Chapter 9
Addressing and Protocol Type

Addressing Problem

- Given a multi-access network, how do we know which machine the packet is destined for?

Packet-type Problem

- Assuming you can get the data to the destination machine,

  How does the receiver know what type of data is in the packet?

What kinds of addresses are possible?

- There are basically three types of addresses.
  Each type represents a different set of destinations:

  1.
  2.
  3.

- Which address types are required?

Hardware Addressing

- Most network technologies have a hardware addressing scheme to uniquely identify machines on the network
- Each machine is assigned a numeric hardware address (also called a physical address)
- The hardware address must be unique to
- Typcially, the sender includes the hardware address in every frame transmitted
- Only the machine with the specified hardware address accepts a copy of the frame (others discard the frame)
- Does the sender's address need to be in the frame?

Assigning Unicast Hardware Addresses

- Address format depends on the network technology used
- Unicast addresses must be unique on a network
- How can we ensure that each machine has a unique address?

Assigning the Broadcast Address

- Only need one broadcast address
- Must reserve one address as the broadcast address
- Obviously the broadcast address cannot be the same as any machine's unicast address
- typical broadcast addresses are:

Assigning Multicast Addresses

- A multicast address represents a group of receivers.
- Group members are not known ahead of time - machines must be allowed to join and leave a group on-the-fly
- Members of the group are often never known
- A machine may be a member of several groups
- Thus a machine may listen to multiple multicast addresses simultaneously
- Questions:

Getting the Packet to the Host

- How does the packet get to the right host?
- Destination address is contained in the packet.
- LAN Addressing: receiver checks the address

- WAN Addressing: intermediate notes check address and forward

Packet Types

- Question: How does the receiver know what is in the packet?
- Answer: Need a type field to describe the packet contents.
- Two ways to define the type:

Frame Headers

- Question: Where do we place the destination address and frame type?
- Answer: in the Frame Header
- The frame header contains information about the frame
- All contemporary standards use the following general format:

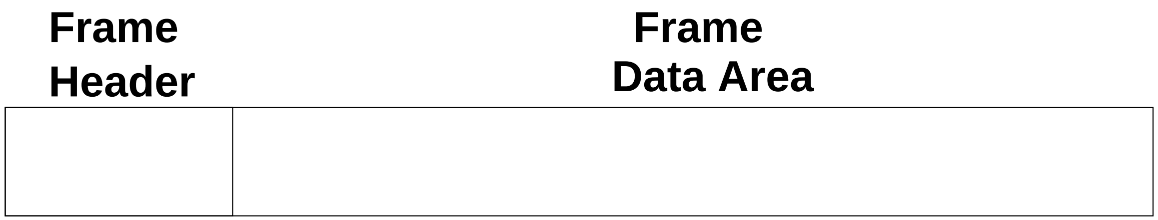

Figure 1: Frame Header and Data Area

- The header is typically subdivided into fixed-length fields
- The data area may vary in size

Ethernet: Addresses

- Ethernet addresses are 48 bits long (6 octets)
- Every NIC card has a unique address (How?)
- Changing cards means changing addresses
- Three types of addresses supported, unicast, bcast, mcast
- Broadcast address: all 1's
- Multicast addresses: start with 1 bit (except bcast addr)
- Unicast addresses: the rest
- Written using 8:0:2b:e4:b1:2 notation
- What addresses does an Ethernet NIC card have to look for?

Ethernet: Frame Format

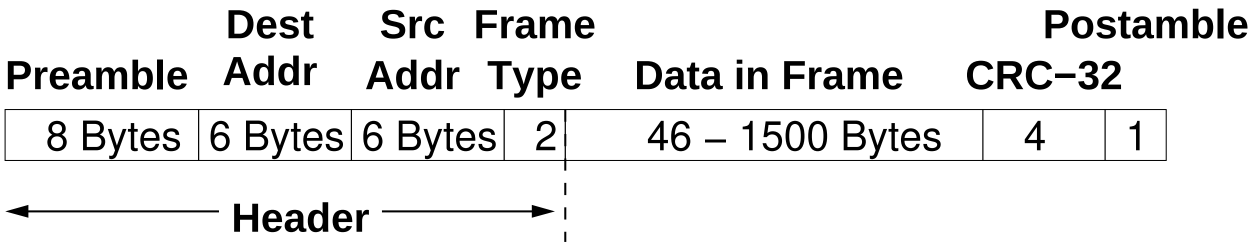

Figure 2: Ethernet Frame Format

- DIX Ethernet frames are bit-oriented frames that contain:
  - Preamble - 64 bits (alternating 1's and 0's)
  - Dest addr - 48 bits
  - Src addr - 48 bits
  - Type - 16 bits (identifies the type of data in the frame)
  - Body - up to 1500 bytes (minimum of 46 bytes - why?)
  - CRC - 32 bits
  - Postamble - 8 bits
- Like HDLC, it uses bit stuffing

