EL5373

INTERNET ARCHITECTURE AND PROTOCOLS

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Workstation: APAH Othello_I

MAC: f8:0f:41:c4:7f:aa

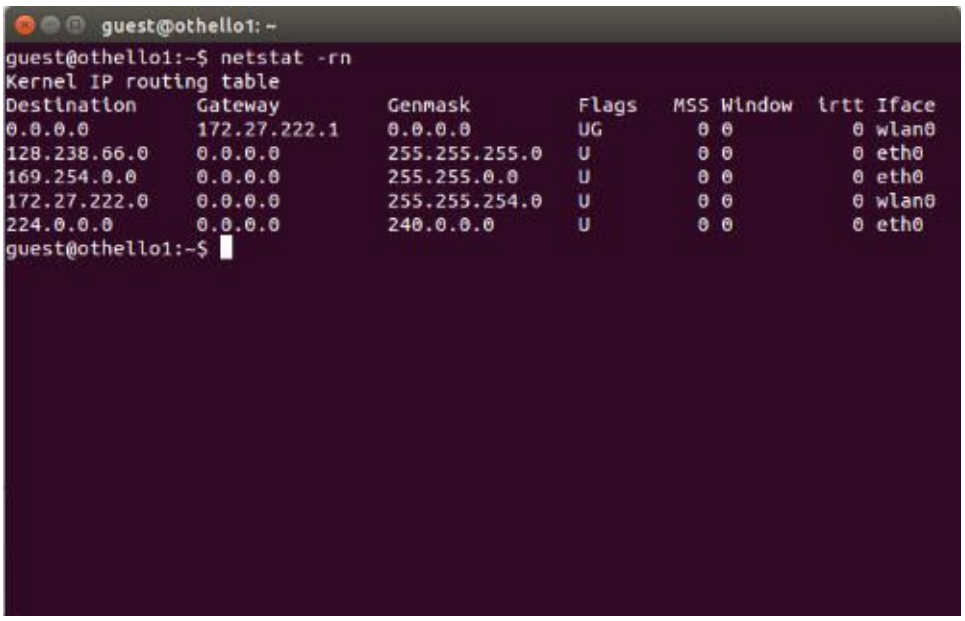
IP: 128.238.66.104

Lab Report 7

Due Nov 25, 2014

Exercise 1

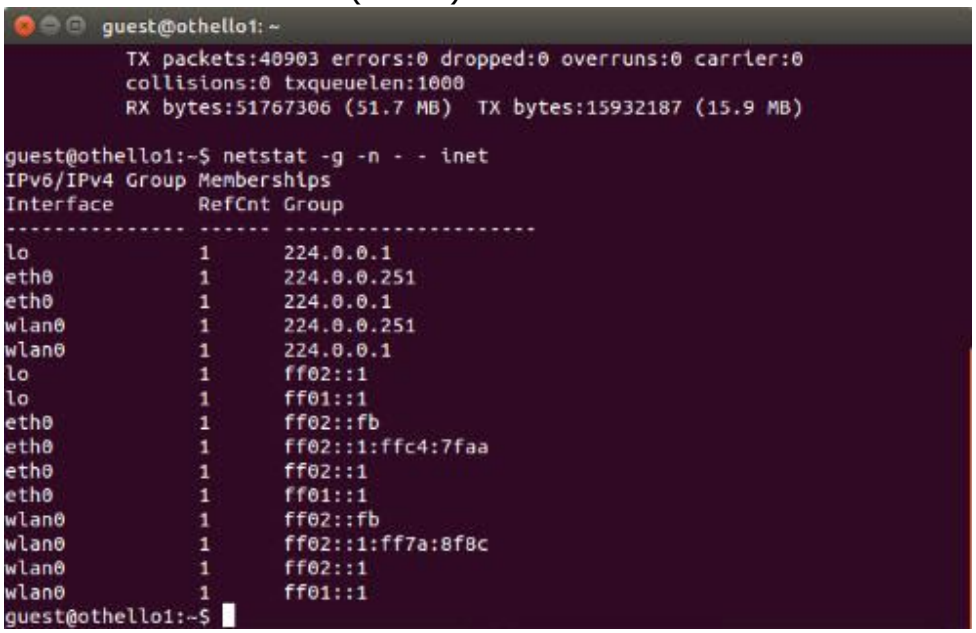
Submit the routing table you saved.



