INTEGRATED TECHNICAL EDUCATION CLUSTER
AT ALAMEERIA

E-626-A
Data Communication and Industrial Networks (DC-IN)

Lecture #8
LANs & Bridges

Instructor:

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Agenda

Review of LAN concepts

- Elements, topologies, media & protocols

Bridges

- Function, architecture & algorithms

LANS

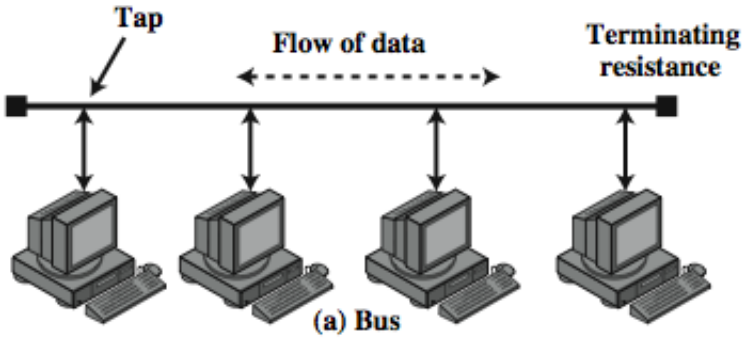
Local Area Network (LAN)

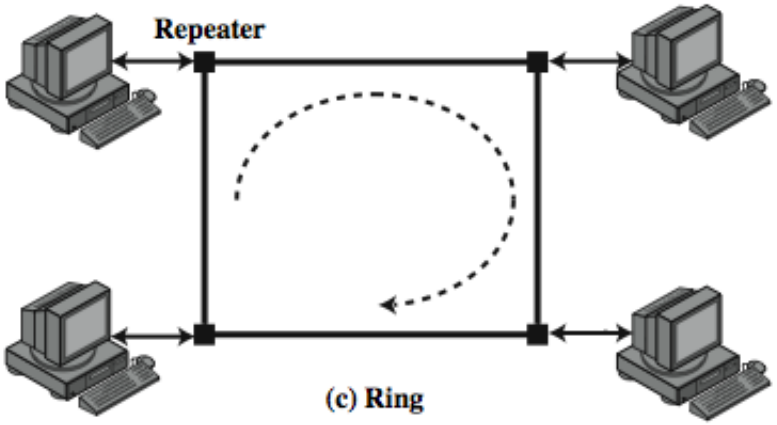
- Wide Area Network (WAN)
  - Cover large geographical area
  - Can be either public or private
- Local Area Network (LAN)
  - Cover single building or cluster of buildings
  - Privately owned
  - Network assets and network management typically controlled by user organization

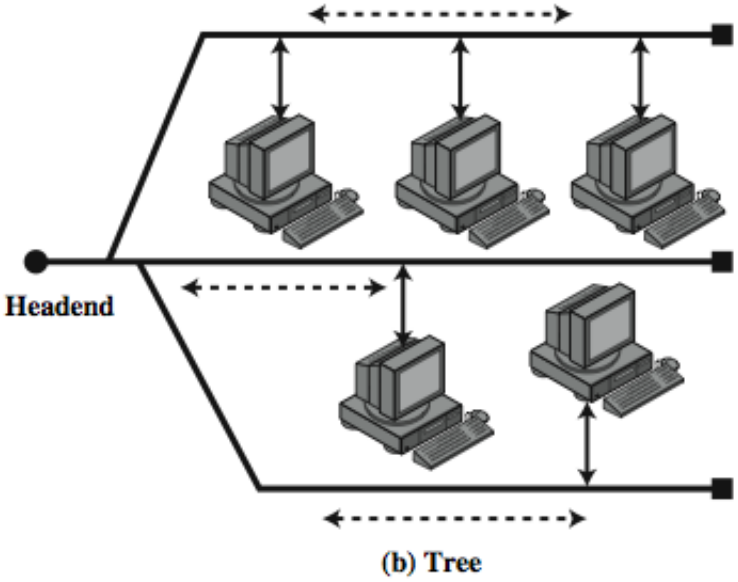
LAN Key Elements

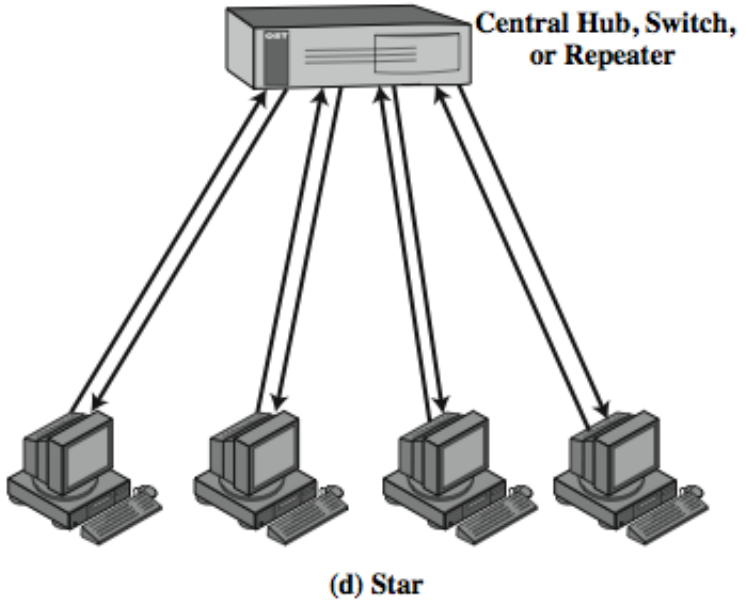
- Topology
  - Way in which end points (stations) interconnect
- Transmission medium
- Wiring Layout
- Protocol
- Medium Access Control

