Assignment No:01

The Name of Assignment : Zodiac OpenFlow Switch.

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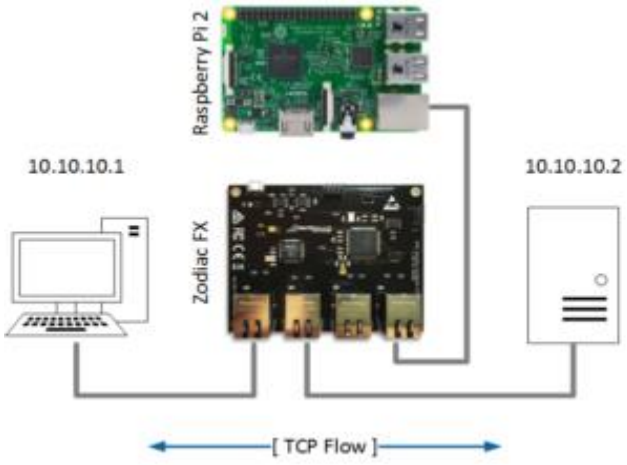
Theory:

Zodiac FX Switch:

Zodiac FX is the first OpenFlow switch designed to sit in a desk, not in a datacenter. Until now the power of Software Defined Networking (SDN) was only available to the administrators of large corporate networks. Even though there are numerous free or open source SDN controllers the one thing that was missing was a small, affordable OpenFlow switch. In this demo, we present Zodiac FX the world's smallest OpenFlow Software Defined Network Switch.

Zodiac FX Description: The Zodiac FX is a 4 port network development board designed for hobbyists, students, researchers, embedded developers or anyone who requires a low cost network development platform. Even though it was initially designed to allow affordable access to OpenFlow
enabled hardware it's open source firmware it can be used in any number of other applications. By providing the firmware source code users are free to not only create their own versions but also use it as a basis for a completely different type of device. Some such
applications may include: Router, Bridge, Load Balancer, Web server, VPN concentrator and many more.



IP addressing:

Static IP Addressing: With static IP addressing, addresses are assigned manually, and have to be provisioned carefully so that each device has its own address—with no overlap. When you connect a new device, you would have to select the "manual" configuration option and enter in the IP address, the subnet mask, the default gateway and the DNS server(s).

Dynamic Host Configuration Protocol (DHCP): DHCP takes all of the manual work out of IP addressing. Generally, the device that's at the "top" of your home network—whether it's a standalone firewall or a router/gateway device or your Control home controller—will provide DHCP by default as a service on the network. When DHCP is enabled, a new device connected to the network asks the DHCP server for an address, and the server assigns one from its pool of unused locations.

Mixing Configurations: It's entirely possible to mix static IP and DHCP addressing schemes. Since the default DHCP address range is between 100 and 149, you'll want to avoid all of the addresses between 192.168.1.100 and 192.168.1.149 when you're assigning static IP addresses. That leaves the ranges from 2-99 and from 150-254 wide open, which is usually plenty for most home networks.

Virtual Local Area Network (VLAN):

Virtual Local Area Networks or Virtual LANs (VLANs) are a logical group of computers that appear to be on the same LAN irrespective of the configuration of the underlying physical network. Network administrators partition the networks to match the functional requirements of the VLANs so that each VLAN comprise of a subset of ports on a single or multiple switches or bridges. This allows computers and devices in a VLAN to communicate in the simulated environment as if it is a separate LAN.

Question 5.1: Explain the difference between the Native and OpenFlow

ports? Answer: The difference is given below:

Native port: Any networking process or device uses a specific network port to transmit and receive data. This means that it listens for incoming packets whose destination port matches that port number, and/or transmits outgoing packets whose source port is set to that port number. Processes may use multiple network ports to receive and send data.

The port numbers that range from 0 to 1023 are known as well-known port numbers. Well- known port numbers are allotted to standard server processes, such as FTP and Telnet. They are referenced by system processes providing widely used types of network services. Specific port numbers are assigned and recorded by the Internet Assigned Numbers Authority (IANA).

However, in common practice, there is much unofficial use of both officially assigned numbers and unofficial numbers. Additionally, some network ports are in use for multiple applications and may be designated as either official or unofficial.

OpenFlow port: OpenFlow is an open standard for a communications protocol that enables the control plane to break off and interact with the forwarding plane of multiple devices from some central point, decoupling roles for higher functionality and programmability.
Application developers typically have no need to worry about underlying hardware when writing applications. The hardware has been abstracted by the operating system. Often times, even the Operating System itself has been abstracted from the hardware via hypervisors or containerization. This layer of abstraction is a relatively new concept in the networking industry, with OpenFlow as a freedom fighter creating an open interface for network abstraction layers.

This abstraction capability could be done with a controller layer. You can manipulate flow tables and flow entries on network devices without directly connecting to the network devices. The application developer can use an API to communicate to the controller, and the controller takes care of the details needed to update the network devices flow

tables. The beauty of SDN is in the Application layer. OpenFlow is one (of many) possible means to achieve the abstraction needed for SDN

Question 5.3: What is the difference between and OpenFlow and non-OpenFlow switch?

