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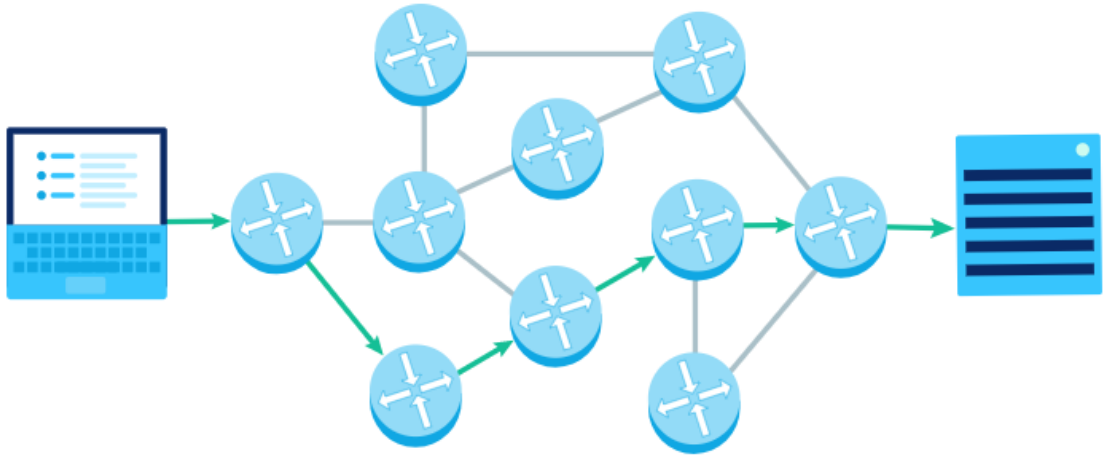
# Computer Networks

( RCS-601 )

## Routing - III



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# Link State Routing


## Key Features:

- **The routers share the knowledge only about their neighbors** compared to all the routers in the autonomous system.
- **Sharing of information takes place only with all the routers** in the network, by sending small updates using flooding compared to sending larger updates to their neighbors
- Sharing of information takes place only when there is a change, which leads to lesser internet traffic compared to distance vector routing.

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# Link State Routing (contd.)

## Overview of algorithm:

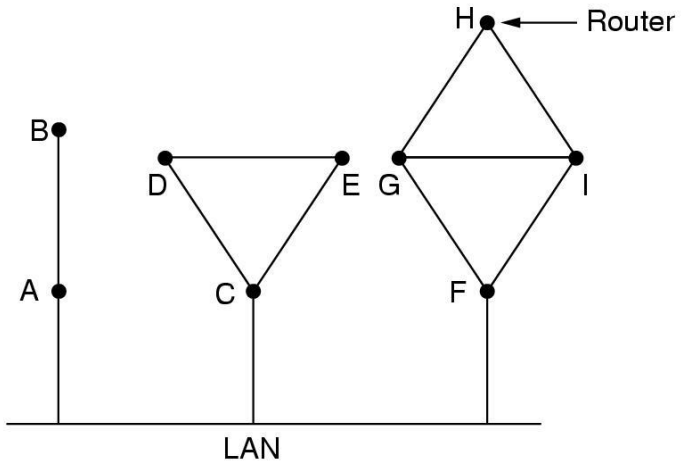
Each router must:

1) Discover its **neighbours** and **learn** their network addresses
2) Measure the delay or **cost** to each of its neighbours
3) Construct a **link state packet** with these distances
4) Send this packet to **all** other routers
5) Compute the **shortest path** to every other router

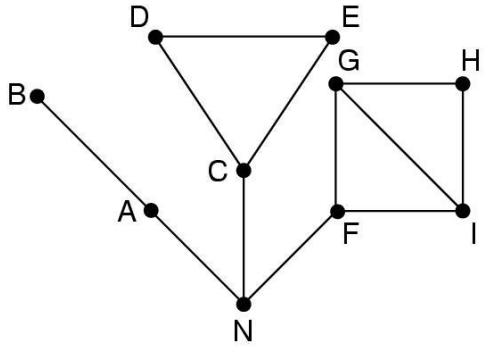
# Link State Routing (contd.)

## 1) Learning about neighbours:

- Upon boot of router
  - Send HELLO packet on each point-to-point line
  - Routers are supposed to send reply with a globally unique name
- LAN model




(a)




(b)

# Link State Routing (contd.)

## 2) Measuring Line Cost

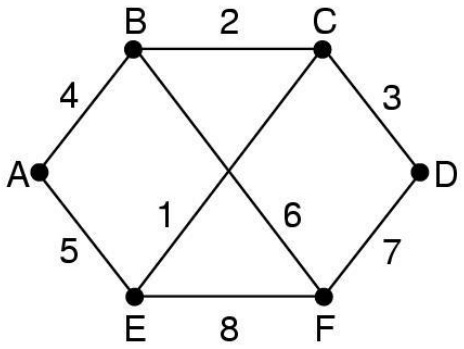
- The link state routing algorithm requires each router to know, or at least have a reasonable estimate of, the delay to each of its neighbors. The most direct way to determine this delay is to send over the line a special ECHO packet that the other side is required to send back immediately. By measuring the round-trip time and dividing it by two, the sending router can get a reasonable estimate of the delay. For even better results, the test can be conducted several times, and the average used.

# Link State Routing (contd.)

## 3) Building link state packets

- Packet containing:
  - Identity of sender
  - Sequence number + age
  - For each neighbour: name + distance

- When to build?
  - periodically
  - when significant events occur




(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)

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# Link State Routing (contd.)

4) **Distributing link state packets**

- **Trickiest part of algorithm**
  - Arrival time for packets different
  - How to keep consistent routing tables
- **Basic algorithm**
  - Flooding + Sequence number (in each packet) to limit duplicates
- **Manageable problems**
  - Wrap around of sequence numbers:
  - Wrong sequence number used:
    - lost in case of crash
    - Corruption
- **Refinements**
  - Link state packets are not forwarded immediately
  - During holding time:
    - duplicates are discarded
    - Old packets are thrown out

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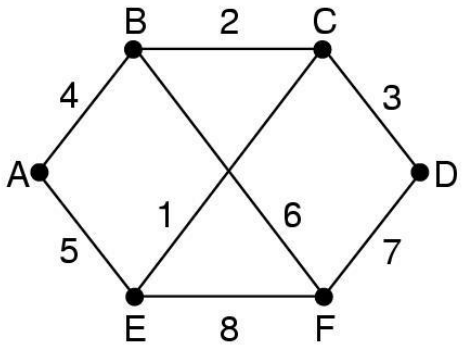
# Link State Routing (contd.)

Packet buffer for router B

- ACK flag: ACK to send
- Send flag: packet to forward




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 |

| 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**

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# Link State Routing (contd.)

## 5) Computing new routes:

- With a full set of link state packets, a router can:
  - Construct the entire subnet graph
  - Run Dijkstra's algorithm to compute the shortest path to each destination
- Problems for large subnets
  - Memory to store data
  - Compute time

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# Thank you