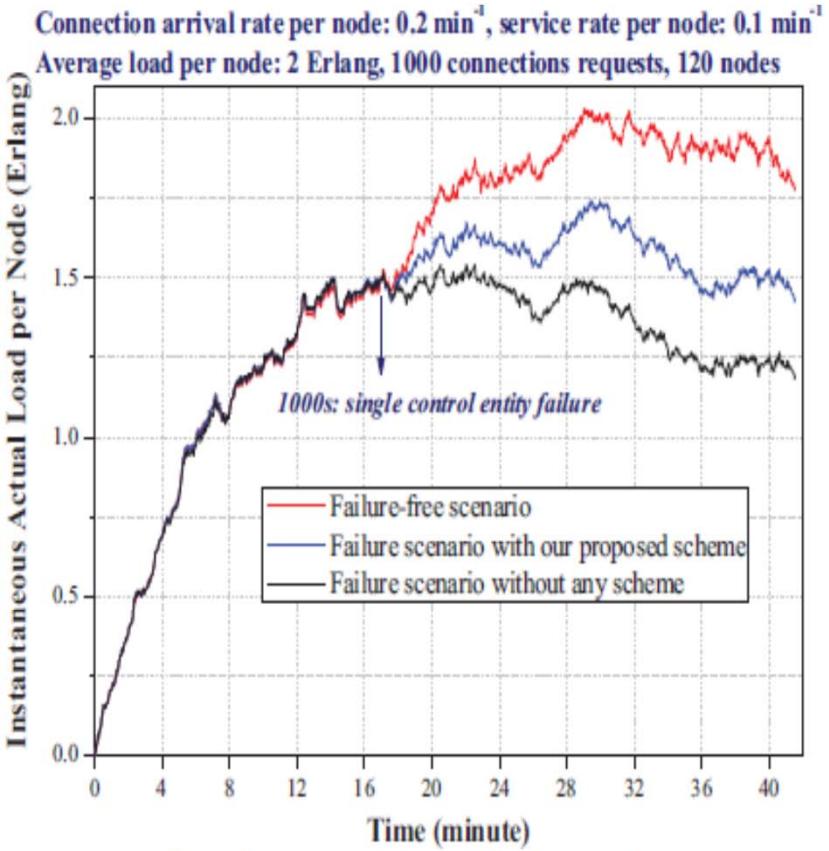

Fig. 4 Instantaneous actual load per node

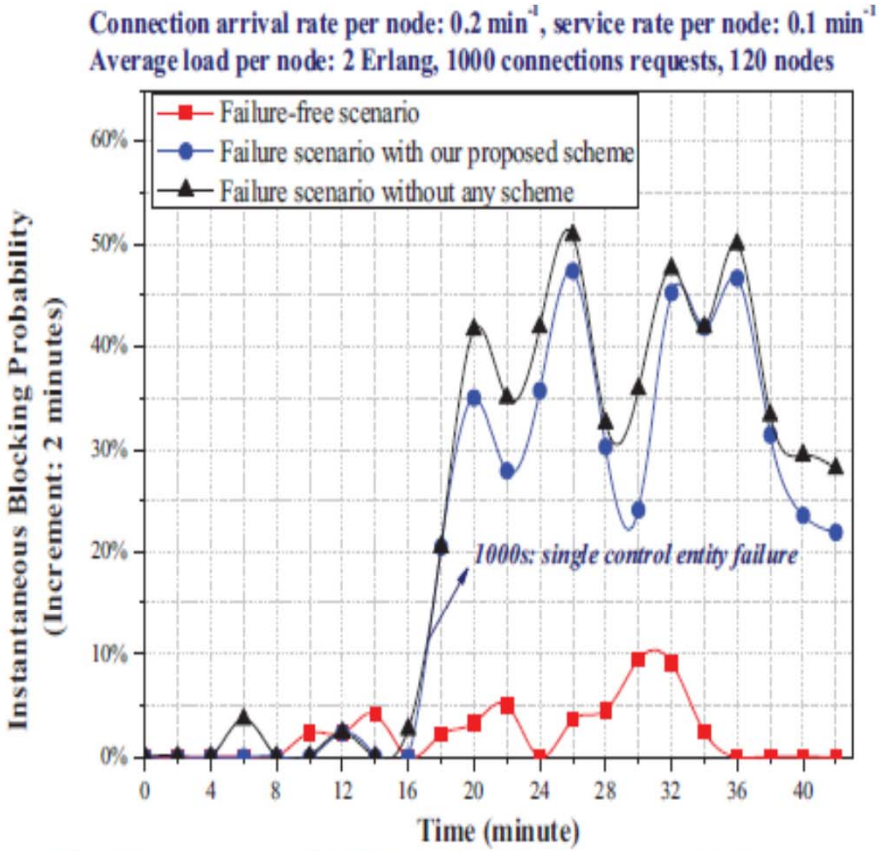

Fig. 5 Instantaneous blocking probability (increment: 2minutes)

W4J.4-Overview

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

Ruiquan Jing[1], Chengliang Zhang[1], Yiran Ma[1], Junjie Li[1], Xiaoli Huo[1],
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3. Huawei, Shenzhen, China 4.ZTE, Beijing, China 5.Fiberhome, Wuhan, China
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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

