EL5373 INTERNET ARCHITECTURE AND PROTOCOLS

Lening Wang

N12100909

lw1577@nyu.edu

Workstation: Juliet

Mac: f8:0f:41:c3:85:a4

Lab Report 7

November 21st, 2014

Exercise1

Lab Report:

Submit the routing table you saved.

ANS:

```
guest@juliet:~$ netstat -rn
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
0.0.0.0         172.27.222.1    0.0.0.0         UG        0 0          0 wlan0
128.238.66.0    0.0.0.0         255.255.255.0   U         0 0          0 eth0
169.254.0.0     0.0.0.0         255.255.0.0     U         0 0          0 eth0
172.27.222.0    0.0.0.0         255.255.254.0   U         0 0          0 wlan0
guest@juliet:~$ route add -net 224.0.0.0 netmask 240.0.0.0 dev eth0
SIOCADDRT: Operation not permitted
guest@juliet:~$ sudo route add -net 224.0.0.0 netmask 240.0.0.0 dev eth0
[sudo] password for guest:
guest@juliet:~$ netstat -rn
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
0.0.0.0         172.27.222.1    0.0.0.0         UG        0 0          0 wlan0
128.238.66.0    0.0.0.0         255.255.255.0   U         0 0          0 eth0
169.254.0.0     0.0.0.0         255.255.0.0     U         0 0          0 eth0
172.27.222.0    0.0.0.0         255.255.254.0   U         0 0          0 wlan0
224.0.0.0       0.0.0.0         240.0.0.0       U         0 0          0 eth0
guest@juliet:~$
```

Exercise2

Lab Report

How many multicast groups did the interface belong to? What were the groups? Explain the meaning of the group IDs.

ANS:

```
guest@juliet:~$ netstat -g -n --inet
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
IPv6/IPv4 Group Memberships
Interface       RefCnt Group
--------------- ------ ---------------------
lo              1      224.0.0.1
eth0            1      224.0.0.251
eth0            1      224.0.0.1
wlan0           1      224.0.0.251
wlan0           1      224.0.0.1
guest@juliet:~$
```

There are 2 multicast groups that the interfaces belong to. The groups are 224.0.0.1 and 224.0.0.251. 224.0.0.1 is the multicast address for all systems in this subnet. 224.0.0.251 is the multicast address for the mDNS (multicast Domain Name System). The group ID is the multicast address for the group.

Exercise3&4

Lab Report

1) Which hosts replied when the multicast address was pinged? Which hosts replied when the broadcast address was pinged? In each case, was there a reply from your host?

2) Examine the captured packets in both cases, especially how a multicast group address is mapped to a multicast MAC address. For the two cases, do the ICMP echo packets have the same destination MAC addresses? Why?

ANS:

1)

23 8.486051	128.238.66.101	224.0.0.1	ICMP	98 Echo (ping) request	id=0x249d, seq=3/768, ttl=1 (no respons
24 8.486648	128.238.66.102	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x249d, seq=3/768, ttl=64
25 8.486688	128.238.66.107	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x249d, seq=3/768, ttl=64
26 8.486695	128.238.66.106	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x249d, seq=3/768, ttl=64
27 8.486699	128.238.66.103	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x249d, seq=3/768, ttl=64
28 8.486703	128.238.66.100	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x249d, seq=3/768, ttl=64
29 8.486709	128.238.66.104	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x249d, seq=3/768, ttl=64
30 8.486716	128.238.66.105	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x249d, seq=3/768, ttl=64
31 9.485428	128.238.66.101	224.0.0.1	ICMP	98 Echo (ping) request	id=0x249d, seq=4/1024, ttl=1 (no respor
32 9.486082	128.238.66.103	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x249d, seq=4/1024, ttl=64
33 9.486121	128.238.66.106	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x249d, seq=4/1024, ttl=64
34 9.486128	128.238.66.105	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x249d, seq=4/1024, ttl=64
35 9.486132	128.238.66.107	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x249d, seq=4/1024, ttl=64
36 9.486137	128.238.66.100	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x249d, seq=4/1024, ttl=64
37 9.486143	128.238.66.102	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x249d, seq=4/1024, ttl=64
38 9.486150	128.238.66.104	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x249d, seq=4/1024, ttl=64

When the multicast address was pinged, all of the hosts in the group replied. All the hosts are in multicast group 224.0.0.1.

