COMMUNICATION NETWORKS
NETW 501

TUTORIAL 5

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LAN Extension

- For Multiple Users to be connected within the same Network they may suffer from some problems such as:

1) **Extension range problems:** When some users are connected to other users which are far away.

2) **Traffic problems:** These problems can arise from one of two reasons:

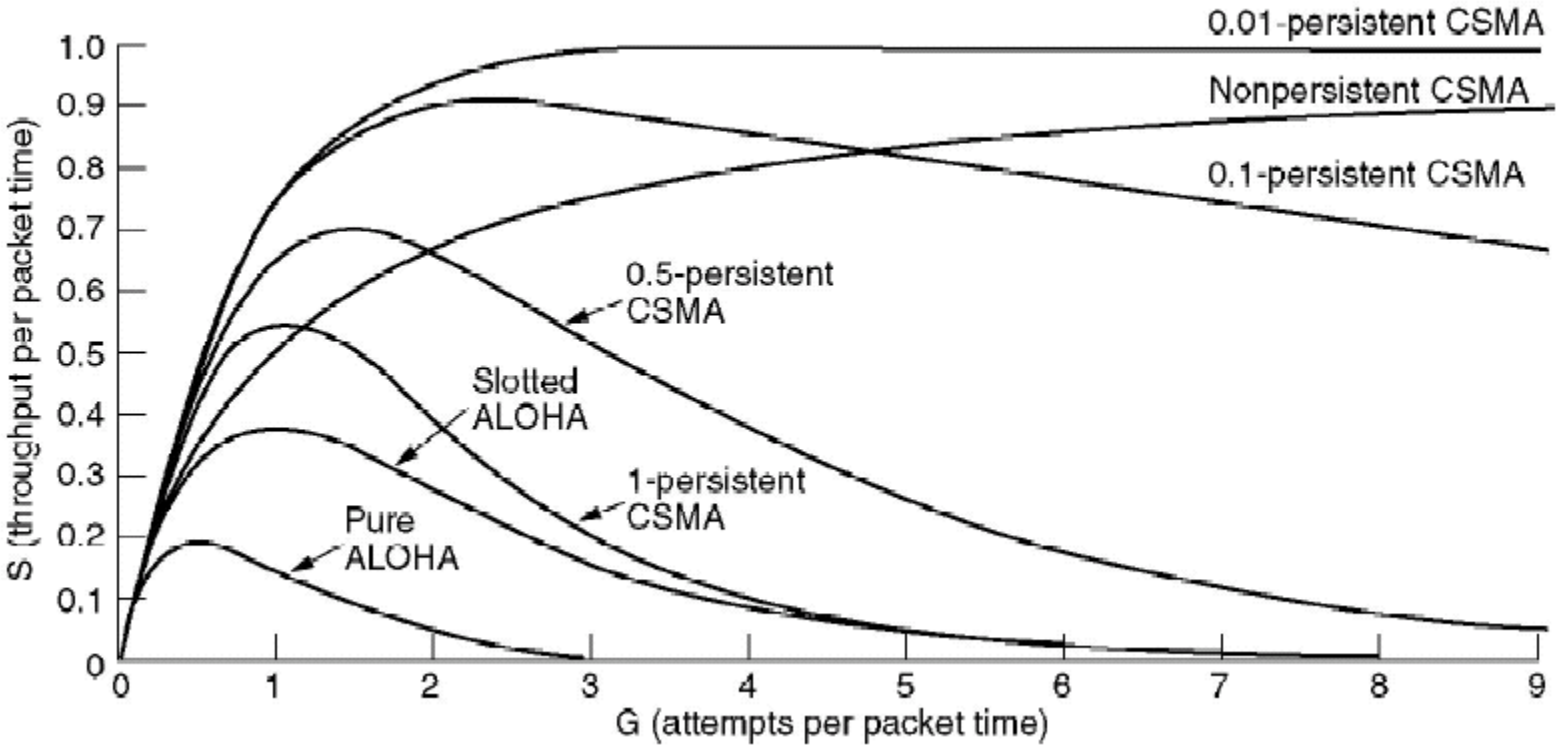
a) Many users exist in the same LAN

b) The traffic generated per user increases

Mainly LANs use Random Access MAC protocols (ALOHA – CSMA, …etc.)

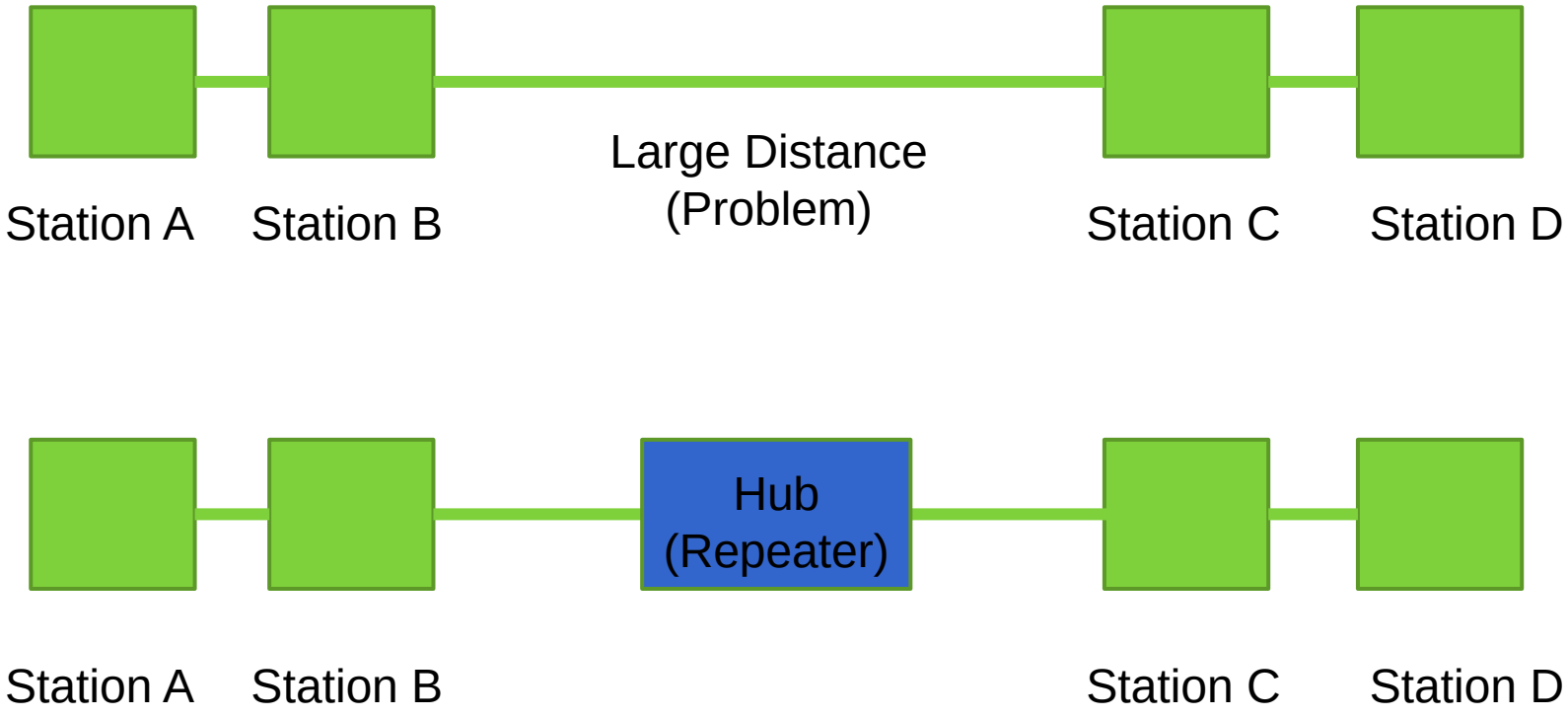
These protocols can handle a maximum level of traffic and then it saturates and the performance can degrade dramatically

