LAN Overview

Radhika Sukapuram

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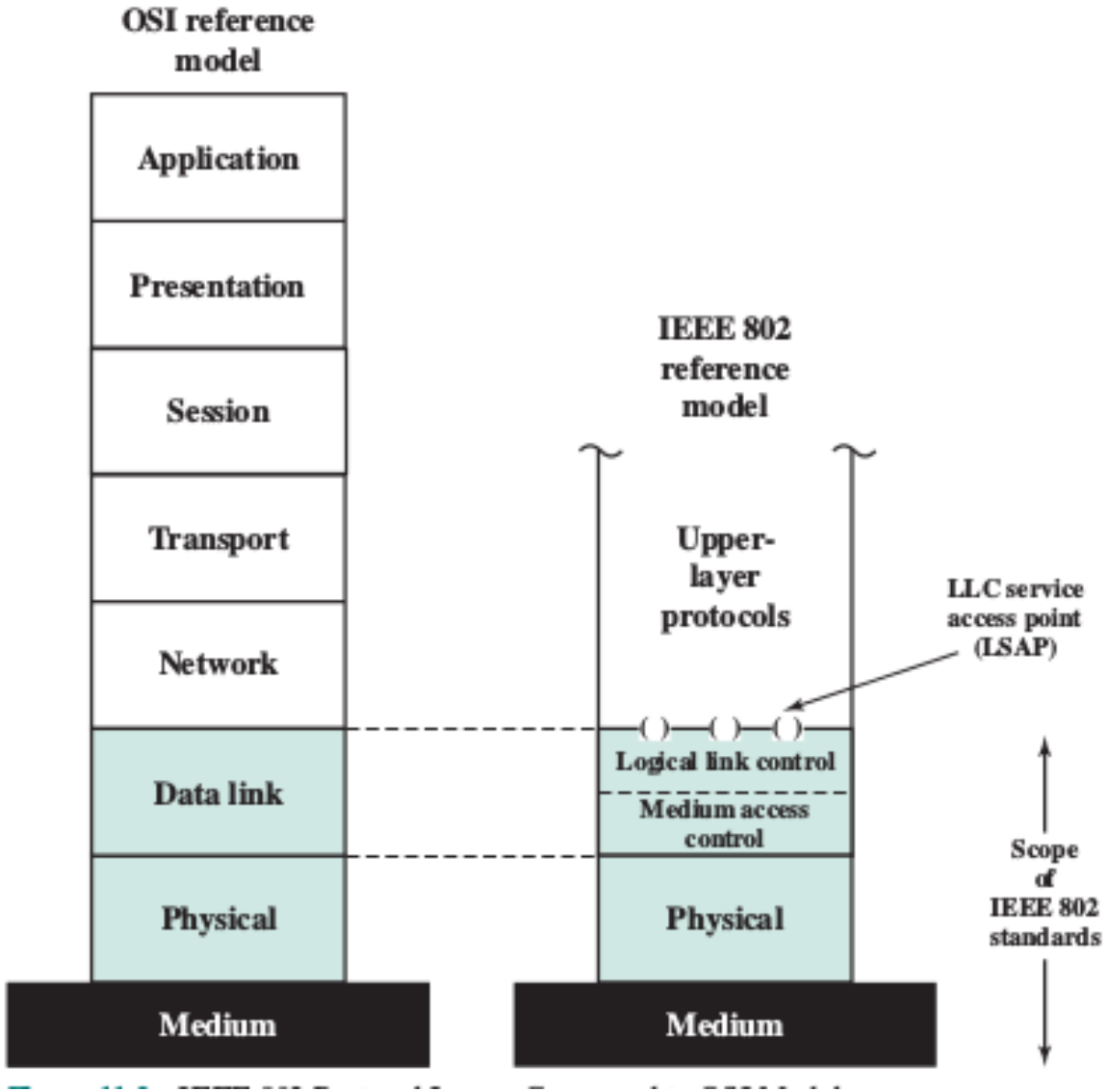
LAN protocol architecture

- IEEE 802 is a family of Institute of Electrical and Electronics Engineers (IEEE) standards for local area networks (LAN), personal area network (PAN), and metropolitan area networks (MAN)
- Earlier references: "Manchester code has been specified for the IEEE 802.3 (Ethernet) standard for baseband coaxial cable and twisted-pair bus LANs. Differential Manchester has been specified for the IEEE 802.5 token ring LAN, using shielded twisted pair."

