Solutions for Sample Final Exam: 2023 Term 3

MCQ1. 01100011
MCQ2. 37
MCQ3. About 12%
MCQ4. None of these
MCQ5. LTE-M
MCQ6. Class A
MCQ7. Longer than 2ms
MCQ8. FMCW radars estimate range by transmitting chirps
MCQ9. 60 degree

ESSAY 1.

"Bluetooth (BT) provides relatively low data rates for supporting short-range (<10m), wireless personal area network (WPANs) applications in the 5 GHz ISM band using frequency-hopping spread spectrum techniques. BT's radio hops at a nominal rate of 1600 hops/ms in a pseudo-random manner through a set of 79 2-MHz-wide channels available in 5 GHz band. The basic architectural unit in a BT system is the scatternet, consisting of a master device and a maximum of eight active slave devices, which only communicate with the master. The master device determines the hopping sequence, the timing and the scheduling of all packets in the scatternet. Time is divided into slots of 625 ms. The master starts its transmissions in odd-numbered time slots only, and the slave starts its transmissions in even-numbered slots only. For single-slot-packet transmission, the hop frequency changes every slot. Multi-slot-packets are restricted to 3 or 4 consecutive slots in which the hop frequency follows that of the first slot throughout the transmission."

SOL:

1. 5 GHz → 2.4 GHz
2. 1600 hops/ms → 1600 hops/s
3. 2-MHz-wide → 1-MHz-wide
4. 5 GHz → 2.4 GHz
5. scatternet → piconet
6. eight → seven
7. scatternet → piconet
8. 625 ms → 625 us
9. odd-numbered → even-numbered
10. even-numbered → odd-numbered
11. 4 consecutive slots → 5 consecutive slots

ESSAY2.

SOL Q1: The ones transmitted with CM_min=15 are originals.
T1: original transmission and successful (because at T2 CW has not increased)
T2: original
T3: retransmission
T4: original
T5: retransmission
T6: retransmission
T7: retransmission
T8: retransmission
T9: original
T10: retransmission

(1) 6 retransmissions
(2) 127

ESSAY3.

There are 6 different SFs, 7 to 12, which means only 6 devices can be active simultaneously. With 1% duty cycling, 6/0.01 = 600 devices can be connected.

ESSAY4.

Yes, it would work in principle. If the non-linear function is known, then the frequency difference between Tx-Rx signals at different times would also be known (note that frequency difference is not the same at different parts of the chirp), it would be possible to know the time of flight.

ESSAY5.

From 10 Mbps to 25 Mbps is a 2.5x increase. 16-QAM yields 4 bits per symbol. We need 4x2.5 = 10 bits per symbol to achieve 2.5x increase data rate. 1024-QAM would give 10 bits per symbol.

ESSAY6.

Larger the distance, the higher the SF allocation usually. Based on this concept, a possible allocation could be as follows: Device 5 (SF7), Device 4 (SF8), Device 1 (SF9), Device 3 (SF10), Device 2 (SF11)

End of Sample Final Exam