LAN Topologies









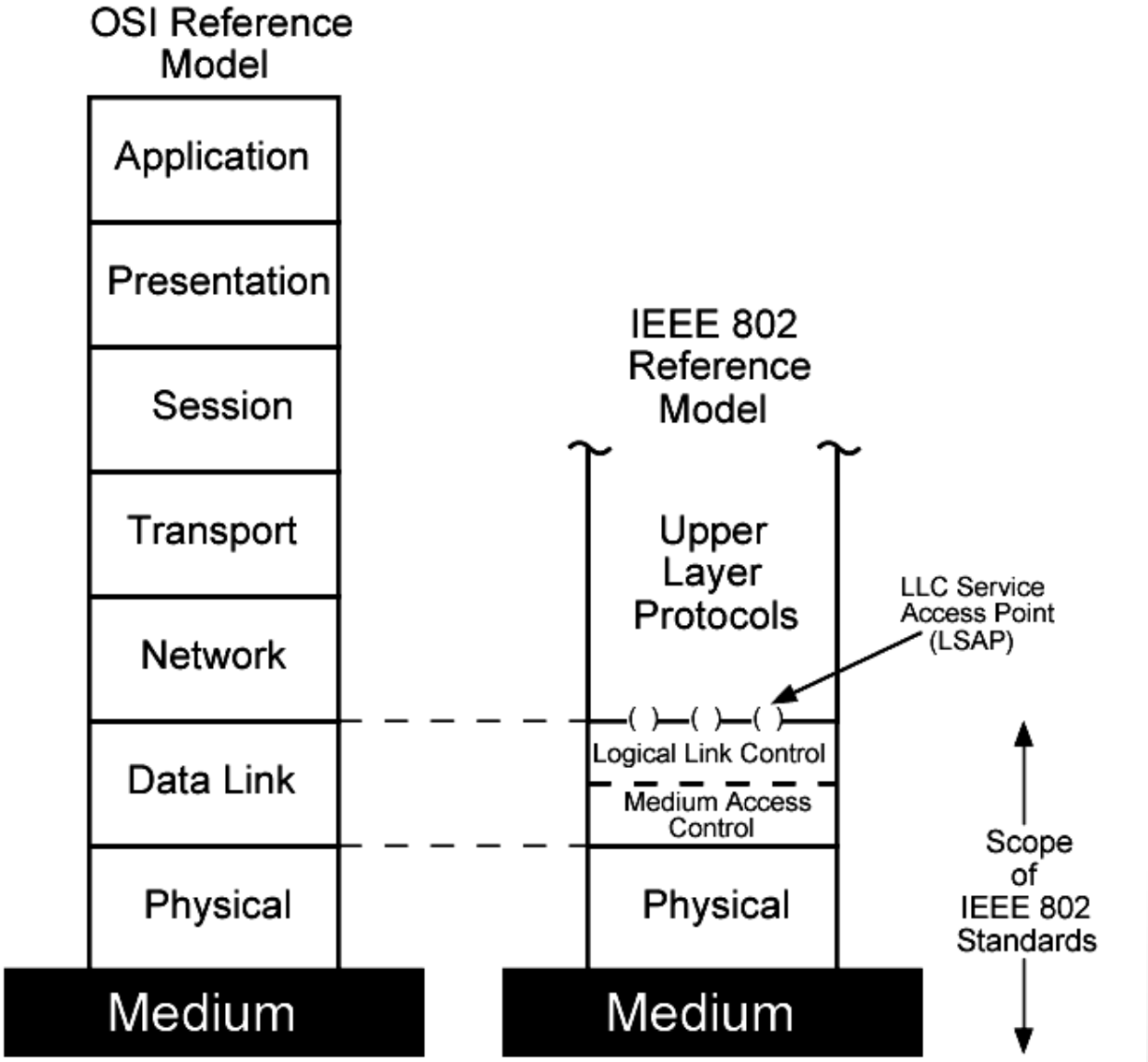
LAN Transmission Media

- Unshielded Twisted Pair (UTP)
  - Early LANs used voice-grade cable
  - Scaling up for higher data rates not practical
- Shielded Twisted Pair (STP)
  - Much higher performance
- Baseband coaxial cable
  - Digital signaling – used in original Ethernet
- Broadband coaxial cable
  - Used in cable TV systems
  - Expensive, difficult to install and maintain
- Optical fiber – used in high-speed backbones

Selecting Transmission Media

- Capacity
  - Can it support expected traffic?
- Reliability
  - Can it meet requirements for availability?
- Types of data supported
  - Is it well-suited to the applications involved?
- Environmental scope
  - Can it provide service in required environments?

