Building a high-performance data center network system

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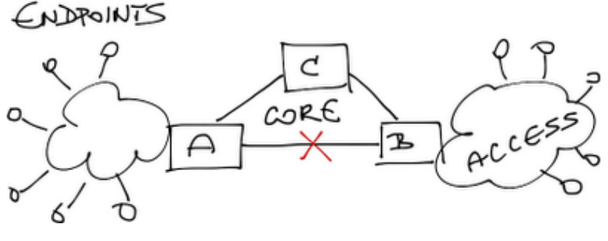
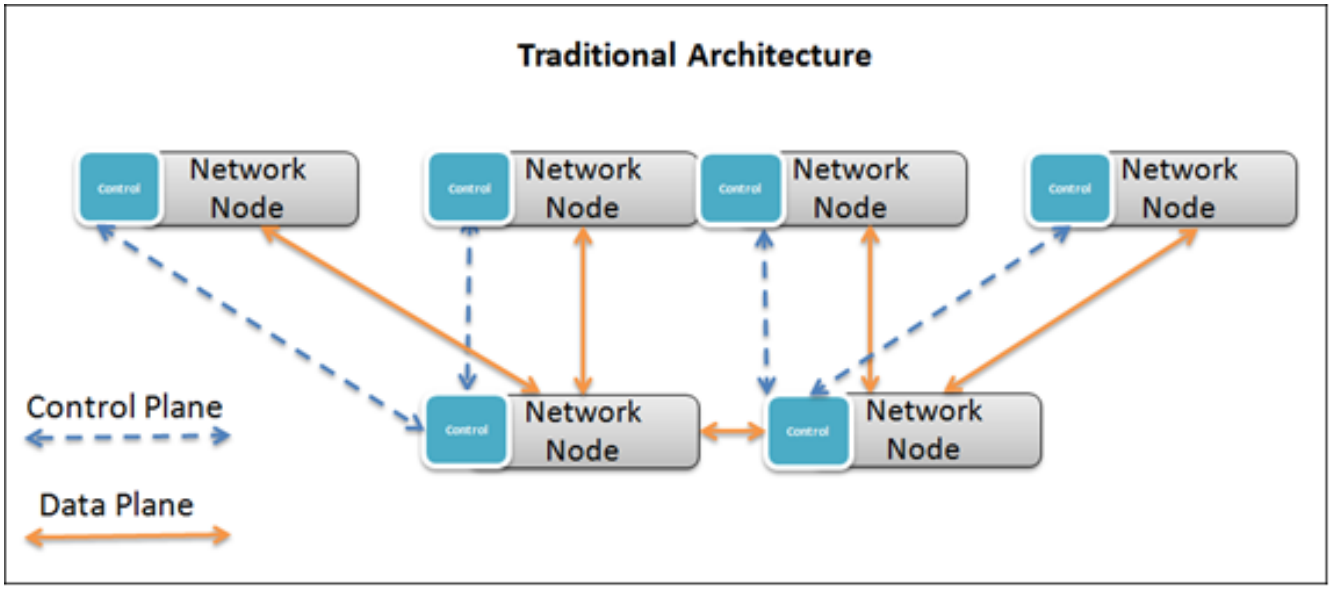


Overview

Traditional distributed networks building with switches, routers and other end devices are scalable and reliable in theory. But it become more and more complex for nowadays new networking services and applications as they usually requires data in real time, the workload of network increases significantly, which highly increases the workload of data centers.