Exercise 2

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

lo 224.0.0.1
eth0 224.0.0.251
eth0 224.0.0.1
224.0.0.1 is for all hosts multicast group addresses on the same subnet.
224.0.0.251 is Multicast DNS (mDNS) Address.



Exercise 3&4

Which hosts replied when the multicast address was pinged? Which hosts replied when the broadcast address was pinged?

Multicast address pinged

All seven hosts should reply. But actually when I pinged several times, I missed 123.238.66.100.

80	24.130609	128.238.66.104	224.0.0.1	ICMP	98 Echo (ping) request
81	24.339524	128.238.66.104	128.238.66.106	ICMP	98 Echo (ping) reply
82	25.129605	128.238.66.104	224.0.0.1	ICMP	98 Echo (ping) request
83	25.130596	128.238.66.103	128.238.66.104	ICMP	98 Echo (ping) reply
84	25.339562	128.238.66.104	128.238.66.106	ICMP	98 Echo (ping) reply
85	26.130826	128.238.66.104	224.0.0.1	ICMP	98 Echo (ping) request
86	26.131803	128.238.66.103	128.238.66.104	ICMP	98 Echo (ping) reply
87	26.131844	128.238.66.105	128.238.66.104	ICMP	98 Echo (ping) reply
88	26.341049	128.238.66.104	128.238.66.106	ICMP	98 Echo (ping) reply
89	27.132127	128.238.66.104	224.0.0.1	ICMP	98 Echo (ping) request
90	27.133136	128.238.66.106	128.238.66.104	ICMP	98 Echo (ping) reply
91	27.133176	128.238.66.105	128.238.66.104	ICMP	98 Echo (ping) reply
92	27.342129	128.238.66.104	128.238.66.106	ICMP	98 Echo (ping) reply
93	28.133383	128.238.66.104	224.0.0.1	ICMP	98 Echo (ping) request
94	28.134346	128.238.66.101	128.238.66.104	ICMP	98 Echo (ping) reply
95	28.134558	128.238.66.105	128.238.66.104	ICMP	98 Echo (ping) reply
96	28.341065	128.238.66.104	128.238.66.106	ICMP	98 Echo (ping) reply
97	29.134748	128.238.66.104	224.0.0.1	ICMP	98 Echo (ping) request
98	29.135817	128.238.66.102	128.238.66.104	ICMP	98 Echo (ping) reply

Broadcast address pinged

All seven hosts should reply. But actually when I pinged several times, I missed 123.238.66.100.

30	20.279180	128.238.66.105	128.238.66.104	ICMP	98 Echo (ping) reply
31	20.279224	128.238.66.101	128.238.66.104	ICMP	98 Echo (ping) reply
32	21.061294	128.238.66.104	128.238.66.100	ICMP	98 Echo (ping) reply
33	21.279554	128.238.66.104	128.238.66.255	ICMP	98 Echo (ping) request
34	21.280672	128.238.66.103	128.238.66.104	ICMP	98 Echo (ping) reply
35	21.280717	128.238.66.105	128.238.66.104	ICMP	98 Echo (ping) reply
36	22.062489	128.238.66.104	128.238.66.100	ICMP	98 Echo (ping) reply
37	22.280990	128.238.66.104	128.238.66.255	ICMP	98 Echo (ping) request
38	22.282138	128.238.66.107	128.238.66.104	ICMP	98 Echo (ping) reply
39	22.282178	128.238.66.105	128.238.66.104	ICMP	98 Echo (ping) reply
40	23.063669	128.238.66.104	128.238.66.100	ICMP	98 Echo (ping) reply
41	23.282381	128.238.66.104	128.238.66.255	ICMP	98 Echo (ping) request
42	23.283335	128.238.66.102	128.238.66.104	ICMP	98 Echo (ping) reply

