

COMPUTER NETWORKS

▪ Chapter 4 Medium Access Control Sublayer 3

王昊翔

WANG Haoxiang

hxwang@scut.edu.cn

School of Computer Science & Engineering

国家双语教学试点项目 广东省精品课

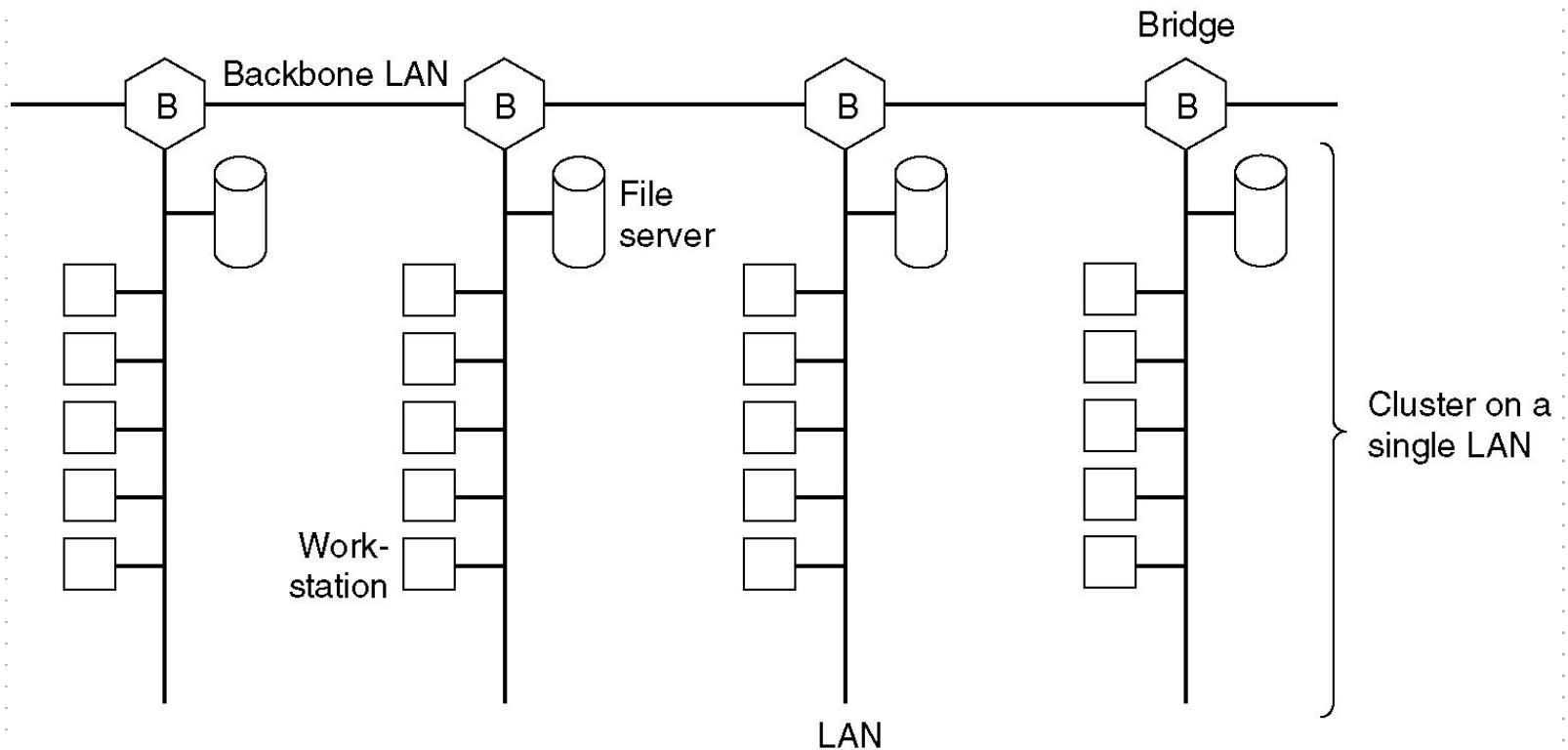
Contents of this lecture

- ☐ Learn basic idea of frame switch (L2 switching)
- ☐ Master basic principle of L2 switch
- ☐ Learn bridge
- ☐ Learn switch

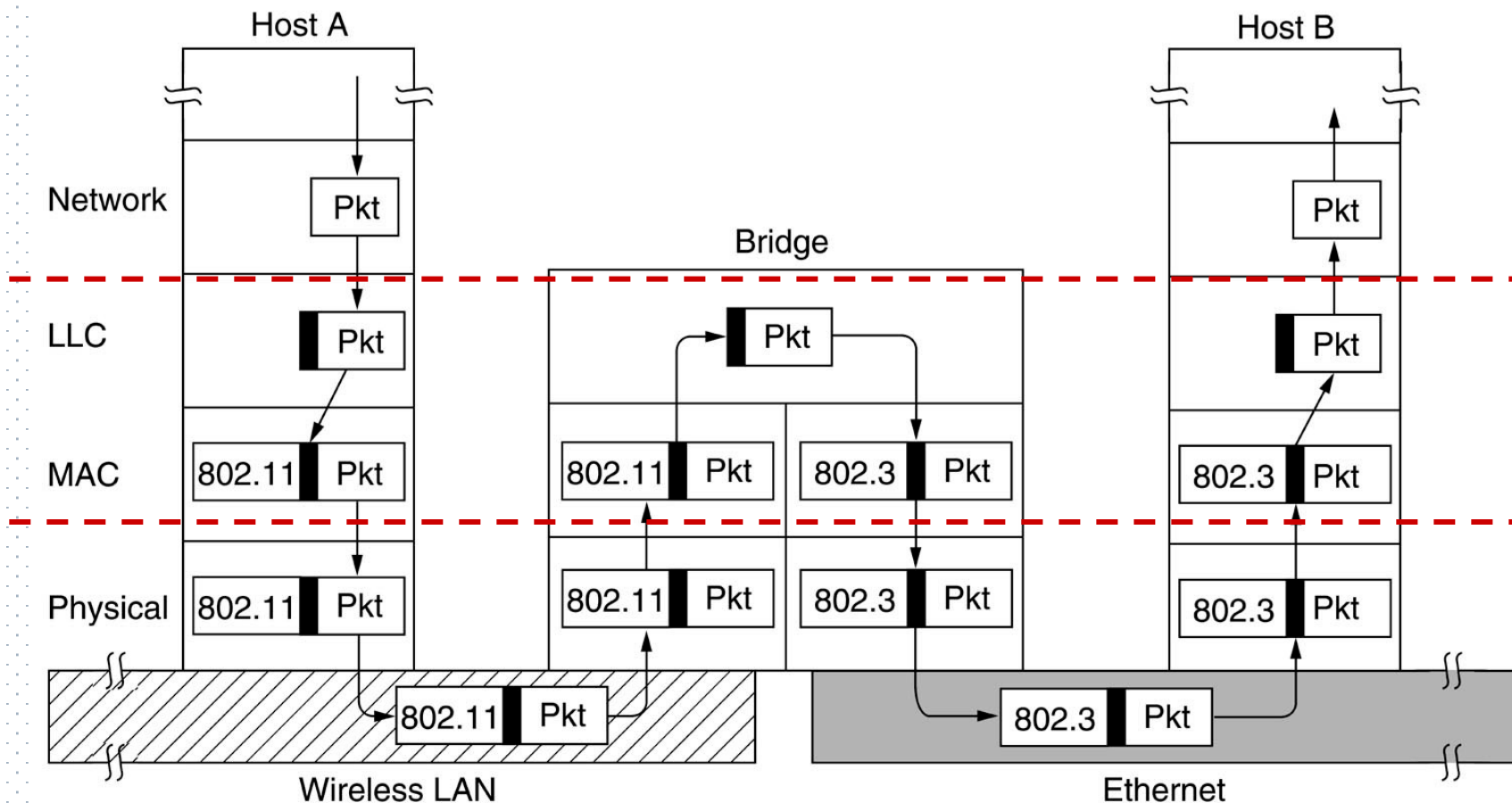
Why are there multiple LANs?

