

# CARLETON UNIVERSITY

## Department of Systems and Computer Engineering

**SYSC 4700 Telecommunications Engineering Winter 2006**

### Assignment 3

**Posting date: Friday, March 17, 2006**

**Due date: 4:15 pm, Tuesday, March 28, 2006 (in box outside ME 4438)**

#### Question 1 [20 marks] Link Budget

A line of sight radio system is required to carry 128 digitized DS0 voice channels, using binary double-sideband modulation. The total antenna gain of transmitter and receiver is 30 dB. The receiver noise figure is 6 dB. Assume free space propagation. The minimum required signal to noise ratio at the receiver, for satisfactory performance is 20 dB.

- (a) Determine the required bit rate and bandwidth required for the radio system to handle this traffic load.
- (b) Assuming a carrier frequency of 30 GHz, plot a graph of the required transmitter power in dBW as a function of distance between transmitter and receiver from 0.1 km. to 100 km. (plot distance on a logarithmic scale). Boltzman constant  $k=1.38 \times 10^{-23}$ , and temperature  $T=290^\circ\text{K}$ .
- (c) Repeat (b) for a frequency of 700 MHz, plotting the result on the same graph.
- (d) Discuss the advantages and disadvantages of using 700 MHz vs. 30 GHz for radio transmission of this type of signal over distances up to 100 km.

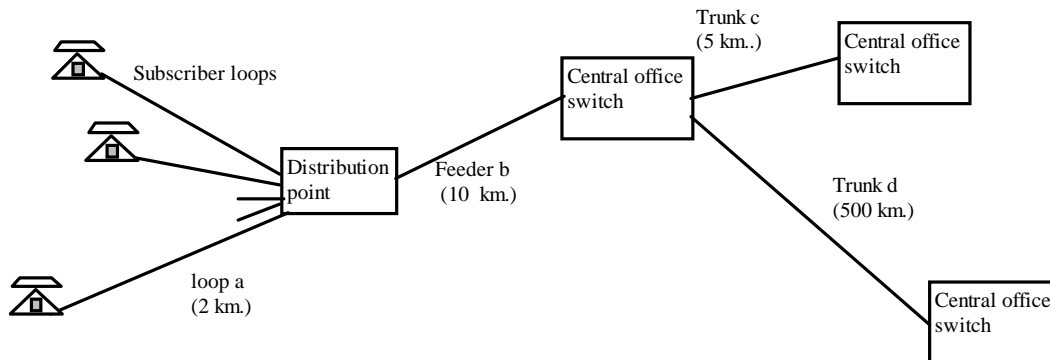
#### Question 2 [10 marks]

Suggest appropriate transmission media for the following. Give reasons and assumptions for your choices.

- (a) A new high capacity trunk facility between Ottawa and Toronto.
- (b) To provide telecommunications to a newly-opened oil-drilling rig, situated in a remote area of the far north.
- (c) A facility providing trunks between two medium-sized towns in a developing country with not much present telecommunications infrastructure. The two towns are separated by mountainous, rugged terrain, with few roads.
- (d) To provide video on demand (i.e. movie rentals) to houses in a city such as Ottawa or Nepean.

### Question 3 [10 marks]

Consider the hypothetical portion of the telephone network shown below. Choose the most suitable transmission medium (twisted pair, coax, fibre, radio, or satellite, etc.) for each of links a, b, c, and d. For each of these links, give reasons for your choice, and also describe an appropriate form of transmission facility (such as for example multiplexed analog, DS?, or non-multiplexed analog, etc.); i.e. design the transmission systems. [Note: there is no single “correct” answer to this question.]



*Portion of a network. Note: feeder b contains all the voice circuits for the subscriber loops. Trunk c is one of a group of 20 trunks between the two central offices, and trunk d is one of a group of 500 trunks.*