

2017/2018 SEMESTER TWO EXAMINATION

Diploma in Engineering with Business
3rd Year Full Time

WIRELESS TECHNOLOGY APPLICATIONS

Time Allowed: 2.0 Hours

Instructions to Candidates

1. The examination rules set out on the last page of the answer booklet are to be complied with.
2. This paper consists of **TWO** sections :

Section A	-	10 Multiple Choice Questions, 2 marks each.
Section B	-	8 Short Questions, 10 marks each.
3. **ALL** questions are **COMPULSORY**.
4. All questions are to be answered in the answer booklet. Start each question in Sections B on a new page.
5. Fill in the Question Numbers, in the order that they were answered, in the boxes found on the front cover of the answer booklet under the column "Question Answered".
6. This paper consists of 12 pages.

SECTION A

MULTIPLE CHOICE QUESTIONS [2 marks each]

1. Please **tick** your answers in the **MCQ box** behind the front cover of the answer booklet.
2. No marks will be deducted for incorrect answers.

A1. Which one of the following IEEE 802 standards is a wireless technology using UHF frequency band to provide Ethernet access at maximum bit rate of 54 Mbps?

- (a) IEEE 802.11a
- (b) IEEE 802.11b
- (c) IEEE 802.15.1
- (d) IEEE 802.11g

A2. In a FDMA system with the channel bandwidth of 1 MHz, the frequency range is from 2015 MHz to 2095 MHz. How many channels are available to users?

- (a) 80
- (b) 81
- (c) 79
- (d) 78

A3. Figure A3 shows the signal waveform with the binary bit pattern (101001101)_b which was transmitted from an RFID tag to the reader in an RFID Item Management system. What type of signal coding methods is used in the signal waveform shown in Figure A3?

- (a) Miller Coding
- (b) Manchester Coding
- (c) Bi-phase Coding
- (d) Modified Milling Coding

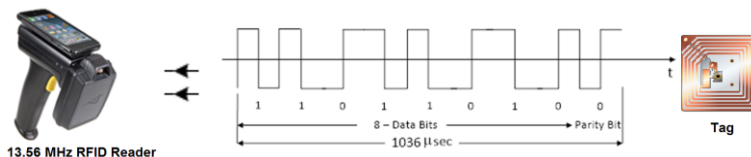


Figure A3

A4. Which one of the following options is TRUE for Mutual Symmetrical Authentication in RFID security?

- (a) Random no. R_A is generated at the reader.
- (b) Token 1 is transmitted from tag to reader.
- (c) Token 2 is transmitted from tag to reader.
- (d) Random no. R_B is generated at the tag.

- A5. How many non-overlapping channels are available in WLAN IEEE802.11a?
- (a) 10 channels
 - (b) 12 channels
 - (c) 14 channels
 - (d) 16 channels
- A6. Which one of the following options is the most suitable reason for using the ZigBee technology in Environmental Monitoring Applications?
- (a) Reliability, simplicity, low power and low cost.
 - (b) Using license free frequency band.
 - (c) Specifications based on IEEE 802.15.4.
 - (d) 16 frequency channels in ZigBee technology.
- A7. Which one of the following modulation techniques is used in Bluetooth low energy (BLE)?
- (a) QPSK
 - (b) 8PSK
 - (c) G2FSK
 - (d) GMSK
- A8. In 3G UMTS system, the user equipment, UE transmits in 1920 MHz to 1980 MHz frequency range and Node Bs transmit in 2110 MHz to 2170 MHz frequency range. What is the reason that the uplink frequency is lower than the downlink frequency?
- (a) UE is movable.
 - (b) Node Bs are fixed.
 - (c) UE is powered by battery.
 - (d) Node Bs are larger than UE.

A9. Which one of the following is the function provided by the MAC convergence sublayer of IEEE 802.16 WiMAX?

- (a) Provides subscribers with privacy
- (b) Formats SDUs from the upper layers according to MAC PDU format
- (c) Enables QoS requirement
- (d) Enables Encryption

A10. Which one of the following options is the most important factor to be included in wireless site survey for building a Wireless Infrastructure for Business?

- (a) Measuring the strength and quality of the signal
- (b) Determining the costs of the project
- (c) Sending out a request for information (RFI)
- (d) Conducting training for all users

SECTION B [80 Marks]

- B1. Figure B1.1 shows the two data bytes (F7_h & 31_h) and the 4-bit CRC check sum “(0101)_b” which were received by an RFID tag in 0.5 msec using CRC error checking. Figure B1.2 shows the **intermediate** output checksum “(0001)_b” of the data byte (F7_h) being divided by the given generator polynomial (X^4+X^3+1) as an example.