63 23.357690	128.238.66.101	128.238.66.255	ICMP	98 Echo (ping) request	id=0x24a0, seq=9/2304, ttl=64 (no respo
64 23.358272	128.238.66.104	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x24a0, seq=9/2304, ttl=64
65 23.358302	128.238.66.102	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x24a0, seq=9/2304, ttl=64
66 23.358306	128.238.66.105	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x24a0, seq=9/2304, ttl=64
67 23.358312	128.238.66.100	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x24a0, seq=9/2304, ttl=64
68 23.358316	128.238.66.103	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x24a0, seq=9/2304, ttl=64
69 24.357691	128.238.66.101	128.238.66.255	ICMP	98 Echo (ping) request	id=0x24a0, seq=10/2560, ttl=64 (no resp
70 24.358316	128.238.66.100	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x24a0, seq=10/2560, ttl=64
71 24.358346	128.238.66.105	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x24a0, seq=10/2560, ttl=64
72 24.358351	128.238.66.103	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x24a0, seq=10/2560, ttl=64
73 24.358356	128.238.66.102	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x24a0, seq=10/2560, ttl=64
74 24.358359	128.238.66.104	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x24a0, seq=10/2560, ttl=64
75 25.357690	128.238.66.101	128.238.66.255	ICMP	98 Echo (ping) request	id=0x24a0, seq=11/2816, ttl=64 (no resp
76 25.358301	128.238.66.104	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x24a0, seq=11/2816, ttl=64
77 25.358332	128.238.66.103	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x24a0, seq=11/2816, ttl=64
78 25.358336	128.238.66.105	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x24a0, seq=11/2816, ttl=64
79 25.358341	128.238.66.100	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x24a0, seq=11/2816, ttl=64
80 25.358345	128.238.66.102	128.238.66.101	ICMP	98 Echo (ping) reply	id=0x24a0, seq=11/2816, ttl=64

When the broadcast address was pinged, all of the hosts in the group replied too. There is also a reply from my own host.

2)

1 0.000000	128.238.66.101	230.11.111.10	ICMP	98 Echo (ping) request	id=0x24a3, seq=1/256, ttl=1 (no response f
2 0.999514	128.238.66.101	230.11.111.10	ICMP	98 Echo (ping) request	id=0x24a3, seq=2/512, ttl=1 (no response f
3 1.999515	128.238.66.101	230.11.111.10	ICMP	98 Echo (ping) request	id=0x24a3, seq=3/768, ttl=1 (no response f
4 3.629722	128.238.66.100	224.0.0.1	ICMP	98 Echo (ping) request	id=0x27b9, seq=1/256, ttl=1 (no response f
5 4.631310	128.238.66.100	224.0.0.1	ICMP	98 Echo (ping) request	id=0x27b9, seq=2/512, ttl=1 (no response f
6 5.630322	128.238.66.100	224.0.0.1	ICMP	98 Echo (ping) request	id=0x27b9, seq=3/768, ttl=1 (no response f
7 6.630186	128.238.66.100	224.0.0.1	ICMP	98 Echo (ping) request	id=0x27b9, seq=4/1024, ttl=1 (no response
8 7.630161	128.238.66.100	224.0.0.1	ICMP	98 Echo (ping) request	id=0x27b9, seq=5/1280, ttl=1 (no response
9 8.630226	128.238.66.100	224.0.0.1	ICMP	98 Echo (ping) request	id=0x27b9, seq=6/1536, ttl=1 (no response
10 9.630149	128.238.66.100	224.0.0.1	ICMP	98 Echo (ping) request	id=0x27b9, seq=7/1792, ttl=1 (no response
11 10.630228	128.238.66.100	224.0.0.1	ICMP	98 Echo (ping) request	id=0x27b9, seq=8/2048, ttl=1 (no response
12 11.630181	128.238.66.100	224.0.0.1	ICMP	98 Echo (ping) request	id=0x27b9, seq=9/2304, ttl=1 (no response
13 12.630120	128.238.66.100	224.0.0.1	ICMP	98 Echo (ping) request	id=0x27b9, seq=10/2560, ttl=1 (no response

