

PRINCE OF SONGKLA UNIVERSITY  
FACULTY OF ENGINEERING

**Midterm Examination:** Semester 2

**Academic Year:** 2010-2011

**Date:** December 27, 2010 (2553)

**Time:** 13:30 – 16:30

**Subject Number:** 241-642

**Room:** Robot Lecture Theatre

**Subject Title:** Multicast Protocols and Applications

---

Name: \_\_\_\_\_

Student Number: \_\_\_\_\_

---

**Exam Duration:** 3 hours

**This paper has 10 pages** (including this page).

- Write the answers in the spaces provided in the examination paper.
- Clearly write your student number in the space provided at the top of each page. Write your name and student number in the spaces provided on this cover page.
- There are 70 marks total for this exam.

**Authorised Materials:**

- Anything the student can carry (except communication devices.)

**Instructions to Students:**

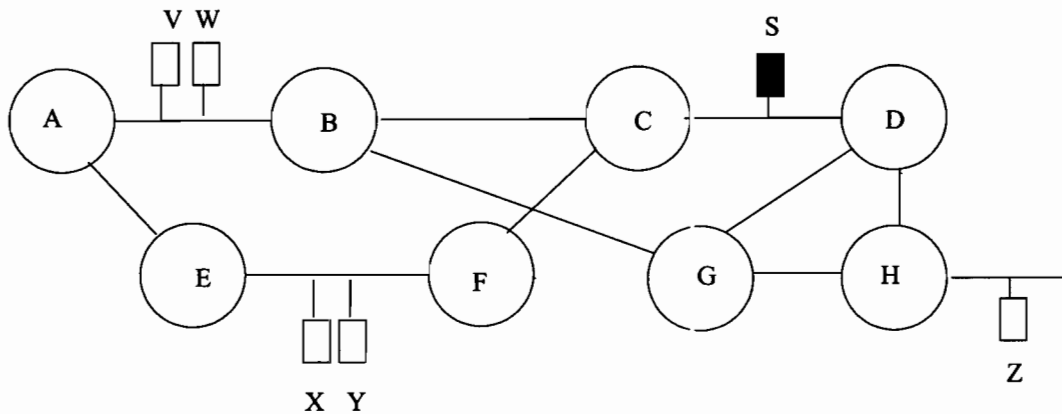
- Attempt all 4 questions .
  - Anything illegible is incorrect.
  - Answer briefly where possible, essays are **not** required. There is no need to use all of the space provided for each answer!
  - The marks allocated for each question are shown next to that question.
  - *Answer questions in English.* Good English is **not** required.
- 

*For marker's use only.*

1	2	3	4	Total

Use the information on the following pages when answering the following questions.

The diagram below shows a small network. The circles (A .. H) represent routers, and the small rectangles (S and V .. Z) represent hosts. The lines show network links.

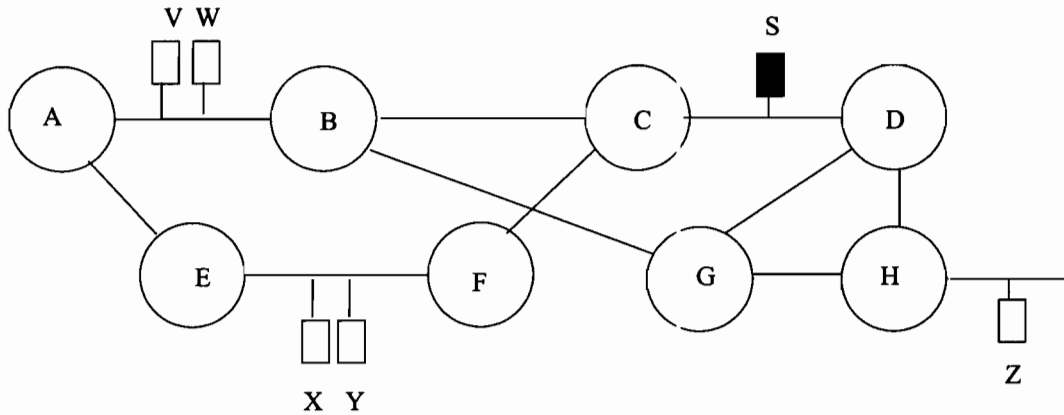


The following tables give some information about this network.

First we have the network (IPv4) addresses assigned to the hosts and routers shown on the diagram.

Node	Network Addresses		
A	10.1.2.1	10.1.5.1	
B	10.1.2.2	10.2.3.2	10.2.7.2
C	10.2.3.3	10.3.4.3	10.3.6.3
D	10.3.4.4	10.4.7.4	10.4.8.4
E	10.1.5.5	10.5.6.5	
F	10.5.6.6	10.3.6.6	
G	10.2.7.7	10.4.7.7	10.7.8.7
H	10.4.8.8	10.7.8.8	10.8.0.8
S	10.3.4.10		
V	10.1.2.20		
W	10.1.2.21		
X	10.5.6.22		
Y	10.5.6.23		
Z	10.8.0.24		

Notice that the routers (A – H) are numbered 1 .. 8 in the final octet of each of their addresses. This was designed to make it easier to recognise the various nodes, any address that ends ...6 is router F (etc).