- ❑ Goal of each department may be different
- ❑ May be geographically spread over several building
- ❑ May be necessary to split into separate LANs to accommodate the load
- ❑ Physical distance between the most distant machines may be too great
- ❑ In order to improve performance
- ❑ Bridges can contribute to organization's security

Provide a higher load



Bridge-operation from 802.11 to 802.3



Bridge from 802.X to 802.Y

□ Problem:

- Different frame format – re-encapsulation
- Different transmission speed - Buffering.
- Different the most frame length （如， 802.3 1526 字节, 802.11 2346 字节）
- Different security policy
- Different QoS policy

Local internetworking

- ❑ Multiple LANs connected by **transparent bridges** do not need any change on their hardware and software.
- ❑ Transparent bridges operate in **promiscuous** mode (混杂模式), accepting every frame transmitted on all the LANs to which it is attached.
- ❑ When a frame arrives, a bridge must decide whether to **discard** or **forward** it, and if the latter, on which LAN to put the frame.
- ❑ The decision is made by looking up the destination address in a big (hash) **table** inside the bridge.

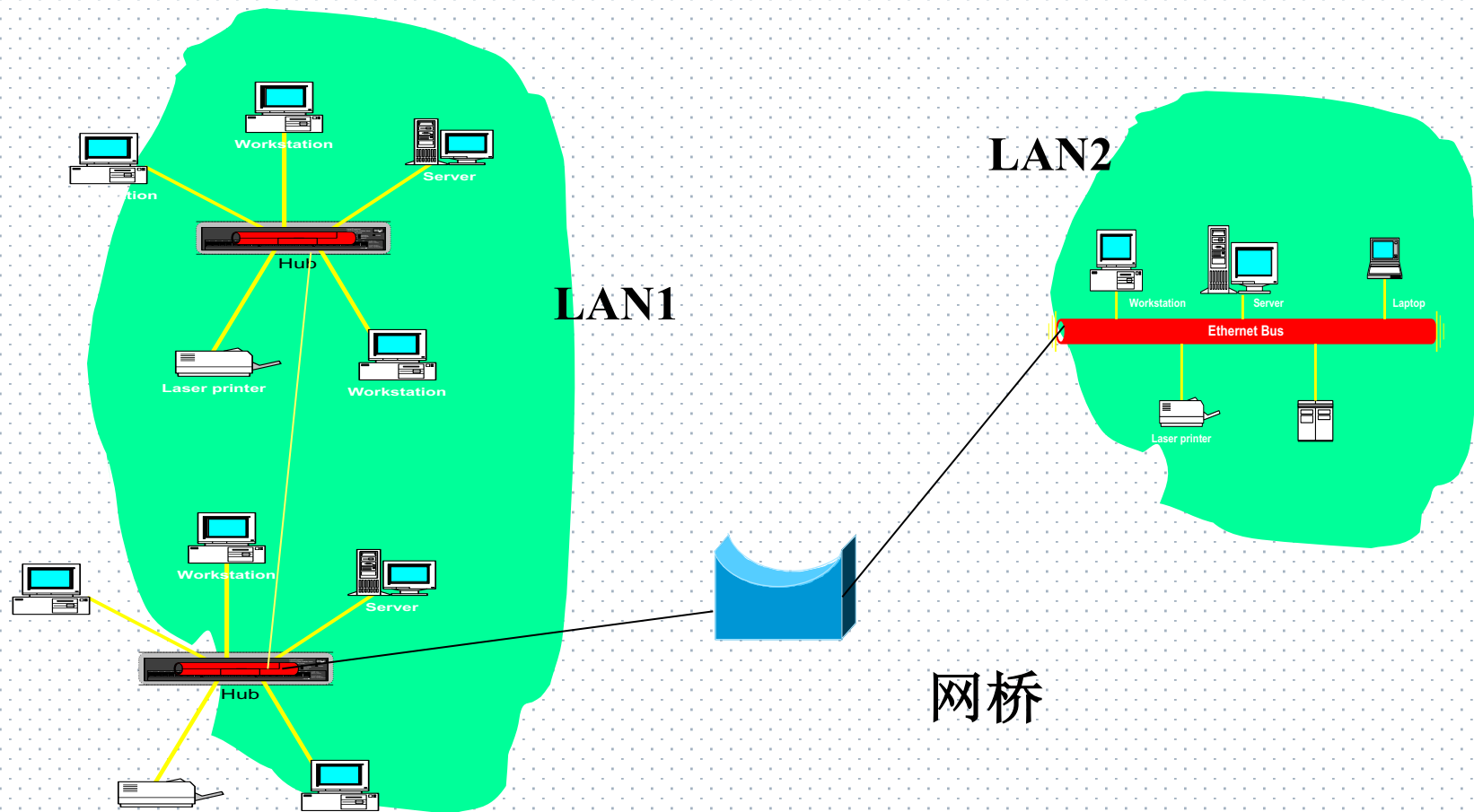
Local internetworking(cont'd)

- A bridge maintains a table of destination addresses and the corresponding output line as follows:
- Initially all the hash tables are empty.
- **flooding algorithm:(泛洪)**
 - Every incoming frame for an **unknown destination** is output on all the LANs to which the bridge is connected except the one it arrived on.
- **backward learning (逆向学习)**
 - By looking at the incoming frame's **source address**, a bridge is able to know which machine is accessible on which LAN, so it make an entry in its hash table linking the source machine with the incoming LAN.
- How to handle dynamic topologies?
 - **Whenever** a hash table entry is made, the arrival time of the frame is noted in the entry.
 - **The entry time is updated** whenever a frame from the address in that entry arrives.
 - Periodically, a process in the bridge scans the hash table and **purges(清除)** all entries more than a few minutes old.

