

# Sirindhorn International Institute of Technology Thammasat University

**Final Examination: Semester 2/2006**

Course Title : ITS 413 Internet Technologies and Applications

Instructor : Dr Steven Gordon

Date/Time : Friday 16 March 2007, 13:30 – 16:30

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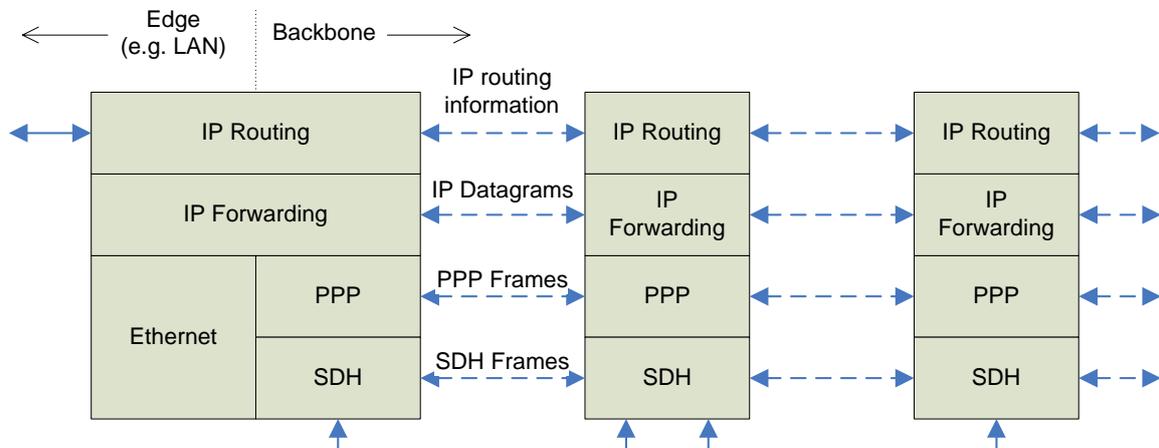
## **Instructions:**

- ③ This examination paper has 16 pages (including this page).
- ③ Condition of Examination  
Closed book (No dictionary, No calculator allowed)
- ③ Students are not allowed to be out of the exam room during examination. Going to the restroom may result in score deduction.
- ③ Turn off all communication devices (mobile phone etc.) and leave them under your seat.
- ③ Write your name, student ID, section, and seat number clearly on the answer sheet.
- ③ The space on the back of each page can be used if necessary.

## Part A – Multiple Choice Questions [14 marks]

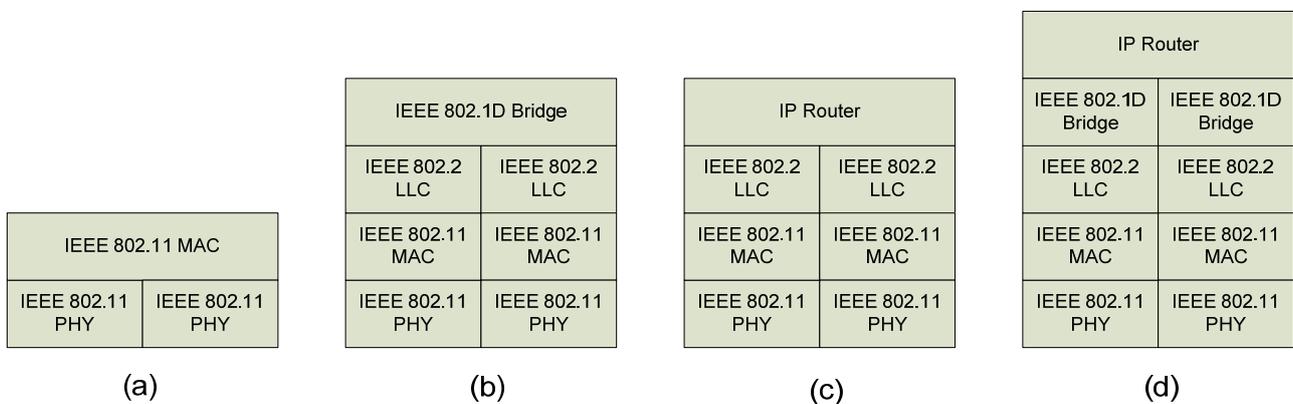
Select the most accurate answer (only select one answer). Each correct answer is worth 2 marks. You receive 0 marks for an incorrect answer or no answer.

