Name	Initials	Student number	Study

Examination Mobile & Wireless Networking (262001)
April 10, 2008
13.30 – 17.00

Notes:

- Only the overhead sheets used in the course, 2 double sided sheets of notes (any font size/density!), and a dictionary are allowed as reference material. Use of the book by Schiller or any other material is not allowed.
- Use of PDA, laptop, mobile phone etc. is not allowed. Please switch off your mobile phone.
- Although the questions are stated in English, you may answer in English or Dutch, whichever you are more comfortable with.
- Please provide your answers on this form. If you need more space, you may use extra sheets of paper.
- Indications like "[10]" at questions mean that you can obtain 10 points for that question.
- Fill in your name, student number, etc. at the top of this form, and on any extra sheets you are using.

Grading:

Question	1	2	3	4	Total
Score					
Maximum	22	31	18	19	90

Abbreviations

CDMA	-	Code Division Multiple Access
CSMA/CA	-	Carrier Sense Multiple Access with Collision Avoidance
DSDV	-	Destination Sequence Distance Vector
FDMA	-	Frequency Division Multiple Access
GPRS	-	General Packet Radio Service
GSM	-	Global System for Mobile Communication
HA	-	Home Agent
IP	-	Internet Protocol
RTS/CTS	-	Request To Send / Clear To Send
TDMA	-	Time Division Multiple Access
UMTS	-	Universal Mobile Telecommunication System

1 Propagation and medium access [22]

a) Explain how the RTS/CTS mechanism can, in theory, solve the exposed terminal problem?

b) Give a reason why this solution might not work in practice, considering the fact that transmission range and interference range of a node may not be the same.

c) Which propagation effect is combatted by antenna diversity (e.g., selection diversity). Explain how the effect works, and how it is counteracted.

d) Why are the antennas used for antenna diversity spaced half the wavelength apart?

e) How does Bluetooth deal with the hidden terminal problem when all nodes involved belong to the same piconet?

f) How does Bluetooth deal with the hidden terminal problem when involved nodes belong to different piconets?

2   Cellular Systems [31]

a) For cellular systems, a commonly used migration path for operators is to go from GSM to GPRS and from GPRS to UMTS. Give for both steps the essential difference of the new technology, compared to the previous one, the main difference in the service provided to the user, and the most important nodes that need to be added to or replaced in the network.

GSM → GPRS - difference in technology:

GSM → GPRS - difference in service:

GSM → GPRS - difference in nodes:

GPRS → UMTS - difference in technology:

GPRS → UMTS - difference in service:

GPRS → UMTS - difference in nodes:

b) What limits the number of active users in a cell in case of a FDMA/TDMA system (e.g. GSM)? And in case of a CDMA system (e.g. UMTS)?

FDMA/TDMA:

CDMA:

c) Why are both the location update procedure and the paging procedure needed in a cellular system?

d) In a cellular system, what is the effect of increasing the location area size on the volume of signaling traffic for the location update procedure? And for the paging procedure?

e) How is the volume of signaling traffic for the location update procedure influenced by the user behavior? And the volume of traffic for the paging procedure?

f) Explain how the reuse distance in a cellular system is affected by the required signal to interference ratio of the mobile receiver.

g) Why can the reuse distance be decreased when sectorized antennas are used?

h) Why is soft handover so important for good functioning of power control in UMTS? What happens w.r.t. power control if no soft handover is used in a system? How does a soft handover avoid this?

i) Why can a mobile operator implement his own authentication algorithm, and why can he not implement his won encryption algorithm? Discuss this both from a network and from a mobile phone point of view.

3 **Satellite Systems [18]**

   a) Why is satellite communications difficult with a low elevation?

   b) Mention 3 properties of geostationary satellites that are a disadvantage when they are used for a mobile telephony system but that are not a disadvantage when they are used for a tv broadcasting system. Explain your answer.

   c) How does the use of inter-satellite links affect the coverage area of a satellite system?

   d) Why does CSMA/CA not work in a satellite system?

   e) Explain why the channel efficiency in slotted Aloha is double the channel efficiency in standard (unslotted) Aloha.

4 Mobile IP [19]

Consider a scenario where two mobile hosts (host A and host B) using standard Mobile IP are both in the same foreign network. Both are using co-located care-of addresses. They both have the same home network and home agent HA.

a) Explain the flow of data packets in both directions between host A and host B using a diagram. Via which nodes are the packets going?

Assume that the various nodes have the following IP addresses (some nodes may have other IP addresses as well.):
- host A has home address 130.89.16.2 and care-of address 130.89.20.2
- host B has home address 130.89.16.3 and care-of address 130.89.20.3
- HA has IP address 130.89.18.1

Suppose host A is sending data packets to host B.

b) For each part of the path from host A to host B (as given in the answer to (a)), give the IP addresses that can be found in the headers of the data packets.

Suppose host A returns to its home network.

c) How does host A detect that it has returned to its home network? Mention the relevant protocol, protocol message, and message field used.

d) How does the home agent (HA) detect that host A has returned to its home network? Mention the relevant protocol, protocol message, and message field used.

e) Why does Mobile IP need tunnels to route packets to mobile hosts, whereas ad-hoc routing protocols (such as DSDV) do not?