LAN Extension



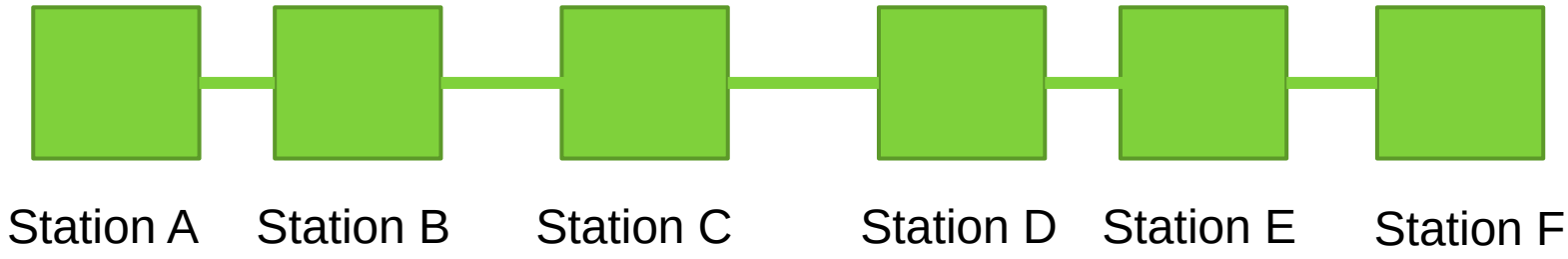
LAN Extension

- Solution LAN Extension

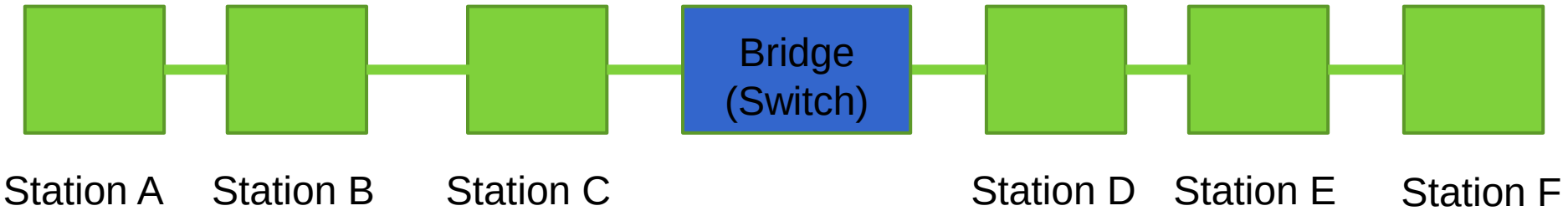


LAN Extension

- Solution LAN Extension



High Traffic Load, Thus lots of collisions and low efficiency (Problem)



Interconnecting LANs

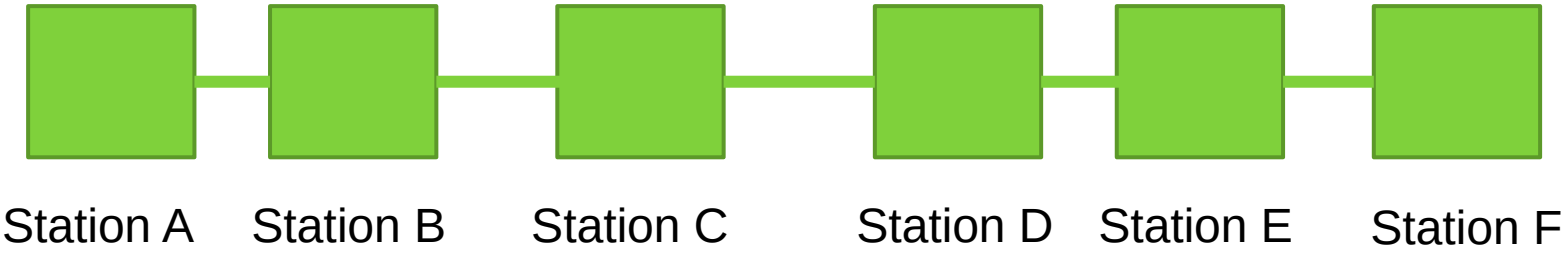
There are several ways of interconnecting Networks:

1) When two or more networks are interconnected in the **physical layer**, the device is called (**Repeater - Hub**)
(solving distance extension problem)

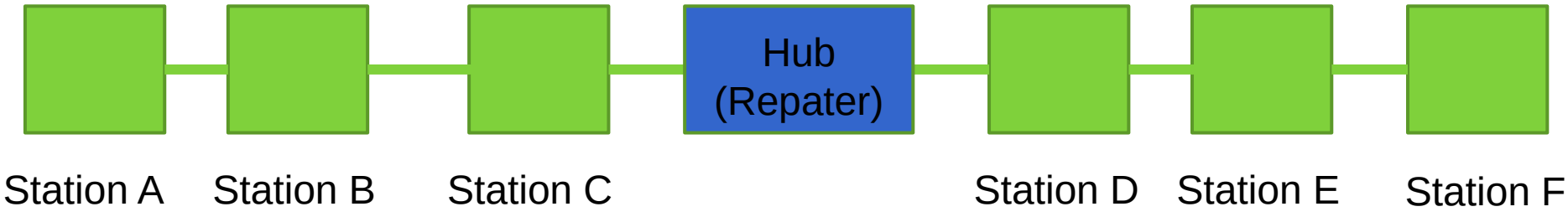
2) When two or more networks are interconnected in the **Data Link layer**, the device is called (**Bridge - Switch**)
(solving the traffic and collision problems)

3) When two or more networks are interconnected in the **Network layer**, the device is called (**Router**)
(solving higher scalability problems with higher efficiency and lower delays)

