

# LLC and Bridges

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This presentation is available on-line at

<http://www.cis.ohio-state.edu/~jain/cis677-98/>



- ❑ Logical Link Control
- ❑ Bridges
- ❑ Path determination: Spanning tree, source routing

# IEEE 802

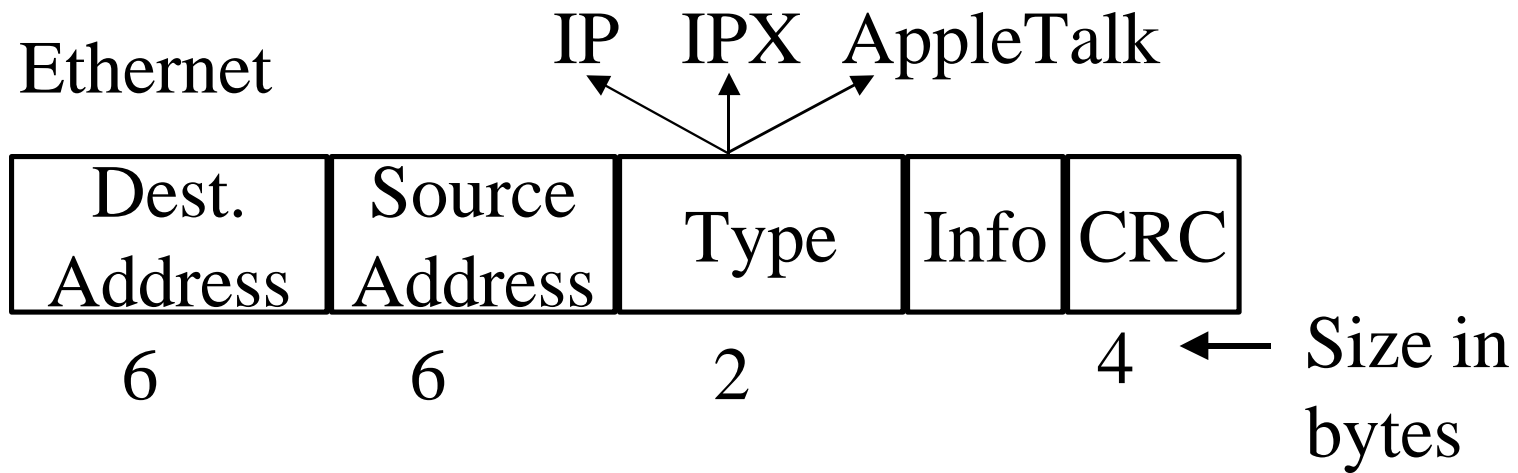
- ❑ 802.1 Network management and bridging
- ❑ 802.2 Logical link control
- ❑ 802.3 Ethernet (CSMA/CD)
- ❑ 802.4 Token Bus
- ❑ 802.5 Token Ring
- ❑ 802.6 DQDB
- ❑ 802.7 Broadband technical advisory group
- ❑ 802.8 Fiber-optic technical advisory group
- ❑ 802.9 Integrated data and voice
- ❑ 802.10 Security and privacy

# IEEE 802 (Cont)

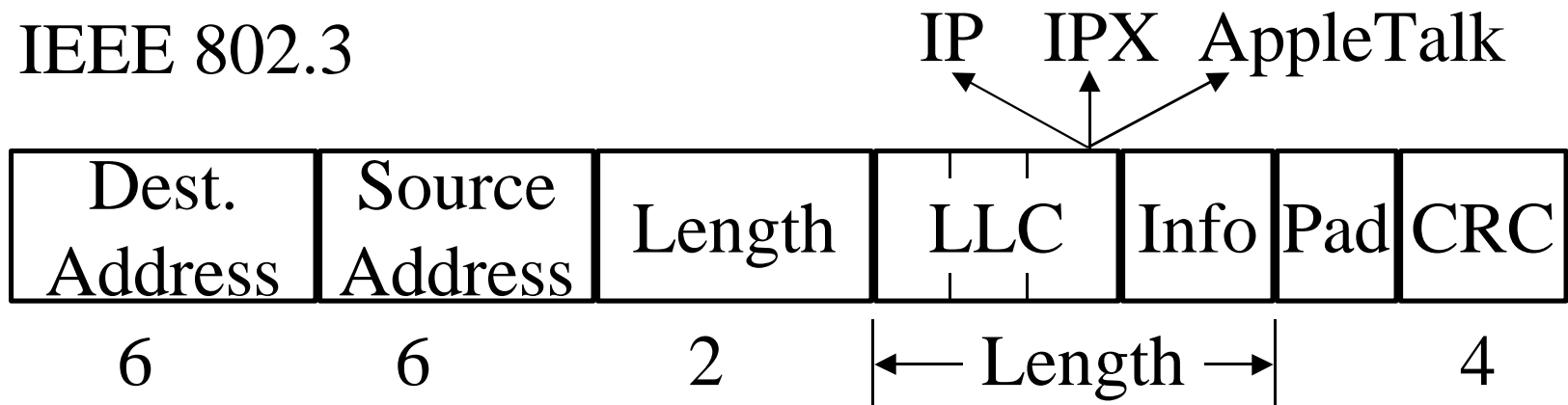
- ❑ 802.11 Wireless LANs
- ❑ 802.12 100VG-AnyLAN
- ❑ 802.13 ?Bad Luck
- ❑ 802.14

