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SDN Controller Requirement
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Abstract

The requirements of SDN controllers including fundamental technical requirements, requirements of the SDN controller architecture and the requirements of the SDN controller functionality are provided. All these requirements raised are focused on the scalability, reliability, programmability, intercommunity, security and the network management of the SDN controller.

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1. Introduction

Software-defined networking (SDN) is an intelligent network, especially used in Data Centers, with configuration and operation through a centralized software controller. SDN controller is a core entity of the SDN architecture indicating how the network behaves and where the traffic is sent. Network intelligence is logically centralized in software-based SDN controllers that maintain an abstract view of the network, which appears to applications and policy engines as a single, logical switch.

Due to the importance of SDN controllers to the SDN architecture, the requirements of SDN controllers should be come up with. The requirements are divided into three parts: fundamental technical requirements, requirements of the SDN controller architecture and the requirements of the SDN controller functionality.

2. Terminology

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. Fundamental technical requirements of SDN controllers

The fundamental technical requirements include scalability, reliability, programmability, intercommunity, security, and the network-based management.

Scalability:

SDN controller should meet the requirement of scalability in order to adapt the changes and adjustments of the network. The computing and controlling ability can be extended as the performance of hardware increases.

Reliability:

SDN controller should meet the carrier-level requirement with rapid fail-over mechanism.

Programmability:

SDN controller should offer APIs in order to provide rapid deployment of new service through executing scripts such as Python and Java or loading third-party module dynamically.

Intercommunity:

One SDN controller should support standard protocols in interacting with other SDN controllers or with traditional network.

Security:

SDN controller should qualify the security requirements including the communication security between the controllers and the switches, the access control security of controllers and switches, TLS and IPsec mechanism of the communication channels, DoS attacks prevention, digital certificate of third-party support.

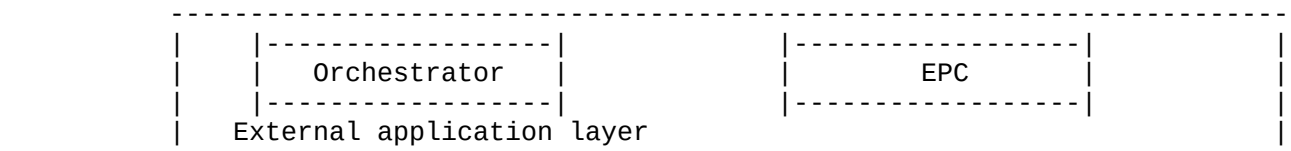
Network-based management:

SDN controller should provide tools for basic network management and trouble diagnosis, such as secure access, status report, statistics, forwarding operations and so on.

4. Requirements of the SDN controller architecture

SDN controller should support both traditional distributed forwarding and centralized forwarding based on openflow. SDN controller interacts with switch through southbound interface.

SDN controller is logically divided into several models, including subsystem of protocol, forwarding abstraction layer (FAL), topology management, route management, host management, flow table management, interface management, database management, OAM interface management and inter-application subsystems.