Answer: SDN networking relies heavily on the use of SDN switches. An SDN switch typically works without the cooperation of other parts of the network and is capable of independent functioning in the working environment. The second aspect of the difference between an SDN and non-SDN switch is the path, followed by the data packets. In the traditional system which operates under optical switching devices, data packets are forwarded and routed on a single device. In contrast, the OpenFlow operated SDN switch isolates the control and data paths from one another. A dedicated controller decides the routes to be taken by these data packets. OpenFlow protocol is used extensively for communication between the controller and the switch. Ease of use is another factor to be considered when differentiating an SDN switch vs. non-SDN switch. Under the old model, each switch was required to be configured individually in a command-line interface after logging in.

Now, with the new SDN switches powered by OpenFlow technology, the switches can be programmed by entering commands in the form of OpenFlow messages. This programming is achieved with the help of the SDN controller for all switches. To put it a bit differently, SDN controllers rely on OpenFlow technology which serves as the interface for programming switches.

Question 5.4: Provided others examples of commercial OpenFlow switches?

Answer: SDN Openflow applications

I have categorized the applications into the following categories:

1. TAP Monitoring fabric application
2. Security application
3. Network performance optimization and monitoring application
4. Data center fabric application

I will cover each of the categories below with examples.

TAP Monitoring fabric application

Span ports are critical for monitoring and and debug purposes in a data center. Typically, there are different groups within the same organization monitoring the same traffic and there are also different tools that the monitored traffic needs to be filtered and sent. The tools could be Wireshark, IDS etc. Previous monitoring solutions consisted of custom switches that did not give enough flexibility. Creating a monitoring fabric with Open flow switches gives maximum flexibility and also provides a scale-out design. Following are some examples:

Big switch's Big Tap monitoring fabric

- Filter layer contains different filtering mechanisms for filtering traffic.
- Service layer is used for packet modifications and the packets are handed here to Network packet brokers(NPB).
- Delivery layer hands over the filtered and serviced trafficto different tools that are interested in monitoring.
- Big Tap controller programs the monitoring fabric using Openflow.
- In Big switch solution, the monitoring fabric consists of bare metal switches that runs Big switch's Switch light OS. Switch light OS has the Openflow agent built in.

HP Network protector

HP Network protector is a SDN application on top of HP VAN SDN controller which programs the Openflow switches. Its mainly targeted for BYOD scenarios in Enterprises. Some of the important features of HP Network protector are:

- Creating custom white and black filter lists
- Monitoring suspicious DNS requests
- Malicious identity detection

Microsoft's DEMON

Microsoft uses DEMon(Distributed Ethernet monitoring) system to monitor their data center. This was implemented by Microsoft. Following is a block diagram of their system.

- Monitor ports are connected to filter switches that are programmed using Openflow.
- Filter switches send the sflow data which the delivery switches handover to the monitoring tools.
- The monitored data is used for different analytics applications

as well as for understanding anyanomalies.

Security application

Security is a big concern in Data centers and use of SDN technology gives the capability to dynamically adapt to new threats. Openflow is used both to get useful information from the L2/L3 switches as well as to redirect/drop the traffic in case a positive threat is identified. SDN controllers work closely with Ddos application platforms in most cases.
Following are some examples of SDN applications in this category. F5's Big

Ddos umbrella

Following is a block diagram of F5's Big Ddos umbrella application that works with HP VAN SDN controller.

F5's Big IP platform is a Ddos application that monitors different kinds of threats and once it confirms that the threat is real, it talks to HP'S VAN SDN controller so that the traffic can be filtered out in the edge which is closer to where the data enters the network.
HP VAN SDN controller programs the Open flow switches todrop the malicious traffic.

- This approach saves precious network bandwidth in the data center.

BlueCat DNS director

Following is a block diagram of BlueCat's Big DNS director application that works with HP VAN SDN controller.

- This application is targeted towards security threats caused by BYOD.
- DNS director programs Openflow switches in the network using HP VAN SDN controller to redirect requests for non-corporate DNS servers towards BlueCat's DNS server.
- BlueCat's DNS server sends back proper DNS response and the requestor will not even know that the DNS request was intercepted.

Radware has a joint solution with Mellanox where filtering of malicious traffic is done at the network adapter.

- Mellanox NIC adapters are Openflow enabled. Radware's

Defenseflow application monitors statistics on Mellanox adapaters for suspicious activity.

- When suspicious activity is detected, Defenseflow application installs Openflow rules in the Mellanox adapters to redirect traffic to DefensePro IDS.
- DefensePro IDS filters the traffic and sends it back to the destination.
- The advantage of monitoring at the adapter level is that the suspicious flow is detected as close as possible to the VM.

Conclusion: Zodiac FX, the world's smallest OpenFlow SDN switch allows Developers, Hobbyists and Students unprecedented access to affordable OpenFlow hardware for the very first time. Many people would love to experiment with SDN, particularly on their home network, but unfortunately the option has never been available due to the high cost of OpenFlow hardware. Northbound Networks is set to bring that power right to the desktop with the Zodiac FX, the world's most affordable OpenFlow SDN Switch and they have turned to Kickstarter to make it happen.