Theory

1. Compare Bridge, Hub, layer-2 Switch

	Hub	Bridge	Switch
Definitions	- Central element of star layout physically (a bus logically), act as repeater - Each station connects to hub using 2 lines - Broadcast model (frame is forwarded to all stations)	- Connects similar LANs with identical physical & link layer protocols - Review destination address but do not modify MAC fields, thus do not contain LLC layer - Frame handling by SW - Fw 1 frame at a time - Only has store & fwd ops	- Frame is delivered to recipient node (no broadcast) - Frame forwarding using HW - Can handle multiple frames at a time - Can have cut-through ops (beside store & fwd)
Pros & Cons	- Good for building wiring practices - Limited length of line 100m - Collision occurs if 2 stations transmit at the same time	- Reliability - Performance - Security - Geography - Only 2 ports	- Dedicated capacity equal to original LAN - Total throughput of the network increases (because of no broadcast) - No change to SW or HW is required to replace current bus/hub to switch - Scale easily - More ports than bridge

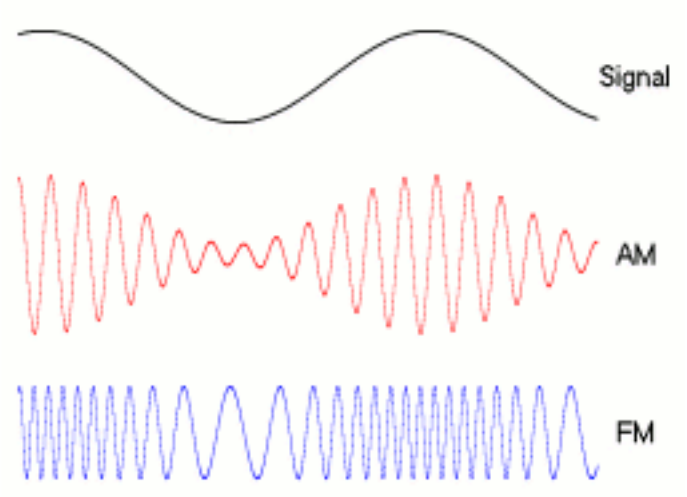
2. Why certain devices are used for certain bandwidth?

3. How does info flow in different cable types?

4. Compare twisted pair, coaxial cable, optical fiber.

[Signal Encoding]

5. Compare AM & FM



	AM	FM
Definitions	- Amplitude Modulation - Freq: 535-1705Khz - Up to 1200 bps	- Frequency Modulation - Freq: 88-108 Mhz - 1200 to 2400 bps
Pros and Cons	- Poorer quality sound than FM - Cheaper - longer distance	- Less prone to interference than AM. - Better sound quality (higher bandwidth) - Shorter distance
Bandwidth	- Twice the modulating freq	- Twice the sum of modulating signal freq & deviation freq
Noise	- More susceptible to noise	- Less susceptible to noise

6. Compare ASK, FSK, PSK, & QAM

	ASK	FSK	PSK
Definitions	- Amplitude of carrier signal is varied to represent 1 or 0	- Frequency of carrier signal is varied to represent 1 or 0	- Phase of carrier signal is varied to represent 1 or 0
Demodulation	- Determines the presence or absence of a sinusoid in a given time	- Determines 2 frequencies is present at a time	- Determines the phase of received sinusoid wrt some reference phase

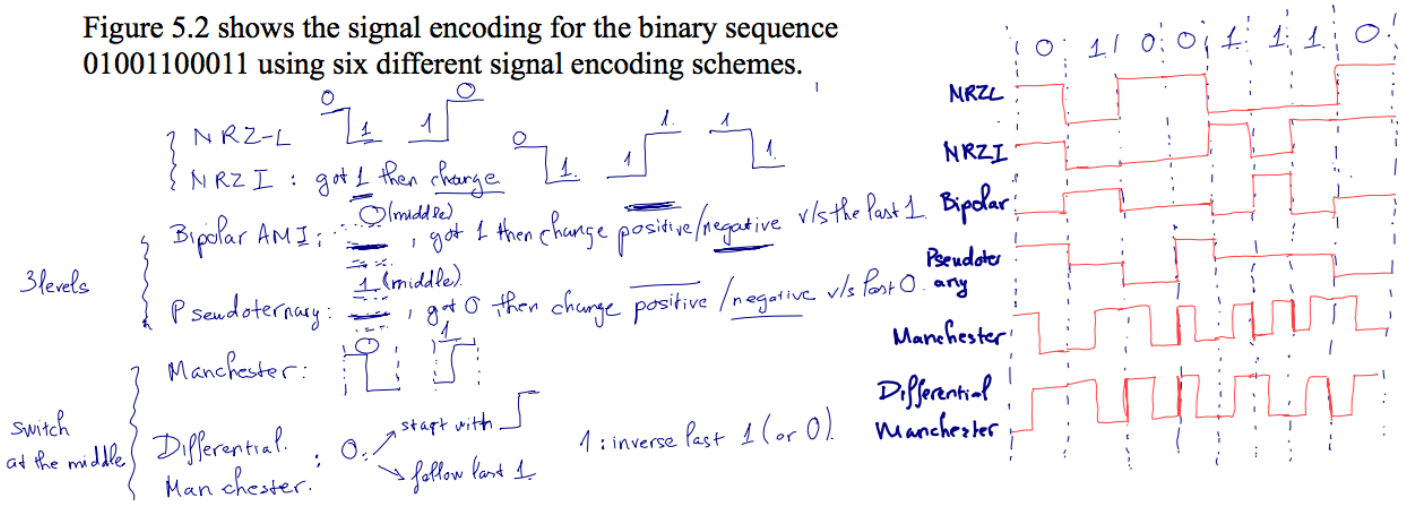
Pros & Cons	- Simplicity - Susceptible to noise - Probability of error (Pe) is high, SNR low	- less susceptible to noise than ASK - Pe is low, SNR is high - Spectrum is 2x ASK spectrum	- less susceptible to errors than ASK while requiring same b/w as ASK - more efficient use of b/w (higher data rate) v/s FSK - Pe is low, SNR is high - More complex signal detection / recovery process than ASK, FSK
Application	- Transmit digital data over optical fiber	- Voice lines, high freq. radio transmission	- Widely used in wireless transmission