Collision Domains

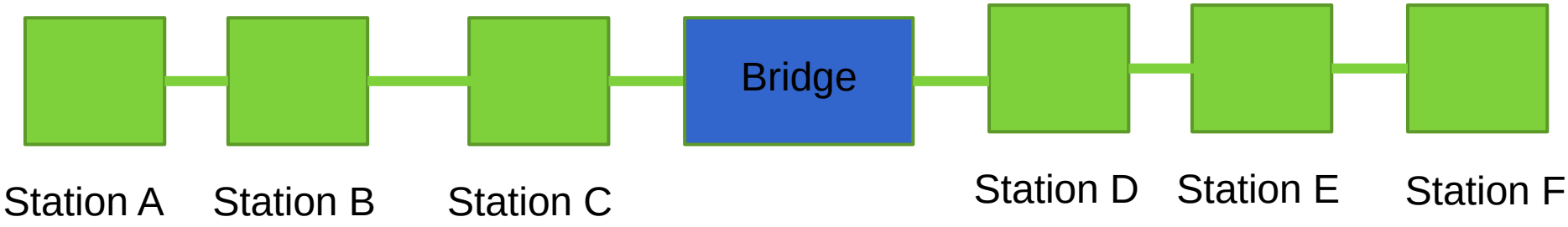


Number of Collision Domains = 1

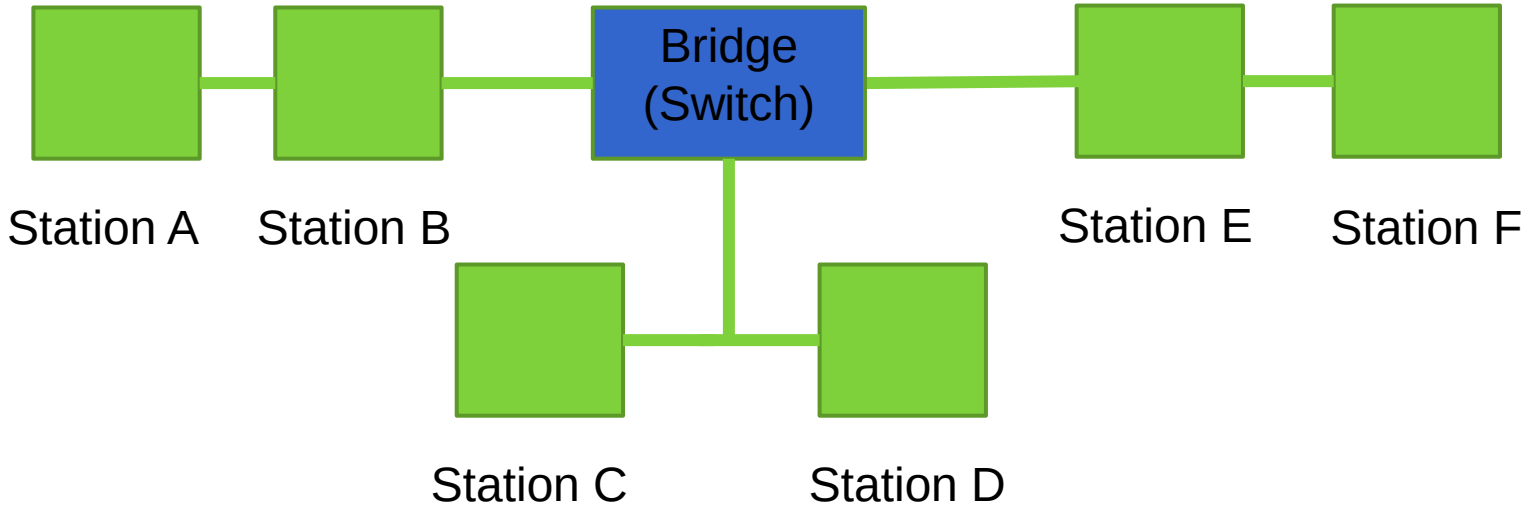


Number of Collision Domains = 1

Collision Domains



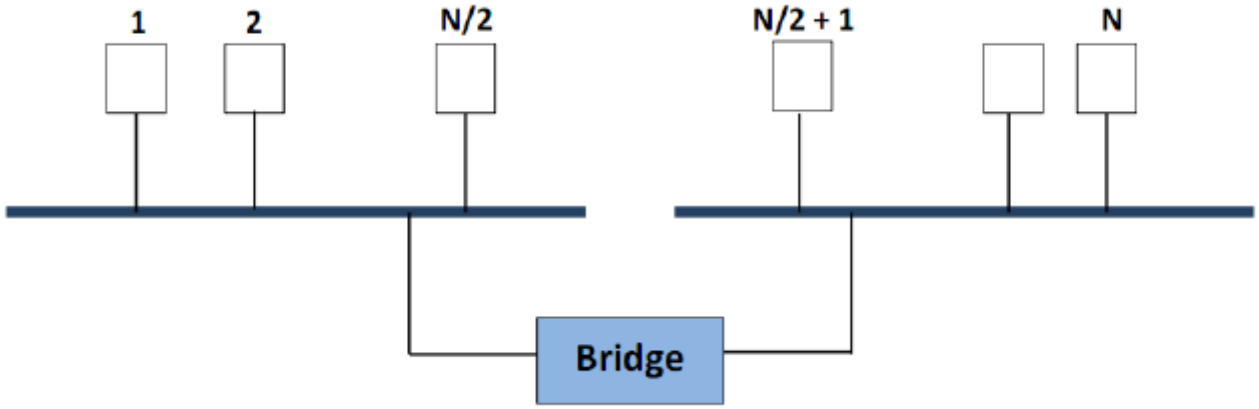
Number of Collision Domains = 2



Number of Collision Domains = 3

Sheet 7 Problem 1

- Suppose N stations are connected to an extended Ethernet LAN, as shown below operating at rate of 10 Mbps. Given that the efficiency of the network is about 80% and the required transmission rate of each station is Rs =100 Kbps. Find the maximum number if stations N.
- Repeat if a hub is used instead of bridge.



Sheet 7 Problem 1

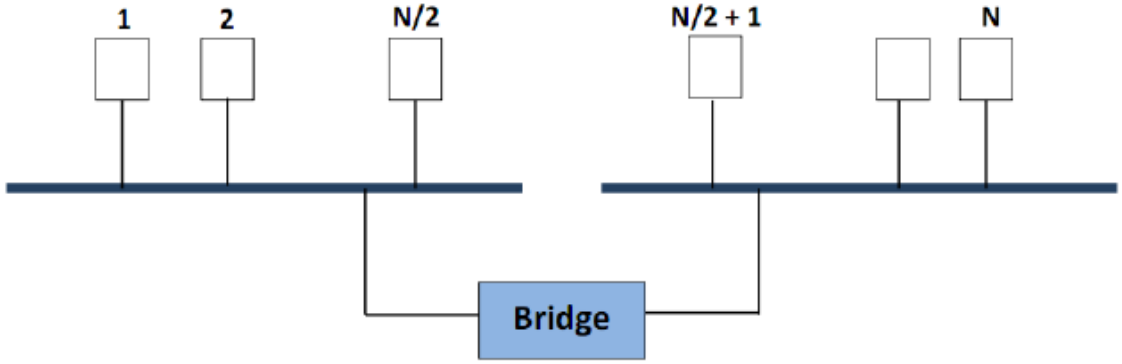
Given:

N Stations

R = 10Mbps

μ = 80%

Required Rate = 100Kbps



Required:

Max no. of stations (N_{max}) a) if a Bridge is used b) if a Hub is used

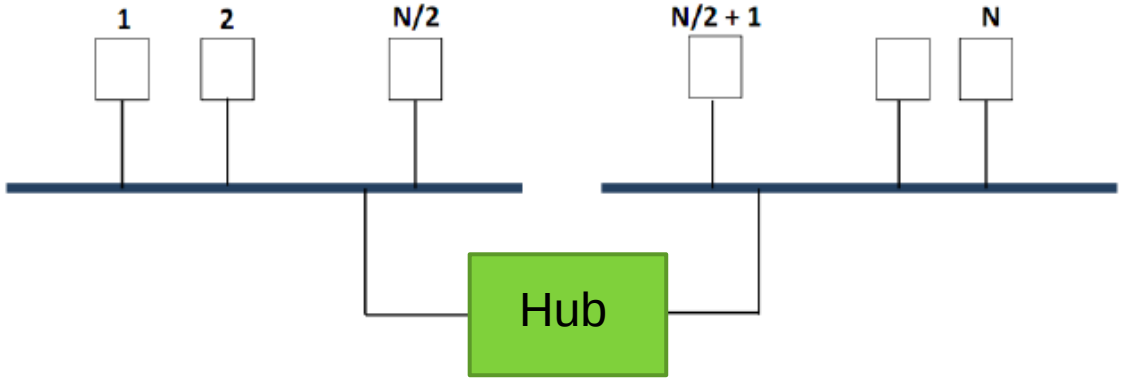
a) Using a Bridge:

Note: We are using a bridge, so we have 2 collision domains.

$$N_{max} = \frac{(\text{Total Rate provided} * \mu_{total}) * \text{No.of Bridge Collision Domains}}{\text{station Required Rate}} = \frac{(10x10^6 * 0.8) * 2}{100x10^3}$$

N_{max} = 160 stations

Sheet 7 Problem 1



b) Using a Hub:

Note: We are using a bridge, so we have 1 collision domain.

$$N_{max} = \frac{\text{Total Rate provided} * \mu_{total}}{\text{station Required Rate}} = \frac{10x10^6 * 0.8}{100x10^3}$$

$N_{max} = 80$ stations

This shows how the hub restricts the geographical coverage due to having one collision domain.

Transparent Bridges

There are two main types of Bridges:

1) **Transparent bridges** 2) Source routing bridges (out of scope)

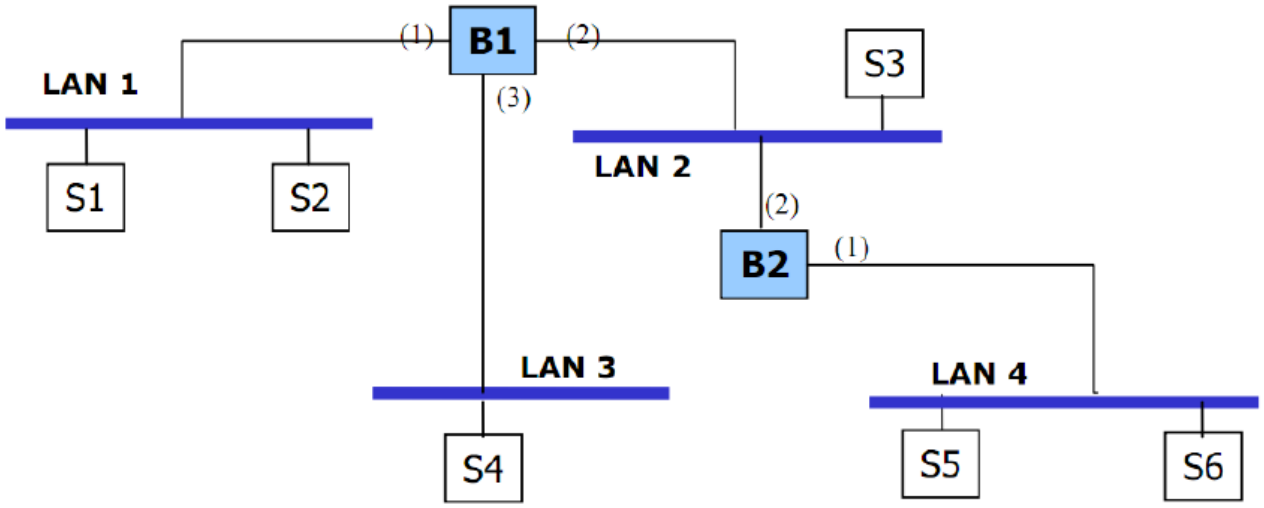
- The term **transparent** refers to the fact that the stations are completely unaware of the presence of the bridge in the network. Thus introducing the bridge to the network doesn't require the stations to be configured.

- Transparent Bridges has 3 basic functions:

  - ❑ Learns where the stations are attached (Bridge Learning)
  - ❑ Controls the forwards of frames from one LAN to another (Filtering)
  - ❑ Prevents loops in the topology (Spanning Tree Algorithm)

Bridge Learning: Sheet 7 Problem 2

- Six stations (S1-S6) are connected to an extended LAN through transparent bridges (B1 and B2), as shown in the figure below. Initially, the forwarding tables are empty.



B1	
Station	Port

B2	
Station	Port

Bridge Learning: Sheet 7 Problem 2

i. Fill in the forwarding tables with appropriate entries after the frames listed below have been completely transmitted.

