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Network Virtualization with Slicing Techniques

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INTRODUCTION

Network virtualization enables the network resources of a software defined network (SDN) to be better utilized, with the capability of serving different tenants with different needs.
This project presents a Layer-3 capable network slicing technique with the use of the Multi-Protocol Label Switching (MPLS) header field in provisioning virtual SDNs as SD-WANs to manage and control the multi-tenant OF@TEIN+ WAN test bed environment.

OBJECTIVES

1. To support multi-tenancy for the OF@TEIN+ testbed environment
2. To automate the virtual network provisioning process
3. To achieve address, topology and control function virtualization

SYSTEM ARCHITECTURE & DEVELOPMENT

Self-Healing	Access Control
LSP Builder	ProxyARP
Flow Rule Store	Virtual Network Gateway
Path Computation	Virtual Network Routing
Network Slicing	
Tenant Management	Virtual Network Manager
Virtual Network Subsystem	
ONOS	

Figure 1 – System Components and Architecture

RESULTS & DISCUSSIONS

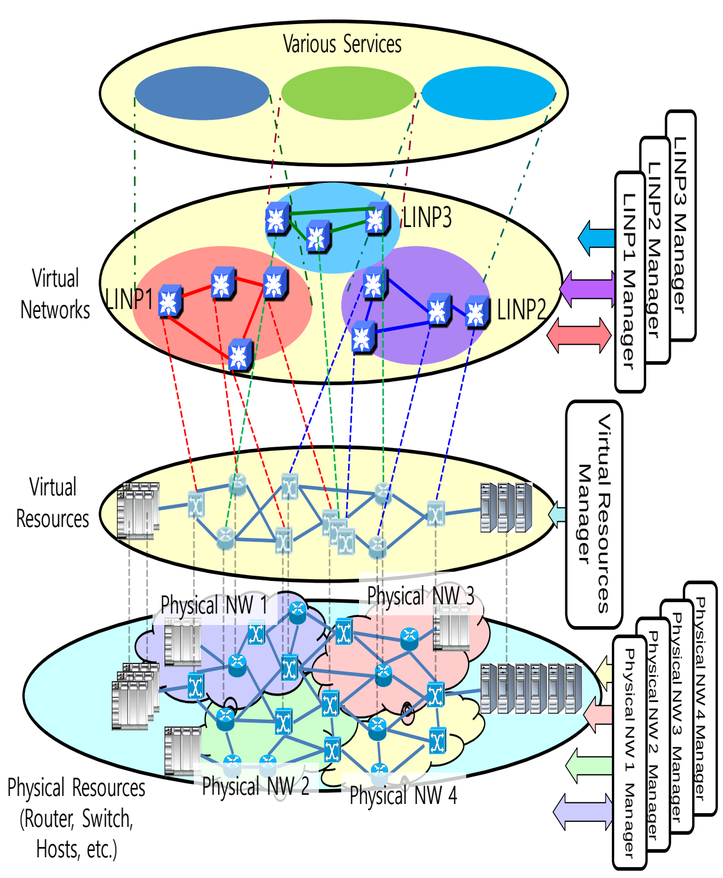

