TRƯỜNG ĐẠI HỌC CÔNG NGHỆ THÔNG TIN - ĐHQG-HCM
KHOA MẠNG MÁY TÍNH VÀ TRUYỀN THÔNG

LINK-STATE ROUTING PROTOCOL

OSPF

QUẢN TRỊ MẠNG VÀ HỆ THỐNG
Networks and Systems Administration

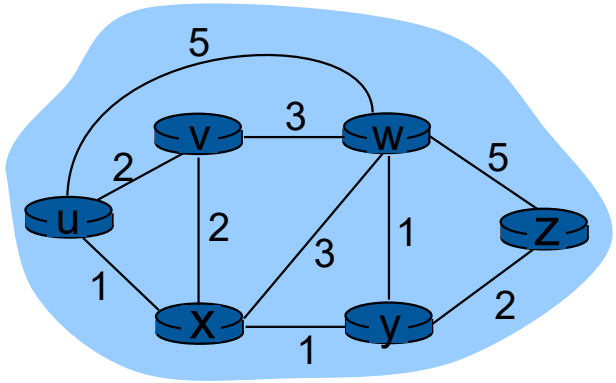
MSc. Trần Thị Dung

Review...

- Dijkstra algorithm

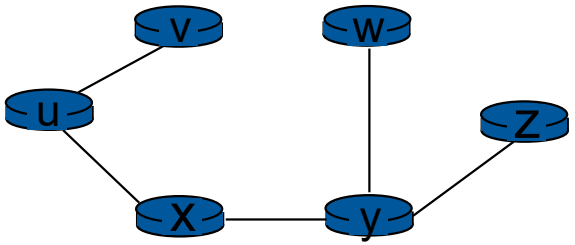
Dijkstra algorithm- 1

Bước	N'	D(v),p(v)	D(w),p(w)	D(x),p(x)	D(y),p(y)	D(z),p(z)
0	u	2,u	5,u	1,u	∞	∞
1	ux	2,u	4,x		2,x	∞
2	uxy	2,u	3,y			4,y
3	uxyv		3,y			4,y
4	uxyvw					4,y
5	uxyvwz					



Dijkstra algorithm - 2

- Shortest path from u:



- Forwarding table of u:

Dest	link
v	(u,v)
x	(u,x)
y	(u,x)
w	(u,x)
z	(u,x)

Content

- Overview
- Terminology
- Link-state (LS) operation
- Exercise

Overview

- Each router can create a complete view or topology of the network by gathering information from all of the other routers.
- Using Dijkstra algorithm to find the best path.
- Protocols:
  - Open Shortest Path First (OSPF)
  - Intermediate System-to-Intermediate System (IS-IS)

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Terminology

- *Link*
- *Link-state*
- *Neighbors*
- *Cost*
- *Link-state packet*
- *Link-state database*

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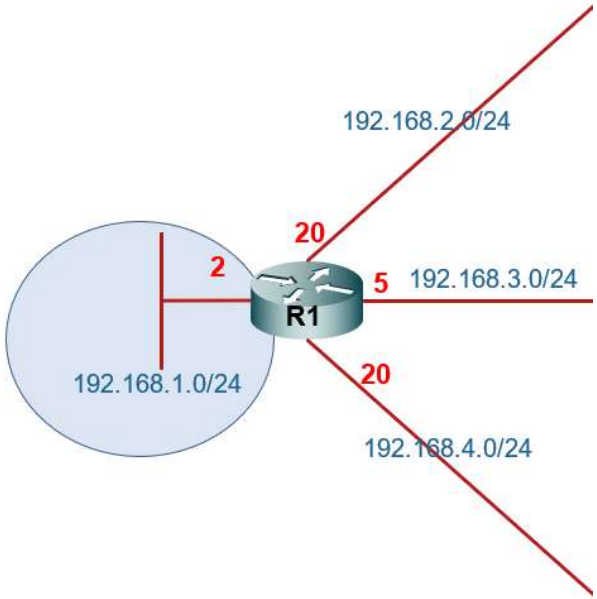
LS protocol operation - 1

Router detects the directly connected link.