# Frame Format

## □ Ethernet



## q IEEE 802.3



# LLC Type 1

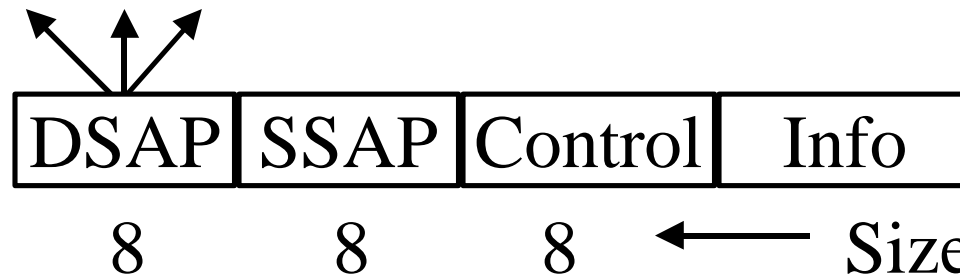
- Unacknowledged connectionless (on 802.3)  
No flow or error control.  
Provides protocol multiplexing.  
Uses 3 types of protocol data units (PDUs):  
UI = Unnumbered informaton  
XID = Exchange ID  
= Types of operation supported, window  
Test = Loop back test

# LLC Type 2, 3

- ❑ Type 2: Acknowledged connection oriented (on 802.5)  
Provides flow control, error control. Uses SABME (Set asynchronous balanced mode), UA (unnumbered ack), DM (disconnected mode), DISC (disconnect)
- ❑ Type 3: Acknowledged connectionless  
Uses one-bit sequence number  
AC command PDUs acked by AC response PDUs

# LLC Multiplexing

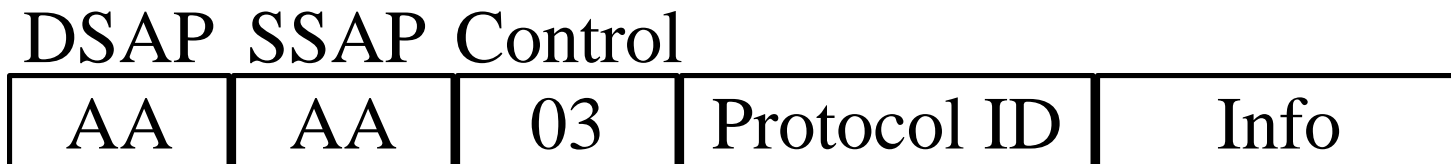
- ❑ Multiplexing allows multiple users (network layer protocols) to share a datalink
- ❑ Each user is identified by a “service access point (SAP)”



- q Eight-bit SAP  
⇒ Only 256 standard values possible
- q Even IP couldn't get a standard SAP.  
Use Subnetwork Access Protocol SAP (SNAP SAP)

# SNAP SAP

- ❑ SubNetwork Access Protocol Service Access Point
- ❑ When DSAP=AA, SSAP=AA, Control=UI, protocol ID field is used for multiplexing



40 bits

- q Protocol ID is 40 bit long. The first 24 bits are Organizationally Unique Identifiers (OUI). OUI of 0 is used. The Ethernet type values are used in the last 16 bits.