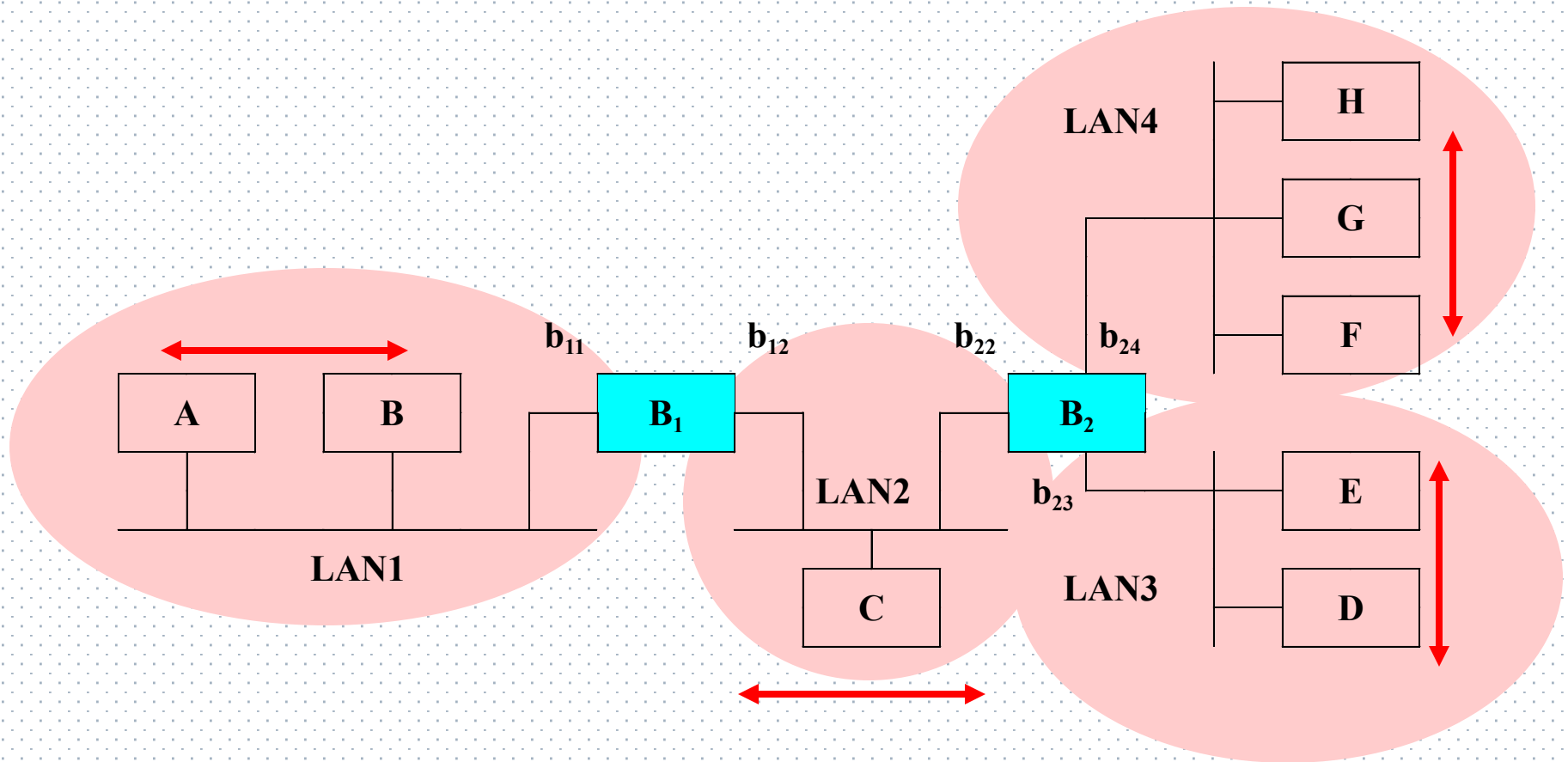
Principle of bridge

- Routing procedure for an incoming frame:
 - If destination and source LANs are the same, **discard** the frame.
 - If the destination and source LANs are different, **forward** the frame.
 - If the destination LAN is unknown, use **flooding**.
- As each frame arrives, the above algorithm must be applied.
- Special purpose VLSI chips exist to do the lookup and update the table entry, all in a few microsecond.

