

# COMPUTER NETWORKS AND INTERNET PROTOCOLS

## IP Routing - II [Intra-domain – Distance Vector, Link State]

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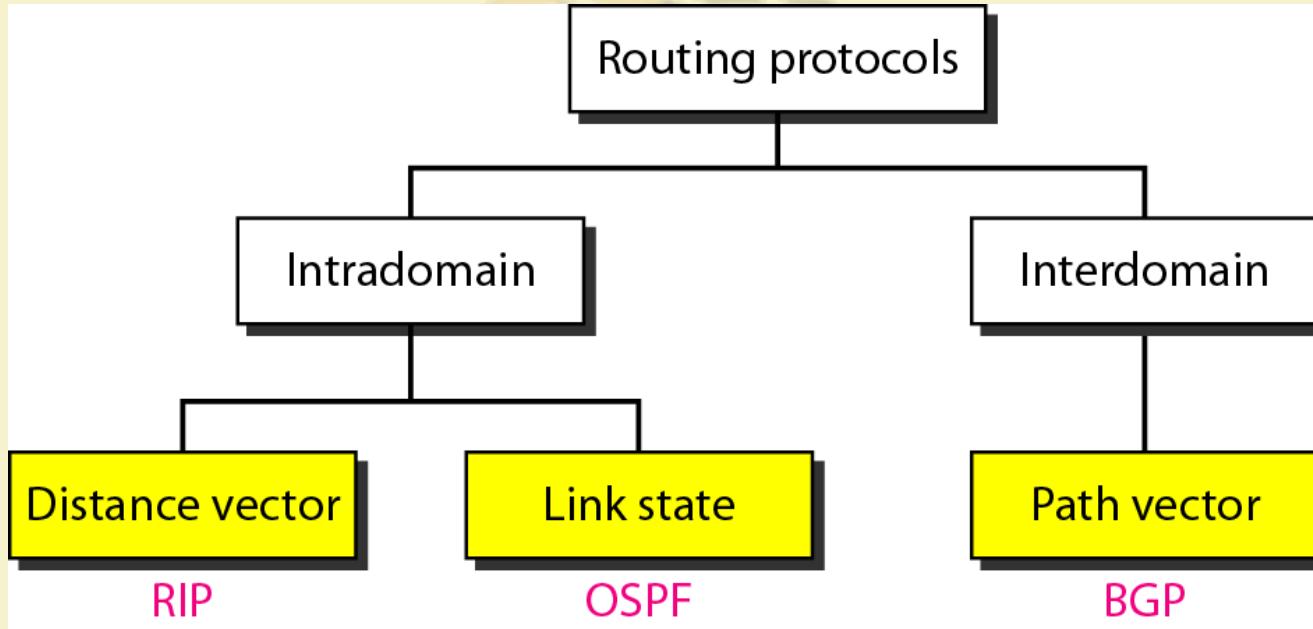


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# Dynamic Routing Protocols



Ref: Data communications and networking by Behrouz A. Forouzan; TCP/IP Tutorials and Technical Overview, IBM Redbooks

# Routing Protocols

- **Static routing:** Static routing uses preprogrammed definitions representing paths through the network.
- **Dynamic routing:** Dynamic routing algorithms allow routers to automatically discover and maintain awareness of the paths through the network. The difference between these protocols is the way they discover and calculate new routes to destination networks.

Four broad categories:

- Distance vector protocols
- Link state protocols
- Path vector protocols
- Hybrid protocols

*Ref: TCP/IP Tutorials and Technical Overview, IBM Redbooks*

# Routing Protocols

**Distance vector protocols** - Each router in the internetwork maintains the distance or cost from itself to its neighbors. The path represented by the smallest cost becomes the preferred path to reach the destination. This information is maintained in a distance vector table. The table is periodically advertised to each neighboring router. Each router processes these advertisements to determine the best paths through the network.

**Link state protocols** - Each router advertises a list of all directly connected network links and the associated cost of each link. This is performed through the exchange of link state advertisements (LSAs) with other routers in the network. Using these advertisements, each router creates a database detailing the current network topology. The topology database in each router is same.

