University of Waterloo

ECE 655 Final Exam, Fall 2014

ECE 655 – Protocols, Software and Issues in Mobile Computing

Instructor: Prof. Sagar Naik

Date and time: December 4, 2014, 9:00 AM—11:30 AM

Room: E5--5106/28

Instructions

- You have 2.5 hours to complete the exam.
- This is a closed book exam.
- Should there be a need, make an assumption and proceed.

Question	Marks
Q1. GSM	**/7**
Q2. Support for Mobility	**/6**
Q3. Broadcasting Techniques	**/6**
Q4. Energy Efficiency of Smartphones	**/6**
Q5. Multiple Choice	**/25**
Total	**/50**

Student ID **Student Name** **Student Signature**

Continue writing on the reverse side of this page, except page 1.

1. GSM + Channel Assignment 7 marks

Clearly explain the functional architecture of a GPRS network, by drawing a diagram and explaining the roles of the various communicating and computing elements.

2. Support for Mobility 6 marks

Clearly explain the Mobile IPv4 protocol.

3. Energy Saving on Smartphones 6 marks

Clearly explain the *standard power saving mode* of the WiFi protocol (i.e., the IEEE 802.11 family of protocols).

Continue writing on the reverse side of this page, except page 1.

4. Broadcasting Techniques 6 marks

Clearly explain the *dominant pruning* algorithm in detail.

5. General (25 x 1 mark): Choose *one* for each question. **25 marks**

i. An uplink frame and a downlink frame are shifted in GSM networks by how much time?

- 57 microseconds
- 0.577 milliseconds
- 1.731 milliseconds
- 4.615 milliseconds

ii. In one slot, how many bits of data a smartphone can send to a BTS? (x means multiplication)

- 57 x 1
- 57 x 2
- 57 x 2 + 3 x 2 + 1 x 2
- 57 x 8

iii. Identify the correct statement about GSM networks.

- The network allocates one logical/traffic channel over one carrier to each mobile phone for its user to be able to set up a full-duplex voice channel with another user.
- The network allocates one logical/traffic channel over two carriers to each mobile phone for its user to be able to set up a full-duplex voice channel with another user.
- The network allocates two logical/traffic channels over one carrier to each mobile phone for its user to be able to establish a full-duplex voice channel with another user.
- The network allocates two logical/traffic channels over two carriers to each mobile phone for its user to be able to establish a full-duplex voice channel with another user.

iv. Which of the following channels is *not* used while setting up a connection in GSM networks?

- AGCH (Access Grant Channel)
- BCCH (Broadcast Channel)
- PCH (Paging Channel)
- RACH (Random Access Channel)

v. Which of the following channels is created by borrowing slots from an in-use traffic channel?

- AGCH (Access Grant Channel)
- FACCH (Fast Associated dedicated Control Channel)
- SACCH (Slow Associated dedicated Control Channel)
- SDCCH (Stand-alone Dedicated Control Channel)

vi. For efficient utilization of radio channels, a GSM network might assign one of the following channels to a mobile phone *before* actually assigning a traffic channel (TCH) to carry voice data. What channel is that?

- BCCH
- FACCH
- SACCH
- SDCCH

vii. A mobile phone in a GSM network sends information about channel quality to its connected BTS (Base Transceiver Station). What channel does the phone use for the said purpose?

- FACCH
- RACH
- SACCH
- SDCCH

viii. Assume that you lost your mobile phone while roaming in a different country and reported the loss to your GSM network operator. What number will be used by your network to identify the device even if the new user of your phone decides to use a different SIM (System Identification Module) card?

- IMEI (International Mobile Equipment Identity)
- IMSI (International Mobile Subscriber Identity)
- MSISDN (Mobile Station Int. Subscriber Directory Num.)
- MSRN (Mobile Station Roaming Number)
- TMSI (Temporary Mobile Subscriber Identity)

ix. In a GSM network, subscriber identity authentication with no roaming involves communication between a mobile phone and what other entities? Choose one option with the largest number of appropriate communicating elements.

- BTS
- BTS and BSC
- BTS, BSC, and MSC
- BTS, BSC, MSC, and (AC) Authentication Centre

x. If the minimum reuse distance for all carriers is 6xR, where R is the radius of all cells, how many cells are there in the interference region of a cell?