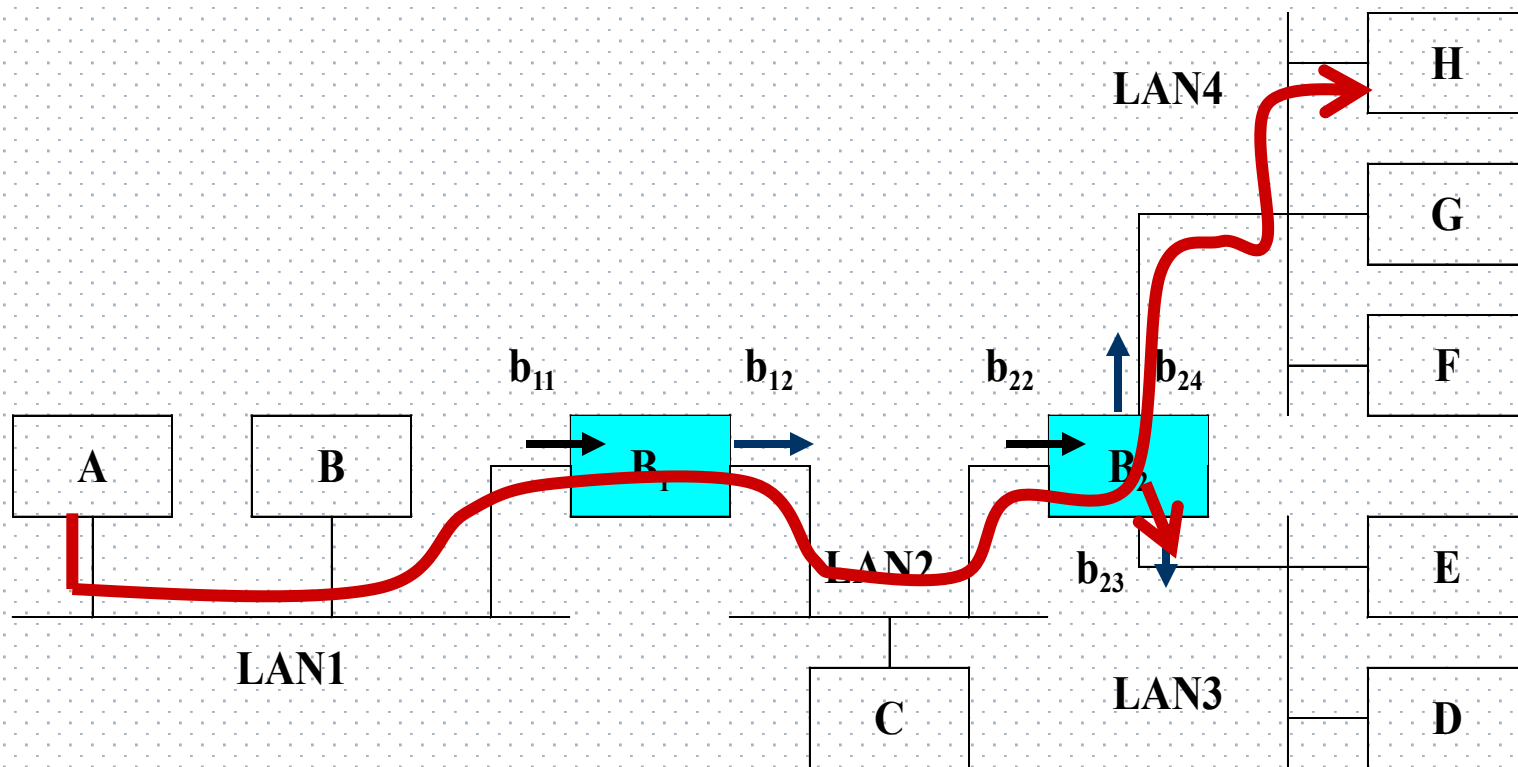
Bridge can segment collision-domain



Transparent bridge



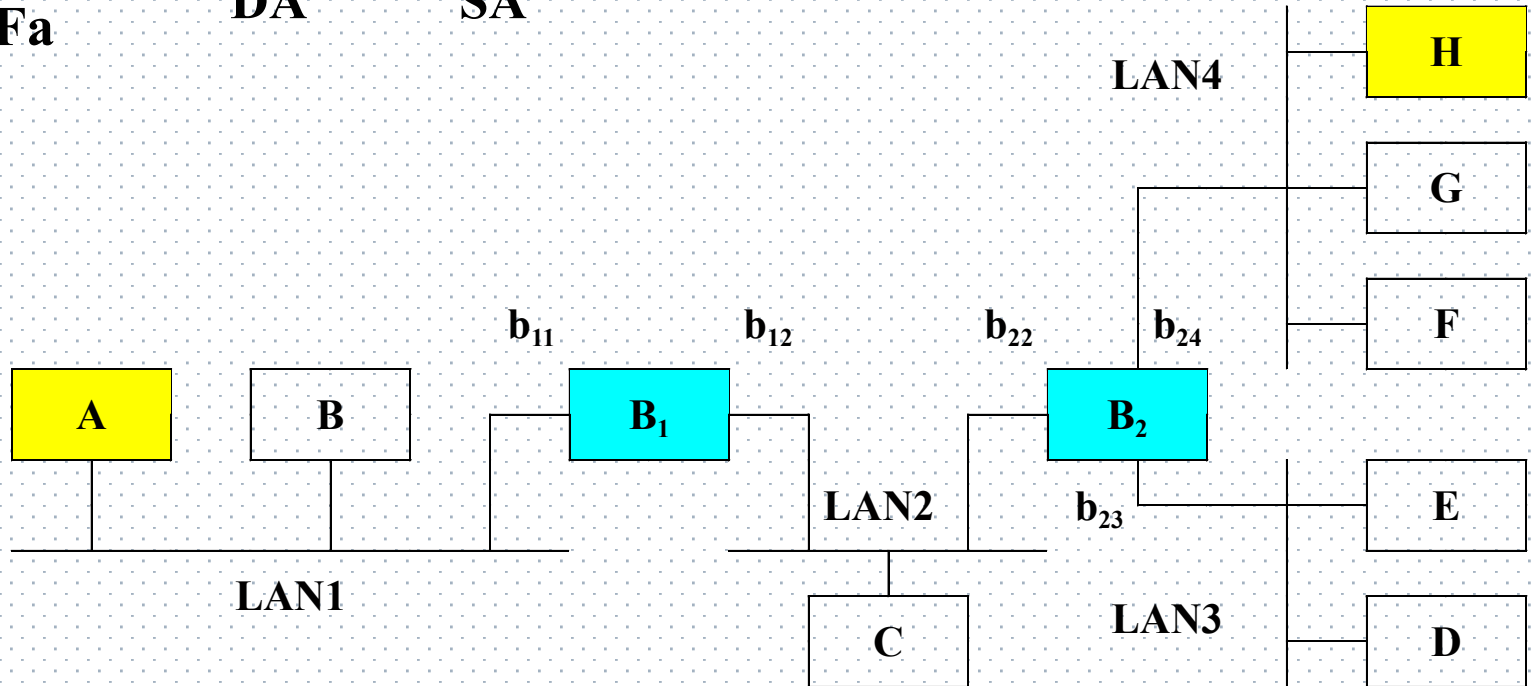
Flooding (扩散、泛洪)