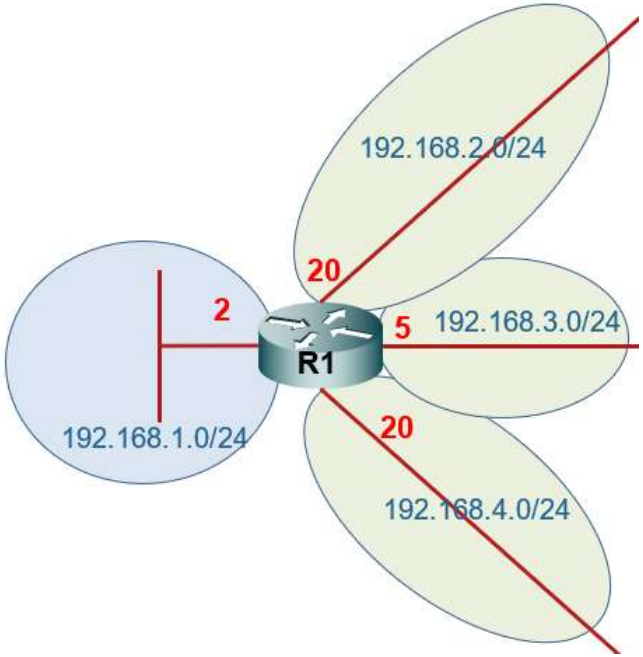
Link 1:
- Network: 192.168.1.0/24
- IP address: 192.168.1.1
- Neighbor: Không
- Cost: 2



LS protocol operation - 1

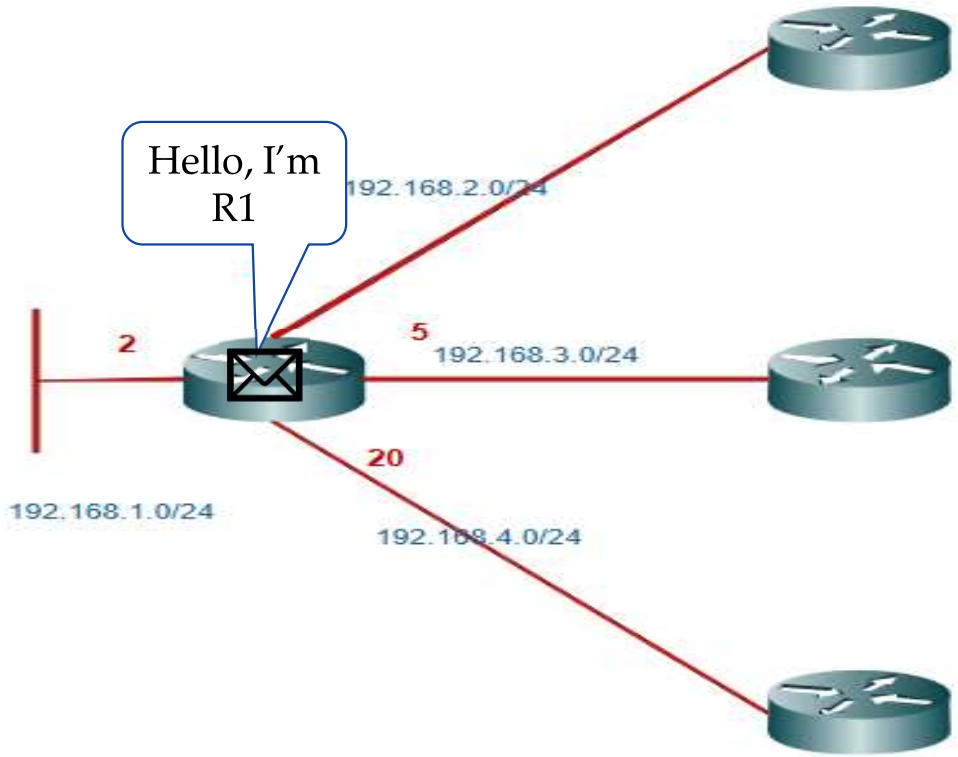
Router detects the directly connected link.

Link 1: - Network: 192.168.1.0/24 - IP address: 192.168.1.1 - Neighbor: No - Cost: 2	**Link 3:** - Network: 192.168.3.0/24 - IP address: 192.168.3.1 - Neighbor: R3 - Cost: 5
Link 2: - Network: 192.168.2.0/24 - IP address: 192.168.2.1 - Neighbor: R2 - Cost: 20	**Link 4:** - Network: 192.168.4.0/24 - IP address: 192.168.4.1 - Neighbor: R4 - Cost: 20



