Introduction to Wireless and Mobile Networking

Routing in Mobile Ad Hoc Networks: AODV and DSDV

Hung-Yu Wei
National Taiwan University

Problems of traditional routing algorithms

- Dynamic of the topology
  - frequent changes of connections, connection quality, participants
- Limited performance of mobile systems
  - periodic updates of routing tables need energy without contributing to the transmission of user data, sleep modes difficult to realize
  - limited bandwidth of the system is reduced even more due to the exchange of routing information
  - links can be asymmetric, i.e., they can have a direction dependent transmission quality

Classifications of Routing Protocols

- On-demand routing protocol
  - Also know as reactive routing protocol
  - Discover route "on-demand" (when needed)
  - Example
    - **AODV** (Ad hoc On-Demand Distance Vector Routing)
    - DSR (Dynamic Source Routing Protocol)
- Proactive routing protocol
  - Actively maintain valid routes
  - Example
    - OLSR (Optimized Link State Routing)
    - **DSDV** (Destination-Sequenced Distance-Vector)
- Hybrid routing protocol
  - Mixture of proactive and on-demand protocol
  - Example
    - ZRP (The Zone Routing Protocol)

AODV

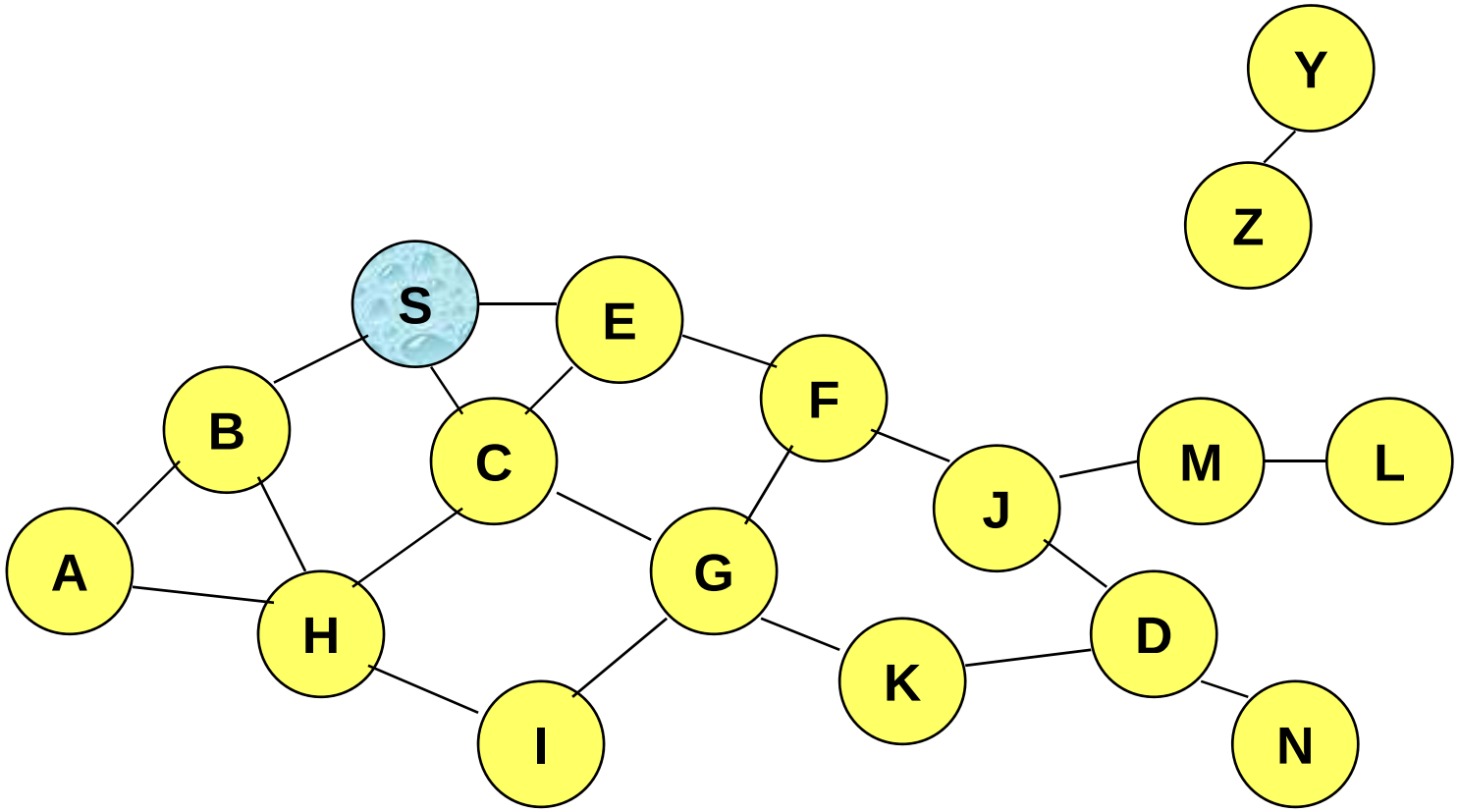
Ad Hoc On-Demand Distance Vector Routing (AODV) [Perkins99Wmcsa]

