**CS5310.001/002, Fall 2020  
Computer Networks and Communication Systems**

**Assignment 2**

Zebo Xiong | A04907051

1. (20 pts) In class discussions it was pointed out that in asynchronous transmission mode a receiving DTE should have a receiving clock R × C that is N times faster than arriving data rate R × D. We demonstrated through examples that this N should be at least 8 and ideally greater than or equal to 16. Student Jon Doe didn’t agree with this. He said that he only needs a receiving clock that has the same frequency as the arriving data rate. He said with such a clock the receiver can just sample the arriving signal in the middle of each receiving clock cycle. Please point out why this argument is fault.

Answer:

* The incoming data sometimes is randomly generated, the receiver need to resynchronize when receiving new data – adjust the clock. If the receiving clock share the same speed with the incoming data, there is no way to adjust the clock correctly.
* We need bit synchronization – and the ratio N plays a critical role. The receiver needs to determine the signal status by sampling at the center of each bit cell period. If ratio is 1, there is no way we can achieve the clock adjustment
* The problem is, how can you sample the arriving signal in the middle of the each receiving clock cycle. Even if we can do at the 1st time, how can we guarantee the future incoming data – which are randomly generated.
* On the other hand, even we sometimes can catch all the data by sampling in the middle of the cell, we still will lose data when the clock is not synchronized.
* The problem is the failure of bit synchronization.

1. (15 pts) How do you understand the notion of link utilizations discussed in class? Is high link utilization good or not? Please answer these questions with your own words.

Answer:

* Broadly speaking, the link utilizations is the ration of “incoming data transmission time” and “total time is needed to confirm the transmission succeed”. Detailly speaking, the ratio is for individual frames – “frame’s transmission” / “totally time to confirm the transmission”
* The link utilization can be very high when: 1) distance is short or 2) the transmission rate is low.
* Thus, high link utilization can also be an issue for low transmission rate

3. (10+10=20pts)  
Deduce the maximum theoretical information rate associated with the following transmission channels:

1. (a)  Telex (international message switching) network with a bandwidth of 64KHz and a signal-to-noise ratio of 20dB;

1. (b)  Switched telephone network with a bandwidth of 3000Hz and a signal-to-noise ratio of 30dB.

Text, letter

Description automatically generated

Text, letter

Description automatically generated

4. (15+15=30pts)

1. (1)  Explain the 4-QAM constellation diagram in Fig.2.6(b), p.105. Can you draw a sample wave of modulated signals, i.e. draw a sequence of signals like the signal in Fig.2.6(a), p.105, that demonstrates the phase changes?

Diagram, schematic

Description automatically generated Chart, line chart

Description automatically generated

In 2.6(b), we use the positions in different quadrant to present the status: 00, 01, 10, 11

* When 45 degree, it means 00
* When -45 degree, it means 01
* When 135 degree, it means 10
* When 225 degree, it means 11

A close up of text on a whiteboard

Description automatically generated

1. (2)  Informally or formally Explain the 16-QAM constellation diagram in Fig.2.6(b), p.105.

Diagram

Description automatically generated

* As we can see from the above figure, I use green circuit and blue circuit
* For the line: L1, L2, L3, L4, L5 🡪 They presents with various phase angle and amplitude
* We can see the length of each lines are different 🡪 they are presenting different amplitude
* We can see the angle of the lines 🡪 They are presenting different phase
* When we combine the amplitude and phase, we can make 16 different status.

Chart, diagram, bubble chart

Description automatically generated

* Chart

  Description automatically generated

Chart, bubble chart

Description automatically generated

Diagram

Description automatically generated

Chart, line chart

Description automatically generated

Diagram

Description automatically generated

Diagram

Description automatically generated

5. (15 pts) What is modulation? Why is modulation needed? Do we need modulation in ISDN? How about PSDN?

Answer:

* What is modulation ? Modulation is the process of varying one or more properties of a periodic waveform, called the carrier signal, with a modulating signal that typically contains information to be transmitted. The term analog or digital modulation is used when the modulating signal is analog or digital, respectively.

In another words, modulations are techniques that change the way the baseband (digital) signals are transmitted and sampled over analog transmission channels (PSTN). The main purposes of modulations are to provide higher data rate and transmission multiplexing.

* Why it is needed?

Due to the problems of sending DC square wave signals, AC signals are transmitted. More speciﬁcally, a continuous tone of AC signals in the frequency range 1000Hz to 2400Hz, called sine wave carrier, is produced by the sending side. By manipulating (called modulation) the amplitude, frequency, or phase, called amplitude modulation, frequency modulation, and phase modulation respectively, of the sine wave carrier, more information (i.e. bits) per signal sample can be achieved. They are also called amplitude-shift keying (ASK), frequency-shift keying (FSK), and phase-shift keying (PSK), respectively.

* When analog transmission is used over the access lines, the total network is known as the PSTN. When digital transmission is used over the access lines, the total network is known as ISDN.

* Yes we need modulation for ISDN, as it is combined with PSDN’s existing network
* Yes we need modulation for PSDN.