LS protocol operation - 2

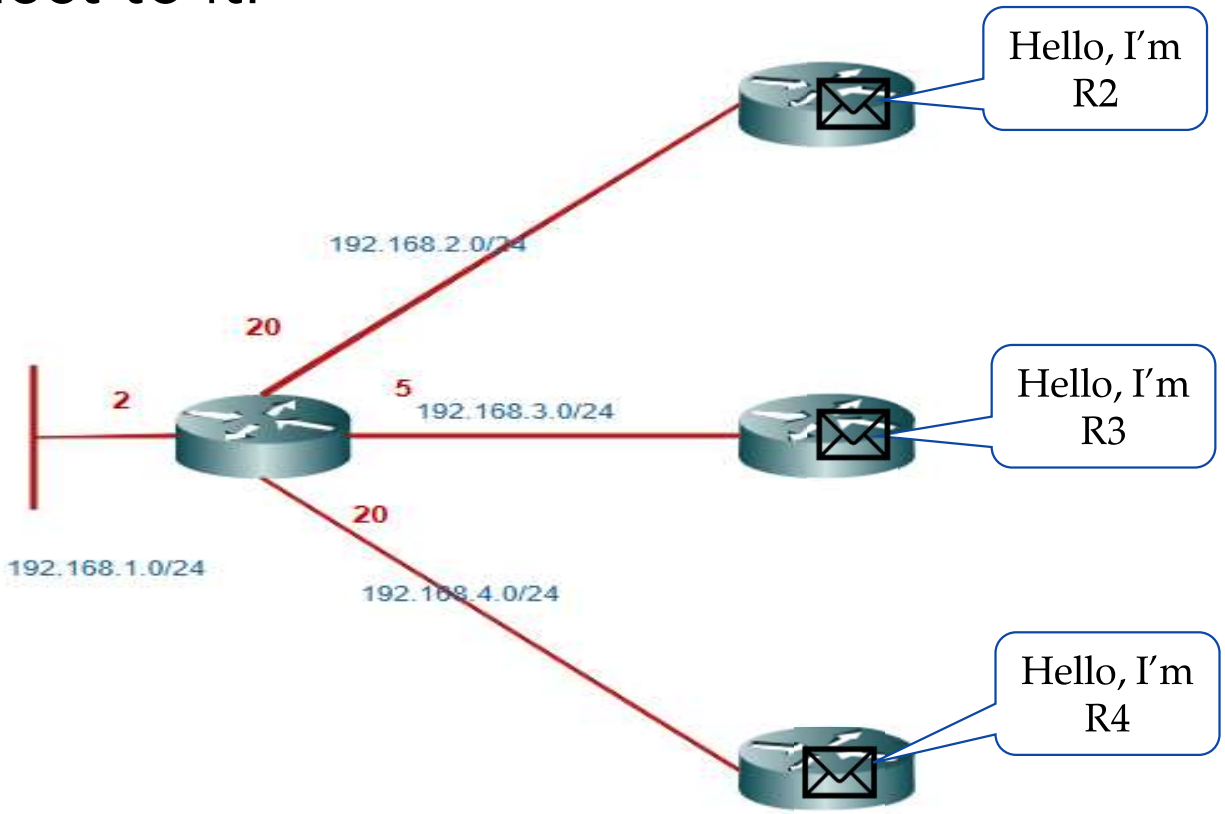
- Each router sends the “Hello” packet to find the neighbors that directly connect to it.



12

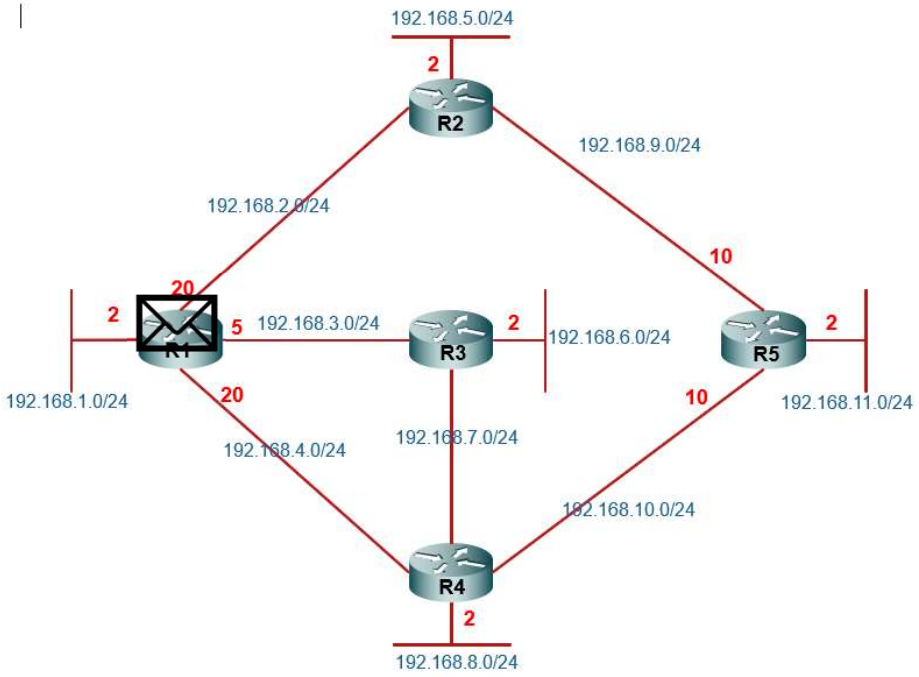
LS protocol operation - 2

- Each router sends the “Hello” packet to find the neighbors that directly connect to it.



LS protocol operation - 3

- Router builds the Link-state Packet – LSP that contains the link-state information.

