

LAN Switching and Traffic Classes

Raj Jain

Professor of Computer and Information Sciences
The Ohio State University

Please download and print the handouts from:

<http://www.cis.ohio-state.edu/~jain/cis788-97/>

or

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MBone Instructions

- ❑ Handouts for the class are available on-line:
<http://www.cis.ohio-state.edu/~jain/cis788-97/index.html> or
<http://www.netlab.ohio-state.edu/~jain/cis788-97/index.html> or
<ftp://netlab.ohio-state.edu/pub/jain/cis788-97/>
- ❑ The schedule keeps changing. Please always check current schedule at:
<http://www.cis.ohio-state.edu/~jain/cis788-97/schedule.html>

Instructions (Cont)

- ❑ Please email your positive and negative feedback about the quality of the reception as well as the content with a subject field of “**Feedback**” to mbone@netlab.ohio-state.edu
- ❑ If you are not able to receive the program due to some technical difficulties, please email “**Feedback**” to mbone@netlab.ohio-state.edu
- ❑ Please email technical questions with the subject field “**Question**” to mbone@netlab.ohio-state.edu. We will try to answer selected questions live.



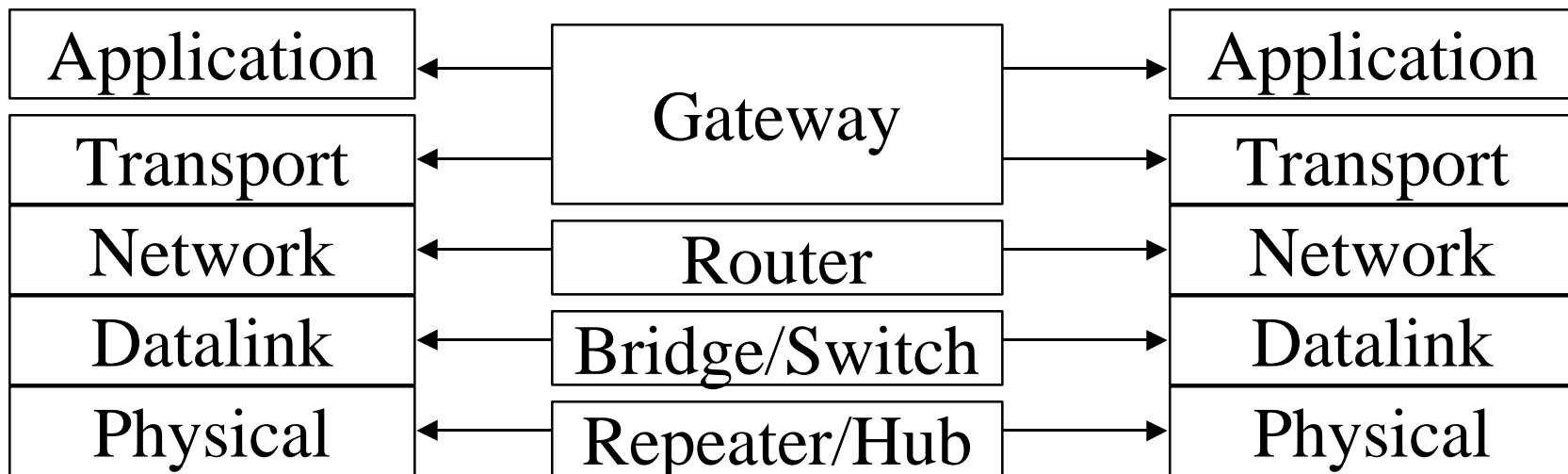
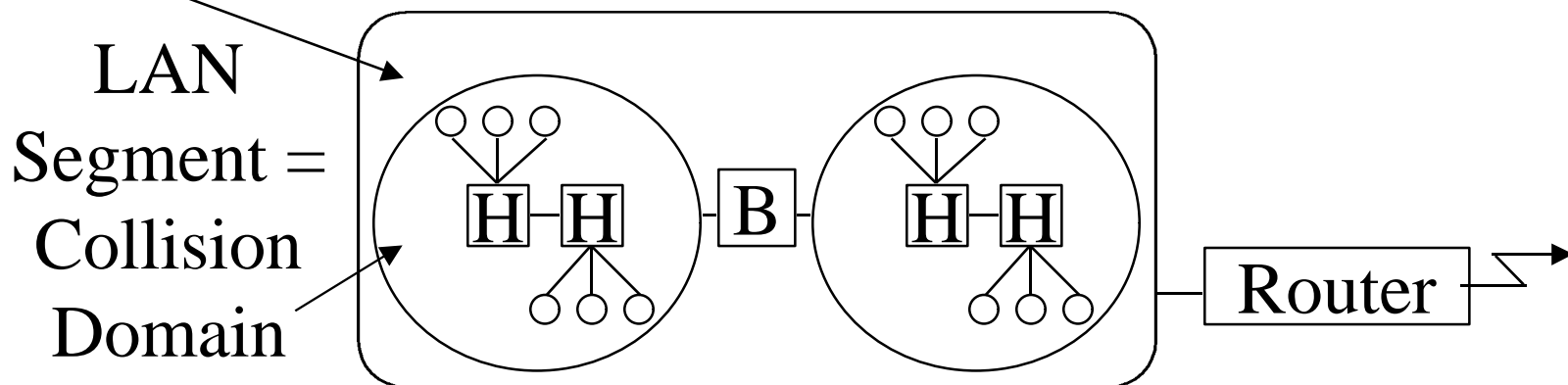
- ❑ Fundamentals: Hub, bridge, router, switch
- ❑ Full-duplex link
- ❑ Features of switches
- ❑ IEEE 802.1p standard on traffic classes in LANs and Dynamic multicast
- ❑ Generic Attribute Registration Protocol (GARP)