The links between routers are numbered according to the routers they connect to. The link between router P and router Q is 10.P.Q.0/24 (assuming that P is the earlier named router).

A link that connects only to router P will be 10.P.0.0/24 (no routers have more than one such link.)

The full list of links is:

Link Between	Network Number		Link Between	Network Number
A - B	10.1.2.0/24		A - E	10.1.5.0/24
B - C	10.2.3.0/24		B - G	10.2.7.0/24
C - D	10.3.4.0/24		C - F	10.3.6.0/24
D - G	10.4.7.0/24		D - H	10.4.8.0/24
E - F	10.5.6.0/24		G - H	10.7.8.0/24
H - Z	10.8.0.0/24			

Parts of the unicast routing protocol's forwarding tables for a subset of the known destinations (all that will be required when answering the following questions) are given in the following table:

Node	Destination	Next	Cost		Node	Destination	Next	Cost
A	10.1.2.0/24	—	1		B	10.1.2.0/24	—	1
A	10.1.5.0/24	—	1		B	10.2.3.0/24	—	1
A	10.2.3.0/24	10.1.2.2	2		B	10.2.7.0/24	—	1
A	10.5.6.0/24	10.1.5.5	2		B	10.1.5.0/24	10.1.2.1	2
A	10.3.4.0/24	10.1.2.2	3		B	10.3.4.0/24	10.2.3.3	2
A	10.8.0.0/24	10.1.2.2	4		B	10.5.6.0/24	10.2.3.3	3
					B	10.8.0.0/24	10.2.7.7	3
C	10.2.3.0/24	—	1		D	10.3.4.0/24	—	1
C	10.3.4.0/24	—	1		D	10.4.7.0/24	—	1
C	10.3.6.0/24	—	1		D	10.4.8.0/24	—	1
C	10.1.2.0/24	10.2.3.2	2		D	10.8.0.0/24	10.4.8.8	2
C	10.5.6.0/24	10.3.6.6	2		D	10.1.2.0/24	10.3.4.3	3
C	10.8.0.0/24	10.3.4.4	3		D	10.5.6.0/24	10.3.4.3	3
E	10.1.5.0/24	—	1		F	10.3.6.0/24	—	1
E	10.5.6.0/24	—	1		F	10.5.6.0/24	—	1
E	10.1.2.0/24	10.1.5.1	2		F	10.3.4.0/24	10.3.6.3	2
E	10.3.4.0/24	10.5.6.6	2		F	10.1.2.0/24	10.5.6.5	3
E	10.8.0.0/24	10.1.5.1	5		F	10.8.0.0/24	10.5.6.5	4
G	10.2.7.0/24	—	1		H	10.4.8.0/24	—	1
G	10.4.7.0/24	—	1		H	10.7.8.0/24	—	1
G	10.7.8.0/24	—	1		H	10.8.0.0/24	—	1
G	10.3.4.0/24	10.4.7.4	2		H	10.3.4.0/24	10.4.8.4	2
G	10.8.0.0/24	10.7.8.8	2		H	10.1.2.0/24	10.7.8.7	3
G	10.1.2.0/24	10.2.7.2	2		H	10.5.6.0/24	10.7.8.7	5
G	10.5.6.0/24	10.2.7.2	4					

The columns show that at the node named, to get to a destination on the network shown, a unicast packet would be forwarded to the router shown as **Next** in the table, and the path cost (which in this case is the hop count) is as shown.

**Question 1.**

*(20 marks)*

Refer to the network diagram and tables given in the preamble to this examination. For the purposes of this question, assume that the multicast routing protocol in use is **PIM dense mode**.

Node S (10.3.4.10) transmits a multicast packet to the group 224.2.13.123, and sends with an initial TTL of 255. Nodes V, W, X, Y, and Z have all joined that multicast group. Then, assuming that this is the first packet sent to the group (and hence no nodes have any pruning state for it):

- A) Assuming router C receives the packet (directly from host S), to which links will C forward it?

---

---

---

---

- B) Assuming router D receives the packet (directly from host S), to which links will D forward it?

---

---

---

---

- C) If router F receives the packet from router C (on link 10.3.6.0/24) to which links will F forward that packet?

---

---

---

---

D) If router **E** receives the packet from router **F** (on link 10.5.6.0/24) to which links will E forward that packet?

---

---

---

---

E) How many copies of this packet would you expect host **V** (10.1.2.20) to receive, assuming none are lost due to network congestion or data corruption errors?

---

---

---

F) How many copies of this packet would you expect host **X** (10.5.6.22) to receive, assuming none are lost due to network congestion or data corruption errors?

