Review of Networking Concepts

Shivkumar Kalyanaraman
Rensselaer Polytechnic Institute
shivkuma@ecse.rpi.edu
http://www.ecse.rpi.edu/Homepages/shivkuma

- **Concept list**
- **ISO/OSI Reference Model**
- **TCP/IP Reference Model**
- **Differences between ISO and TCP**
- **Ethernet/IEEE 802.3 LANs, SLIP, PPP**
- **Interconnection Devices**
  Many of these concepts are taught in 35467

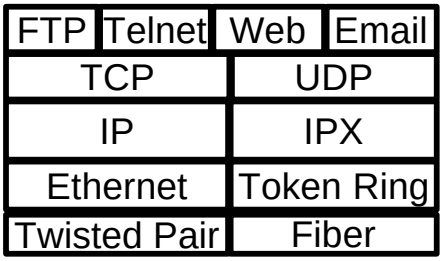
Key networking concepts

- Layering: **interfaces, services, peer-peer protocols.**
- Encapsulation: **(de)multiplexing, overlays**
- Addressing/Naming: **address/name resolution, hierarchical vs flat addresses, routing, conn'n setup**
- Communication type: **message passing, packet switching, connection-oriented, connectionless**
- Error & flow control: **framing, CRC, retransmission, backoff, sliding window ARQ protocols.**

Key networking concepts (contd)

- Media access: **shared, switched, collision, carrier sense, collision detect, multiple access, slots, tokens**
- Interconnect devices: **repeaters, hubs, bridges, switches, routers, application gateways**

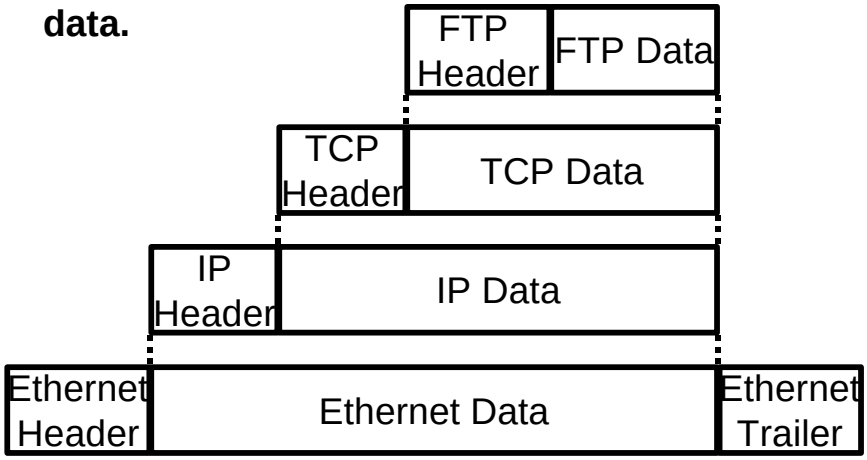
Layering



- **Protocols@each layer perform a set of functions**
- **All alternatives for a row have the same interfaces**
- **Choice of protocols at each layer is independent of those of at other layers.**
- **May not be the most efficient implementation**