ATM vs LANs

- ❑ Quality of service
- ❑ Switching
- ❑ LAN emulation
- Ease of management
- ❑ Traffic management
- ❑ High Speed
- ❑ Priority
- ❑ Switching
- ❑ VLANs
- ❑ Flow control
- ❑ Gigabit Ethernet

Interconnection Devices

LAN = Broadcast domain

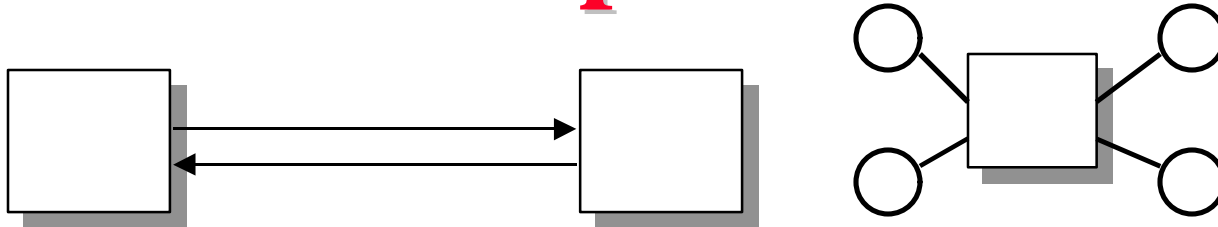


Interconnection Devices

- ❑ **Repeater:** PHY device that restores data and collision signals
- ❑ **Hub:** Multiport repeater + fault detection and recovery
- ❑ **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.

Full-Duplex LANs



- ❑ Uses point-to-point links between **TWO** nodes
- ❑ Full-duplex bi-directional transmission
Transmit any time
- ❑ Not yet standardized in IEEE 802
- ❑ Many switch/bridge/NICs with full duplex
- ❑ No collisions \Rightarrow 50+ Km on fiber.
- ❑ Commonly used between servers and switches or between switches

Frame Switches: Features

- ❑ **Forwarding Type:** Cut-through, Store and forward
 - Cut-through gives lower latency but erroneous/partial frames get forwarded
 - Collision fragments (runt)
⇒ Adaptive Cut-through (after 64 bytes)
- ❑ **Switch Matrix:** Cell vs Frame switching
 - Frame switching mostly
- ❑ **Buffer Sharing:** Static or dynamic (based on usage), Input or output buffer

Switch Features (Cont)

- ❑ **Flow Control:** Switch jams the input port
 - Some switches jam all traffic
 - Others selectively jam packets only if they are going to congested port
- ❑ **Number of MAC addresses per port:**
Small in workgroup switches
- ❑ **VLAN support:** by port, by MAC address, by subnets
 - Some allow stations to be in multiple VLANs, others don't.