- DSR includes source routes in packet headers
- Resulting large headers can sometimes degrade performance
  - particularly when data contents of a packet are small
- AODV attempts to improve on DSR by maintaining routing tables at the nodes, so that data packets do not have to contain routes
- AODV retains the desirable feature of DSR that routes are maintained only between nodes which need to communicate

AODV

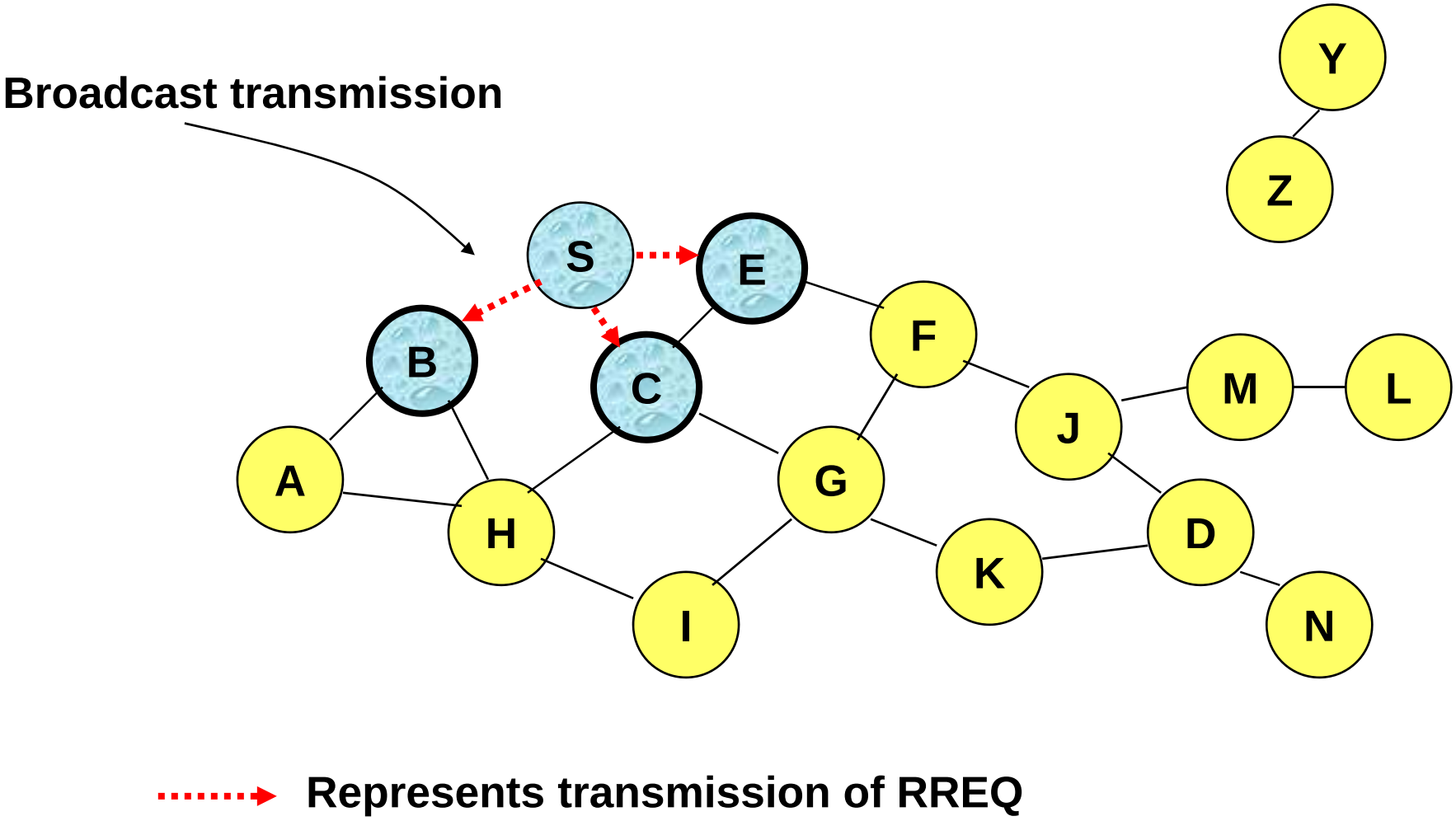
- Route Requests (RREQ) are forwarded in a manner similar to DSR
- When a node re-broadcasts a Route Request, it sets up a reverse path pointing towards the source
  - AODV assumes symmetric (bi-directional) links
- When the intended destination receives a Route Request, it replies by sending a Route Reply
- Route Reply travels along the reverse path set-up when Route Request is forwarded

