

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

SEMESTER II EXAMINATIONS, 2000

B.E. DEGREE EXAMINATION (ELECTRONIC ENGINEERING)

COMMUNICATION SYSTEMS ENGINEERING II

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Duration of examination: *Two Hours*

Instructions: Answer any *Four* questions.

1. (a) 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.

[10 marks]

(b) Describe, using a diagram, how a time division multiplexing is used on an E1 link. In your answer, you must outline the use of the various timeslots, which constitute an E1 TDM frame.

[7 marks]

(c) Describe the operation, and two advantages, of one **CCS** AND one **CAS** technique, which can be used to conveying signalling information between exchanges over E1 TDM links.

[8 marks]

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

[4 marks]

(b) What do you understand by the term **ISDN Basic Rate Interface (BRI)** ?

[5 marks]

(c) 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]

(d) Explain, stating examples, the meaning of **bearer service** AND **supplementary service** in the context of ISDN.

[4 marks]

(e) Describe the operation of the ISDN **frame relay service** and outline **TWO** disadvantages of frame relay compared to more traditional packet switched services.

[5 marks]

[pto]

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 large business is currently using PSTN dial up lines to carry voice traffic between two sites. The busy hour traffic between the two sites is 50 calls with an average call holding time of 1.5 minutes. The company plans to install a 48kbps leased satellite link between the two sites, which is subdivided into timeslots of 4kbps. The first 4kbps in every frame is used for framing purposes and cannot be used. Additionally, voice traffic that is being carried over the satellite link is compressed to 8kbps between the two sites.

A telecommunications engineer monitors the signalling traffic associated with the voice calls and determines that a reliable "worst case" estimate of the signalling traffic associated with EVERY call is 24000 bits.

- (i) Using this estimate of signalling traffic, determine how many 4kbps timeslots need to be allocated as common signalling channels in order to achieve a GOS of 0.1% for signalling traffic over the proposed satellite link. **Note:** If you fail to determine an answer for this part, you may assume that the answer is 3 timeslots for use in part (ii).
- (ii) Determine the GOS, which would be achievable for the voice traffic over the links, after the framing and signalling timeslot capacity, determined in (i), have been allocated.
- (iii) Comment as to whether the GOS, as determined in (ii), would typically be deemed acceptable for voice traffic.

You may assume that you can use Erlang's B formula below, in both cases.

$$E_1(n, A_0) = \frac{\frac{A_0^n}{n!}}{\sum_{i=0}^n \frac{A_0^i}{i!}}$$

[13 marks]

(c) Explain what you understand by the following terms in the context of satellite communication systems : **Look Angles and Radiation Pattern.** [4 marks]

(d) 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 with a throughput of 0.25 (25%). Determine the (higher of the two possible) number of earth stations in the system if the average probability of an earth station transmitting during a frame period is 0.05. Figure 1, at the end of this paper, may be used to provide an initial guess at the value of G to use in answering this question. [3 marks]

(c) A TDMA satellite network is operating with the following parameters:

Bit Rate	2 Mbps
Frame Length	2000 ms
Timeslots per Frame	10 timeslots
Earth Station Preamble	6 bits
Guard period per timeslot	5% of earth station's actual transmission time (Transmission time for preamble + user data)

In the first timeslot of each TDMA frame, a reference earth station transmits a single reference preamble of 15 bits but without any additional user information.

Determine for this TDMA system,

- (i) The maximum length of user data that an individual earth station can transmit (to the nearest byte) in a single frame on this network,
- (ii) An efficiency value for the TDMA frame transmission.

[4 marks]

(d) 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.

The random access burst used by GSM mobiles has a duration of 88 bits at the GSM transmission bit rate of 270 kbps. Given that a single GSM burst period has a duration of 156.25 bits, show that the maximum size of a GSM cell is just under 40 km.

[4 marks]

(c) Describe, using a diagram, the structure of a typical GSM network and the role of the following devices in such a network.

- (i) Subscriber Identity Module,
- (ii) Mobile Equipment,
- (iii) Base Station Subsystem,
- (iv) Home Location Register,
- (v) Visitor Location Register,
- (vi) Authentication Centre,

[15 marks]

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

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

[12 marks]

[pto]

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

[8 marks]

(c) Explain the meaning of the term **handover** in a GSM network and describe the procedure involved in a typical call handover within the GSM network

[5 marks]

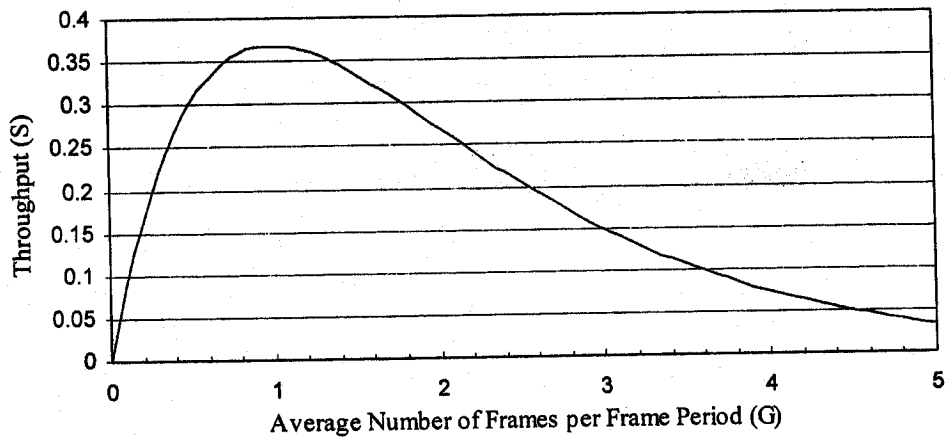


Figure 1 – Graph of Throughput for a Slotted ALOHA transmission system