Switch Features (Cont)

- ❑ **Routing:** Some switches route IP, IPX, and/or AppleTalk internally. Others require external routers between VLANs.
- ❑ **Fault Tolerance:**
 - Hot swappable media, power, uplinks, and fans.
 - Redundant port, power, mgmt processor, fans

Switch Features (Cont)

- ❑ **Manageability:**
 - Proprietary, SNMP and/or RMON support
 - Traffic monitoring using mirror ports.
 - In some switches, single mirror port can monitor multiple ports.
- ❑ **Types of LANs Supported:** Ethernet, Fast Ethernet, FDDI, Token ring, 100VGAnyLAN
- ❑ **Switch Matrix Location:** Centralized vs distributed (on each port)

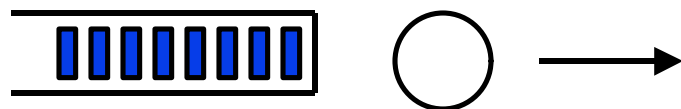
Traffic Classes in LANs

- ❑ IEEE 802.1p working group
- ❑ Goal: To support time-critical (continuous media) traffic
- ❑ Method:
 - 1. Prioritization of traffic
 - 2. Efficient support of multicasting
- ❑ Bridge filtering database for each port indicates whether any members of the group exist on the port
⇒ Need Group registration protocol

What's in a Name?

- ❑ The “p” in 802.1p is lower case.
- ❑ Uppercase letter \Rightarrow Base standard
- ❑ Lowercase letter \Rightarrow supplement
- ❑ 802.1p is a supplement to 802.1D bridge standard
- ❑ 802.1Q is a base VLAN standard
- ❑ 802.3z is a 1000 Mbps supplement to Ethernet Standard

Priority



- ❑ Total delay = Queueing delay + Access delay
- ❑ Access priority: As in token rings
- ❑ Queueing priority: Even in Ethernets
- ❑ User priority: Requested by the originator
Used to determine both queueing and access priorities

IEEE 802.1p: Features

- ❑ Allows up to 8 traffic classes (priorities)
- ❑ Priority \Rightarrow Both queueing and access
- ❑ Allows queueing priority on LANs that have no access priorities, e.g., Ethernet
- ❑ Different number of priorities on different ports
- ❑ Allows dynamic multicast filtering
- ❑ Applies to all 802 MAC protocols + FDDI
- ❑ **802 MAC Protocols:** 802.3 (Ethernet), 802.4 (Token Bus), 802.5 (Token Ring), 802.6 (DQDB), 802.9 (Integrated Services), 802.12 (Demand Priority)

Number of Priorities

- ❑ Up to 8 traffic classes (0 through n-1).
0 = Normal service = Low priority.
- ❑ Different ports/bridges may have different number of traffic classes
⇒ Low-speed ports need priorities first
- ❑ Recommended four priorities:
 - Time and safety critical
 - Time critical
 - Non-time critical, loss sensitive
 - Non-time critical, loss insensitive

How is Priority Set?

- ❑ Priority may be set by user, destination address, input port, output port, access priority, or by VLAN
- ❑ A priority may be assigned for a port
⇒ For a source station connected to a switch
- ❑ In some LANs, priority can be encoded in frames.
- ❑ In some LANs, priority cannot be encoded in frames. 802.1p does not have a mechanism to communicate priority in such LANs.
 - It has to be regenerated locally using local database, or use 802.1Q VLAN tags.

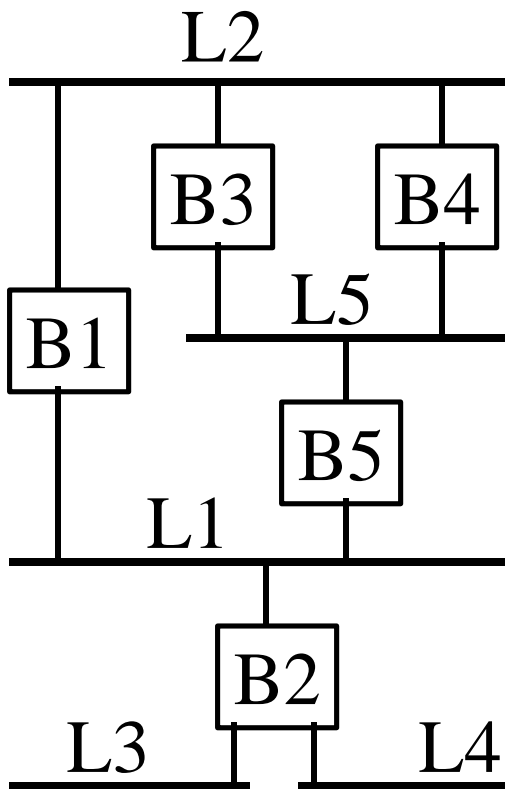
Scheduling

- ❑ Separate queue for each priority
- ❑ higher priority first (strict priority).
- ❑ No reordering of frames for a given priority and a given source and destination address pair