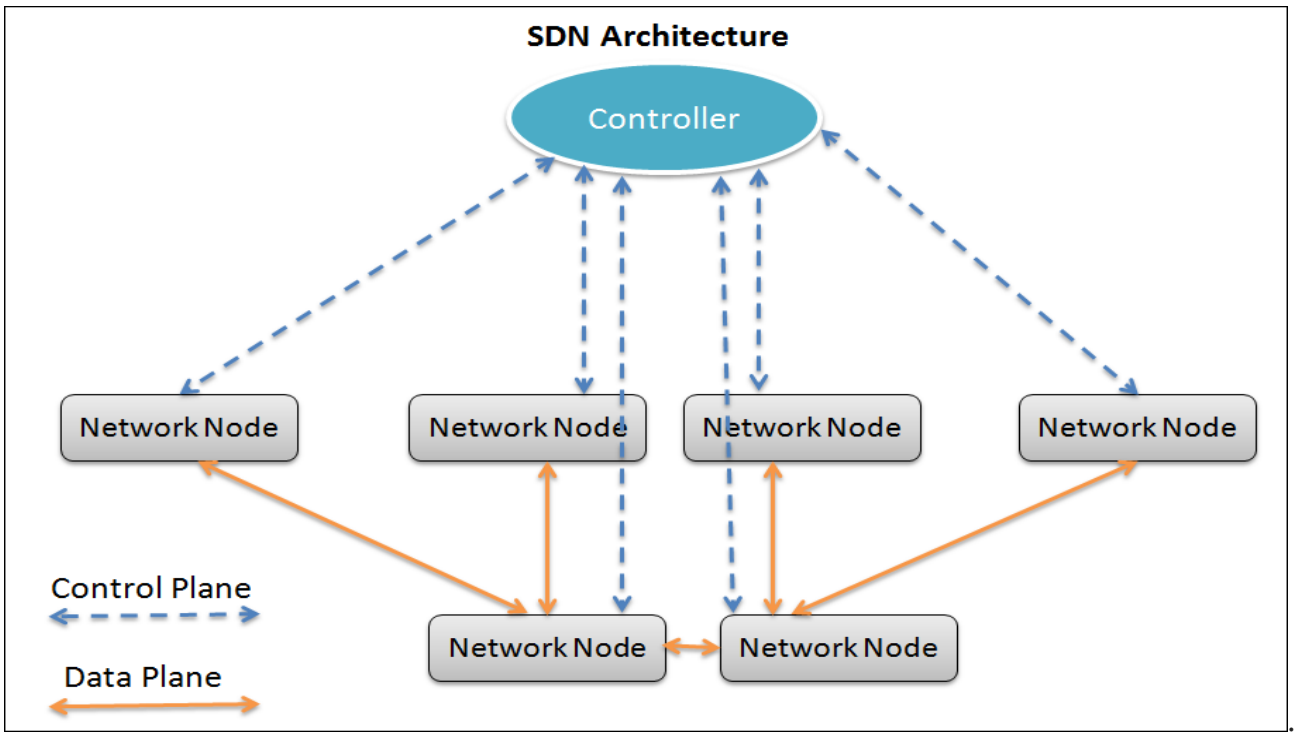
Traditional Networks

The formation of the network can be segmented into layers of management, data plane and control plane. The traditional networks rely very much on protocols from services between devices to exchange information, which protocol are defined by the services themselves.



Software Defined Networks

With a centralized control plane which uses the APIs to program the network elements. And with a global view of the network, the control plane can make smart decisions without even if the network infrastructure changes. The fundamental idea of SDN is that the network elements need to be programmable and has to be dynamic to changes in network environment



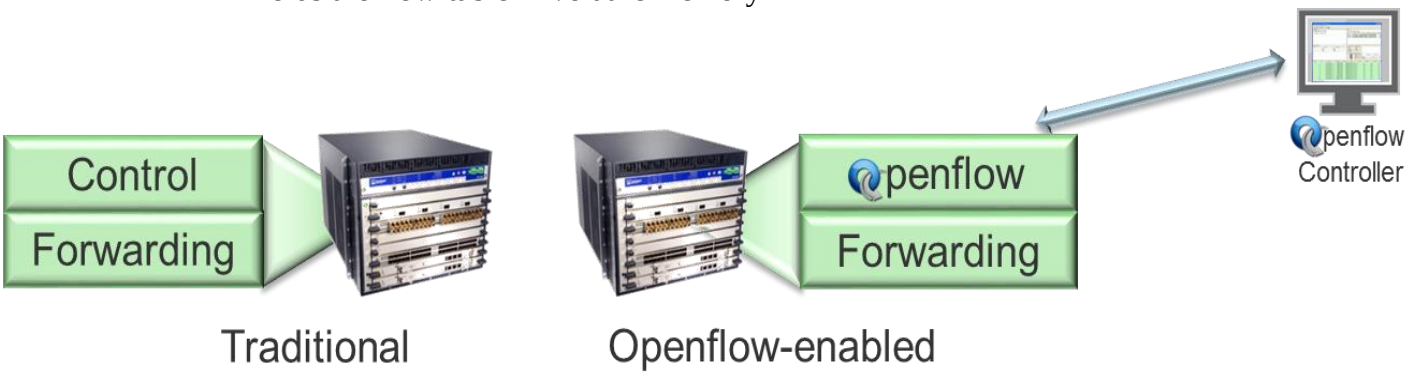
OpenFlow - A type of SDN mechanism

OpenFlow is a complement of network protocol, which enables a network towards SDN environment.

In OpenFlow architecture, an interface is created on the network device so that the device will follow the rules given by a controlling device called 'controller'. The OpenFlow Controller and Switch communicate using OpenFlow protocol – a standardized protocol for all services, which define all messages, such as packet-received, send-packet-out, modify-forwarding-table, and get-stats.

