LAN Overview (part 2)

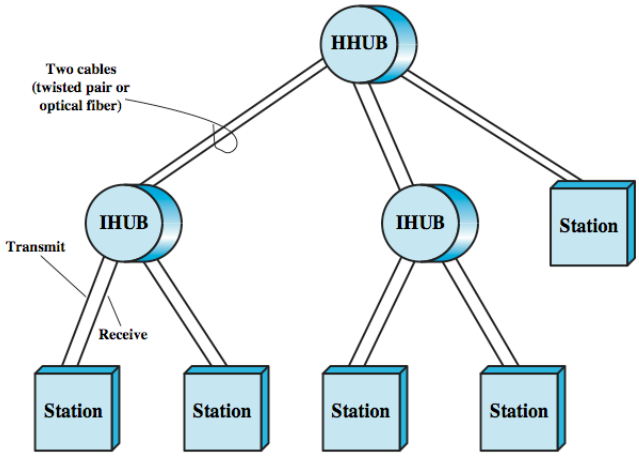
CSE 3213

Fall 2011

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



Buses, Hubs and Switches

bus configuration

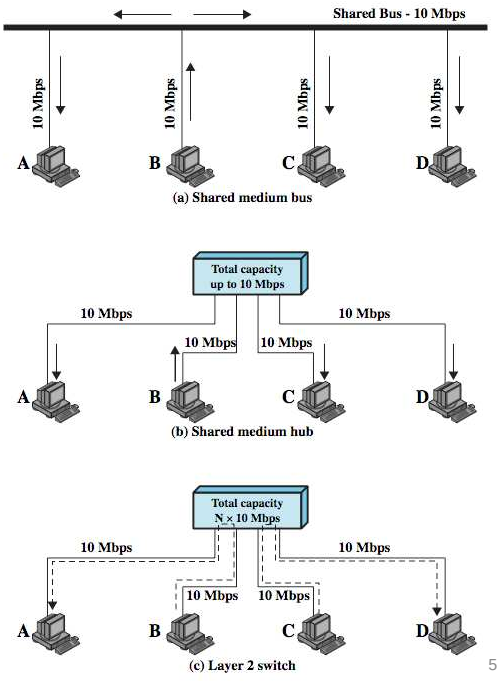
all stations share capacity of bus (e.g. 10Mbps)	only one station transmitting at a time

hub uses star wiring to attach stations

transmission from any station received by hub and retransmitted on all outgoing lines	only one station can transmit at a time	total capacity of LAN is 10 Mbps

- can improve performance using a layer 2 switch
  - can switch multiple frames between separate ports
  - multiplying capacity of LAN

Shared Medium Bus and Hub

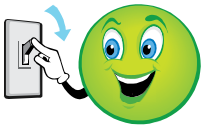


Layer 2 Switch Benefits

- no change to attached devices to convert bus LAN or hub LAN to switched LAN
  - e.g. Ethernet LANs use Ethernet MAC protocol
- have dedicated capacity equal to original LAN
  - assuming switch has sufficient capacity to keep up with all devices
- scales easily
  - additional devices attached to switch by increasing capacity of the layer 2 switch.