1. The protocol architecture diagram below shows a configuration for:



- Using Ethernet as a backbone network
- Carrying Internet traffic over optical networks
- Using the advanced QoS features of ATM
- Using the MPLS standard

2. Which of the following protocol stacks best represent an IEEE 802.11 access point?



MAC = Medium Access Control; LLC = Logical Link Control; PHY = Physical; IP = Internet Protocol

- If a small office network consists of two IEEE 802.11g 54Mb/s access points, then which of the following statements is true:
  - Both access points should use the same channel to maximize the network throughput
  - Clients using IEEE 802.11b cannot access the network
  - The total network throughput will be 108Mb/s if the access points use different channels
  - Users will experience a delay when a handover between access points occur

4. The auto-configuration features of IPv6:
  - a. Require a DHCP server to be present
  - b. Allows a computer to choose a IPv6 address based on its MAC address
  - c. Is used as a transition method from IPv4 to IPv6
  - d. Uses duplicate address detection to select the initial link-local address
  
5. IEEE 802.11 MAC defines a maximum value from which the back-off period is chosen from (e.g. 31). If this value was decreased in the standard then:
  - a. Individual frame transmissions would be more efficient, but more collisions will occur
  - b. Individual frame transmissions would be less efficient, but less collisions will occur
  - c. Individual frame transmissions would be more efficient, but the nodes will not get fair (equal) access to the channel
  - d. Less collisions will occur, but the nodes will not get fair (equal) access to the channel
  - e. None of the above
  
6. Tunneling IPv6 over an IPv4 network
  - a. Improves the efficiency of the end-to-end connection
  - b. Provides a method for upgrading IPv4 to IPv6 networks
  - c. Allows all nodes in the network to use auto-configuration
  - d. Improves the security of the end-to-end connection
  - e. None of the above
  
7. Which instant messaging protocols use asymmetric servers:
  - a. Jabber
  - b. AIM and MSN
  - c. Yahoo Messenger and Jabber
  - d. AIM
  - e. Yahoo Messenger
  - f. XMPP and Jabber
  - g. XMPP and MSN

## Part B – Short-Answer Questions [10 marks]

In the following questions write the appropriate word, phrase or protocol to complete the sentence. It is acceptable to use the protocol acronym instead of the full protocol name. Each question is worth 1 mark.

1. \_\_\_\_\_ is used by TCP as an indicator of congestion in the network.
2. Source and destination \_\_\_\_\_ and \_\_\_\_\_ are used to identify a connection in TCP.
3. In TCP Reno, a retransmission may occur after \_\_\_\_\_ or after \_\_\_\_\_ are received.
4. \_\_\_\_\_ is an example of a *service user* of TCP.
5. If describing the protocol rules of TCP, then two events that may occur are \_\_\_\_\_ and \_\_\_\_\_ .
6. \_\_\_\_\_ is a transport network technology that includes built in quality of service mechanisms.
7. The concept of \_\_\_\_\_ is used by both IPsec and methods for transitioning IPv4 to IPv6 networks.
8. Advantages of Peer-to-peer systems over client/server systems include \_\_\_\_\_ and \_\_\_\_\_ .
9. \_\_\_\_\_ uses a client/server architecture for storing the resource index, but a peer-to-peer architecture when peers access resources.
10. \_\_\_\_\_ can be used to provide state information for web applications.