*Ref: TCP/IP Tutorials and Technical Overview, IBM Redbooks*

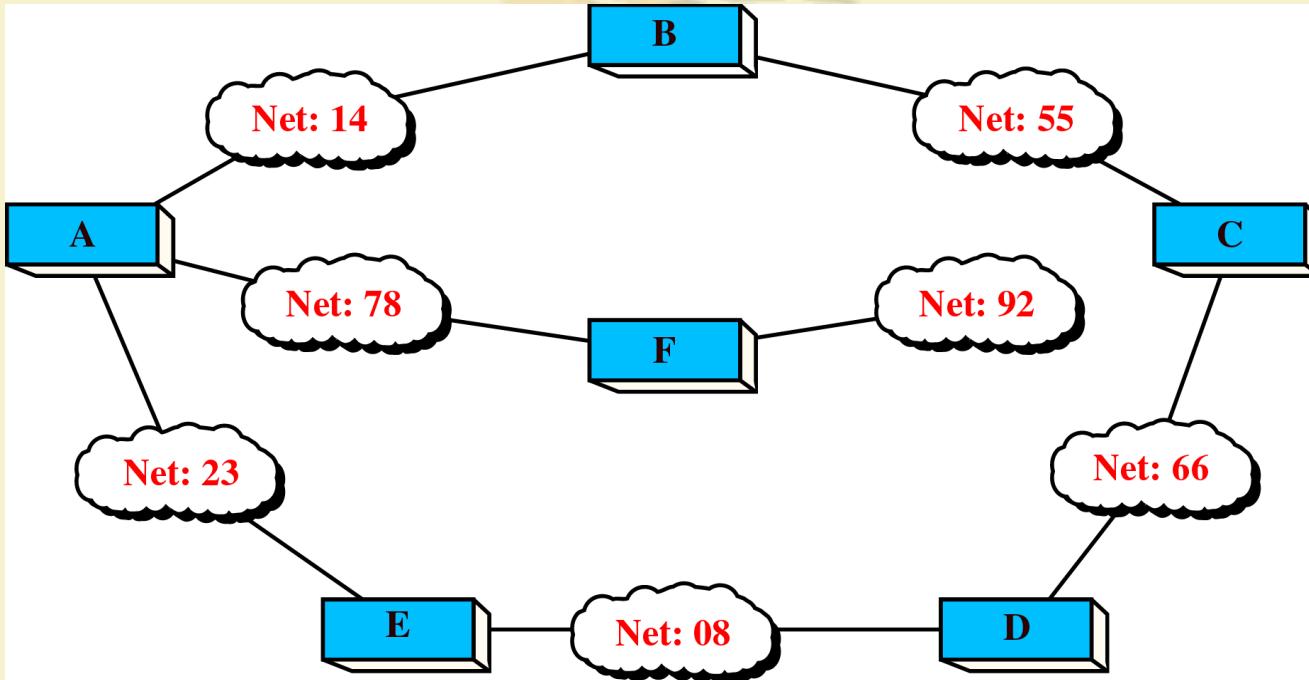
# Routing Protocols

**Path vector protocols** - The path vector routing algorithm is somewhat similar to the distance vector algorithm. However, instead of advertising networks in terms of a destination and the distance to that destination, networks are advertised as destination addresses and path descriptions to reach those destinations.

**Hybrid protocols** - These protocols attempt to combine the positive attributes of both distance vector and link state protocols. Networks using hybrid protocols tend to converge more quickly than networks using distance vector protocols. Finally, these protocols potentially reduce the costs of link state updates and distance vector advertisements.

*Ref: TCP/IP Tutorials and Technical Overview, IBM Redbooks*

# Example of an Internet



Ref: Data communications and networking by Behrouz A. Forouzan;

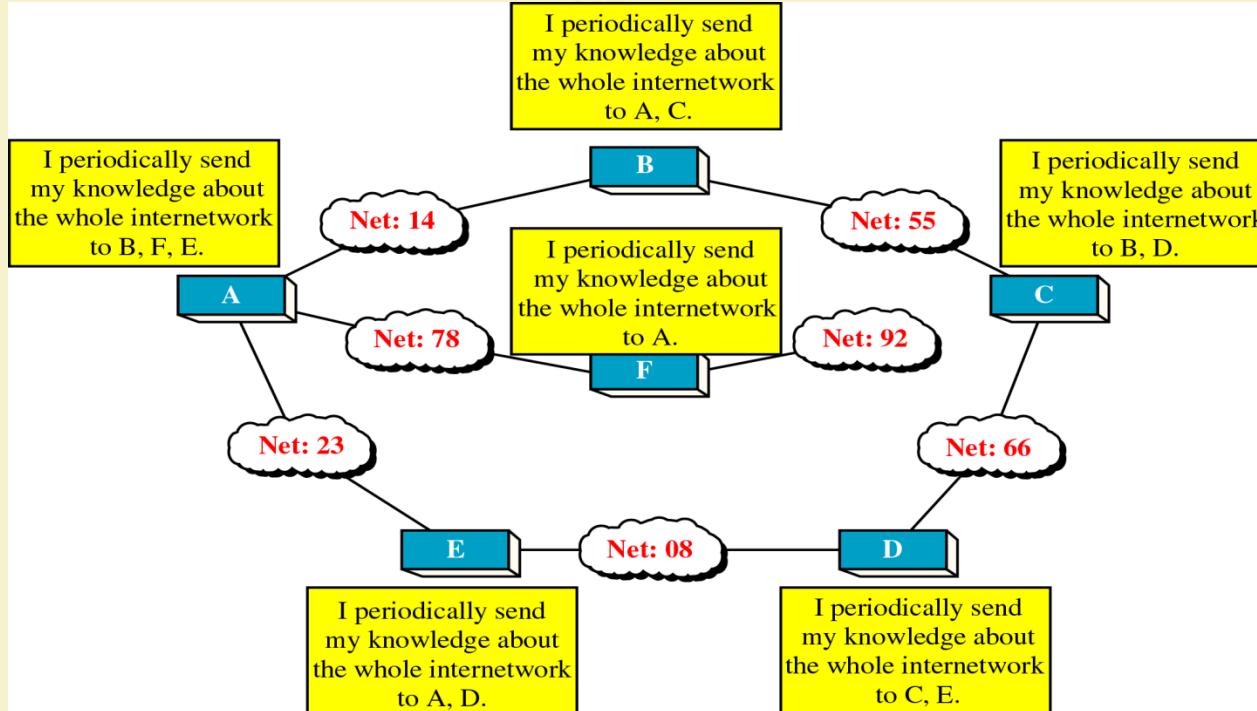


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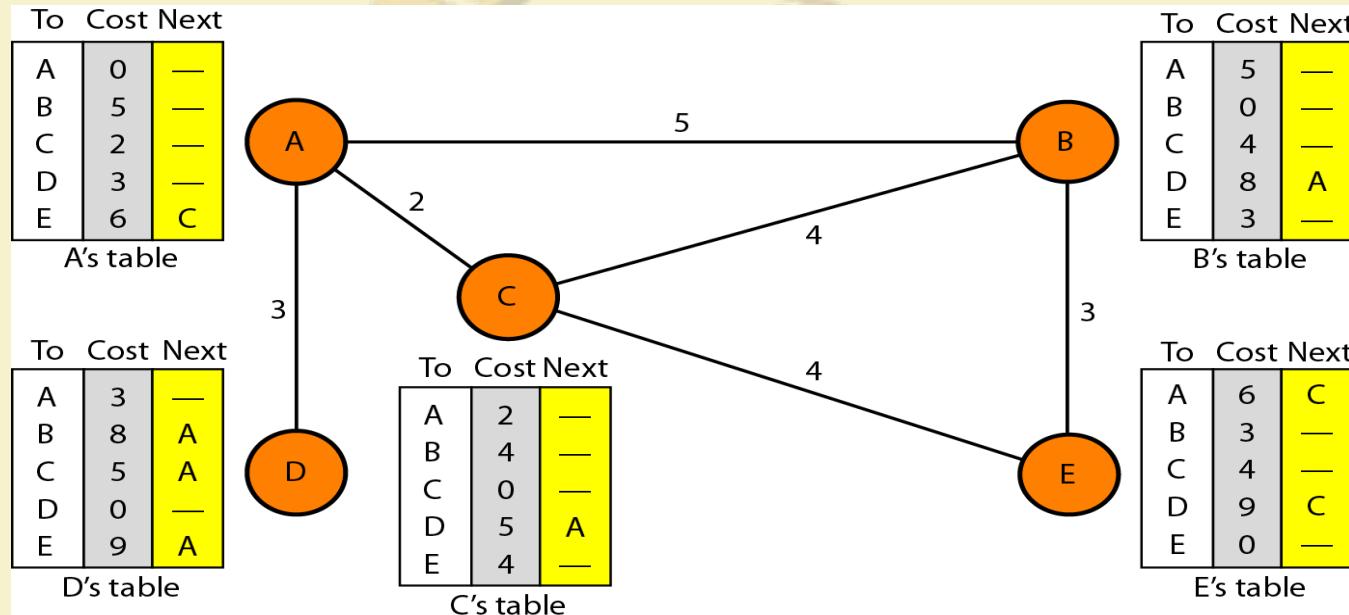
# Distance Vector Routing - Concept