Route Requests in AODV

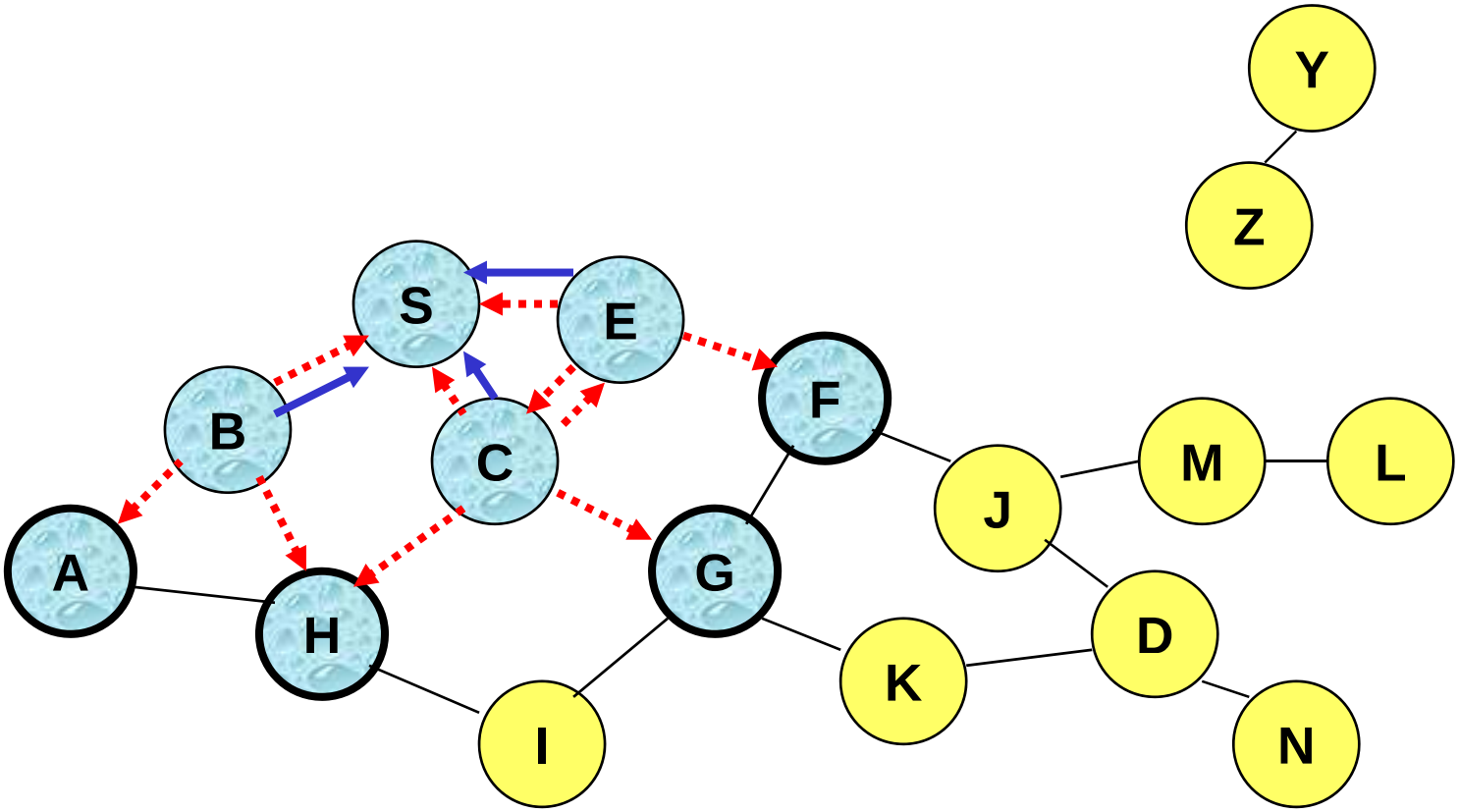


Represents a node that has received RREQ for D from S

Route Requests in AODV

