FIT9137 Workshop Week 9

Topics

- Network Layer:
  - Routing
  - Static Routing
  - Dynamic Routing
- Transport Layer
  - Reliable Communication

Covered Learning Outcomes:

- Analyse and formulate the functions of communication architectures of local area networks, wide area networks and the Internet.
- Examine networks using the underlying fundamental theories, models, and protocols for data transmission.

Instructions

- One of the main purposes of an applied session is to build the learning community, create connections and include the learners. The other goal is to give and receive feedback from your peers and or your tutors.
- Form groups of 2 students (peers) to work through the exercises. If met a problem, try to solve it by asking direct questions to your peer. If the issue was not solved within peers, ask your tutor. If did not get a chance to solve the problem during your applied session with your peer or tutor, jump into one of many consultation hours and ask any of the tutors to help you. Please visit the "Teaching Team and Unit Resources" tile in the FIT9137 Moodle site.

ACTIVITY A: Network Routing

Activity A.1 Static Routing

Download the file `FIT9137_w9.imn` from Moodle and save it in the shared folder on the host machine (your laptop or PC). Open core and from the file menu open the downloaded core configuration from the shared folder in the VM (under `/media/sf_YOUR_SHARED_FOLDER_NAME`). Perform the following tasks.

1. Run the emulation and open a terminal on the node `clio` and ping the two interfaces of the node `zeus`. Do you receive replies? Explain why by inspecting the routing table of both nodes (`ip route` command, `man ip-route` for more information).

2. From the node `clio` ping the `eth0` interface of the node `hera`.
   a) Do you receive replies? Explain why or why not.
   b) Open a terminal on the node `hera` and run the following command:

```
tcpdump -l -i eth0
```

The `tcpdump` is a command line packet capture tool (`man tcpdump` for more information). With the above options it starts capturing packets on `eth0` interface and print a summary on the screen (standard output `stdout`)

Try the ping command from `clio` and observe whether `hera` receives the ping requests.

c) If you did not receive replies in previous step then find out how to resolve the issue. Apply your fix and try the ping from `clio` again.
d) From `clio` ping the node `calliope`. Do you receive replies?
e) If you did not receive replies in previous step then find out how to resolve the issue. Explain why your fix resolves the issue.
f) Stop the emulation.

Note: Any changes you make while the emulation is running will be lost when you stop the emulation. To test this run the emulation again and try the steps and observe that none of the changes we made via command line on the nodes persisted. To make the changes persistent we need to use the core GUI and edit proper script/configuration files.

g) Place the necessary changes to the StaticRoute scripts of the identified nodes in previous steps so that `clio` can ping `calliope`. Save the configuration.

Note: If you make changes to a core configuration file and then close the window without saving the changes, you will not be warned, and the changes will be lost. If you have made changes that you want to keep, make sure to save the file before closing the core GUI window.

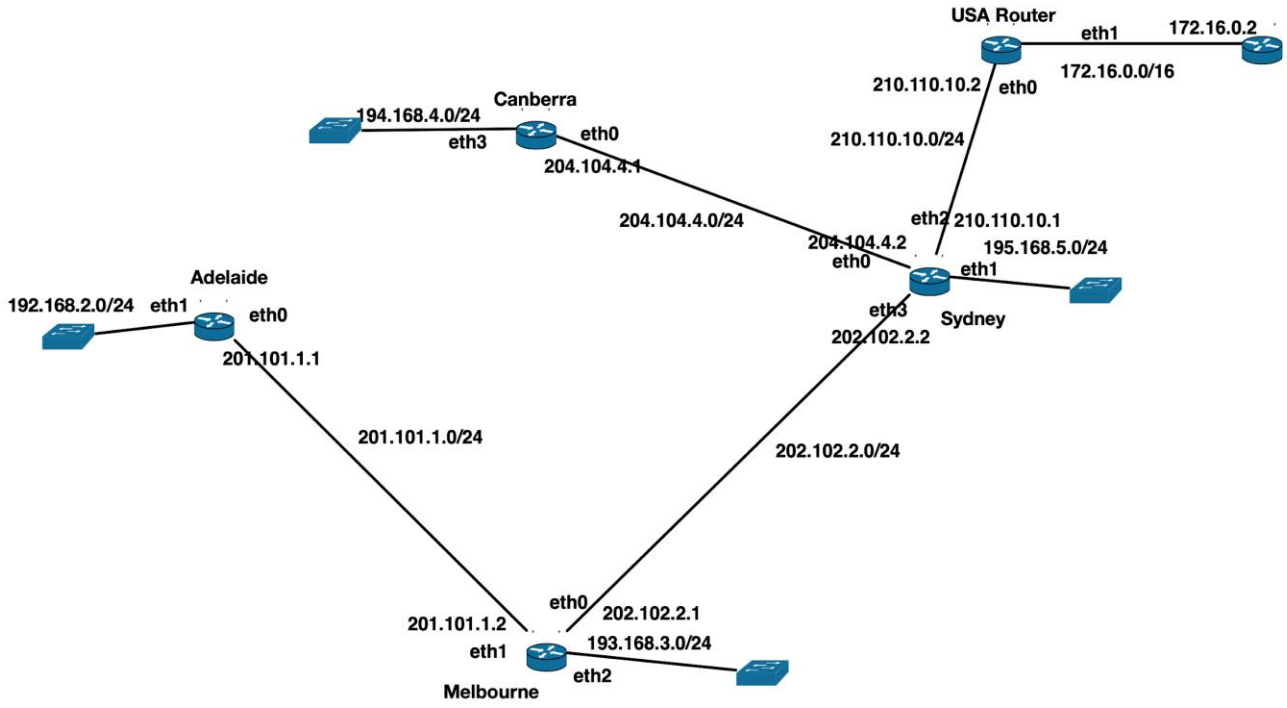
DYNAMIC ROUTING: Additional Tasks (Take home Exercise):