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



- 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

A Partitioned LAN Configuration

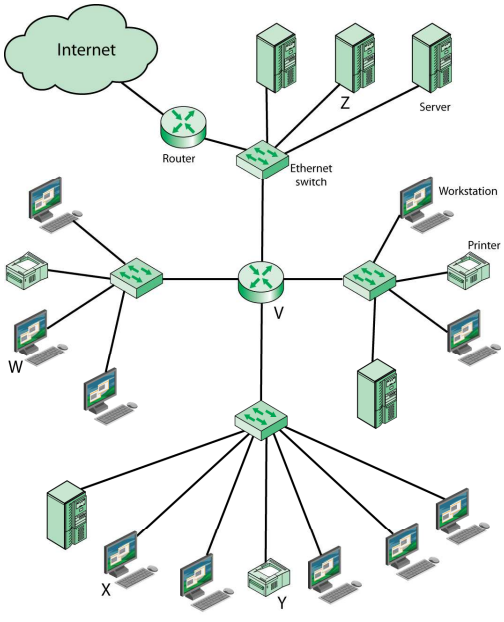


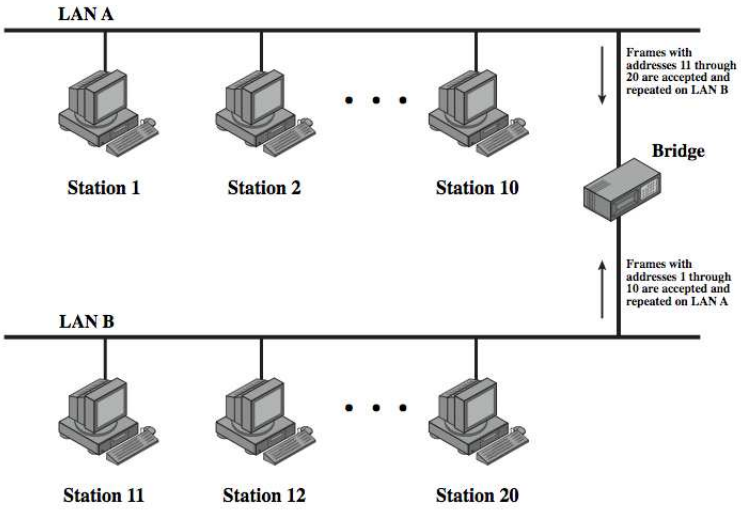
Figure 15.14 A Partitioned LAN

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 (microwave bridges)

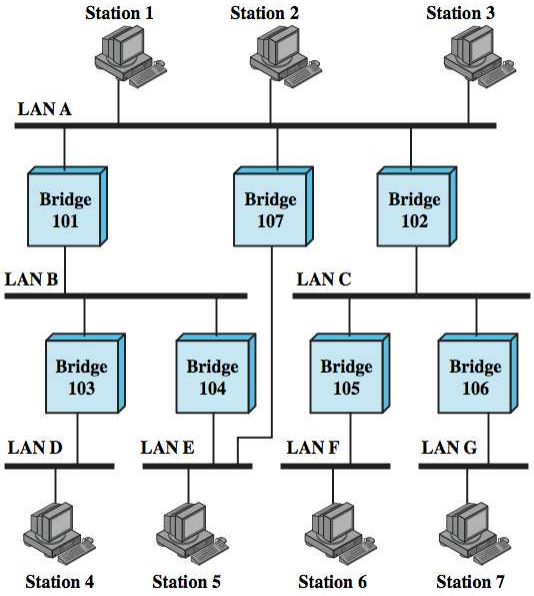
Bridge Function



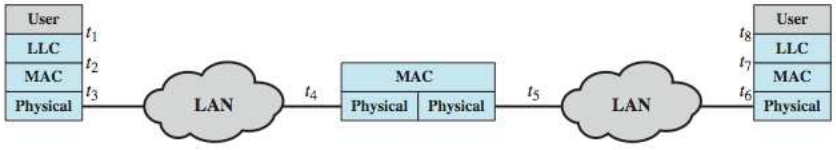
Bridge Design Aspects

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

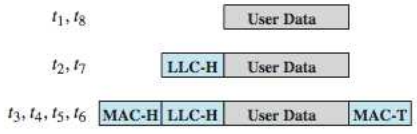
Bridges and LANs with Alternative Routes



Connection of Two LANs



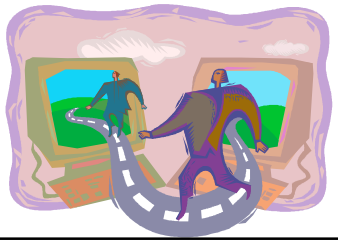
(a) Architecture



(b) Operation

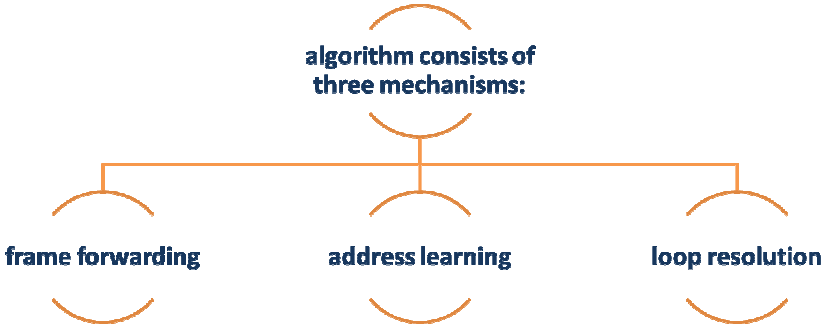
Fixed Routing

- simplest and most common
- suitable for Internets 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