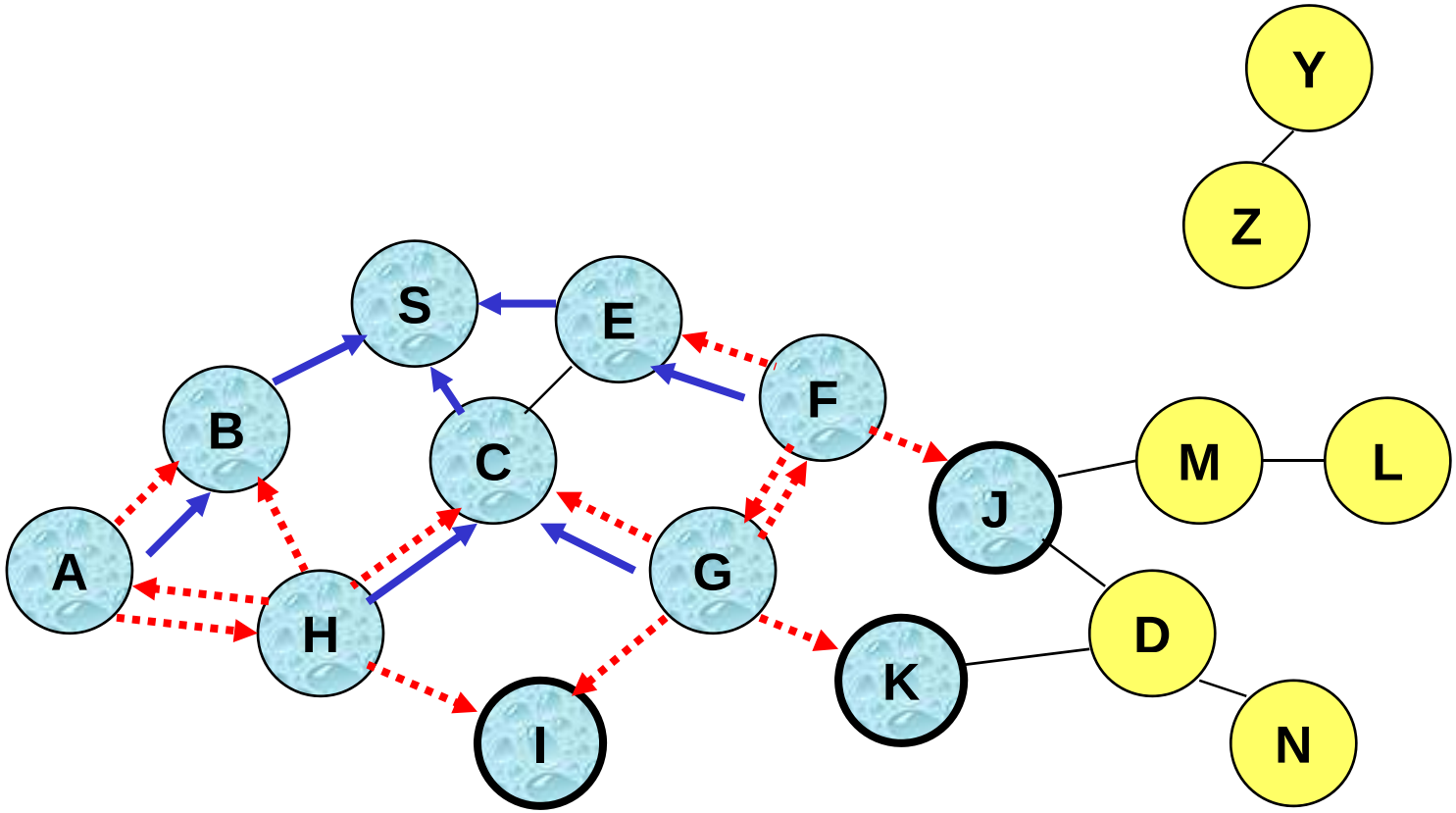


Route Requests in AODV



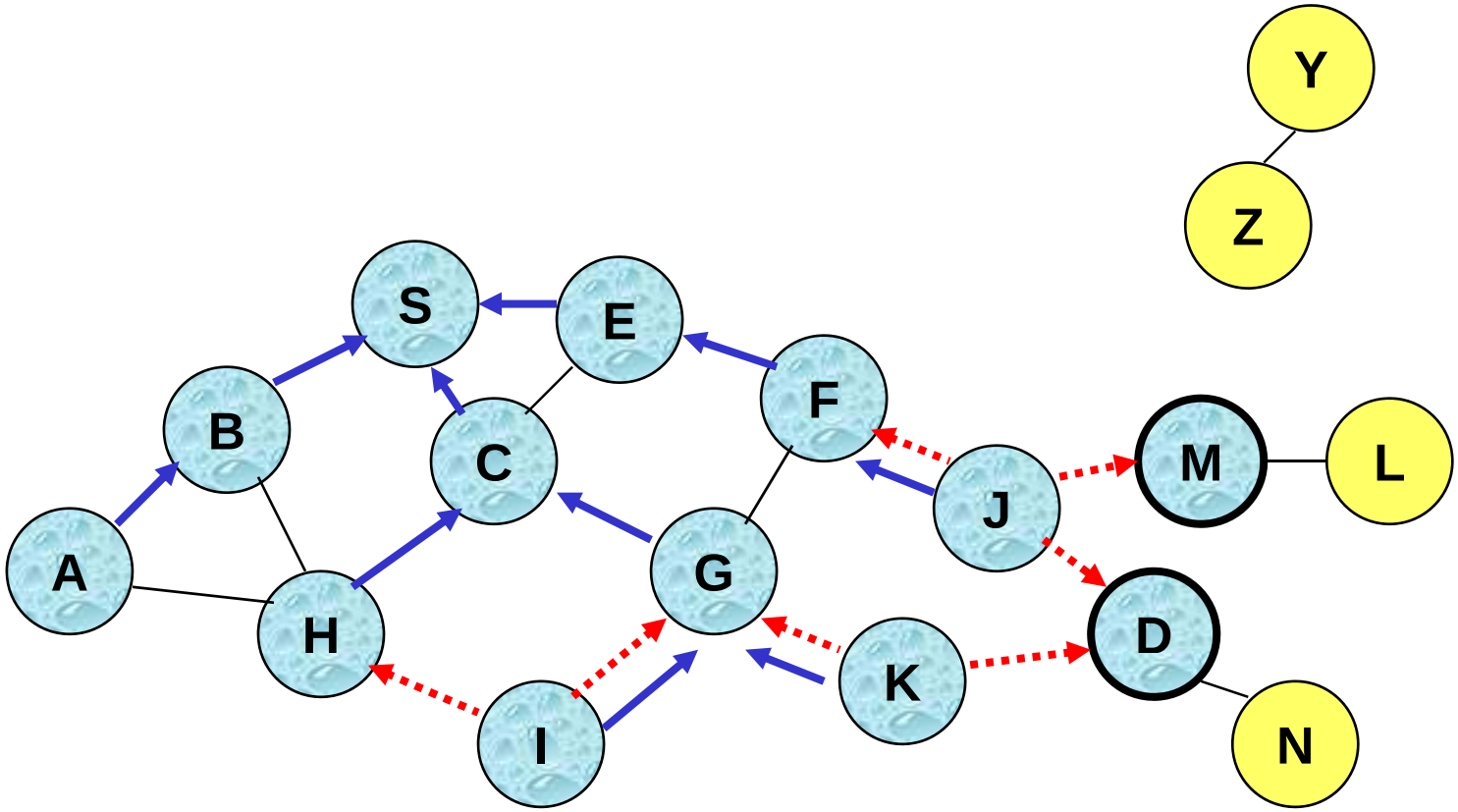
Represents links on Reverse Path

Reverse Path Setup in AODV