1 0.000000	128.238.66.105	230.11.111.10	ICMP	98 Echo (ping) request	id=0x1195, seq=2/512, ttl=1 (no response f
2 1.000059	128.238.66.105	230.11.111.10	ICMP	98 Echo (ping) request	id=0x1195, seq=3/768, ttl=1 (no response f
3 6.977681	128.238.66.106	224.0.0.1	ICMP	98 Echo (ping) request	id=0x1f22, seq=1/256, ttl=1 (no response f
4 7.977614	128.238.66.106	224.0.0.1	ICMP	98 Echo (ping) request	id=0x1f22, seq=2/512, ttl=1 (no response f
5 8.977694	128.238.66.106	224.0.0.1	ICMP	98 Echo (ping) request	id=0x1f22, seq=3/768, ttl=1 (no response f
6 9.977635	128.238.66.106	224.0.0.1	ICMP	98 Echo (ping) request	id=0x1f22, seq=4/1024, ttl=1 (no response
7 10.977663	128.238.66.106	224.0.0.1	ICMP	98 Echo (ping) request	id=0x1f22, seq=5/1280, ttl=1 (no response
8 11.977649	128.238.66.106	224.0.0.1	ICMP	98 Echo (ping) request	id=0x1f22, seq=6/1536, ttl=1 (no response
9 12.438446	128.238.66.101	232.139.111.10	ICMP	98 Echo (ping) request	id=0x24a6, seq=1/256, ttl=1 (no response f
10 12.977678	128.238.66.106	224.0.0.1	ICMP	98 Echo (ping) request	id=0x1f22, seq=7/1792, ttl=1 (no response
11 13.437615	128.238.66.101	232.139.111.10	ICMP	98 Echo (ping) request	id=0x24a6, seq=2/512, ttl=1 (no response f
12 13.977660	128.238.66.106	224.0.0.1	ICMP	98 Echo (ping) request	id=0x1f22, seq=8/2048, ttl=1 (no response
13 14.437619	128.238.66.101	232.139.111.10	ICMP	98 Echo (ping) request	id=0x24a6, seq=3/768, ttl=1 (no response f
14 14.977658	128.238.66.106	224.0.0.1	ICMP	98 Echo (ping) request	id=0x1f22, seq=9/2304, ttl=1 (no response
15 19.210774	128.238.66.104	128.238.66.255	ICMP	98 Echo (ping) request	id=0x1289, seq=1/256, ttl=64 (no response

When mapping a multicast IP address to a multicast MAC address, only the last 23 bits of the IP address is used into the MAC address. The first 24 bits of Ethernet address is fixed '01:00:5e'.

From *file 3c:*

```
▽ Ethernet II, Src: WistronI_c3:85:a4 (f8:0f:41:c3:85:a4), Dst: IPv4mcast_0b:6f:0a (01:00:5e:0b:6f:0a)
  ▷ Destination: IPv4mcast_0b:6f:0a (01:00:5e:0b:6f:0a)
```

From *file 3d:*

```
▽ Ethernet II, Src: WistronI_c4:83:c2 (f8:0f:41:c4:83:c2), Dst: IPv4mcast_0b:6f:0a (01:00:5e:0b:6f:0a)
  ▷ Destination: IPv4mcast_0b:6f:0a (01:00:5e:0b:6f:0a)
```

Yes, for the two cases, the ICMP echo packets have the same destination MAC address. Because only the last 23 bits of the IP address are mapped into the multicast address. There are still 5 bits in the IP address not participates in the mapping. In that way, 2^5=32 class D IP address will map to the same multicast Ethernet address. The two IP addresses are in this case.

