

OLLSCOIL NA hÉIREANN, GAILLIMH
THE NATIONAL UNIVERSITY OF IRELAND, GALWAY

SEMESTER I EXAMINATIONS, 2002

B.E. DEGREE EXAMINATION (ELECTRONIC ENGINEERING)
B.E. DEGREE EXAMINATION (ELECTRONIC AND COMPUTER ENGINEERING)

COMMUNICATION SYSTEMS ENGINEERING II

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Duration of examination: *Two Hours*

Instructions: Answer any *Four* questions.

1. (a) Explain what you understand by the following terms in the context of the PSTN:

- (i) Gateway exchange,
- (ii) Transit exchange,
- (iii) Local exchange,
- (iv) Local loop.

[4 marks]

(b) Outline the role of the **Subscriber Line Interface Circuit (SLIC)** in the PSTN and describe the role of the **BORSCHT** functions which are implemented by a typical SLIC.

[11 marks]

(c) Signaling information relating to specific voice calls in the PSTN can be conveyed between exchanges over an E1 TDM link using any of the three techniques below:

- (i) Digitised in-band tones,
- (ii) TS16 based bit toggling,
- (iii) Multi-byte digital messages.

For each technique:

- (i) Explain, using a specific example, how precisely the signaling information is conveyed over the E1 TDM link,
- (ii) Clearly explain why the technique is either a CAS or CCS protocol,
- (iii) Indicate **one** advantage and **one** disadvantage of the technique.

[10 marks]

2. (a) Describe any **TWO** advantages of a digital local loop as implemented in ISDN.

[4 marks]

(b) Using a diagram of the ISDN BRI reference model, explain the meaning of the following terms:

- (i) Network Termination (Type 1),
- (ii) Terminal Adapter,
- (iii) Terminal Equipment (Type 1 and 2),
- (iv) S/T interface,

(v) U interface.

[7 marks]

(c) Describe the role of the following bits which are transmitted in the Layer 1 frame of an ISDN basic rate connection:

- (i) B bits,
- (ii) D bits,
- (iii) E bits,
- (iv) L bits.

[8 marks]

(d) Explain, stating specific examples, the meaning of **bearer services, supplementary services and tele-services** in the context of ISDN.

[6 marks]

3. (a) Explain TWO methods for calculating the traffic through a telecommunication device when traffic is measures in units of Erlangs, clearly indicating under what conditions each definition would be applicable.

[4 marks]

(b) A small business currently uses a single basic rate interface to connect it to the ISDN. It is estimated that during the busy hour of traffic, approximately one in five call attempts fail due to the lack of an available B channel on the ISDN interface. Given that the average call holding time is 3 minutes in duration, determine the average number of call attempts made during this busy hour.

If the company installs a second ISDN basic rate interface, determine the overall GOS which these two basic rate interfaces will provide.

[8 marks]

(c) A business based in two sites currently uses PSTN dial up connections for all calls between the two sites. The annual bill for calls between the two sites is £50,000. On analyzing the call patterns between the two sites, it was estimated that the busy hour traffic between the two sites was 125 calls per hour with an average call holding time of 8 minutes. Additionally, it was estimated that 1 in 100 call attempts made over the PSTN failed due to network congestion.

Determine if it would be cost effective for the company to utilize a lease line between the two sites, given a cost of £1,500 per channel on the leased line. You may wish to use figure 1, at the end of the paper, in completing this design.

[5 marks]

(d) Explain what you understand by the following terms in the context of satellite communication systems: **Look Angles** and **Radiation Pattern**.

[4 marks]

(e) Outline any TWO advantages AND TWO disadvantages which **geo-stationary satellites** have compared to **orbital satellites**.

[4 marks]

4. (a) Determine, from first principles, the **optimum throughput** and associated **average number of attempts to achieve successful transmission** of a satellite network, which has an access mechanism, based on a **slotted ALOHA** protocol. Clearly state any assumptions which you are making.

[10 marks]

(b) A slotted ALOHA system is operating such that 50% of slots contain collisions due to multiple earth stations attempting to transmit simultaneously. If all earth stations have a probability of transmitting during a timeslot of 0.05, determine:

- (i) The average number of frame transmission attempts in the timeslot period (to one decimal place),
- (ii) The number of earth stations in the system,
- (iii) The average number of attempts required to ensure successful transmission of a frame.

[7 marks]

(c) Discuss the role of **speech compression** AND **digital speech interpolation** technologies in increasing the capacity of a satellite link in carrying voice calls.

[8 marks]

5. (a) Explain the meaning of the following terms in the context of cellular telephony networks: **cells**, **frequency re-use** and **trunking**.

[6 marks]

(b) Explain why, in the GSM system, the Random Access Burst is substantially shorter than the Normal Burst generated by transmitters.

In the GSM specification, the bit rate transmitted on the radio carrier is 270 kbps. Given that a single GSM burst period has a duration of 156.25 bits. If it was desired that a GSM cell should only have a maximum radius of 50 km, determine the duration of Random Access Burst, which would have to be used in this system.

[5 marks]

(c) Subscribers A and B are clients of a GSM network in Ireland. Subscriber A travels to France but before leaving Ireland, A sets up a diversion for voice calls to his/her voicemail, applicable to when the subscriber is in an area with no network coverage. While in France, A moves into an area with no network coverage and very shortly after this (less than a minute), a call is made to A from B. Describe, with the aid of a diagram, how the GSM networks in A and B handle this call.

[8 marks]

(d) Describe the operation of any TWO techniques that provide security for the transmissions between a mobile station and base station.

[6 marks]

6. (a) Describe the role of the following terms, in the context of the GSM Air Interface:

- (i) Time Division Duplexing,
- (ii) Timing Advance,
- (iii) Adaptive Power Control,
- (iv) Discontinuous Transmission.

[8 marks]

(b) Describe (i) the general type of information type carried on, and (ii) the physical transmission channel of the following logical channels in a GSM network.

- (i) Broadcast Control Channels,
- (ii) Common Control Channels,
- (iii) Associated Control Channels.

[9 marks]

(c) Describe the various types of call handover which are supported within GSM networks. Your answer should also include a description of the algorithms typically used to decide when a GSM call should be handed over from one cell to another.

[8 marks]