Step 1: A send Fa to H

毫紫	11	H	A	似	寰脯	梅
----	----	---	---	---	----	---

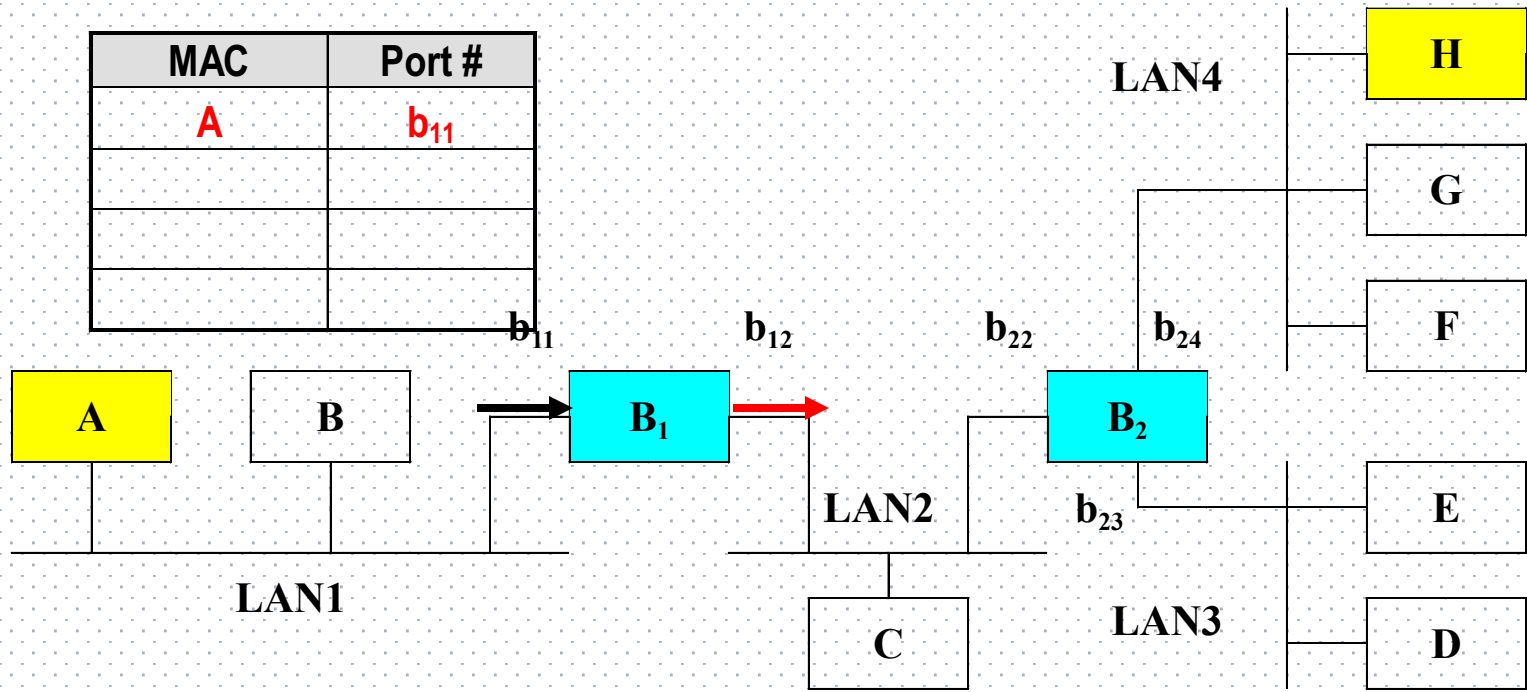
Frame: Fa DA SA



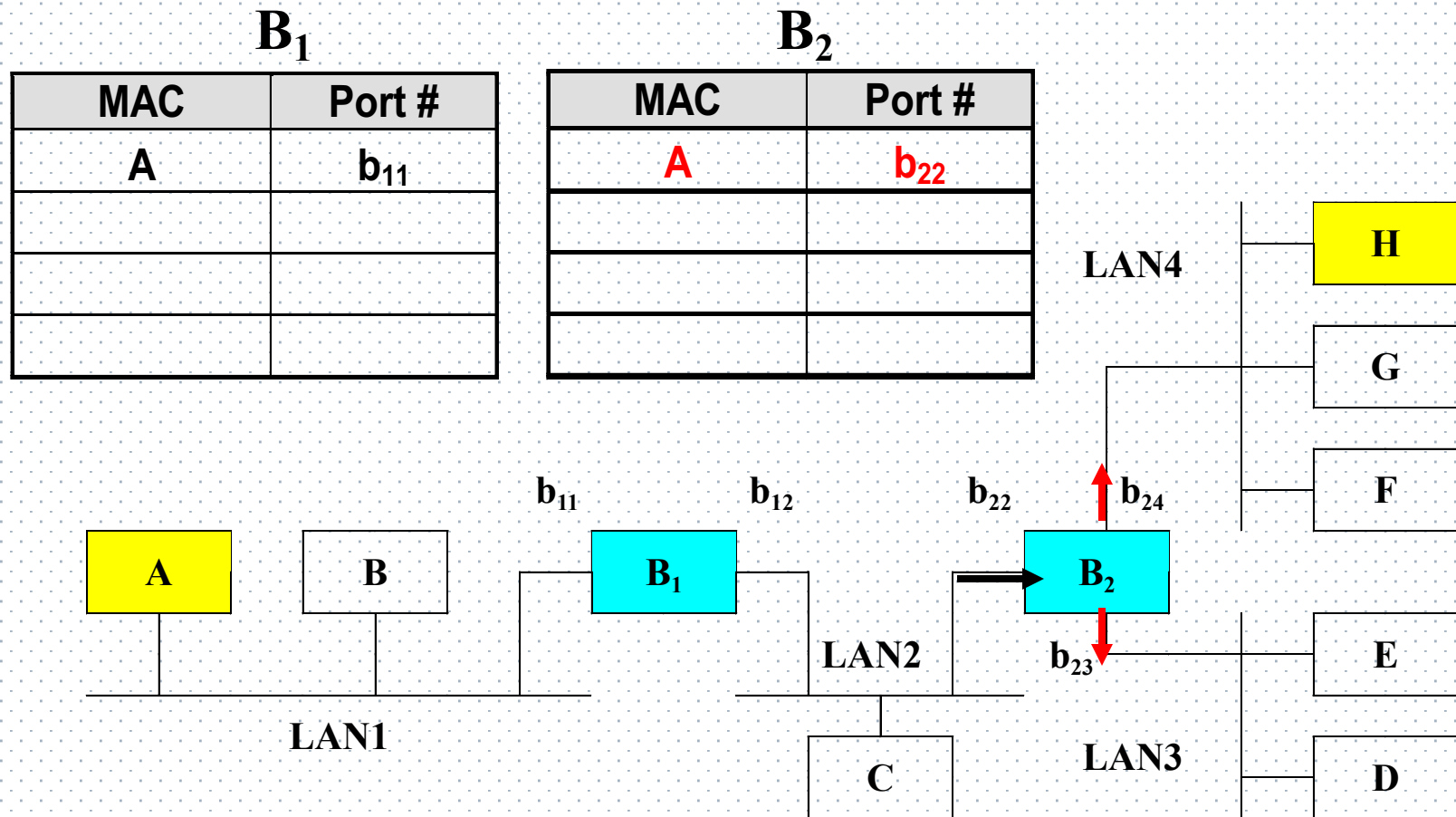
Step 2: bridge B1

□ B1 receives Fa from b11, flooding Fa to b12
(LAN2)

□ B1 learns source addr. of Fa



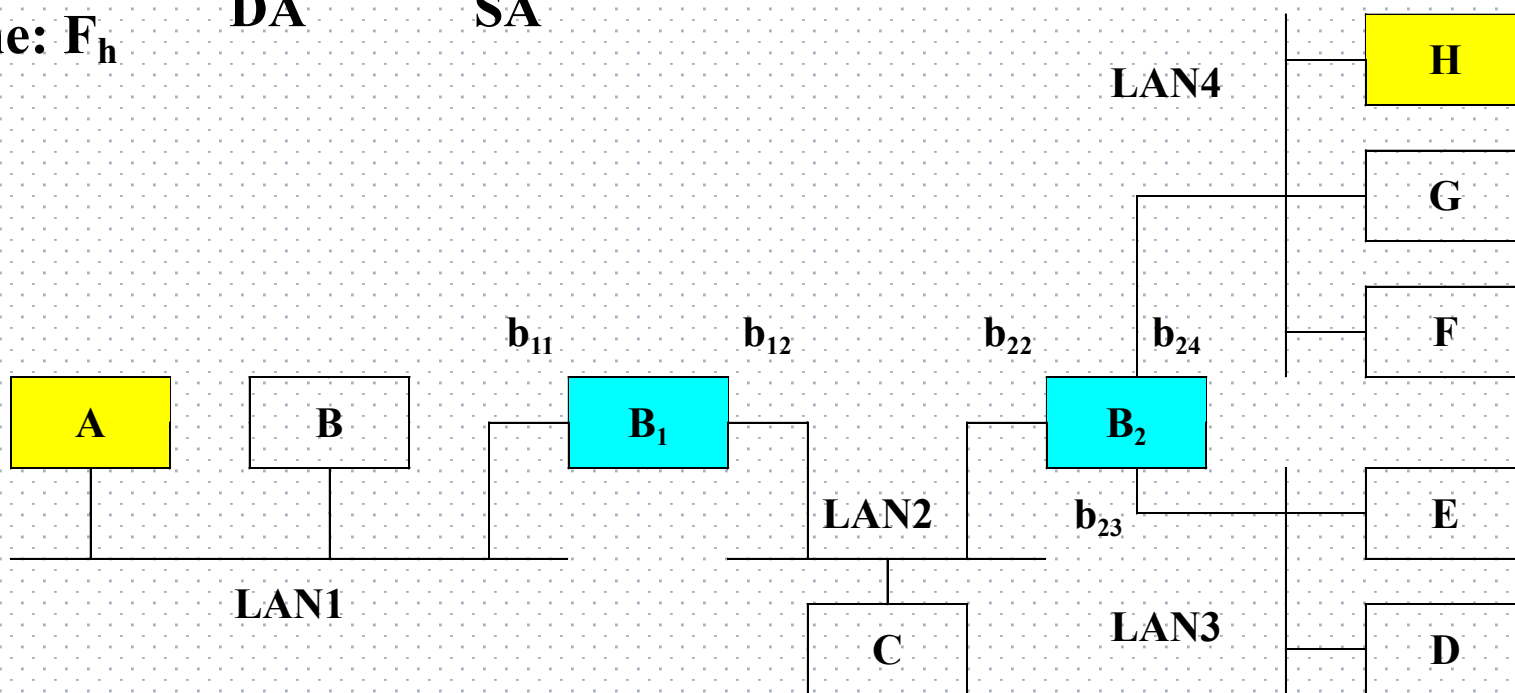
Step 3: Bridge B2



Step4: H send F_h back to A

毫紫	11	A	H	似	窦肺	梅
----	----	---	---	---	----	---

Frame: F_h DA SA



Step 5: Bridge B2 (forward F_h)