Ref: Data communications and networking by Behrouz A. Forouzan;

# Distance Vector Routing

In distance vector routing, each node shares its routing table with its immediate neighbors periodically and when there is a change.



Ref: Data communications and networking by Behrouz A. Forouzan

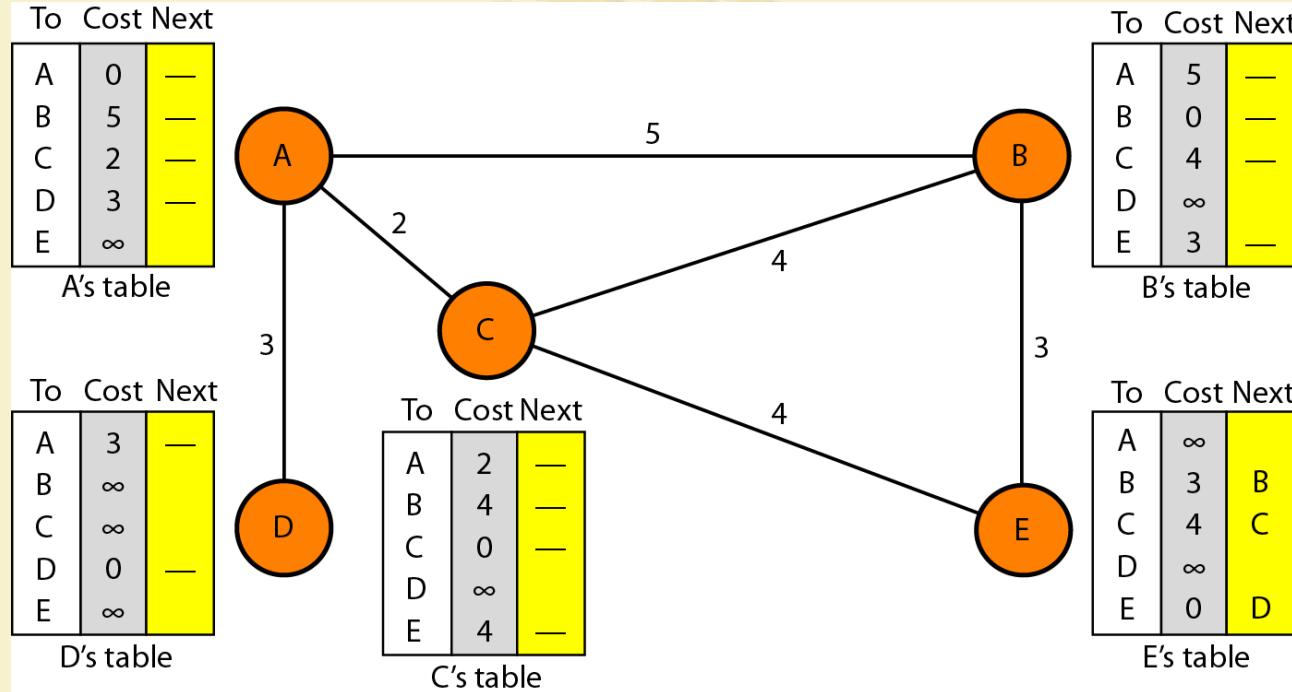


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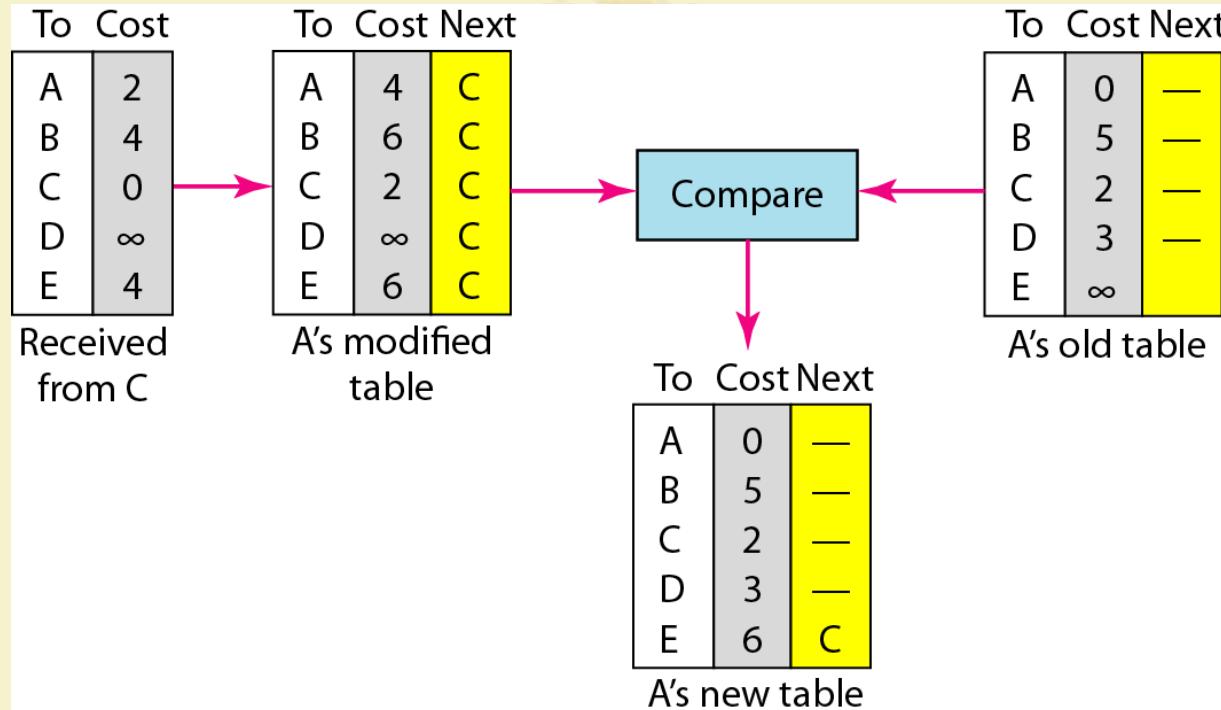
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# Distance Vector Routing: Initialization of routing tables