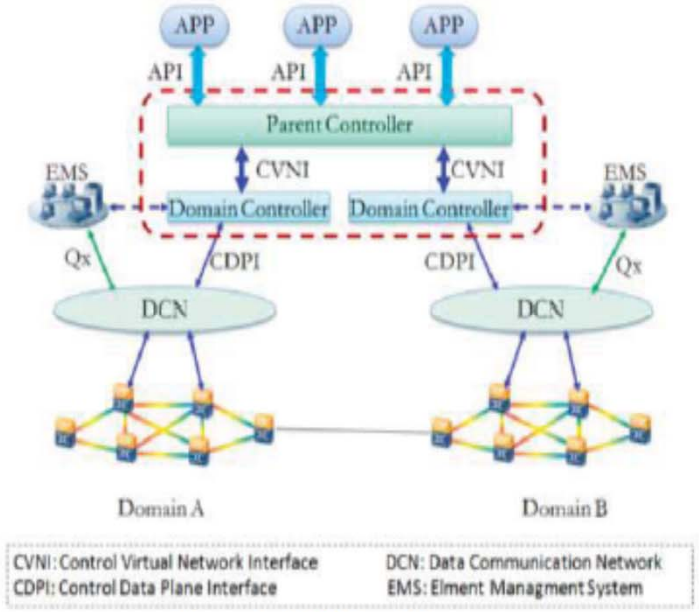

Figure 1 SDON architecture

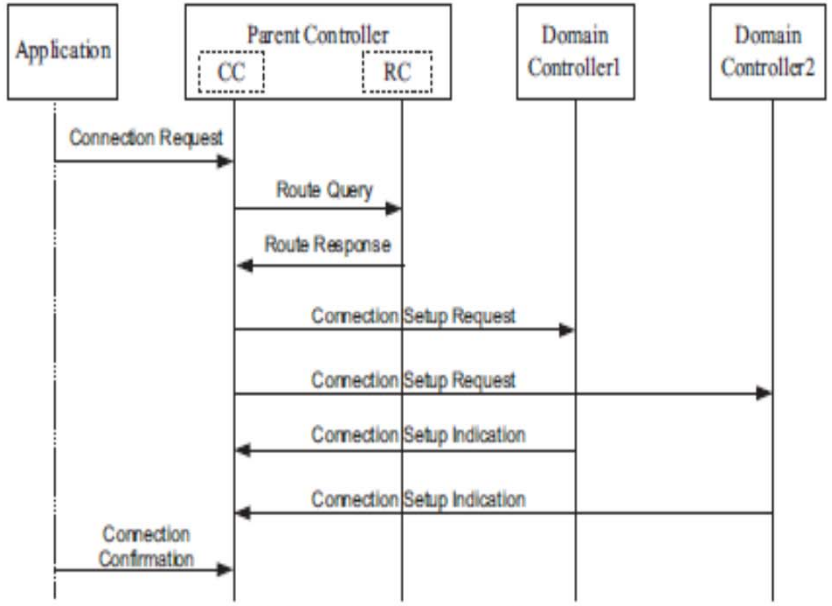

Figure 2 Hierarchical connection control

- 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

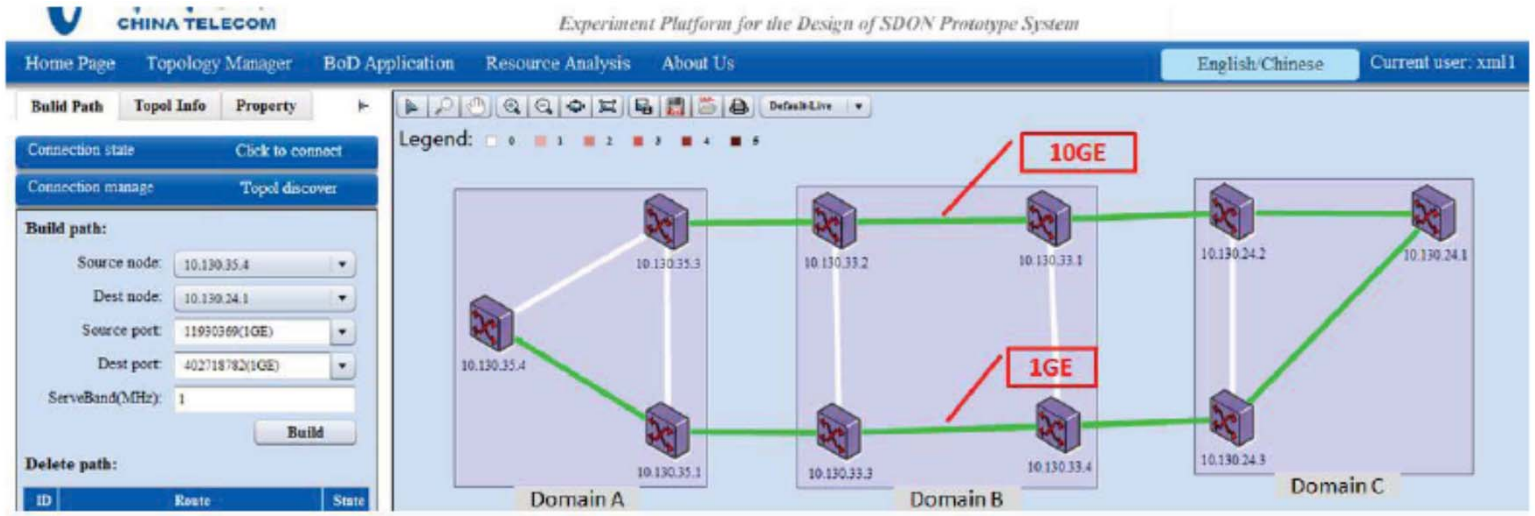

Figure 5 Network topology show on MDM APP

No.	Time	Destination	Protocol	Length	Info
304	*REF*	10.130.24.10	OpenFlow	162	Type: OFPT_FLOW_MOD
305	0.000655000	10.130.24.10	OpenFlow	162	Type: OFPT_FLOW_MOD
306	0.001142000	10.130.24.10	OpenFlow	162	Type: OFPT_FLOW_MOD
307	0.001787000	10.130.24.10	OpenFlow	162	Type: OFPT_FLOW_MOD
308	0.002546000	10.130.5.100	OpenFlow	150	Type: OFPT_FLOW_MOD
309	0.003335000	10.130.5.100	OpenFlow	150	Type: OFPT_FLOW_MOD
311	0.004280000	10.130.5.100	OpenFlow	150	Type: OFPT_FLOW_MOD
312	0.005064000	10.130.5.100	OpenFlow	150	Type: OFPT_FLOW_MOD
315	0.014040000	10.130.5.211	OpenFlow	162	Type: OFPT_FLOW_MOD
316	0.015185000	10.130.5.211	OpenFlow	162	Type: OFPT_FLOW_MOD
349	0.267560000	10.130.5.100	OpenFlow	62	Type: OFPT_BARRIER_REQUEST
350	0.274711000	10.130.5.11	OpenFlow	62	Type: OFPT_BARRIER_REPLY
353	0.300265000	10.130.5.211	OpenFlow	74	Type: OFPT_BARRIER_REQUEST
355	2.125475000	10.130.5.11	OpenFlow	74	Type: OFPT_BARRIER_REPLY
357	2.127389000	10.130.24.10	OpenFlow	74	Type: OFPT_BARRIER_REQUEST
358	2.128325000	10.130.5.11	OpenFlow	74	Type: OFPT_BARRIER_REPLY