Protocol ID = 00-00-00-xx-xx

# Bridges

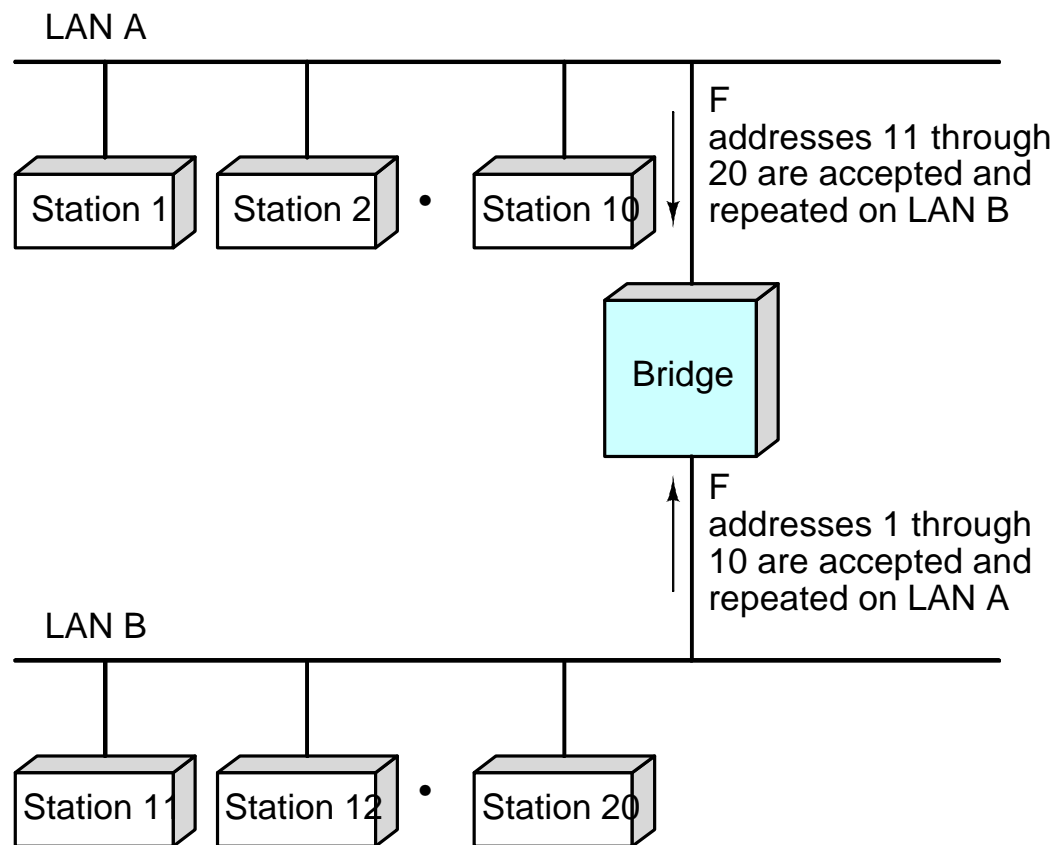


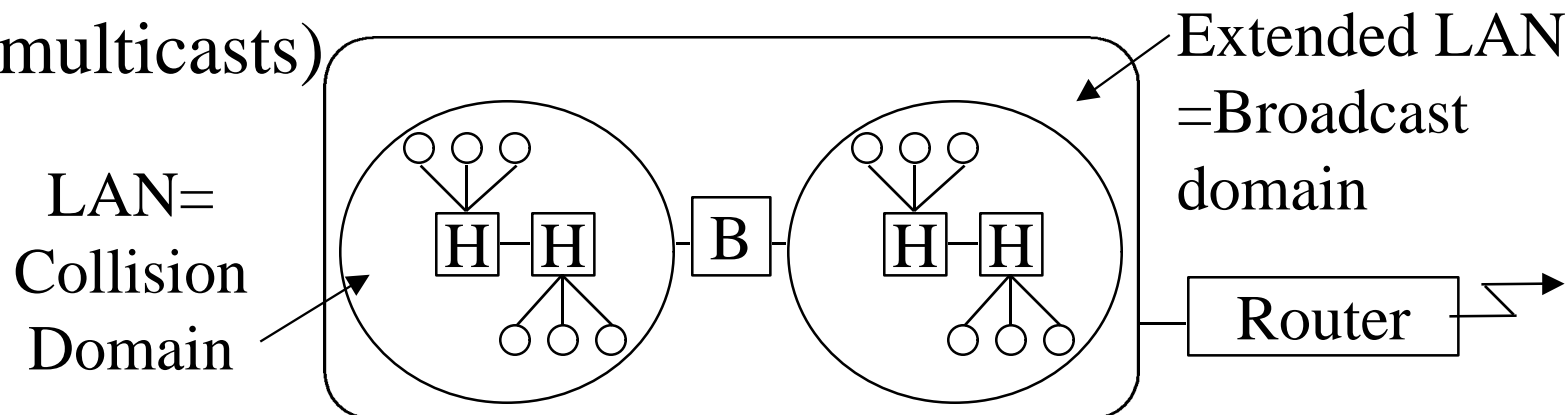
Fig 14.1

# Bridge: Functions

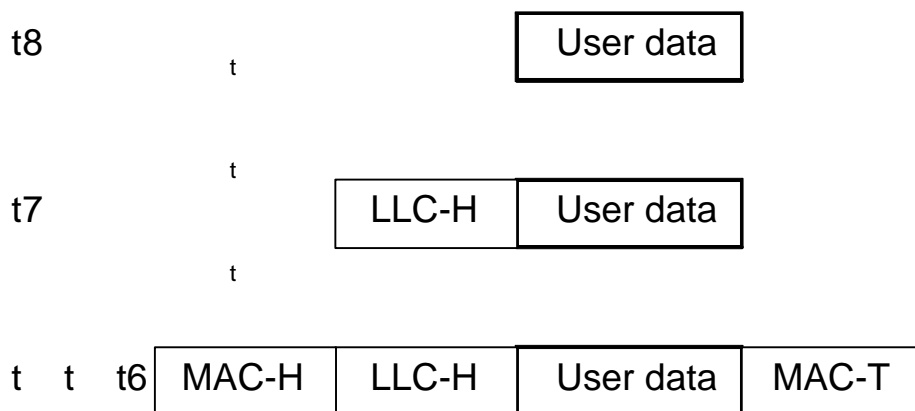
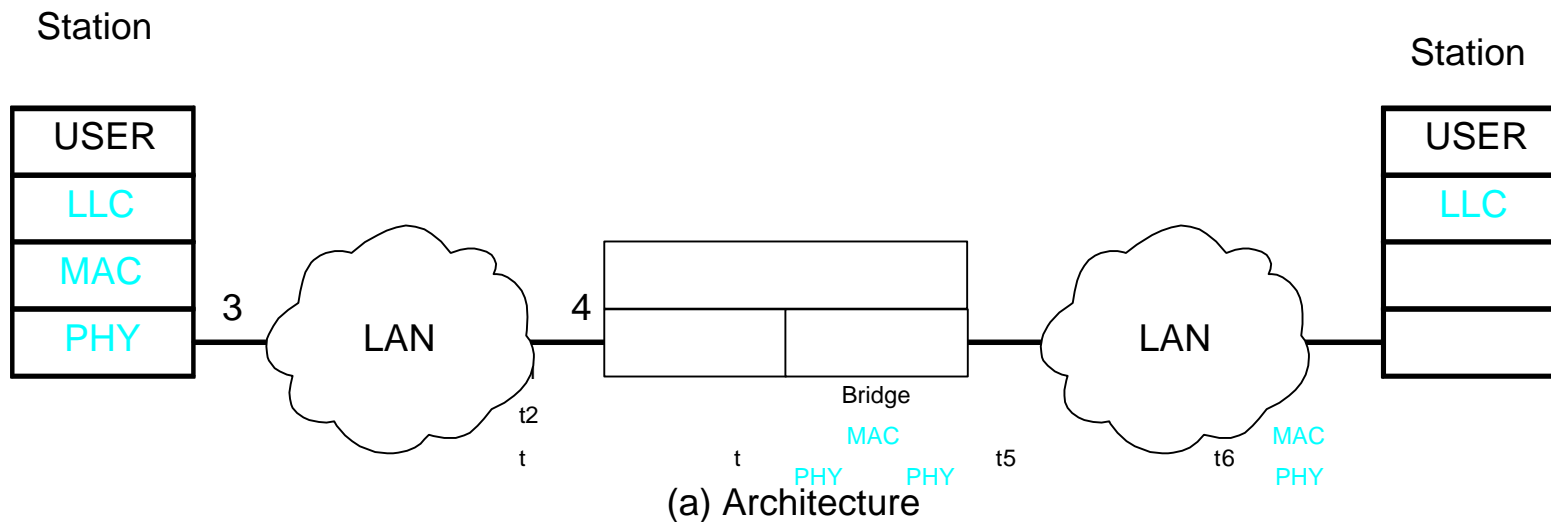
- ❑ Monitor all frames on LAN A
- ❑ Pickup frames that are for stations on the other side
- ❑ Retransmit the frames on the other side
- ❑ Knows or learns about stations are on various sides
- ❑ Makes no modification to content of the frames.  
May change headers.
- ❑ Provides storage for frames to be forwarded
- ❑ Improves reliability (less nodes per LAN)
- ❑ Improves performance (more bandwidth per node)
- ❑ Security (Keeps different traffic from entering a LAN)
- ❑ May provide flow and congestion control