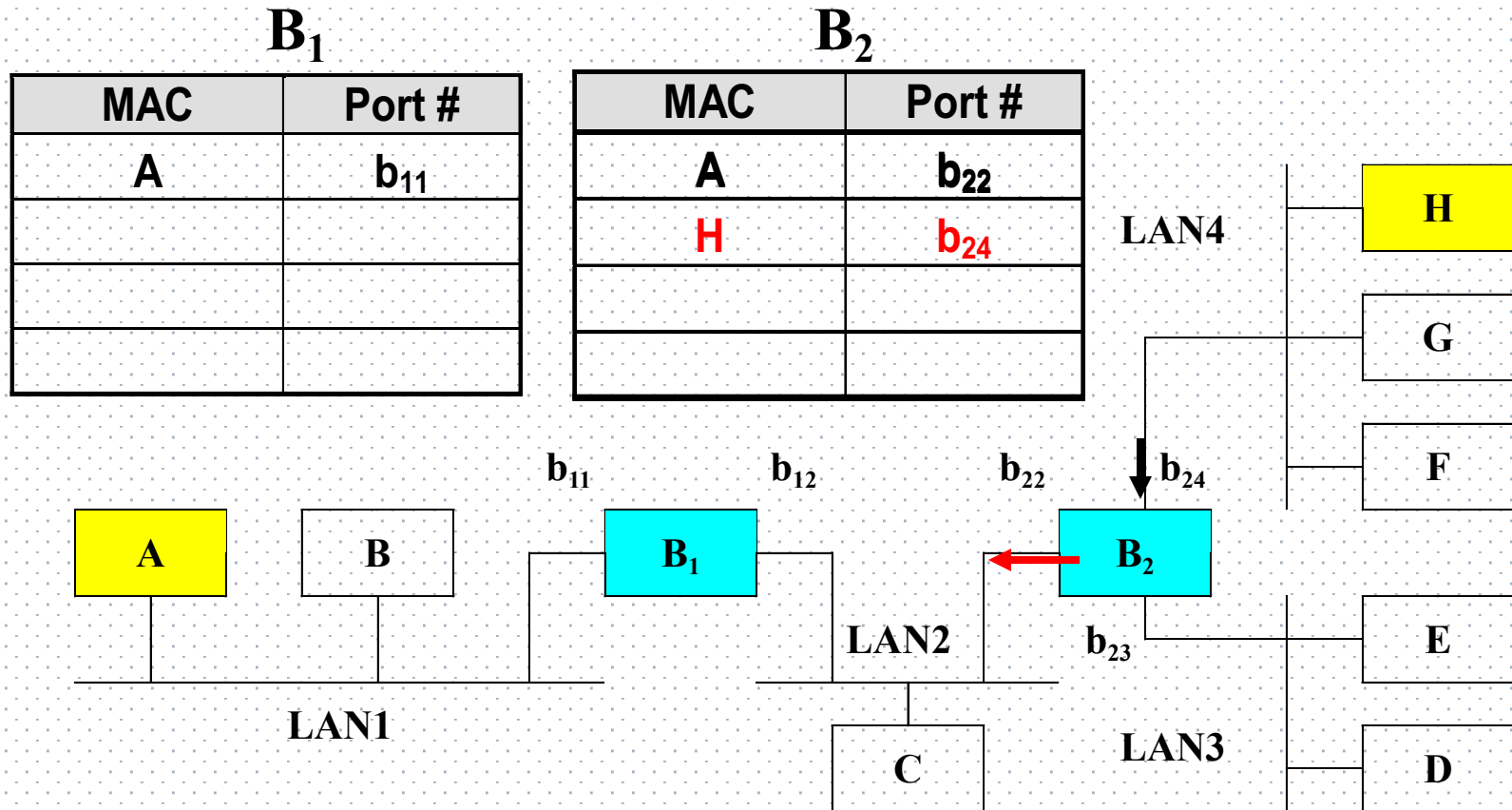
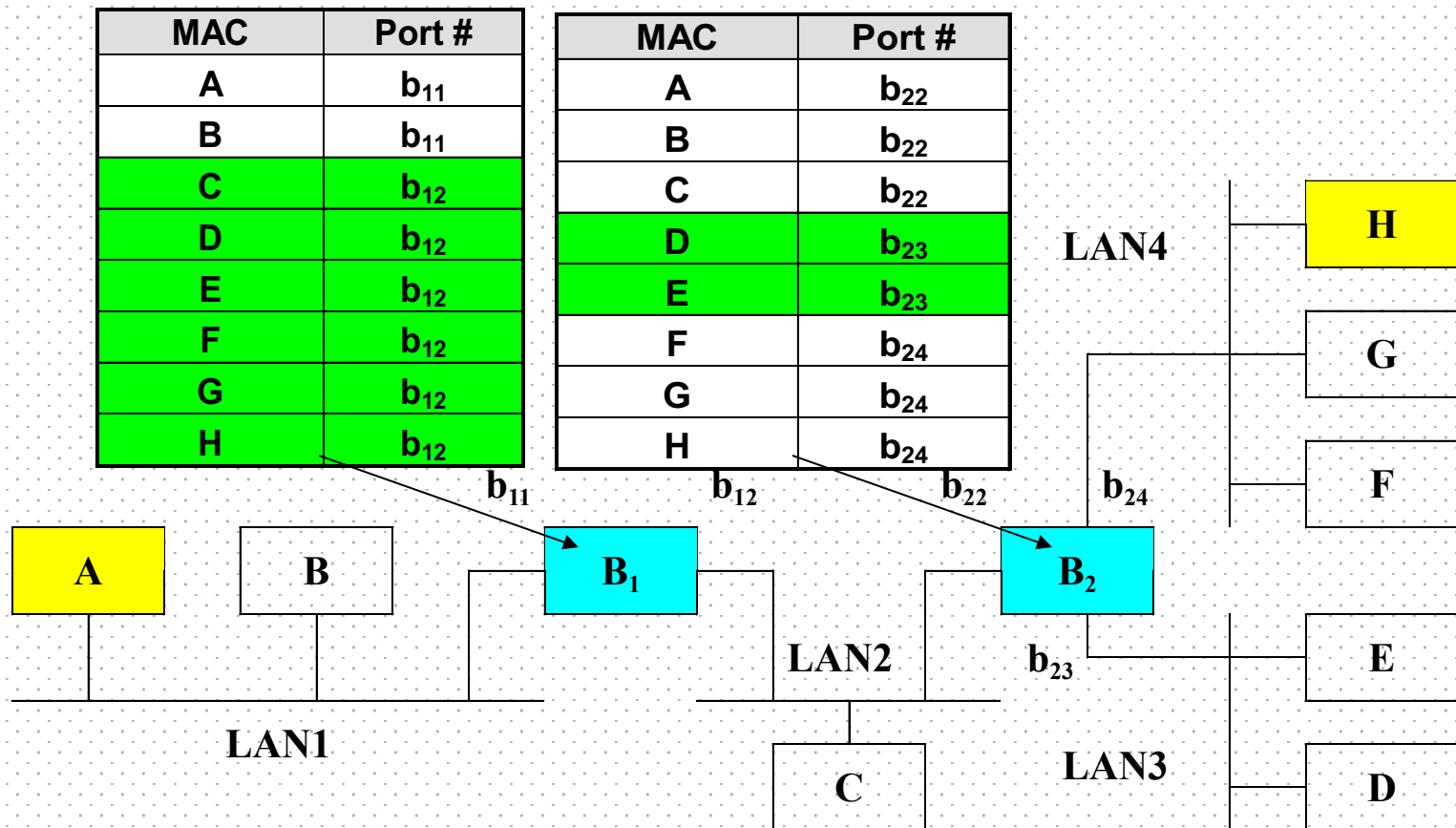
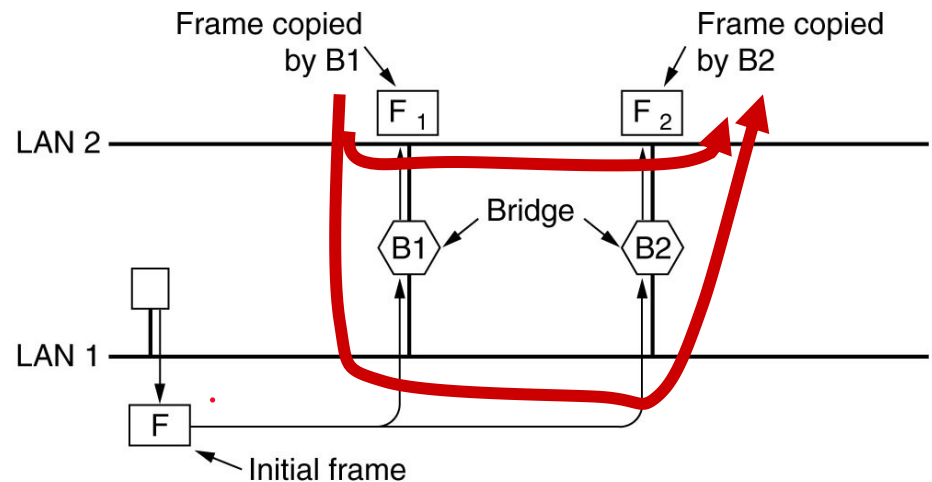