Self-Identifying Frames

- The DIX Ethernet frame is said to be Self-Identifying

  Self-Identifying means the frame header contains a Type field that tells what is contained in the frame

- Possible types of data include:

Value	Meaning
0000-05DC	Reserved for use with IEEE 802.3
0800	Internet IP Version 4
0805	CCITT X.25
0900	Ungermann-Bass Corporation network debugger
0BAD	Banyan Systems Corporation VINES
1000-100F	Berkeley UNIX Trailer encapsulation
6004	Digital Equipment Corporation LAT
6559	Frame Relay
8005	Hewlett Packard Corporation network probe
8008	AT&T Corporation
8014	Silicon Graphics Corporation network games
8035	Internet Reverse ARP
8038	Digital Equipment Corporation LANBridge
805C	Stanford University V Kernel
809B	Apple Computer Corporation AppleTalk
80C4-80C5	Banyan Systems Corporation
80D5	IBM Corporation SNA
80FF-8103	Wellfleet Communications
8137-8138	Novell Corporation IPX
818D	Motorola Corporation
FFFF	Reserved

Figure 3: Ethernet Frame Types

Implicit Frame Type

- A later Ethernet standard defined by the IEEE, called IEEE 802.3 is not Self-Identifying.
- IEEE 802.3 is identical to DIX except that:
  - It uses an implicit frame type mechanism
  - It substitutes a Length field in the place of the Type field
  - Thus the Type of data is not known and must be inferred from the data field

Implicit Frame Type: (continued)

- To help infer the correct type, the first few bytes of the data field are used to store the data's Type

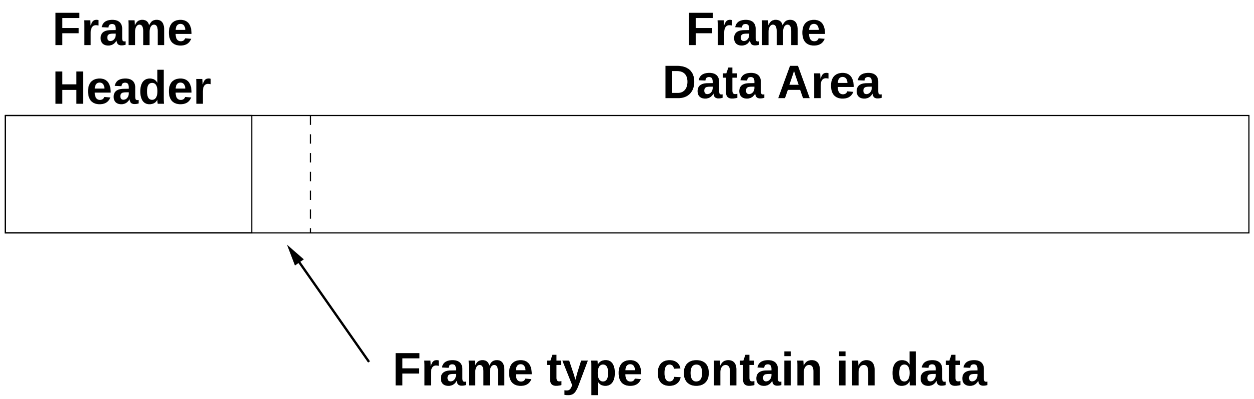

Figure 4: Date Field Contains Frame Type

IEEE SNAP/LLC

- IEEE Ethernet standard uses the IEEE 802.2 protocol to identify the type
- IEEE 802.2 includes a Logical Link Control (LLP) SubNetwork Attachment Point (SNAP) field as the first part of the data field
- the SNAP/LLC format looks like:

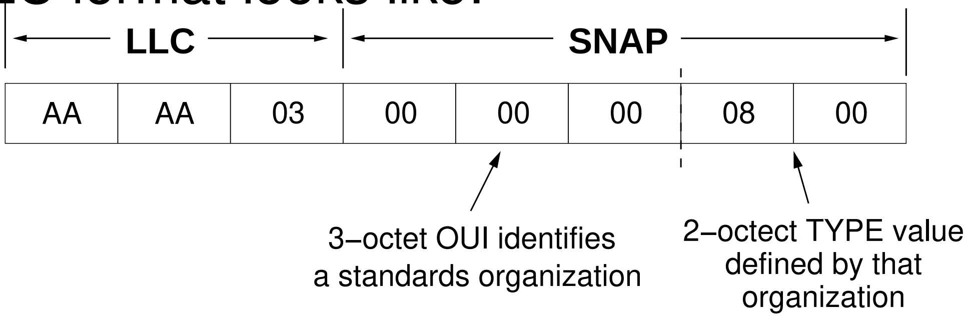

Figure 5: SNAP/LLC format

- LLC portion indicates that a SNAP field follows
- OUI (Organizationally Unique Identifier) identifies Ethernet specification organization (i.e., the organization that defined the type number)
- TYPE field identifies the data type (in this case, IP)