LAN Protocol Architecture



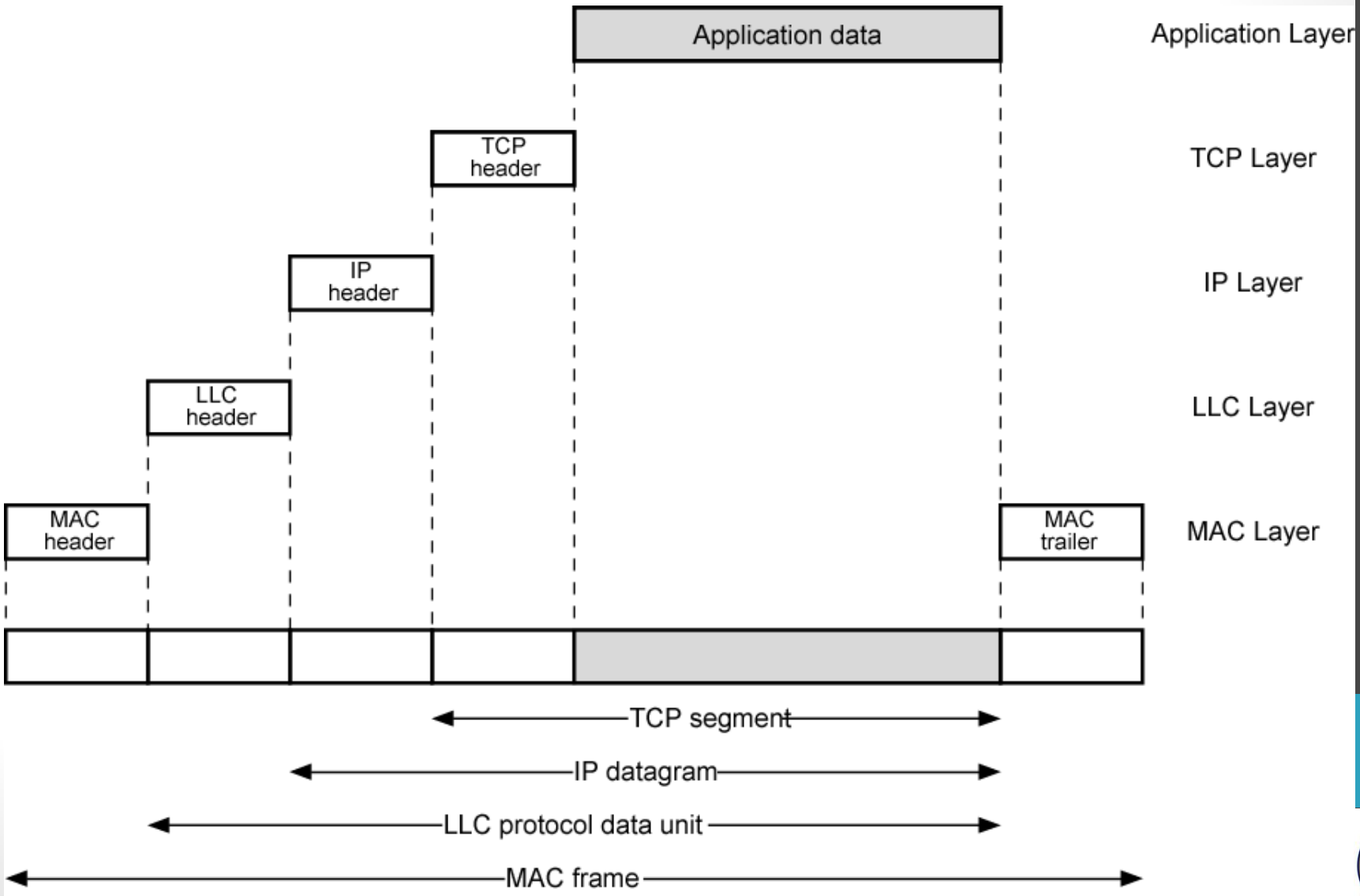
IEEE 802 Layers

- Physical Layer
  - Encoding / decoding of signals
  - Preamble generation / removal - synchronization
  - Bit transmission / reception
  - Transmission medium and topology
    - Considered below physical layer of OSI model
    - Critical in LAN design

IEEE 802 LLC and MAC

- Logical Link Control Layer (LLC)
  - Provides interface to higher levels
  - Performs flow and error control
- Medium Access Control (MAC)
  - Assemble data into frame – address, error control
  - Disassemble frame
    - address recognition and error detection
  - Govern access to transmission medium
- For same LLC, several MAC options provided

