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Assignment No	:	01
Assignment Name	:	Zodiac OpenFlow Switch (Configure)
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Zodiac FX : The OpenFlow switch that is powerful enough to develop world changing SDN applications yet small enough to sit on our desk.The Zodiac FX provides many of the features of an OpenFlow switch costing thousands of dollars, yet is small enough to fit in the palm of your hand. Some of those amazing features include:

- 4 x 10/100 Fast Ethernet ports with integrated magnetics
- Command line interface accessible via USB virtual serial port
- Amtel ATSAM4E Cortex M4 processor
- Support for OpenFlow 1.0, 1.3 & 1.4
- 512 entry software flow table
- 64KB frame buffer with non-blocking store and forward
- 802.1q VLAN support for 64 groups from 4096 IDs
- Per port based 802.1x authentication
- 802.1w Rapid Spanning Tree Protocol (RSTP)
- 16 ACLs per port
- 2KB jumbo frame support
- QoS / CoS prioritisation with 802.1q tag insertion
- Auto MDIX with X-over detection
- Per port link and activity LEDs
- High speed SPI expansion header
- USB powered
- Ultra small size of only 10 cm x 8 cm

The Zodiac FX firmware utilises the Atmel Software Framework (ASF) for generic device drivers such as USB, SPI, etc. On top of this it then adds a custom written driver for the KSZ8795. FreeRTOS is used to provide task and memory management for the three core processes; Command (CLI), Switching and OpenFlow.

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. The server itself tracks which addresses are used and which addresses are available, and keeps a record of which addresses have been assigned to the various devices. This ensures that addresses don't

conflict with each other. However, it also means that, if a device goes offline, when it reconnects it may not have the same IP address it had before. 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. 2.2. Virtual Local Area Network (VLAN): A VLAN is a group of devices on one or more LANs that are configured to communicate as if they were attached to the same wire, when in fact they are located on a number of different LAN segments. There are two main reasons for the development of VLANs: 1. the amount of broadcast traffic 2. increased security Broadcast traffic increases in direct proportion to the number of stations in the LAN. The goal of the virtual LAN (VLAN) is the isolation of groups of users so that one group is not interrupted by the broadcast traffic of another. By segregating a group of devices to a particular VLAN, a switch will block broadcasts from devices in that VLAN to devices that are not in that VLAN instead of flooding it out every port. VLANs also have the benefit of added security by separating the network into distinct logical networks. Traffic in one VLAN is separated from another VLAN as if they were physically separate networks. If traffic is to pass from one VLAN to another, it must be routed. Each VLAN is identified by a VLAN ID (VID), which is usually a number. They can reside on only a single switch, or they can be distributed throughout the entire network on each switch. Each VLAN is a broadcast domain. Each device in a VLAN, regardless of its physical location, can communicate directly with every other device in the same VLAN. However, they cannot communicate outside of the VLAN except through a router. A VLAN is usually created using physical ports.

Zodiac FX Command Line Interface (Z-CLI): The Zodiac CLI provides the ability to configure setting and monitor the operation of the Zodiac FX. To simplify operations the CLI uses the concept of a context's, this limits the available commands to only those available in the currently selected context. There are currently four available contexts: Base, Config, OpenFlow Page | 45 SDN-Labs and Debug. To enter the required context simply type the name of the context on the command line while at the base level. The return to the base level type exit. The current context is shown in bracket between the device name and the prompt. The following sections describe the commands available within each context; please note that all commands are lower-case only.

1. Base Functionalities: The following commands are available in this context:
   - config Enter the config's context.
   - openflow Enter the OpenFlow's context.
   - debug Enter the debug's context.
   - show status Displays the current device status.
   - show ports Displays information about each Ethernet port including state, VLAN membership and traffic statistics.
   - show version Display the firmware version.

- help Display a list of available commands.