Figure 2 – Overview on Network Virtualization

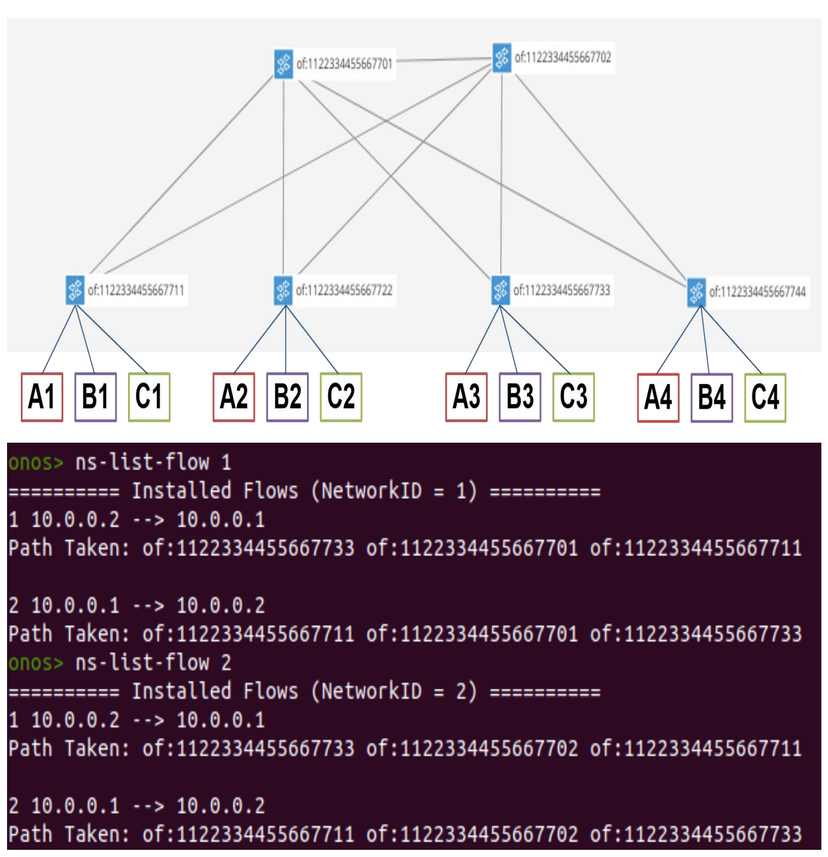

Figure 3 – Paths that are taken by A1-A3 and B1-B3

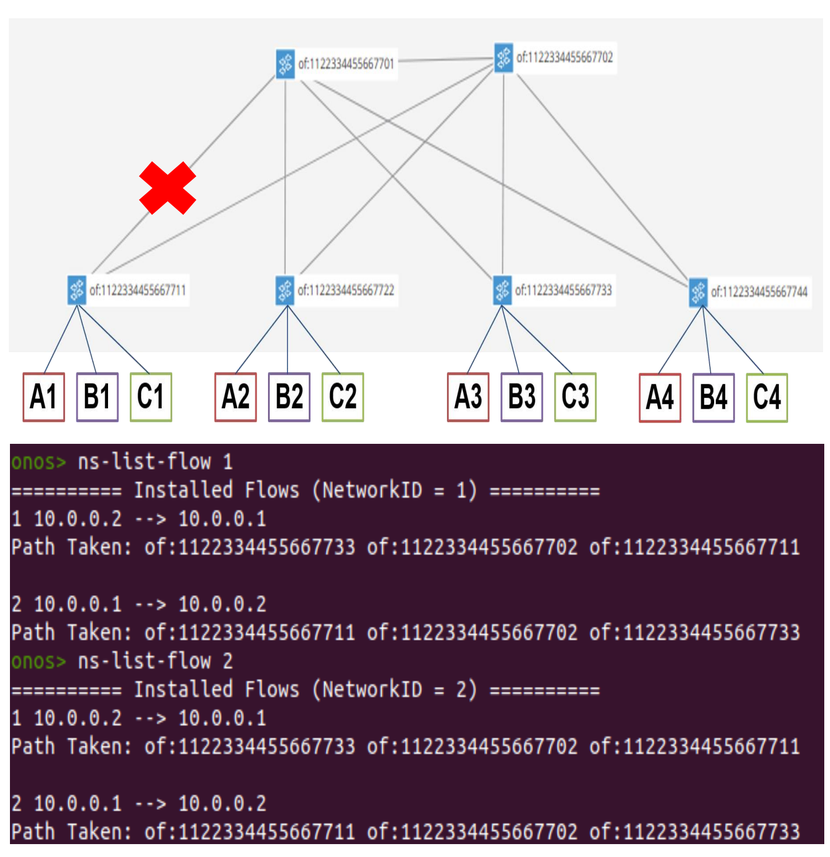

Figure 4 – New recovered path that are taken by A1-A3 when link L1-S1 failed

A

Host	IP Address
A1	10.0.0.1/8
A2	192.168.1.1/24
A3	10.0.0.2/8
A4	192.168.1.2/24

B

Host	IP Address
B1	10.0.0.1/8
B2	172.16.0.1/16
B3	10.0.0.2/8
B4	172.16.0.2/16

C

Host	IP Address
C1	10.0.0.1/8
C2	172.16.0.1/16
C3	10.0.0.2/8
C4	172.16.0.2/16

Table 1 – Tenant configurations used for testing

The system was tested over a leaf and spine topology with 2 spines and 4 leaves as per Figure 3 & 4. The tenant host configurations were done accordingly to Table 1. A1-A3 and B1-B3 who are using similar address spaces were able to communicate within each other without affecting each other using different paths as show in Figure 3. This proves that our system successfully achieved address virtualization.
Tenant A were able to use all the network resources available while Tenant B does not have access of any connections to S1 (OF:1122334455667711). Each of the tenant's topology are virtualized.