a) Now save the original file `FIT9137_w9.imn as` **`FIT9137_w9_Dynamic_routing_RIP.imn`** `and test the dynamic RIP routing.`
b) Now again save the original file `FIT9137_w9.imn as` **`FIT9137_w9_Dynamic_routing_OSPF.imn`** `and test the dynamic OSPF routing.`

Activity A.2 Routing Table Analysis

From the captured routing tables (as shown in the Appendix I) of five routers: Adelaide, Melbourne, Sydney, Canberra, and USA. We have constructed the network topology diagram showing the following details:

a) The linking of the routers
b) The interfaces on each router
c) all point-to-point links between routers and links to LANs and
d) all network addresses



Network topology diagram

Answer the following questions:

a) Which routers use RIP?
b) Which routers use static routes?
c) Which routers use only static routes?
d) Which router is the gateway to the Internet?
e) Which routers learnt their gateway via RIP?
f) Which routers use a static route to point to the gateway?
g) Which networks are learnt via RIP on each Router?
h) What do [120/1] and [1/0] mean? [Hint: https://en.wikipedia.org/wiki/Administrative_distance]
i) What do the times e.g., `00:01:09` mean in Melbourne Router? [hint: https://en.wikipedia.org/wiki/Routing_Information_Protocol#Timers]
j) Which routers have LANs?

Appendix I

Codes: `C` connected, `S` static, `R` RIP

The network address `0.0.0.0/0` stands for the default gateway.

Adelaide Router

```
S>* 0.0.0.0/0 [1/0] via 201.101.1.2, eth0
C>* 192.168.2.0/24 is directly connected, eth1
S>* 193.168.3.0/24 [1/0] via 201.101.1.2, eth0
S>* 194.168.4.0/24 [1/0] via 201.101.1.2, eth0
S>* 195.168.5.0/24 [1/0] via 201.101.1.2, eth0
C>* 201.101.1.0/24 is directly connected, eth0
```

Melbourne Router

```
R>* 0.0.0.0/0 [120/3] via 202.102.2.2, eth0, 00:01:09
R>* 172.16.0.0/16 [120/3] via 202.102.2.2, eth0, 00:01:09
S>* 192.168.2.0/24 [1/0] via 201.101.1.1, eth1
C>* 193.168.3.0/24 is directly connected, eth2
R>* 194.168.4.0/24 [120/3] via 202.102.2.2, eth0, 00:01:11
R>* 195.168.5.0/24 [120/2] via 202.102.2.2, eth0, 00:01:11
C>* 201.101.1.0/24 is directly connected, eth1
C>* 202.102.2.0/24 is directly connected, eth0
R>* 204.104.4.0/24 [120/2] via 202.102.2.2, eth0, 00:01:11
R>* 210.110.10.0/24 [120/2] via 202.102.2.2, eth0, 00:01:11
```

