

City University of Hong Kong
Department of Electrical Engineering

EE4316 Mobile Data Networks

Solution to Test 2

1. All cells in a UMTS radio network use the same frequency, no frequency planning is required. [2 marks]
2. Soft handover. [1 mark]
3. Node B, RNC (or Radio Network Controller). [2 marks]

4.

a. Using

$$L = 6R \left[\frac{1}{3} + \frac{1}{2\sqrt{3N} - 3} \right]$$

$$L = 6 \times 0.5 \left[\frac{1}{3} + \frac{1}{2\sqrt{3 \times 10} - 3} \right] = 1.377 \text{ km}$$

$$\lambda_{LU}^j = \frac{vL\rho}{\pi} = \frac{10 \times 1.377 \times 10000}{\pi} = 43831 \text{ LUs/hour}$$

[5 marks]

b. Mean duration of LU = $\frac{20 \times 0.6 + 40 \times 3 + 60 \times 5}{120} = 3.6 \text{ s}$

$$\text{Traffic intensity} = 43831 \times \frac{3.6}{3600} = 43.831 \text{ Erlang}$$

From Erlang B table, to achieve 1% blocking, the number of time slots = 57, which is equivalent to $\text{ceil}(57/8) = 8$ channels

[10 marks]

5.

- a. Packet control unit (PCU), Serving GPRS support node (SGSN) and Gateway GPRS support node

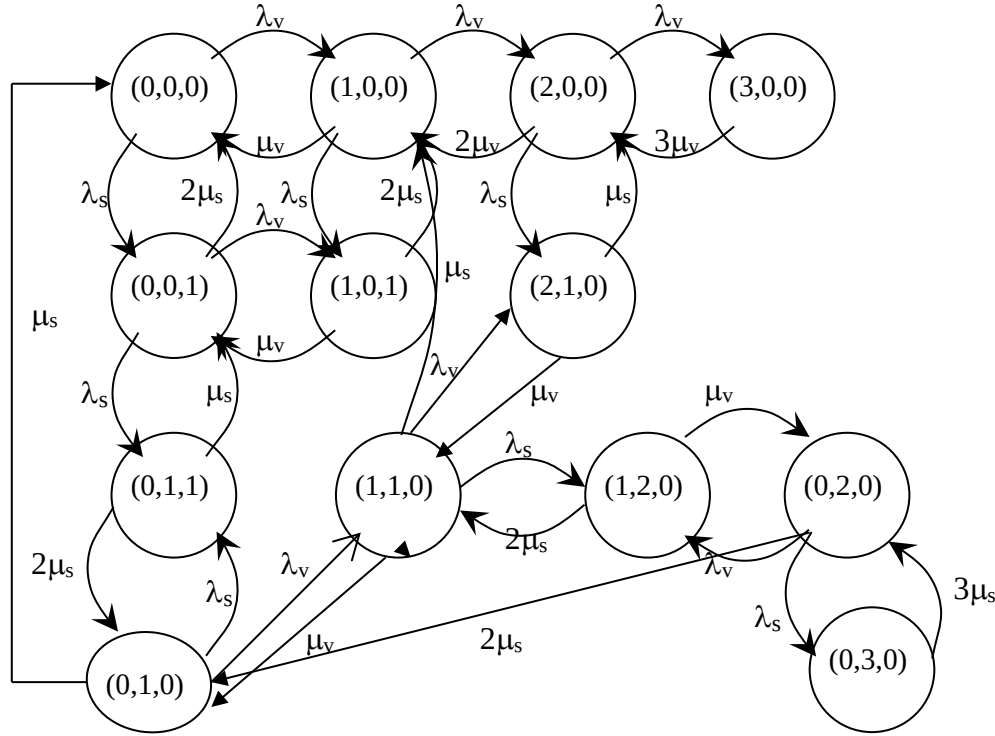
The PCU handles the data packetizing process and communicates with SGSN.

The SGSN is responsible for delivery of packets to the MS in its service area and from the MS to the Internet. It also performs the logical link management, authentication, and charging functions.

The GGSN acts as a logical interface to the Internet. It maintains routing information related to a MS, so that it can route packets to the SGSN servicing the MS. It analyses the PDN address of the MS and converts it to the corresponding IMSI.

[6 marks]

b. $C=3, M=2$



[15 marks]

6.

- a. Prob. that both mobile transmits at the same time in any one of the 8 time slots $= 1/8 * 1/8 = 1/64 = 0.015625$, and collision can occur at any one of the eight slots, therefore prob of collision $= 8 * 1/64 = 0.125$

Therefore, prob of no collision $= 1 - 8(\frac{1}{8} \times \frac{1}{8}) = \frac{7}{8} (=0.875)$

[3 marks]

b. Define:

F_i = prob[collision on attempt i], where $i = 1, 2, \dots, 6$

P_i = prob[collision on first $i-1$ attempt, and succeed on the i^{th}]

$F_i = 1/8 = 0.125$ for all i

$P_i = F_1 \times F_2 \times F_3 \times \dots \times F_{i-1} \times (1 - F_i) = (0.125)^{i-1} \times 0.875$

or

$$P_1 = 7/8 = 0.875$$

$$P_2 = \frac{1}{8} \times \frac{7}{8} = 0.125 \times 0.875 = 0.1097$$

$$P_3 = \frac{1}{8} \times \frac{1}{8} \times \frac{7}{8} = 0.125 \times 0.125 \times 0.875 = 0.01367$$

$$P_4 = \frac{1}{8} \times \frac{1}{8} \times \frac{1}{8} \times \frac{7}{8} = 0.125 \times 0.125 \times 0.125 \times 0.875 = 0.001709$$

$$P_5 = \frac{1}{8} \times \frac{1}{8} \times \frac{1}{8} \times \frac{1}{8} \times \frac{7}{8} = 0.125 \times 0.125 \times 0.125 \times 0.125 \times 0.875 = 0.0002136$$

$$P_6 = \frac{1}{8} \times \frac{1}{8} \times \frac{1}{8} \times \frac{1}{8} \times \frac{1}{8} \times \frac{7}{8} = 0.125 \times 0.125 \times 0.125 \times 0.125 \times 0.125 \times 0.875 = 2.67 \times 10^{-5}$$

Further attempts are not allowed as MAX_RETRANS=5.

$$\begin{aligned} E[\text{number of attempts for successful access}] &= \sum_{i=1}^6 i p_i \\ &= 0.875 + 2 \times 0.1097 + 3 \times 0.01367 + 4 \times 0.001709 + 5 \times 0.0002136 + 6 \times 2.67 \\ &\quad \times 10^{-5} \\ &= 1.1065 \end{aligned}$$

[12 marks]

7. For the data rate supported by 4G networks, the inter-symbol interference becomes so significant that the received symbols are easily corrupted if single carrier frequency is used. When OFDM is used, the transmitted symbols are spread among multiple carriers. As a result, the symbol rate in each carrier is much lower, and the inter-symbol interference can be tolerated.

[4 marks]