

HUMBER COLLEGE INSTITUTE OF TECHNOLOGY AND ADVANCED LEARNING

FACULTY OF APPLIED SCIENCES AND TECHNOLOGY

FINAL EXAMINATION

<u>TERM</u>	<u>COURSE NAME</u>	<u>COURSE CODE</u>
Winter 2023	Software Defined Networks	CCGC5002

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DATE: April 10, 2023

TIME ALLOWED: 60 Minutes

TOTAL MARKS: 30

INSTRUCTION: **must upload the solution file in Blackboard within the deadline time: 1:35pm,** pdf format preferred. No late submission will be accepted after the Tests section Dropbox closes. Email me a copy of your final exam solution by the deadline – Muhammad.alam@humber.ca.

There are 11 questions in total.

1. What measure can a SDN controller take to prevent from DoS attacks? How can blockchain architecture be used for this purpose? [3 marks]

Answer: Measures such as authorized and authorisation, flow rule violation like following protocols, going through destined source and destination, limiting flow of traffic to prevent congestion, scalability of a network can be a part of them. Blockchain can assure the networked that is authorised with hash tokens for every nodes, in order to follow the chain instead of moving around defining source and destination as it is de centralised, network flow can be validate and verified. Consensus ensure malicious traffic prevention. Smart contracts can be used to automate security policies in order to secure the sdn network.

2. You want to start a Ryu controller with filename Network.py for a new client utilizing port 6674. Write the command to start the controller? [1 mark]

Answer: ryu-manager --ofp-tcp-listen-port 6674 ryu.app.Network.py

3. As a cloud service provider, you must automate to discover network resource topology frequently in parallel due to the scalability nature of the resource allocation. Write a python method to be added in a simple switch controller code for discovering and logging in the controller output the following info of the network:

Switches

Hosts

Links

Ports

[4 marks]

Answer:

Citation: lab 6 file-

```
from mininet.topo import Topo
from mininet.net import Mininet
from mininet.log import setLogLevel
from mininet.cli import CLI
from mininet.node import RemoteController
from time import sleep
from mininet.link import Intf
```

#change the COMPUTER IPs

CONTROLLER_IP = "192.168.122.1"

class SingleSwitchTopo(Topo):

"Single switch connected to n hosts."

def build(self):

s2 = self.addSwitch('s2', dpid="200")

#tenant1

a3 = self.addHost('a3', mac="00:00:00:00:00:03", ip="10.1.1.3/24")

a4 = self.addHost('a4', mac="00:00:00:00:00:04", ip="10.1.1.4/24")

#tenant2

b3 = self.addHost('b3', mac="00:00:00:00:10:03", ip="172.16.1.3/24")

b4 = self.addHost('b4', mac="00:00:00:00:10:04", ip="172.16.1.4/24")

#tenant3

c3 = self.addHost('c3', mac="00:00:00:00:20:03", ip="10.2.1.3/24")

c4 = self.addHost('c4', mac="00:00:00:00:20:04", ip="10.2.1.4/24")

self.addLink(a3, s2)

self.addLink(a4, s2)

self.addLink(b3, s2)

self.addLink(b4, s2)

self.addLink(c3, s2)

self.addLink(c4, s2)

if __name__ == '__main__':

setLogLevel('info')

topo = SingleSwitchTopo()

```
c1 = RemoteController('c1', ip=CONTROLLER_IP)
net = Mininet(topo=topo, controller=c1)
net.start()
sleep(5)
net.pingAll()
CLI(net)
net.stop()
```

4. CloudFormation in AWS is a popular tool to allow clients to select the necessary resources. How can the resource allocation be facilitated by a SDN controller such as OpenDaylight? [4 marks]

Answer:

Citation: <https://docs.opendaylight.org/en/stable-phosphorus/user-guide/opendaylight-controller-overview.html>

The controller exposes open northbound APIs which are used by applications. The OSGi framework and bidirectional REST are supported for the northbound APIs. The OSGi framework is used for applications that run in the same address space as the controller while the REST (web-based) API is used for applications that do not run in the same address space (or even the same system) as the controller.

The OpenDaylight controller starts with an OpenFlow 1.0 southbound plugin. Other OpenDaylight contributors begin adding to the controller code. These modules are linked dynamically into a Service Abstraction Layer (SAL).

The SAL exposes services to which the modules north of it are written. The SAL figures out how to fulfil the requested service irrespective of the underlying protocol used between the controller and the network devices.

To control the controller in its domain . it has to know what all necessary devices, capabilities, reachability. This information is stored in Topology manager.

5. Briefly explain FIB and PIT in Information Centric Networking model. [3 marks]

Answer:

Citation: <http://www.icn2020.org/information-centric-networking/>

Forwarding Information Base (FIB) is like a map that helps routers find the best way to deliver content in an Information Centric Networking (ICN) network. When someone requests a certain piece of content, the router looks at the FIB to see where the content is located and which router it needs to send the request to. Once the content is found, the router follows the FIB to send the content back to the person who requested it.

In Information Centric Networking (ICN), routers use a Forwarding Information Base (FIB) to route requests for named content objects. If a router doesn't have the requested content object, it creates an entry in its Pending Interest Table (PIT) to keep track of the request. The PIT entry includes the incoming interface and next-hop router to forward the request to. When the content object is found, the router checks its PIT to match it with the corresponding request and forward the content object back to the requester.