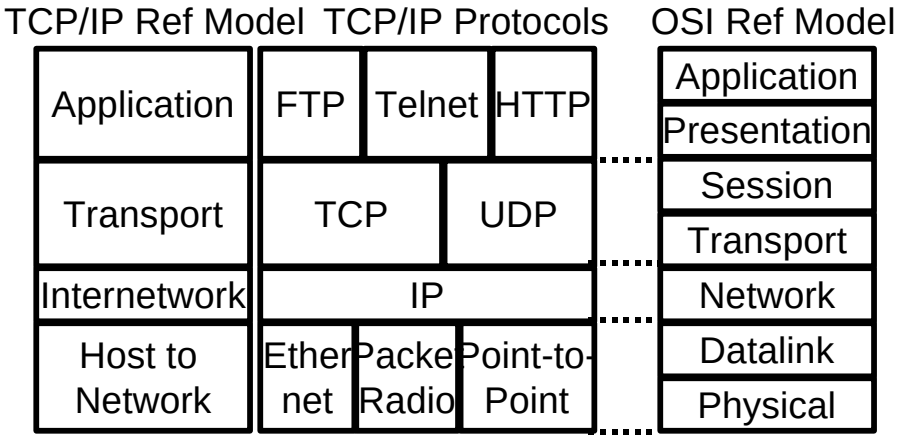
Encapsulation

- **Nth layer control info is passed as N-1th layer data.**

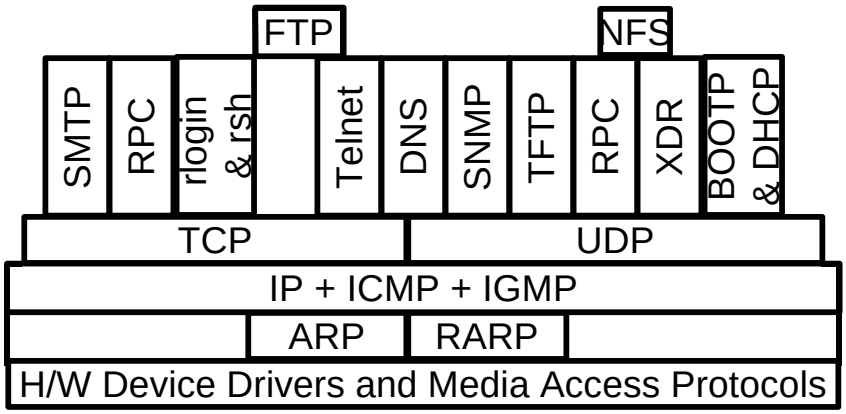


TCP/IP Reference Model

- **TCP = Transmission Control Protocol**
- **IP = Internet Protocol (Routing)**



The Internet Protocol Tree



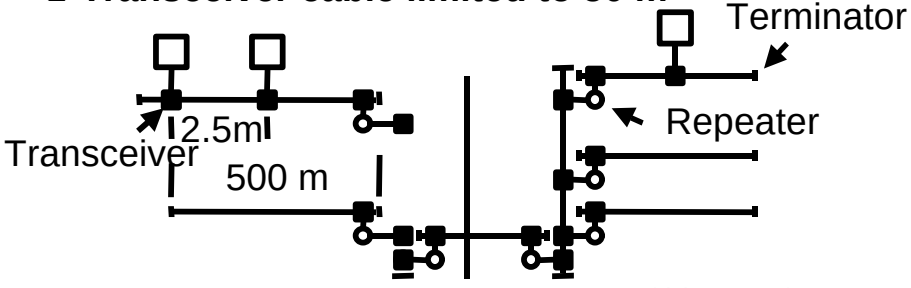
- Also see fig 1.4 in text

Multiple Access Protocols

- **Aloha at University of Hawaii:**
  Transmit whenever you like
  Worst case utilization = 1/(2e) =18%
- **CSMA: Carrier Sense Multiple Access**
  Listen before you transmit
- **CSMA/CD: CSMA with Collision Detection**
  Listen while transmitting.
  Stop if you hear someone else.
- **Ethernet uses CSMA/CD.**
  Standardized by IEEE 802.3 committee.

Original Ethernet Cabling Rules

- **Thick coax**
- **Length of the cable is limited to 2.5 km, no more than 4 repeaters between stations**
- **Less than 500 m per segment ⇒ 10Base5**
- **No more than 2.5 m between stations**
- **Transceiver cable limited to 50 m**

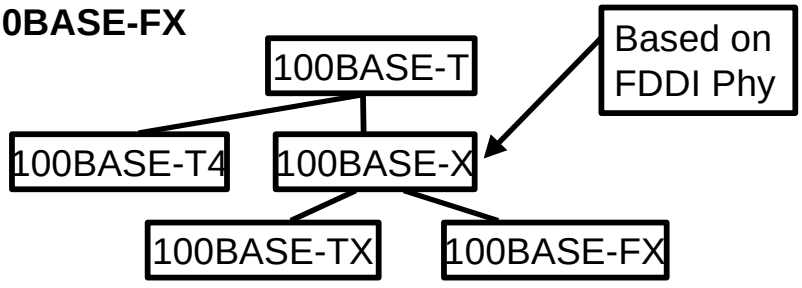


802.3 PHY Standards

- 10BASE5: **10 Mb/s over coaxial cable (ThickWire)**
- 10BROAD36: **10 Mb/s over broadband cable, 3600 m max segments**
- 10BASE2: **10 Mb/s over thin RG58 coaxial cable (ThinWire), 185 m max segments**
- 1BASE5: **1 Mb/s over 2 pairs of UTP**
- 10BASE-T: **10 Mb/s over 2 pairs of UTP**
- 10BASE-F: **Fiber Optic inter-repeater link (FOIRL)**, **10BASE-FL (link), 10BASE-FB (backbone), or 10BASE-FP (Passive)**

