UNIVERSITY OF EDINBURGH

COLLEGE OF SCIENCE AND ENGINEERING

SCHOOL OF INFORMATICS

INFR11049 COMPUTER NETWORKING (LEVEL 11)

Monday 5th May 2014

14:30 to 16:30

INSTRUCTIONS TO CANDIDATES

Answer any TWO questions.

All questions carry equal weight.

CALCULATORS MAY BE USED IN THIS EXAMINATION

Year 4 Courses

Convener: I. Stark
External Examiners: A. Cohn, T. Field

THIS EXAMINATION WILL BE MARKED ANONYMOUSLY

1. (a) Give three reasons why HTTP streaming is preferred over UDP streaming for video streaming applications? [*6 marks*]

   (b) With HTTP streaming, are the TCP receive buffer and the media player client's application buffer the same thing? If so, why? If not, how do they interact? [*2 marks*]

   (c) Consider the following notation to model client-side buffering for video streaming. Let B denote the size of the client's application buffer in bits. Let $Q(< B)$ denote the number of bits that must be buffered before the client application begins playout. Let r denote the video consumption rate during playback. Finally, assume that the client receives data into the application buffer from the network at a rate x (referred to as the *fill rate*) when the client buffer is not full.

      i. When $x < r$, determine the length of each continuous playout and freezing period as a function of Q, r and x. [*6 marks*]

      ii. If $x > r$, then at what time, say t_f, does the client application buffer become full? [*3 marks*]

   (d) Briefly describe two different approaches for the placement of CDN server clusters. [*2 marks*]

   (e) What is a work-conserving queuing discipline? Give an example. [*3 marks*]

   (f) How would you extend the leaky bucket policer to police a traffic flow's peak rate in addition to policing the flow's maximum burst size and long-term average rate? Give a schematic of your solution. [*3 marks*]

2. (a) Identify four characteristics of wireless networks that set them apart from their wired counterparts. [*4 marks*]

   (b) Infrastructure mode communication in 802.11 wireless networks between an access point (AP) and its associated clients bears similarity with reader-tag communication in UHF (EPC Gen 2) RFID networks in the sense that both cases employ contention-based random multiple access methods. Why are the actual multiple access protocols in the two cases so different? Explain your answer with respect to the key aspects of 802.11 MAC and EPC Gen 2 tag identification protocols. [*5 marks*]

   (c) Discuss the key issues to be addressed in order to perform effective rate adaptation in 802.11 wireless networks. [*3 marks*]

   (d) Suppose you are tasked with optimizing voice over IP (VoIP) performance over WiFi (802.11) for mobile smartphone users in an enterprise while being compliant to the 802.11 standard. What aspects/parameters of the protocol would you choose to optimize and why? Assume that you can update the 802.11 related software on access points as well as user devices. [*4 marks*]

   (e) Give two reasons why a Bluetooth device cannot be a master of two piconets at the same time? [*3 marks*]

   (f) The efficiency of a 1-slot Bluetooth frame with repetition encoding is about 13% at basic data rate. What will the efficiency be if a 5-slot frame with repetition encoding is used at basic data rate instead? [*3 marks*]

   (g) Suppose that there are 10 RFID tags around an RFID reader. What is the best value for the 'Q' parameter? How likely is it that one tag responds with no collision in a given slot? [*3 marks*]

3. (a) Explain why the built-in mobility support provided in the IEEE 802.11 standard is insufficient for addressing the problem of supporting seamless mobility across networks in the Internet. [*2 marks*]

   (b) Agent advertisement messages in Mobile IP are used by mobility agents (home/foreign) to announce their presence. Identify a similar mechanism in the context of 802.11 mobility support. [*2 marks*]

   (c) How is the role of an SIP registrar different from that of a home agent in Mobile IP? [*2 marks*]

   (d) Distinguish between frequency division duplex (FDD) and time division duplex (TDD) modes in the context of mobile cellular networks. [*3 marks*]

   (e) Outline three advances made in GSM (a 2G cellular standard) in comparison with the older AMPS (a 1G standard). [*3 marks*]

   (f) Explain the rationale behind the choice of CDMA as the channel access method in 3G cellular wireless networks. Outline two key practical challenges for effectively using CDMA in cellular networks. [*4 marks*]

   (g) It used to be typical to deploy about 6 macrocells for mobile coverage in a square kilometre area but this approach is no longer able to keep up the exponentially growing mobile data traffic. What would be your remedy if you were tasked with addressing this challenge? Discuss your proposed approach and any associated limitations. [*6 marks*]

   (h) Why does TCP performance degrade in the presence of wireless channel related losses? Suggest a way to overcome this problem. [*3 marks*]