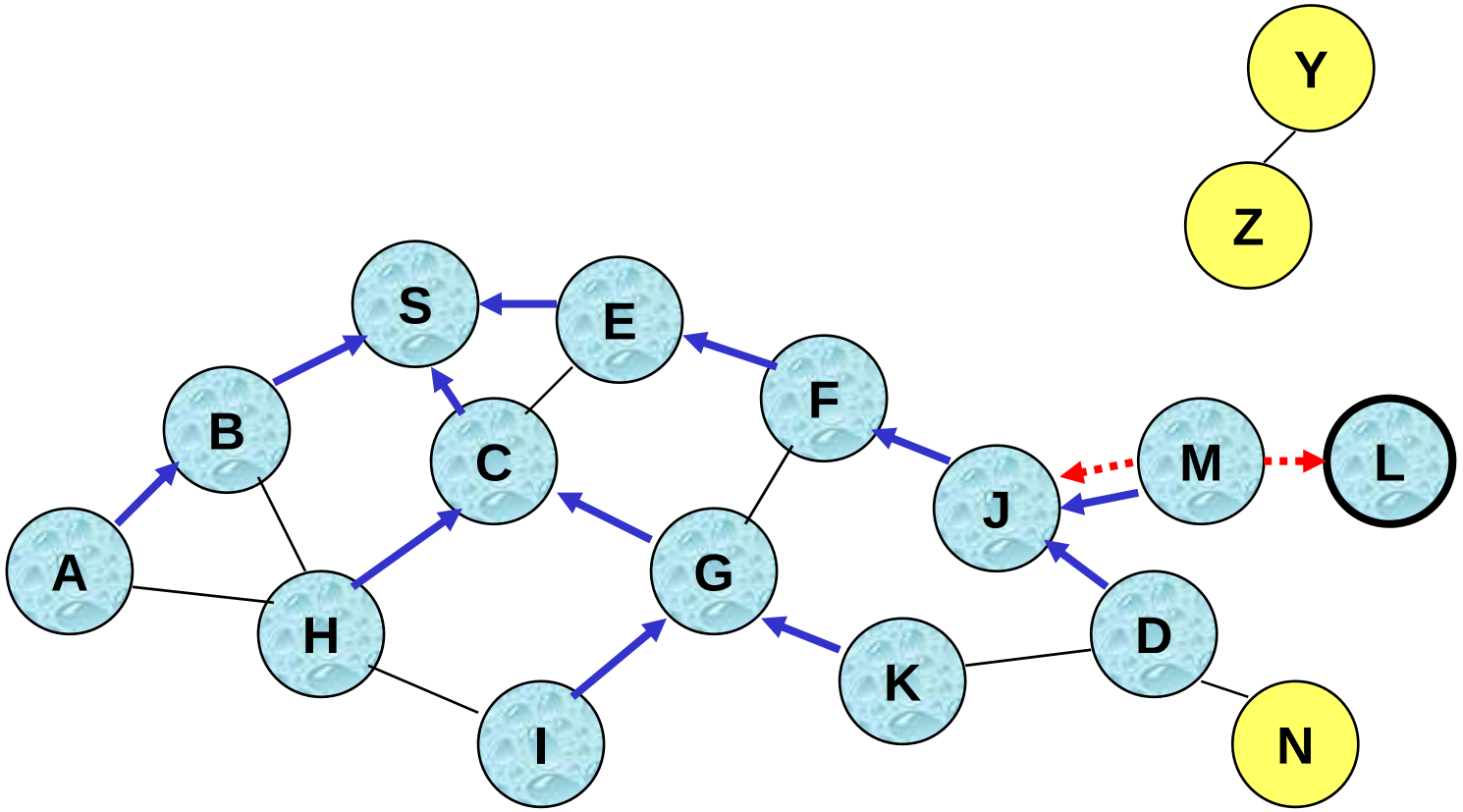


- **Node C receives RREQ from G and H, but does not forward it again, because node C has already forwarded RREQ once**