- < 30
- 30
- > 30
- $3\sqrt{3}$

xi. Assume that you have partitioned a certain geographic area into a 15x15 cell grid to apply the Geometric dynamic channel assignment algorithm. What is the maximum number of cells in which the same carrier can be simultaneously assigned?

- 9
- 16
- 25
- 27
- 36
- 225

xii. If you want to simulate the performance of the Geometric dynamic channel assignment algorithm, which of the following parameters should *not* be considered?

- The way users are moving
- The average length of time for which users are talking
- The data rates of the traffic channels assigned to the users
- The geographic area covered by the network

xiii. Which of the following is *not* used in GPRS (General Packet Radio Service) networks?

- Circuit switching
- GPS based localization (GPS: Global Positioning System)
- Network Prefix Matching
- Packet switching
- TCP protocol (TCP: Transmission Control Protocol)

xiv. Which of the following entities runs Packet Control Unit (PCU) in a GPRS network?

- BSS (Base Station Subsystem)
- MSC (Mobile Switching Centre)
- GGSN (Gateway GPRS Support Node)
- SGSN (Service GPRS Support Node)

xv. In what *ad hoc* network protocol does a node snoop into the packet header to determine the next-hop for the data packet?

- Destination Sequenced Distance Vector Protocol
- Dynamic Source Routing Protocol
- Location Aided Routing Protocol
- Snooping Transmission Control Protocol

xvi. Find the correct statement below.

- The expected zone in a LAR (Location Aided Routing) protocol includes the request zone.
- In a LAR protocol it is possible that a data packet is sometimes forwarded *away* from the destination node to eventually reach the destination.
- In a LAR protocol there is no need to know the mobility behavior of nodes.

xvii. In a broadcasting protocol for, say, sensor networks, a node does not transmit the same packet more than once to achieve what requirement?

- Improve delivery ratio
- Prevent loops
- Reduce broadcast latency
- Reduce jitter

xviii. What broadcast protocol does *not* utilize information about its neighbors to make a decision to further transmit a received packet?

- Area-based protocol
- Counter-based protocol
- Dominant pruning protocol
- Flooding with self-pruning protocol

xix. In the absence of mobile IPv4 on the fixed Internet, a computer stops receiving IPv4 packets if it moves out of its home network because of what reason?

- The end-to-end TCP connection is broken.
- Routers on the fixed Internet do not run the DSDV (Destination Sequenced Distance Vector) protocol.
- Routers on the fixed Internet do not run the Dynamic Source Routing protocol.
- Routers on the fixed Internet construct routing tables based on destination network prefix.

xx. In mobile IPv4, identify the correct statement about a Care-of-Address (COA).

- A COA is permanently assigned to a mobile host for continued IP-level communication.
- A COA is part of the home network of the mobile host.
- A COA is part of the current foreign network.
- In mobile IPv4, there is no concept of COA.

xxi. Identify the correct meaning of mobility binding in mobile IPv4.

- It is a permanent association between the home IP address and COA of the mobile host.
- It is an association between the home IP address of the mobile host and its current COA, for a renewable time period.
- It is an association between the Home Agent and the home IP address of the mobile host, for a renewable time period.
- It is an association between the Home Agent and the current Foreign Agent of the mobile host, for a renewable time period.

xxii. The Hick-Hyman law is about what aspect of human capabilities:

- Cognitive speed
- Motor speed
- Typing speed
- Walking speed

xxiii. In the Bounded Slow Down protocol, what is the key idea that lets mobile devices save energy?

- User devices slow down their data transmission rates.
- Servers slow down their data transmission rates.
- User devices listen for Beacons with decreased frequency.
- Better channel quality leads to bounded transmission delay for data packets.

xxiv. What power saving approach does not need to know about the wireless device's capabilities?

- Power Aware Streaming Proxy
- Streaming Audio Proxy
- Remote Power Control from Server
- Power Aware Web Proxy

xxv. In smartphones, what component generally consumes the least amount of power?

- Display
- Memory
- Network interface
- Processor

****** This is the last page. ******

Continue writing on the reverse side of this page, except page 1.