Agile VPN for Carrier/SP Network

ONOS-based SDN Controller for China Unicom MPLS L3VPN Service

Introduction

In order to meet strong service demand on their network and respond to the new competition (who use very different ways to provide the services built on a different cost base), Carrier/SP use SDN technology with their current network assets (e.g. MPLS network) to address the operating efficiency and fast service deployment before migrating to a new architecture and new equipment.

SDN Technology brings new challenges not only to carrier/SP but also to network equipment vendor. After the control plane is moved out from current router/switch box and is running separately (aka SDN controller), the controller is required to address the issues like: how to scale the controller from controlling a small island to a larger end-to-end network; how to reduce the latency in response to the network state changes, how to make it secure and five nines reliable carrier-grade controller, etc.

China Unicom, Huawei and ON.Lab have teamed up on an agile VPN PoC, which demonstrates that Huawei ONOS-based controller (aka SNC) can provide fast L3VPN provisioning and per-VPN based bandwidth on demand on both legacy and OF network.

ONOS – a platform for vendors to build a SDN controller

ONOS, Open Networking Operating System, is an open source project. It provides a platform for a vendor to build their controller through adding services/applications on top of ONOS. From the vendor perspective, Huawei sees ONOS bringing in the following values when building an ONOS-based system.

1. Its south-bound provider architecture makes it easy for a vendor to implement plugins to support diversified southbound protocols and devices. Its abstracted south-bound common API allows single controller to control the devices from different vendors. This greatly helps the vendor’s solution by not only working with its own devices but also by working with other vendors’. This architecture makes it possible for the controller to control both OF and legacy network devices.
2. ONOS is architected as logically centralized but physically distributed clustering system. ONOS core addresses the requirements in scalability, high performance and high availability. This design offloads vendor’s development resource so that a vendor can focus on services and network control application development, which brings in more value to the vendor.
3. Abstracted Global View and Application Intent framework in ONOS north-bound is beyond academic concept and research phase. It will change the way to think and to implement network control applications.

4. Services provided by ONOS core are designed and implemented as a set of collaborating subsystems. Network control applications can use those services through the NB API. This is a very high efficient system design.

Agile VPN Demo Overview

Requirements
China Unicom has two basic requirements for this PoC

1. Fast/Agile VPN Provisioning

In current MPLS network, adding a new L3 VPN site and providing a calendaring L3VPN service is not easy. Much manual configuration is required, existing service and VPN user may be interrupted, and months might be taken to complete the whole process. China Unicom requires a faster and more efficient way to provide VPN service for his customer.

2. Bandwidth on Demand service per VPN user

Bandwidth on Demand service is required by VPN user. This service is Time/Event based. For example, for cost saving, enterprise customer requests extra bandwidth during telepresence conference and will release it after the conference ends.

Implementation Highlights

1. SNC is implemented as an external application running on the top of ONOS. In this demo, SNC provides L3VPN service, PCE engine, interface to Portal software, etc.

2. SNC keeps a snapshot of network global view and network resource availability, which is mainly used by Path Calculation Engine (PCE) for path calculation in the demo.
3. Use Producer-Consumer model to provision VPN. In this P-C model, Producer and Consumer are separate applications. Producer provisions network for Consumer to use. In this demo, Producer provisions MPLS tunnel. Consumer is L3VPN service that uses the tunnel.

4. ONOS core is enhanced with WAN service, such as MPLS Label Manager (support global and local label management), Tunnel Manager, and FlowRule extension.

5. Huawei south bound provider allows ONOS to talk with both legacy and OF devices and control both Legacy and OF network.

6. Northbound support both REST API and a faster communication channel between SNC and ONOS.

Huawei’s ONOS-based Controller Architecture
Refer to the diagram that follows.

SNC

SNC is Huawei’s in house built controller with network services and control applications. In this demo, it provides following functions:

- Path Calculation Engine (PCE), to provide a path calculation between start and end nodes with constraints.
- A snapshot of ONOS network global view and network resource availability
- L3VPN service, to complete L3VPN service required process.
- API to orchestrator and portal software.
• SNC uses REST interface and Huawei specific interface to communicate with ONOS. When communicating through Huawei specific interface, Huawei Agent is required by ONOS.

ONOS

Agile VPN demo requires ONOS to provide several basic services in core and associated northbound APIs for application to use.

• Northbound (FlowRule API, Label Management API, and Tunnel Management API)
• Core (MPLS label service, Tunnel service, FlowRule service).
• Southbound (The changes are mainly required by Huawei devices and none-openflow network).

Protocol Processor

This software is Huawei in-house developed (not open-sourced) software, which is running on any machine with Linux OS. Protocol Processor basically handles IGP and OF (but not limited to) protocol and provides the communication service between network element and SDN controller. For the upstream traffic, Protocol Processor uses IGP protocol to communicate with Huawei’s southbound agent in ONOS to notify network state change. For the downstream, use OF protocol (1.0 and 1.3) to install flow rules to devices;

This Protocol Processor is not part of Huawei’s final production plan. The protocols supported by this Protocol Processor are planned to be implemented as a plugin in ONOS in the future release.

Agile VPN Demo Setup

In the demo setup, three VPN sites are created through portal software. Video Traffic flows among those sites. The request to VPN provision, add/remove VPN site and Per VPN user BoD are managed by Portal software. See the following diagram.