Exercise7&8

Lab Report

1) Open the capture file with Wireshark and study the IGMP and PIM packets. How many different (in terms of source and destination) IGMP and PIM packets can you see? What are their purposes? Also, check whether or not the video stream reaches the subnet that you are in. Is the video flow forwarded by Router 4? Why?

2) What could be the reason for the malfunctioning of the PIM multicast routing protocol?

ANS:

1)

```
guest@juliet: ~
router1#show ip igmp interface
FastEthernet0/0 is up, line protocol is up
  Internet address is 128.238.61.1/24
  IGMP is enabled on interface
  Current IGMP version is 2
  CGMP is disabled on interface
  IGMP query interval is 60 seconds
  IGMP querier timeout is 120 seconds
  IGMP max query response time is 10 seconds
  Last member query response interval is 1000 ms
  Inbound IGMP access group is not set
  IGMP activity: 2 joins, 1 leaves
  Multicast routing is enabled on interface
  Multicast TTL threshold is 0
  Multicast designated router (DR) is 128.238.61.1 (this system)
  IGMP querying router is 128.238.61.1 (this system)
  Multicast groups joined (number of users):
      224.0.1.40(1)
FastEthernet0/1 is up, line protocol is up
  Internet address is 128.238.62.1/24
  IGMP is enabled on interface
  Current IGMP version is 2
  CGMP is disabled on interface
  IGMP query interval is 60 seconds
  IGMP querier timeout is 120 seconds
  IGMP max query response time is 10 seconds
  Last member query response interval is 1000 ms
  Inbound IGMP access group is not set
  IGMP activity: 0 joins, 0 leaves
  Multicast routing is enabled on interface
  Multicast TTL threshold is 0
  Multicast designated router (DR) is 128.238.62.2
  IGMP querying router is 128.238.62.1 (this system)
  No multicast groups joined
```

```
0 packets dropped by kernel
guest@juliet:~$ sudo tcpdump igmp or pim -c 12 -w lwlab7exe4b.out
tcpdump: listening on eth0, link-type EN10MB (Ethernet), capture size 65535 byte
s
12 packets captured
13 packets received by filter
0 packets dropped by kernel
guest@juliet:~$ telnet 128.238.61.1
Trying 128.238.61.1...
Connected to 128.238.61.1.
Escape character is '^]'.


User Access Verification

Password:
router1>enable
Password:
router1#show ip igmp group
IGMP Connected Group Membership
Group Address    Interface            Uptime    Expires   Last Reporter
230.230.230.230  FastEthernet0/1      00:19:40  00:02:49  128.238.62.103
224.0.1.40       FastEthernet0/0      01:16:09  never     128.238.61.1
router1#
```

1	0.000000	128.238.61.1	224.0.1.40	IGMPv2	60 Membership Report group 224.0.1.40
3	54.021164	128.238.61.1	224.0.0.1	IGMPv2	60 Membership Query, general
5	57.021218	128.238.61.1	224.0.1.40	IGMPv2	60 Membership Report group 224.0.1.40
6	62.682024	128.238.61.101	224.0.0.251	IGMPv2	46 Membership Report group 224.0.0.251
8	114.042059	128.238.61.1	224.0.0.1	IGMPv2	60 Membership Query, general
10	117.682024	128.238.61.101	224.0.0.251	IGMPv2	46 Membership Report group 224.0.0.251
11	122.042258	128.238.61.1	224.0.1.40	IGMPv2	60 Membership Report group 224.0.1.40
2	26.020493	128.238.61.1	224.0.0.13	PIMv2	60 Hello
4	56.020727	128.238.61.1	224.0.0.13	PIMv2	60 Hello
7	86.041170	128.238.61.1	224.0.0.13	PIMv2	60 Hello
9	116.041636	128.238.61.1	224.0.0.13	PIMv2	60 Hello
12	146.062109	128.238.61.1	224.0.0.13	PIMv2	60 Hello

There are 3 different IGMP packets in the tcpdump output.