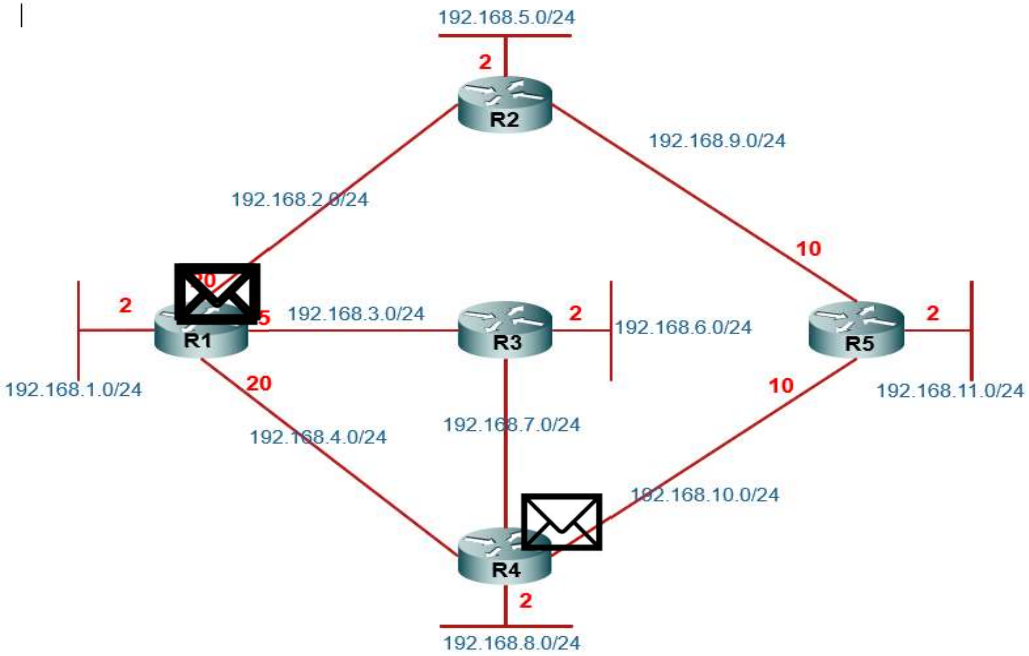


Link-state Packet of R1

- R1 LAN; 192.168.1.0/24; Cost 2
- R1 -> R2; 192.168.2.0/24; Cost 20
- R1 -> R3; 192.168.3.0/24; Cost 5
- R1 -> R4; 192.168.4.0/24, Cost 20

LS protocol operation - 4

- The router sends the LSP to its neighbors, the neighbors receive the LSP, save the information into their Link-state database and forward to the LSP to the other router.



LS protocol operation - 5

- Router collects the information from the other routers and builds the Link-State Database – LSD.

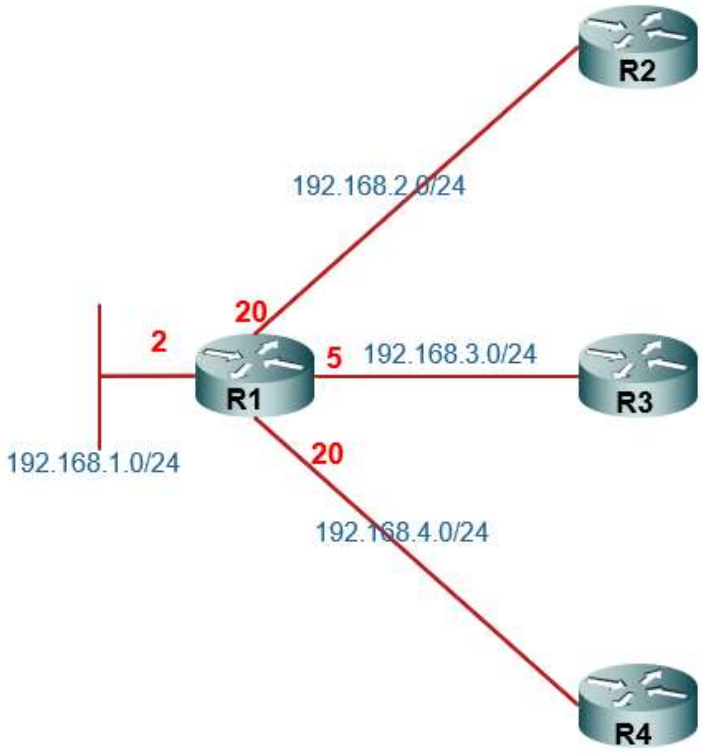
R1 Link-state Database	
R1 Link-states: • R1 LAN; 192.168.1.0/24; Cost 2 • R1->R2; 192.168.2.0/24; Cost 20 • R1->R3; 192.168.3.0/24; Cost 5 • R1->R4; 192.168.4.0/24, Cost 20	R4 Link-states: • R4 LAN; 192.168.8.0/24; Cost 2 • R4->R1; 192.168.4.0/24; Cost 20 • R4->R3; 192.168.9.0/24; Cost 10 • R4->R5; 192.168.10.0/24, Cost 10
R2 Link-states: • R2 LAN; 192.168.5.0/24; Cost 2 • R2->R1; 192.168.2.0/24; Cost 20 • R2->R5; 192.168.9.0/24; Cost 10	R5 Link-states: • R5 LAN; 192.168.11.0/24; Cost 2 • R5->R2; 192.168.9.0/24; Cost 10 • R5->R4; 192.168.10.0/24; Cost 10
R3 Link-states: • R3 LAN; 192.168.6.0/24; Cost 2 • R3->R1; 192.168.3.0/24; Cost 5 • R3->R4; 192.168.9.0/24; Cost 10	

