ITEC851 Mobile Data Networks

Assignment 1

Due: Thursday (Week 8) – 6th of October, 2016, 6 pm.
Total Marks: 60
Weighting (Value): 20%

Submission

- Attach the Computing Department's assignment cover sheet to your submission.
- Staple your submission in the top-left corner. Do not use binders, folders or plastic sleeves as these require more work for the marker and will not be returned.
- Do not submit a copy of this assignment sheet with your submission.
- Submit your assignment in the assignment submission box labelled ITEC851 on the first floor of building E6A.

Objectives

This assignment has been designed to test the following areas:

- Medium Access Control
- Wireless LAN
- Mobile IP

Note

- Answers must be within the specified word limit. This is an absolute word limit and no excess will be allowed.
- Assumptions (if any) must be stated clearly in your answers.

  Remember, there may not be one right answer for some of the questions. Rather, your explanations do need to present your case clearly. The explanations you provide do not have to be long, conciseness is preferred to meandering.

Assessment

For all questions in this assignment not only **content** but also **presentation** will affect your mark. You will lose marks (and not necessarily only a small portion) if there are problems with the presentation, particularly with clarity. This means that your answers to each question should be a coherent statement and that the spelling and grammar of your submission will be taken into account in assessing its presentation.

For full marks, your answers should all be clear, coherent and correct.

The standards of marking described in the unit outline L.O. 1-6 will be applied to this assignment as relevant to the assignment topics.

In addition, the following particular standards will be applied in marking this assignment:

- **Spelling and grammar**:
  - Assignment submissions with more than 4 spelling or grammatical errors will not achieve a grade higher than distinction; submissions with more than 8 such errors will not achieve a grade higher than credit.
- **Clarity**:
  - Ambiguous or poorly worded answers will receive a grade no more than a pass for the individual question.
  - Minor issues of clarity will receive a grade no more than credit for the individual question.
- **Correctness of approach taken and answer obtained**:
  - Incorrect answers with the correct logic or approach will receive no more than a pass for the individual question.
  - Correct answers with incorrect logic or approach will receive no more than pass for the individual question.
  - Incorrect answers with no explanation of the approach taken or with the incorrect approach will receive a fail grade for the individual question.

The questions will be marked individually, the marks totalled, and a final grade assigned that is no more than indicated by the total marks,

and no more than allowed by the standards specified above and in the unit outline.

1. A CDMA system includes two stations X and Y. The Walsh codes for stations X and Y (-1 1 -11 -1 1 -11) and (-1 -111 -1 -111), respectively. **(18 marks)**

a. Show the output at the receiver if X transmits a data bit 1 and Y does not transmit. **(2 marks)**
b. Show the output at the receiver if X transmits a data bit 0 and Y does not transmit. **(2 marks)**
c. Show the output at the receiver if X transmits a data bit 1 and Y transmits a data bit 1. Assume the received power from both X and Y is the same.**(2 marks)**
d. Show the output at the receiver if X transmits a data bit 0 and Y transmits a data bit 1. Assume the received power from both X and Y is the same. **(2 marks)**
e. Show the output at the receiver if X transmits a data bit 1 and Y transmits a data bit O. Assume the received power from both X and Y is the same. **(2 marks)**
f. Show the output at the receiver if X transmits a data bit 0 and Y transmits a data bit O. Assume the received power from both X and Y is the same. **(2 marks)**
g. Show the output at the receiver if X transmits a data bit 1 and Y transmits a data bit 1. Assume the received power from Y is twice the received power from X. This can be represented by showing the received signal component from X as consisting of elements of magnitude 1(+1, -1) and the received signal component from Y as consisting of elements of magnitude 2(+2, - 2). **(3 marks)**
h. Show the output at the receiver if X transmits a data bit 0 and B transmits a data bit 1. Assume the received power from Y is twice the received power from X. **(3 marks)**