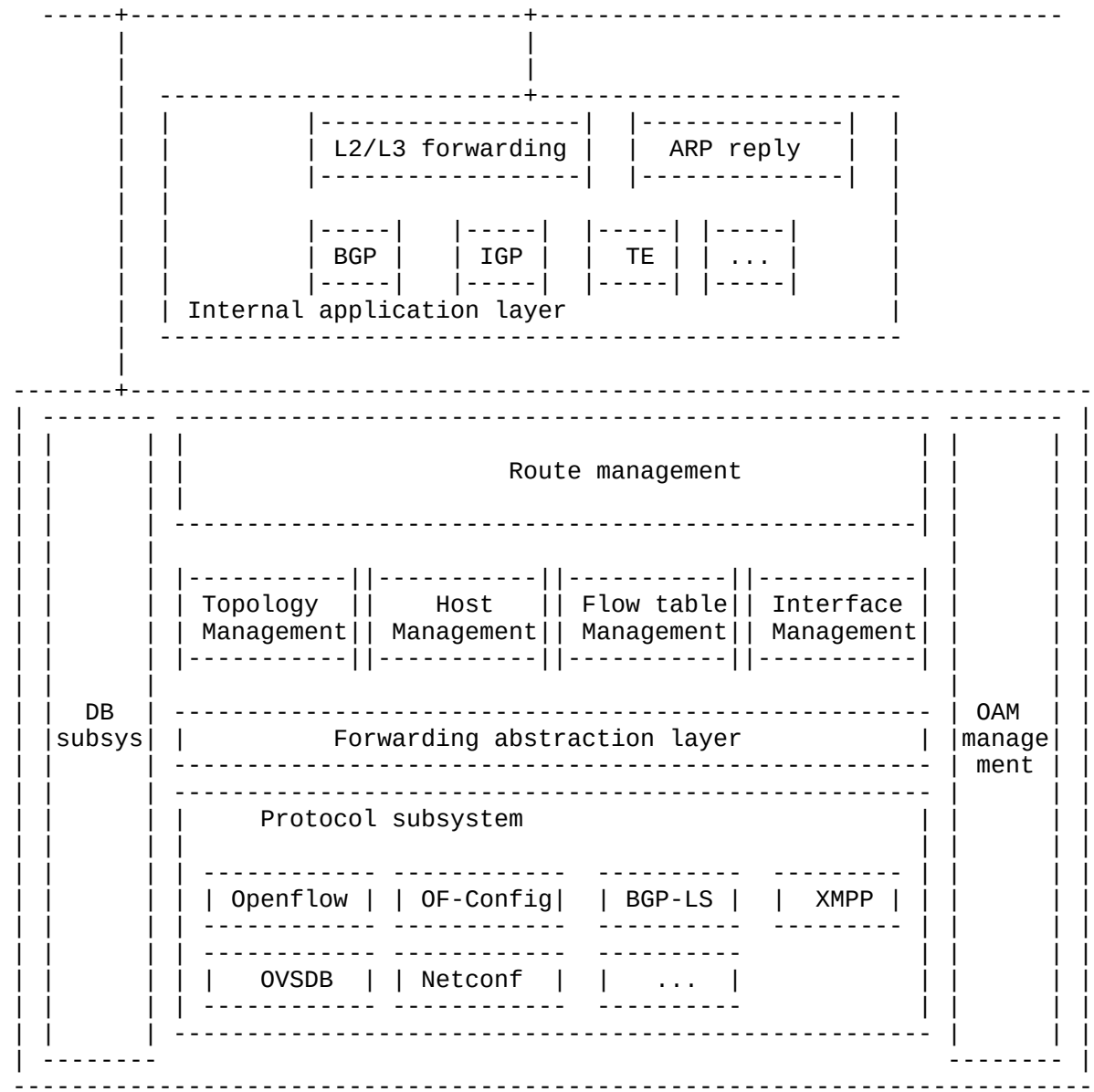


Figure 1: Sample Calibration Permutation

Protocol subsystem:

The protocol subsystem of the SDN controller focuses on southbound interface with protocols such as openflow, OF-Config, BGP-LS, OVSDB, Netconf, XMPP and so on.

Forwarding abstraction layer (FAL):

FAL translates the different forwarding plane into the unified interface upside in order to realize the abstraction of SDN controller node.

Topology management:

Topology is calculated through the status of port reported by the switch with the protocol such as LLDP, BGP-LS and so on. Logical networks are supported by SDN controller. Physical network can be divided into several logical networks with physical port and host corresponding to the virtual networks.

Route management:

Centralized computing of every virtual network is supported by controller. Forwarding path is calculated according to the ability of switch and the constraint conditions such as link cost, and bandwidth and network information.

Host management:

Host management takes the function of MAC and ARP learning. Host position and ARP information is recorded and aging at a certain time.

Flow table management:

Basic functions such as forwarding table storage, routing coalescence and re-forwarding are realized by the flow table management. It’s suggested that both distributed and centralized forwarding models are supported.

Interface management:

Interface configurations are maintained in the interface management, including dynamic and static interface configuration information. Virtual ARP table is also generated in the interface management model.

Database management:

Forwarding table and openflow table are managed in the database management with data synchronization.

OAM interface management:

Configuration command of command-line terminal and visualized network management server is written into database. Management interface is provided.

Inter-application subsystem:

Inter-application subsystem supports the interface to openstack and cloud platform by restful. Layer 2 and Layer 3 forwarding, traffic engineering, and ARP reply features are equipped. IGP/BGP protocols are supported.

5. Requirements of the SDN controller functionality

Due to the fundamental techinical requirements of SDN controllers, the follow functionality aspects need to be considered.

1. Requirement of multi-tenants and self-service

Multi-tenants with their self-service are typical scenarios of SDN. Multi tenants are existed in data centers with several virtual networks per tenant. IP address pool is allocated in every virtual network. Virtual network is logically isolated with each other. Same IP addresses can be assigned to different tenants. Virtual routers are used in different virtual network communications.

2. Requirement of network function

Basic network functions SDN controller needs to support list as follows.

(a) The number of tenants should be over 4000 by tunneling technique.

(b)Virtual machines in one subnet can communicate with each other by unicast of layer 2.

(c) Virtual machines in different subnets can’t communicate with each other.

(d)Virtual machines in different subnets can communicate with other by configuring a virtual router.

(e)Virtual machine can access to the network by assigning a public IP address.

(f)Tenants can translate private IP address into public IP address by NAT.

(g)Different tenants can use the same IP address and VLAN ID.

(h)Network can be recovered rapidly when fails.

(i)ARP Broadcast storm should be suppressed.

(j) Equal-Cost Load Sharing is supported in both underlay and overlay networks.

(k)Traditional protocols such as IGP , BGP and others are supported.

3. Requirement of administrator features

Administrators are responsible for tenants creation and deletion, network creation and deletion, unbinding the relation between tenants and network, query for tenants' information, query for physical and virtual information, virtual machine immigration and so on.

4. Requirement of network management

The information of switches, hosts and network topologies can be queried by management. Monitoring on network traffic is supported by network management. Network management is also responsible for network policies release and flow table configuration.

5. Requirement of reliability and scalability

Reliability of SDN controller relies on active-standby mode by controller node, secure connection between controller and switch nodes, multi-controllers based on openflow and so on. Scalability of SDN controller relies on node upgrading without service interruption and unique node upgrade in the distribute systems without any influence on the whole system.

6. Requirement of performance

Performance of SDN controller is reflected in the number of forwarding nodes supported per controller node, the capacity of flow table per controller node, speed of forwarding table processing per node and standby time of controller node.

7. Requirement of northbound and southbound interface

The northbound interface of the SDN controller is to achieve the requirement of the administrators and network management. While the southbound interface of the SDN controller is including the interface of status/configuration information such as OVSDB, OF-Config, XMPP

and the interface of routing/forwarding information such as Openflow, XMPP, IGP, BGP and so on.

8. Requirement of processing flow

The process of packet-forwarding network networks added or modified, physical network topology discovered and network failure advertised should be required.

6. Conclusion

All the requirements provided above are recommended to be taken into consideration for the SDN controllers.

7. Security Considerations

None.

8. IANA Considerations

None.

9. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC2234] Crocker, D., Ed. and P. Overell, "Augmented BNF for Syntax Specifications: ABNF", RFC 2234, November 1997.

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