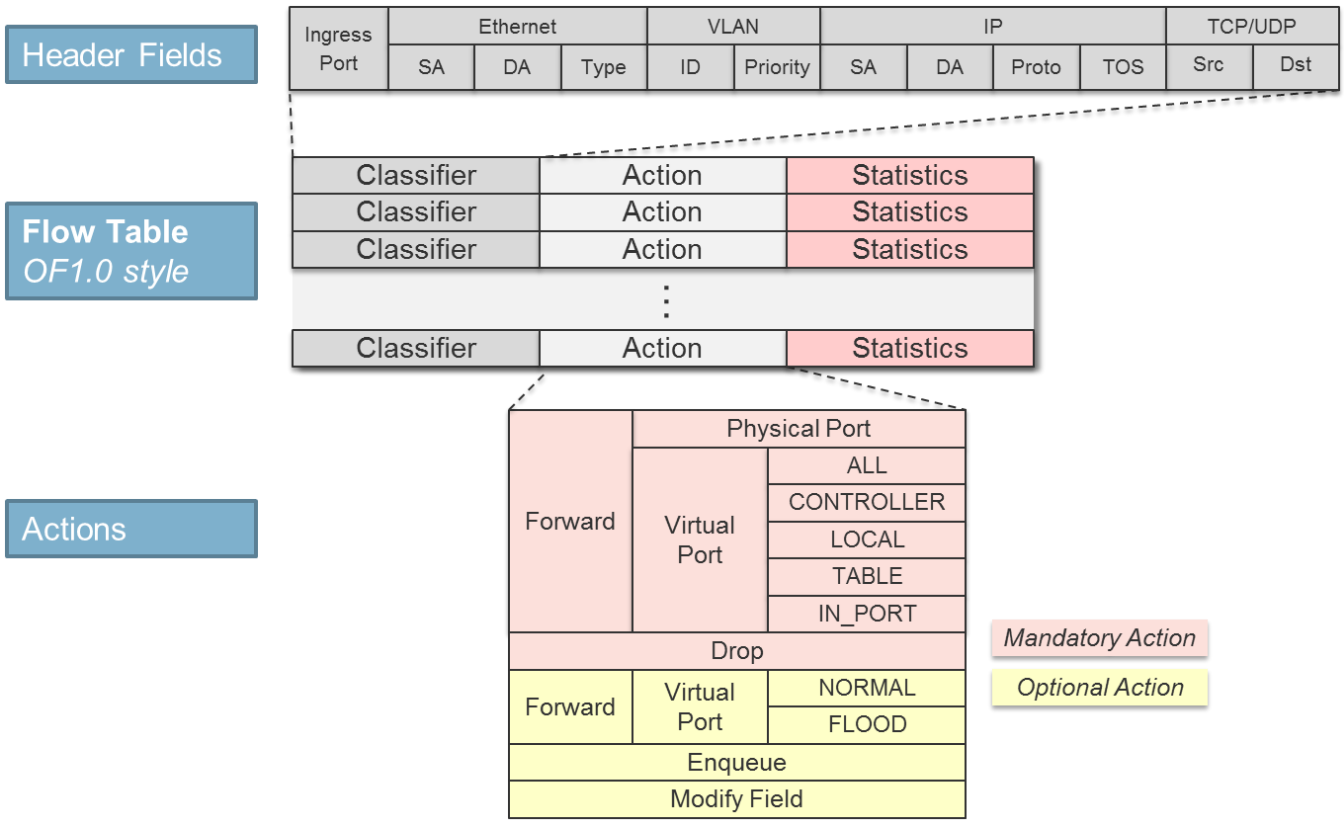
Two components :

- OpenFlow Controller
  - Controls one or more switches
  - Computes paths, maintains state, formulates flows and programs OpenFlow Switches
- OpenFlow Switch
  - Receives commands (flow entries, queries) from the OpenFlow controller in order to populate entries in the flow-table
  - Holds the flow-table in volatile memory



