ICT 9025: Mobile Applications and Technologies
Test 2 (Solutions)
[May 2022]

Instructions
Answer *all* the questions
Duration: 1 hour
Total Marks: 35

Write your answers in the answer sheets provided (ensure that your name and student ID are written at the top of each answer sheet submitted)

1) State which 3G network standard is the most dominant and explain why it became the most dominant. [2]
   UMTS (also known as **WCDMA**) is the most dominant 3G standard
   It became the most dominant because it was the official upgrade path to a 3G network from the most dominant 2G Network, GSM, as such it utilized GSM's established dominance.

2) Give two differences between 3G networks and 4G networks [2]
   - 3G networks uses circuit switching for voice-calls, 4G networks uses an all-IP network including VOIP (Voice Over IP).
   - 4G networks have faster data transmission speeds than 3G networks
   - 4G networks uses OFDMA and SC-FDMA access methods whereas 3G Networks use the CDMA access method

3) Regarding 2G networks that came before 3G networks: besides GSM and iDEN, name and describe two other 2G networks [4]

   - IS-54 North American TDMA
   - DECT and PHS
   - cdmaOne (also known as IS-95 CDMA)

   (Pick any two. See Lecture 03 slides 4 to 7 for more information)

4) Regarding LTE 4G Components:
   a. Explain what the P-GW does [1]
   b. Describe what the eNodeB does [2]
   c. Explain what the HSS does [2]
   d. State one function of the MME [1]

a) The P-GW (PDN Gateway) is a **gateway component** which **connects** the 4G Core Network to **external IP Networks** (like the Internet).
b) The eNodeB (Enhanced NodeB) allows user equipment (UE) to **connect to the 4G Network** using data transmissions sent as **radio signals** from the eNode to the UE and **vice versa**

c) The HSS (Home Subscriber Server) is **the main central database** which stores **information on users'** user identification, location, and subscriptions.

d) The MME: Manages data sessions,
manages user authentication,
manages network handover

5) Regarding the Wireless Application Protocol:
   a. What is the function of WAP [2]
   b. Explain the function of the WAP Gateway [2]
   c. Give the name of the markup language that WAP uses [1]
   d. WAP includes five Layers, give the name of one WAP Layer [1]

a) WAP provides Internet access on older mobile phones with lower resource capabilities using micro-browsers, WML and the WAP Gateway.
b) The WAP Gateway **converts** web content into an **encoded** format suitable for the older mobile phones. It **also decodes** WAP encoded content into a format suitable for Web Servers when necessary
c) Wireless Markup Language (WML)
d) WAP Layers:

- WAE (Application Environment)
- WSP (Session Layer)
- WTP (Transaction Layer)
- WTLS (Security Layer)
- WDP (Transport Layer)

(Pick any one layer, see Lecture 04 for more information)

6) State the differences between FDMA, TDMA and CDMA [3]

FDMA is technology which allocates 1 frequency to 1 user for communication over the network
TDMA allocates 1 frequency to multiple users, however, each user uses the frequency for a short time (known as a timeslot). After a few timeslots (such as 8 timeslots) the 1st user uses the frequency again and this process is repeated.
CDMA assigns a unique code to each user's data session such that multiple users can use multiple frequencies/ a range of frequencies (known as a spread spectrum) at the same time, but the system can distinguish and correctly forward each data transmission

7) Explain why LTE uses OFDMA for data downloads but uses SC-FDMA for data uploads [3]

OFDMA provides faster data transmission speeds however, on average it requires more power to transmit the radio signals (more than SC-FDMA) which is not a problem for the base stations but is not suitable for the user equipment/mobile phones

8) UMB was canceled, whereby LTE and WiMax became the most widely used 4G network technologies. Give the full name of UMB and give one reason why UMB was cancelled [2]

Ultra Mobile Broadband(UMB)was a 4G network standard; it was cancelled as WiMax gained more popularity and WiMax became the more preferred alternative to LTE, thus, with little adoption from service providers, UMB was cancelled.

9) Give two differences between LTE and WiMax [2]

- WiMax initially used TDD (Time Division Duplexing) whereas LTE initially used FDD.
- WiMax has better specification whereas LTE had flawed none-rigid specification
- WiMax was cheaper to implement whereas LTE is more expensive to implement
- WiMax requires its own network architecture whereas LTE can be implemented starting from existing 3G Network
- LTE Advanced has a higher theoretical maximum data transmission speed(300Mbps) than WiMax Advanced(100Mbs)

10) Regarding 3G networks

a. Name one 3G network developed by 3GPP [1]
b. Name one 3G network developed by 3GPP2 [1]
c. Describe any 3 components which are part of the 3GPP's 3G network [3]

a) UMTS (also known as WCDMA)
b) CDMA2000
c) WCDMA Components:

- GMSC
- MSC
- AUC
- HLR
- EIR
- GGSN
- SGSN
- RNC
- Node B
- IMS

(Pick and describe any three, see Lecture 03 slides 38 to 45)

Total: [35 marks]