Sydney Router

```
R>* 0.0.0.0/0 [120/2] via 210.110.10.2, eth2, 00:02:02
R>* 172.16.0.0/16 [120/2] via 210.110.10.2, eth2, 00:02:02
S>* 192.168.2.0/24 [1/0] via 202.102.2.1, eth3
R>* 193.168.3.0/24 [120/2] via 202.102.2.1, eth3, 00:02:02
R>* 194.168.4.0/24 [120/2] via 204.104.4.1, eth0, 00:02:03
C>* 195.168.5.0/24 is directly connected, eth1
R>* 201.101.1.0/24 [120/2] via 202.102.2.1, eth3, 00:02:02
C>* 202.102.2.0/24 is directly connected, eth3
C>* 204.104.4.0/24 is directly connected, eth0
C>* 210.110.10.0/24 is directly connected, eth2
```

Canberra Router

```
R>* 0.0.0.0/0 [120/3] via 204.104.4.2, eth0, 00:01:38
R>* 172.16.0.0/16 [120/3] via 204.104.4.2, eth0, 00:01:38
R>* 192.168.2.0/24 [120/2] via 204.104.4.2, eth0, 00:01:39
R>* 193.168.3.0/24 [120/3] via 204.104.4.2, eth0, 00:01:39
C>* 194.168.4.0/24 is directly connected, eth3
R>* 195.168.5.0/24 [120/2] via 204.104.4.2, eth0, 00:01:39
R>* 201.101.1.0/24 [120/3] via 204.104.4.2, eth0, 00:01:39
R>* 202.102.2.0/24 [120/2] via 204.104.4.2, eth0, 00:01:39
C>* 204.104.4.0/24 is directly connected, eth0
R>* 210.110.10.0/24 [120/2] via 204.104.4.2, eth0, 00:01:39
```

USA Router

```
S>* 0.0.0.0/0 [1/0] via 172.16.0.2, eth1
C>* 172.16.0.0/16 is directly connected, eth1
R>* 192.168.2.0/24 [120/2] via 210.110.10.1, eth0, 00:00:15
R>* 193.168.3.0/24 [120/3] via 210.110.10.1, eth0, 00:00:14
R>* 194.168.4.0/24 [120/3] via 210.110.10.1, eth0, 00:00:15
R>* 195.168.5.0/24 [120/2] via 210.110.10.1, eth0, 00:00:15
R>* 201.101.1.0/24 [120/3] via 210.110.10.1, eth0, 00:00:14
R>* 202.102.2.0/24 [120/2] via 210.110.10.1, eth0, 00:00:15
R>* 204.104.4.0/24 [120/2] via 210.110.10.1, eth0, 00:00:15
C>* 210.110.10.0/24 is directly connected, eth0
```

ACTIVITY B: Transport Layer

Activity B.1: TCP Protocol: Reliable Communication

Open Wireshark in the VM and start capturing traffic on `enp0s3` interface. Open Firefox and clear the history and cache then visit the page http://shell.cas.usf.edu/mccook/uwy/hyperlinks.html Stop the capture and answer the following questions.

a) Find the `GET` request for the page `HTTP GET` message (`GET /mccook/uwy/hyperlinks.html HTTP/1.1`). and select the packet in the top pane. Is this the beginning of the communication between the client (VM) and the (Web server)? If no find out the first datagram sent from the client to the server to start the communication.

Hint: There are few ways to do this if there are too many captured packets.

- One way is to right click on the selected packet and choose follow TCP stream. This will open a new window showing the communicated content between the client and server. You can close this window. You should now see a filter added in the **Display Filter** bar as `tcp.stream eq x` (the last number may be different for you as it depends on the number of TCP connections at the time of capture).
- Another way is to put a display filter using the `ip.addr eq 131.247.250.66` to limit the traffic between the client and Monash web server. This also allows looking at the transmitted picture from the server.

b) For each of the datagrams from the TCP `SYN` request to `HTTP/1.1 200 OK` observe the values of `Sequence number` and `Acknowledgement number`. What values are highlighted in the raw section (third window pane) when you select the mentioned fields in the middle section? Explain why Wireshark shows `(relative sequence number)` and `(relative ack number)`.

c) Identify the `GET` request for image002.gif the picture to HTTP/1.1 200 OK. How many TCP segments are used to transfer the gif file? How TCP is able to put the picture back together? What is the size of the picture?

Note: Each segment also between the request and the HTTP status shows the frame number of the reassembled PDU in the middle section.

d) Explain how the TCP connection is closed down?