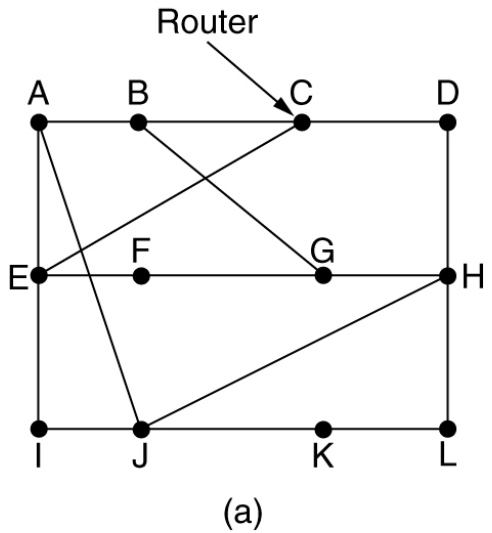
Routing Protocol

Distance Vector Routing

- i.e. Bellman-Ford and Ford Fulkerson
- Each router maintains a routing table indexed

Distance Vector Routing

(a) A subnet. (b) Input from A, I, H, K, and the new routing table for J.



(a)

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	

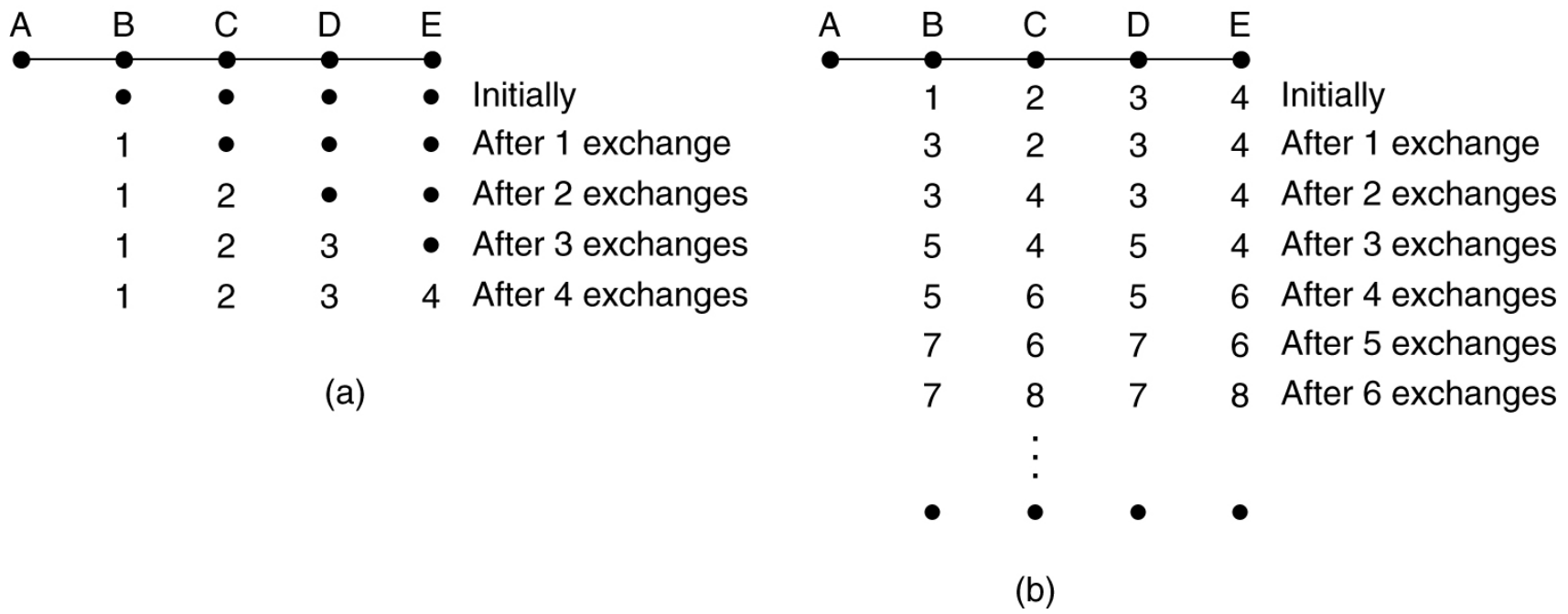
Vectors received from J's four neighbors

(b)

Delay measured from J to all neighbors

Distance Vector Routing (2)
-Count to Infinity Problem

- Rapidly to good news, but leisurely to bad news



The count-to-infinity problem.