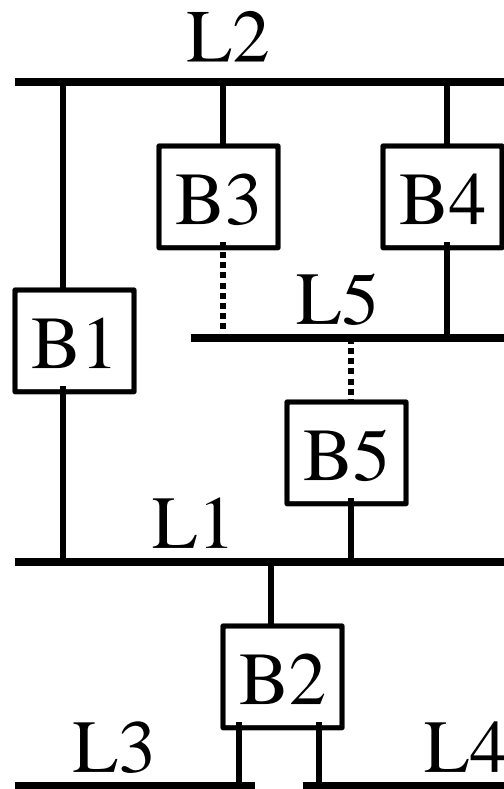
Multicast: Today

- ❑ Bridges forward multicast on all active ports
- ❑ A spanning tree is formed to avoid loops

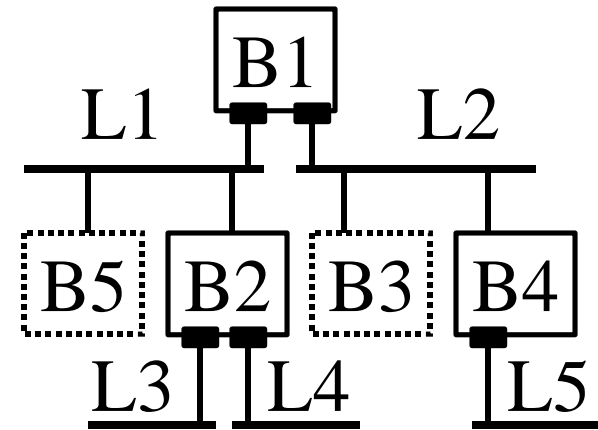
Spanning Tree



(a) Original Network



(b) Active Network



(c) Spanning Tree

Spanning Tree (Cont)

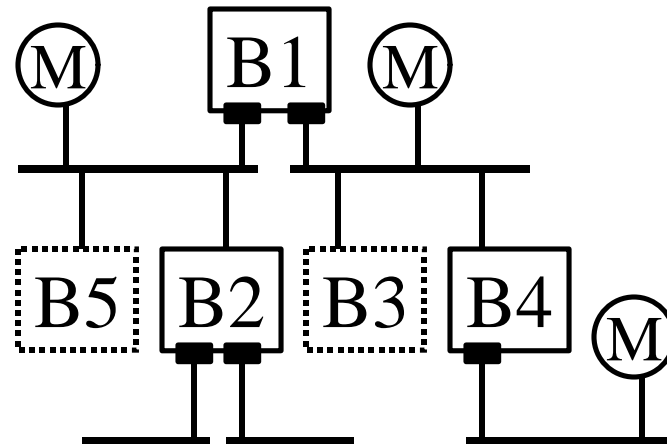
- ❑ Unique path from each source is ensured by spanning tree
- ❑ Each tree has a root bridge
- ❑ Each LAN has a designated bridge
- ❑ The port connecting the LAN towards the root is the designated port for the LAN
- ❑ The bridge containing the designated port is the designated bridge for the LAN

Dynamic Multicast Filtering

- ❑ Send multicast frames only on LANs where receivers exist
- ❑ Multicast address registration: Join/leave a group
- ❑ Legacy multicast addresses: Unregistered
- ❑ Join/leave “all groups” (Used on legacy segments)
- ❑ Join/leave “all unregistered groups” (For coexistence of legacy and new stations during migration.)
- ❑ Static entries can exclude some multicast addresses from "all groups"
- ❑ Membership information is forwarded to other bridges

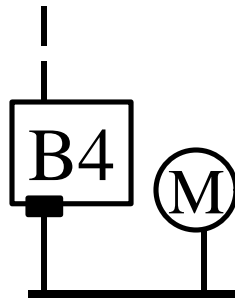
Dynamic Filtering (Cont)

