Chapter5 Network Layer(2)

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Review

- **Network Layer Outline**
  - **VC/Datagram subnet**
- **Routing Algorithms**
  - **Static**
  - **Dynamic**
- **Shortest Path**
  - **Sink tree**
- **Flooding**

Outline

- ☐ **Dynamic routing algorithm**

- ☐ **Distance-vector algorithm**

  - ■ **An example：Rip**

- ☐ **Problem of DV and solution**

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Dynamic Routing algorithm

- **Distance vector routing algorithm**

  - **For example: RIP**

- **Link state routing algorithm**

  - **For example: OSPF**

- **Hybrid routing**

  - **For example: IGRP**

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How is dynamic property realized？

- **If routers need to communication, they must say same language, that is same routing protocol**

- **A new router must introduce itself in it's own initiative (say hello)**

- **Send hello packets periodically to learn other's health (keep alive)**

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Distance Vector Routing

- 距离矢量路由选择:operate by having each router maintain a table (i.e, a vector) giving the best known distance to each destination and which line to use to get there .

- D-V algorithm is dynamic and distributed. It is common used in small network, RIP is a typical example of DV

- RIP：Routing information protocol，路由选择信息协议，1988，RFC1058

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Working principle of DV

- **Each router use two vectors, D_i and S_i, to denote the distance from a node to all other nodes and next node (hop)**

- **Exchange path-information among Neighbor routers**

- **Each node update it's routing table according to path information**

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Working principle of DV(cont'd)

- ☐ d_{i1} : the distance (f.g. delay) from node i to node 1
- ☐ S_{i1} : the next node along the best way from node i to node 1
- ☐ n : node number of network

$$D_i = \begin{bmatrix} d_{i1} \\ d_{i2} \\ d_{i3} \\ \dots \\ d_{in} \end{bmatrix} \qquad S_i = \begin{bmatrix} s_{i1} \\ s_{i2} \\ s_{i3} \\ \dots \\ s_{in} \end{bmatrix}$$

Update routing table

□ **After exchange vector:**

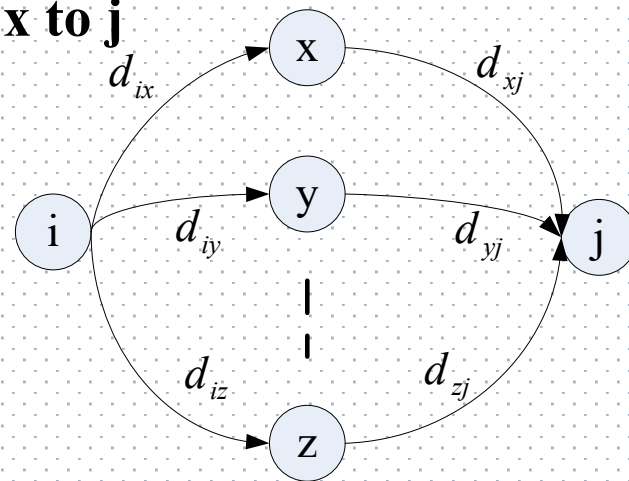▪ **Update distance : d_{ij}= Min[d_{ix}+ d_{xj}] (x ∈A)**

