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

Dynamic Routing algorithm

- Distance vector routing algorithm
  - For example: RIP
- Link state routing algorithm
  - For example: OSPF
- Hybrid routing
  - For example: IGRP

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)

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

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

Working principle of DV(cont'd)

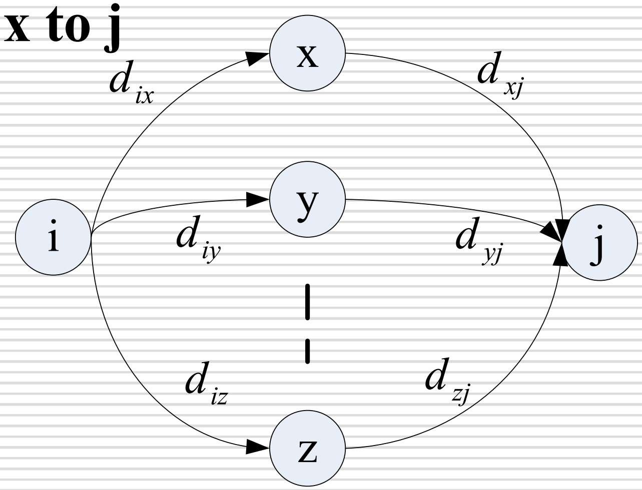
- d_{i1}: the distance (f.g. delay) from node i to node 1
- S_{i1} : the next node along the best way from node i to node 1
- n : node

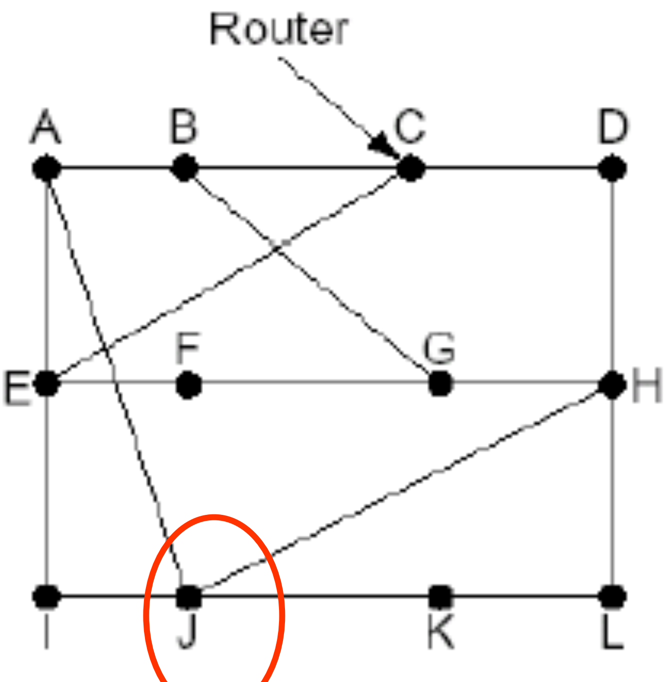
number of network

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

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





(a)

New estimated delay from J

To	A	I	H	K	New estimated delay from J	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	

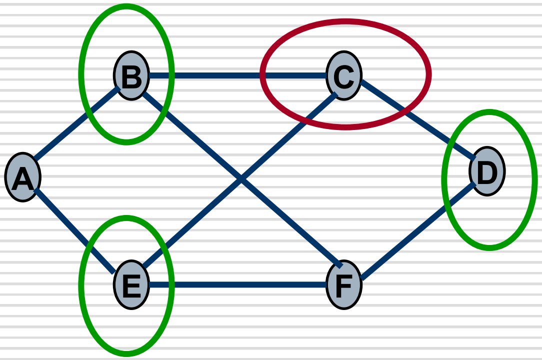
Vectors received from J's four neighbors