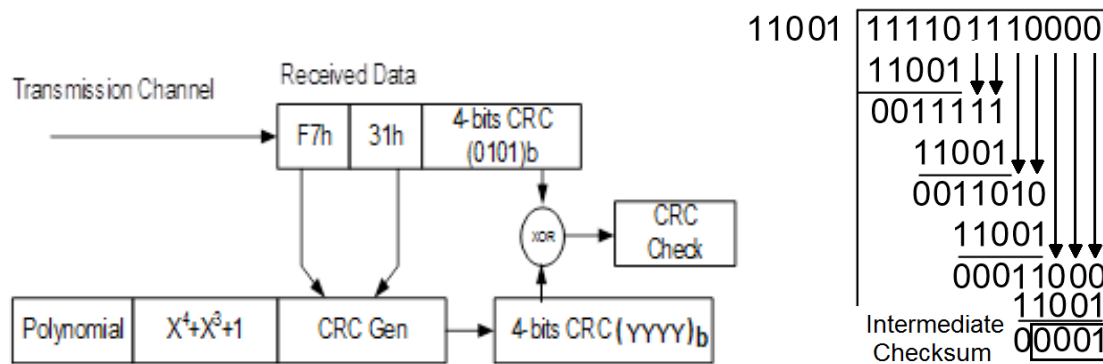


Figure B1.1

Figure B1.2

- How many bits are required to be transmitted in total as shown in Figure B1.1?
(1 mark)
- Determine the final 4-bit CRC check sum output “(YYYY)_b”. Show your calculation in your answer.
(3 marks)
- If the received 4-bit CRC check sum is “(0101)_b” as in the Figure B1.1, is there any error in the received data?
(1 mark)
- Calculate the data transfer rate of this RFID system in kbps?
Hint: 1 byte = 8 bits
(2 marks)
- List two advantages of a passive RFID compared to an active RFID.
(2 marks)
- Between the two main categories of RFID systems, namely **near-field systems** and **far-field systems**, which RFID system employs the inductive coupling and reactive energy?
(1 mark)

- B2. Figure B2.1 shows the infrastructure mode for IEEE 802.11 WLAN standard and Figure B2.2 shows the three local states for a STA in IEEE 802.11 WLAN standard.

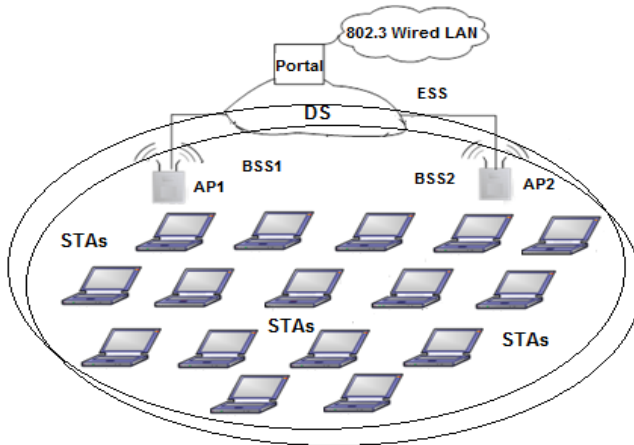


Figure B2.1

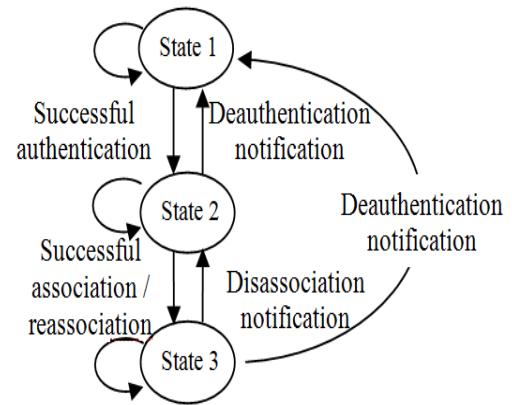


Figure B2.2

- Which entity found in Figure B2.1 is to provide the routing of packets from one AP to another AP to communicate seamlessly among all the STAs at different BSSs?
(1 mark)
- Which entity found in Figure B2.1 is a collection of devices that can transmit and receive to one another within the RF transmission range?
(1 mark)
- What ESS configuration is represented by BSS1 and BSS2 in Figure B2.1?
(1 mark)
- What are the values of the two variables used in Initial State 1 in Figure B2.2?
(2 marks)
- What are the values of the two variables used in State 2 in Figure B2.2?
(2 marks)
- What are the values of the two variables used in State 3 in Figure B2.2?
(2 marks)
- Which WLAN logical service is used for terminating an existing association?
(1 mark)

- B3. The protocol stack of the ZigBee technology is illustrated in Figure B3.1. Figure B3.2 shows the routing of frames/messages when a designated device comes and joins into a ZigBee network with a cluster head.