- ❑ A directed subtree of the spanning tree is formed for each group
- ❑ Multicast frames are forwarded along the directed graph



Source Pruning

- ❑ Sources can stop transmission if there are no members
- ❑ Helps save local LAN bandwidth
- ❑ Implementation optional



Filtering Database

1. Static entries set by management
 2. Dynamic entries:
 - a. Learning Process: Observe the source addresses of frames received on each port. Aged out.
 - b. Registration
- Static entries may specify: Forward, filter, use dynamic info to forward or filter

Input Port	Dest Address	Output Port
1	AA-01-03-44-56-78	2
2	09-12-34-56-78-88	Filter

Filtering Database (Cont)

- ❑ Priority-aware bridges use all three types of entries
- ❑ Priority-unaware bridges use only static and learned entries
- ❑ Static port entries may specify:
 - Forward all groups
 - Forward unregistered groups
 - Filter unregistered groups.

GARP

- ❑ Generic Attribute Registration Protocol
- ❑ General purpose registration/distribution protocol
- ❑ The information is propagated, if necessary, to all GARP-aware bridges
- ❑ Attribute numbers have been standardized
- ❑ GARP is used for multicast and VLAN registration.
- ❑ Registrar: Records registrations by other participants on the segment. Does not send any messages.
- ❑ Applicant: Sends registration requests and queries

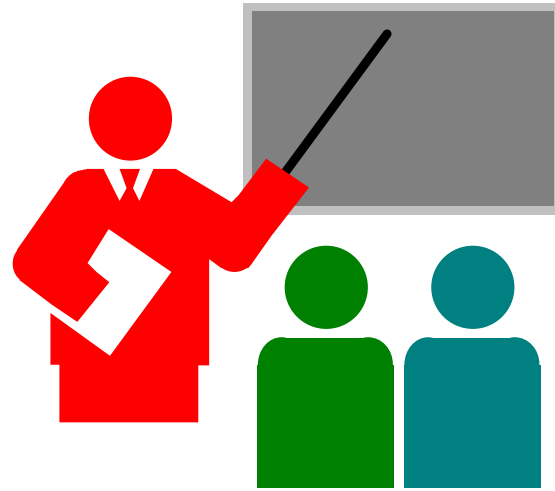
GARP Messages

- ❑ If two other stations have joined a group on your segment, you do not need to join. Protocol works even if one message is lost.
- ❑ JoinIn: I know that one other station is listening to this group. I want to join too.
- ❑ Leave: I want to leave.
- ❑ LeaveAll: “Everybody! This attribute will be de-registered soon. Rejoin if you want.”
- ❑ Empty: Are there any members of this attribute?
- ❑ JoinEmpty: I have not seen any other station join this group. I am the first one to Join.

GMRP

- ❑ Group Multicast Registration Protocol
- ❑ A GARP application
- ❑ Attributes:
 - 1 = Group address registration
 - 2 = Service requirement registration
 - ❑ 0 = All groups
 - ❑ 1 = All unregistered groups

Summary



- ❑ LAN switches = Multiport bridges
- ❑ Traffic classes and dynamic multicast on LANs to allow multimedia
- ❑ IEEE 802.1p allows 8 priorities
- ❑ Distributed multicast registration protocol

References

- ❑ For a detailed list of references, see http://www.cis.ohio-state.edu/~jain/refs/lsw_refs.htm
- ❑ IEEE 802.1 Email list: p8021-request@hepnrc.hep.net
Mail archive: <http://www.hep.net/mail/p8021.html>
- ❑ Traffic Class Expediting and Dynamic Multicast Filtering, IEEE P802.1p/D6, April 28, 1997.
- ❑ Other Related Standards
 - 802.1D MAC bridges
 - 802.1G Remote MAC Bridging
 - 802.1H Ethernet V2.0 and 802 bridging

Current Schedule

7/17/97 Priority and Multicasting on LANs

7/22/97 **No Class**

7/24/97 Virtual LANs

7/29/97 Gigabit Ethernet

7/31/97 Quiz 2 (No MBone transmission)

8/5/97 Residential broadband: Cable Modems, xDSL

8/7/97 Multimedia: Compression Standards

8/12/97 Multimedia over IP: RSVP, RTP

8/14/97 Wireless LANs and WANs

8/19/97 Quiz 3 (No MBone transmission)

Credits

The MBone transmission of this lecture was made possible by:

- ❑ Mark Fullmer, OSU/UTS
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