LAN Protocols in Context



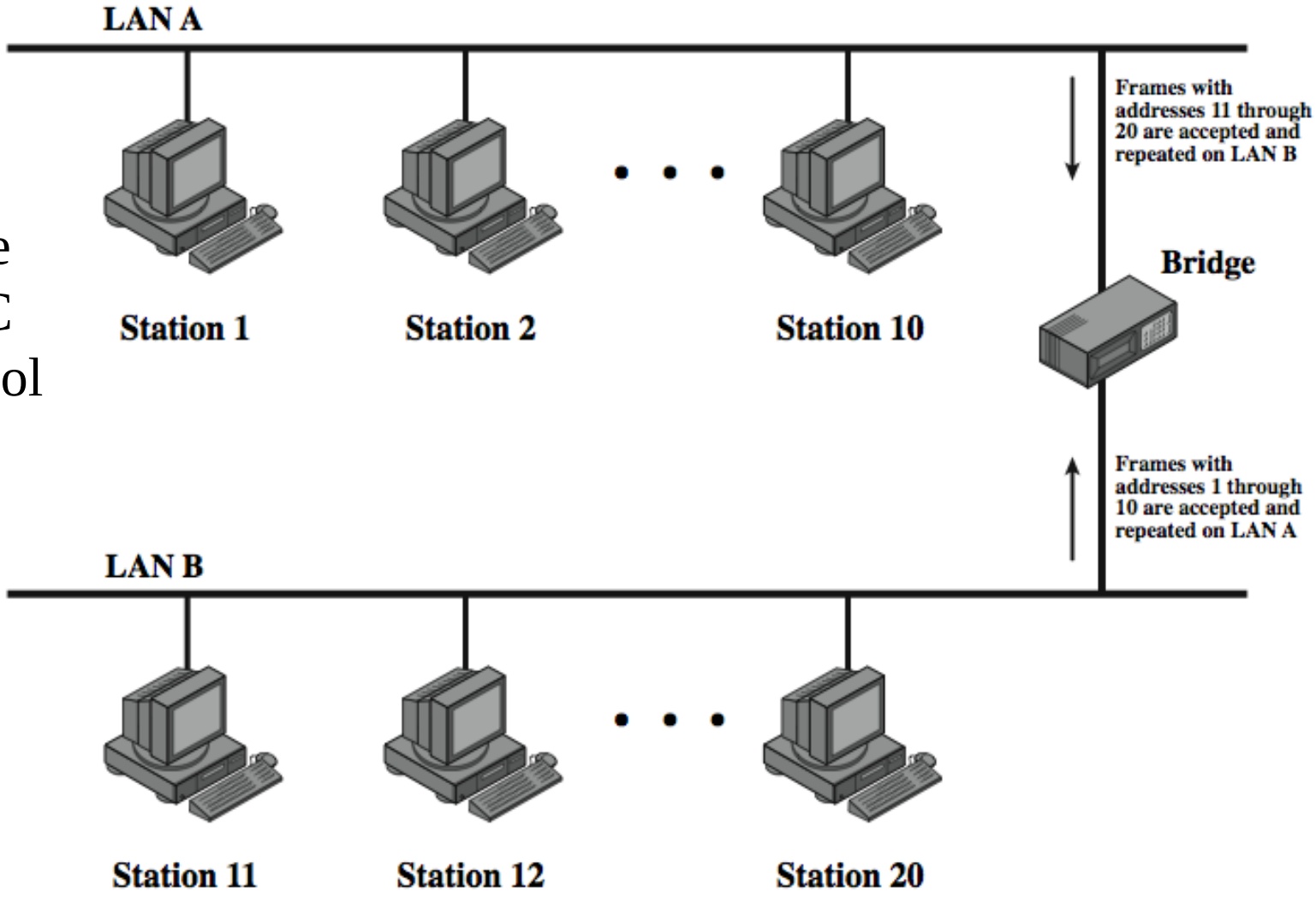
BRIDGES

Bridges

- connects similar LANs with identical physical and link layer protocols
  - minimal processing
  - can map between MAC formats
- reasons for use:
  - reliability
  - performance
  - security
  - geography

Bridge Function

Same MAC Protocol



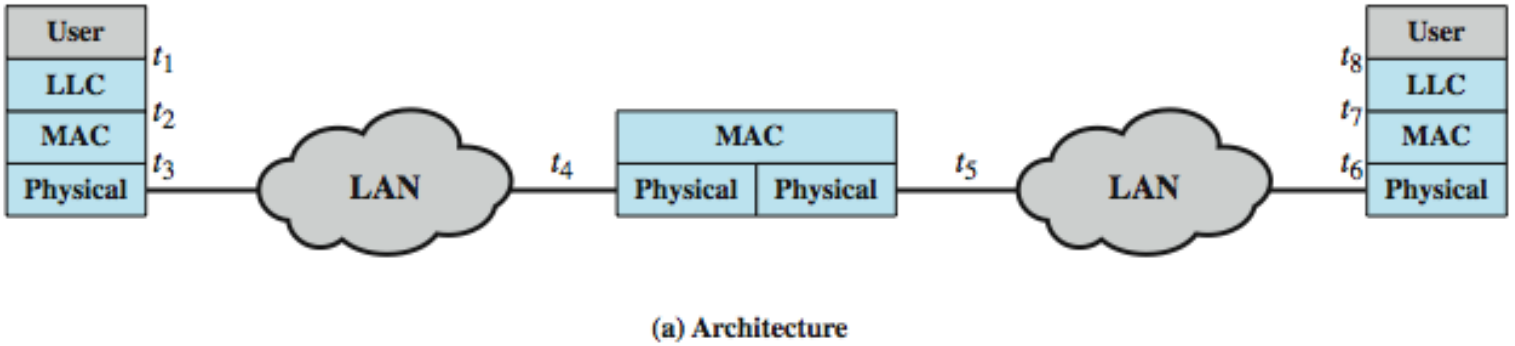
Bridge Design Aspects

- exact bitwise copy of frame
  - no modification to frame content or format
  - bridging is transparent to stations
- buffering to meet peak demand
- contains routing and address intelligence
- may connect more than two LANs

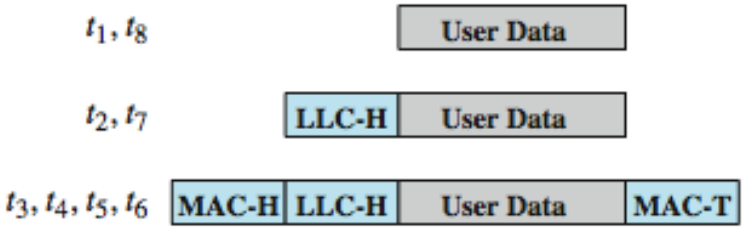
Bridge Protocol Architecture

- IEEE 802.1D defines architecture
- MAC level designates endpoint
- Bridge does not need LLC layer
- Operations
  - Captures frame and encapsulates it
  - Forwards it across link
  - Removes encapsulation
  - Transmits to destination