Table show



Spanning tree bridge

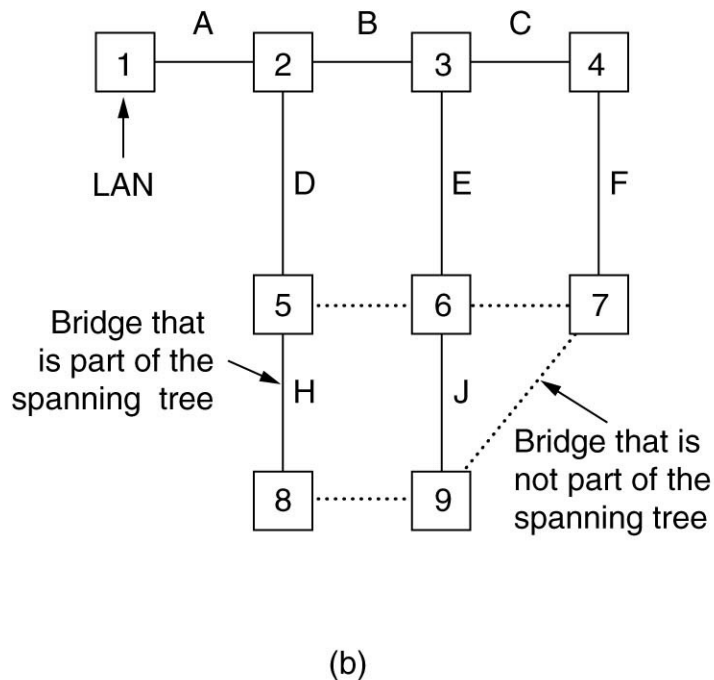
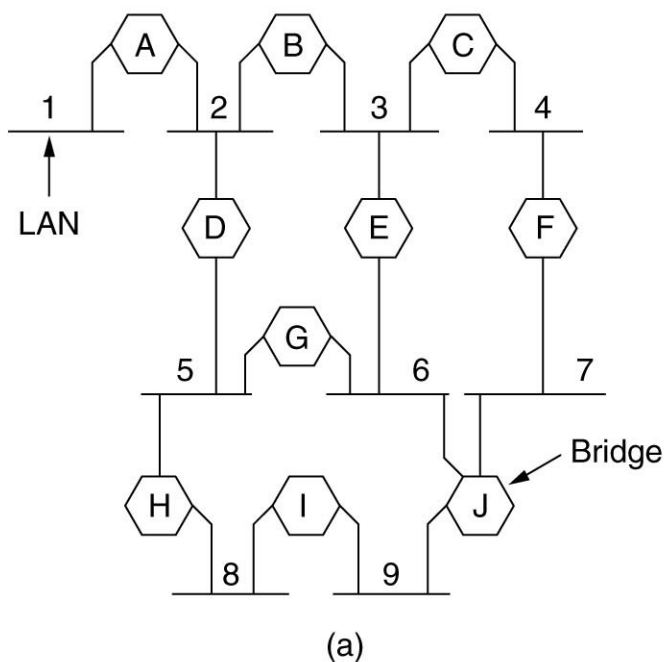
- ❑ To increase reliability, some sites use **two or more bridges** in parallel between pairs of LANs. This arrangement creates **loops** in the topology.
- ❑ What happens if a frame with an unknown destination arrives ?