IEEE 802

- Address issues relating to the transmission of blocks of data over the network
- Concerned with layers 1 and 2 of the network
- Higher layer protocols (layer 3 or 4 and above) are independent of network architecture and are applicable to all networks

IEEE 802 Protocol Layers Compared to OSI Model



Physical layer of IEEE 802

- Encoding/decoding of signals
- Preamble generation/removal (for synchronization)
- Bit transmission/reception
- specification of the transmission medium and the topology.

MAC and LLC

Functions associated with providing services to LAN users:
1) Medium Access Control layer:

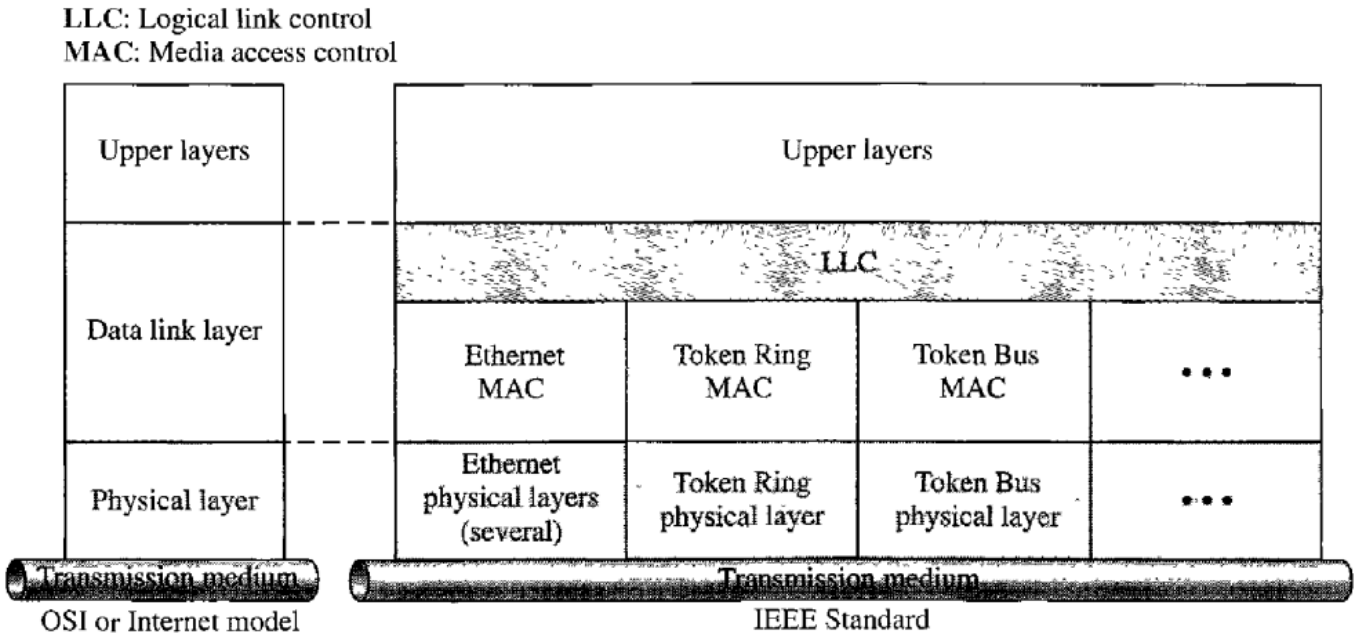
- On transmission, assemble data into a frame with address and error-detection fields.
- On reception, disassemble frame and perform address recognition and error detection.
- Govern access to the LAN transmission medium.

