

Assignment 1

1. A monochrome video surveillance camera outputs its video as a sequence of 240 lines of 480 pixels per video frame at a rate of 30 frames per second. Each pixel is encoded as one byte. What is the data rate at the output of the camera in Mbps?

A video signal multiplexer combines the outputs of four of these cameras for transmission to a central monitoring site. The multiplexer inserts a gap of 10ms every four frames. What is the throughput of the system in Mbps?

2. Take the last four digits of your student ID (e.g. 1234). Express this value in hexadecimal notation (e.g. 4D2). Write out the corresponding bits in msb-first order assuming a 16-bit value (e.g. 0000 0100 1101 0010).
3. Take the first 4 characters of your surname (pad with trailing spaces if necessary). What are the values of ASCII encodings for these characters in hexadecimal notation? How many bytes will be required for the UTF-8-encoded Unicode characters?
4. Using a high-impedance multimeter you measure a voltage of 40 volts between the pairs of a phone loop (a twisted pair cable). You then measure a voltage of 10 volts from the the lower-voltage of the two wires to ground. What is the differential voltage? What is the common-mode voltage? *Note that there is an error in the lecture notes: the common mode voltage is half of the sum of the voltages on the two pairs.*
5. Using a TDR (instrument for measuring propagation delays) you measure the propagation delay of a 100m length of co-ax cable as 330ns. The inner conductor has a diameter of 2mm and the outer conductor has a diameter of 5mm. What is the characteristic impedance of this cable?
6. A TV transmitter transmits a signal of 500kW. The transmit antenna has a gain of 15dB. The receive antenna has a gain of 0dB. The transmit frequency is 200 MHz. At what distance is the received power $1 \mu W$?