Abstract

This draft discusses interworking (IW) of OpenFlow and Segment routing. Several possible scenarios are introduced in this document. We believe that such discussion and research are helpful for both deployment/implementation and wider acceptance of the segment routing technology.

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Segment Routing (SR) leverages the source routing paradigm. An ingress node steers a packet through a controlled set of instructions, called segments, by pre-pending the packet with an SR header. A segment can represent any instruction, topological or service-based. A segment can have a local semantic to an SR node or global within an SR domain. Segment Routing allows one to enforce a flow through any topological path and service chaining while maintaining per-flow state only at the ingress node to the Segment Routing domain.

The Segment Routing architecture is described in ([I-D.filsfils-rtgwg-segment-routing]) The Segment Routing control plane is agnostic to the data plane, and hence it can be applied to both MPLS (and its many variants) and IPv6.

OpenFlow is a communications protocol and open interface defined between the control and forwarding layers([OpenFlow]). It allows direct access to and manipulation of the forwarding plane of network devices such as switches and routers, both physical and virtual (hypervisor-based).

This document introduces several scenarios and discusses the interworking between segment routing and openflow.
2. Conventions and Abbreviations

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

3. Data Center (DC) Inter-connection

Modern day DCs are increasingly utilizing Openflow protocol now, while the WAN network keeps maintaining the traditional IP/MPLS network. Therefore, there exits a need for interworking between OpenFlow and the traditional IP/MPLS network. This scenario discusses how to control the inter-DC flow based on the SDN architecture and segment routing technology.

As shown in Figure 1, the data center is controlled by one or several OF controllers, and all the switches and routers support flow forwarding. The switches and routers communicate with OF controller by OpenFlow protocol. The router is the layer 3 gateway for that data center. The IP/MPLS network between the data centers support segment routing technology. The segment routing label stacks are encapsulated in the edge routers of the data center.

The security app and Traffic Engineering app are the application layer. They communicate with controller through north bound interface. If there are some policies, such as TE App, or security App and policy App for the inter-flow forwarding, the Apps download the service decision to the controller to result into forwarding instance, and the forwarding instances are downloaded to the gateway router of the data center to or from the forwarding label stack.
4. OpenFlow Based WAN Control

Figure 2 shows an SDN based WAN control scenario. The controller is introduced to the WAN network. The controller should support an externally visible Discovery Service and a Routing Service. The Discovery Service is responsible for bootstrapping and configuring the network, discovering node-capabilities, discovering and maintaining the topology graph, providing statistics and troubleshooting services and finally implementing an API for the Routing Service as well as external requests. The Routing Service is responsible for default routing on the configured network using Segment Routing principles like Node Segments and ECMP. It should also support capabilities allowing for Policy Routing, Traffic Engineering and Steering.

The transit routers (Route 2 and Router 3) are only responsible for MPLS label forwarding. The SR forwarding tables could be built by the controller or the IGP protocols ([I-D.ietf-isis-segment-routing-extensions]) ([I-D.ietf-ospf-segment-routing-extensions]).
5. Interworking of OpenFlow and BGP Edge Routers

There are four PEs, two of them (PE1 and PE3) support Openflow protocol, and the other two (PE2 and PE4) support traditional BGP protocol as shown in Figure 3. The routes on the PE2 and PE4 are reflected to PE1 and PE3 through the BGP route reflector. For unified control and interoperability the OF controller needs to interpret the route control messages from the BGP route reflector/controller, and vice versa. The details of the interface and the messages that need to be exchanged between OF Controller and BGP Route Reflector/Controller need to be determined (future work).

We introduce an OF controller in the network and an application layer server. The Apps in the Server can have visibility to the routes from BGP RR as the figure shows. This makes it feasible to export the route to OF controller. The OF controller makes its forwarding decision based on the route exported from application and the application policy. The forwarding decision is made of label stack and downloaded to PE2 and PE4. The PE2 and PE3 are responsible for the segment routing encapsulation as ingress routers.
6. Implementation Examples

We plan to discuss the high-level implementation options in a later version of this draft or in a companion document.

7. High-Level Requirements

We note that the high-level requirements of SR OF interworking depend on both the IW architecture and applications or services. A companion draft will discuss these in details.

8. Security Considerations

We plan to discuss the security considerations in a later version of this draft or in a companion document.

9. Acknowledgements

In progress.

10. IANA Considerations

We plan to discuss the IANA considerations in a later version of this draft.
11. Normative References

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Authors’ Addresses

Fangwei Hu
ZTE Corporation
No.889 Bibo Rd
Shanghai  201203
China

Phone: +86 21 68897637
Email: hu.fangwei@zte.com.cn