2) Logical Link Control layer:

- Provide an interface to higher layers and perform flow and error control.

MAC and LLC

- For the same LLC, several MAC options may be provided.



Medium Access Control

IEEE 802 defines the specific access method for each LAN type

- Carrier Sense Multiple Access with Collision Detection (CSMA/CD) : for Ethernet LANs
- Token passing method for Token Ring and Token Bus LANs

Question

All LANs and MANs consist of collections of devices that must share the networks transmission capacity. Some means of controlling access to the transmission medium is needed to provide for an orderly and efficient use of that capacity. This is the function of

(A) MAC protocol

(B) LLC protocol

(C) The physical layer

Parameters in Medium Access Control

1) Where: whether control is exercised in a centralized or distributed fashion

- Centralized: In a centralized scheme, a controller is designated that has the authority to grant access to the network.
- –A station wishing to transmit must wait until it receives permission from the controller
- Decentralized: the stations collectively perform a medium access control function to determine dynamically the order in which stations transmit

Comparison: centralized and decentralized

Centralized (advantages):

- may afford greater control over access for providing such things as priorities, overrides, and guaranteed capacity
- enables the use of relatively simple access logic at each station
- avoids problems of distributed coordination among peer entities.

Disadvantages:

- creates a single point of failure; that is, there is a point in the network that, if it fails, causes the entire network to fail.
- may act as a bottleneck, reducing performance.

Parameters in Medium Access Control contd.

2) How: How is control exercised?

- Synchronous: a specific capacity is dedicated to a connection. Similar to _____
- –generally not optimal in LANs and MANs because the needs of the stations are unpredictable.
- Asynchronous(dynamic): more or less in response to immediate demand
- –round robin, reservation, and contention

Round Robin

- Each station in turn is given the opportunity to transmit
- During that opportunity, the station may decline to transmit or may transmit subject to a specified upper bound (maximum amount of data transmitted / time for the opportunity)
- When finished, relinquishes its turn, and the right to transmit passes to the next station in logical sequence
- Control of sequence may be centralized or distributed

Question

Polling is an example of a

(A) centralized round-robin technique

(B) distributed round-robin technique

(C) distributed technique, but not round-robin

Question

When many stations have data to transmit over an extended period of time, round-robin techniques can be very efficient. If only a few stations have data to transmit over an extended period of time, a round-robin technique is

(A) inefficient because most of the stations will not transmit but simply pass their turns.

(B) efficient because most of the stations will not transmit but simply pass their turns.

(C) efficient because only less data is transmitted

Stream traffic and bursty traffic

- Stream traffic: lengthy and fairly continuous transmissions
- – examples: voice communication, telemetry, and bulk file transfer
- Bursty traffic is characterized by short, sporadic transmissions
- – examples: interactive terminal-host traffic

Reservation

Reservation: Suitable for stream traffic

- Time on the medium is divided into slots (like synchronous TDM)
- A station wishing to transmit reserves future slots for an extended or even an indefinite period
- Reservations may be made in a centralized or distributed fashion

Contention

- No control is exercised to determine whose turn it is
- All stations contend for time
- Necessarily distributed
- advantage : 1) simple to implement and, 2) under light-to-moderate load, efficient.

Round-robin and contention techniques are the most common on LANs

Question

Which method is usually appropriate for bursty traffic?