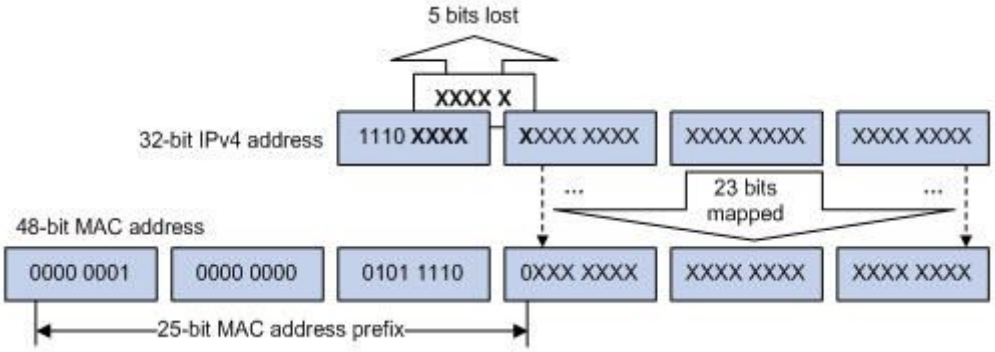
In each case, was there a reply from your host?

Yes. My host reply.

66	20.128642	128.238.66.107	128.238.66.104	ICMP	98 Echo (ping) reply
67	20.338513	128.238.66.104	128.238.66.106	ICMP	98 Echo (ping) reply
68	21.110557	128.238.66.104	128.238.66.100	ICMP	98 Echo (ping) reply
69	21.128907	128.238.66.104	224.0.0.1	ICMP	98 Echo (ping) request
70	21.129890	128.238.66.103	128.238.66.104	ICMP	98 Echo (ping) reply
71	21.339657	128.238.66.104	128.238.66.106	ICMP	98 Echo (ping) reply
72	22.130177	128.238.66.104	224.0.0.1	ICMP	98 Echo (ping) request

Examine the captured packets in both cases, especially how a multicast group address is mapped to a multicast MAC address.

For IPv4 multicast mapping, the high order of 25bits of a multicast MAC address is fixed. 0x01005E-000000 to 0x01005E-7FFFFF. The low order 23 bits of the IP multicast address are mapped directly to the low order 23 bits in the MAC-layer multicast address



Ping 230.11.111.10

Source MAC: f8:0f:41:c4:7f:aa

Destination MAC: 01:00:5e:0b:6f:0a

Ping 232.139.111.10

Source MAC: f8:0f:41:c4:7f:aa

Destination MAC: 01:00:5e:0b:6f:0a

1	0.000000	128.238.66.104	230.11.111.10	ICMP	98
Echo	(ping)	request	id=0x1124,	seq=1/256,	ttl=1
2	1.006491	128.238.66.104	230.11.111.10	ICMP	98
Echo	(ping)	request	id=0x1124,	seq=2/512,	ttl=1
3	2.014503	128.238.66.104	230.11.111.10	ICMP	98
Echo	(ping)	request	id=0x1124,	seq=3/768,	ttl=1

Source: WistronI_c4:7f:aa (f8:0f:41:c4:7f:aa)

Destination: IPv4mcast_0b:6f:0a (01:00:5e:0b:6f:0a)

For the two cases, do the ICMP echo packets have the same destination MAC addresses? Why?

Yes. During the mapping, there are 5 bits in the IP multicast address that do not map to the MAC-layer multicast address.

230.11.111.10 1110**0110,0**0001011,01101111,00001010

232.139.111.10 1110**1000,1**0001011,01101111,00001010

5 different bits are lost during mapping

Therefore, it is possible for a host to receive MAC-layer multicast packets for groups to which it does not belong. However, these packets are dropped by IP once the destination IP address is determined.

Exercise 7&8

How many different (in terms of source and destination) IGMP and PIM packets can you see?