Reverse Path Setup in AODV

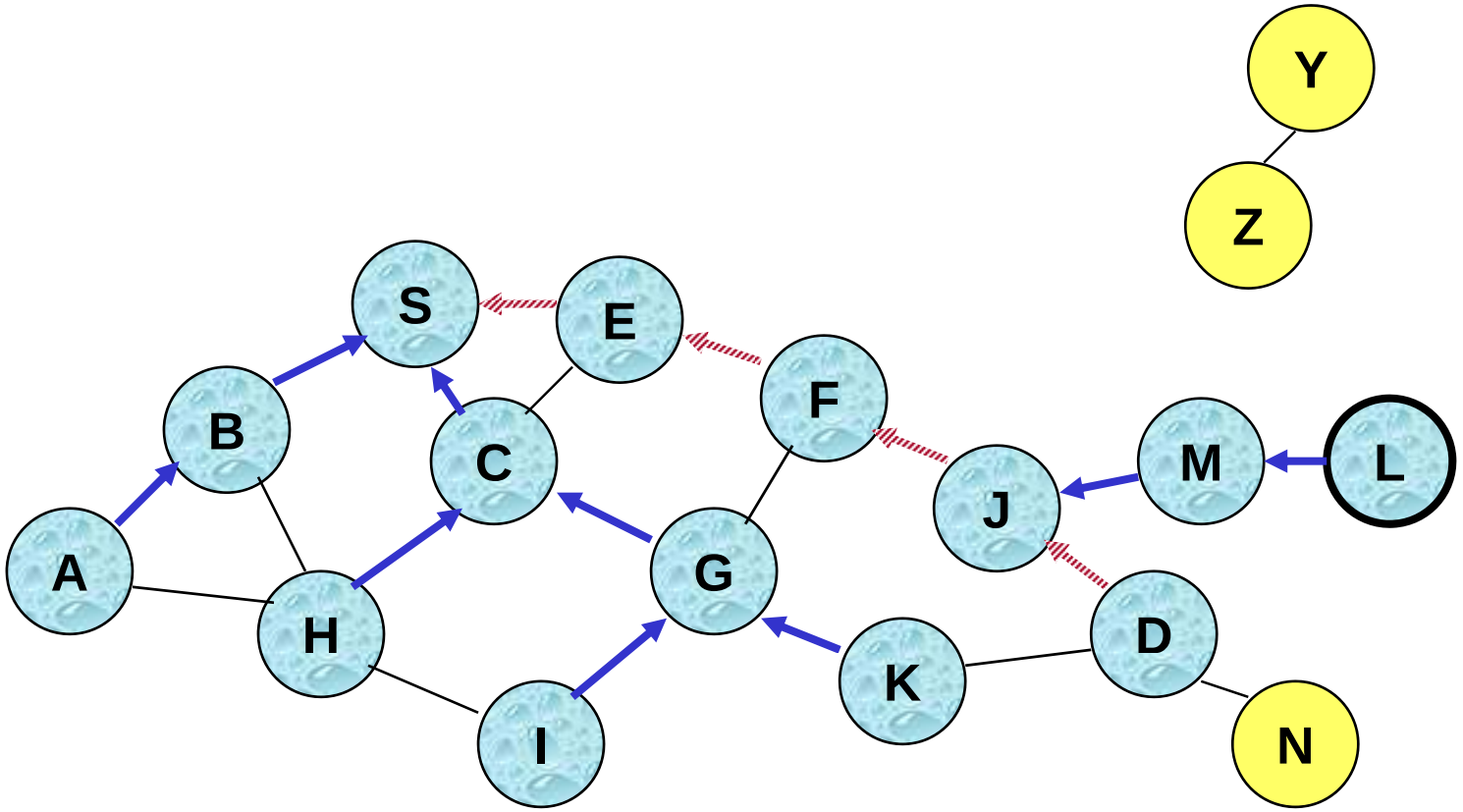


Reverse Path Setup in AODV



- **Node D does not forward RREQ, because node D is the intended target of the RREQ**