Split Horizon

- In computer networks, distance-vector routing protocols employ the split horizon rule which prohibits a router from advertising a route back out the interface from which it was learned. Split horizon is one of the methods used to prevent routing loops due to the slow convergence times of distance-vector routing protocols.

Route poisoning

- **Route poisoning** is a way to prevent routing loops. Distance-vector routing protocols in computer networks use route poisoning to indicate to other routers that a route is no longer reachable and should be removed from their routing tables. A variation of route poisoning is *split horizon with poison reverse* whereby a router sends updates with unreachable hop counts back to the sender for every route received to help prevent routing loops.

Link State Routing

- Distance Vector routing was used in the ARPANET until 1979, when it was replaced by "*Link State Routing*".

Link State Routing

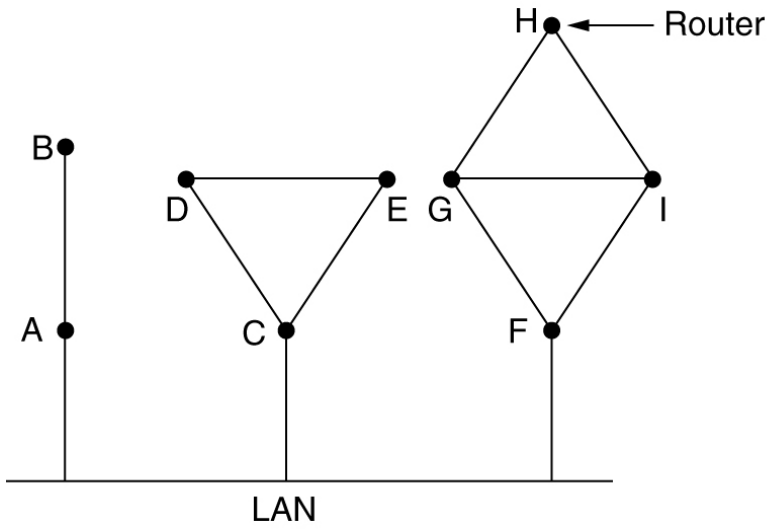
Each router must do the following:

1. Discover its neighbors, learn their network address.
2. Measure the delay or cost to each of its neighbors.
3. Construct a packet telling all it has just learned.
4. Send this packet to *all other routers*.
5. Compute the shortest path to every other router.

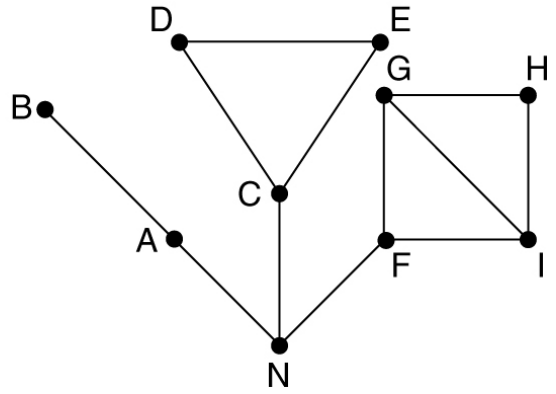
Dijkstra's Algorithm can be used to find the shortest paths to every routers.

Learning about the Neighbors

(a) Nine routers and a LAN. (b) A graph model of (a).