5 different IGMP packets

2 different PIM packets

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	128.238.64.3	224.0.0.13	PIMv2	68	Hello
2	1.049790	128.238.64.3	224.0.0.1	IGMPv2	60	Membership Query, general
3	1.298931	128.238.64.105	224.0.0.251	IGMPv2	60	Membership Report group 224.0.0.251
4	3.054452	128.238.64.3	224.0.1.40	IGMPv2	60	Membership Report group 224.0.1.40
5	3.873561	128.238.64.4	224.0.0.13	PIMv2	60	Hello
6	29.593134	128.238.64.3	224.0.0.13	PIMv2	68	Hello
7	33.923144	128.238.64.4	224.0.0.13	PIMv2	60	Hello
8	59.378556	128.238.64.3	224.0.0.13	PIMv2	68	Hello
9	61.150214	128.238.64.3	224.0.0.1	IGMPv2	60	Membership Query, general
10	61.976575	128.238.64.105	230.230.230.230	IGMPv2	60	Membership Report group 230.230.230.230
11	62.447739	128.238.64.104	224.0.0.251	IGMPv2	46	Membership Report group 224.0.0.251
12	63.972720	128.238.64.4	224.0.0.13	PIMv2	60	Hello

What are their purposes?

IGMP is used to keep track of multicast group memberships in the last hop of the multicast tree. A host uses IGMP to announce its multicast memberships, and a router uses IGMP to query multicast memberships in the attached networks.

PIM is a multi-modal protocol that can switch its operation mode for different scenarios. It has two modes: the dense mode where source based trees are used, and the sparse mode where a shared tree is used.

Whether or not the video stream reaches the subnet that you are in. Is the video flow forwarded by Router 4? Why?

No, the stream doesn't reach our subnet, 128.238.64.*. Router4 doesn't forward this video. Since we set TTL=1, it only supports this video flowing within its original subnet, 128.238.65.*.

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

When the TTL was set as 5, only hosts in subnet 123.238.65.* and 128.238.64.* can see the video. Since we didn't enable rip for router, a multicast distribution tree will not be built among routers. When stream reaches router3, it just drops the packets instead of forwarding to other routers.

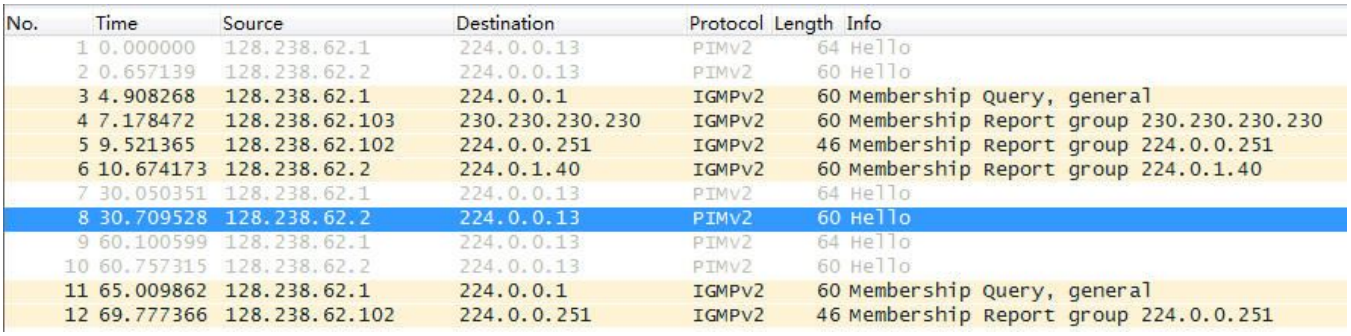
Exercise 9

Among the captured packets, find and examine the Join/Prune PIM packet and the IGMP leave group message. Explain (briefly) its function

When enable router rip, multicast tree can be built and all 8 hosts can see this video on VLC. And finally, Romeo and Juliet closed their VLC, which means these two hosts exited 61.1 multicast group.