Figure 6 Sequence of connection setup messages

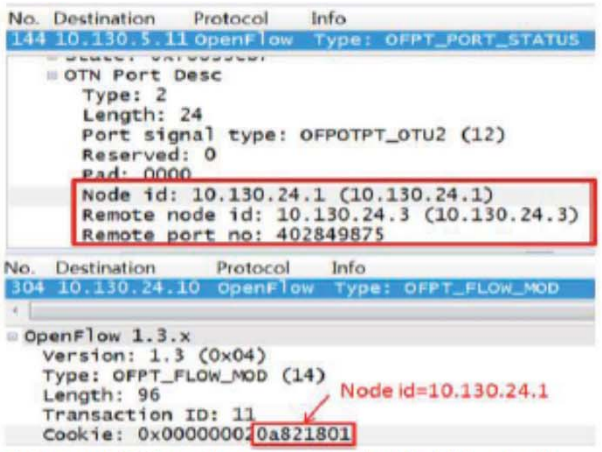

Figure 7 Extend OF packets captured with Wireshark

W4J.5-Overview

SDN/NFV orchestration for dynamic deployment of virtual SDN controllers as VNF for multi-tenant optical networks

R. Muñoz[1], R. Vilalta[1], R.Casellas[1], R.Martínez[1], T. Szyrkowiec[2], A. Autenrieth[2], V. López[3], D. López[3]
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- Contribution
  - Propose virtualize the SDN control function and move them to the cloud.