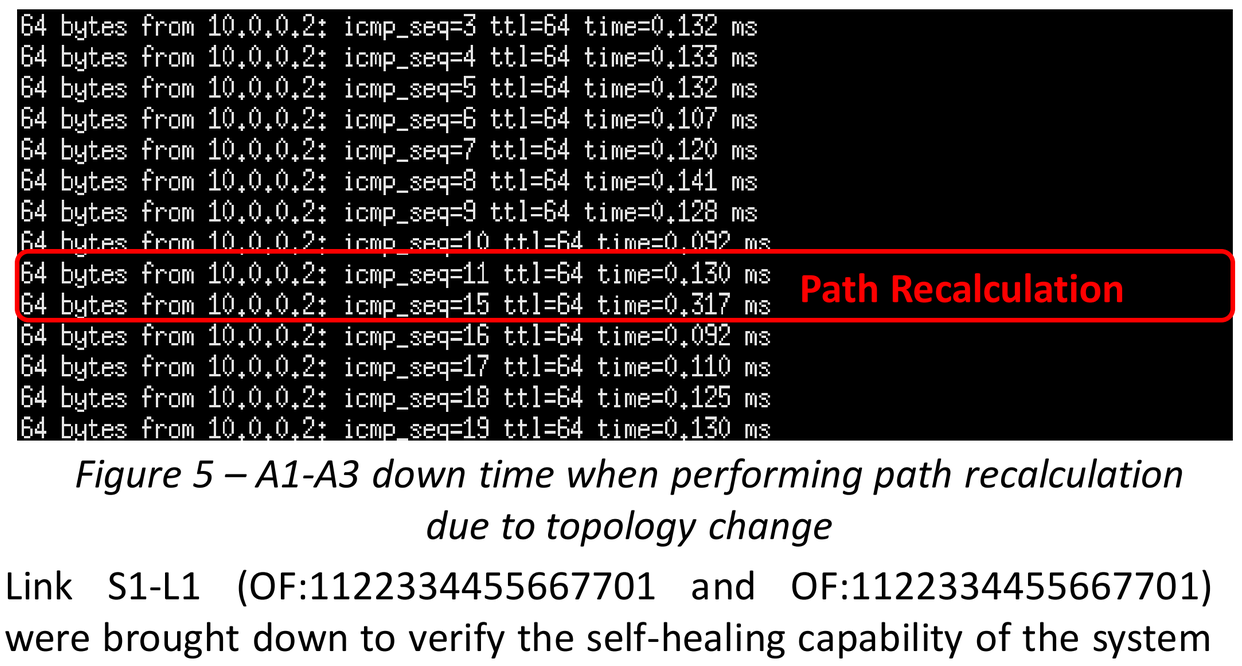

Figure 5 – A1-A3 down time when performing path recalculation due to topology change

Link S1-L1 (OF:1122334455667701 and OF:1122334455667701) were brought down to verify the self-healing capability of the system in recovering network connectivity. Within 5 packet losses, A1-A3's connectivity was recovered by the system as shown in Figure 5.

CONCLUSION

This project proposed network slicing technique utilizes the MPLS header field to isolate between tenants.
The system achieved its objective in supporting a multi-tenant environment, provisioning virtual networks and virtualizing the address space, topology, and control function.

INNOVATION

This project replaces the current method of creating multiple VXLAN WAN links to support multi-tenancy with a single Software-Defined WAN (SD-WAN) with Self-Healing capabilities.
This research work is accepted into the Proceedings of the Asia Pacific Advanced Network Research Workshop 2018, at the 46th APAN, NZ.