

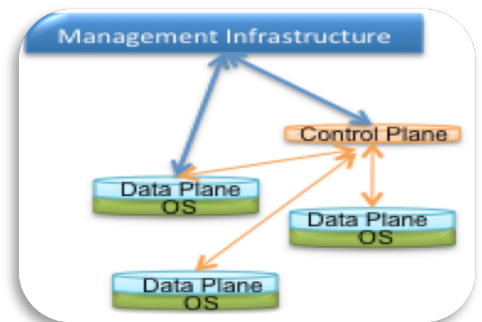
Background

This document serves as a brief introduction of Software-Defined Networking (SDN) and the associated components. In the validated topology below, the SDN network comprise with Agema Systems switches, which are loaded with Open Network Linux (ONL) and installed with OpenFlow Data Plane Abstraction (OFDPA) app. The control plane is separated out of the switches and moved onto the Open Network Operating System (ONOS) controllers.

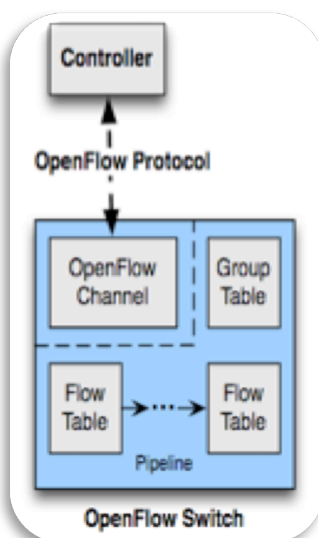
Software-Defined Networking (SDN)

Software-Defined Networking is an umbrella term encompassing:

- Move of networking equipment from proprietary to standard CPU and a standard Network Processor Unit (NPU)
- Separating control plane from data plane
- Making forwarding and flows programmable



OpenFlow Data Plane Abstraction (OFDPA)

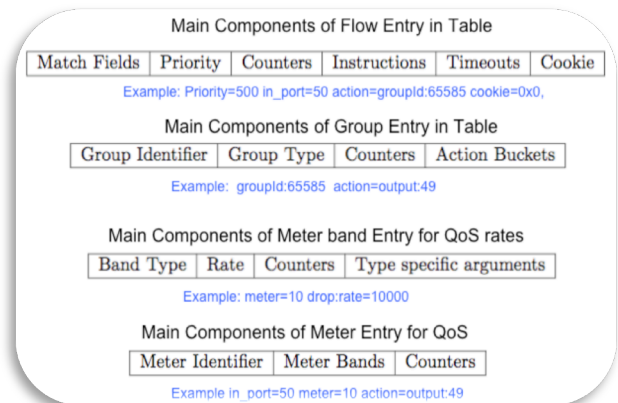
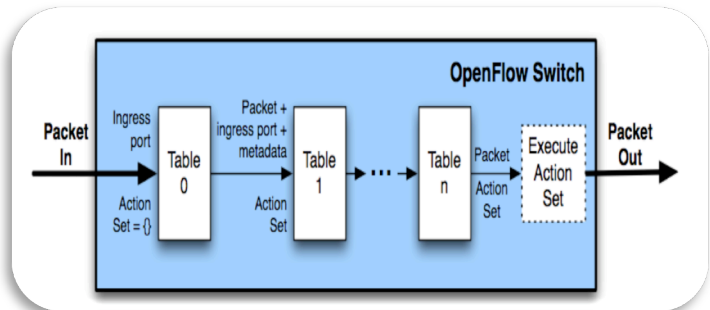


Following are the main components of OFDPA. For the latest specifications, refer to <http://archive.openflow.org/wp/documents/>.

1. **Controller:** to manage and push the flows
2. **OpenFlow protocol:** to exchange messages
3. **OpenFlow Channel:** interface that connects each OpenFlow switch to a controller
4. **Flow Table:** Table containing flow entries
5. **Flow Group:** Group of flows and their corresponding actions

Received packets can be matched against multiple tables before they egress out other ports. The following steps take place in every flow table:

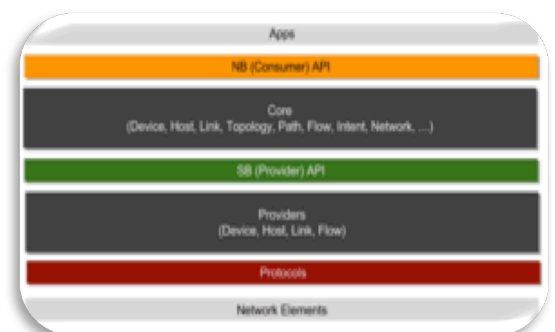
1. Find highest-priority matching for flow entry
2. Apply instructions such as:
 - i. Modify packet and update match fields (apply actions instruction)
 - ii. Update action set (clear actions and/or write actions instructions)
 - iii. Update metadata
3. Send match data and action set to next table



ONOS Controller

Open Network Operating System is an open-source control plane for SDN. At a high level, it consists of:

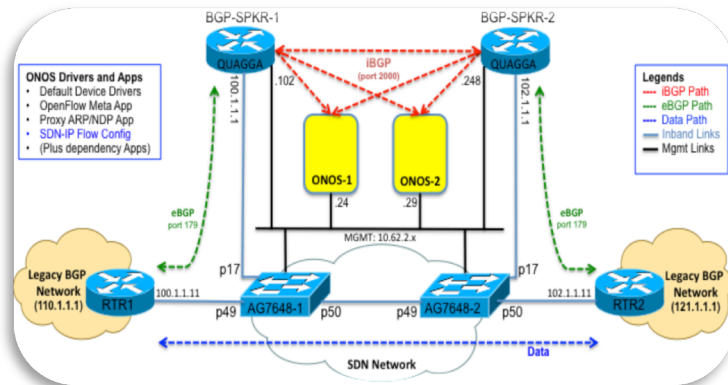
- OpenFlow protocol
- RESTAPI, NetConf, GUI, and CLI interface
- Apps to drive intents



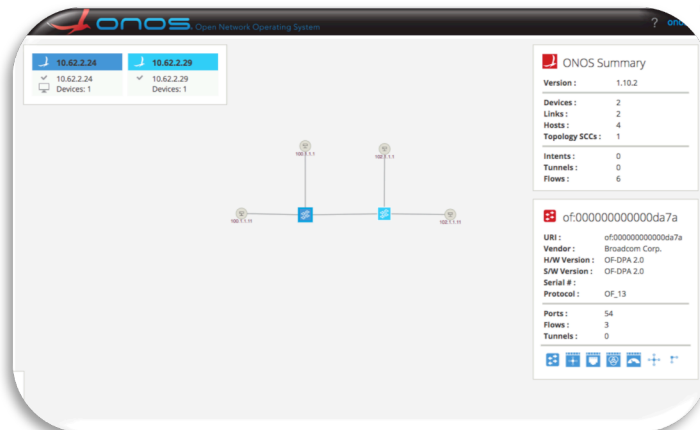
ONOS supports clustering for high-availability and load sharing

Validated Topology with Agema Systems Switches

In this setup, the SDN Network comprise with Agema Systems switches. The legacy BGP networks are simulated with BGP routers. Quagga instances are used as BGP speakers, although any router would work. Because ONOS Cluster talks to BGP speakers, it may be best to use



Quagga running on VM as low-cost reflector to ONOS. The following shows Agema Systems Switches on ONOS Controller UI.



For complete setup, configurations, and test results, refer to [SDN-IP-ONOS White-paper](#).