Connection of Two LANs



(a) Architecture

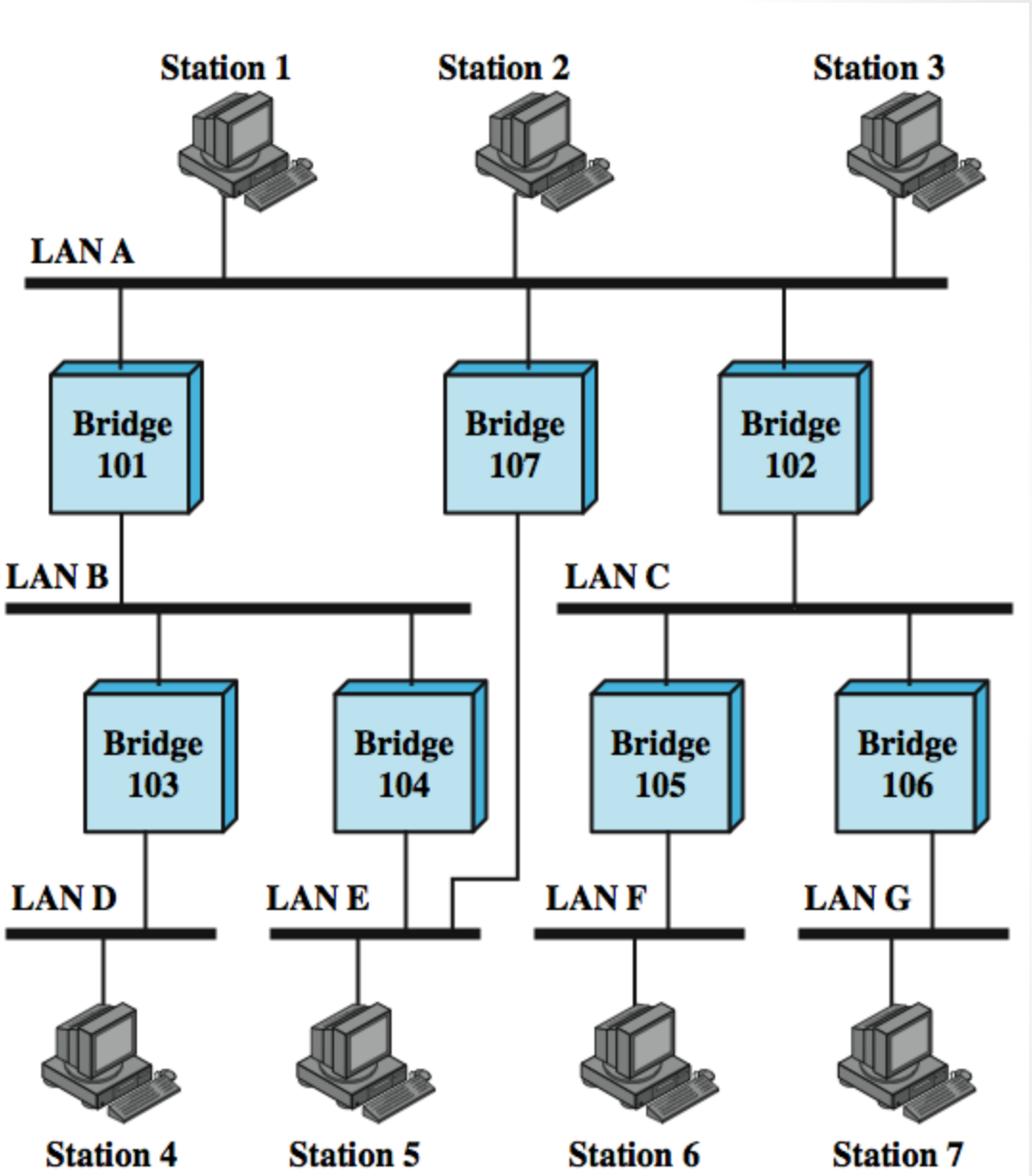


(b) Operation

Bridges and LANs with Alternative Routes

Used for load balancing and backup

Need routing tables



Fixed Routing

- Simplest and most common
- Suitable for intranets that are stable
- A fixed route is selected for each pair of LANs
  - Usually least hop route
- Only changed when topology changes
- Widely used but limited flexibility

Spanning Tree

- Bridge automatically develops routing table
- Automatically updates routing table in response to changing topology
- Algorithm consists of three mechanisms
  - Frame forwarding
  - Address learning – as it sees frames record sender
  - Loop resolution – avoid sending it around loop