Route Reply in AODV

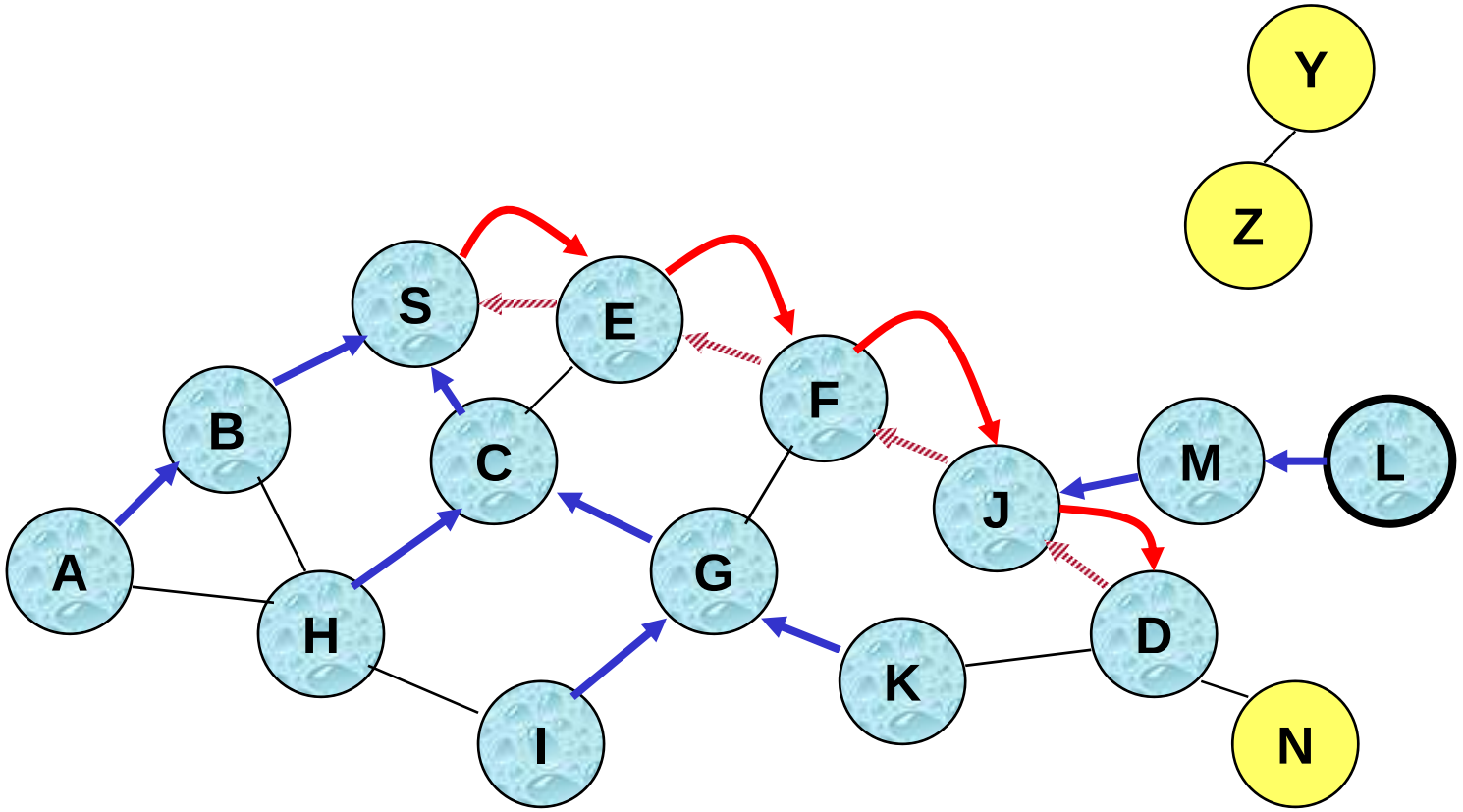


Represents links on path taken by RREP

Route Reply in AODV

- An intermediate node (not the destination) may also send a Route Reply (RREP) provided that it knows a more recent path than the one previously known to sender S
- To determine whether the path known to an intermediate node is more recent, *destination sequence numbers* are used
- The likelihood that an intermediate node will send a Route Reply when using AODV not as high as DSR
  - A new Route Request by node S for a destination is assigned a higher destination sequence number. An intermediate node which knows a route, but with a smaller sequence number, cannot send Route Reply

