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5 – Page Project Proposal

Blending the Old and the New

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Executive Summary

Hybrid-SDN enabled switches are switches which perform both legacy switch packet forwarding and support software-defined networking (SDN) methodologies. Software-defined networking (SDN) is based on the concept of detaching the data plane and the control plane. Control plane in SDN is programmable and can handle multiple data planes making it the unit where all the intelligence of the network infrastructure resides [3].

The controller communicates with the SDN-enabled switch using OpenFlow protocol. This communication includes updating flow rules, information of neighboring nodes of the network, and application specific model actions - for example, an application such as load balancer can utilize the internal database for storing a high volume of queued packet requests instead of dropping or congesting the link. OpenFlow protocol in the SDN switch updates the flow tables to manipulate how traffic flows through the networking environment.

Use of hybrid SDN-enabled switches in the backbone architecture of the Comcast network in San Jose downtown will allow us to use the OpenFlow enable switches to gain maximum control over the network. Hybrid switches also give us the facility to write software applications such as Firewall, Load balancers etc which result in low hardware dependency. To manage our network, SDN architecture will contain event sources like intrusion detection system (IDS), network bandwidth monitoring including SNMP or NETCONF making the network manageability a prime factor [1]. And in order to make application development and remote control access to the switch with the controller, we can make use of open-source controllers like OpenDaylight, Floodlight, Ryu or POX [2].

The Proposed Bussiness Concept

The main aim of the project is to manage network topology, balance traffic and optimize the usage of the channel links in the Comcast San Jose downtown network by installing hybrid SDN-enabled switches instead of the legacy Cisco 2960-L 24 port switch in the backbone architecture that connects to the ISP gateway router.

The hybrid switch will allow us to configure 12 ports of the switch as legacy switch-ports and the other 12 ports as OpenFlow-enabled ports. Being OpenFlow-enabled ports don't mean those port are

limited only to carry OpenFlow messages; when we disable the OpenFlow ports, the switch acts like a legacy switch. This architecture allows us to take advantage of SDN features in the existing network infrastructure.

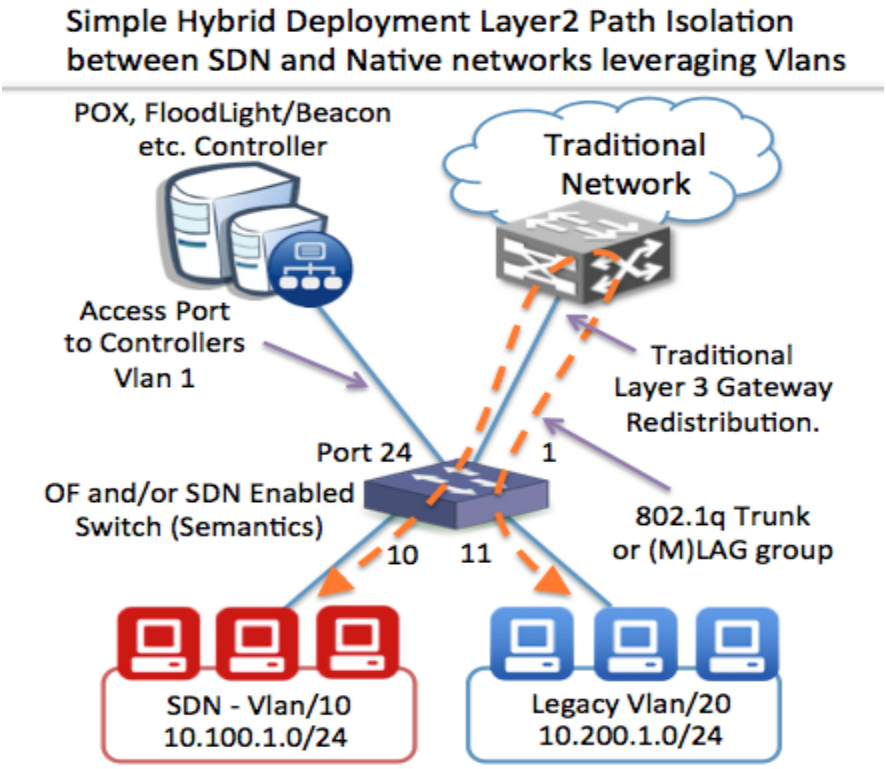

Figure 1 Proposed architecture block diagram

SDN features that shall enhance our productivity include:

1) Low hardware dependencies due to application software
   - Applications such as firewalls and load balancer can be written in the controller, which can block restricted site access and make use of SQL database to store excess packet request of giving priority. Requirement of separate hardware's is eliminated
2) Network management without using traditional protocol like SNMP
3) Orchestration, Programmable, Dynamic scaling, and Automation
4) Pushing rules on the switch will reduce complex multiplications and increase productivity of the switch

Research & Analysis

Software-defined network (SDN) came into existence 2 decades ago. With the introduction of SDN by Open Networking Foundation (ONF) and virtualization by VMware, networking giants such as Cisco, Arista, Nexus, Juniper etc, all started making SDN-enabled switches to utilize SDN features. SDN-enabled nodes are used in big data centers, WANs, enterprise Wifi, and as main backbone switch.