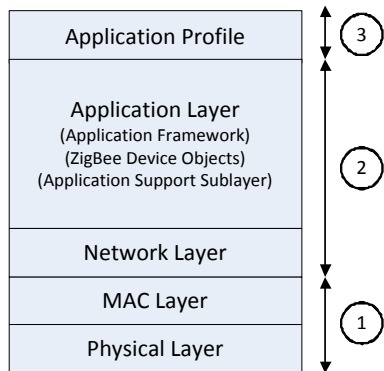


Figure B3.1

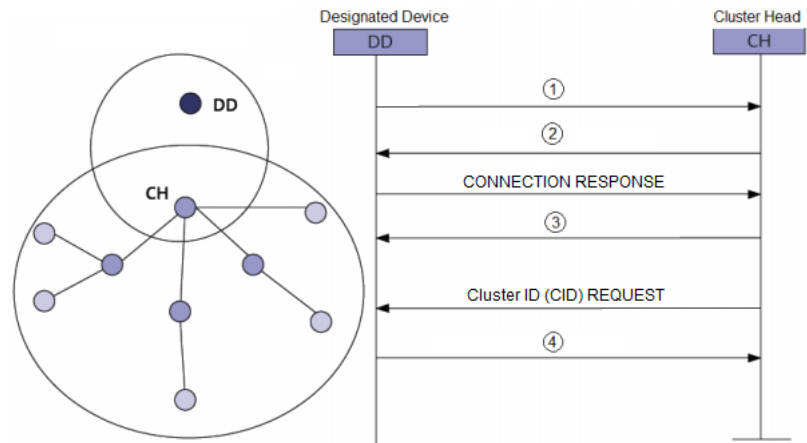


Figure B3.2

- Which one of the layers in ZigBee technology is defined by the customer?
(1 mark)
- Name the organization/promoter who builds on IEEE 802 standard and defines the network and application layers in the ZigBee wireless technology.
(1 mark)
- Which layer defines the channel access mechanism called CSMA/CA in the ZigBee wireless technology?
(1 mark)
- There are three network topologies in the ZigBee technology. Name the network topology used in Figure B3.2.
(1 mark)
- There are two types of devices in the ZigBee technology. Name the device that was defined by IEEE 802.15.4 and is able to act as a coordinator or a router.
(1 mark)
- From Figure B3.2, determine the transmitted messages/frames (frame ①, ②, ③ & ④) between the designated device and cluster head.
(4 marks)
- Two modulation techniques namely BPSK, O-QPSK are used in ZigBee technology. Which modulation technique is used to provide the maximum bitrate of 40 kbps for ZigBee?
(1 mark)

- B4. Figures B4 shows the timing diagram of transmitted packets among a master Bluetooth device and two Bluetooth slaves.