New routing table for J

Do exercise

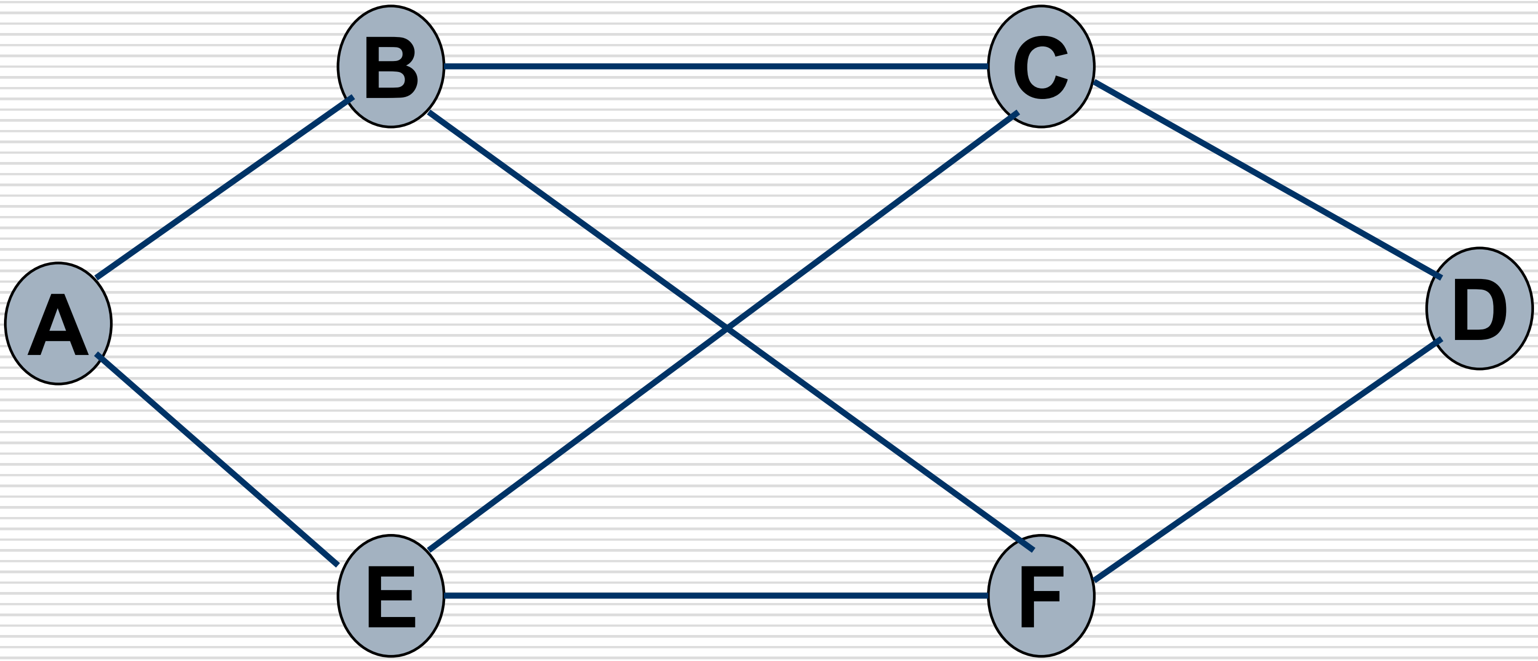
- Topology is following, router C receive three routing delay vectors from router B,D,and E

	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

Disadvantage of RIP

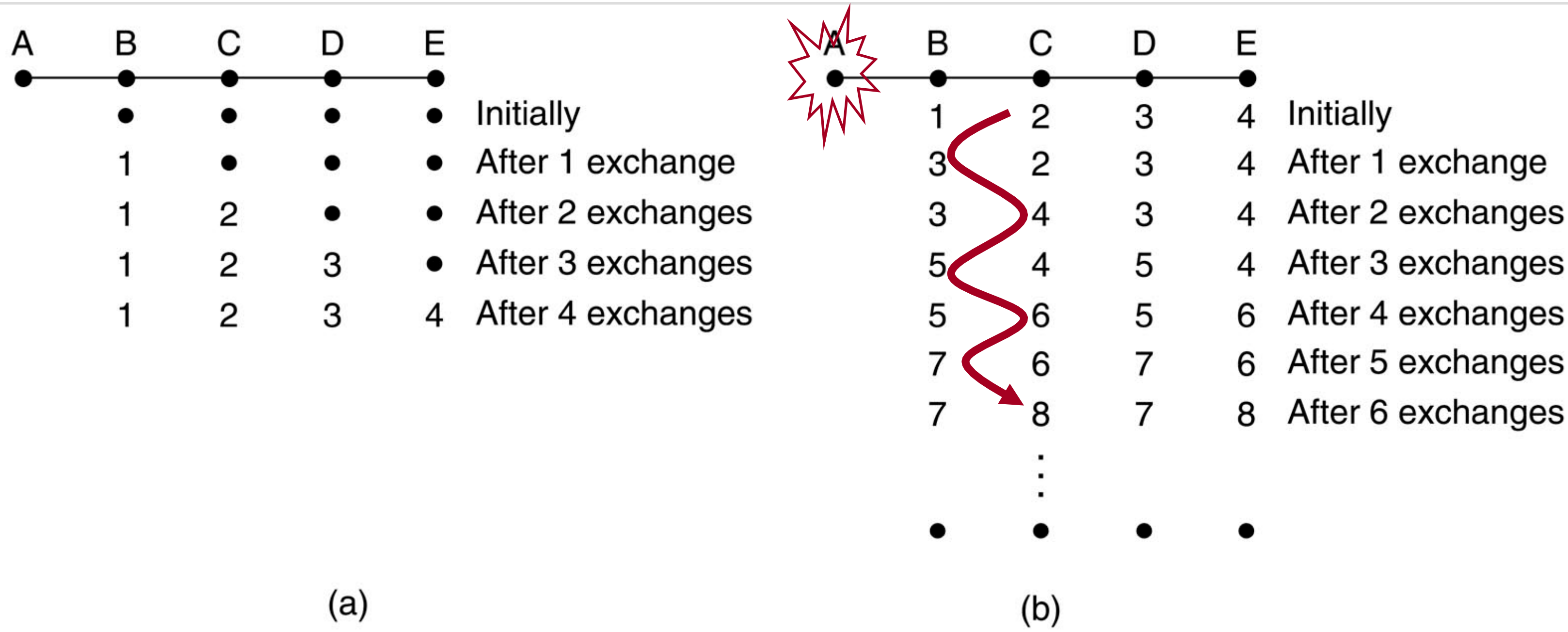
- Unable to reach when a destination-network's metric is bigger than 15 (so small)
- RIP's metric is hop， that is router's number all the way， It's not so reasonable
- In practice, it's common to count to infinite, and convergence slowly

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)



Summary

- Principle of DV-algorithm
  - A typical example: RIP
- Problem of DV