Loop of Bridges

t_0 – station A transmits

t_1 – bridge α retransmits

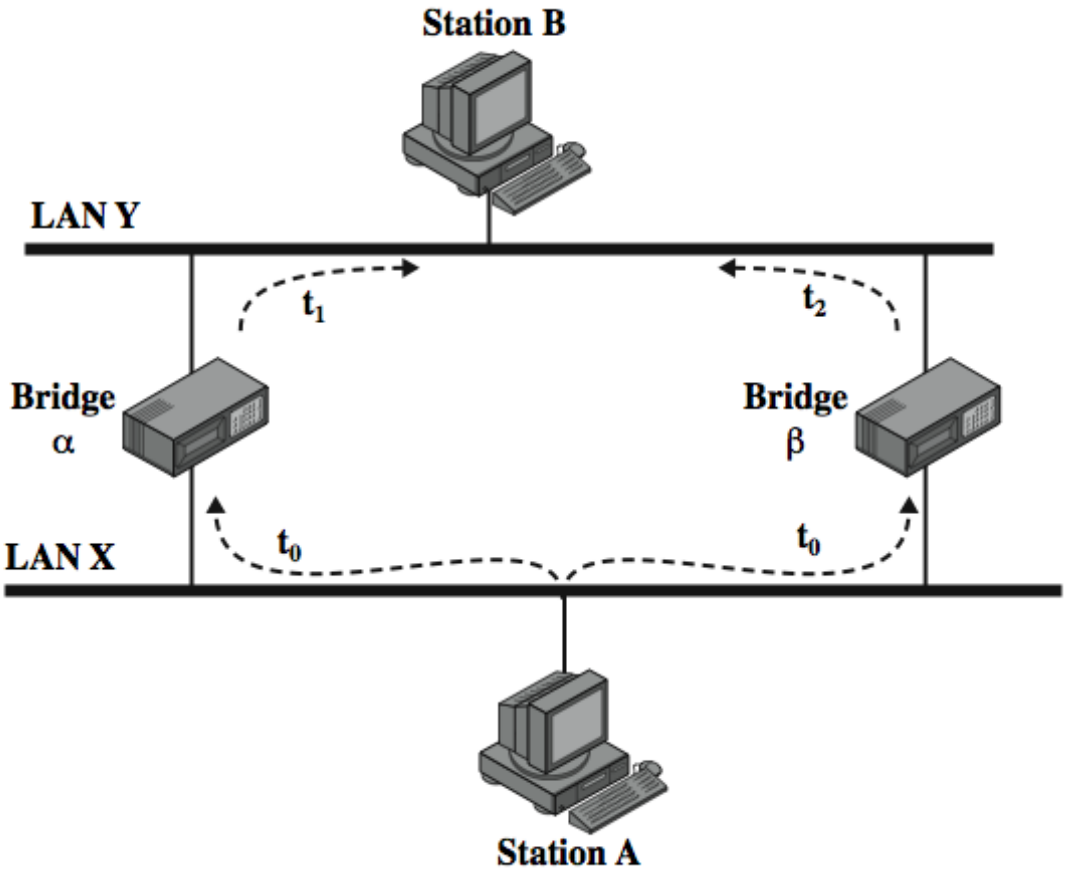
t_2 – bridge β retransmits

- Both set A on LAN X

B receives two copies

Bridges see each other's

- Both will now think
  A is on LAN Y



Interconnecting LANs - Hubs

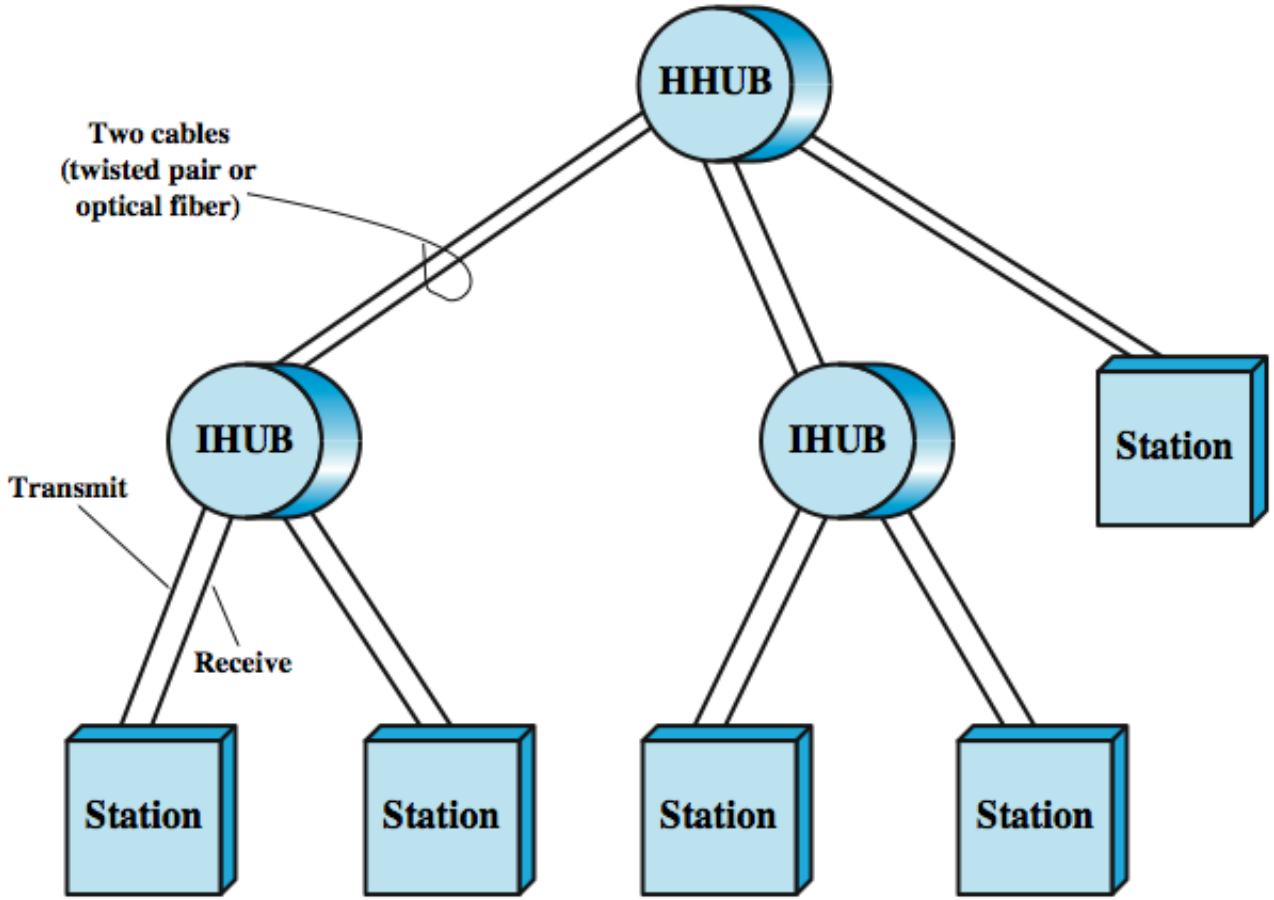
- Active central element of star layout
  - each station connected to hub by two UTP lines
  - hub acts as a repeater
  - limited to about 100m by UTP properties
  - optical fiber may be used out to 500m
- Physically star, logically bus
  - transmission from a station seen by all others
  - if two stations transmit at the same time have a collision