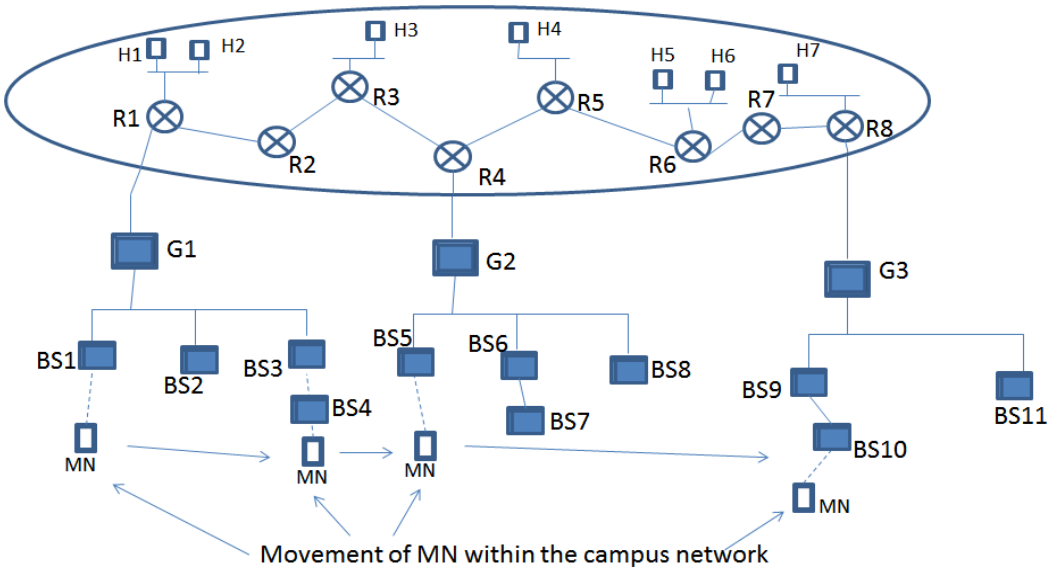
2. Explain why the vulnerable time in ALOHA depends on the frame transmission time (T_{fr}), but in CSMA it depends on frame propagation time (*Tp)?* **(5 marks) (300 words)**

3. In the CSMA protocol, if a station successfully receives an acknowledgement, it knows that its frame has been correctly received at the destination station. Now, if the station has another frame to send, the protocol forces the station to re-enter the back-off phase in which the station chooses a random back-off value and counts down this value when the channel is sensed idle. What rationale might the designers of CSMA/CA have had in mind by having such a station not transmit the second frame immediately –after the DIFS period (if the channel is sensed idle)? **(4 marks) (200 Words)**

4. In MACAW, the scheme of having the congestion information disseminated explicitly by media access protocol produced a fairer allocation of resources. What problems can surface when using such a scheme? **(3 marks) (200 Words)**

5. Consider a novel Mobile IP scheme in which a mobile station announces its permanent (home) IP address to agents in foreign networks. These agents, in turn, announce this information to other routers using their regular routing protocol update messages. What are some benefits and drawbacks of this scheme when compared to the IETF Mobile IP scheme? **(8 marks) (300 Words)**

6. An organization has deployed a campus network using cellular IP. The cellular IP network extends the wired infrastructure of the campus as shown in the figure below. The gateways in cellular IP connect their respective wireless segments to the wired segment. Each Base station in the wireless segment provides layer 3 functionality (in other words, they act as IP forwarding engines). The campus network supports multicast routing. All the components in the wireless part strictly adhere to cellular IP standard. Assume that this campus network deploys a source based multicast routing scheme – a protocol that builds source based multicast distribution trees (*Refer to Appendix for a brief explanation on Source based multicast routing*).
   A visiting mobile node MN enters the wireless network and initially gets registered to its home network via BS1-G1 and acquires a Care of Address (CoA - an address from the campus network address space). The CoA assigned to the MN remains unchanged irrespective of MN's movements within the campus network. In other words, MN does not need to acquire a new CoA upon moving to a wireless segment under the same or under a different gateway.
   While initially at BS1, the MN joins a multicast group G whose scope is local to this campus network (all sources, and members reside in the campus network). Assume that hosts H1, H3, H5, and H7 are members of this group with H1 and H7 also acting as Multicast sources. Furthermore, assume that MN itself is a source for multicast traffic. In this scenario, explain what problems can arise in multicast communication due to MN's mobility. **(10 marks) (300 Words)**



7. Briefly explain the architectural difference between IETF Mobile-IP and Columbia Mobile-IP. Highlight the architectural difference along the following dimensions:

a. HA
b. FA
c. Location Directory
d. Location Update **(12 marks) (500 Words)**

Appendix

Source Based Multicast Routing

Consider a single sender. In source based multicast Routing, the routing process builds shortest path trees rooted at the sender. The router delivers packets to each receiver along the shortest path. In a nutshell, it builds a shortest path spanning tree routed at source to all intended destinations.

Source Based Multicast Routing (SBMR)

The SBMR techniques implement the Reverse Path Multicast (RPM) algorithm. The RPM constructs an implicit spanning tree for each source.

- It accepts a packet from a source S, on link L, if L is the shortest path toward S. (Reverse Path Check)
- Uses unicast routing table which contains shortest paths to each node in the network.

In this technique, the first packet flooded across the internetwork. The packet scope is restricted by a TTL value. Due to flooding, all routers in the network get a copy of the packet. Routers not having any downstream router in multicast tree are called leaf routers. If a leaf router has no group members on its sub-networks, a Prune message to parent router (one hop up). The prune state is maintained in every router. This process is repeated every hop upwards. These cascaded prune messages create/truncate the original RPM tree. Prune information only held for a certain lifetime (soft state). A Graft message is sent to quickly recover back a previous pruned branch. It cancels out previously received prune message. Graft cascades reliably hop by hop toward the source. Due to this graft and prune feature, messages are forwarded on only those links leading to a group member.