National University of Singapore
School of Computing
CS2105: Introduction to Computer Networks
Semester 1, 2018/2019

Tutorial 10
Physical Layer

These questions will be discussed during the next week's discussion group meetings. Please be prepared to answer these questions during the session in class. Some of the questions are taken from the textbook, so please bring it along for reference.

1. Show how the bit sequence `01011001` is encoded in **RZ**, **NRZ-L**, **NRZ-I** and **Manchester**.

   For **NRZ**, assume that the signal level is at negative voltage at the start.

2. A constellation diagram helps us visualize the *amplitude* and *phase* of signal elements. Draw a constellation diagram for ASK scheme illustrated in the lecture.

3. A given transmission medium has a SNR of 127 and supports frequency ranging from 1 MHz to 3 MHz. A signal is transmitted using the following modulation scheme:

$$s(t) = \begin{cases} 5\cos(2\pi ft + 45\deg) & \texttt{000} \\ 5\cos(2\pi ft + 135\deg) & \texttt{001} \\ 5\cos(2\pi ft + 225\deg) & \texttt{011} \\ 5\cos(2\pi ft + 315\deg) & \texttt{010} \\ 10\cos(2\pi ft + 45\deg) & \texttt{100} \\ 10\cos(2\pi ft + 135\deg) & \texttt{101} \\ 10\cos(2\pi ft + 225\deg) & \texttt{111} \\ 10\cos(2\pi ft + 315\deg) & \texttt{110} \end{cases}$$

   (a) Draw the constellation diagram for the modulation scheme above.

   (b) What is the theoretical maximum bit rate that can be transmitted throughout the medium.

4. [**CS2105 Final Exam, April 2014**] 256-QAM modulation is used to transmit data at 256 kbps. What is the baud rate of the signal?

5. A DHCP discover message is encapsulated in UDP segment, IP datagram, Ethernet frame and then broadcasted in the subnet.

   (a) What is the destination MAC address of this frame?

   (b) What is the destination IP address of the datagram contained in this frame?

   (c) What are the source and destination port numbers of the UDP segment contained in this frame? (Check lecture notes or search online for the answer)

   (d) Why will all other nodes besides the DHCP server on the same subnet ignore this DHCP query message?