FDDI: Addresses

- Like ethernet, addresses can be 48 bits (6 bytes) long
- However, 16 bit address are also defined, but rarely used
- The 48 bit addresses are interpreted just like ethernet addresses

FDDI: Frame Format

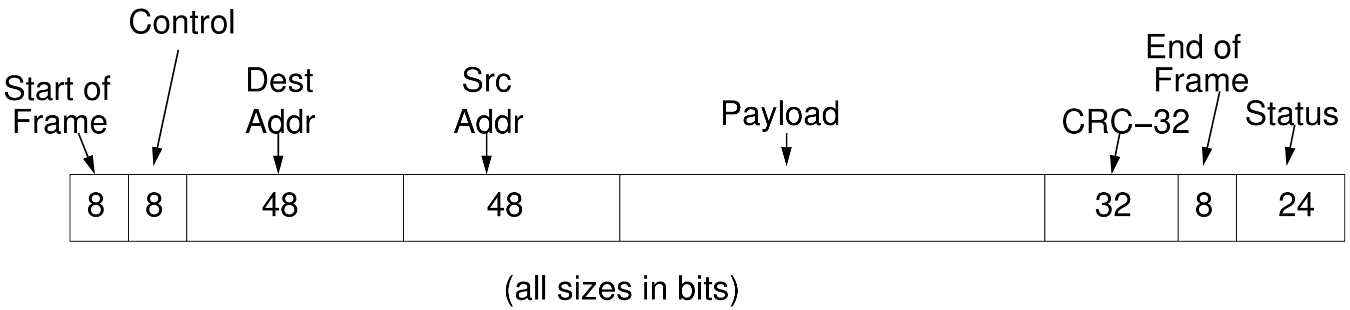

Figure 6: FDDI format

- also uses a bit-oriented frame
- max frame length is approx 4500 bytes
- frame fields are:

Field Descriptions

- control field specifies

- status field

ATM: Addresses

- Each machine is identified by a unique NSAP address
- NSAP stands for *Network Service Access Point* (a term from the OSI standard)
- An ATM NSAP address is 160 bits long! (20 octets)
- The NSAP address is NOT include in an ATM cell
- So how do we know where to send the cell?
  (wait till chapter 11)

ATM: Frame Format

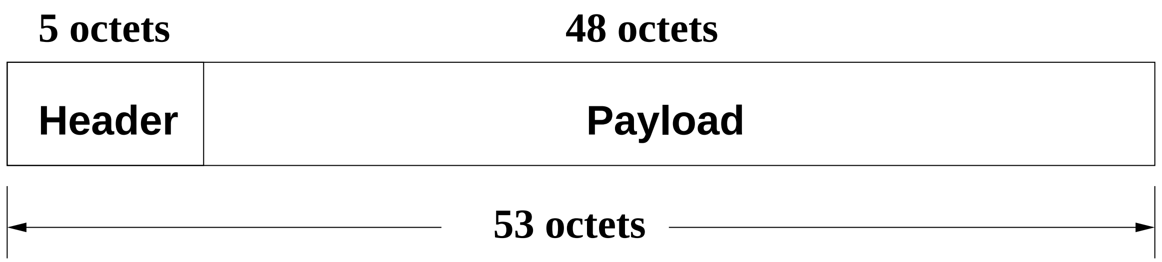

Figure 7: ATM Packet Format

- Each cell is 53 octets long with a 5 octet header and a 48 octet data area
- The header contains
  - 30-bits of addressing info (see chapter 11)

– 3-bit Payload Type field

– 1-bit Cell Loss Priority field

– 8-bit CRC field

- There are actually two cell formats (depends on the address info)
  – NNI cell format
  – UNI cell format

ATM: Frame Format: (continued)

Some things to note about ATM format:

- no SYN characters to start off the cell
- no byte stuffing
- no bit stuff (no magic bit string to start/end cell)
- what does it use instead?
- ATM runs over fiber. Why waste 8 bits (out of a 40-bit header) on a CRC?
- Does it matter that the CRC is in the header?