Computer Facilities and Network Management

BUS3150

Assignment 1

Due date: Friday 1st September 2006 (Week 7)

This Assignment has 6 questions, and you should complete answers for all 6. The Assignment contributes 10% to the assessment of the subject. Make sure you provide justification for decisions and assumptions you make. **Plagiarised and copied assignments will be given a zero mark.**

Please hand your assignment in at the FIT School Office on your Campus.

Late submission - An assignment handed in late will receive a late penalty of a 5% deduction per day (including Saturday and Sunday), after the due date.

Question 1 - The French and Chinese Prime Ministers need to come to an agreement by telephone, but neither speaks the other's language. Further neither has on hand a translator that can translate to the language of the other. **[6+6=12 marks]**

(a) In the first scenario, both Prime Ministers have English translators on their staffs. Draw a three-layer diagram, similar to the one presented during the Week 2 Lecture, which depicts this situation. Describe how the conversation will proceed.

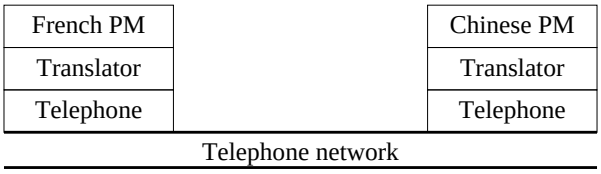

Figure 1: Hypothetical telephone conversation between French and Chinese PMs.

The two PMs speak as if they are speaking directly to each other. For example, when the French PM speaks, he addresses his remarks directly to the Chinese PM. However, the message is actually passed through two translators via the phone system. The French PM's translator translates his remarks into English and telephones these to the Chinese PM's translator, who translates these remarks into Chinese.

(b) Now suppose that the Chinese prime minister's translator can translate only into Japanese and that the French prime minister has a German translator available. A translator between German and Japanese is available in Germany. Draw a new diagram that reflects this arrangement and describe the hypothetical phone conversation.

As before, the prime ministers still communicate directly with each other. However, now an intermediate node serves to translate the message before passing it on. The

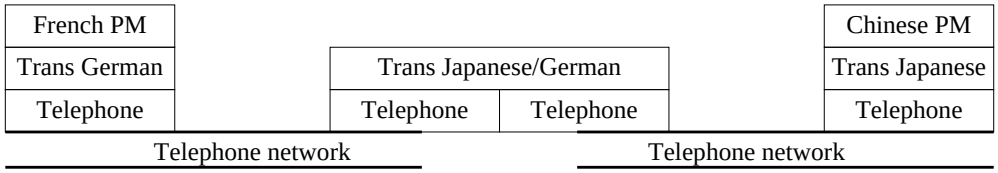

Figure 2: Hypothetical telephone conversation using an intermediate node.

telephone link between the France and Germany will carry messages in Japanese while the link between Germany and China will carry messages in German. The intermediate translates the messages on each link.

Question 2 - The following questions relate to transmission impairments. **[5+5+7=17 marks]**

(a) What is meant by the term noise and how does noise affect data transmission?

Noise is the addition of an unwanted electromagnetic signal onto the transmitted signal. Types of noise include:

- *Thermal*
- *Intermodulation noise*
- *Crosstalk*
- *Impulse Noise*

Data transmission consists of the transmission of a binary bit stream by the transmitter on a data link to the receiver. For example, the following bit stream could be sent: 010010011100101. *If noise is added to the link, some of the bits may be corrupted. That is, a 0 could be changed to a 1, or a 1 could be changed to a 0. These are known as bit errors. For example, the previous stream could be corrupted as follows:* 0**0**0010**10**111**1**0101.

(b) What is meant by the term attenuation and how does attenuation affect data transmission?