## Part C – General Questions [86 marks]

### Question 1 [8 marks]

- a) Explain the purpose of a robot exclusion file and how it works (including where the file is and what information the file contains, and how it controls robots – but *you do not have to give the format of the file*). [5 marks]

- b) Is a robot exclusion file suitable for protecting (that is, restricting access to) content on a web site? Explain your answer [3 marks]

**Question 2** [25 marks]

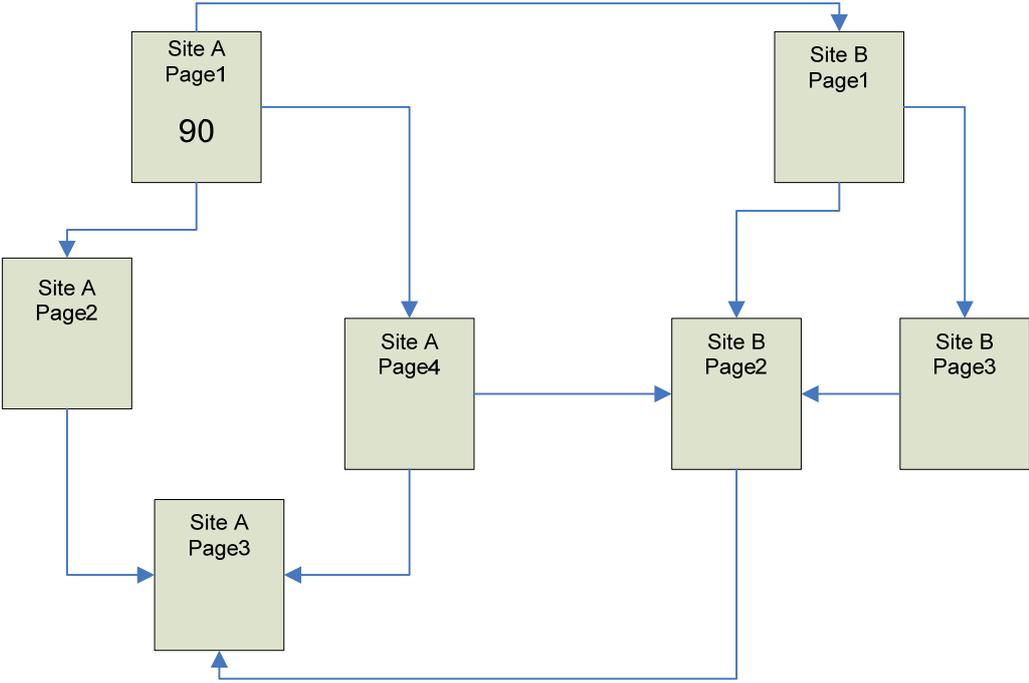
- a) Draw the architecture of a typical search engine. Make sure you label each component and show the connectivity between components. [8 marks]

- b) Explain how a search engine crawler works. [4 marks]

c) A search engine crawler picks a URL from a “To be crawled” list. Why is the picking algorithm important? [2 marks]

d) Explain the difference between query dependant and query independent ranking algorithms. Give an example set of criteria for each and also give an advantage of each approach (compared to the other approach). [6 marks]

e) Calculate the Google PageRank for each page in the diagram below. Write the PageRank value inside the page. [3 marks]