(A) Round-Robin

(B) Reservation

(C) Contention

MAC frame format

- MAC Control: This field contains any protocol control information needed for the functioning of the MAC protocol (priority level)
- Destination MAC Address: The destination physical attachment point
- Source MAC Address
- LLC: The LLC data from the next higher layer
- CRC: The Cyclic Redundancy Check field (also known as the Frame Check Sequence, FCS, field) – an error-detecting code

MAC frame format

In the LAN protocol architecture

- MAC layer: responsible for detecting errors and discarding any frames that are in error.
- LLC layer: optionally keeps track of which frames have been successfully received and retransmits unsuccessful frames.

Bridges

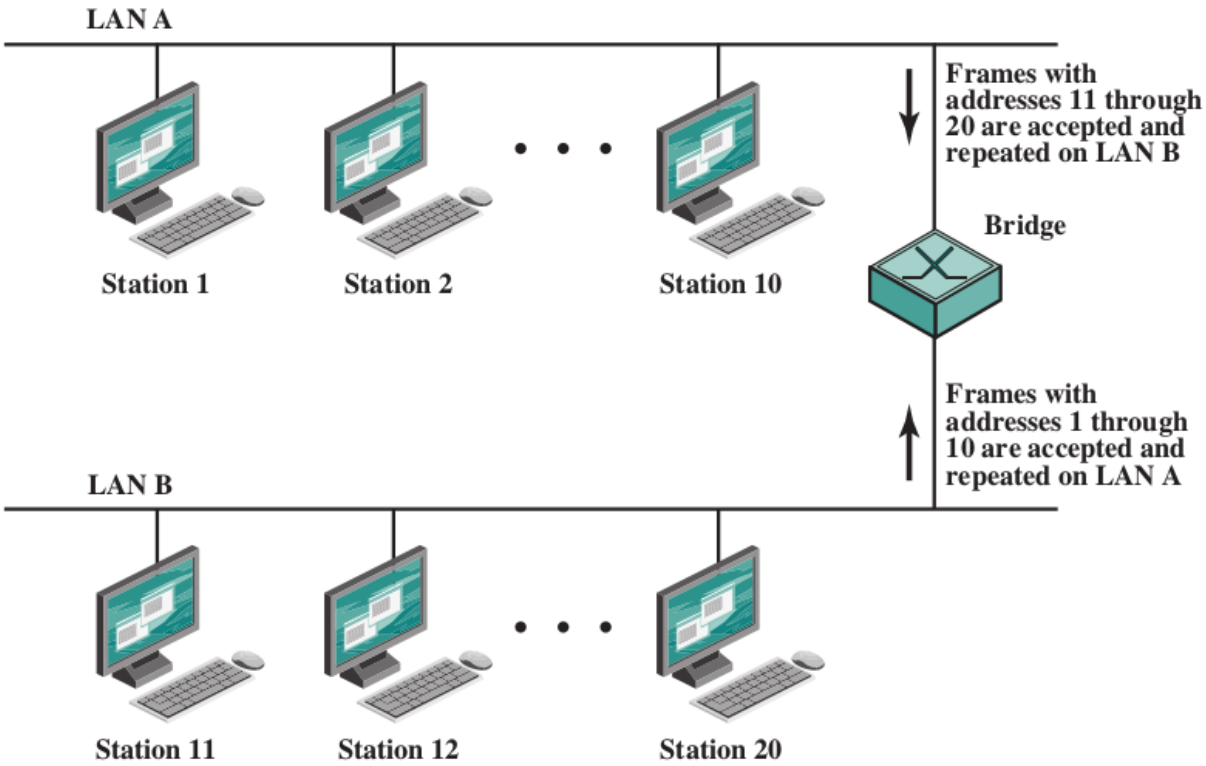
- How to interconnect LANs?
- Use bridges to interconnect similar LANs
- — Between LANs that use identical protocols for the physical and link layers (example: all conforming to IEEE 802.3)
- — the amount of processing required at the bridge is minimal
- — More sophisticated bridges are capable of mapping from one MAC format to another (e.g., to interconnect an Ethernet and a token ring LAN
- Use routers to interconnect a variety of LANs and WANs

Why not have a very large LAN?