# Interconnection Devices

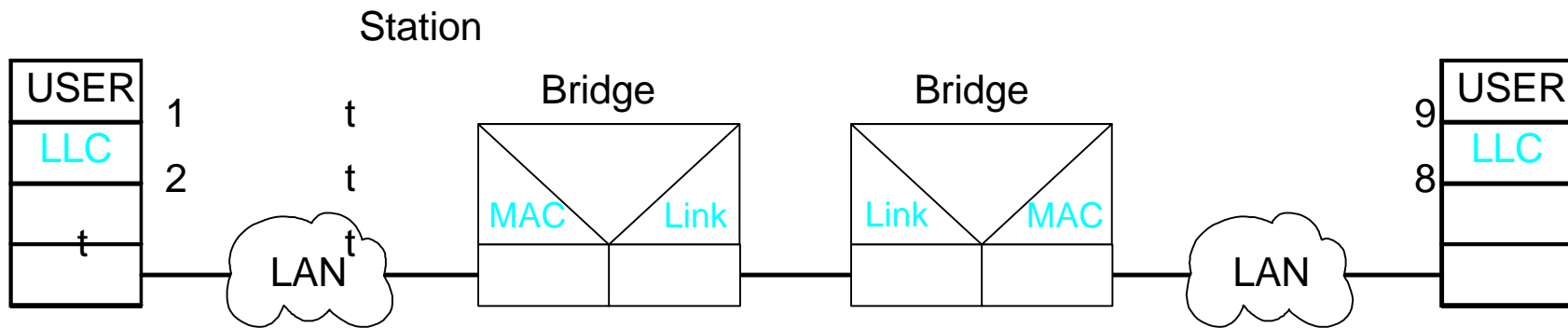
- ❑ **Repeater:** PHY device that restores data and collision signals
- ❑ **Hub:** Multiport repeater + collision detection, notification and signal broadcast
- ❑ **Bridge:** Datalink layer device connecting two or more collision domains
- ❑ **Router:** Network layer device (does propagate MAC multicasts)



