At this point, we've talked about HDLC, which is used on WANs and LANs (LLC – Logical Link Control) on the Data Link Layer.

We're going to switch gears from WANs and move to discussion on LANs.

Two types of Local Area Networks

1. **Base Band Networks**
   Data is unmodulated.
   Ethernet is an example.
   Also called broadcast.

   When you have information to send, it goes out onto the bus and is transmitted to everyone. This introduces the potential for **collisions**. Thus, some sort of *medium access control* must be implemented. We are going to discuss CSMA/CD (Carrier Sense, Multiple Access with Collision Detection), which is used in Ethernet and Token Ring.

   In a Token Ring network, since only one station can transmit at a time, there isn't as much of a chance of a collision. It is deterministic because stations are guaranteed an opportunity to send data within a certain amount of time.

   In Ethernet, you're not guaranteed that you're able to send within a given amount of time.

2. **Broadband**

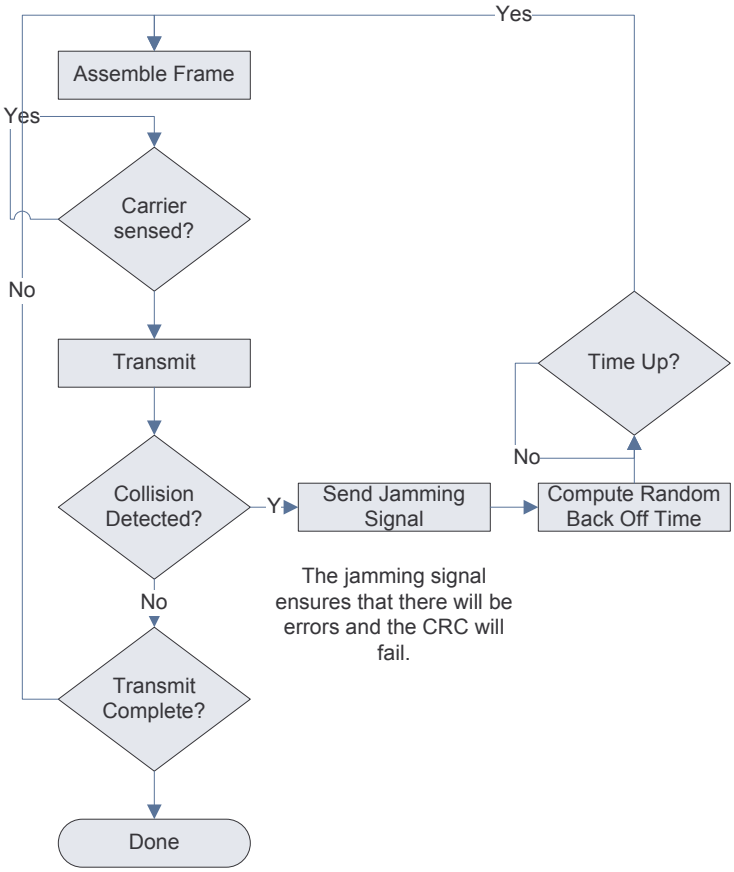
Protocols

IEEE 802 Standards cover the Physical and Data Link layers of the OSI model.

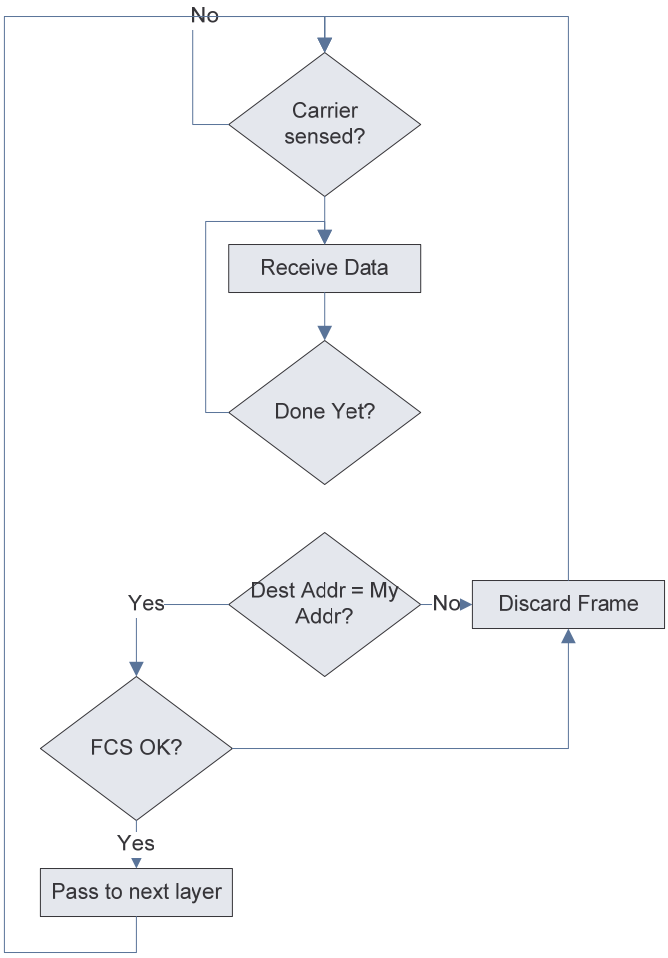
802.3 is Ethernet

CSMA/CD Algorithm

Sender



Receiver



Ethernet Frame

7 Bytes	1 Byte	6 Bytes	6 Bytes	2 Bytes		4 Bytes	
Preamble	SFD	Src Addr	Dest Addr	Type	Data	CRC	Interframe Gap

Preamble – Used for synchronization of the transmitter and receiver. It is an alternating 0 and 1 pattern.

SFD – Start of Frame Delimiter. Looks like the preamble. The last two bits, though, are both 1s. This indicates to the receiver that data is going to follow. The receiver and transmitter should be synced at this point.

Type – Usually used for containing details about which network layer protocol that the data is intended before. Example: If the network layer protocol being used is IP, 0x0800 would be used for the type.

Data – Variable length in the range of 46 bytes – 1500 bytes. If the receiver gets a frame that is smaller or larger, it discards it. If the data being sent is less than 46 bytes, the transmitter must pad it.

Using Preamble for Synchronization

As the information comes in to the receiver, a clock is used to sample the data that is coming in. The clock is 32 times the nominal bit rate of the data being transmitted.

The receiver shifts the received data into a 32-bit shift register. If the two sides are synchronized, half of the shift register will be all 0s and the other half will be all 1s.

On Ethernet, the data is sent with the least significant bit first.

Collision Detection in Ethernet

A collision has to be detected while a frame is being transmitted.

Look at the two nodes that have the greatest distance (wire length) between them

For A to detect a collision while it is still transmitting, the time for a frame must be at least $2T_{Prop}$

10Base5
10Mbps
5 * 100 = 500 meters = max distance between nodes on the bus.

$$T_{frame} \geq 2T_{prop}$$

$$T_{prop} = \frac{500m}{2 \cdot 10^8 m/s} = 2.5 \cdot 10^{-6} s$$

$$\therefore T_{frame} \geq 5 \cdot 10^{-6} s$$

$$\left(10 \times 10^6 bits/s\right)\left(5 \times 10^{-6} \text{ s/ } frame\right) = 50 bits/frame \approx 8 Bytes$$