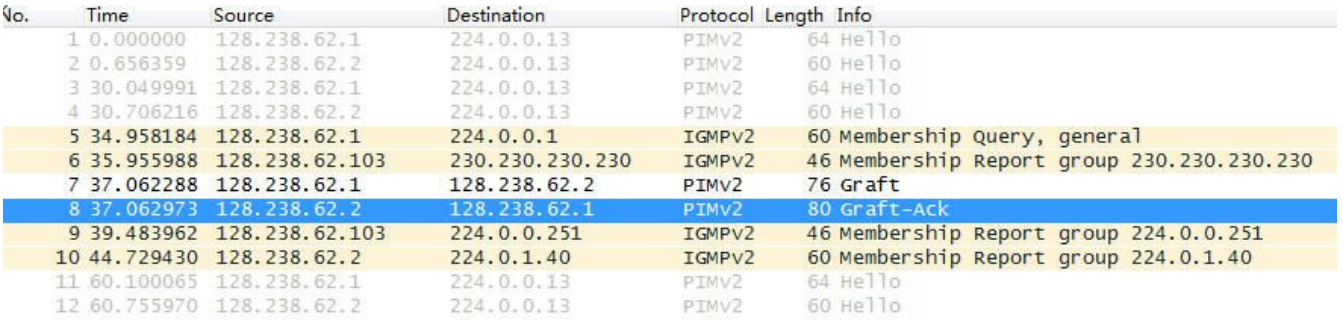
When the packet arrives at router1, it find there is no record of membership in that group. Router1 will send a prune message to the upstream of the tree, so that the branch will be deleted from the multicast tree.

Hamlet.out



No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	128.238.62.1	224.0.0.13	PIMv2	64	Hello
2	0.657139	128.238.62.2	224.0.0.13	PIMv2	60	Hello
3	4.908268	128.238.62.1	224.0.0.1	IGMPv2	60	Membership Query, general
4	7.178472	128.238.62.103	230.230.230.230	IGMPv2	60	Membership Report group 230.230.230.230
5	9.521365	128.238.62.102	224.0.0.251	IGMPv2	46	Membership Report group 224.0.0.251
6	10.674173	128.238.62.2	224.0.1.40	IGMPv2	60	Membership Report group 224.0.1.40
7	30.050351	128.238.62.1	224.0.0.13	PIMv2	64	Hello
8	30.709528	128.238.62.2	224.0.0.13	PIMv2	60	Hello
9	60.100599	128.238.62.1	224.0.0.13	PIMv2	64	Hello
10	60.757315	128.238.62.2	224.0.0.13	PIMv2	60	Hello
11	65.009862	128.238.62.1	224.0.0.1	IGMPv2	60	Membership Query, general
12	69.777366	128.238.62.102	224.0.0.251	IGMPv2	46	Membership Report group 224.0.0.251

Ophelia.out



No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	128.238.62.1	224.0.0.13	PIMv2	64	Hello
2	0.656359	128.238.62.2	224.0.0.13	PIMv2	60	Hello
3	30.049991	128.238.62.1	224.0.0.13	PIMv2	64	Hello
4	30.706216	128.238.62.2	224.0.0.13	PIMv2	60	Hello
5	34.958184	128.238.62.1	224.0.0.1	IGMPv2	60	Membership Query, general
6	35.955988	128.238.62.103	230.230.230.230	IGMPv2	46	Membership Report group 230.230.230.230
7	37.062288	128.238.62.1	128.238.62.2	PIMv2	76	Graft
8	37.062973	128.238.62.2	128.238.62.1	PIMv2	80	Graft-Ack
9	39.483962	128.238.62.103	224.0.0.251	IGMPv2	46	Membership Report group 224.0.0.251
10	44.729430	128.238.62.2	224.0.1.40	IGMPv2	60	Membership Report group 224.0.1.40
11	60.100065	128.238.62.1	224.0.0.13	PIMv2	64	Hello
12	60.755970	128.238.62.2	224.0.0.13	PIMv2	60	Hello