Ref: Data communications and networking by Behrouz A. Forouzan

## Distance Vector Routing – Updating Routing Table

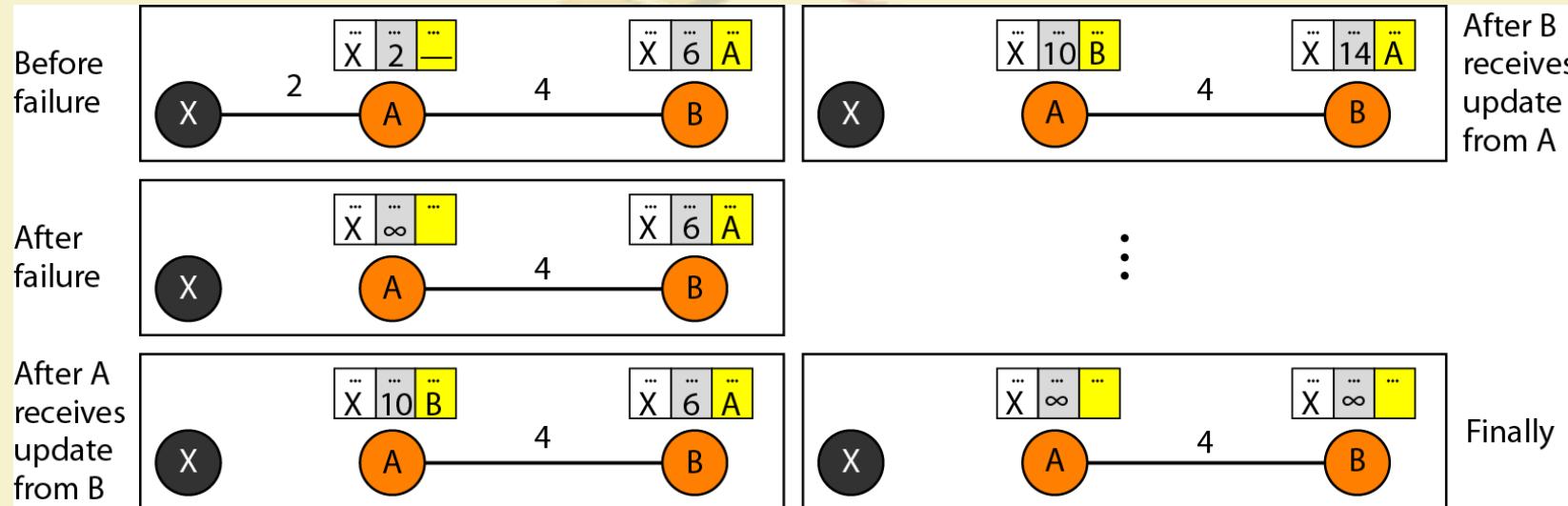


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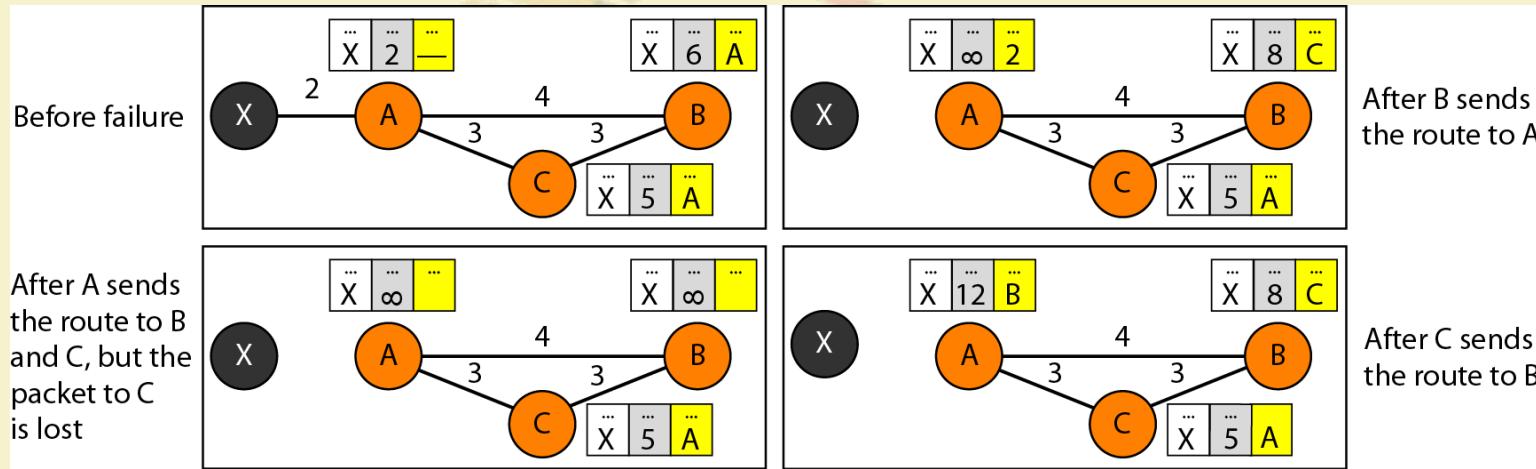
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# Two-node Instability