W4J.5-Architecture

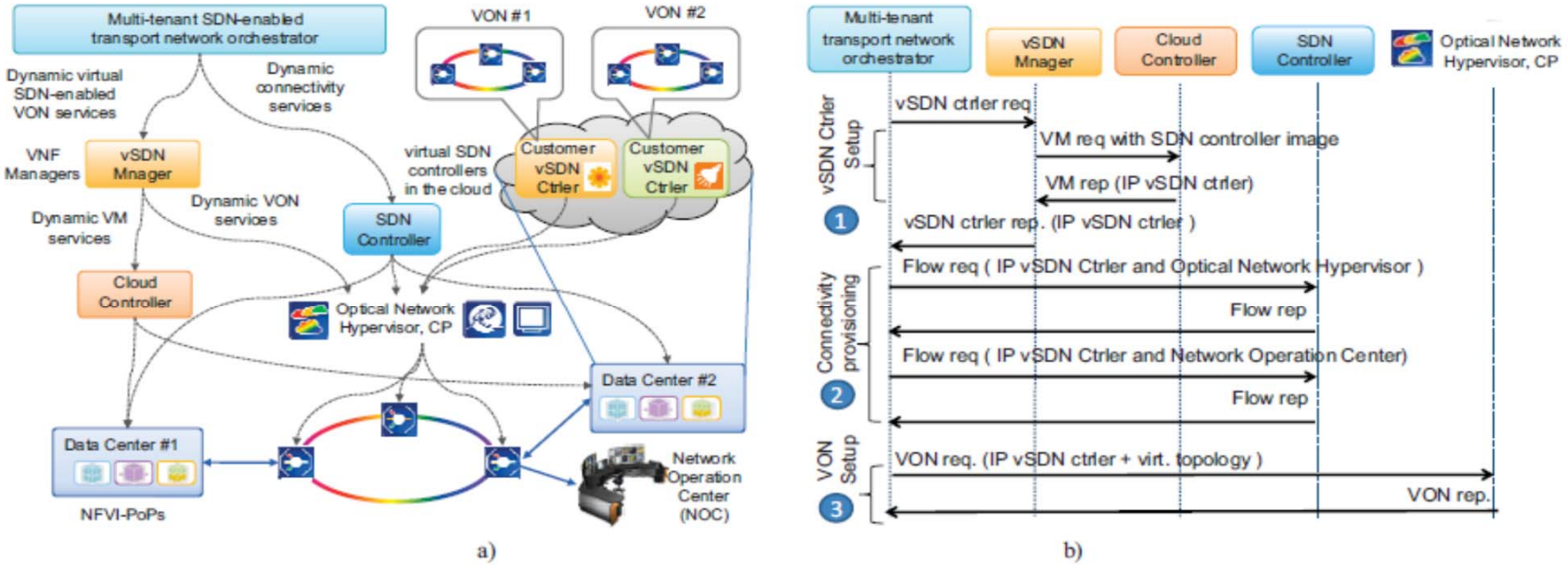
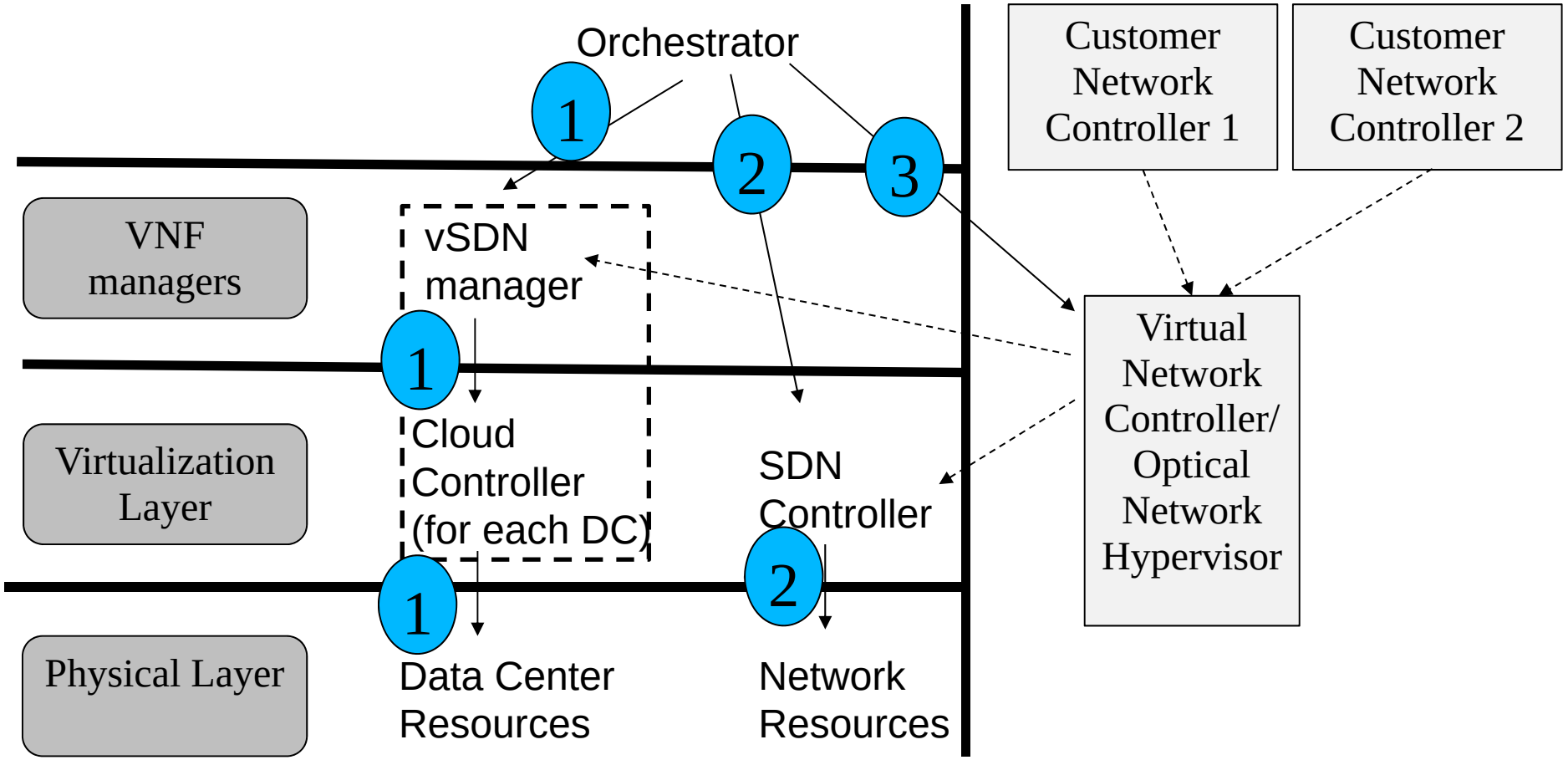