Attenuation is the loss of (electromagnetic) signal strength (power) over distance, due to the resistance of the medium, as the signal is propagating through the transmission medium. The medium absorbs the signal. As the signal attenuates over distance it can become so weak that the receiver cannot detect it. If the receiver cannot detect the signal, it cannot decode it and retrieve the original data bits (0s and 1s). To avoid attenuation, a repeater can be used to regenerate a digital signal. For both digital and analog signals, an amplifier can be used to boost the signal power. However, an amplifier will also boost noise in a signal, therefore for a digital signal, a repeater is a better choice.

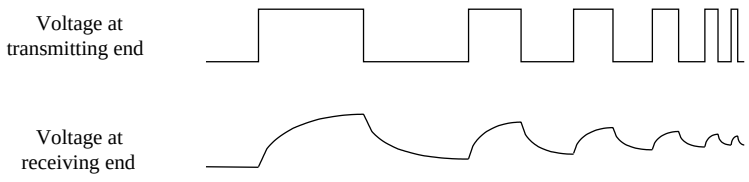

Figure 3: Attenuation of a digital signal.

(c) Attenuation is an increasing function of frequency. What are the implications?

Bandwidth limiting: Higher frequencies allow for higher bandwidth. Transmission media that attenuate higher frequencies place a limit on the available bandwidth of

the transmission media over a given distance.
Attenuation distortion: Because attenuation is an increasing function of frequency, the received signal is distorted reducing intelligibility. This is particularly noticeable for analog signals. To overcome this problem, techniques are available for equalising attenuation across a band of frequencies. Voice grade lines use loading coils that change the electrical properties of the line; the result is to smooth out attenuation effects. Another approach is to use amplifiers that amplify high frequencies more than lower frequencies. For a digital signal the strength falls off with increasing frequency, but as most of the content is concentrated near the fundamental frequency (refer Stallings 7E fig 3.5b), attenuation distortion has less affect. An example is provided in Stallings 7E fig 3.15a, which shows attenuation for a typical leased line. The attenuation is measured relative to the attenuation at 1000Hz.

Question 3 - Give a brief description of the application and limitations of the following types of transmission media: **[16 marks]**

(a) Unshielded twisted pair,

(b) Coaxial cable,

(c) Optical fibre, and

(d) Terrestrial microwaves.

See lecture notes from week 4 on transmission media for the basic details. Further details found in Chapter 4 of Stallings and Chapter 7 of Forouzan.

Question 4 - Imagine you wish to transmit your student ID number over some form of wired medium. First you will need to convert your student ID from its decimal (base 10) representation into a 28-bit binary (base 2) representation. A web page has been created to assist you in this task: http://www.csse.monash.edu.au/∼timf/idbin.html. For example, a student ID of 12345678 will be 0000101111000110000101001110 in binary form. **[12+4=16 marks]**

(a) Using clearly labelled diagrams, show an encoding of your student ID using:

(i) a NRZ-L signal,

(ii) a NRZ-I signal,

(iii) a Pseudoternary signal, and

(iv) a Manchester signal.

Note that you must clearly show the timing and amplitude of each signal.

Solutions provided with the returned assignments. Figure 4 shows the 12345678 example. Note that pseudoternary and NRZ-I may be inverted from the provided solutions. It depends on the assumptions made for the previous pulse or starting signal level respectively.
Encoding rules:

- *NRZ-L:*
  - *0 = high level*
  - *1 = low level*
- *NRZ-I*
  - *0 = no transition at beginning of bit time interval*
  - *1 = transition at beginning of bit time interval*
- *Pseudoternary*

  - *0 = positive or negative level pulse, alternating for successive zeros*
  - *1 = no line signal*
- *Manchester*
  - *0 = transition from high to low in middle of interval*
  - *1 = transition from low to high in middle of interval*

(b) Identity one advantage and disadvantage of each data encoding technique.