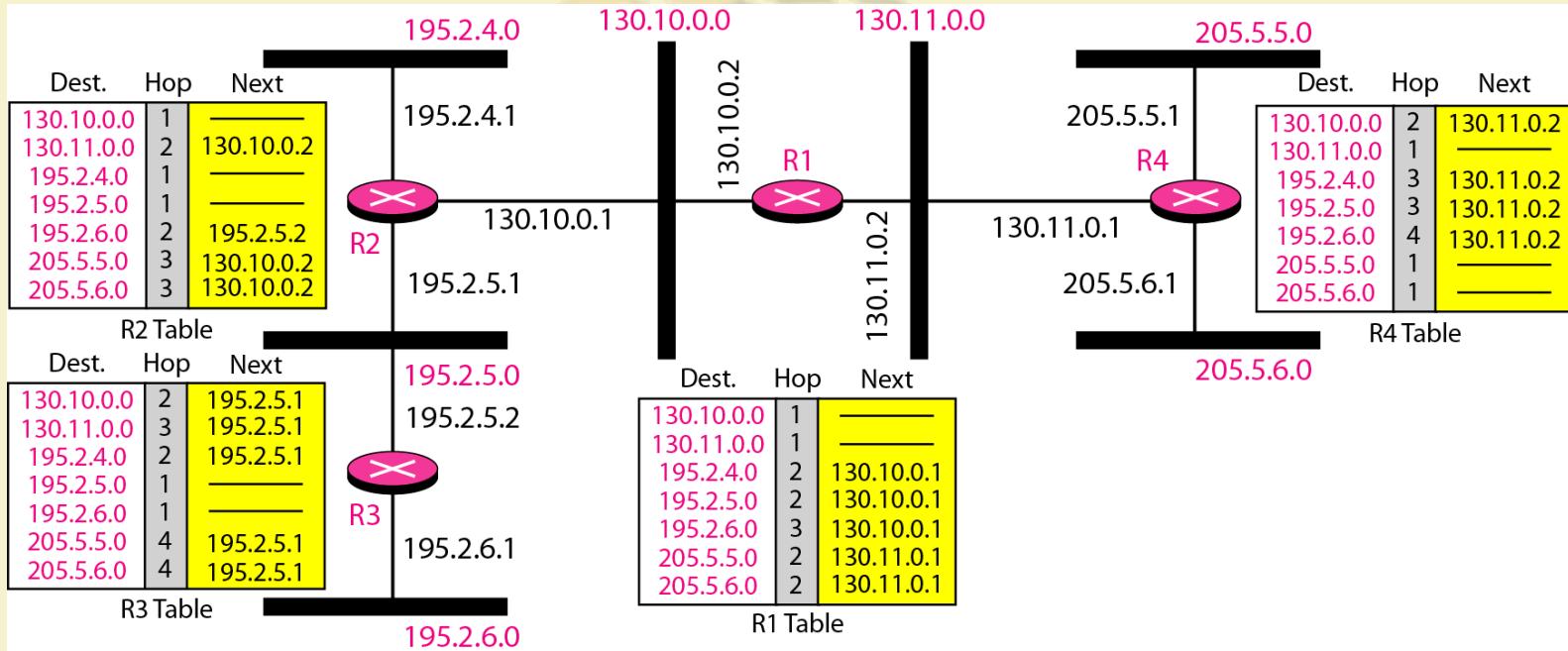
Ref: Data communications and networking by Behrouz A. Forouzan

# Three-node Instability



Ref: Data communications and networking by Behrouz A. Forouzan

## *Example of a domain using RIP*



Ref: Data communications and networking by Behrouz A. Forouzan

# Link State Routing

A link state is the description of an interface on a router (e.g., IP address, subnet mask, network type) and its connectivity to neighboring routers. The collection of these link states forms a link state database. The routing algorithms use the principle of a *link state* to determine network topology.

## Link state approach to determine network topology

1. Each router identifies all other routing devices on the directly connected networks.
2. Each router advertises a list of all directly connected network links and the associated cost of each link; through the exchange of link state advertisements (LSAs) with other routers in the network.
3. Using these advertisements, each router creates a database detailing the current network topology. The topology database in each router is identical.
4. Each router uses the information in the topology database to compute the most desirable routes to each destination network. This information is used to update the IP routing table.