LS protocol operation - 6

- Router uses the LSD to build the network topology.

R1 Link-states:

- R1 LAN; 192.168.1.0/24; Cost 2
- R1->R2; 192.168.2.0/24; Cost 20
- R1->R3; 192.168.3.0/24; Cost 5
- R1->R4; 192.168.4.0/24, Cost 20

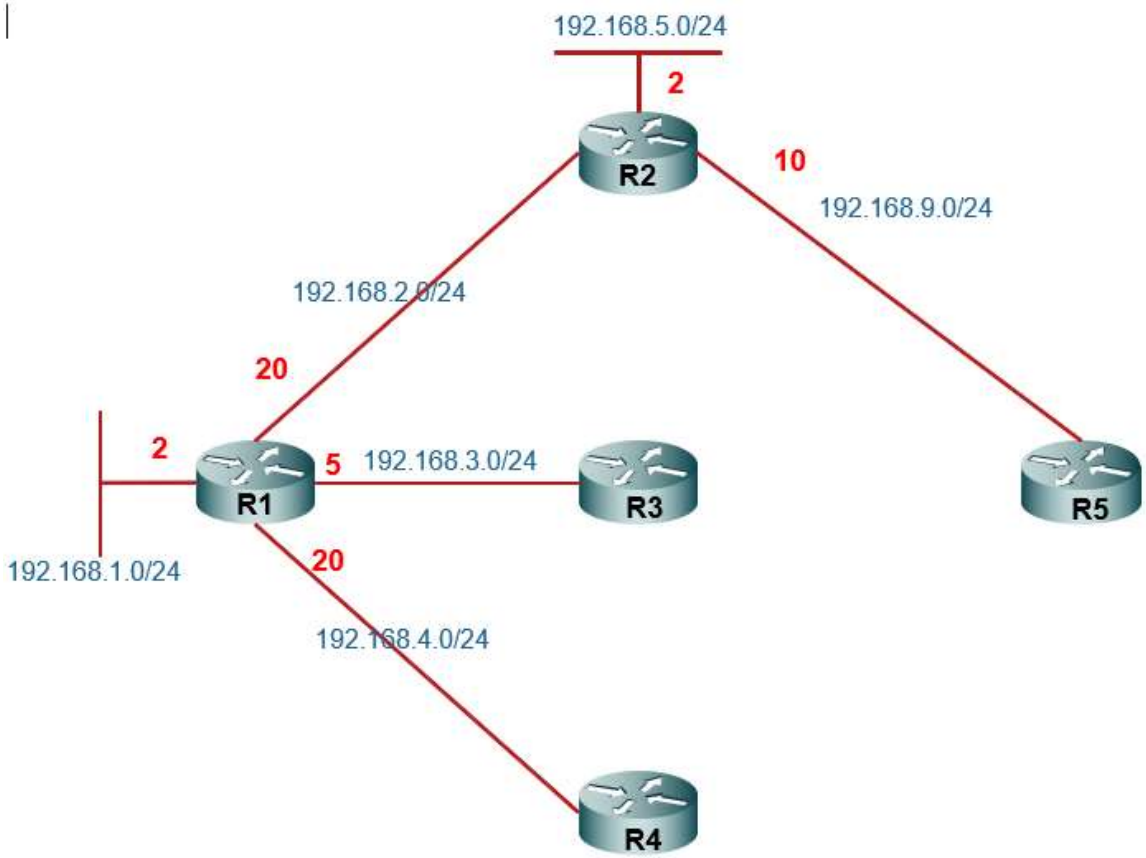


LS protocol operation - 6

- Router uses the LSD to build the network topology.