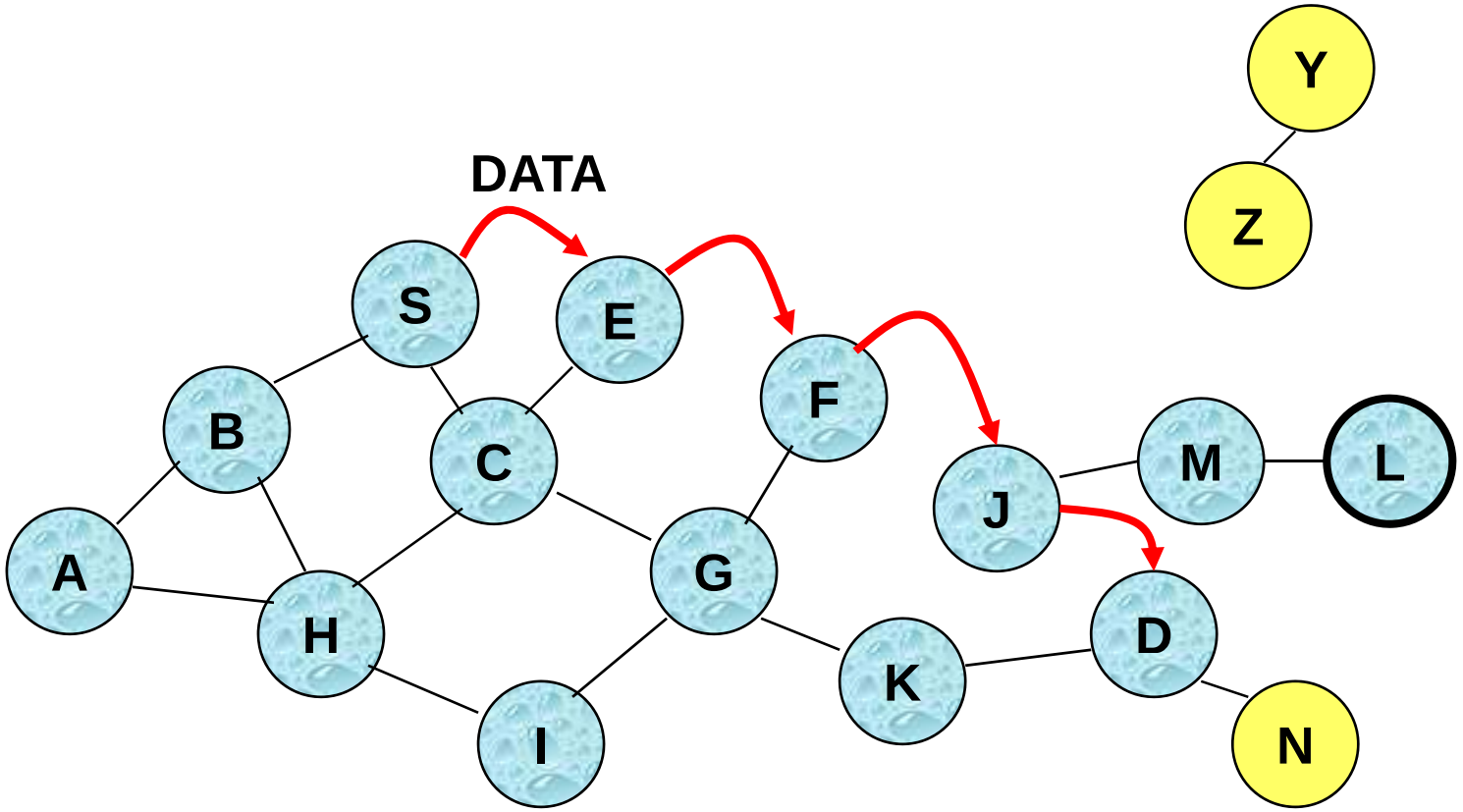
Forward Path Setup in AODV



Forward links are setup when RREP travels along the reverse path

Represents a link on the forward path

Data Delivery in AODV



Routing table entries used to forward data packet.

Route is *not* included in packet header.

DSDV

Traditional routing algorithms

- Distance Vector
  - periodic exchange of messages with all physical neighbors that contain information about who can be reached at what distance
  - selection of the shortest path if several paths available
- Link State
  - periodic notification of all routers about the current state of all physical links
  - router get a complete picture of the network

Destination-Sequenced Distance-Vector (DSDV) [Perkins94Sigcomm]

- Each node maintains a routing table which stores
  - next hop towards each destination
  - a cost metric for the path to each destination
  - a destination sequence number that is created by the destination itself
  - Sequence numbers used to avoid formation of loops

- Each node periodically forwards the routing table to its neighbors
  - Each node increments and appends its sequence number when sending its local routing table
  - This sequence number will be attached to route entries created for this node

DSDV Protocol

- Routing Algorithm
  - Link-State algorithm:
    - Each node maintains a view of the network topology
  - Distance-Vector algorithm:
    - Every node maintains the distance of each destination
- DSDV is a variation of Distance Vector routing for MANET environment
  - DSDV is Destination Based
  - No global view of topology

DSDV Protocol

- DSDV is Proactive (Table Driven)
  - Each node maintains routing information for all known destinations
  - Routing information must be updated periodically
  - Traffic overhead even if there is no change in network topology
  - Maintains routes which are never used

DSDV Protocol

- Keep the simplicity of Distance Vector
- Guarantee Loop Freeness
  - New Table Entry for Destination Sequence Number
- Allow fast reaction to topology changes
  - Make immediate route advertisement on significant changes in routing table
  - but wait with advertising of unstable routes (damping fluctuations)

Summary

- DSDV
  - Periodically distribute (distance vector) routing information
- AODV
  - Route Discovery when needed
    - Route Request
      - Flooding
    - Route Reply