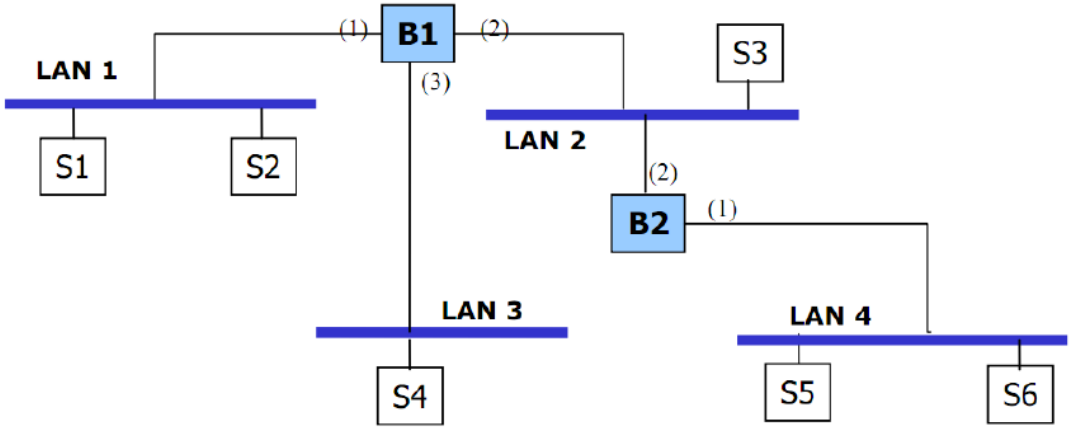
S2 transmits to S1,
S5 transmits to S4,
S3 transmits to S5,
S1 transmits to S2,
S4 transmits to S3,
S6 transmits to S5.