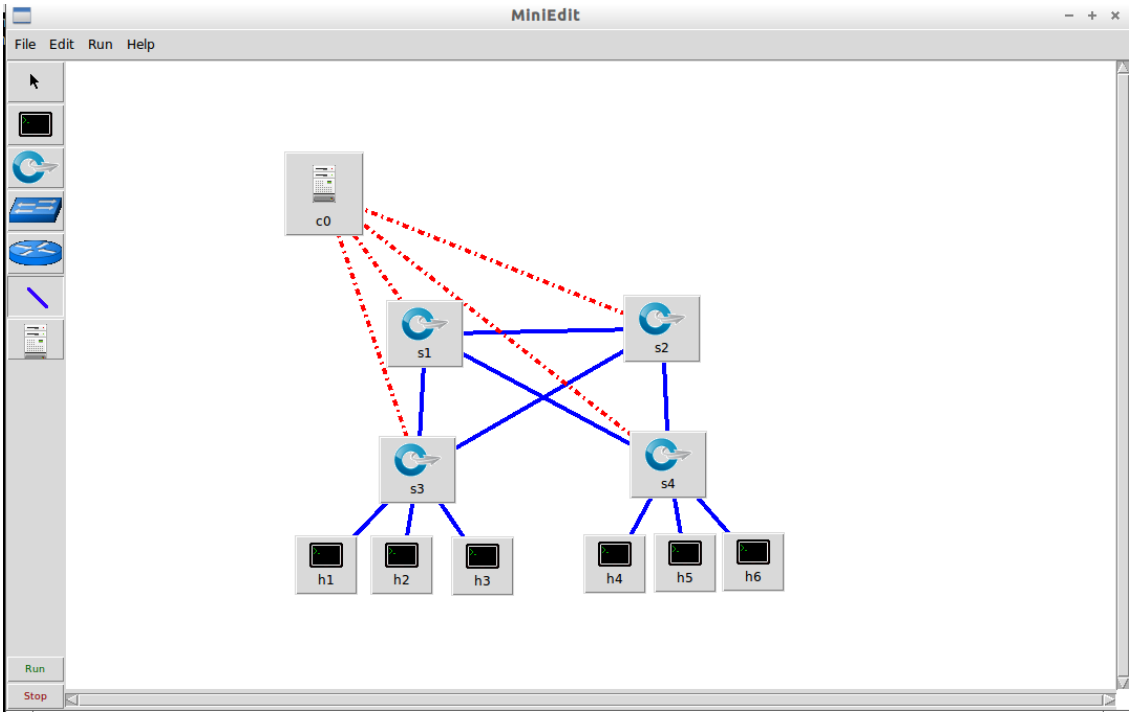
OpenFlow Flow-tables contain :

Header Fields – fields against which a packet can be matched
Counters – statistics reporting capabilities
Actions – defining how the packet should be treated (forward, drop, modify)

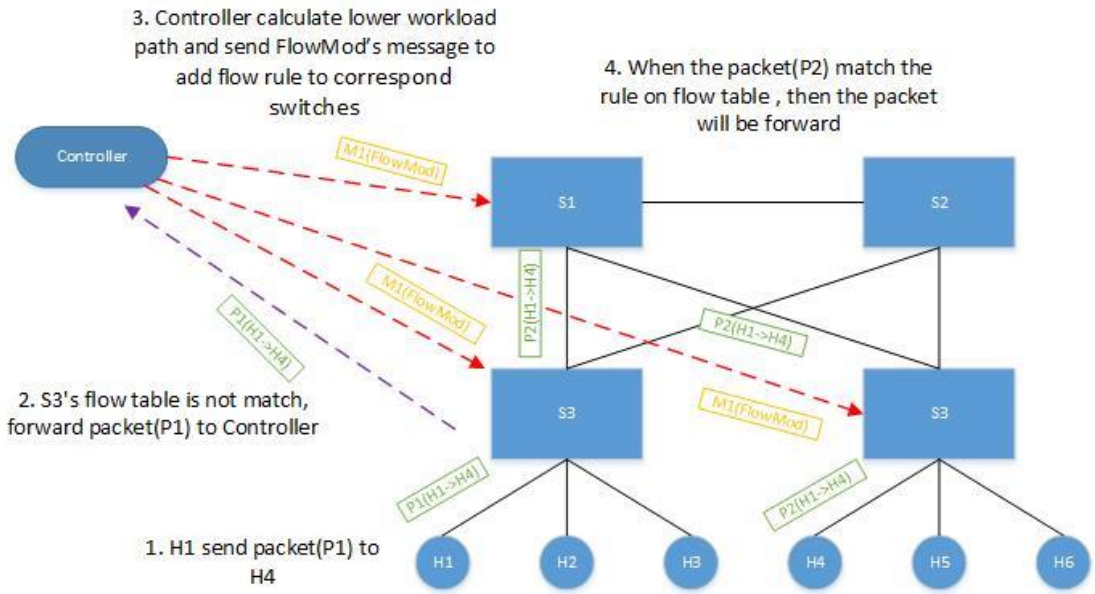


Algorithm of load balancer

In traditional layer 2 network, all switches uses spanning tree protocol to prevent loop and broadcast radiation. Although there might have multiple paths between switches, only one path will be active as the transmission channel and other redundant paths will be blocked. The redundant path will be active only when previous active link fails. This wastes the availability of redundant paths, besides, all traffic concentrated in one path also reduces the performance of the network.



In a SDN network, control panel and data panel is separated. Due to such architecture, the control plane is centralized, so the controller recognizes entire network environment. The centralized controller thus can control the network's traffic flow in a bigger picture, and the controller can add/edit/remove entries of flow table in switches for traffic decision.



Improvements of SDN networks

1. In a layer 2 environment, enable all possible paths to transmit packet.
2. Lower workload path will have higher priority as the selected path.
3. Each flow will have its own timer, all transmission will follow the same flow before the flow expires.