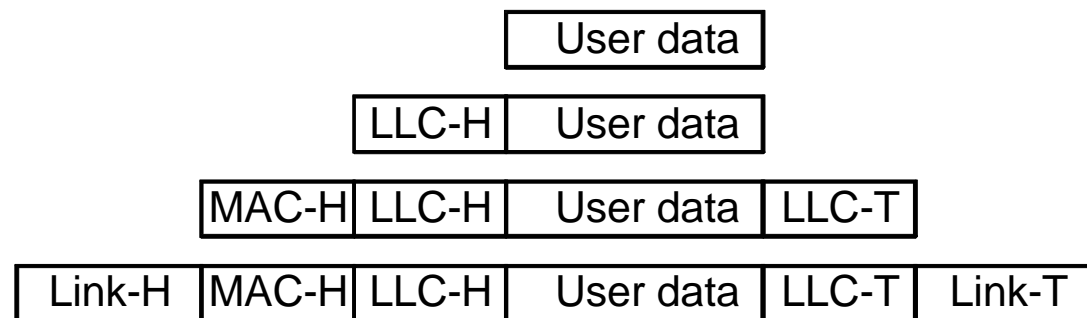
# Data Encapsulation by Bridges



# Bridges for Point-to-point links



(a) Architecture



(b) Operation

# Path Determination By Bridges

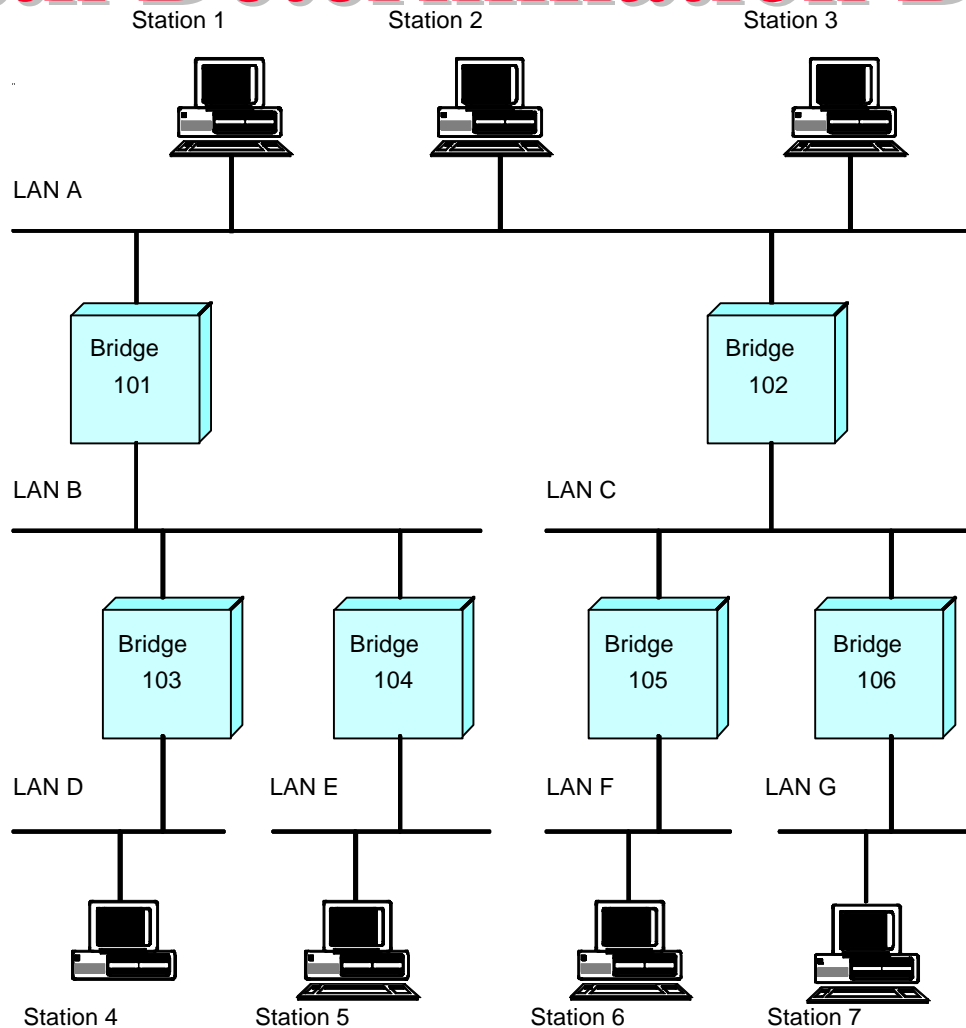


Fig 14.5

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# 1. Fixed Routing

		Central Routing Matrix						
		Destination LAN						
		A	B	C	D	E	F	G
Source LAN	A	-	101	102	101	107	102	102
	B	101	-	101	103	104	101	101
	C	102	102	-	102	102	105	106
	D	103	103	103	-	103	103	103
	E	107	104	107	104	-	107	107
	F	105	105	105	105	105	-	105
	G	106	106	106	106	106	106	-

Bridge 101 table			
from LAN A		from LAN B	
Dest	Next	Dest	Next
B	B	A	A
C	-	C	A
D	B	D	-
E	-	E	-
F	-	F	A
G	-	G	A

Bridge 102 table			
from LAN A		from LAN C	
Dest	Next	Dest	Next
B	-	A	A
C	C	B	A
D	-	D	A
E	-	E	A
F	C	F	-
G	C	G	-

Bridge 103 table			
from LAN B		from LAN D	
Dest	Next	Dest	Next
A	-	A	B
C	-	B	B
D	D	C	B
E	-	E	B
F	-	F	B
G	-	G	B

Bridge 104 table			
from LAN B		from LAN E	
Dest	Next	Dest	Next
A	-	A	-
C	-	B	B
D	-	C	-
E	E	D	B
F	-	F	-
G	-	G	-

Bridge 105 table			
from LAN C		from LAN F	
Dest	Next	Dest	Next
A	-	A	C
B	-	B	C
D	-	C	C
E	-	D	C
F	F	E	C
G	-	G	C

Bridge 106 table			
from LAN C		from LAN G	
Dest	Next	Dest	Next
A	-	A	C
B	-	B	C
D	-	C	C
E	-	D	C
F	-	E	C
G	G	F	C

Bridge 107 table			
from LAN A		from LAN E	
Dest	Next	Dest	Next
B	-	A	A
C	-	B	-
D	-	C	A
E	E	D	-
F	-	F	A
G	-	G	A