B1	
Station	**Port**

B2	
Station	**Port**

Bridge Learning: Sheet 7 Problem 2

1) S2 to S1

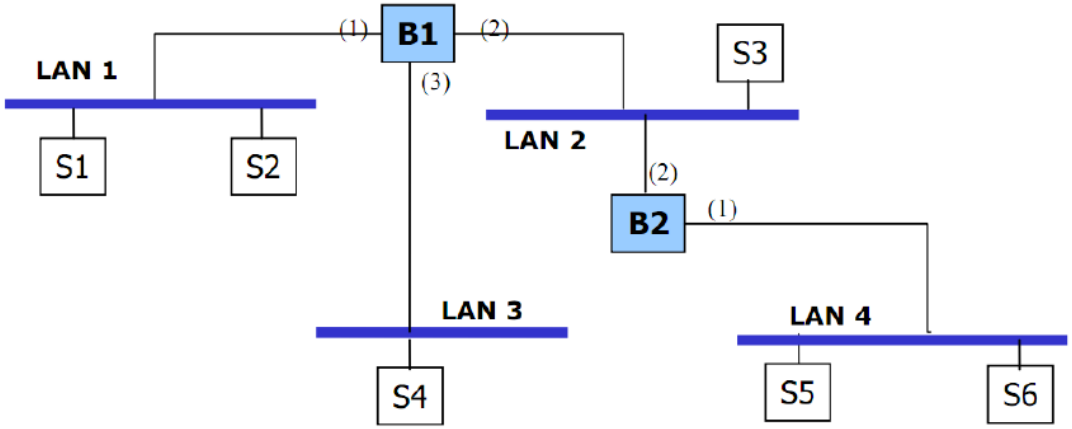


B1	
Station	**Port**
S2	1

B2	
Station	**Port**
S2	2

Bridge Learning: Sheet 7 Problem 2

2) S5 to S4

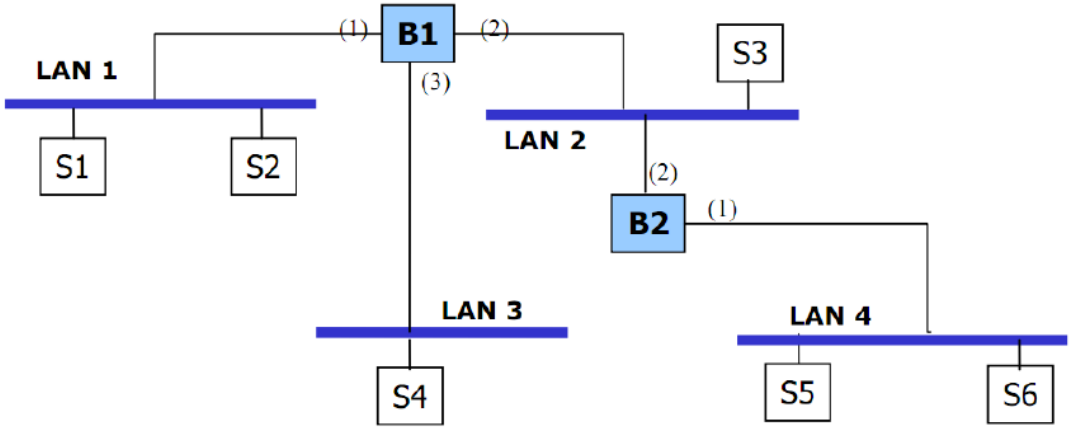


B1	
Station	**Port**
S2	1
S5	2

B2	
Station	**Port**
S2	2
S5	1

Bridge Learning: Sheet 7 Problem 2

3) S3 to S5

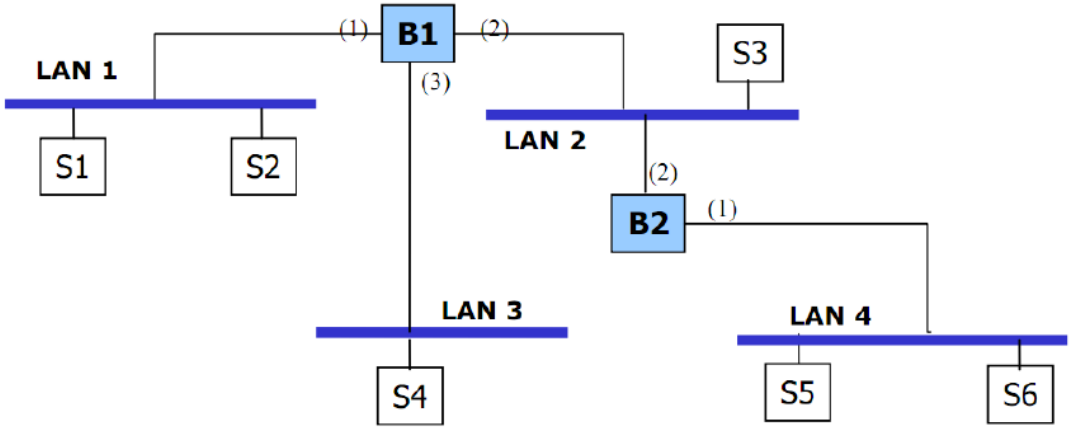


B1	
Station	**Port**
S2	1
S5	2
S3	2

B2	
Station	**Port**
S2	2
S5	1
S3	2

Bridge Learning: Sheet 7 Problem 2

4) S1 to S2

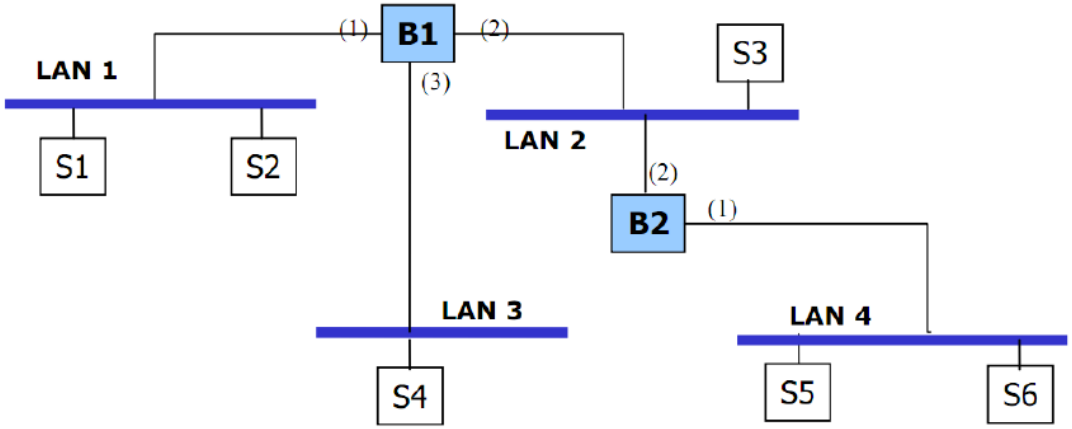


B1	
Station	**Port**
S2	1
S5	2
S3	2
S1	1

B2	
Station	**Port**
S2	2
S5	1
S3	2

Bridge Learning: Sheet 7 Problem 2

5) S4 to S3

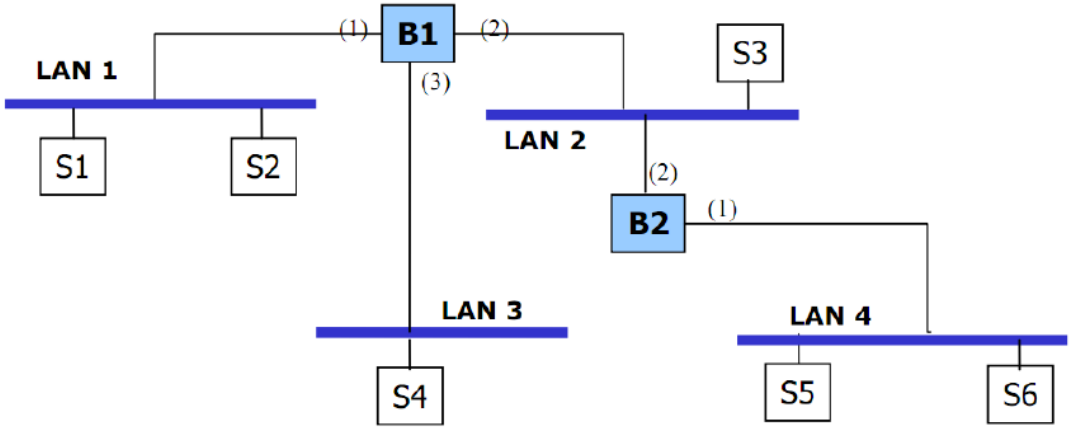


B1	
Station	**Port**
S2	1
S5	2
S3	2
S1	1
S4	3

B2	
Station	**Port**
S2	2
S5	1
S3	2
S4	2

Bridge Learning: Sheet 7 Problem 2

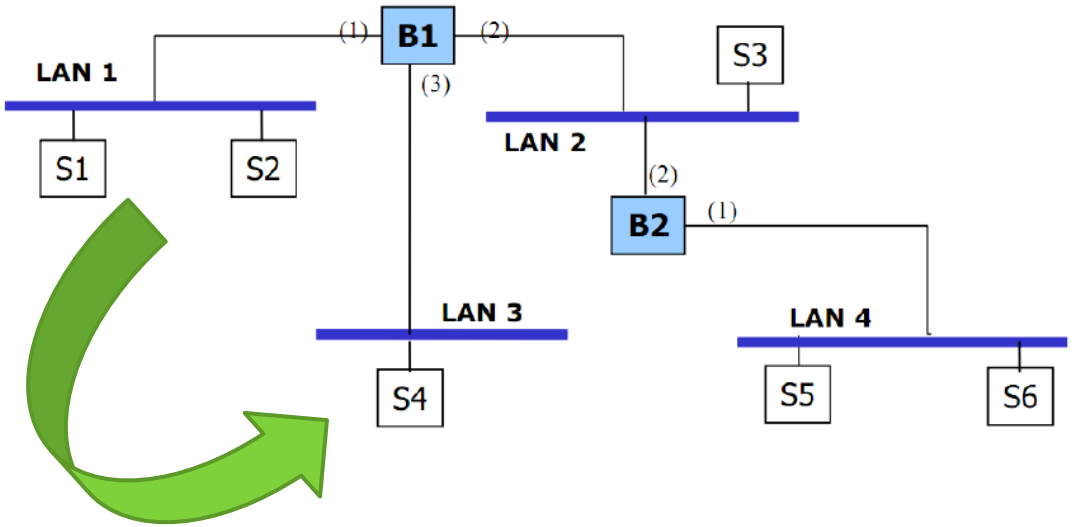
6) S6 to S5



B1	
Station	**Port**
S2	1
S5	2
S3	2
S1	1
S4	3

B2	
Station	**Port**
S2	2
S5	1
S3	2
S4	2
S6	1

Bridge Learning: Sheet 7 Problem 2



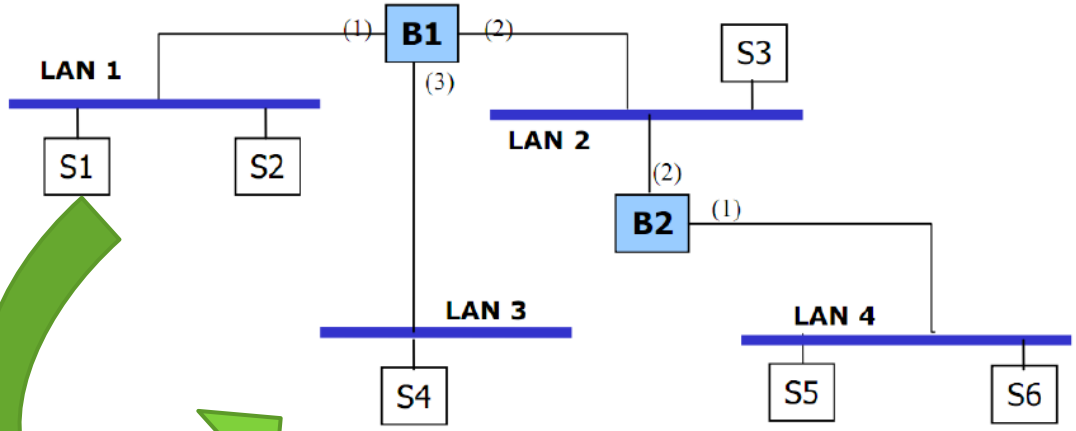
ii. If S1 is moved from LAN 1 to LAN 3 and S1 sends a new message to S2. afterwards Show the updated entries of the forwarding tables

B1	
Station	**Port**

B2	
Station	**Port**

Bridge Learning: Sheet 7 Problem 2

ii) S1 to S2



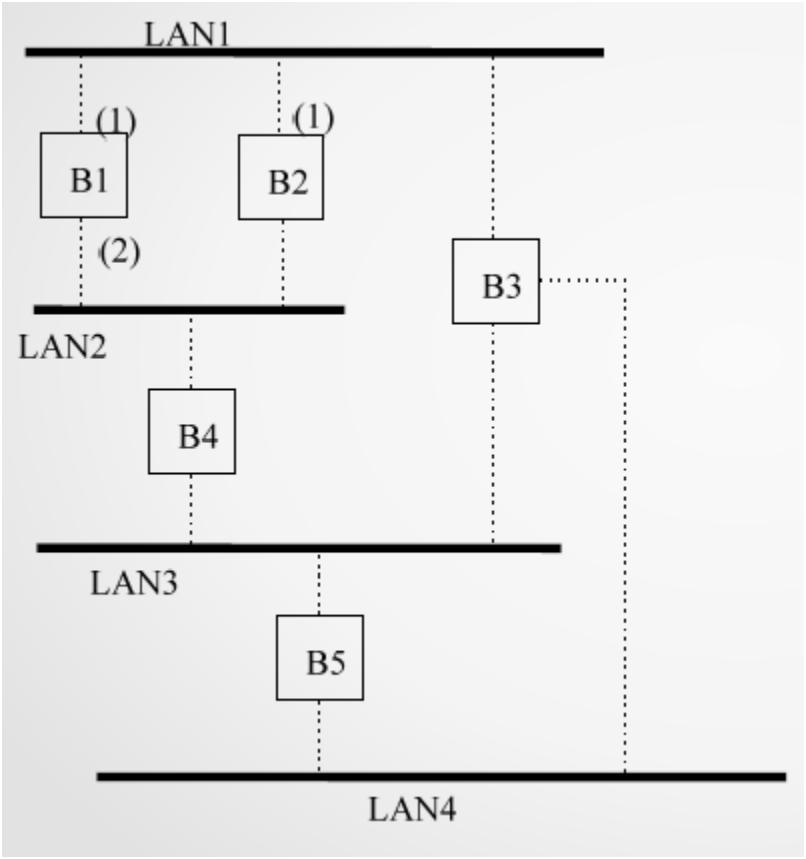
B1	
Station	**Port**
S2	1
S5	2
S3	2
S1	**1**
S4	3
S1	**3**

Delete This

B2	
Station	**Port**
S2	2
S5	1
S3	2
S4	2
S6	1

Bridge Loops and solution: Spanning Tree

- Bridging loops can result in inaccurate forwarding and learning in transparent bridging environments
- Example: A host in LAN 1 (host A) sends a frame to a host in LAN 2 (host B)
  - Host B receive two copies of the frame
  - Each bridge now believes that Host A resides on the same segment as Host B.
  - When Host B replies to Host A's frame, both bridges will receive and subsequently filter the replies because the bridge table will indicate that the destination (Host A) is on the same network segment as the frame's source (i.e., Host B).



Spanning Tree Algorithm Steps

1) Choose Root Bridge:

   bridge with the lowest **bridge ID**

2) Choose Root Ports:

   The other **bridges ports** with the least cost path (Least number of LANs) to the **root bridge**. If more than one have the same cost, select the minimum port number.