- *NRZ-L*
  - *Advantage:*
    - *Using two signal levels is the easiest way to transmit digital signals.*
    - *Efficient use of bandwidth.*
  - *Disadvantage:*
    - *Bit synchronisation lost if long strings of 0s or 1s transmitted, there are not enough transitions generated for the receiver's clock to lock onto the bit time.*
    - *Presence of a DC component.*
- *NRZ-I*
  - *Advantage:*
    - *Using two signal levels is the easiest way to transmit digital signals.*
    - *Efficient use of bandwidth.*
    - *Uses differential encoding: easier to detect the transition in the presence of noise.*
    - *No loss of bit synchronisation on a long strings of 1s.*
  - *Disadvantage:*
    - *Loss of bit synchronisation, if long strings of 0s transmitted, there are not enough transitions generated for the receiver's clock to lock onto the bit time.*
    - *Presence of a DC component.*
- *Pseudoternary*
  - *Advantage:*
    - *No loss of bit synchronisation on long strings of 0s.*
    - *Bandwidth usage less than NRZ techniques.*
    - *Pulse alternation property provides a simple means of error detection. Any isolated error, whether it deletes a pulse or adds a pulse, may causes a violation of this property.*
  - *Disadvantage:*
    - *Loss of bit synchronisation, if long strings of 1s transmitted.*
    - *The receiver must distinguish between three voltage levels (+A, -A, 0) instead of two. This is more difficult to do in the presence of noise.*
- *Manchester*
  - *Advantage:*
    - *No loss of bit synchronisation on long strings of 0s or 1s.*
    - *No DC component.*
    - *Some error detection: a transition is expected in the middle of each bit time. Noise would have to invert both before and after the transition.*

  - *Disadvantage:*
    - *Bandwidth usage greater than NRZ techniques since the maximum modulation rate is twice that of NRZ.*

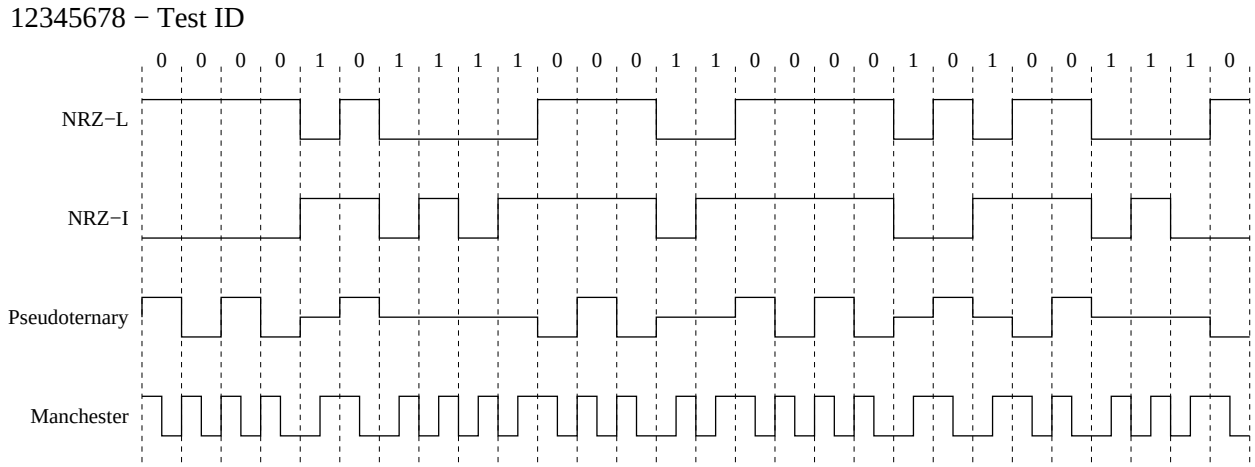

Figure 4: Example encoding of 12345678 using digital encoding techniques.

Question 5 - Consider the modulated signals shown in Figure 5. **[6+3=9 marks]**

(a) What is the type of modulation used to encode each of Figures 5, and what bits do each of the signals represent?

