Data Provided: None

DEPARTMENT OF ELECTRONIC AND ELECTRICAL ENGINEERING

Spring Semester 2008-2009 (2 hours)

Mobile Networks and Low Level Protocols 6

Answer **THREE** questions. **No marks will be awarded for solutions to a fourth question.** Solutions will be considered in the order that they are presented in the answer book. Trial answers will be ignored if they are clearly crossed out. **The numbers given after each section of a question indicate the relative weighting of that section.** Where a symbol or abbreviation is not defined it can be assumed to have its usual meaning, with which candidates should be familiar.

1. **a.** Describe the type of bit sequences and their duration in a normal burst within the *GSM* protocol, and which logical channels are mapped onto it. **(8)**

   b. If a *GSM* mobile handset transmits a normal burst in one time slot per frame on the uplink, draw a calibrated sketch of the resulting signal spectrum, explaining any Fourier techniques used in its derivation. Assume for simplicity that all the *FSK* bits are set equal at *1800MHz*, and that power ramping is instantaneous. **(10)**

   c. Hence explain briefly why a *GSM* handset sometimes causes a 'buzzing' noise in audio equipment. **(2)**

2. **a.** Sketch the bit sequence in a random access burst in the *GSM* protocol, and explain its purpose. **(7)**

   b. A handset is instructed to use a Time Advance of *20* by the network. Estimate the distance of the handset from the *BTS*. Explain why the maximum coverage of a *GSM* cell is limited compared to an analogue cell. Assume $c = 3 \times 10^8 \, m/s$. **(7)**

   c. Explain how location information about a handset user could be obtained using the *TA*, and discuss its accuracy. Compare this with *GPS* derived data. **(6)**

3. **a.** Sketch block diagrams of the dedicated channel (*DPDCH* and *DPCCH*) frame structures in the uplink and downlink directions in the *3G* mobile system, and briefly describe their payloads. **(7)**

b. Describe how these channels are transmitted over the physical layer. A detailed explanation of *CDMA* is not required, but quantitative information such as data and chip rates should be given where appropriate and the modulation schemes explained. **(7)**

c. If a spreading factor of *32* is used, give the following parameters for (I) the uplink *DPDCH* and (II) the downlink *DPCH*:

    (i)   The symbol rate

    (ii)   The bit rate

    (iii)   The maximum user data rate with ½ rate coding. **(6)**

4. **a.** List the main differences between the *3G* and *GSM* air interfaces. **(6)**

b. Explain why frequency diversity is used in mobile systems, and describe the different implementations of this in *GSM* and *3G*. **(8)**

c. A *BTS* transmits signal components at *2.0GHz* and *2.005GHz* which are received at the mobile handset via a direct path and an indirect reflected path. If the effective path length difference between the two paths is *150.075m* (including any phase shift at reflection), comment on the relative amplitudes of the signal components at the handset. Assume $c = 3 \times 10^8 m/s$. **(6)**

GGC