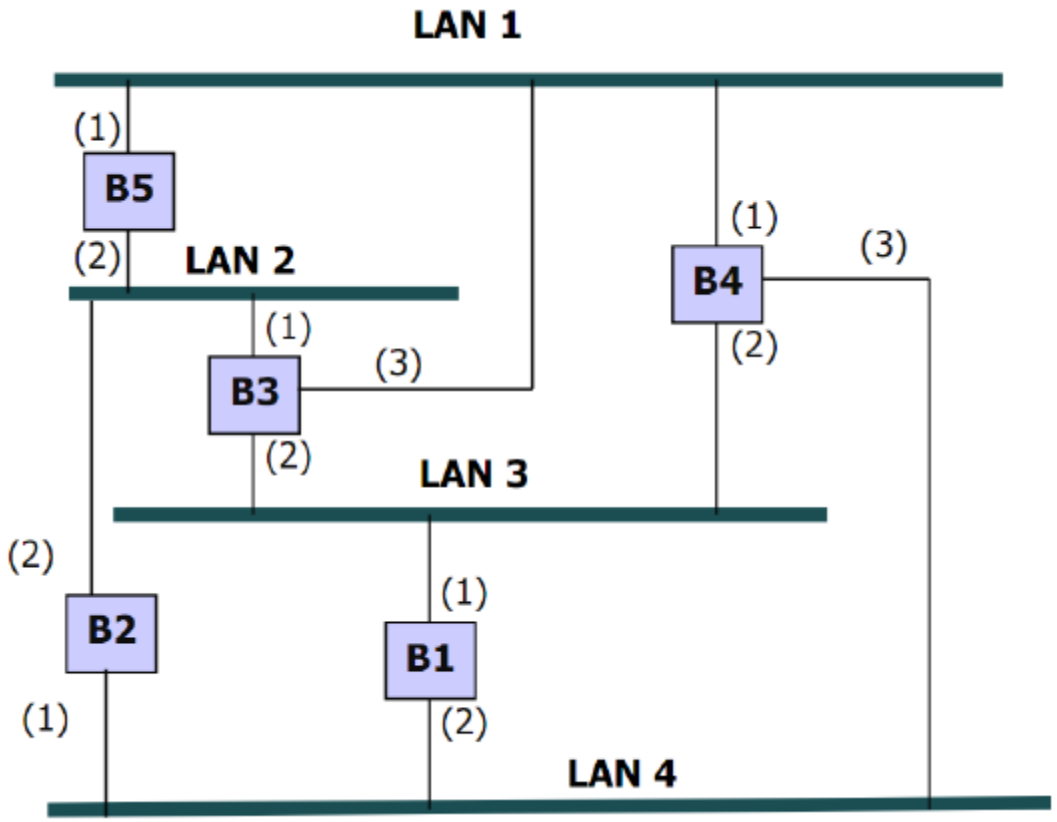
3) Choose Designated Bridge:

   For each LAN, it's the **bridge** that offers minimum cost (Least number of LANs) to the **root bridge**. If the same, select the minimum bridge ID. Designated ports connects the designated bridge to LANs

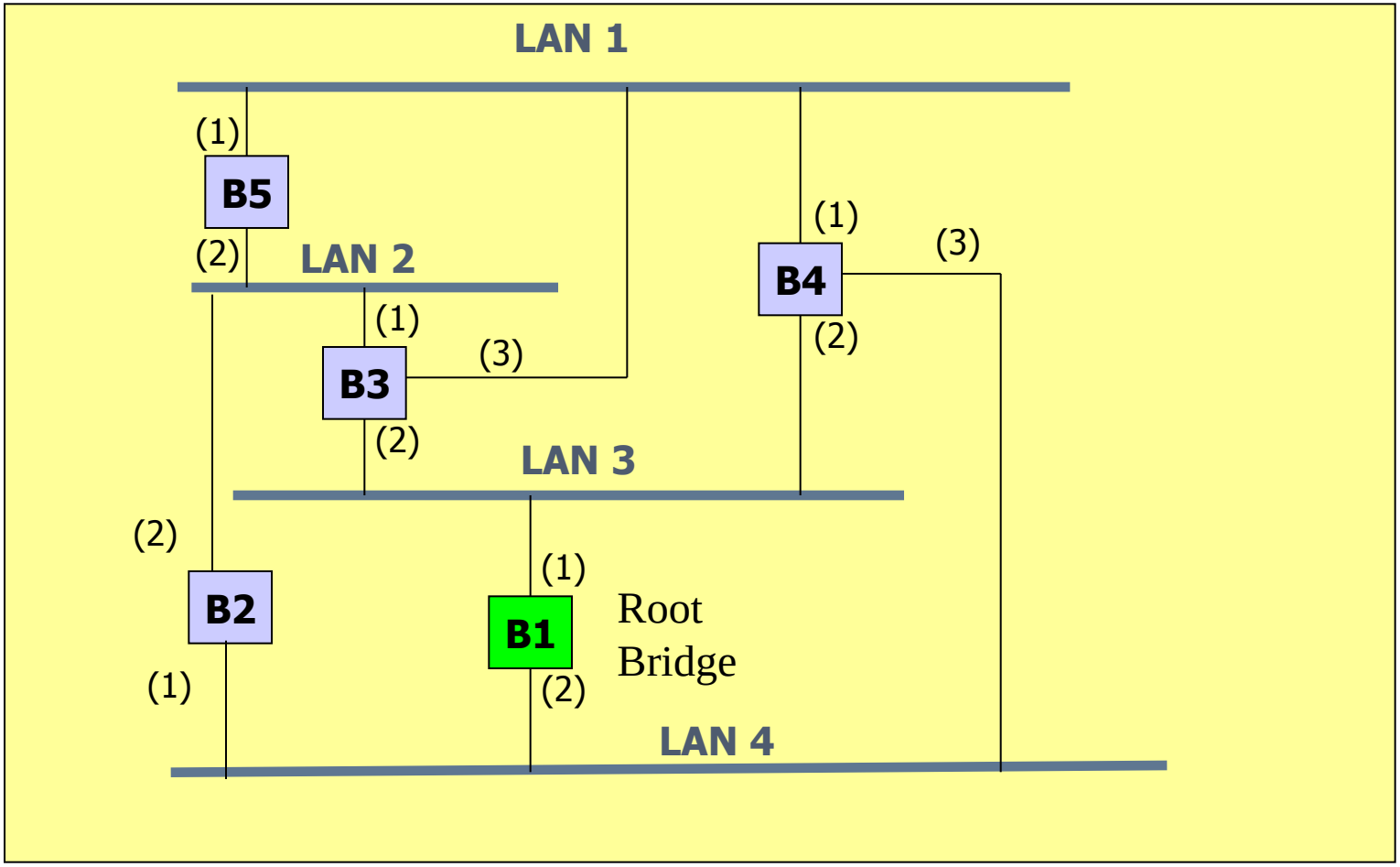
For no looping, remove links that are not with Root or Destined ports !

Sheet 7 Problem 3 (Spanning Tree)