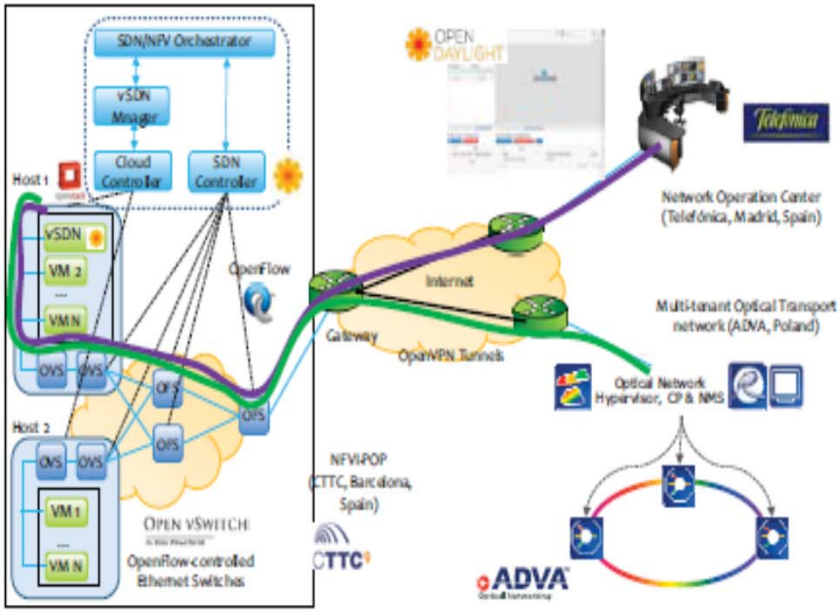
Fig. 1 a) Proposed SDN/NFV orchestration architecture for multi-tenant optical transport networks with virtual SDN controllers as VNF, b) Workflow for deploying a virtual SDN-enabled optical transport network

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

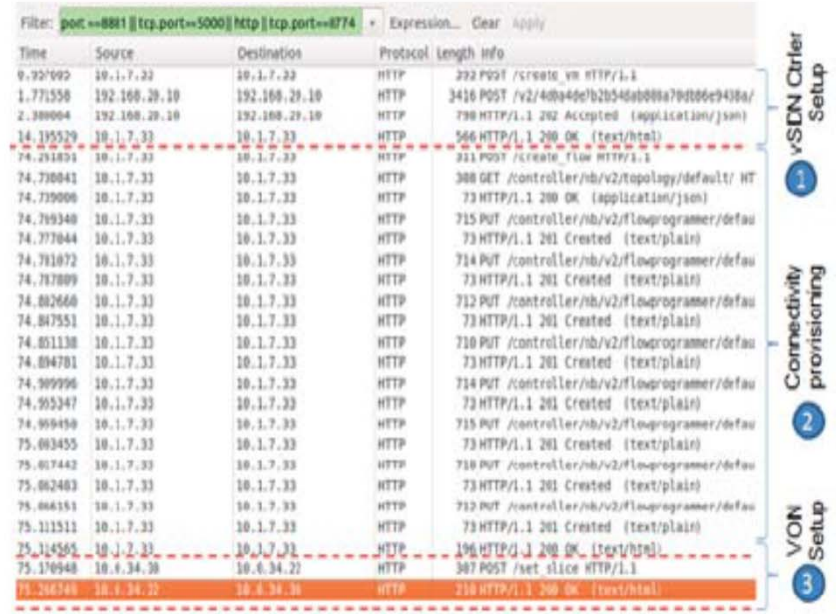
W4J.5-Architecture



W4J.5-Results



a)



b)

Av. vSDN Ctlrer Setup delay		Av. connectivity provisioning delay	Av. virtual network setup delay	Av. Total deployment delay
VM creation	vSDN Ctrler Conf.			
73.6s	0.4 s	0.9 s	0.1 s	75s

b)

REF	NOC	vSDN	HTTP	POST /controller/web/flows/fl
0.028925	vSDN	OHV	OpenFlow	Type: OFPT_FLOW_MOD
0.029027	vSDN	OHV	OpenFlow	Type: OFPT_BARRIER_REQUEST
5.698622	OHV	vSDN	OpenFlow	Type: OFPT_BARRIER_REPLY
5.707736	vSDN	NOC	HTTP	HTTP/1.1 200 OK (text/plain)

c)

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!