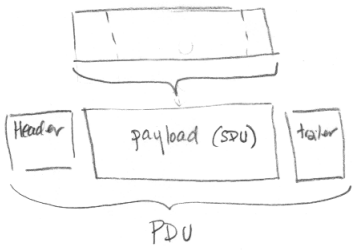
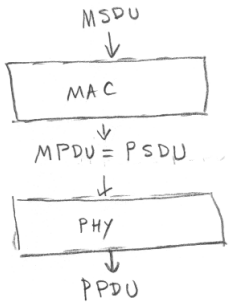
Miscellaneous Topics 2

OSI Protocol Layers

The Open Systems Interconnect model for data networks is an attempt to divide the functions that are performed by typical data communication networks into protocol layers. The OSI model defines 7 layers. However, the OSI division of functionality is only one of various way to divide up the functions and does not correspond to any particular implementation. However, it is useful to understand the terminology and functions of each of the layers.

As discussed earlier, data travels down the stack at the transmitter and up the stack at the receiver. Each layer adds it's own information in the form of headers and/or trailers. The data flowing into each layer is called a Service Data Unit (SDU) while the encapsulated frame leaving a layer is called a Protocol Data Unit (PDU):





This terminology is primarily used in descriptions of the PHY and MAC layers where the MAC SDU (MSDU) is the input to the MAC layer, the MAC PDU (MPDU) is the MAC output which is the PHY SDU (PSDU) and the input to the PHY layer. The output of the PHY is the PSDU.

Only the lowest three layers are represented by hardware. The four upper layers (Transport, Session, Presentation and Application) are typically implemented in software in the form of device drivers, libraries and application software.

The three lowest layers of the OSI model are:

Physical Layer is the lowest layer (layer 1) of the OSI model. It includes physical features such as connectors, voltages, currents, waveforms, frequencies, modulation formats and line codes, etc.

Data Link Layer is layer 2 of the OSI model. It is often considered to include two sub-layers, the Logical Link Control (LLC) layer and the Medium Access Control (MAC) layer. The LLC layer is responsible for transferring frames between devices on the local network. This includes addressing, error detection and flow control. The MAC is responsible for coordinating access to a shared medium.

Network Layer is layer 3 and is responsible for routing message between local area networks. Layer 3 networks typically consist of point-to-point links between routers. The addressing structure is usually hierarchical to assist with routing. This layer also handles retransmissions, flow control, fragmentation (breaking up large frames into smaller ones).

Certain functions,such as error control, may be performed at multiple layers. For example, a WLAN may included it's own ARQ protocol because errors happen more often on wireless networks. If retransmission were only done by higher layers the delay might become excessive.

802.3 Frame Format

The most common Layer 2 protocol is defined in IEEE standard 802.3 which was based on the "Ethernet" CSMA/CD LAN protocol. The frame consists of:

Destination Address (6 bytes) - this is the MAC or "hardware" address of the destination. The MAC address is unique to each hardware interface. The first three bytes is called an Organizationally Unique Identifier (OUI) which is assigned to each manufacturer. The second three bytes are assigned by the manufacturer.

Source Address (6 bytes) - the MAC address of the source interface.

Length/Type (2 bytes) - this was originally the length of the frame but is now used to identify the type of frame. The type field is necessary because the same hardware interface can be shared by different Layer 3 protocols. This field has been extended in various ways to indicate the presence of additional header fields that can be placed before the data. The actual length of the frame is determined by the PHY layer.

Data (up to 1500 bytes) - the payload.

FCS (4 bytes) - a 32-bit CRC.

As described above each physical and MAC protocol will add specific preamble bytes to help with contention and synchronization.