Fig 14.7

# 2. Spanning Tree

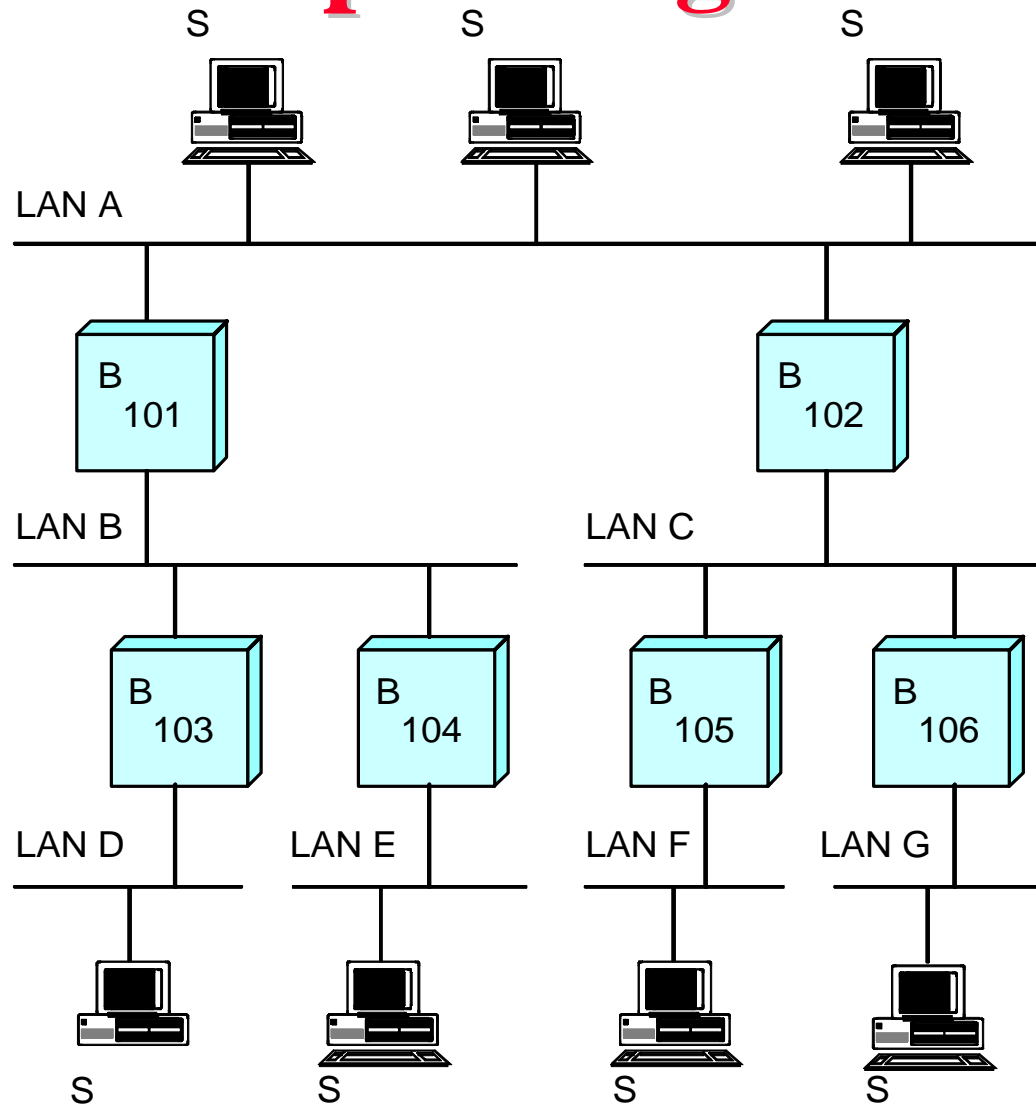


Fig 14.5

# Spanning Tree (Cont)

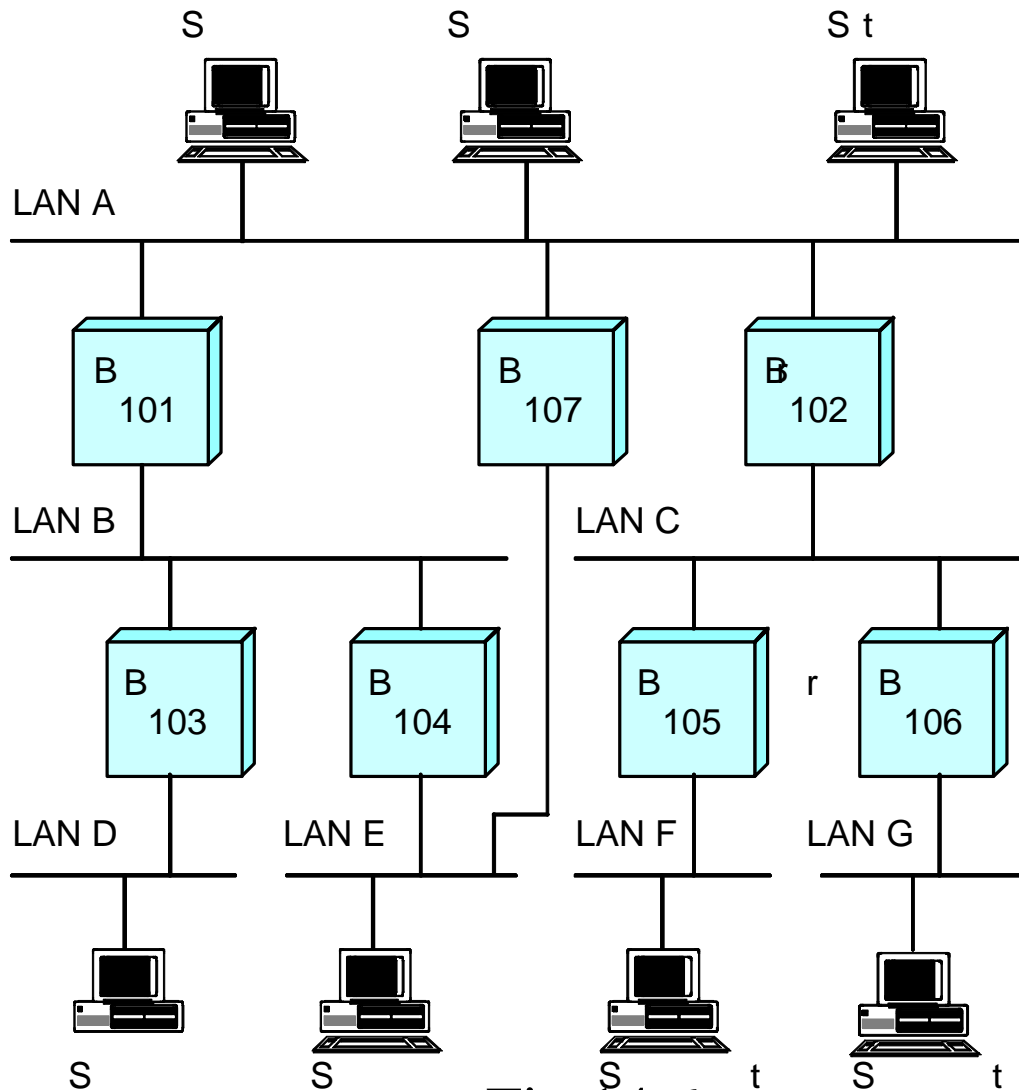


Fig 14.6

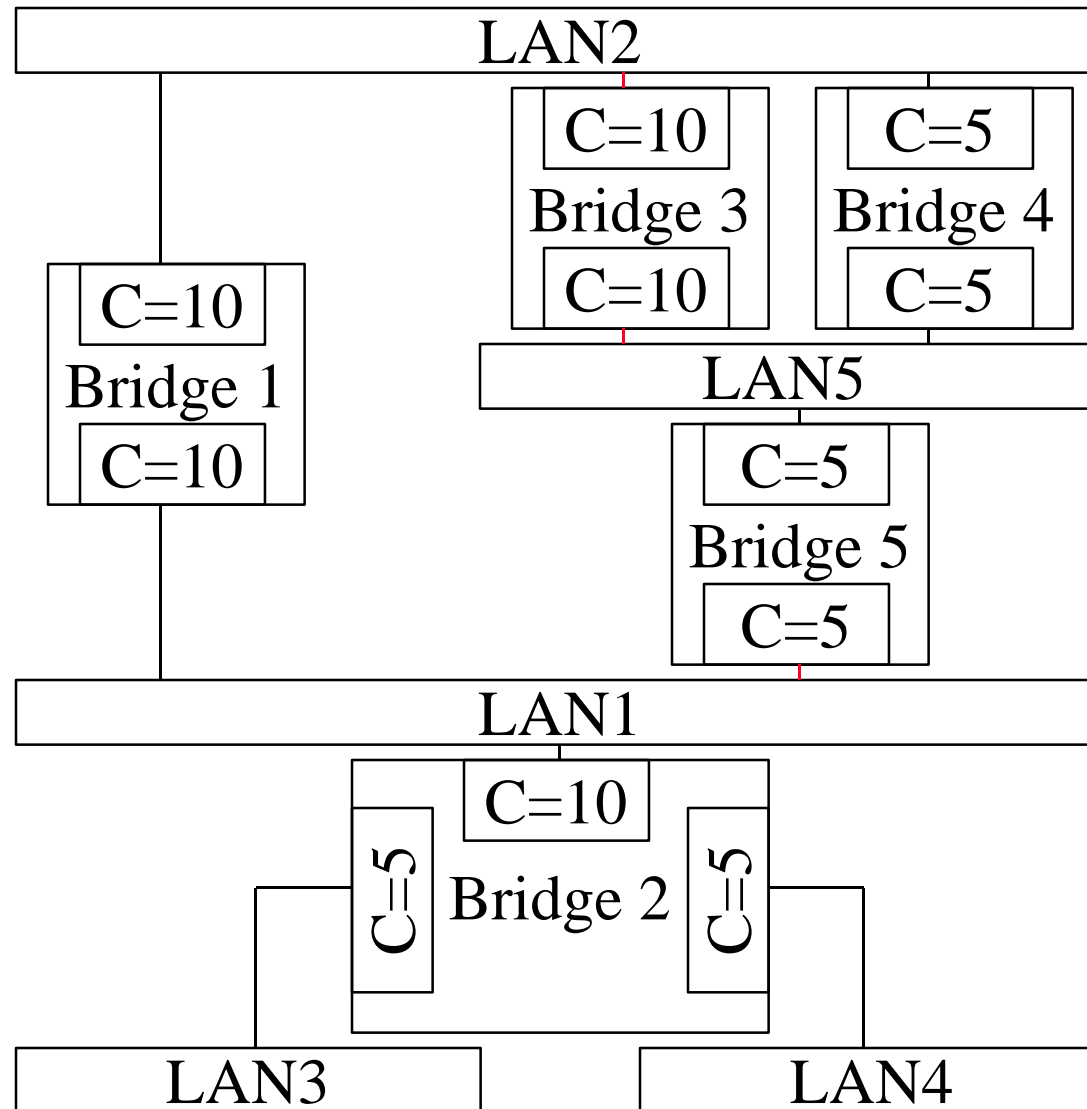
# Spanning Tree: Terminology

- ❑ Bridge Identifier: MAC address plus a priority level
- ❑ Port identifier: For each port of a bridge
- ❑ Path cost: Cost transmitting through a port
- ❑ Root Bridge: The bridge with the lowest identifier
- ❑ Root port: Port with minimum cost to the root bridge
- ❑ Root path cost: Cost of the path to the root bridge
- ❑ Designated bridge: One per LAN. Provides minimum cost path from the LAN to the root bridge.
- ❑ Designated Port: Connects designated bridge to LAN

