Assignment 1

Due Tuesday, March 25. Show your work. Hand in your assignment using the appropriate dropbox on the course web site. Assignments submitted after the solutions are made available will be given a mark of zero.

Question 1

Group the following 10 WAN technology or standards terms into 5 pairs by finding the pairings that are the most closely-related. Use each term only once. For example "CATV" and "head-end" would be a closely-related pair.

The 10 terms are: POTS, ADSL, long-haul, HFC, DOCSIS, PON, SONET, DSLAM, access, PSTN.

Question 2

A state transition diagram shows the conditions that cause the state of a system to change.

We can model a POTS interface as being in one of the following four states: idle, ringing, dialing, talking. The events causing these transitions are: "go off-hook" or "go on-hook" and "dial a number."

Complete the following state-transition diagram for a phone call:
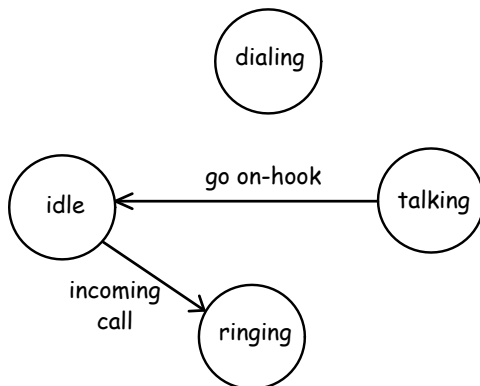
The above is a simplified description of the interface. A more complete description would include more states or additional state transition diagrams for these top-level states. For example, the dialing state might include "waiting for first digit", "waiting for next digit", and "all digits entered" states with appropriate events.

Question 3

You are monitoring the DC (average) voltage across the pairs of a phone line and notice that the voltage is initially steady at about +40VDC. Then the DC voltage starts to alternate between 0V and 40V about very 6 seconds. Then the voltage settles to about 8V. Explain what happened.

Question 4

(a) Would you expect a HFC system to have more optical nodes or more distribution amplifiers? Why?

(b) Is the cable TV company's co-ax cable going into your house a distribution cable or drop cable?

Question 5

You need to set the output level of an RF signal generator in order to measure the distortion introduced by a cable system distribution amplifier. The signal generator, cable and amplifier have 75 ohm impedances. The signal generator is calibrated in dBm. What output signal level (in dBm) should you set on the signal generator to obtain an output level of +4.5 dBmV. Show your calculations.

Question 6

You are configuring the upstream of a DOCSIS system by choosing an appropriate interleaver size and the Reed-Solomon code parameters n and k.

From measurements you've determined that the noise affecting the link is bursty. The noise bursts last 100 microseconds and happen every 8 ms.

(a) Assuming a symbol rate of 1.28 MHz with QPSK modulation, what is the upstream data rate in bits/second? In bytes/second?

(b) What is the length of each error burst in bytes?

(c) We want to design a block interleaver that will result in one error per codeword. How many rows should the interleaver have?

(d) Assuming the maximum interleaver memory size of 2048 bytes, what codeword parameters n, k and $n-k$ will result in all errors being corrected and also achieve the highest code rate? What is the code rate?

(e) What is the delay through the interleaver assuming it must be completely filled before the first byte is read out? What value of n would limit the interleaver delay to 2 ms? What would be the resulting code rate?