- *Binary (BPSK) or Differential (DPSK) Phase Shift Keying*
  - *BPSK: 00100011101000 or DPSK: 00110010011100*
- *Amplitude Shift Keying (ASK): 01100011101011*
- *Frequency Shift Keying (FSK): 10100010111000*

(b) Identity one advantage and disadvantage of each modulation technique.

- *PSK*
  - *Advantage:*
    - *Less susceptible than ASK to error caused by impulse noise.*
    - *Superior to FSK because do not need two carrier signals.*
  - *Disadvantage: Not many. If using BPSK, a reference carrier is required to determine the relative phase. This is relatively complex to implement and is also why DPSK is more commonly used.*
- *ASK*
  - *Advantage: Simple to implement.*
  - *Disadvantage: Since bits are encoding using amplitudes, this technique is most susceptible to error caused by impulse noise when compared with the other techniques.*
- *FSK*
  - *Advantage: Less susceptible error caused by impulse noise. The noise has less of an impact on the frequency of the signal than it does the amplitude of the signal.*

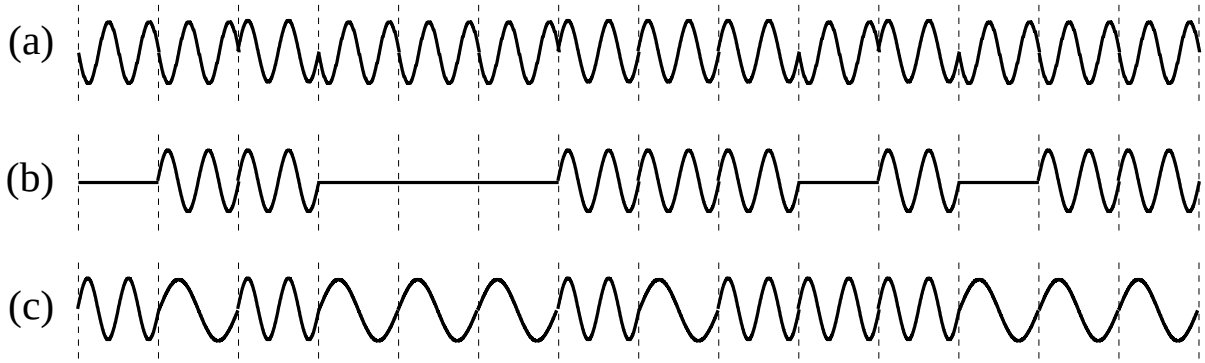

Figure 5: Signals for Question 5.

– *Disadvantage: Need to use two carrier signals, e.g. at frequencies f1 and f2. Bandwidth is wasted in separating these two carrier signals.*

Question 6 - The TCP/IP protocol suite is made up of five layers. Select any one of the five TCP/IP layers and write a brief discussion of the layer. You must target most of your explanation to a layperson. **[30 marks]**

- The discussion should cover the purpose of the layer and how it functions, including how the layer interacts with adjacent layers.
- Examples involving more technical language may be included.
- No general introduction to the TCP/IP protocol suite is required or desirable.
- The discussion should be fully referenced, including any Internet sources.
- If you were to use A4 paper and Times New Roman 12 font, single spaced, then excluding diagrams and references, your discussion should be **no more than** three pages.

There is wide scope for this answer. The layers are as follows:

1. *Application*
2. *Transport (TCP/UDP)*
3. *Internet (IP)*
4. *Network access*
5. *Physical*

Note that the Internet and Network Access layers are different from the OSI network layer. Both of these TCP/IP layers include different elements of the OSI network layer. The Transport layer includes not only the reliable transport protocol of TCP, but also the UDP datagram protocol. The application layer includes protocols such as SNMP, SMTP, FTP, HTTP, Telnet, etc.
The discussion should cover the purpose of the layer and how it functions, including how the layer interacts with adjacent layers . The report layout should include a correctly formated presentation style, be clear and concise and include references which are used within the body of the text . Additional discussion should also be included .

[Total marks: 100]