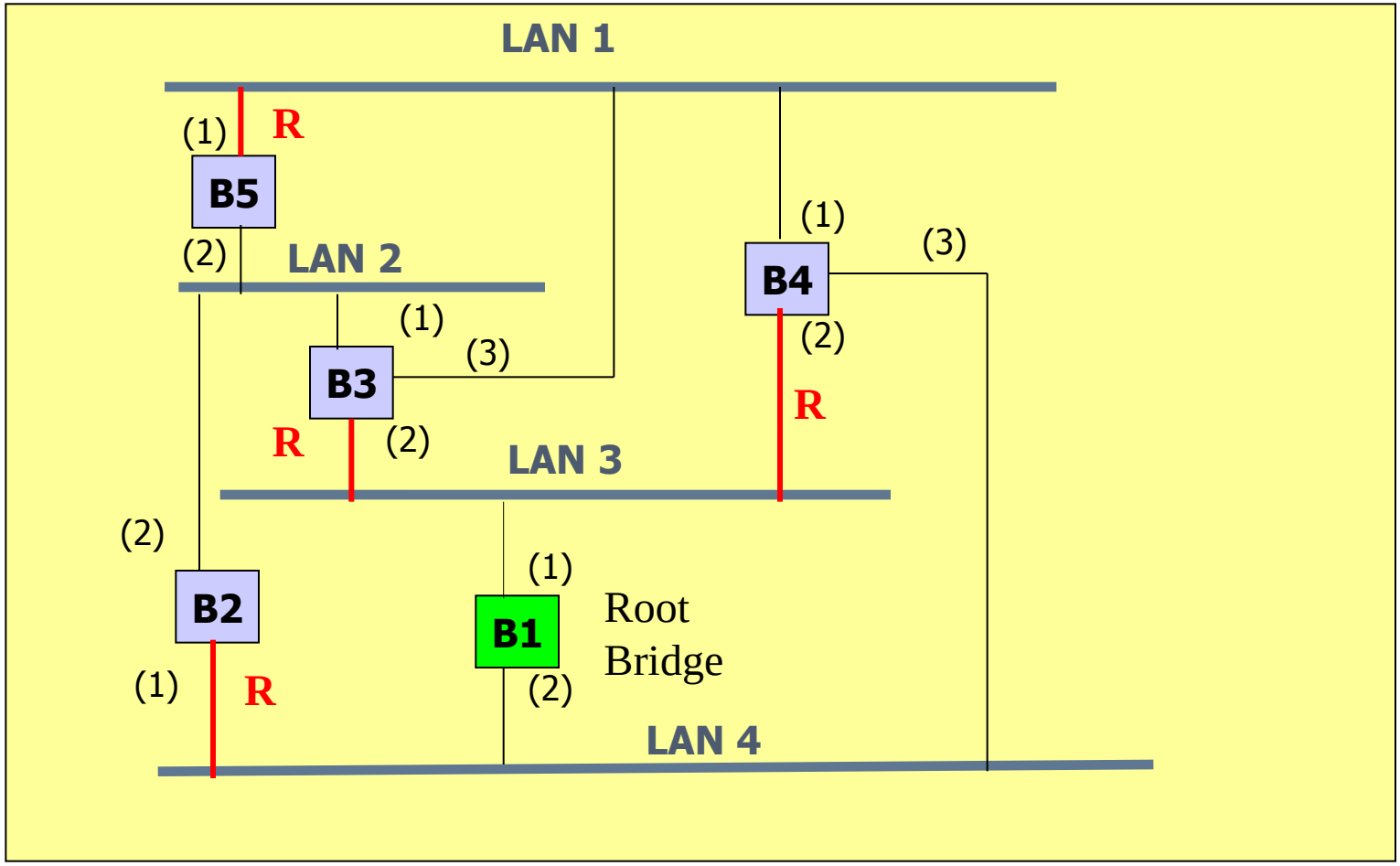
- Generate the spanning tree to avoid looping in the following network, given that the cost is the number of LAN's in the path to the root bridge.



