

UNIVERSITY OF EDINBURGH
COLLEGE OF SCIENCE AND ENGINEERING
SCHOOL OF INFORMATICS

INFR11049 COMPUTER NETWORKING (LEVEL 11)

Tuesday 19th May 2015

09:30 to 11:30

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 different classifications of wireless networks. [6 marks]
- (b) State two advantages and two disadvantages of having standards for network protocols and technologies. [4 marks]
- (c) What are the key changes in the radio access network (RAN) and core parts of cellular networks between second generation (2G GSM), third generation (3G UMTS) and fourth generation (4G LTE) systems? [4 marks]
- (d)
 - i. Express received power at a wireless device (in dB form) as a function of transmit power, channel path loss and antenna gains. [2 marks]
 - ii. Using a transmit power of 17 dBm, 3 dBi for transmit and receive antenna gains and assuming that the channel between transmitter and receiver experiences only distance-dependent deterministic free space based path loss, compute the received powers for the following different transmit-receiver separation distances: 1Km, 2Km and 3Km. Assume that transmissions happen over channels with a carrier frequency of 2437MHz. Also assume that there are no feeder/cable losses. [6 marks]
 - iii. If the thresholds for minimum received power (receive sensitivity values) to support different physical layer data rates are as per the following table, for each of the distances in part (ii) indicate the rates that are supported.

Receive Sensitivity	Rate
-86 dBm	18 Mbps
-80 dBm	36 Mbps
-71 dBm	54 Mbps

[3 marks]

2. (a) Distinguish between basic service set (BSS) and extended service set (ESS) in infrastructure 802.11 wireless LANs. [2 marks]
- (b) Why does 802.11 medium access control (MAC) protocol take the collision avoidance approach as opposed to collision detection as used in Ethernet? How does 802.11 realise collision avoidance? [5 marks]
- (c) The value of RTS/CTS exchange prior to data frame transmissions is questionable for legacy 802.11a/b/g wireless LANs. Is RTS/CTS more useful in the context of newer 802.11n/ac standards? Discuss your answer. [3 marks]
- (d) The channel configuration of home Wi-Fi access points (APs) is typically unchanged from factory settings. This leads to high interference among many APs (and their associated clients) operating on a very small subset of available channels. As a remedy to this problem, suggest an adaptive mechanism to assign channels to APs. [4 marks]
- (e) Compared to the home scenario, AP channel configuration in enterprise wireless LANs is relatively a smaller concern given that channels are carefully assigned to APs either by system administrators or dynamically by a backend controller. However, enterprise wireless LANs typically comprise many APs to serve the client devices over a wider area, which leads to the AP selection problem for clients. Do you think the AP selection problem and AP channel assignment problem are related? If so, how? [4 marks]
- (f) With the newer 802.11n/ac wireless LAN standards providing very high physical layer data rates, throughput seen above the MAC layer can be relatively quite low if suitable measures are not taken at the MAC layer. Why? What enhancements are proposed in 802.11n/ac to address this MAC efficiency issue? Is there a pitfall in aggressively employing these enhancements to increase the MAC efficiency? [7 marks]

3. (a) Discuss an optimisation strategy that is heavily used for delivering stored/live video streaming but not for conversational voice/video over the Internet. [4 marks]
- (b) Multimedia applications, though loss tolerant to some degree, employ proactive loss recovery mechanisms such as forward error correction (FEC) to avoid high percentage of packet losses. Discuss the cost and penalties resulting from use of such loss recovery mechanisms. [3 marks]
- (c) What is the NAT traversal problem and how does Skype address this problem? [4 marks]
- (d) At the time of initiating a call with the Session Initiation Protocol (SIP), a caller may not know the current network (IP) address of the callee. How does the SIP infrastructure aid the caller in getting the callee's IP address? [3 marks]
- (e) Distinguish between the following three types of link scheduling mechanisms: priority queueing, round-robin scheduling and weighted fair queueing. [6 marks]
- (f) With the increasing popularity of video content, Internet Service Providers (ISPs) face the challenge of managing traffic spikes during peak hours. If you were an ISP, how would you shape the traffic of high bandwidth consuming users at peak hours? Suppose that some of those users are willing to pay an extra premium to avoid such traffic shaping. How would you support your premium users? [5 marks]