6. You are a cloud test engineer and implemented a load balancer to distribute traffic into multiple paths via the SDN switch 's1'. You have used the command 'sudo ovs-ofctl -O OpenFlow13 dump-group-stats s1' and the received the output:

'group_id=100, bucket0: packet_count=1000000, bucket1: packet_count=1000000, bucket2: packet_count=500000' during busy time.

The other fields such as duration, byte_count etc. are not included in the output for simplicity.

What can you infer from the output - How many paths are referred for traffic distribution? What about the load distribution in percentage? [3 marks]

Answer: We can see that there are 3 packet counts that implies three paths bucket 0,1,2. The load distribution percentage as follow upon packet count. During busy time, bucket 0,1 has 50% traffic flow each, and on bucket 2 has 25%

7. How can VxLAN facilitate multi tenancy in Cloud Computing and SD-WAN? [2 marks]

Answer:

VxLAN is a technology that allows multiple virtual networks to be created on a single physical network. This helps to simplify network management and allows multiple tenants to share the same physical network while keeping their own private virtual network. VxLAN also helps to extend network connectivity across different locations, which is useful in SD-WAN when multiple branch locations need to communicate with each other.

8. Layer 1 switch will flood all its ports. Write the necessary flow in XML format for an OpenDayLight controller for the following given information to flood all ports:

[2 marks]

Hard timeout – 10s

Idle timeout - 5s

Priority – 10

Flow name – flow2

Flow id - 2

ANSWER:

Citation: from lab 8 files

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<flow xmlns="urn:opendaylight:flow:inventory">
  <hard-timeout>10</hard-timeout>
  <idle-timeout>5</idle-timeout>
  <cookie>1</cookie>
  <priority>10</priority>
  <flow-name>flow2</flow-name>
  <match>
    <ethernet-match>
      <ethernet-source>
        <address>00:00:00:00:00:01</address>
      </ethernet-source>
      <ethernet-destination>
        <address>00:00:00:00:00:02</address>
      </ethernet-destination>
    </ethernet-match>
  </match>
  <id>2</id>
  <table_id>0</table_id>
  <instructions>
```

```

        <instruction>
          <order>0</order>
          <apply-actions>
            <action>
              <output-action>
                <output-node-connector>FLOOD</output-node-
connector>
                <max-length>60</max-length>
              </output-action>
            <order>0</order>
          </action>
        </apply-actions>
      </instruction>
    </instructions>
  </flow>

```

9. You are a network administrator but you are short of fund. You need to implement a few rules to your home network such as blocking some specific web sites or traffic. You know it is easy to implement with a SDN controller and a SDN switch. What can you do to address the situation? [2 marks]

Answer:

To block specific websites or traffic on your home network, you can use a free program called OpenDaylight with a special switch. This program helps you set up rules so certain things are blocked. It's easy to use and you can even run it on a small computer that doesn't cost a lot of money.

10. You are a cloud service provider and you have fixed physical hardware infrastructure and data transfer bandwidth. You are aware that you might be facing client complains due to recent increase of clients and slow service. You decided to identify and limit the traffic rate for low paying clients. One of the low paying client's switch id is 2, Server mac is 00:00:00:00:00:03 and the port the server connected to the switch is 3. Write the necessary flows in JSON format to block/drop more than 2 MBPS traffic destined to this client's server. [3 marks]

Answer:

```

{
  "priority": 100,
  "match": {
    "eth_type": 2048,
    "in_port": 3,
    "ipv4": "10.0.0.3"
  },
  "actions": [
    {
      "type": "meter",

```

```

        "meter_id": 1
    },
    {
        "type": "drop"
    }
]
},
{
    "priority": 200,
    "match": {
        "eth_type": 2048,
        "in_port": 3,
        "ipv4_dst": "10.0.0.3"
    },
    "meter": {
        "meter_id": 1,
        "bands": [
            {
                "type": "drop",
                "rate": 2000000,
                "burst_size": 10000
            }
        ]
    },
    "actions": [
        {
            "type": "output",
            "port": 1
        }
    ]
}
}

```

11. Write a simple function in solidity to add two integers and return the result. Initialize two variables inside the function with last two digits of your N number respectively. Deploy the function as smart contract using remix.ethereum.org. Once deployed, provide screenshot from remix site of the revoked function to display the result i.e., the addition of the last two digits of your N number. [3 marks]

Function:


```



contract AddLast2digitsN_number {
    function add() public view returns (uint) {
        uint num1 = 6; // last two digits of my N number are 67
        uint num2 = 7;
        uint sum = num1 + num2;
        return sum;
    }
}

```



```
}  
}  
0  
1 contract AddNumbers {  
2     function add() public view returns (uint256) {  
3         uint256 num1 = 6; // last two digits of my N number are 67  
4         uint256 num2 = 7;  
5         uint256 sum = num1 + num2;  
6         return sum;  
7     }  
8 }  
9  
0 }
```

ACCOUNT 

0x5B3...eddC4 (99.999999%)  

GAS LIMIT


3000000

VALUE

0

Wei 

CONTRACT (Compiled by Remix)

SolidityTest - contracts/3_Ballot.sol 



Deploy


☐ Publish to IPFS



OR

At Address

Load contract from Address

Transactions recorded 5  


Deployed Contracts 

▼ SOLIDITYTEST AT 0X7EF...8CB47  

Balance: 0 ETH

getResult

0: uint256: 3

Low level interactions 

CALLDATA

Transact