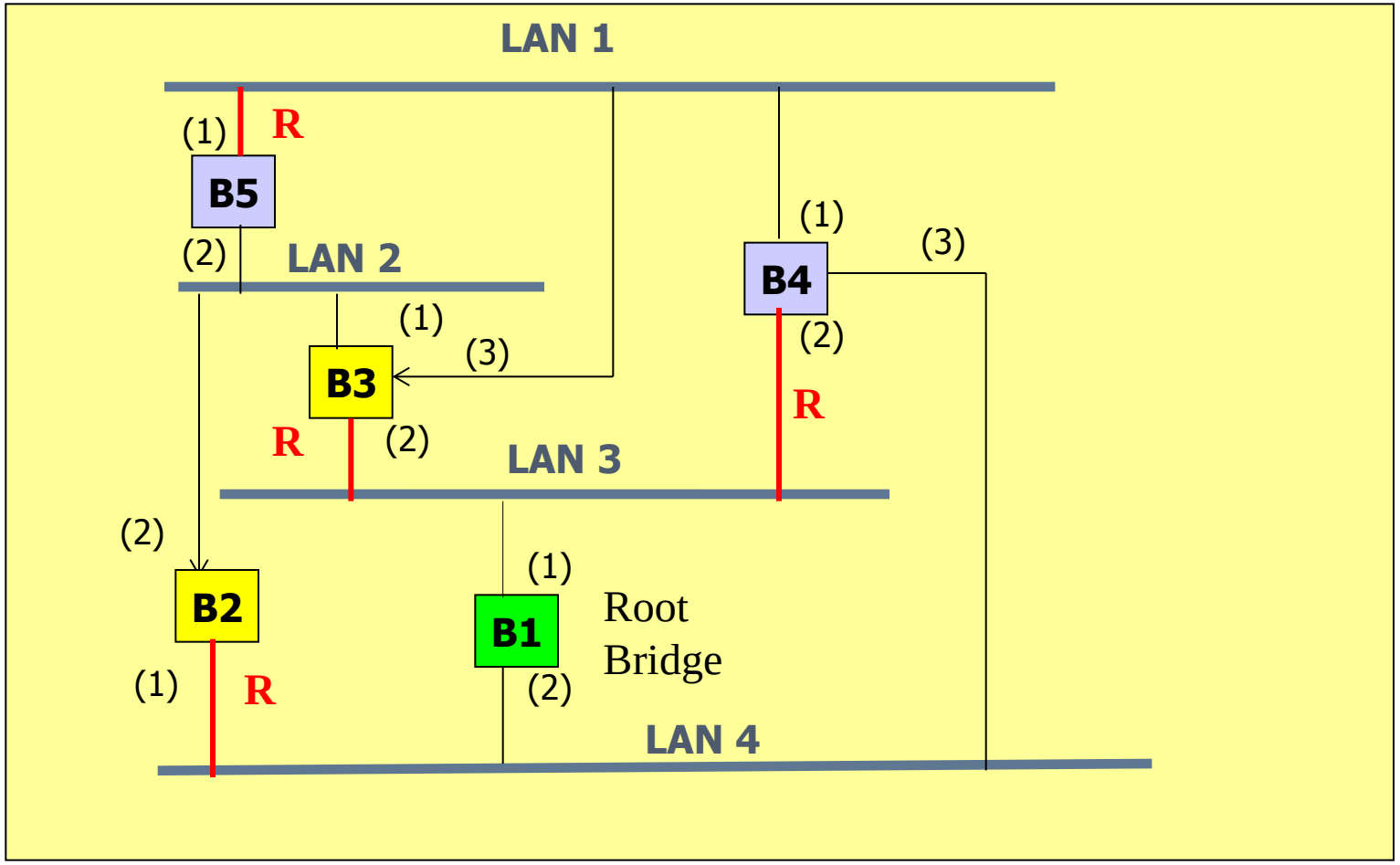
Step 1: Choose the root bridge



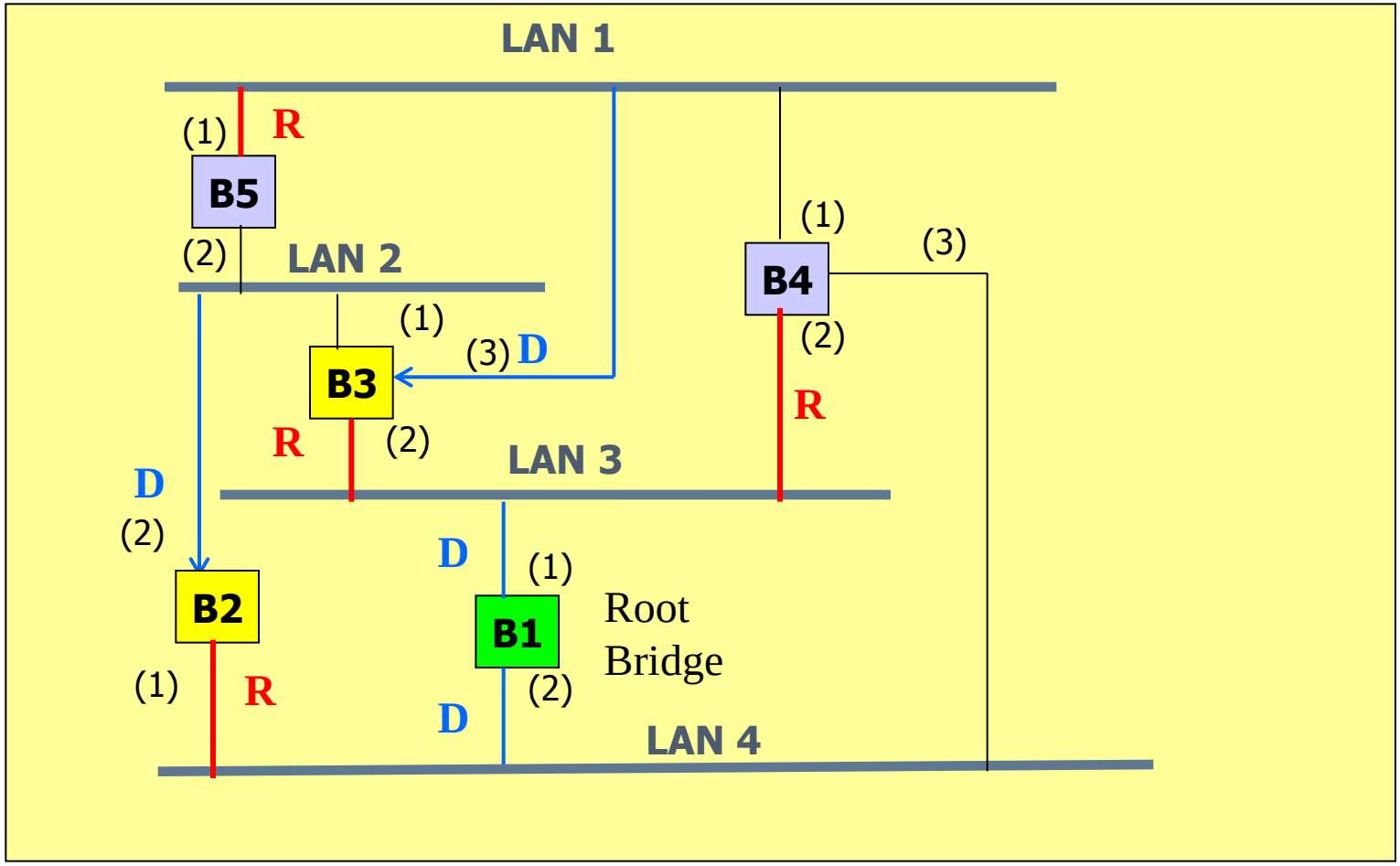
Step 2: Choose the root ports



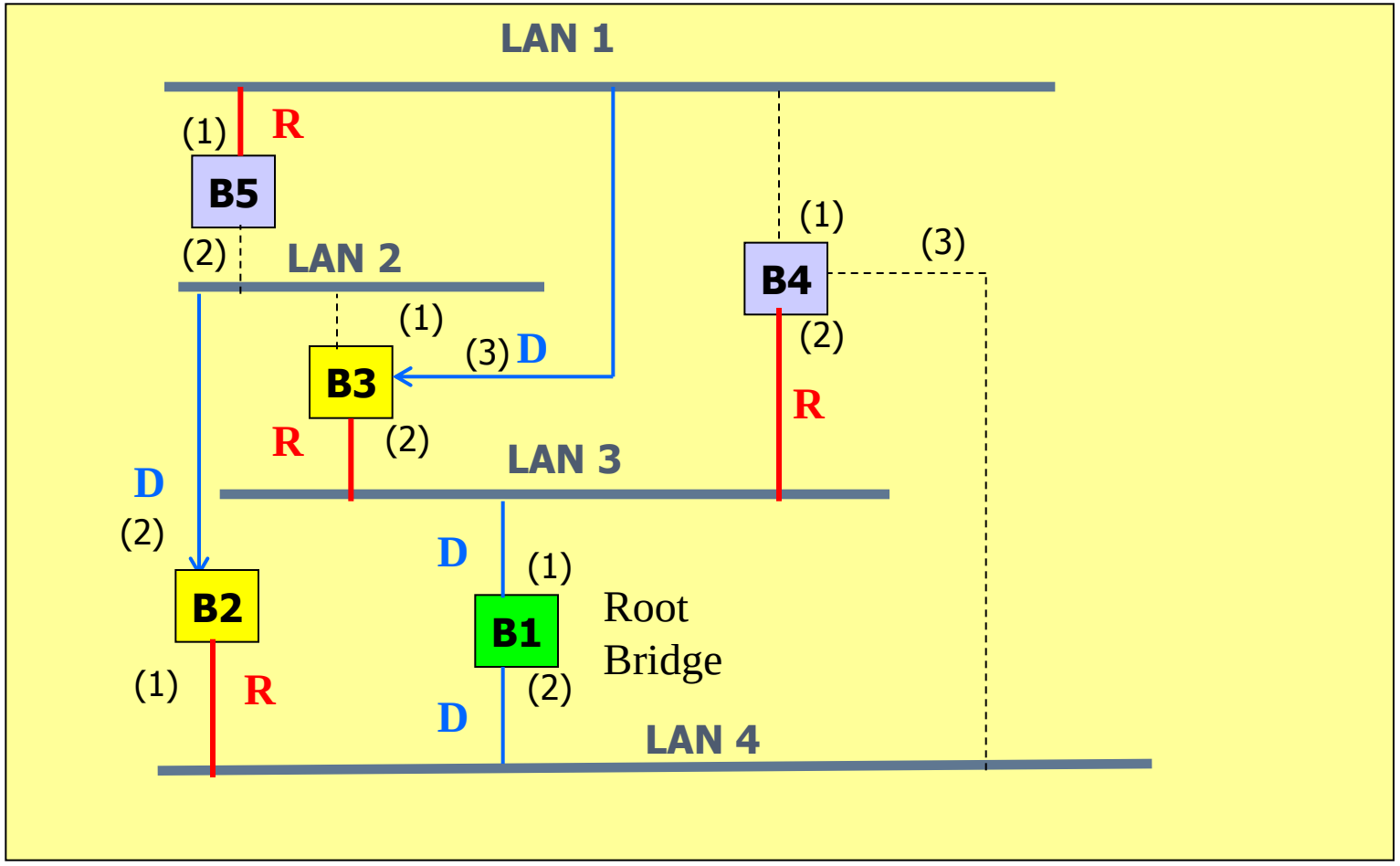
Step 3: Choose the Designated bridges



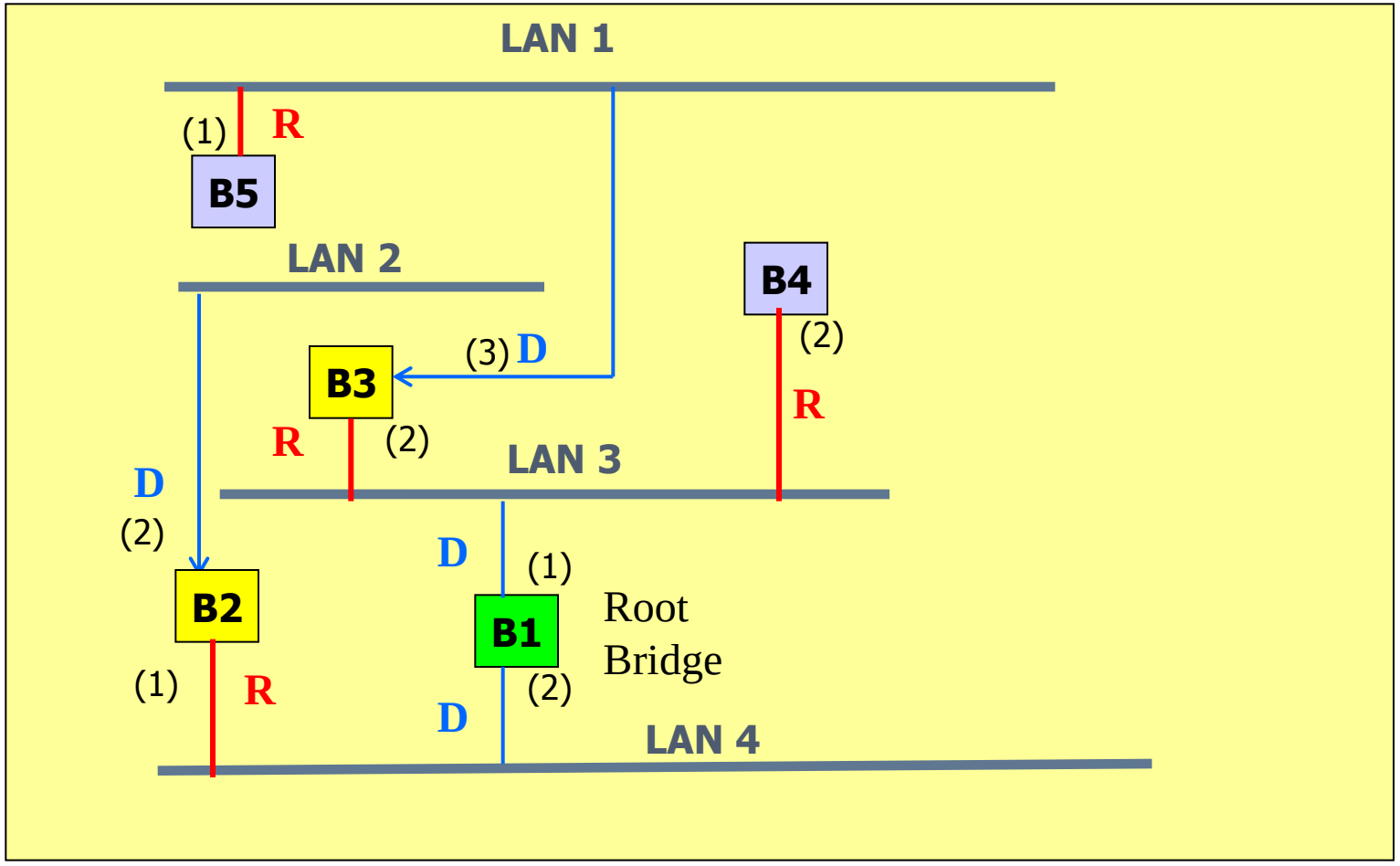
Step 4: Assign the Designated ports



Step 5: Remove the unused links



Step 6: Remove Useless Bridges



Step 7: Redraw the Network