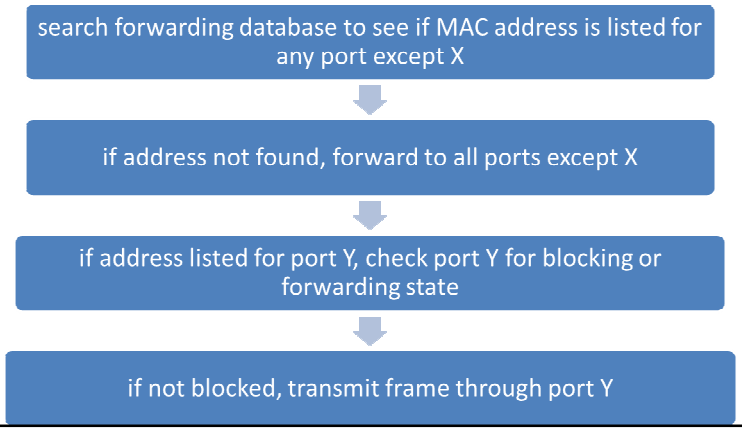


Address Learning

- can preload forwarding database
- when frame arrives at port X, it has come from the LAN attached to port X
- use source address to update forwarding database for port X to include that address
- have a timer on each entry in database
- if timer expires, entry is removed
- each time frame arrives, source address checked against forwarding database
  - if present, direction is recorded and timer is

Frame Forwarding

- maintain forwarding database for each port
- for a frame arriving on port X:



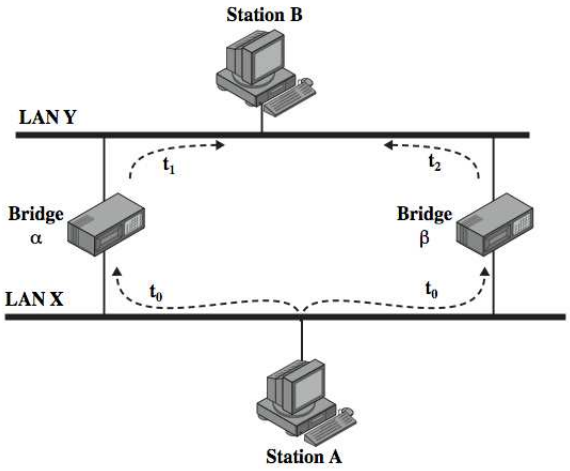
Spanning Tree Algorithm

- address learning works for tree layout if there are no alternate routes in the network
  - alternate route means there is a closed loop
- for any connected graph there is a spanning tree maintaining connectivity with no closed loops
- algorithm must be dynamic

IEEE 802.1 Spanning Tree Algorithm:

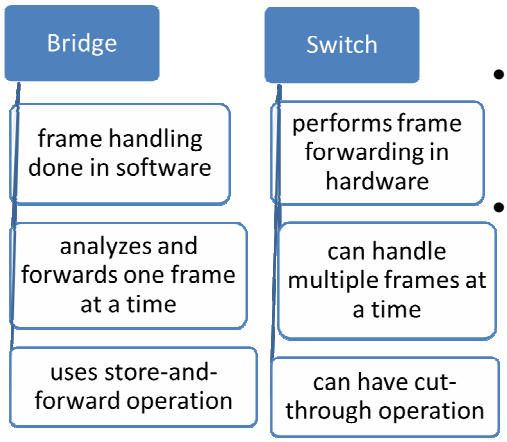
- each bridge assigned unique identifier
- cost assigned to each bridge port
- exchange information between bridges to find spanning tree
- automatically updated whenever topology changes

Loop of Bridges



Layer 2 Switch vs. Bridge

- differences between switches & bridges:



- layer 2 switch can be viewed as full-duplex hub
- incorporates logic to function as multi-port bridge
- new installations typically include layer 2 switches with bridge functionality rather than bridges

Problem with Layer-2 Switches

- As number of devices in building grows, layer 2 switches reveal some inadequacies
- Broadcast overload: set of devices and LANs connected by layer 2 switches have flat address space
- All users share common MAC broadcast address
- If any device issues broadcast frame, that frame is delivered to all devices attached to network connected by layer 2 switches and/or bridges
- In large network, broadcast frames can create big overhead
- Malfunctioning device can create broadcast storm
- Numerous broadcast frames clog network

Layer-3 Switches

- Routers do all IP-level processing in software
  - High-speed LANs and high-performance layer-2 switches pump millions of packets per second
  - Software-based router only able to handle well under a million packets per second
- Solution: layer 3 switches
  - Implement packet-forwarding logic of router in hardware

Reading

- Stallings, 15.3 and 15.4
- Midterm test: Nov. 3
- Next lecture: Wireless LANs (chapter 17)