---

---

---

G) How many copies of this packet would you expect host **Z** (10.8.0.24) to receive, assuming none are lost due to network congestion or data corruption errors?

---

---

---

**Question 2.***(15 marks)*

Refer to the network diagram and tables given in the preamble to this examination.

For the purposes of this question, assume that the various hosts have joined the multicast groups shown in the following table, and no other groups.

Host	Groups		
S	224.2.1.2	224.2.15.7	224.2.22.33
V	224.2.1.2	224.2.15.7	224.2.75.15
W	224.2.1.2	224.2.75.15	224.2.100.100
X	224.2.1.2	224.2.15.7	224.2.75.15
Y	224.2.1.2	224.2.75.15	224.2.100.100
Z	224.2.1.2	224.2.75.15	224.2.22.33

- A) If router A sends an IGMP version 2 general query message (with the group ID field set to 0.0.0.0) on the link 10.1.2.0/24 (between A and B), how will the hosts V and W reply to that query? (*What packets will be sent, to what addresses, and containing what information?*)

For the purposes of this question, assume that where it matters, host V always happens (by chance) to reply first.

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

- B) If router **F** sends an IGMP version 3 general query message (with the group ID field set to 0.0.0.0) on the link 10.5.6.0 (between E and F) how will hosts **X** and **Y** reply to that query? (*What packets will be sent, to what addresses, and containing what information?*)

For the purposes of this question, assume that where it matters, host **X** always happens (by chance) to reply first.

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

- C) Host **S** decides to terminate its membership of group 224.2.22.33 and sends an IGMP version 2 **Leave** message indicating that is no longer a member of the group.

What will routers **C** and **D** do when they receive that message?

---

---

---

---

---

---

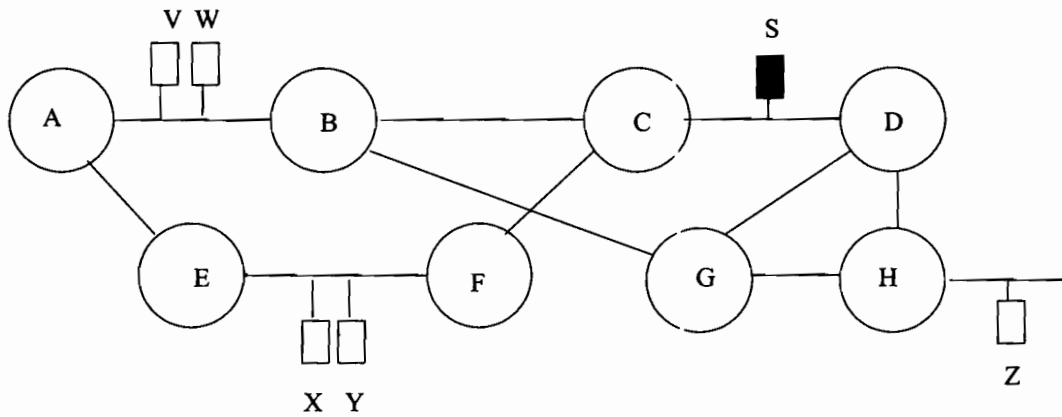
---



**Question 3.**

(20 marks)

Refer to the network diagram and tables given in the preamble to this examination. A copy of the network map from the preamble is reproduced here for your convenience:



The routing protocol in use on the network is **PIM Sparse Mode** for the purposes of this question.

Assume that host S (10.3.4.10) is sending a steady stream of multicast packets to the multicast destination address 224.2.1.1 and that hosts S, V, W, X, Y and Z have all joined that group. There are no other members of the group. Assume that the Rendezvous Point selected when the group was created is router H (using address 10.8.0.8).

- A) Use the forwarding table information given in the preamble to this examination to determine which links will be pruned from the multicast forwarding tree, and **indicate which** those are.

---



---



---



---



---

- B) Show the paths over which the multicast packets will be forwarded on the network map above (from host S to all destinations).

**Question 4.***(15 marks)*

The network shown in the preamble to this examination also has IPv6 implemented.

The IPv6 network prefixes for the various links (all with a prefix length of 64 bits) are as shown in this table:

Link Between	Network Prefix (/64)		Link Between	Network Prefix (/64)
A - B	2001:9876:1234:1122		A - E	2001:9876:1234:1155
B - C	2001:9876:1234:2233		B - G	2001:9876:1234:2277
C - D	2001:9876:1234:3344		C - F	2001:9876:1234:3366
D - G	2001:9876:1234:4477		D - H	2001:9876:1234:4488
E - F	2001:9876:1234:5566		G - H	2001:9876:1234:7788
H - Z	2001:9876:1234:8800			

- A) Assuming host S desires to create a global scope IPv6 multicast group to use for a short term multimedia presentation, suggest a suitable IPv6 multicast group ID for S to use.

---

---

- B) Explain why the group you selected in the previous part is a good choice and what problems could occur if a less careful choice of group ID was made.

---

---

---

---

---

---

---

---