R2 Link-states:

- R2 LAN; 192.168.5.0/24; Cost 2
- R2->R1; 192.168.2.0/24; Cost 20
- R2->R5; 192.168.9.0/24; Cost 10

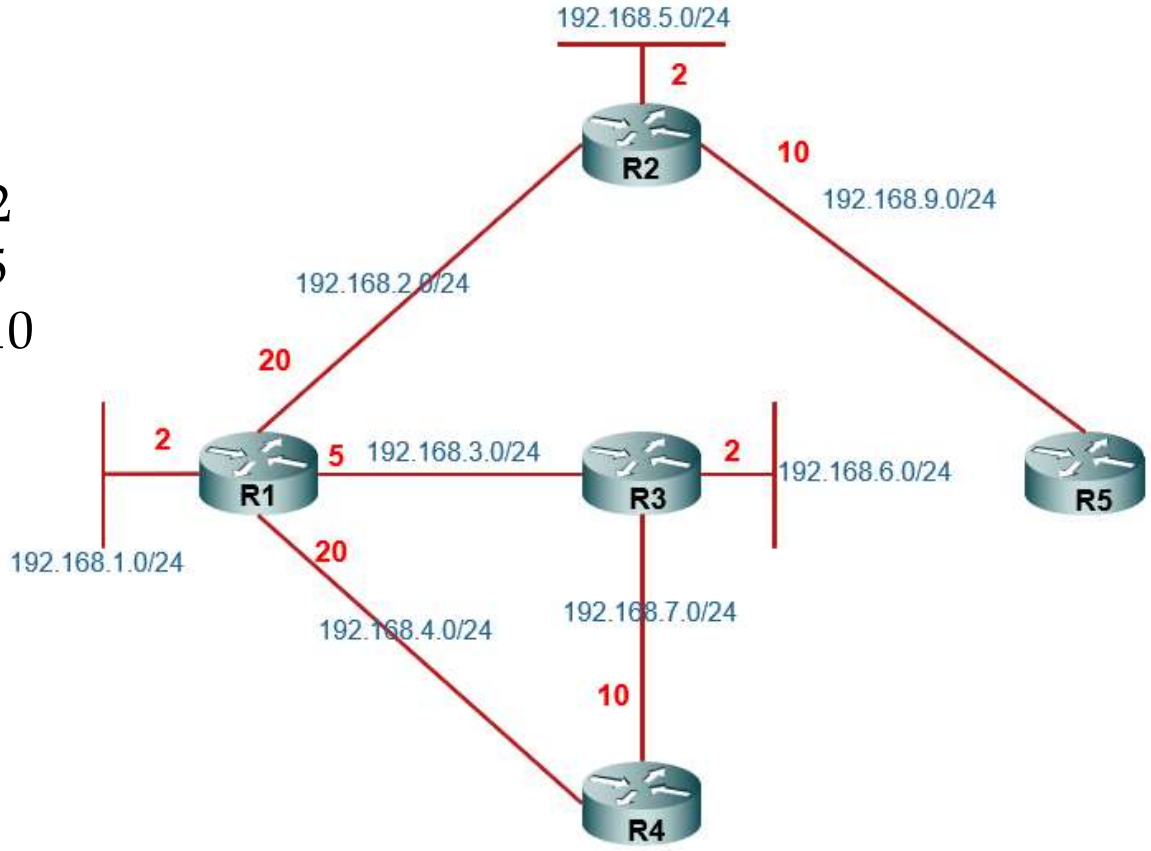


LS protocol operation - 6

- Router uses the LSD to build the network topology.

R3 Link-states:

- R3 LAN; 192.168.6.0/24; Cost 2
- R3->R1; 192.168.3.0/24; Cost 5
- R3->R4; 192.168.9.0/24; Cost 10

