UNIVERSITY OF MORATUWA

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

B.Sc. Engineering
2009 Intake Semester 8 Examination

CS4450 INTERNETWORKING

Time allowed: 2 Hours   February 2014

ADDITIONAL MATERIAL:

1. Students are allowed to take in one A4 sheet (written on both sides) to the exam.

INSTRUCTIONS TO CANDIDATES:

1. This paper consists of **5** questions in **3** pages.

2. Answer all FIVE (5) questions.

3. Please note that the total marks allocated to questions are different.

4. Start answering each of the main questions on a new page.

5. Attach the A4 sheet that you bring into the exam to the end of the answer booklet.

6. The maximum attainable mark for each question is given in brackets.

7. This examination accounts for 50% of the module assessment.

8. In case of any doubt as to the interpretation of the wording of a question, make suitable assumptions and clearly state them on the script.

9. This paper should be answered only in English.

Question 1 (27 marks)

(i)   The fundamental goal of the DARPA Internet Architecture was to "allow the connectivity of many existing networks".

    a) Briefly describe any three 2nd level goals for the design of the DARPA Internet Architecture. Also explain how successful are those goals on today's Internet.   [9]

    b) Security and performance were not among the design goals of the DARPA Internet Architecture. What are implecications of ignoring security and performance in today's Internet.   [2]

    c) Briefly describe possible suggestions to address security and performance issues in current and future Internet.   [4]

(ii)   While network-layer multicasting within a Local Area Network (LAN) is possible, many of the existing networks do not support multicasting at the Internet Protocol (IP) layer. Hence, users are forced to use various application-layer libraries to provide multicast services.

    a) Why is it that many networks do not allow multicating at IP layer?   [2]

    b) Argue whether it is a good implementation decision or not? You may use "end-to-end argument" to support your argument.   [4]

(iii)   Steve Deering's hourglass architecture showed how a wide variety of applications and end-to-end protocols are supported by a single and narrow Internet Protocol (IP). Using a suitable diagram, discuss how the today's hourglass architecture looks like.   [6]

Question 2 (25 marks)

Hikkaduwa National Park is world renowned for high degree of biodiversity of its coral reef. Corals are very sensitive to the quality of sea water and concentration of air in water. They could easily get damaged, if the chemical or air concentrations are changed. A group of public officials, scientists, and volunteers are planning to install sensor networks to monitor the water and air quality of coral reefs like Hikkaduwa National Park. They have decided to monitor parameters like PH level of water, chemical composition of water, oxygen and carbon dioxide concentration of water, amount of sunlight received, etc. Based on the monitored data they plan to take various remedial actions.

Different stakeholders involved in the project have different goals. For example, while public officials of the park are interested in making sure corals are alive, scientists want to further study the biological properties of corals and how they react to various changes in water conditions. Volunteers are interested in not only saving the corals, but also the entire ecosystem in the area. To satisfy these various goals, it has been decided that the sensors may be queried both periodically and as-and-when needed by various stakeholders individually. Actuators such as chemical treaters and air mixers are also part of the sensor network and can be activated remotely when needed.

(i)   Why would a novel networking approach like a Content-Centric Networking (CCN) (a.k.a. Named Data Networking) be better for this sensor network than well-known TCP/IP? Discuss.   [4]

(ii)   Propose, with justification, a suitable naming convention to name the contents (i.e., sensor readings).   [6]

(iii)   Propose, with justification, a suitable naming convention to control the actuators.   [4]

(iv)   Using an example, explain how the sensor readings can be found out using the proposed naming convention and a suitable network setup.   [7]

(v)   What are the limitations of your solution, particularly considering the fact it is based on CCN? Describe.   [4]

Question 3 (18 marks)

(i)   While providing examples briefly describe any two of the following techniques for implementing Content Delivery Networks (CDNs):
   - HTTP Redirects
   - Domain Name Service (DNS) based
   - Content-Centric Networking (CCN) based
   - Software Defined Networking (SDN) based.   [8]

(ii)   Design, with justification, a CDN solution for streaming video using an overlay network. Your solution should include a suitable topology for the overlay, content push and/or pull strategy, chunk scheduling policy, etc.   [10]

Question 4 (10 marks)

(i)   How does TCP slow-start algorithm helps to prevent congestion collapse?   [5]

(ii)   Discuss possible mechanisms that can be used to improve the throughput and responsiveness of TCP connections.   [5]

Question 5 (20 marks)

Following questions are based on the research papers discussed in the class.

(i)   What is Quality of Service (QoS)? To what extent does DiffServ satisfy the QoS requirements?   [5]

(ii)   Using an example, explain how Software Defined Networking (SDN) can help to retain the same levels of network performance (while accessing a cloud application) even when a virtual machine related to that application is migrated from one node to another.   [5]

(iii) Briefly describe how a fat-tree built using commodity hardware can be used to provide better bandwidth within a large datacenter.   [5]

(iv)   Propose a suitable layer two solution to support unique communication patterns within a cloud computing datacenter. What are its advantages over a layer three (network layer) design.   [5]

-------------------------- END OF THE PAPER --------------------------