(a) 128.238.61.1 to 224.0.1.40: router 1 sent membership report to clarify it joined group 224.0.1.40.

(b) 128.238.61.1 to 224.0.0.1: router 1 sent membership query messages to all the hosts in the subnet.

(c) 128.238.62.101 to 224.0.0.251: host Juliet sent membership report to clarify it joined group 224.0.0.251.

The video stream did not reach my subnet (128.238.61.1).

Router 4 did not forward the video flow, because the TTL field was set to be 1, which means the video stream packets will be forward only one hop from the source.

2) When TTL field was set 5, the video flow still did not reach my subnet, because we did not enable the RIP for routers. So the data packets would not be forward from router 2 to router 3.

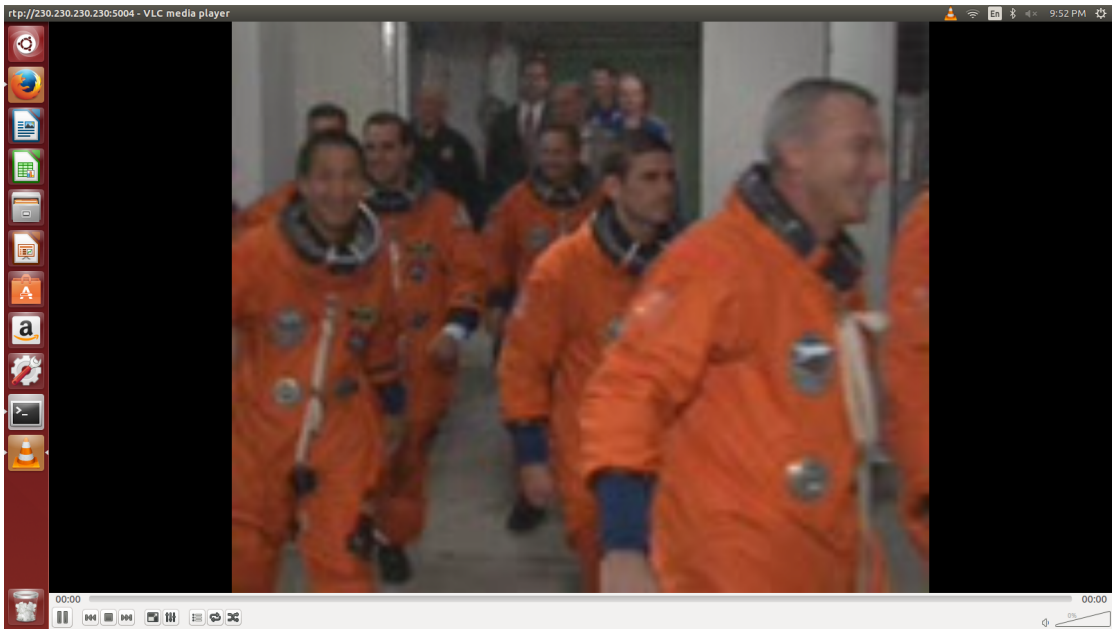
Exercise9

Lab Report

Among the captured packets, find and examine the Join/Prune PIM packet and the IGMP leave group message (you may use FTP or other means to distribute this capture file among yourselves). Explain (briefly) its function.

ANS:

After adding an entry in the routing table:



After I (Juliet) and Romeo closed VLC, and then subnet 61.0 was not in the multicast group. When the packets arrived at router 1 which is not membership of 230.230.230.230 multiple group, the router sent a prune message, so that branch would be deleted from the multicast tree.