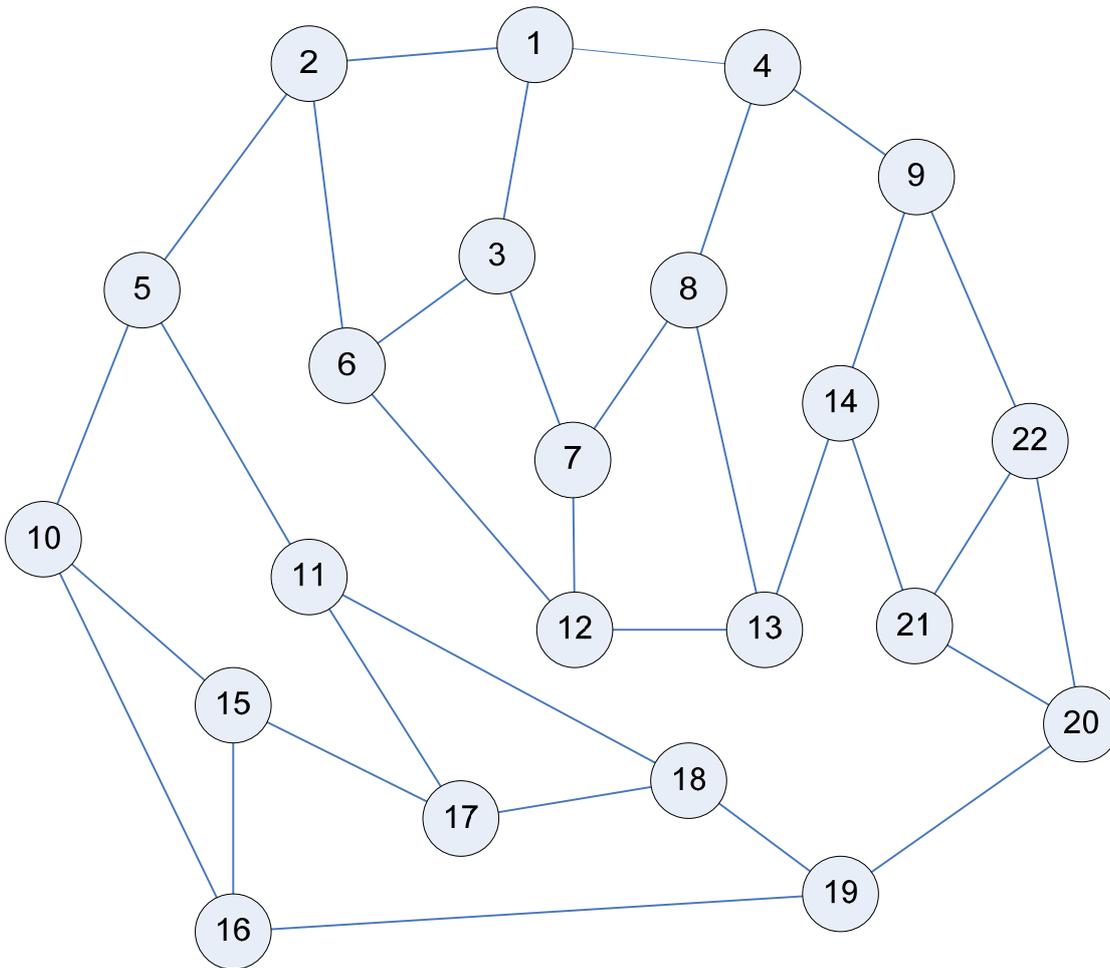
f) Explain a limitation of the Google PageRank algorithm. [2 marks]

**Question 3** [20 marks]

- a) Explain how the Gnutella Peer-to-Peer protocol works, including:
- How do nodes join the network
  - How does a node search the network for a resource

You *do not* have to give details of the protocol (e.g. assumptions, message formats, state diagrams), a brief textual description is sufficient. [6 marks]

- b) Using the diagram below (which shows a set of nodes and their  $C=3$  permanent peers), answer the following questions (assume the nodes have already joined the network and a node forwarding a message counts as one transmission):



In all parts you must explain any additional assumptions you make.

- i. How many times are messages sent in the network using the normal Gnutella protocol if node 1 searches for a resource that is located on nodes 11 and 18 (assume  $TTL=7$ )? [2 marks]
  
- ii. How long does it take for node 1 to receive a reply from part (i) (assume the hop time is 100 milliseconds)? [1 mark]