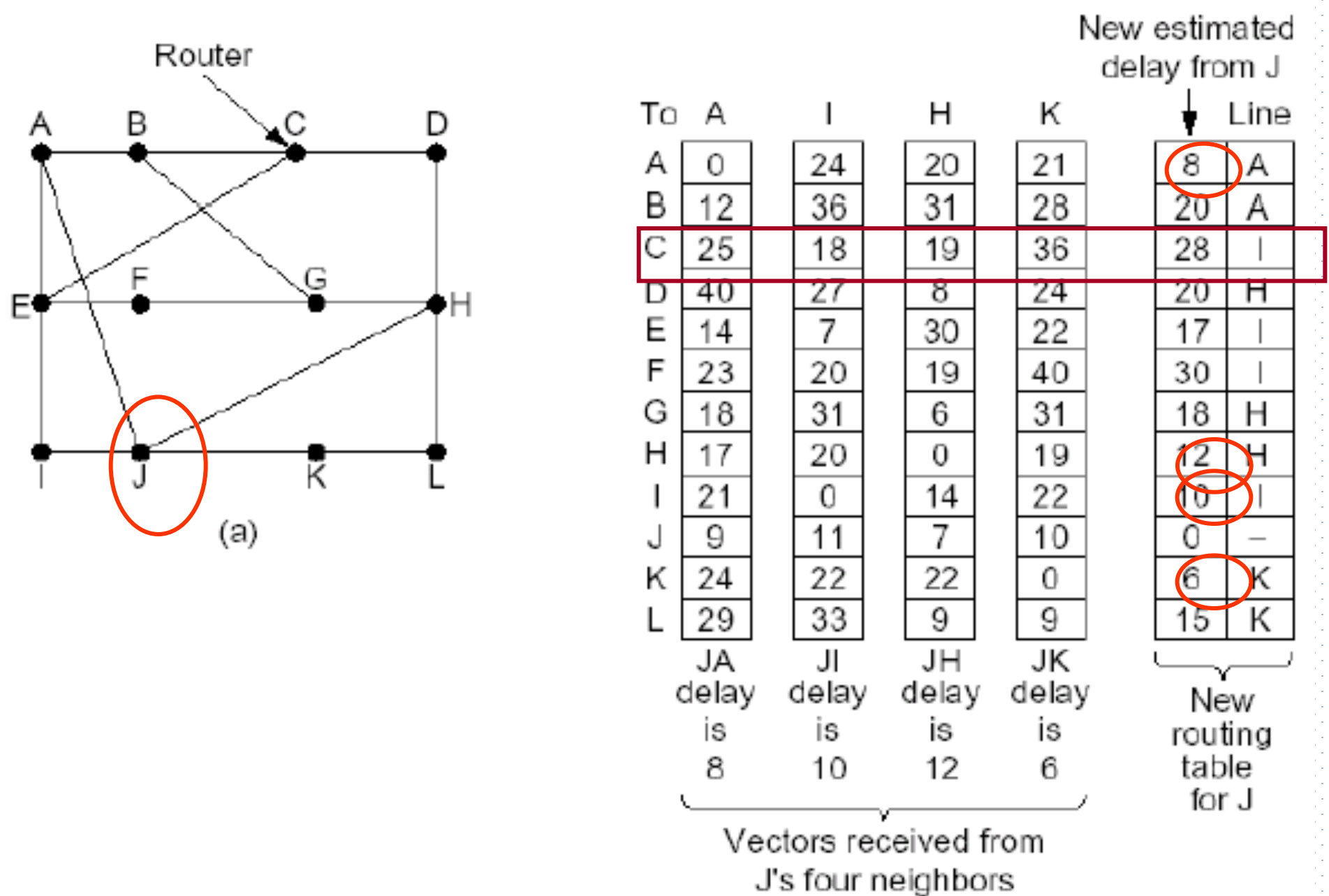□ **A—collection of neighbors of node I;**

□ **d_{ij}—the shortest distance from i to j;**

□ **d_{ix}—the shortest distance from i to x;**

□ **d_{xj}—the shortest distance from x to j**

▪ **Update next node: S_{ij}= x**

Router

(a)

New estimated delay from J

To	A	I	H	K		Line
A	0	24	20	21	8	A
B	12	36	31	28	20	A
C	25	18	19	36	28	I
D	40	27	8	24	20	H
E	14	7	30	22	17	I
F	23	20	19	40	30	I
G	18	31	6	31	18	H
H	17	20	0	19	12	H
I	21	0	14	22	10	I
J	9	11	7	10	0	–
K	24	22	22	0	6	K
L	29	33	9	9	15	K

JA delay is 8	JI delay is 10	JH delay is 12	JK delay is 6	New routing table for J

Vectors received from
J's four neighbors

Do exercise

☐ **Topology is following, router C receive three routing delay vectors from router B,D,and E**