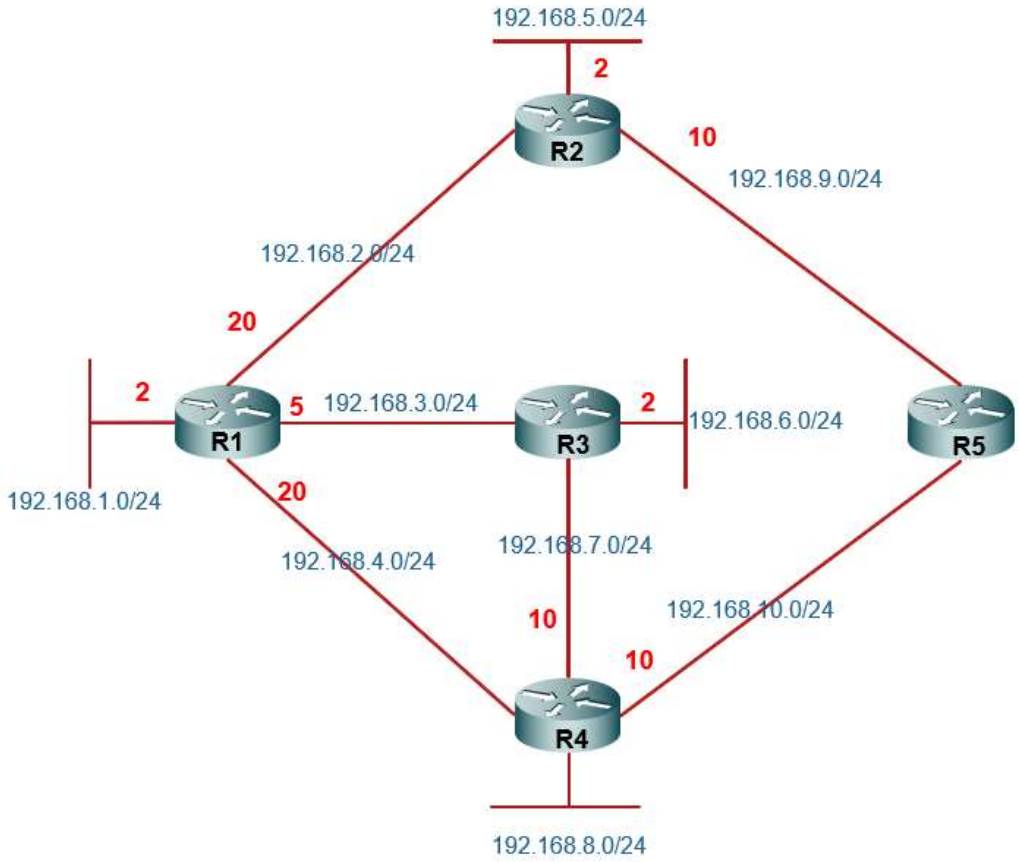


LS protocol operation - 6

- Router uses the LSD to build the network topology.

R4 Link-states:

- R4 LAN; 192.168.8.0/24; Cost 2
- R4->R1; 192.168.4.0/24; Cost 20
- R4->R3; 192.168.9.0/24; Cost 10
- R4->R5; 192.168.10.0/24, Cost 1

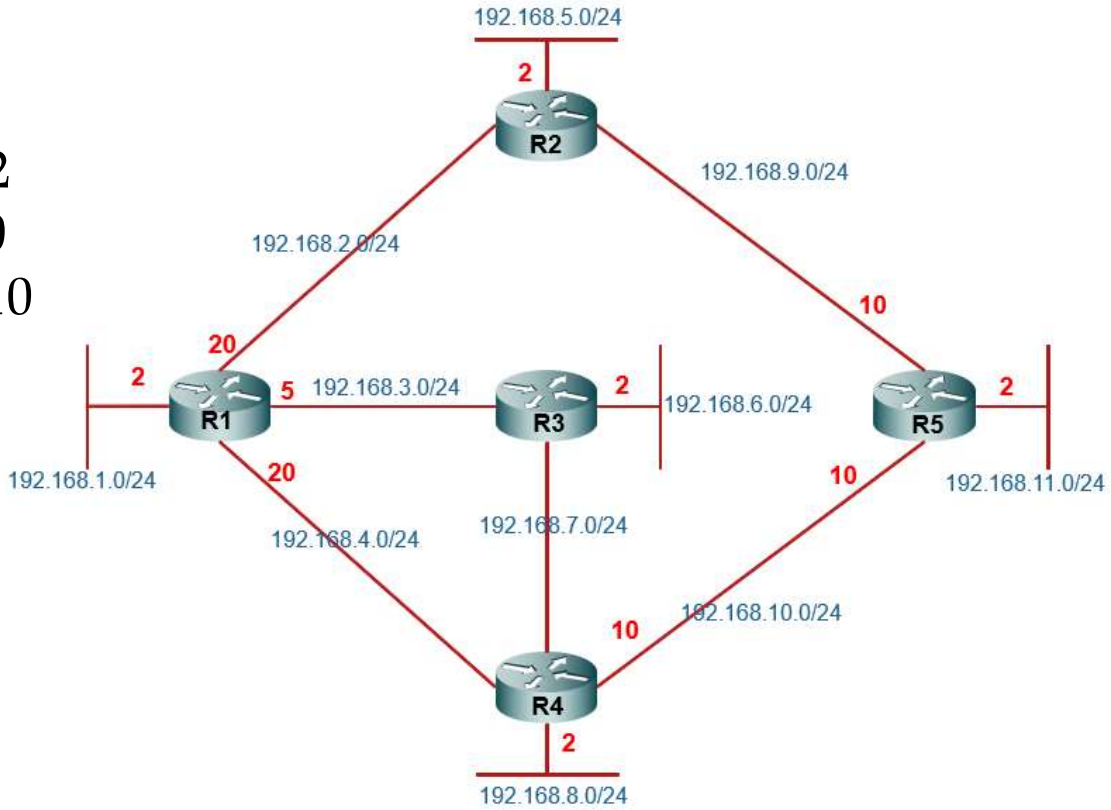


LS protocol operation - 6

- Router uses the LSD to build the network topology.