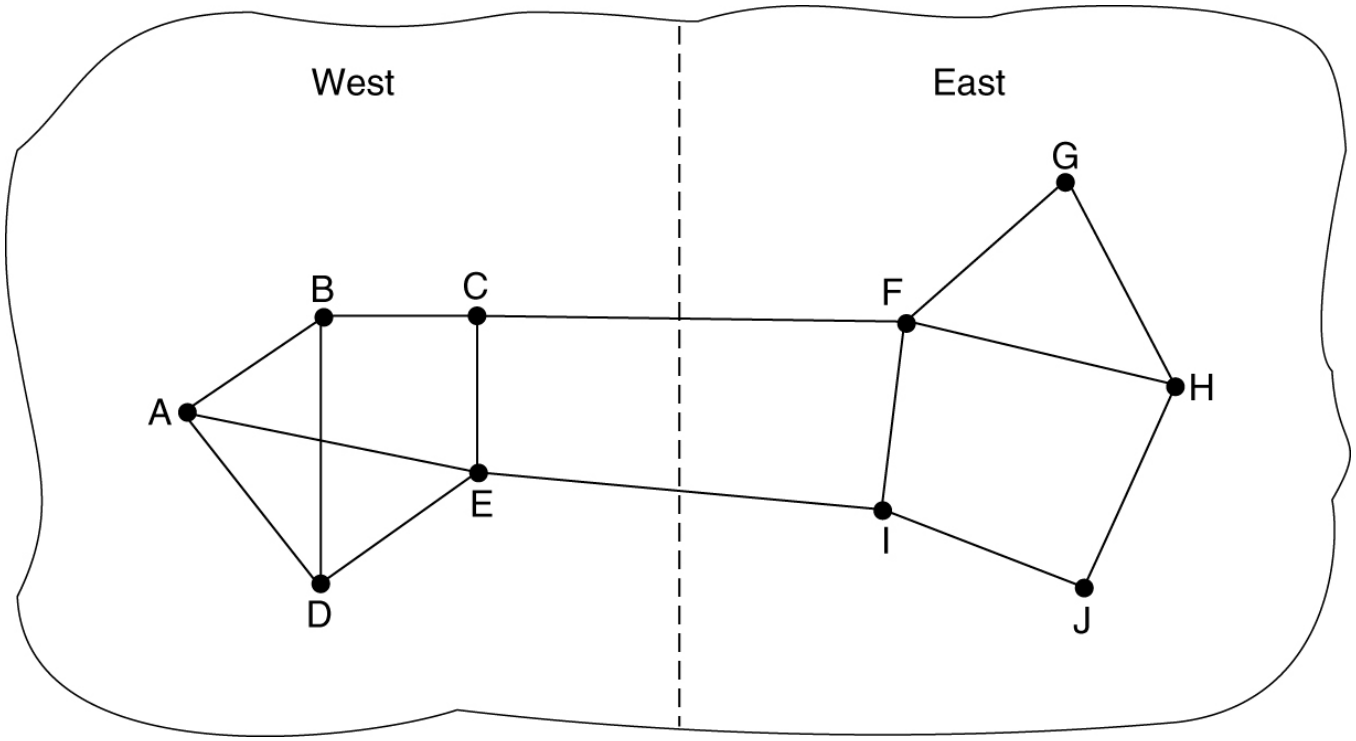
(a)



(b)

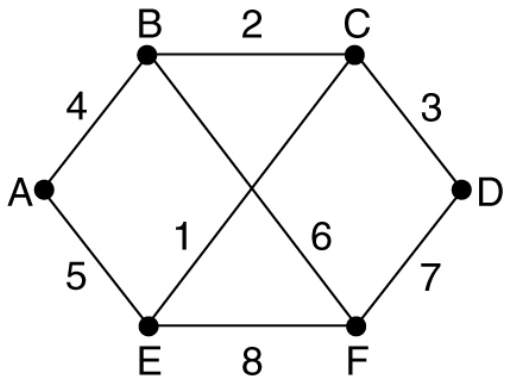
Measuring Line Cost

A subnet in which the East and West parts are connected by two lines.



Swap between CF and EI time after time….! problem

Building Link State Packets



(a)

Link State Packets

A		B		C		D		E		F	
Seq.		Seq.		Seq.		Seq.		Seq.		Seq.	
Age		Age		Age		Age		Age		Age	
B	4	A	4	B	2	C	3	A	5	B	6
E	5	C	2	D	3	F	7	C	1	D	7
		F	6	E	1			F	8	E	8

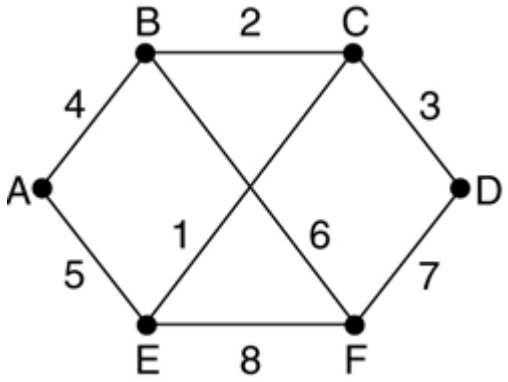
(b)

(a) A subnet. (b) The link state packets for this subnet.

Building Link State Packets

- When to build them
  1. Periodically at regular intervals
  2. When some event occurs.
     - Line or Neighbors going down or coming back

Distributing the Link State Packets



Source	Seq.	Age	Send flags A	Send flags C	Send flags F	ACK flags A	ACK flags C	ACK flags F	Data
A	21	60	0	1	1	1	0	0	
F	21	60	1	1	0	0	0	1	
E	21	59	0	1	0	1	0	1	
C	20	60	1	0	1	0	1	0	
D	21	59	1	0	0	0	1	1	

The packet buffer for router B in the previous slide