Two-Level Hub Topology

Header Hub

Intermediate Hubs

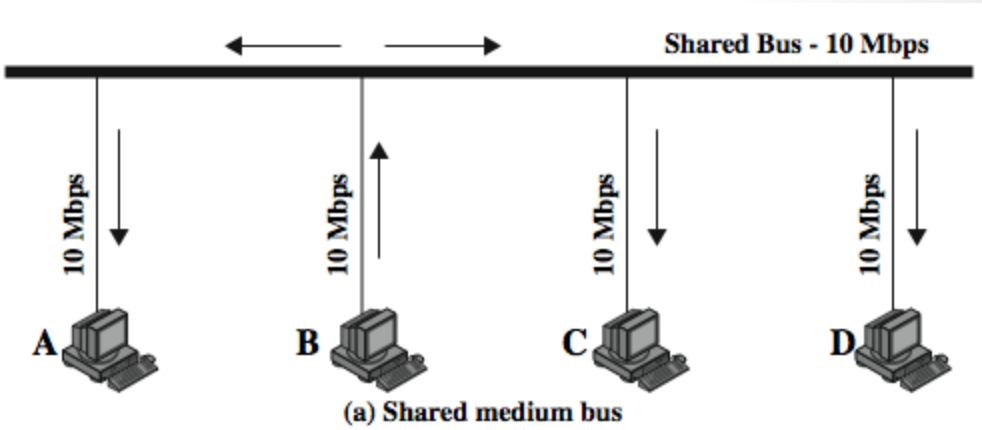
- Good for floor-based wiring closets



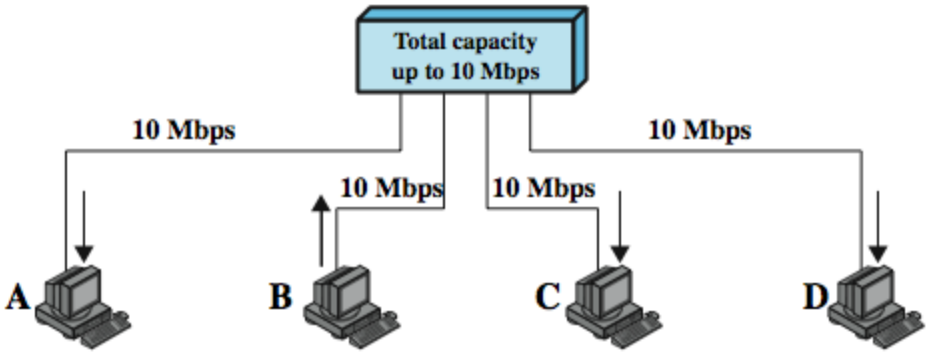
Buses, Hubs, and Switches

- Bus configuration
  - All stations share capacity of bus (e.g. 10 Mbps)
  - Only one station can transmit at a time
- Hub uses star wiring to attach devices
  - transmission from any station retransmitted on all outgoing lines
  - only one station can transmit at a time
  - total capacity of LAN still 10 Mbps
- Can improve performance using a Layer 2 switch
  - can switch multiple frames between separate ports
  - multiplying capacity of LAN – don't relay unless necessary

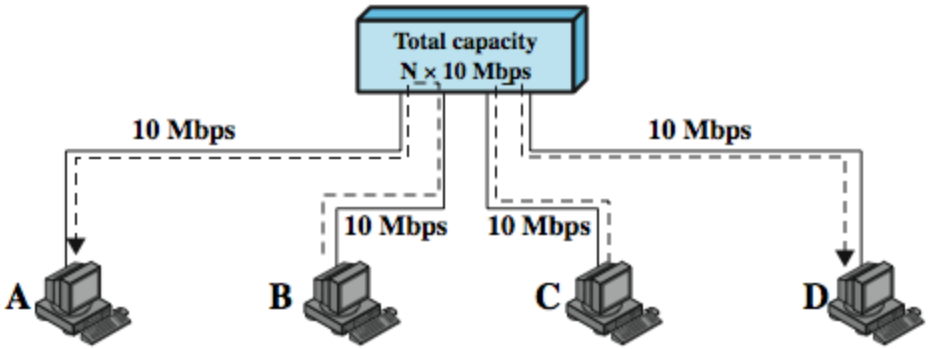
Shared Medium Bus and Hub



(a) Shared medium bus



(b) Shared medium hub



(c) Layer 2 switch

Layer 2 Switch Benefits

- No change to attached devices to convert bus LAN or hub LAN to switched LAN
  - e.g. Ethernet LANs use Ethernet MAC protocol
- Each attached device has dedicated capacity equal to original LAN
  - assuming switch has capacity to keep up with all devices
- Scales easily
  - additional devices can be attached to switch if capacity of layer 2 switch is increased accordingly
- Can incorporate logic to function as multiport bridge