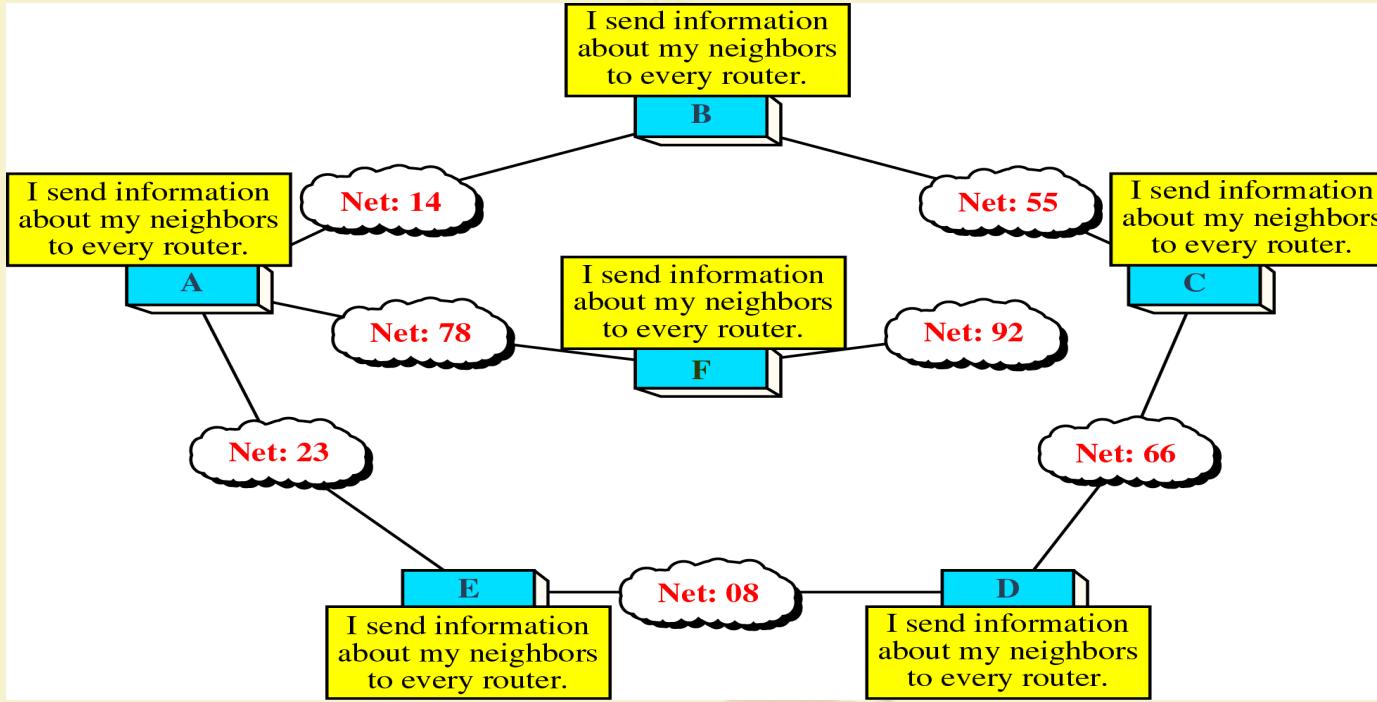


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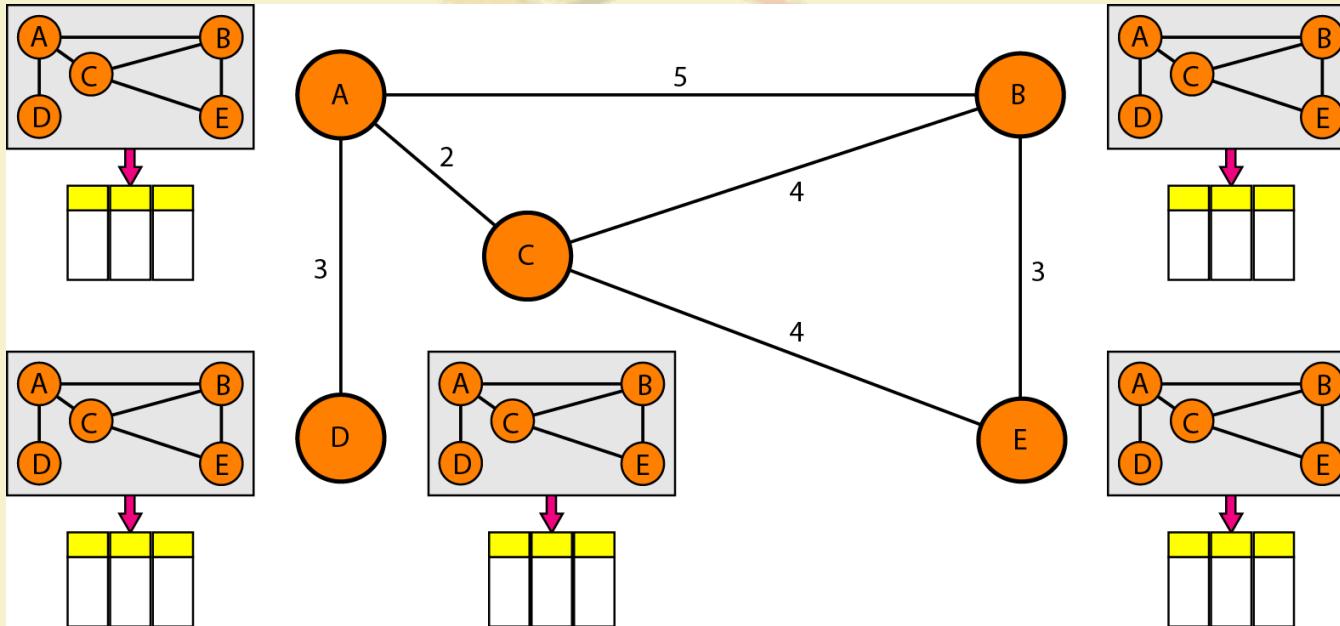
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# Link State Routing - Concept



Ref: Data communications and networking by Behrouz A. Forouzan;