VMware spent $1.26 billion to buy a start-up company "Nicira" in July 2012 which was working on making SDN-enabled switches. International Data Corporation forecast SDN/NFV market will worth nearly $12.5 billion in 2020 with the annual growth rate of 53.9% [4].

SDN switches can be faster in discovering changes in the topology than the legacy switches. These changes can help manage network congestion and channel utilization of the network. SDN switch takes about 0.57 sec in establishing a connection for the first time and 0.40 ms to poll for network change, whereas legacy network management takes 0.87 sec on an average [5]. This study proves SDN switches to be better in discovering changes in the network.

Thus, as SDN technologies have served successfully in above-mentioned areas, placing an SDN-enabled switch in the backbone of the network will conquer the issue of network management, load balancing, and utilization of channel with ease.

State of the art summary:

This section includes the tools or architecture we are planning to build. In the survey, I found a few products which are available and used commercially in the industry to manage a network using SDN.

Junos space: It is a network management tool which is used to monitor and automate the configuration of the juniper network devices. Functions provided by the Junos space are:

- Device discovery
- Inventory management
- Configuration management

It is only for juniper devices and it uses SNMP and NETCONF for all configuration and management purposes.

Arista EOS CloudVision: It is a network management and monitoring tool for arista switches supporting EOS architecture. Functionalities of CloudVision are

- Provides centralized control to manage and provision switch configuration and scripts
- Creates custom scripts for managing switches
- Create switch configuration for Core, aggregate switches (different switch architecture in data center networks)

HP Network Node Manager i: HP provides network monitoring and management tool for managing network infrastructure. It utilizes SNMP information to gather device details for monitoring purposes. HP NNMi supports various environments such as Cisco, Avaya, Nortel, and Microsoft. We can make use of the HP NNMi in our SDN-enabled switch to gain network management access.

Finance and Economics:

The initial investment that would be required is setting up the hybrid SDN-enabled switch and HP NNMi packages, as it will be compatible with the Cisco environment present in the network. Legacy Cisco 2960-L 24g switch costs about $1100 whereas HP 2920-24g OpenFlow enabled switch costs about $800. Also, dedicating a computer which shall act as a controller that updates the flow rules in the SDN-enabled switch is required. SDN controllers are open source and cost nothing; but for the controller to access the switch, an extra set of Ethernet links (primary and secondary for redundancy) are required. Total estimated cost of installing proposed environment will be about $2000 (including OpenFlow switch, computer, and Ethernet links).

Management Team:

1) Network operations team can configure the nodes using regular command line configuration commands that manage the network on the 12 legacy switch-ports. This way, flow rules defined for managing traffic that is compatible with legacy devices won't be hindered.
2) The OpenFlow management team will be responsible for accruing any new flow rules, actions, and applications – if required – in the controller, updating the OpenFlow-enabled switch accordingly. Basic functioning of the SDN-controller which includes adding, deleting, updating

flows are to be known by this team. This team must also know how to disable OpenFlow to convert the switch into a legacy switch that can be handled by the network operations team.

Risks & Assumptions:

Risks included:

1. Failure of switch can cause network outage
2. Intelligence of the network lies in the controller if controller goes down/ reboots, switch loses its intelligence and cannot process routes for the packets that are not in the flow tables
3. High cost of network outage
4. Redundant person with SDN skills required when one's not available

Assumptions:

1. Controller will always be active
2. Legacy packets won't interfere with OpenFlow packets
3. Transition from OpenFlow to complete Legacy will result in zero outage of network

Conclusions:

Software-defined networking is on the rise due to the features it provides in managing a network. Also, as discussed above, statistics show an increase in the usage of OpenFlow-enabled switches that support SDN capabilities. Newer versions of OpenFlow protocol support newer functionalities in managing network architectures such as introduction to group table and multiple flow tables in OpenFlow1.0 and increased header capabilities as MPLS, VLAN capabilities in OpenFlow1.3. Using these features, we can connect to MPLS networks directly, manage the quality of service and secure links using VLANs enabling our company to reach new heights.

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