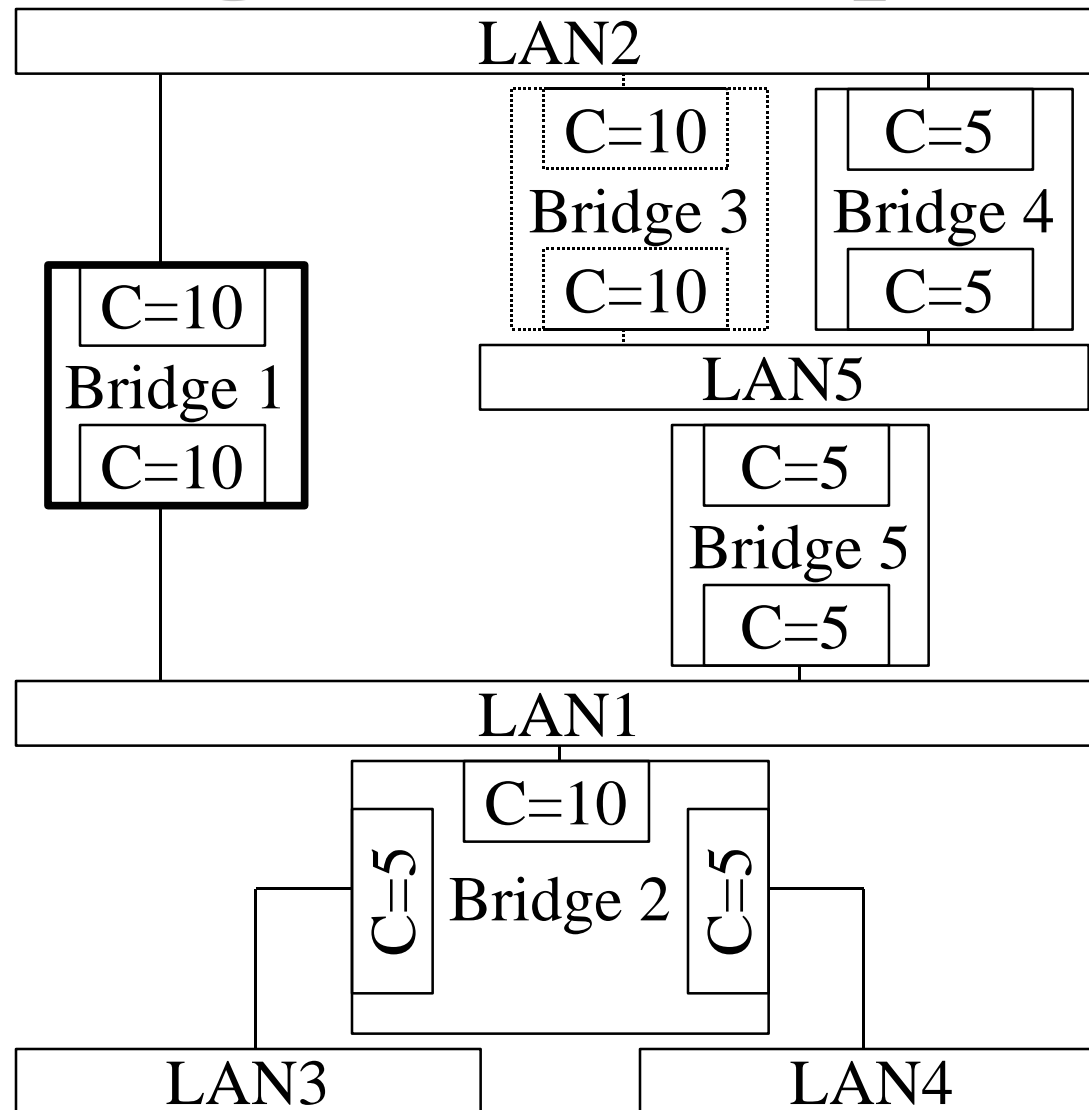
# Spanning Tree Algorithm

- ❑ All bridges multicast to “All bridges”
  - My ID
  - Root ID
  - My cost to root
- ❑ The bridges update their info using Dijkstra’s algorithm and rebroadcast
- ❑ Initially all bridges are roots but eventually converge to one root as they find out the lowest Bridge ID.
- ❑ On each LAN, the bridge with minimum cost to the root becomes the Designated bridge
- ❑ All ports of all non-designated bridges are blocked.

# Spanning Tree Example



# Spanning Tree Example (Cont)



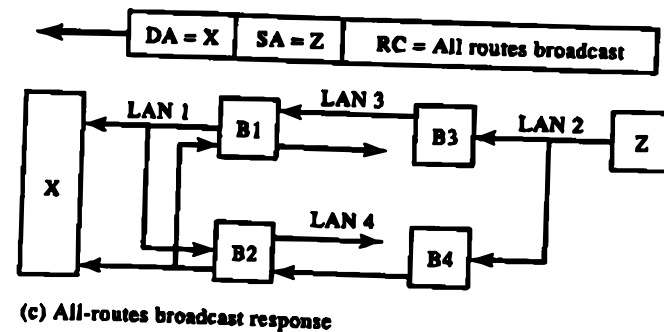
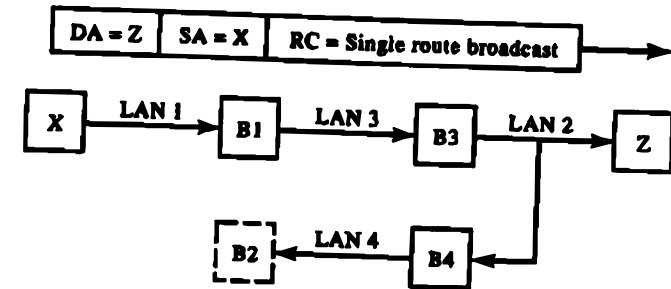
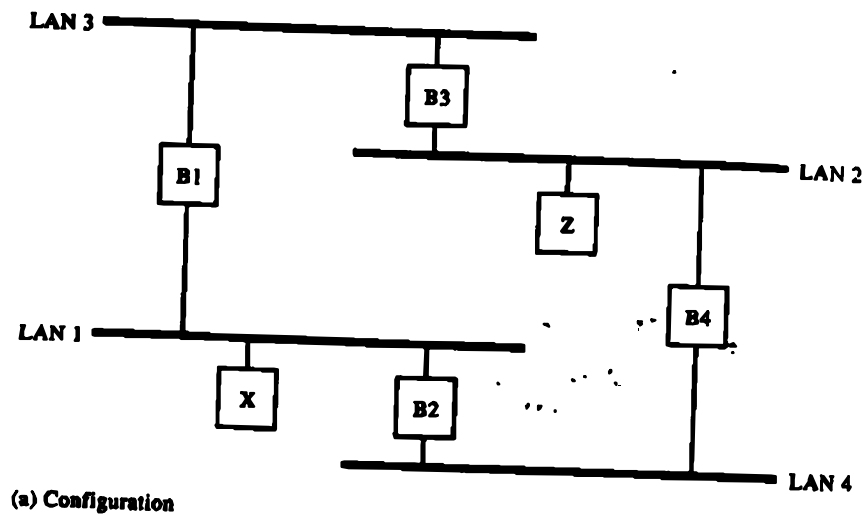
## 3. Source Routing

- ❑ The frame header contains the complete route:  
LAN 1 - Bridge B1 - LAN 3 - Bridge B3 - LAN 2 - Dest
- ❑ Bridges are simple, end systems do the routing
- ❑ Four types of destination addressing:
  - Null: Destination on the same LAN
  - Non-broadcast: Includes a route to destination
  - All-route Broadcast: Flooded.  
Bridges record route in the frame.
  - Single-route Broadcast: Once and only once on each LAN. Spanning tree used for broadcast

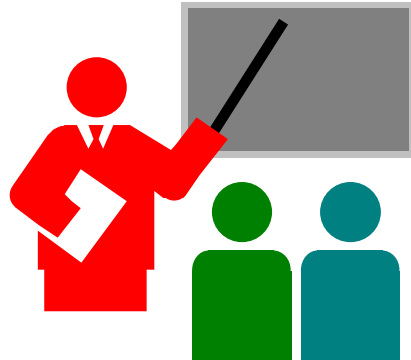
# Route Discovery

- ❑ Manually on small internets
- ❑ Route server
- ❑ Dynamic route discovery
  - Transmit “All-route request frame” to destination  
The destination sends back “non-broadcast response” on each frame. Source knows all routes to the destination. Selects one.
  - Transmit “single-route request frame” to dest.  
The destination responds with one “All-routes response.” The source receives many responses and discovers all routes.

# Example



# Summary



- ❑ Ethernet bridges learn source addresses
- ❑ Spanning tree algorithm
- ❑ Token ring bridges use source route

# Homework

- Read chapter 14.1, 14.2

# Thank You!