# Link State Routing

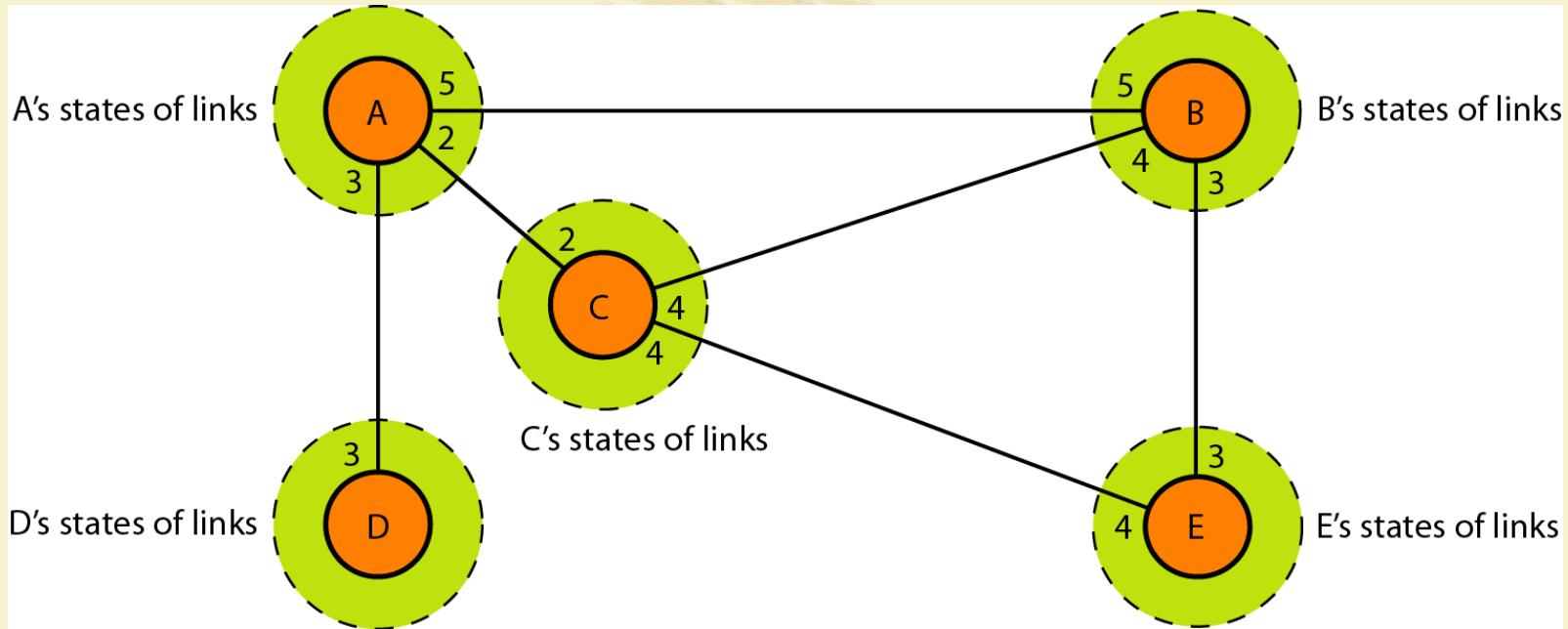


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## Link state knowledge

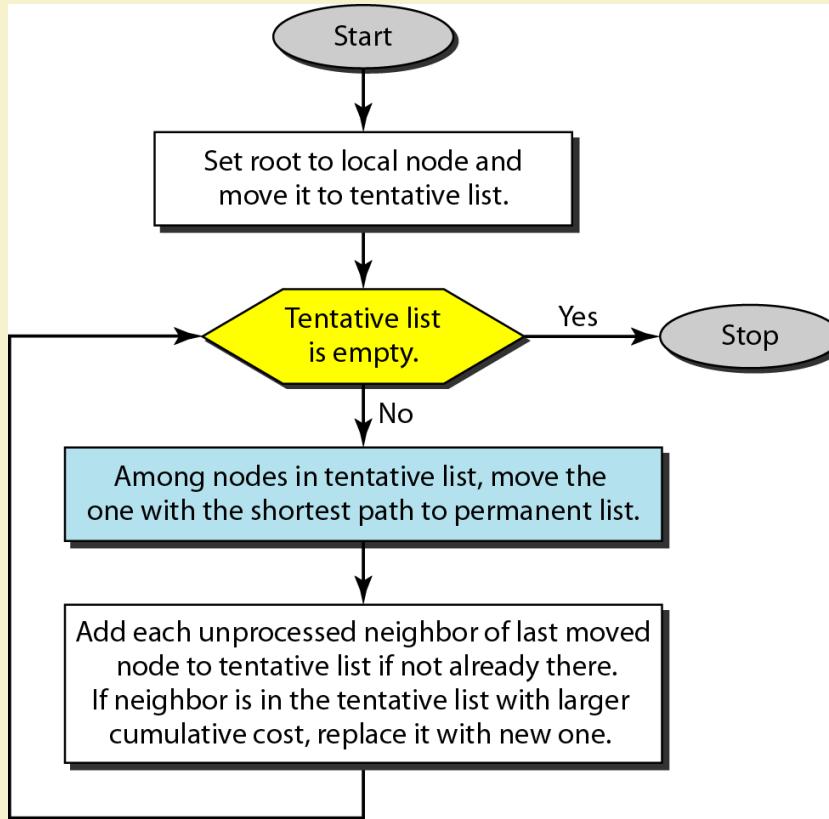


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# Dijkstra algorithm

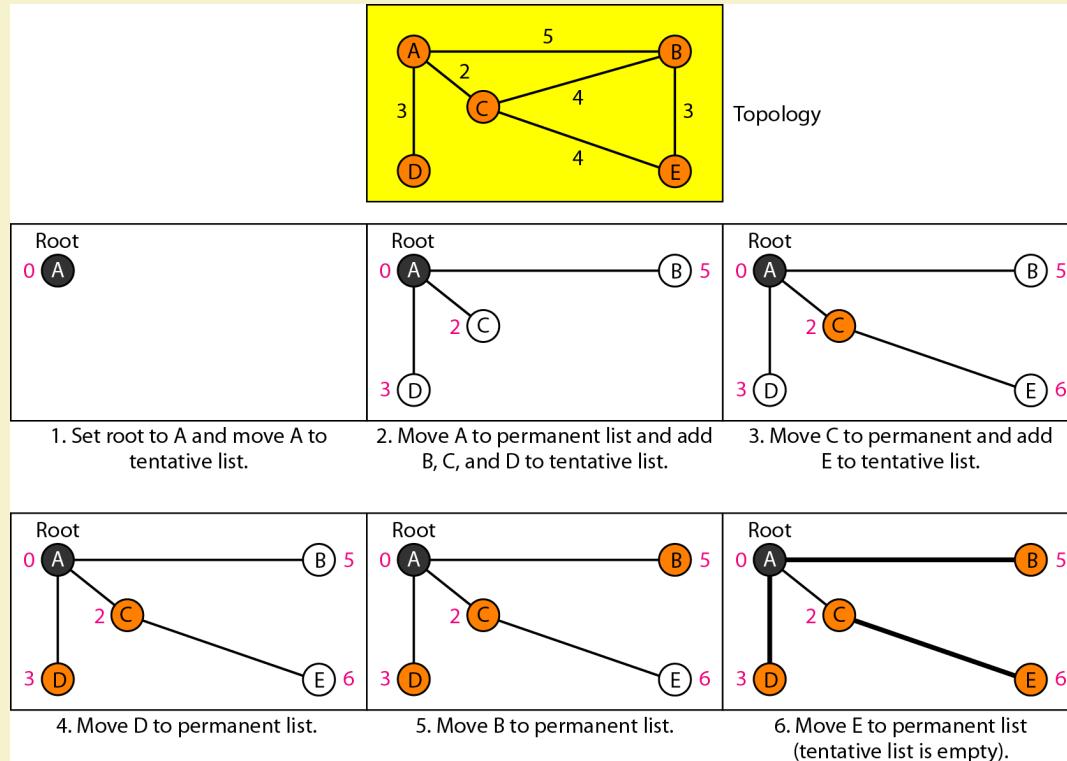


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# Shortest Path tree



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## Node A - Routing table

<i>Node</i>	<i>Cost</i>	<i>Next Router</i>
A	0	—
B	5	—
C	2	—
D	3	—
E	6	C



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## Link State Routing - Summary