Fast Ethernet Standards

- 100BASE-T4:**100 Mb/s over 4 pairs CAT-3, 4, 5**
- 100BASE-TX:**100 Mb/s over 2 pairs CAT-5, STP**
- 100BASE-FX: **100 Mb/s CSMA/CD over 2 fibers**
- 100BASE-X: **100BASE-TX or 100BASE-FX**
- 100BASE-T: **100BASE-T4, 100BASE-TX, or 100BASE-FX**

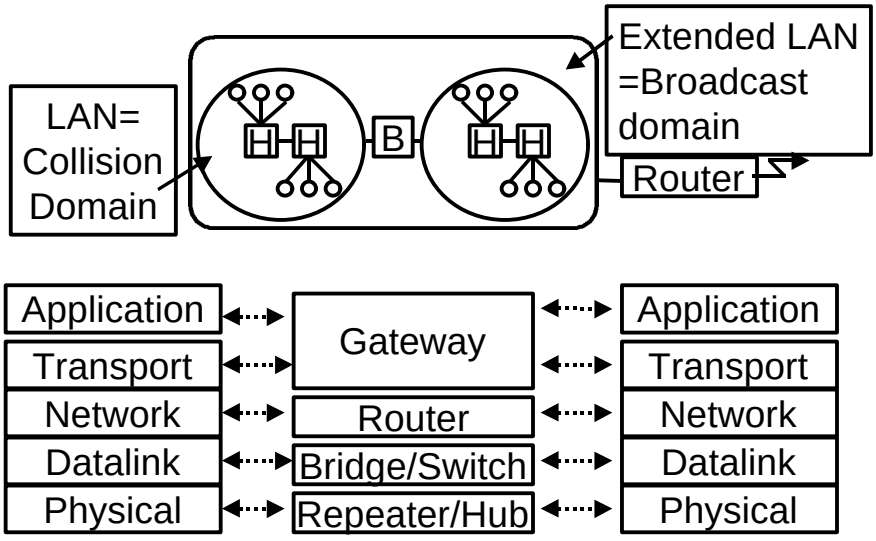


Interconnection Devices

- Repeater**:** PHY device that restores data and collision signals
- Hub: Multiport repeater + fault detection
- Bridge: Datalink layer device connecting two or more collision domains. MAC multicasts are propagated throughout “extended LAN.”
- Router: Network layer device. IP, IPX, AppleTalk. Does not propagate MAC multicasts.
- Switch: Multiport bridge with parallel paths

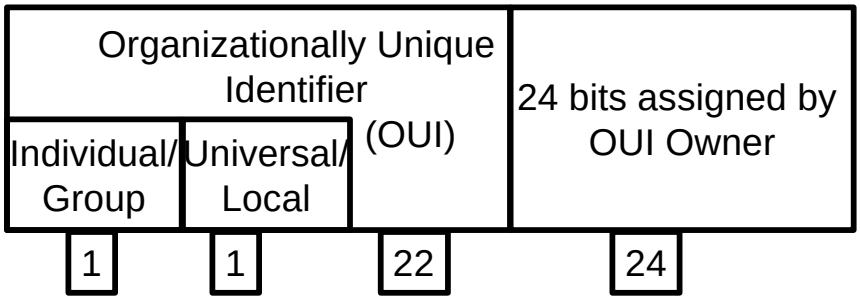
These are functions. Packaging varies.