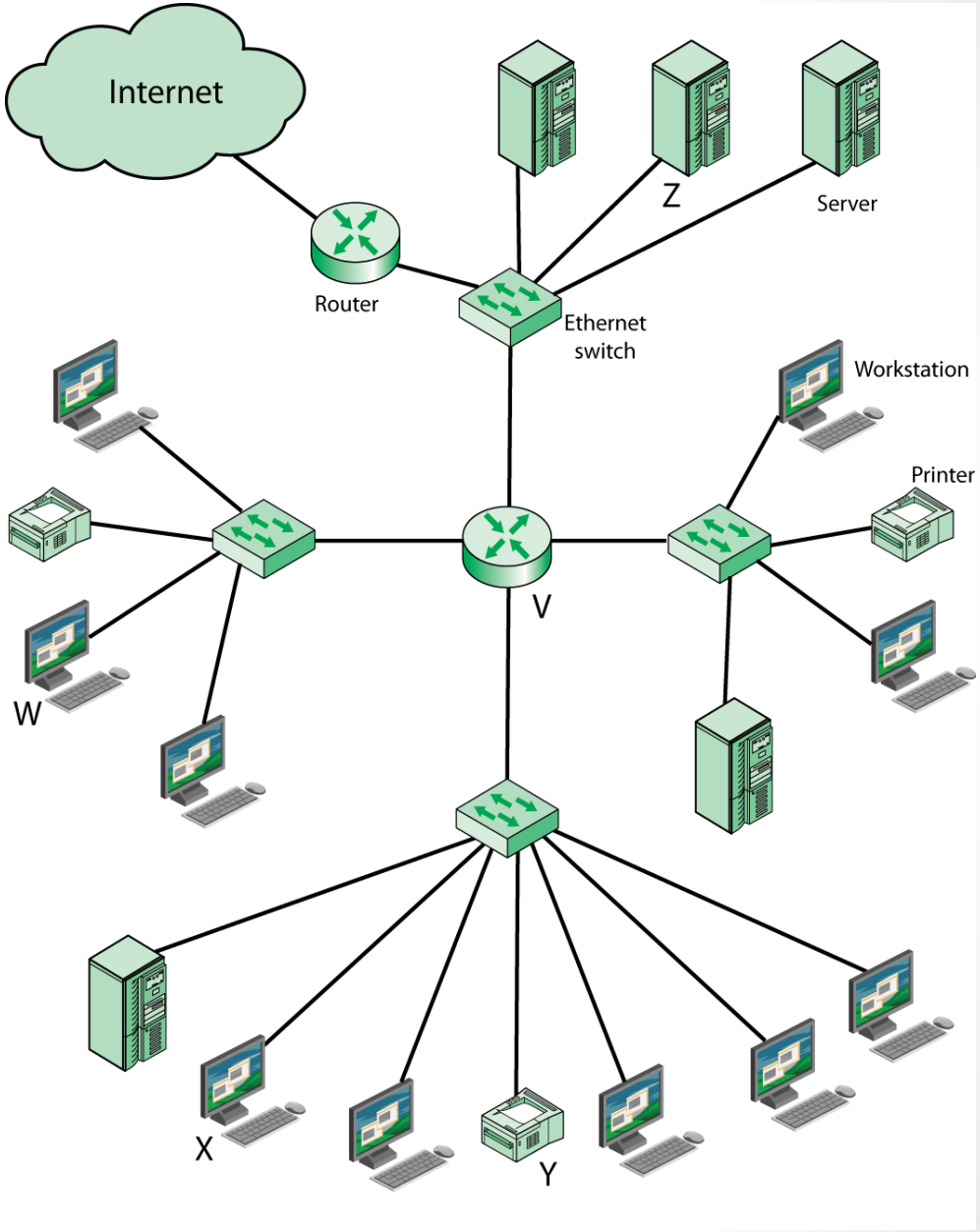
Types of Layer 2 Switches

- store-and-forward switch
  - accepts frame on input line, buffers briefly, routes to destination port
  - see delay between sender and receiver
  - boosts overall integrity
    - Performs CRC check
- cut-through switch
  - use destination address at beginning of frame
  - switch begins repeating frame onto output line as soon as destination address is recognized
  - highest possible throughput
  - risk of propagating bad frames

Layer 2 Switch vs Bridge

- Bridge
  - frame handling done in software
  - analyzes and forwards one frame at a time
  - uses store-and-forward operation
- Switch
  - performs frame forwarding in hardware
  - can handle multiple frames at a time
  - can have cut-through operation
- Result
  - new installations typically include layer 2 switches with bridge functionality rather than bridges

A Partitioned LAN Configuration



- For more details, refer to:
  - Chapters 15 , W. Stallings, **Data and Computer Communications**, 8th ed.
- The lecture is available online at:
- Lecture notes are found at:
  - http://bu.edu.eg/staff/ahmad.elbanna-courses/12133
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