1. Sharing knowledge about the neighbourhood
2. Sharing with every other router
3. Sharing when there is a change

**OSPF** (Open Shortest Path First) uses Link State Routing to update the routing table.



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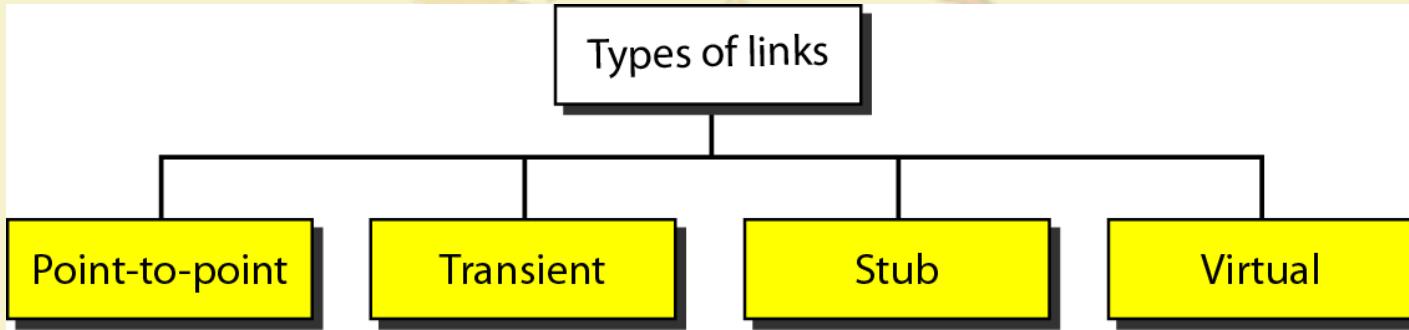


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# Types of links

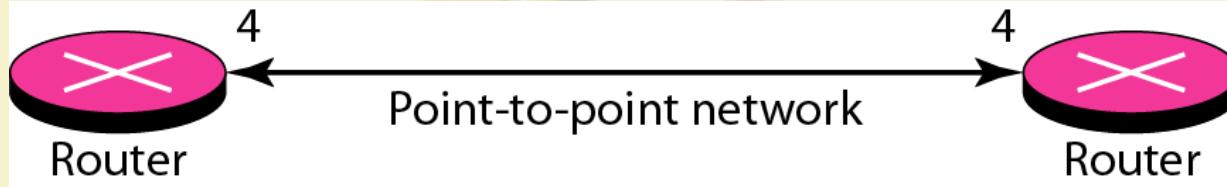


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## Point-to-point link



- Connects two routers without any other router(s) or host(s)

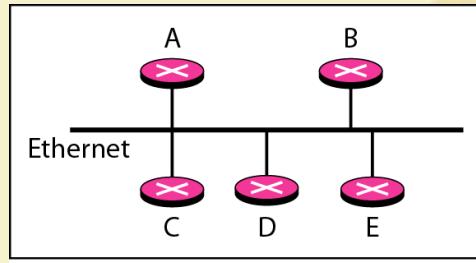


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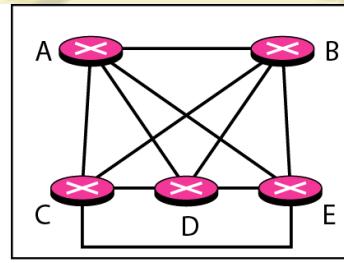


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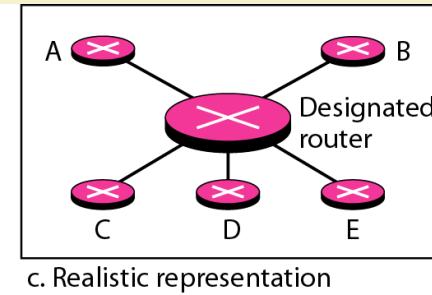
# Transient link



a. Transient network



b. Unrealistic representation



c. Realistic representation

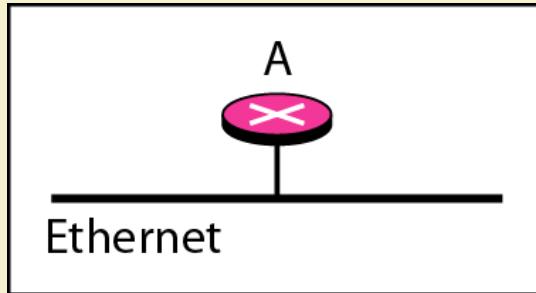


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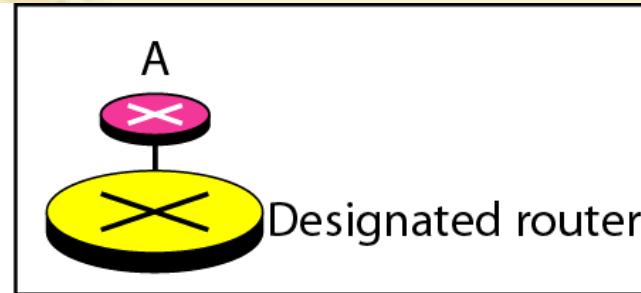


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## Stub link



a. Stub network



b. Representation

## Virtual link

Network administrator may create a virtual link between two routers, when the link between the routers are broken.



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