Need for a bridge

- Reliability: using bridges, the network can be partitioned into self-contained units
- Performance: improved performance if devices can be clustered so that intranetwork traffic significantly exceeds internetwork traffic.
- Security: It is desirable to keep different types of traffic (e.g., accounting, personnel, strategic planning) that have different security needs on physically separate media.
- —different types of users with different levels of security need to communicate through controlled and monitored mechanisms (faculty, students, administration)
- Geography: separate LANs are needed to support devices clustered in two geographically distant locations (buildings separated by a highway: easier to use a microwave bridge link than to attempt to string coaxial cable between the two buildings)

Bridge operation



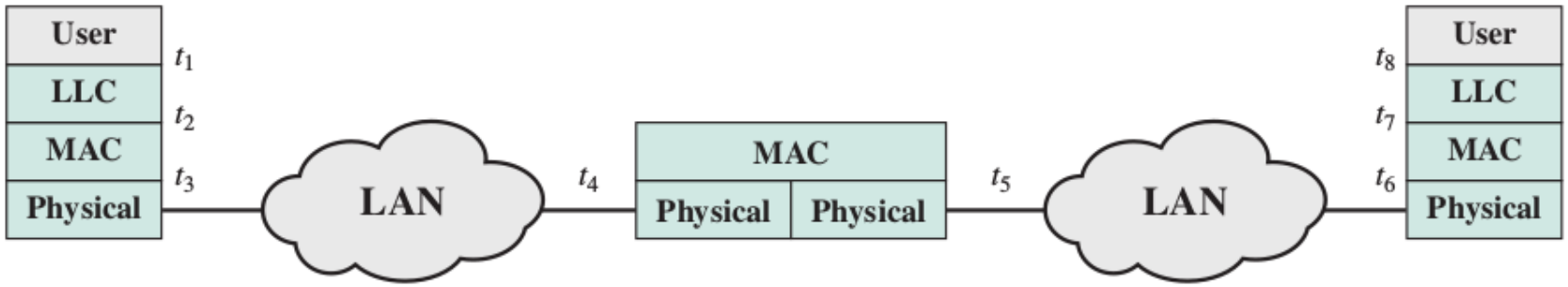
- Read all frames transmitted on A and accept those addressed to any station on B.
- Using the medium access control protocol for B, retransmit each frame on B
- Do the same for B-to-A traffic

Design aspects of a bridge

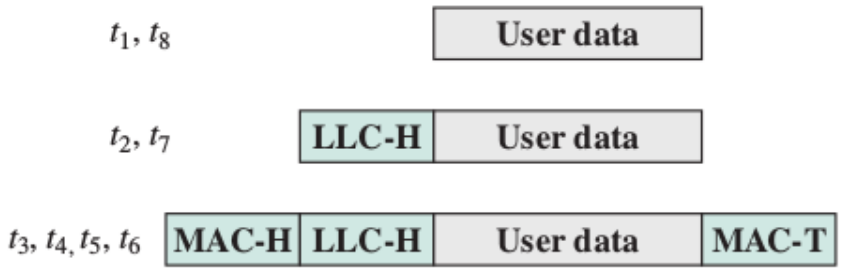
- No modification to the content or format of frames. No additional headers
- Must have enough buffer space
- May connect more than two LANs
- must contain addressing and routing intelligence
- – addressing: which addresses are on which network.
- – routing: A frame may have to be routed through several bridges to reach its destination

Connection of two LANs by a bridge

The IEEE 802.1D specification defines the protocol architecture for MAC bridges.



(a) Architecture



(b) Operation

Question

When a bridge is used, a station on a LAN does not need to know if the station it is communicating with is on the same LAN or not. This statement is

(A) True

(B) False

Question

A bridge operates at

(A) only the physical layer

(B) at the MAC and physical layers

(C) at the LLC, MAC and physical layers