Interconnection Devices (contd)



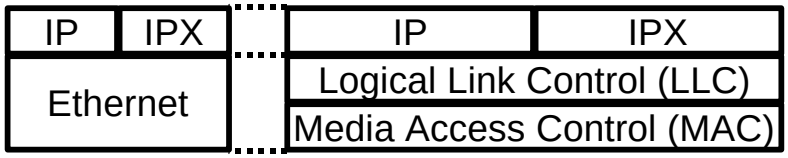
Ethernet (IEEE 802) Address Format

- 48-bit:1000 0000 : 0000 0001 : 0100 0011 : 0000 0000 : 1000 0000 : 0000 1100 = 80:01:43:00:80:0C



- **Multicast = "To all bridges on this LAN"**
- **Broadcast = "To all stations" = 111111....111 = FF:FF:FF:FF:FF:FF**

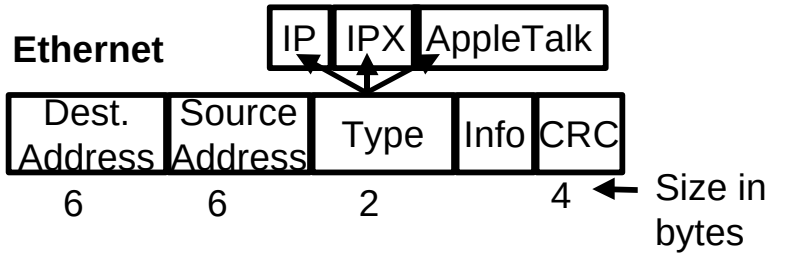
Ethernet vs IEEE 802.3



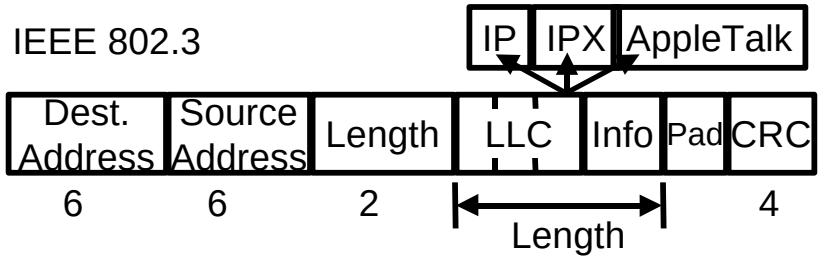
- **In 802.3, datalink was divided into two sublayers: LLC and MAC**
- **LLC provides protocol multiplexing. MAC does not.**
- **MAC does not need a protocol type field.**

Frame Formats: Ethernet & 802.3

- **Ethernet**



- IEEE 802.3



Serial IP (SLIP)

- **Simple: only framing = Flags + byte-stuffing**
- **Compressed headers (CSLIP) for efficiency on low speed links for interactive traffic.**
- **Problems:**
  - **Need other end's IP address a priori (can't dynamically assign IP addresses)**
  - **No "type" field => no multiprotocol encapsulation**
  - **No checksum => all errors detected/corrected by higher layer.**
- **RFCs: 1055, 1144**

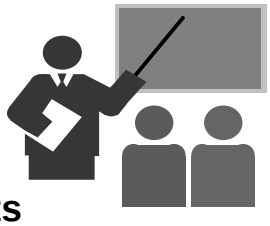
PPP

- Frame format similar to HDLC
- Multiprotocol encapsulation, CRC, dynamic address allocation possible
  - key fields: flags, protocol, CRC (fig 2.3)
- Asynchronous and synchronous commns possible
- Link and Network Control Protocols (LCP, NCP) for flexible control & peer-peer negotiation
- Can be mapped onto low speed (9.6Kbps) and high speed channels (SONET)
- RFCs: 1548, 1332

MTU

- Maximum Transmission Unit
- Key link layer characteristic which affects IP performance.
- (IP datagram size > MTU) => fragment => inefficient
- Path MTU: smallest MTU on any traversed link on path => TCP/IP can be more efficient knowing this.
- Reducing MTU for a low speed CSLIP line can lead to lesser transmission/propagation times for interactive traffic

Summary



- Key concepts
- ISO/OSI reference model has seven layers. TCP/IP Protocol suite has four layers.
- Ethernet/IEEE 802.3 uses CSMA/CD, Fast Ethernet
- Interconnection devices
- Other link layers: SLIP, PPP
- MTU

Informal Exercise

- For each of the following addresses: indicate whether it is a multicast and whether it is a locally assigned address?
  80:01:43:00:00:00
  40:01:43:00:00:01
  Were these addresses assigned by the same manufacturer?
- Why is the first valid "type" field in the Ethernet header 0x0800 ? (hint: avoiding conflict with the 802.3 "length" field)
- Read chapters 1 & 2: you will be quizzed next class!