University of South Wales
Prifysgol De Cymru

UNIVERSITY OF SOUTH WALES
Assessment Cover Sheet and Feedback Form
2017/18

Module Code:	Module Title:	Lecturer:
NG4S800	Satellite Networking	**Prof I Otung**
Assignment No: 1	**No. of pages in total including this page:**	**Maximum Word Count:**

Assignment Title: Selected Fundamental Theories in Satellite Networking

Tasks:

Evaluation of various satellite network topologies.

Design of a telephone exchange with analysis of impact of traffic level and grade of service.

Design and analysis of digital hierarchies and TCP throughput on satellite links.

Section A: Record of Submission

Record of Submission and Plagiarism Declaration

I declare that this assignment is my own work and that the sources of information and material I have used (including the internet) have been fully identified and properly acknowledged as required in the referencing guidelines provided.

Student Number:

You are required to acknowledge that you have read the above statement by writing your student number(s) above.

(If this is a group assignment, please provide the student numbers of **ALL** group members)

Details of Submission

Note that all work handed in after the submission date and within 5 working days will be capped at 40%. No marks will be awarded if the assignment is submitted after the late submission date unless mitigating circumstances are applied for and accepted.

- IT IS YOUR RESPONSIBILITY TO KEEP A RECORD OF ALL WORK SUBMITTED.
- An electronic copy of your work should be submitted via Blackboard.
- Work should also be submitted to the member of academic staff responsible for setting your work.
- Work not submitted to the lecturer responsible may, **exceptionally**, be submitted (on the submission date) to the reception of the Faculty of Advanced Technology, which is on the 2nd floor of G block (Room G221) where a receipt will be issued.

Mitigating Circumstances: if there are any exceptional circumstances which may have affected your ability to undertake or submit this assignment, make sure you contact the Faculty Advice Shop on 01443 482540 (G221).

Section B: Marking and Assessment		
This assignment will be marked out of **100%** This assignment contributes to 40% of the total module marks. This assignment is bonded / non- bonded. Details :		It is estimated that you should spend approximately (at least) 20 hours
Date Set: 29/11/2017	**Submission Date: 08/01/2018**	**Feedback Date:**

Learning Outcomes

This assignment addresses the following learning outcome(s) of the module:

All learning outcomes

Deliverable	**Mark** *(Awarded)*	**Mark** *(Available)*
1. **2.** **3.**		**36** **34** **30**

Section C: Marker's Feedback			
Lecturer's Comments:			
Areas to concentrate on next time:			
Report structure	Research	Content	Team work
Referencing	Presentation		
Lecturer's signature:		**Date:**	**Mark awarded:**
All marks are subject to confirmation by the Board of Examiners			

NG4S800 (Satellite Networking) 2017/18 Coursework: Selected Fundamental Theories in Satellite Networking

Instruction

You are required to submit typewritten solutions to the following tasks. The marks for each task are as indicated against the task. Any required graphs must be plotted in MATLAB (or other suitable software) and imported into your report with all axes fully labelled. You must provide a lucid but brief discussion and interpretation of your results, including a clear statement of their implications. Your entire report (excluding the cover pages) should be no more than 8 pages in length. Please submit online via Blackboard by 5 pm on 8th January 2018.

Task 1: [36 marks]

Write a 2-page essay discussing the operational features, advantages and disadvantages of each of the following satellite network topologies:

- Single-hop, single-satellite (SHSS) or mesh topology
- Double-hop, single satellite (DHSS) or star topology
- Multiple-hop, multiple-satellite (MHMS)
- Single-hop, multiple-satellite (SHMS).

Your write-up should use complete grammatically correct sentences (not phrases or bullet points), and should take into account the following considerations, providing a clear and convincing justification and explanation for any assertion made:

- Delay: Is propagation delay reduced or increased by the topology?
- Terminal size: Does the topology facilitate the use of smaller transmit antennas and/or radiated power?
- Earth segment: Is there more earth-based infrastructure which makes the network topology more vulnerable?
- Space segment: Is it more expensive?
- Complexity: Does it involve intricate interconnections and handover?
- Coverage: How does it affect instantaneous coverage and/or total coverage?

Task 2: [34 marks]

A telephone exchange is to be designed such that calls (assumed to arrive randomly according to a Poisson distribution) always find a trunk available until all trunks are busy at which point new arrivals are blocked. By plotting suitable graphs from which you can read off the results determine,

(i) The number of trunks N required to support a busy hour traffic of 120 erlangs with a grade of service of 10%. *[15 marks]*

(ii) The new size (N) of this telephone exchange under each of the following conditions:

(a) Traffic is increased to 600 erlangs (which is a factor of 5 increase) but grade of service remains fixed at 10%; *[8 marks]*

(b) Grade of service is improved to 0.1% (i.e. an improvement by a factor of 100) but traffic remains at 120 erlangs. *[7 marks]*

(iii) Comment on your results in (ii) above by discussing the relative impact of each of the parameters (namely traffic level and grade of service) on the size of the exchange (i.e. number of trunks). *[4 marks]*

HINT (if needed):

You may find the following equivalent form of the Erlang-B formula useful:

$$P_B \equiv E_{1,N}(\rho) = \frac{10^{\left(N\log\rho - \sum_{r=1}^{N}\log_{10} r\right)}}{1+\sum_{n=1}^{N} 10^{\left(n\log\rho - \sum_{r=1}^{n}\log_{10} r\right)}}$$

The following MATLAB code computes the above formula:

```
N=20; rho=18; %Set your own values of N and ρ
r = (1:N)'; x = 10.^(N*log10(rho) - sum(log10(r)));          % x is the numerator in the above formula
y = 1; for n = 1:N, r = (1:n)'; y = y + 10.^(n*log10(rho) - sum(log10(r))); end          % y is the denominator
PB = x/y;          % This is the desired blocking probability P_B.
```

Task 3: [30 marks]

a) Sketch a detailed and fully labelled block diagram showing the steps involved in assembling an STM-1 signal starting from E3 signals, giving a detailed discussion of the processes involved at each step and the efficiency of the resulting STM-1 signal. *[10 marks]*

b) Explain how it is possible for SDH, which is a synchronous operation under control of a common network clock, to be used to convey a plesiochronous signal such as E3. *[6 marks]*

c) Discuss how the flow control mechanism of TCP, based on the slow start and congestion control algorithms, is unable to efficiently utilise the available bandwidth of a high-delay geostationary satellite link. Hence explain (giving quantitative values to support your case) how the options field within the TCP header may be used to implement a window scaling method that leads to improved TCP throughput on satellite links. *[14 marks]*