2. Config Functionalities: The following commands are available in this context:
   - save Saves the current configuration to non-volatile memory.
   - show config Display the current device configuration.
   - show vlans Displays a list of the currently configured VLANS.
   - set name < name > Sets the device name. Maximum of 16 characters, entries will be truncated.
   - set mac-address < mac address > Sets the MAC address of the device. The MAC address assigned to the device is located on a label on the underside of the device.
   - set ip-address < ip address > Sets the device IP address
   - set netmask < netmask > Set the device netmask
   - set gateway < ip address > Sets the default gateway of the device
   - set of-controller < ip address > Sets the IP address the OpenFlow controller
   - set of-port < tcp port > Sets the TCP port of the OpenFlow Controller
   - set of-version < version > Sets the device to only connect to an controller using the OpenFlow version specified. A value of 0 disables this function and allows the device to negotiate the version.
   - add vlan < vlan id > < vlan name > Creates a new vlan. Valid IDs are 1-4096 and names must be less than 16 characters.
   - delete vlan < vlan id > Deletes an existing vlan.
   - set vlan-type < vlan id > < type > Set the vlan to either openflow or native.
   - add vlan-port < vlan id > < port > Assigns a ethernet port to the designated vlan. A port can only be a member of one vlan.
   - delete vlan-port < port > Remove the named Ethernet port from a vlan.
   - factory reset Configures and saves the configuration back to the factory test configuration.
   - exit Return the context back the base level.

3. OpenFlow Functionalities: The following commands are available in this context:
   - show status Displays the OpenFlow status.
   - show flows Displays a list of the currently installed flows. Page | 46 SDN-Labs
   - enable Enables the OpenFlow functionality.
   - disable Disables the OpenFlow functionality.
   - clean flows Disabling OpenFlow will clear the flow tables and
   - exit Return the context back the base level.

4. Debug Functionalities: The following commands are available in this context:
   - read register Display the value of the KSZ8795 register.

- write register < value> Writes the value into the defined KSZ8795 register.
- exit Return the context back the base level.

Explain the difference between the Native and OpenFlow ports?

Ans :

"OpenFlow" Port: intended for general network traffic. Connect these ports to network hosts.

"Native" Port: intended for management traffic. Connect this port to the OpenFlow controller.

By default, ports 1-3 are set as OpenFlow ports. Port 4 is set to Native.

ports

	Port 1	Port 2	Port 3	Port 4
Status:	DOWN	DOWN	DOWN	UP
VLAN Type:	OpenFlow	OpenFlow	OpenFlow	Native
VLAN ID:	100	100	100	100

What is the difference between and OpenFLow and non-OpenFow switch?

Ans :

In a traditional switch device, packet forwarding and high-level routing are on the same device.

A OpenFlow/SDN switch, when it receives a packet, that it does not have a flow for (Match + exit port) will contact a SDN controller (Server) and ask what must it do with this packet. The controller can then download a flow to the switch, possibly including some packet manipulation. Once the flow is downloaded to the switch it will switch similar packets at wire-speed.

Having a central server that knows the network layout and can make all the switching decisions and build the paths gives us new capabilities.

1. The SDN controller could route non-critical/bulk traffic on longer routes that are not fully utilized.
2. The SDN controller could send the initial couple of packets to a firewall, and once the firewall is happy/accepts the flow, the SDN controller can bypass the firewall thus removing the load from it and allowing multi-gigabit data centers to be fire-walled.
3. The SDN controller can easily implement load-balancing also at high data rates by just directing different flows to different hosts, only doing the set-up of the initial flows.

4. Traffic can be isolated without the need for VLANs, the SDN controller can just refuse certain connections.
5. Setup a network TAP/Sniffer easily for any port or even specific traffic by programming the network to send a duplicate stream to a network monitoring device.
6. It allows for the development of new services and ideas all in software on the SDN controller.

Conclusion : Zodiac FX is the first OpenFlow switch designed to sit in a desk, not in a datacenter. Zodiac is a device . For this experiment, we have to need USB and Ethernet connection between PC and Zodiac FX.