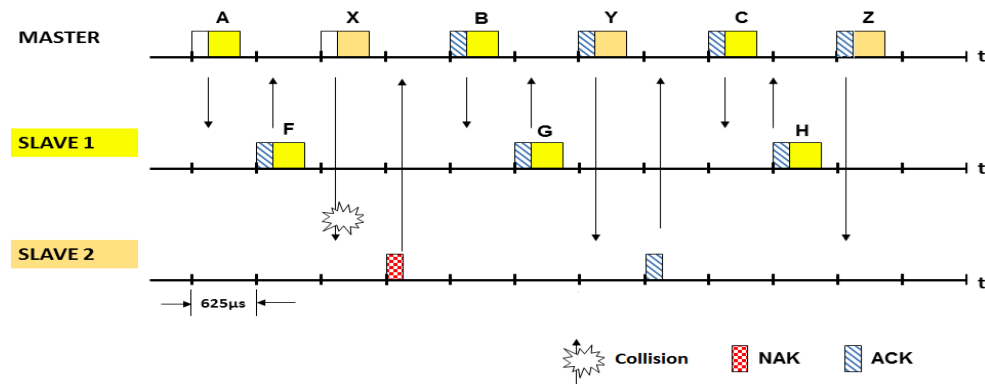


Figure B4

- Name the network topology given in Figure B4 with regard to the Bluetooth technology. (1 mark)
- What is the packet size (in number of slots) was used in the above Bluetooth transmission? (1 mark)
- Time Division Duplex (TDD) was used to provide two way communications in Bluetooth technology. Which time slot is used by the master Bluetooth device in the above Bluetooth network? (1 mark)
- Which type of the physical links was used between the Bluetooth master device and slave 1 in Figure B4? (1 mark)
- Name the **retransmitted packet from the master** to the slave 2 Bluetooth device during the above transmission due to collision. (1 mark)
- What is the maximum number of links **for audio** in Bluetooth that a master device can support? (1 mark)
- Name one of the applications that uses File Transfer Profile in Bluetooth Technology. (1 mark)
- Name one of the applications that uses Human Interface Device Profile in Bluetooth Technology. (1 mark)
- Name one of the applications that uses Hand Free Profile in Bluetooth Technology. (1 mark)
- What is the lowest layer of Bluetooth protocol stack which defines how the basic hardware that controls the radio transmissions functions? (1 mark)

- B5. Table B5.1 shows the transmit power of Bluetooth radio used in Bluetooth Classic. The specifications of Bluetooth Basic and Bluetooth Low Energy are also given in Table B5.2.

Transmit Power (mW)	Transmit Power (dBm)	Class	Typical Range meters
2.5 mW		Class (__)	
100 mW		Class (__)	
1 mW		Class (__)	

Table B5.1

Serial No.	Technical Specification	Detail Descriptions	Mode of Bluetooth (Classic OR BLE)
i	Distance/Range (theoretical max.)	50 m (160 ft)	
ii	Over the air data rate	1 Mbit/s	
iii	Application throughput	0.7–2.1 Mbit/s	
iv	Active slaves	7	
v	Latency (from a non-connected state)	6 ms	
vi	Voice capable	Yes	
vii	Frequency channel	40 channels with 2-MHz BW	
viii	Modulation techniques	GFSK, 4PSK, 8PSK	

Table B5.2

- (a) Copy the Table B5.1 into your answer booklet and complete the table with their respective power in dBm, the Bluetooth power classes and their perspective typical distance?
(6 marks)
- (b) Copy the Table B5.2 into your answer booklet and complete the table with their respective Bluetooth Mode?
(4 marks)

B6. Figure B6 shows the network architecture of the WiMAX technology.

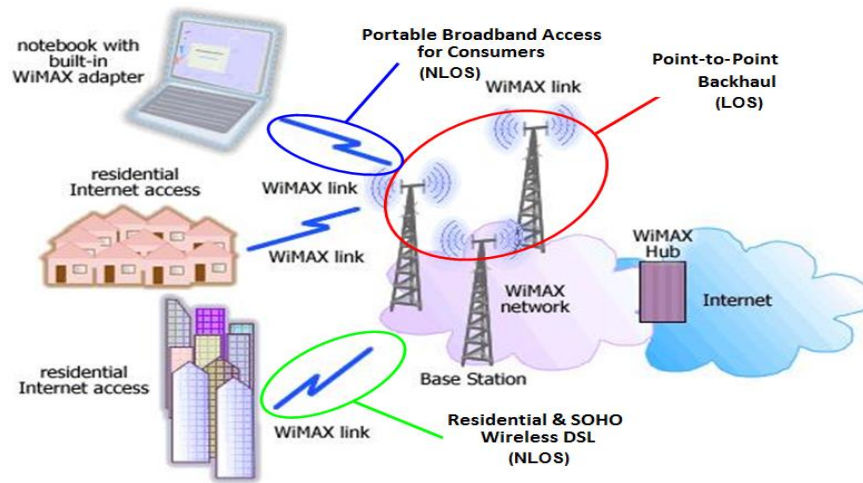


Figure B6

- (a) Which multiple access technique is used in WiMAX? (1 mark)
- (b) Which WiMAX standard is used to connect between the WiMAX gateway and WiMAX stationary users? (1 mark)
- (c) What is the frequency range of the WiMAX standards that requires line-of-sight (LOS) operation for point-to-point communication for Internet Backbone applications? (1 mark)
- (d) What are the two different characteristics between the WirelessMAN-SC and WirelessMAN-SCa physical layer implementations? (2 marks)
- (e) Which physical layer feature is used to build in support of addressing multipath in outdoor LOS and NLOS environments? (1 mark)
- (f) Which feature of WiMAX is to minimize the interference between the WiMAX stations by changing the frequency bands? (1 mark)
- (g) Which MAC sublayer of WiMAX supports a variety of backhaul requirements including ATM, Ethernet, IPv4, IPv6 and VLAN? (1 mark)
- (h) Which MAC sublayer of WiMAX implements the QoS requirements using four service classes such as UGS, rtPS, nrtPS and BE? (1 mark)
- (i) Which relevant layer performs the authentication of a legitimate user in WiMAX network? (1 mark)

B7. Figures B7.1 and B7.2 show the three main sections of 2.5G, “GPRS” and 3G, “UMTS” architectures respectively.