	A	B	C	D	E	F
From router B:	（ 5，	0，	8，	12，	6，	2）
From router D:	（16，	12，	6，	0，	9，	10）
From router E:	（ 7，	6，	3，	9，	0，	4）
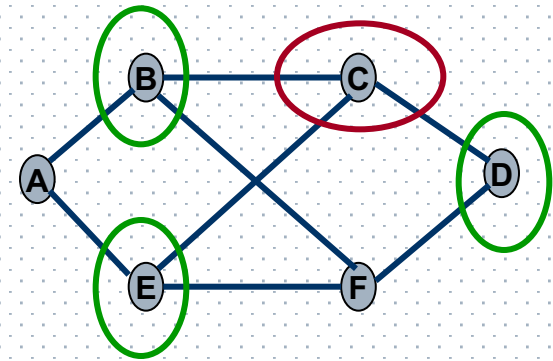
☐ **Now, delay between Router C and router B,D,and E is measured respectively, is 6,3, and 5，try to answer the routing vector of router C after update.**

topology
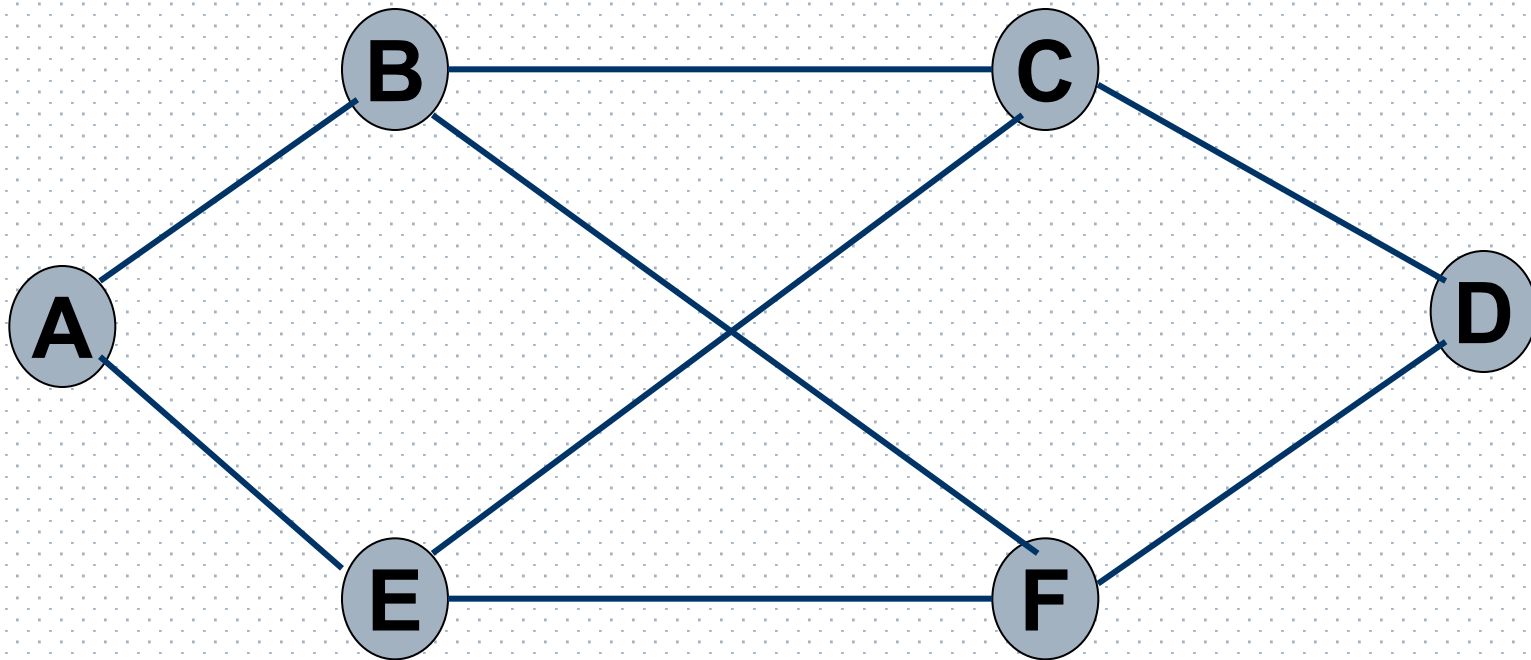
Reference key

□ **Analysis: via router B,D, and E, the vector of router C is:**

Via router B：（11, 6, 14, 18, 12, 8）

Via router D：（19, 15, 9, 3, 12, 13）

Via router E：（12, 11, 8, 14, 5, 9）

So, update routing table of router C as following:

（11, 6, 0, 3, 5, 8）

（B, B, -, D, E, B）

Characteristic of D-V algorithm

- ☐ **advantage**
    - ■ **Algorithm is simple**
- ☐ **Disadvantage**
    - ■ **Exchanged information is too big**
    - ■ **Path information propagates slowly and path information may be different**
    - ■ **Convergence speed is slow, leads to infinite count issue。**
    - ■ **Not fit for big network**