R5 Link-states:

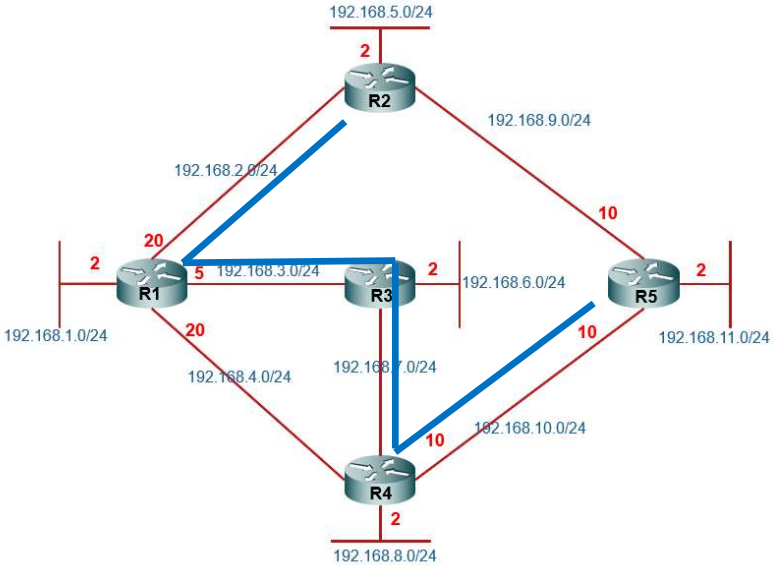
- R5 LAN; 192.168.11.0/24; Cost 2
- R5->R2; 192.168.9.0/24; Cost 10
- R5->R4; 192.168.10.0/24; Cost 10



LS protocol operation - 7

- Router calculates the shortest path using the Dijkstra algorithm.

Destination network	Shortest path	Cost
192.168.5.0/24	R1->R2	22
192.168.6.0/24	R1->R3	7
192.168.7.0/24	R1->R3	15
192.168.8.0/24	R1->R3->R4	17
192.168.9.0/24	R1->R2	30
192.168.10.0/24	R1->R3->R4	25
192.168.11.0/24	R1->R3->R4->R5	27



LS protocol operation - 8

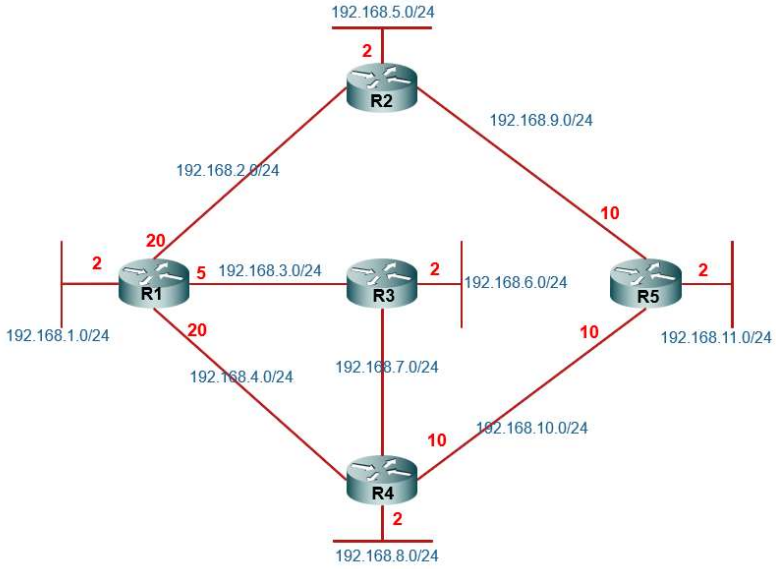
- Router updates the forwarding table

Connected network (Mạng kết nối trực tiếp)

- 192.168.1.0/24, interface 192.168.1.1
- 192.168.2.0/24, interface 192.168.2.1
- 192.168.3.0/24, interface 192.168.3.1
- 192.168.4.0/24, interface 192.168.3.1

Remote network

- 192.168.5.0/24, via R2, interface 192.168.2.1, cost 22
- 192.168.6.0/24, via R3, interface 192.168.3.1, cost 7
- 192.168.7.0/24, via R3, interface 192.168.3.1, cost 15
- 192.168.8.0/24, via R3, interface 192.168.3.1, cost 17
- 192.168.9.0/24, via R2, interface 192.168.2.1, cost 30
- 192.168.10.0/24, via R3, interface 192.168.3.1, cost 25
- 192.168.11.0/24, via R3, interface 192.168.3.1, cost 27



LS protocol operation - 9

- When a link changes, the router builds the Link-state Update (LSU) that contains the changed information and send to the other routers