7. Terms in Digital Data

Unipolar	- All signal elements have same sign
Polar	- Positive and negative voltages
Data Rate	- Rate of data transmission (bps)
Duration (length of bit)	- Time to emit 1 bit
Modulation Rate	- Rate of signal level changes (baud i.e. signal per sec)
Mark and Space	- Binary 1, 0 respectively

8. Compare Encoding Schemes:

Figure 5.2 shows the signal encoding for the binary sequence 01001100011 using six different signal encoding schemes.



	NRZ-L(Non return to zero)	NRZ-I	Binary Bipolar-AMI	Binary Pseudo ternary	Manchester	Differential Manchester
Definitions	- Voltage is constant during a bit interval - Positive and negative voltage levels for binary digits	- Constant voltage pulse during a bit interval - Differential encoding in which signal decoded by comparing the polarity of adjacent levels	- 0 is represented by a lack of pulse; 1 is by a positive or a negative pulse, alternatively.	- A multilevel binary encoding that complements the bipolar-AMI. - 1 is lack of pulse, 0 is positive or negative, alternatively.	- Biphase encoding, transition takes place in the middle of the bit period: 0 is high to low transition, 1 is low to high transition.	- Biphase encoding, transition takes place at the middle of the bit period, and transition at the start of the bit period represents 0, lack of transition at the start of the bit represents 1.
Pros & Cons	- Most of energy spent between dc and half the bit rate. - Easy to engineer - Efficient use of bandwidth - Suffer from the presence of dc component - Lack of synchronization capability due to potential of long runs of unchanged voltage levels.		- Each 1 introduces a transition that can be used for synchronization - Error detection is possible - No dc component - Smaller b/w than NRZ - Long runs of 0s hurt synch - Overhead: three level use log2(3)=1.58 bits, Rx require 3dB more signal power for three-valued signals, smaller b/w than NRZ (based on spectral density graph).		- Easy clocking mechanism (sync) for both kinds of bits. - Modulation rate 2x NRZ, greater b/w. - No dc component and relatively narrow b/w by spectral density graph - Manchester: Specified by IEEE802.3 for baseband coaxial cable and twisted pair CSMA/CD bus LAN. - Require high signaling rate relative to data rate –> costly for long-distance application - Differential Manchester: Specified by IEEE802.5 for token ring LAN, using shielded twisted pair.	
Application	- Digital magnetic recording (but not for signal transmissions)		-	-	-	-

Still no B8ZS and HDB3.

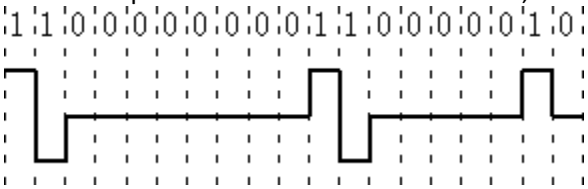
9. How data scrambling works?

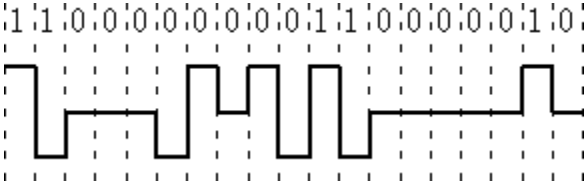
Using B8ZS or HDB3.

B8ZS

The bipolar-AMI encoding supplemented with a scrambling scheme, which uses two code violations to ensure synchronization in runs of 0's.

- Replace `00000000' with `000+-0-+', if the preceding voltage pulse was positive
- Replace `00000000' with `000-+0+-', if the preceding voltage pulse was not positive



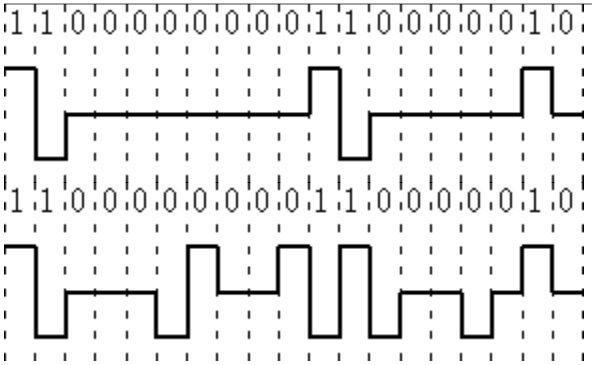


- The amount of data remains unchanged.
- The spectrum graph shows that there is no dc component, with most of the energy concentrating in a relative sharp spectrum. Making the encoding suitable for high-rate transmissions.
- Used mainly in North America.

HDB3

The bipolar-AMI encoding supplemented with the following substitution scheme for `0000' runs.

Number of bipolar pulses (ones) since last substitution		
Polarity of preceding pulse	**Odd**	**even**
-	000-	+00+
+	000+	-00-



- Used in Europe and Japan
- Successive violations are of alternate polarity to avoid dc component.

Exercise

10. Given a binary string, draw how each method encodes the data to digital signal.
11. How modulator work (sender/receiver), explain the mechanism (formula), give an example.