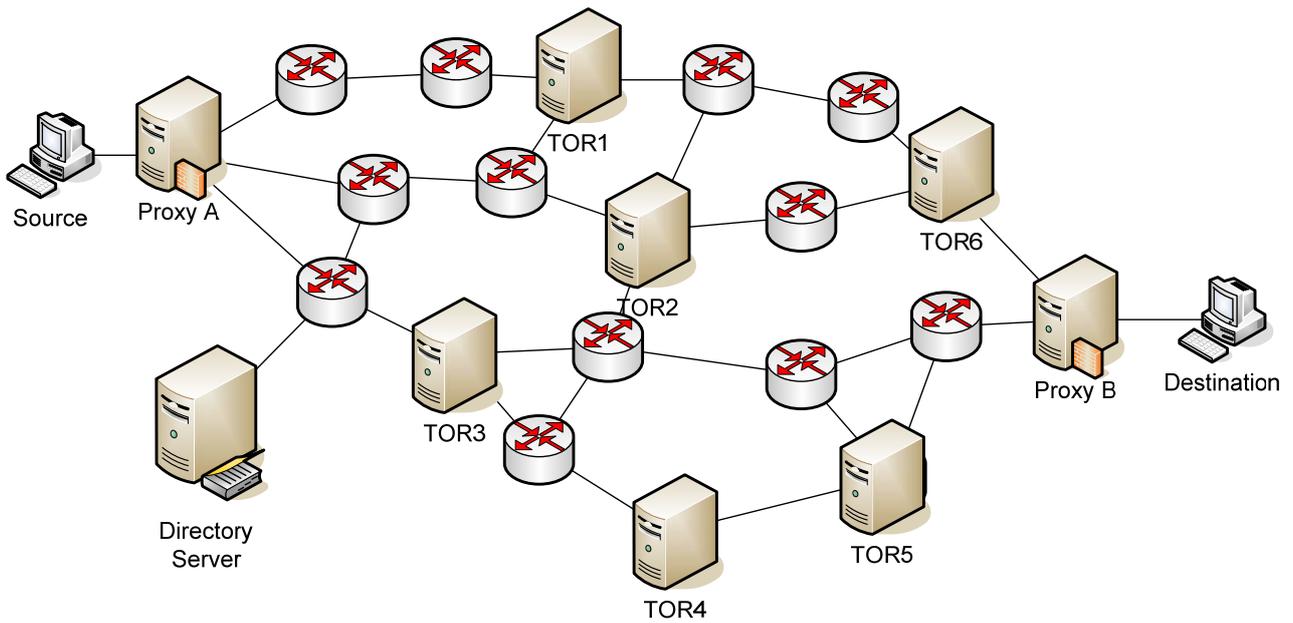
iii. How many replies are received by node 1? Explain your answer. [2 marks]

iv. Explain how the expanding ring search works, including how the number of messages, time for response and number of replies differs from parts (i) to (iii) (you do not have to give exact values, just explain *how* and *why* they would differ in the general case). [5 marks]

- c) How do the following parameters assist in the broadcast (Hint: consider what happens if the parameters were *not* used):
- i. Time to live (TTL) [2 marks]
  - ii. Query (or search) identifier [2 marks]

**Question 4** [13 marks]

The following diagram shows a TOR network.



a) What is the purpose of the Directory Server? [2 marks]

Assume Proxy A selects a path to Proxy B via TOR3, TOR4 and then TOR5.

b) After connection setup is complete, what keys do the following nodes have [3 marks]:

- i. Proxy A
- ii. TOR3
- iii. TOR4
- iv. TOR5
- v. Proxy B

- c) In what order is a packet from Source to Destination encrypted. [2 marks]
- d) Explain how the encryption order in part (c) provides anonymity in TOR. [3 marks]
- e) Explain why using IPsec in tunneling mode (e.g. between proxy A and proxy B) does not provide similar level of anonymity as TOR. [3 marks]

**Question 5** [20 marks]

Chord is a protocol that uses Distributed Hash Tables for peer-to-peer applications.

- a) Draw a diagram of an example Chord network that has 8 nodes (and can support no more than 8 nodes) [1 mark]

b) Using your example network where necessary, explain:

- i. How are nodes given identifiers that represent their position in the Chord network? [2 marks]

ii. What is the relationship between keys and resources in Chord? [1 mark]

iii. What is the relationship between keys and nodes? [2 marks]

iv. What other nodes does a node maintain routes to? [2 marks]

v. In addition to the addresses of other nodes, the routing information maintained by a node should also contain what? [2 mark]

Assume nodes 3, 4 and 7 have left your example network (that is, there are only 5 nodes remaining).

c) For each node, list the keys the node stores. [2.5 marks]

d) For each node, list the other nodes the node maintains routes to. [2.5 marks]

e) Describe the path taken if node 2 sends a query for resource with key 1. [2 marks]

f) If Chord was modified such that each node maintained routes to every second node, then explain an advantage and disadvantage compared to the actual Chord protocol. [3 marks]