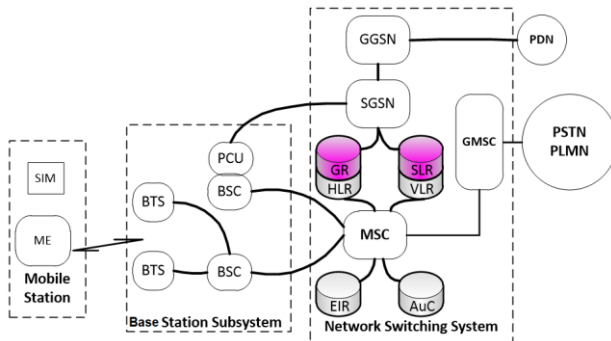


Figure B7.1

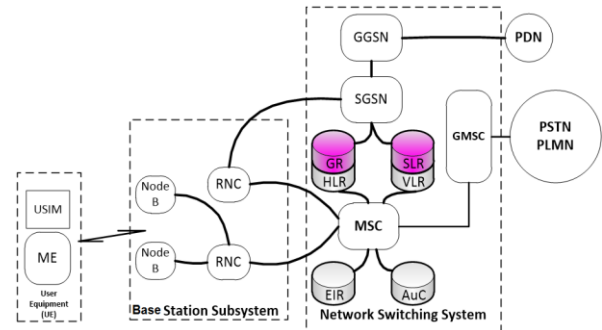


Figure B7.2

- (a) By comparison between the two architectures, which of the subsystems were required to make changes from 2.5G to 3G? (2 marks)
- (b) Which of the network components in 2.5G requires to be changed to user equipment in 3G? (1 mark)
- (c) Which of the network components in 2.5G requires to be changed to Node B in 3G? (1 mark)
- (d) Which of the network components in 2.5G requires to be changed to RNC in 3G? (1 mark)
- (e) What is the air interface used in 2.5G between MS and BTS? (1 mark)
- (f) What is the air interface used in 3G between UE and Node B? (1 mark)
- (g) State one of the similarities between the BTS in 2.5G and Node B in 3G. (1 mark)
- (h) State one of the differences between the BSC in 2.5 G and RNC in 3G? (1 mark)
- (i) Which functional block in UMTS is responsible for encryption of communications between mobiles users? (1 mark)

- B8. There is a need to set up a wireless system for a **Smart City** to monitor of temperature and humidity of the environments consisting of more than 300 locations at seven different city centers. Figure B8 shows the **sample** architecture of the **proposed system**.

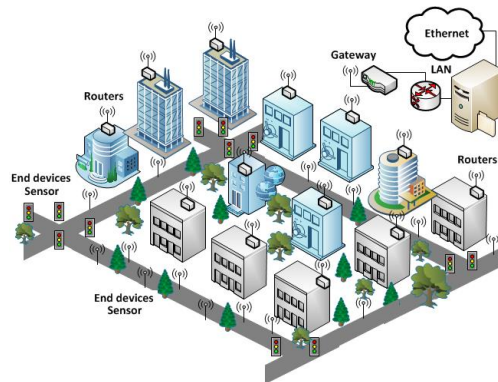


Figure B8

- (a) Name one of the most suitable wireless technologies to be used in this proposed system to monitor the temperature and humidity of environments and send information to the backend as well. (1 mark)
- (b) After the organizational assessment, it was confirmed that the existing network infrastructure need to be upgraded using wireless technologies, what is the next step to be done? (1 mark)
- (c) List any two important factors that need to be considered during the organizational assessment. (2 marks)
- (d) Which document is required to be sent out to gather information in order to set up a new wireless infrastructure for the organization? (1 mark)
- (e) After the company has collected potential solutions from vendor and conducted independent research, what is the important factor to be determined? (1 mark)
- (f) Explain the difference between the request for proposal (RFP) and request for quotation (RFQ). (2 marks)
- (g) Making an investment in wireless technology involves the efforts of many people. Which group is the most important to be involved? (1 mark)
- (h) **Different applications** often have different network requirements. Among Banking, Educational Institution, Manufacturing, which one of the industries must have the networks offering a very high degree of security? (1 mark)

***** END OF PAPER *****