Main features of RIP

□ **RIP is a D-V routing protocol**

□ **RIP uses hop (跳数) as metric**

□ **When metric is bigger than 15, the destination is deemed to unreachable**

□ **Default sending period is 30 seconds**

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Disadvantage of RIP

□ **Unable to reach when a destination-network's metric is bigger than 15 (so small)**

□ **RIP's metric is hop，that is router's number all the way，It's not so reasonable**

□ **In practice, it's common to count to infinite, and convergence slowly**
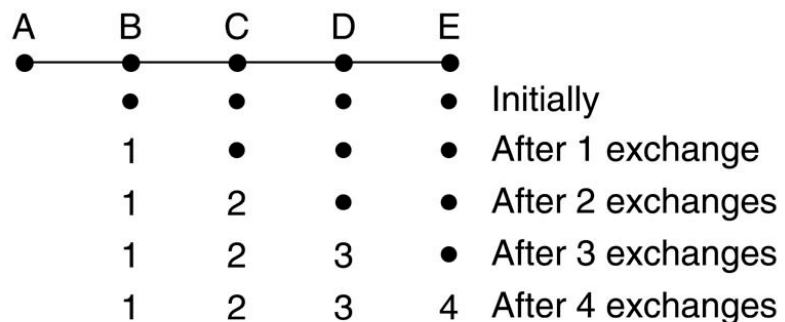
The problems induced by DV

☐ **Representation**

- ■ **routing loop（路由环路）**

- ■ **Count to infinite（计数到无穷问题）**

- ■ **slow Convergence （收敛慢的问题）**

☐ **Cause**

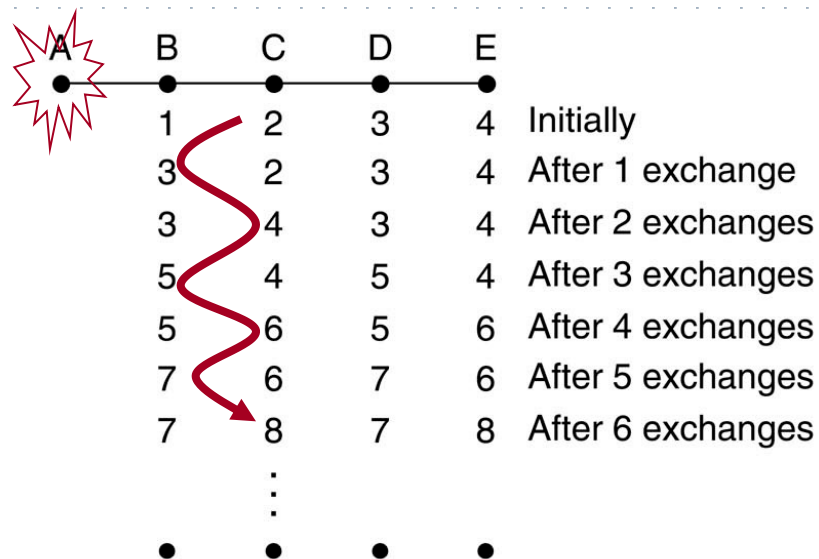- ■ **Trust wrong routing information**

Main problem of DV

☐ **It reacts rapidly to good news, but leisurely to bad news**(好消息跑得快，坏消息传得慢)

	A	B	C	D	E	
	●	●	●	●	●	
		●	●	●	●	Initially
		1	●	●	●	After 1 exchange
		1	2	●	●	After 2 exchanges
		1	2	3	●	After 3 exchanges
		1	2	3	4	After 4 exchanges

(a)

	A	B	C	D	E	
	✦	●	●	●	●	
		1	2	3	4	Initially
		3	2	3	4	After 1 exchange
		3	4	3	4	After 2 exchanges
		5	4	5	4	After 3 exchanges
		5	6	5	6	After 4 exchanges
		7	6	7	6	After 5 exchanges
		7	8	7	8	After 6 exchanges
		●	●	●	●	

(b)

Summary

- ☐ **Principle of DV-algorithm**

  - ■ **A typical example: RIP**

- ☐ **Problem of DV**

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