Discussion 29: Communication Systems

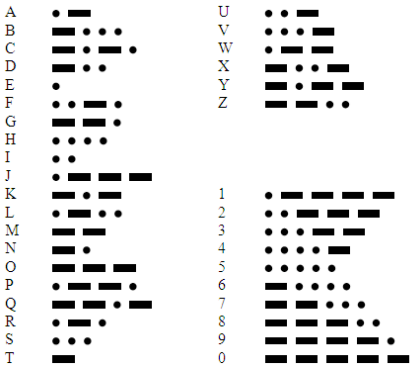
TOPIC 1: Wired Communication

Wired communication is a way of allowing two electrical systems to communicate via wires. Each system has the ability to convert a message or data of some sort into voltage. Most commonly this voltage is either the maximum voltage the system has or the minimum voltage the system has. It switches back and forth between these two voltages with respect to time to "send" a message. It is identical in concept to Morse code.

In Morse code, there are two types of signals, the short sound and the long sound. This communication system has four "rules."

1. The short sound, the dot, is one-third the length of the long sound, the dash.
2. Each letter or number is a combination of dashes and dots and the time between each part of a letter is equal to a dot.
3. The space between two letters in one word is the length of three dots.
4. The space between two words is the length of seven dots.

Below is the "code" for each letter and number.



Digital communication systems are generally based around this same concept with a different method for representing each character. In modern systems there aren't long and short pulses but one length in each system. In place of the long and short pulses are on and off pulses on known length.
The most common form of character representation in modern times is called ASCII (pronounced as-kee). In ASCII representation, eight on and/or off pulses are used in a specific order to represent each character.

The ASCII table is shown below including both the numbers and letters and their binary representation. Binary refers to a type of number consisting on only ones and zeros. A one represents a high voltage (5V for example) and a zero represents zero voltage or ground. This table is incomplete as ASCII can represent every character on a keyboard.

Binary	Character	**Binary**	Character	**Binary**	Character
100 0001	A	110 0001	a	011 0000	0
100 0010	B	110 0010	b	011 0001	1
100 0011	C	110 0011	c	011 0010	2
100 0100	D	110 0100	d	011 0011	3
100 0101	E	110 0101	e	011 0100	4
100 0110	F	110 0110	f	011 0101	5
100 0111	G	110 0111	g	011 0110	6
100 1000	H	110 1000	h	011 0111	7
100 1001	I	110 1001	i	011 1000	8
100 1010	J	110 1010	j	011 1001	9
100 1011	K	110 1011	k		
100 1100	L	110 1100	l		
100 1101	M	110 1101	m		
100 1110	N	110 1110	n		
100 1111	O	110 1111	o		
101 0000	P	111 0000	p		
101 0001	Q	111 0001	q		
101 0010	R	111 0010	r		
101 0011	S	111 0011	s		
101 0100	T	111 0100	t		
101 0101	U	111 0101	u		
101 0110	V	111 0110	v		
101 0111	W	111 0111	w		
101 1000	X	111 1000	x		
101 1001	Y	111 1001	y		
101 1010	Z	111 1010	z		

For example the word TECH would be sent as 1010100 1000101 1000011 1001000 and likewise tech (lowercase) would be sent as 1110100 1100101 1100011 1101000.

Now that we have a way to use voltage vs. time to represent characters we need a description of how data is packaged together. This way of packaging data is referred to as a protocol. Examples of different protocols are RS232 (common serial DB-9 connector on your PC), Ethernet, USB, Firewire, etc.

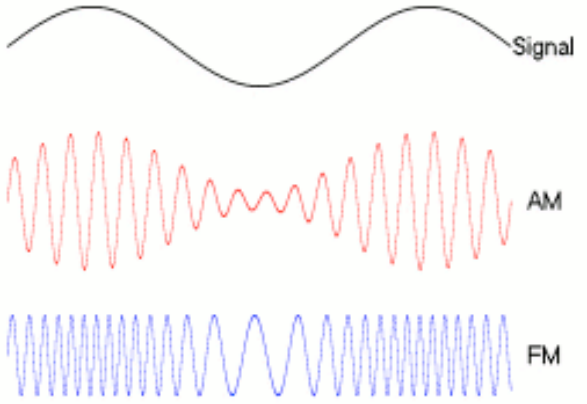
TOPIC 2: Wireless Communication

Wireless communication actually differs very little from wired communication except that it is transmitted using a "carrier frequency." This carrier frequency is the vehicle that carries the information through the air and to the receiving system. There are two types of wireless communication that are common, analog and digital. For example FM and AM radio are analog transmissions.

FM - Frequency Modulation (FM) radio transmissions are transmitted using a "center frequency" along with a range of carrier frequencies. In FM radio, the audio from a microphone is converted into a voltage. FM has a frequency that it transmits that represents a certain voltage (audio level) and voltage above that causes a higher frequency to be broadcast. Likewise, a lower voltage causes a lower frequency to be broad cast.

AM - Amplitude Modulation uses one frequency to transmit but at varying amplitudes. Again, the voltage converted from sound is used to alter the amplitude of the carrier frequency.

The animation below shows both FM and AM waveforms based on a simple sine wave modulation voltage. This would represent a single tone being transmitted.



Digital wireless communications use a similar method but transmit digitally. The range of different methods for digital wireless communication is very vast and advancing quickly. This category includes such things as WiFi, Bluetooth, Zigbee, Cell Phones, Satellite TV, XM Radio, and other proprietary communication methods.

TOPIC 3: Duplexity

When communicating between two systems either through wires or wirelessly, there are two general forms. These forms are Half-Duplex and Full-Duplex. Half-Duplex means that a transceiver (a system capable of transmitting and receiving) cannot receive while transmitting or transmit while receiving. Full-Duplex means that a transceiver can transmit and receive at the same time. When the transmission is done over wires it generally means that a full-duplex system contains two wires. When the transmission is done over a wireless medium it generally means that there are two frequencies being used (frequency division duplexing) or that the systems are taking turns communicating back and forth so fast that you cannot tell they aren't really doing both at the same time (time division duplexing).

You should now be prepared to answer the following questions:

1. Who actually invented the Morse Code used today?

2. In Morse Code, the designer of the code read through a _____ to determine the most used letters so that the shortest code could be assigned to these letters.

3. If ASCII coding was used to send the message "28," what would this message look like in binary?

4. If an ASCII code was used to send a message and the receiver received "011001010000010110101" what should this be interpreted as?

5. A partial transmission arrived at a receiver. ASCII coding was used at the received transmission was "100001 1000001 101010." If the last bit was lost what are the possible interpretations of the transmission?

6. FM stands for _____ _____.

7. AM stands for _____ _____.

8. If a wireless transceiver can transmit and receive at the same time it is said to be _____ _____.

9. If a wireless transceiver must wait to transmit until it is finished receiving it is said to be _____ _____.