Spanning Tree Bridges (cont'd)

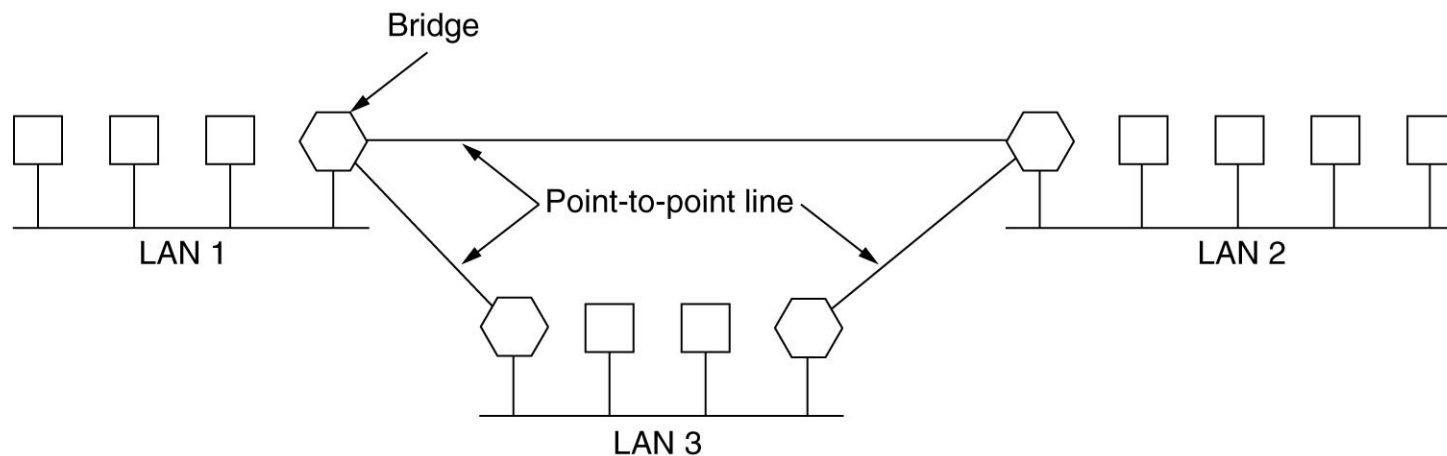
- The solution is for the bridges to communicate with each other and **overlay the actual topology** with a **spanning tree** that reaches every LAN.
- In a spanning tree, there is a unique path from each source to each destination, **loops are impossible**.
- To build the spanning tree
 - Choose one bridge to be the root of the tree
 - The bridge with the lowest serial number becomes the root.
 - A tree of shortest paths from the root to every bridge and LAN is constructed.
 - If a bridge or LAN fails, a new spanning tree is computed.

Spanning Tree Bridges (cont'd)



Remote Bridges

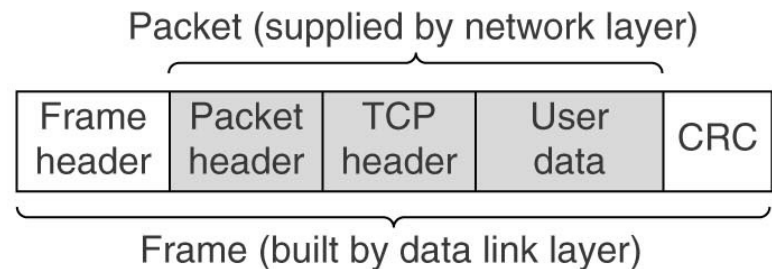
- ❑ Remote bridges can be used to interconnect distant LANs.
- Putting a bridge on each LAN
- Connecting the bridges pairwise with point-to-point lines.



Network Devices

Application layer	Application gateway
Transport layer	Transport gateway
Network layer	Router
Data link layer	Bridge, switch
Physical layer	Repeater, hub

(a)



(b)

Network Devices (cont'd)

□ **Repeaters**

- Are analog devices to connect two cable segments.
- A signal appearing on one segment is amplified and put out on the other segment.
- Can not understand frames, packets, or headers, but understand volts.

□ **Hubs**

- Frames arriving on any of the lines are sent out on all the others.
- The entire hub forms a single collision domain.
- All the lines coming into a hub must operate at the same speed.
- Do not amplify the incoming signals and are designed to hold multiple line cards each with multiple inputs (one collision domain).
- Do not examine the 802 addresses or use them in any way.

□ **Bridge.**

- A bridge connects two or more LANs.
- When a frame arrives, software in the bridge extracts the destination address from the frame header and looks it up in a table to see where to send the frame.
- A bridge may have line cards (like a hub) for different network types and speeds.
- Each line forms its own collision domain.

Network Devices (cont'd)

□ Switches

- A switch is similar to bridge in its routing on frame addresses.
- Switches are often used to connect individual computers (no collision).
- Switches must have space for many more line cards.
- Each line card provides buffer space for frames arriving on its ports.
- Each port forms its own collision domain.

□ Routers

- When a packet comes into a router, the frame header and trailer are stripped off and the packet located in the frame's payload field is passed to the routing software.
- The routing software uses the packet header to choose an output line.
- For an IP packet, the packet header will contain a 32-bit (IPv4) or 128-bit (IPv6) address, but not a 48-bit 802 address.

□ Gateways

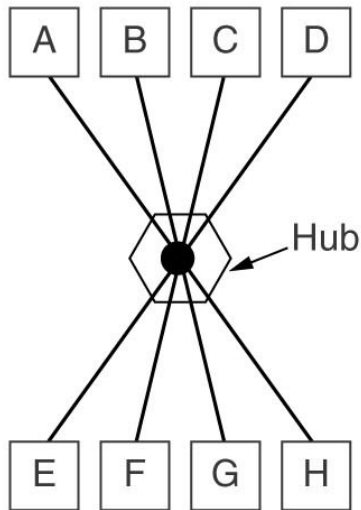
■ Transport gateway

- Connect two computers that use different connection-oriented transport protocols
- Copy the packets from one connection to the other, reformatting them as need be.

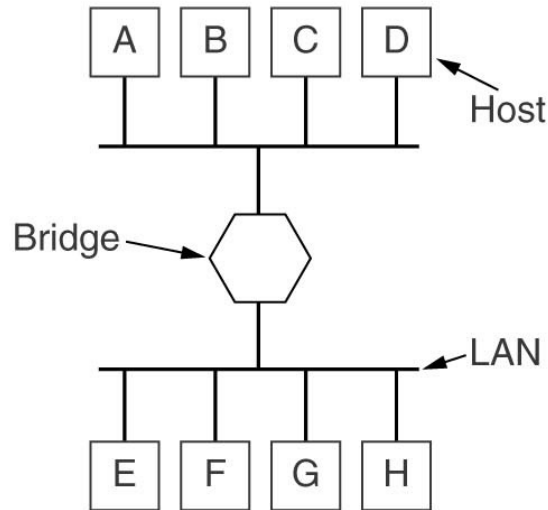
■ Application gateway

- understand the format and contents of the data
- translate messages from one format to another.

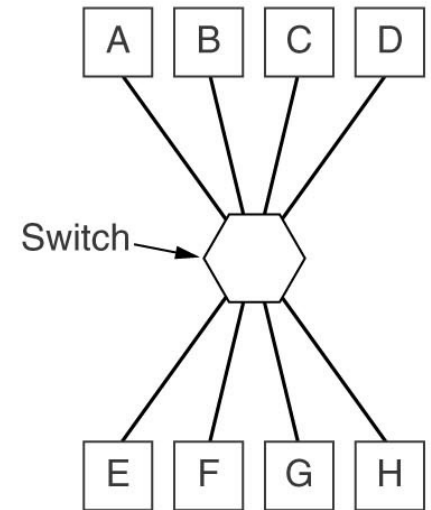
Network Devices (cont'd)



(a)



(b)



(c)

L2 (data link layer) devices

- ☐ Network interface card (NIC)
- ☐ Bridge
- ☐ Switch

Summary

- ☐ Learn basic idea of frame switch (L2 switching)
- ☐ Master basic principle of L2 switch
- ☐ Learn bridge
- ☐ Learn switch