The Network Access Layer

Hour 3

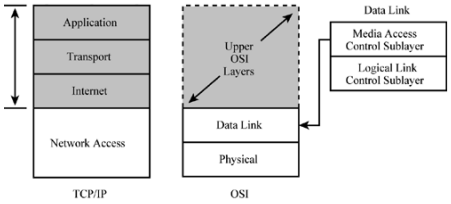
In This Lecture

- Explain what the Network Access layer is
- Discuss how TCP/IP's Network Access layer relates to the OSI networking model
- Explain what a network architecture is
- List the contents of an ethernet frame
- Identify the methods that ethernet, token ring, and FDDI use for controlling access to the transmission medium

Network Access Layer

- Interfacing with the computer's network adapter.
- Coordinating the data transmission with the conventions of the appropriate access method.
- Formatting the data into a unit called a frame and converting that frame into the stream of electric or analog pulses that passes across the transmission medium.
- Checking for errors in incoming frames.
- Adding error-checking information to outgoing frames so that the receiving computer can check the frame for errors.
- Acknowledging receipt of data frames and resending frames if acknowledgment is not received.

Subdivisions of OSI Data Link Layer



Subdivisions of OSI Data Link Layer

- Media Access Control (MAC)— provides an interface with the network adapter. The network adapter driver, in fact, is often called the MAC driver, and the hardware address burned into the card at the factory is often referred to as the MAC address.
- Logical Link Control (LLC)— performs error-checking functions for frames delivered over the subnet and manages links between devices communicating on the subnet.

Network Architecture

- Access method— An access method is a set of rules defining how the computers will share the transmission medium. To avoid data collisions, computers must follow these rules when they transmit data.
- Data frame format— The IP-level datagram from the Internet layer is encapsulated in a data frame with a predefined format. The data enclosed in the header must supply the information necessary to deliver data on the physical network. You'll learn more about data frames later in this hour.
- Cabling type— The type of cable used for a network has an effect on certain other design parameters, such as the electrical properties of the bitstream transmitted by the adapter.
- Cabling rules— The protocols, cable type, and electrical properties of the transmission have an effect on the maximum and minimum lengths for the cable and for the cable connector specifications.

Physical Addressing

- The Network Access layer is necessary in order to relate the logical IP address, which is configured through the protocol software with the actual permanent physical address of the network adapter.
- The physical address is burned into the card at the factory.
- Data frames sent across the LAN must use this physical address to identify the source and destination adapters, but the lengthy physical address (48 bits in the case of ethernet) is so unfriendly that it is impractical for people to use.
- Encoding the physical address at higher protocol levels compromises the flexible modular architecture of TCP/IP, which requires that the upper layers remain independent of physical details.
- TCP/IP uses the Address Resolution Protocol (ARP) and Reverse Address Resolution Protocol (RARP) to relate IP addresses to the physical addresses of the network adapters on the local network. ARP and RARP provide a link between the logical IP addresses seen by the user and the (effectively invisible) hardware addresses used on the LAN.

Network Access Layer

- Step 1 - Break IP Layer Data into chunks of 64 bytes to 1518 bytes
- Step 2 – Package chunks into frames (including header)
  - Preamble (mark beginning of frame – 8 bytes the last is the 1 byte start frame delimiter)
  - Recipient address (physical address)
  - Source address (physical address)
  - Length
  - Data
  - FCS (frame check sequence – Cyclical Redundancy Check (CRC)

Network Access Layer

- Step 3 – passes the data frame to physical layer (as in the OSI model)

LAN Technologies

- Ethernet, including variants such as the following:
  - 10BASE-2 (an ethernet standard using thin coaxial cable)
  - 10BASE-5 (an ethernet standard using thick coaxial cable)
  - 10BASE-T (an ethernet standard using twisted-pair cable in a star configuration)
  - 100BASE-TX (a standard similar to 10BASE-T with faster transmissions speed (100Mbps)
- Token ring

Ethernet

- Most common Lan Technology
- Uses Carrier Sense Multiple Access with Collision Detect (CSMA.CD) access method
  - Using CSMA/CD, all computers monitor the transmission medium and wait until the line is available before transmitting.
  - If two computers try to transmit at the same time, a collision occurs. The computers then stop, wait for a random time interval, and attempt to transmit again.
- Works well for light and moderate traffic but not heavy traffic (Solved by switches and routers (hour 9))

Media

Table 3.1. Ethernet Media Technology

Technology Name	Media Type	Operating Speed	Maximum Distance
10BASE-2	Thin coax	10 megabits	185 meters
10BASE-5	Thick coax	10 megabits	500 meters
10BASE-T	CAT3 or CAT5 UTP	10 megabits	100 meters
10BASE-F	Fiber optic	10 megabits	2,000 meters
100BASE-TX	CAT 5 UTP or STP	100 megabits	100 meters
100BASE-FX	Fiber optic	100 megabits	2,000 meters

Token Ring

- Uses token passing
- Computers on the LAN are connected so that data is passed around the network in a logical ring
- The token ring configuration calls for the computers to be wired to a central hub called a MAU or MSAU.
- Data passes from one computer to the next in a circular motion.
- The computers pass a packet of data called a token around the network.
- Only the computer that holds the token can transmit a message on to the ring.
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Token Ring (Cont)

- Token ring is technically more sophisticated than ethernet, and it includes a number of built-in diagnosis and correction mechanisms that can help troubleshoot network problems.
- Also, because data is transmitted in a more orderly fashion, token ring does not suffer as badly under heavy data traffic.
- More expensive than ethernet by comparison—the cable, the network adapter cards, and the other components as well.
- Token ring typically operates at either 4Mbps or 16Mbps. It is also available at 100Mbps.

FDDI

- Fiber Distributed Data Interface (FDDI)
- Expensive
- Eemploys a pair of fiber-optic rings
  - One ring is considered primary
  - The second ring is principally there to repair the primary ring in the event of a breakdown.
- FDDI uses a token passing access method similar to token ring.
- Has error-detection and correction capabilities.
- In a normally operating FDDI ring, the token passes by each machine every so often. If the token is not seen within the maximum amount of time that it takes to circulate the largest ring, it indicates a problem has occurred such as a broken cable.
- Fiber-optic cable such as the cable used with FDDI can support very large volumes of data over large distances.

Bibliography

- “Teach Yourself TCP/IP in 24 Hours, Second Edition”, Joe Casad, Sams Publishing, March 01, 2001