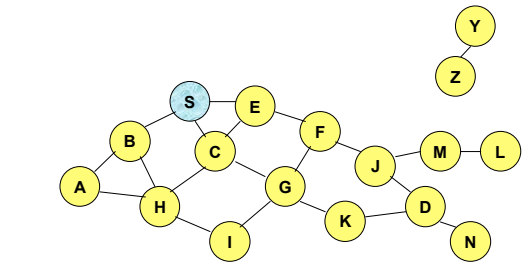
Approaches

- Table driven protocols
  - Each node maintains routing information
  - Tries to keep these table uptodate by sending updates
  - E.g. DSDV, CGSR, WRP
- On Demand Routing
  - Creates routes on demand
  - May have to wait while route discovery
  - May cache information for a "while"
  - E.g AODC, DSR, TORA, ABR, SSR
- Table driven have higher overhead for route maintenance
  - Good when routes are stable

Dynamic Source Routing (DSR)

- When node S wants to send a packet to node D, but does not know a route to D, node S initiates a route discovery
- Source node S floods Route Request (RREQ)
- Each node appends own identifier when forwarding RREQ

Route Discovery in DSR

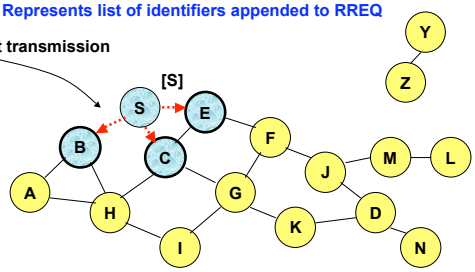


Represents a node that has received RREQ for D from S

Route Discovery in DSR

[X,Y] Represents list of identifiers appended to RREQ

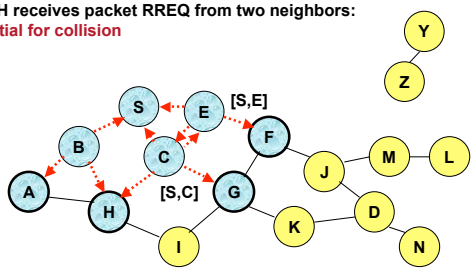
Broadcast transmission



Represents transmission of RREQ

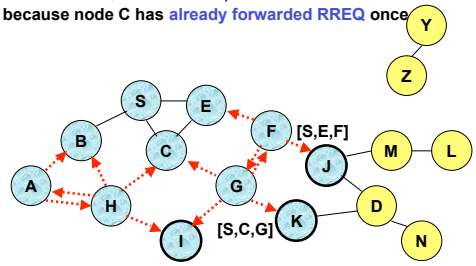
Route Discovery in DSR

- Node H receives packet RREQ from two neighbors: potential for collision



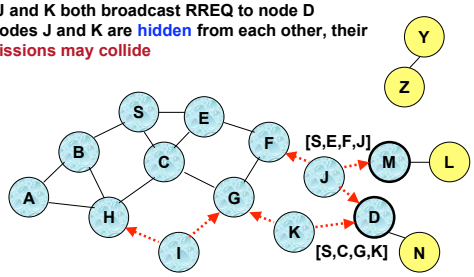
Route Discovery in DSR

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



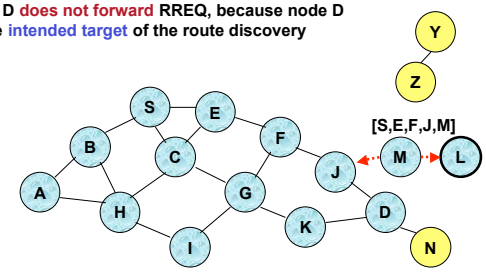
Route Discovery in DSR

- Nodes J and K both broadcast RREQ to node D
- Since nodes J and K are hidden from each other, their transmissions may collide



Route Discovery in DSR

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

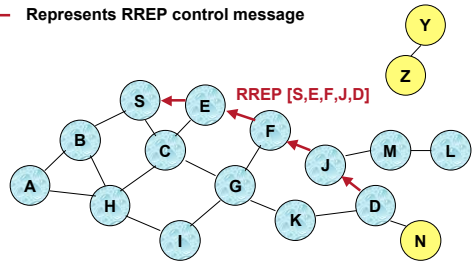


Route Discovery in DSR

- Destination D on receiving the first RREQ, sends a Route Reply (RREP)
- RREP is sent on a route obtained by reversing the route appended to received RREQ
- RREP includes the route from S to D on which RREQ was received by node D

Route Reply in DSR

Represents RREP control message



Route Reply in DSR

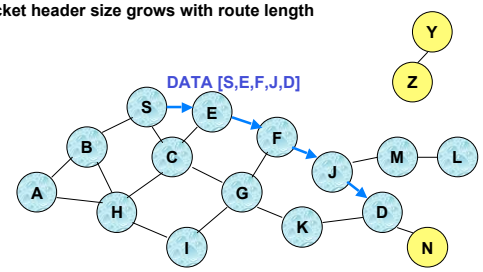
- Route Reply can be sent by reversing the route in Route Request (RREQ) only if links are guaranteed to be bi-directional
  - To ensure this, RREQ should be forwarded only if it received on a link that is known to be bi-directional
- If unidirectional (asymmetric) links are allowed, then RREP may need a route discovery for S from node D
  - Unless node D already knows a route to node S
  - If a route discovery is initiated by D for a route to S, then the Route Reply is piggybacked on the Route Request from D
- If IEEE 802.11 MAC is used to send data, then links have to be bi-directional (since Ack is used)

Dynamic Source Routing (DSR)

- Node S on receiving RREP, caches the route included in the RREP
- When node S sends a data packet to D, the entire route is included in the packet header
  - hence the name source routing
- Intermediate nodes use the source route included in a packet to determine to whom a packet should be forwarded

Data Delivery in DSR

Packet header size grows with route length



When to Perform a Route Discovery

- When node S wants to send data to node D, but does not know a valid route node D

DSR Optimization: Route Caching

- Each node caches a new route it learns by *any means*
- When node S finds route [S,E,F,J,D] to node D, node S also learns route [S,E,F] to node F
- When node K receives Route Request [S,C,G] destined for node, node K learns route [K,G,C,S] to node S
- When node F forwards Route Reply RREP [S,E,F,J,D], node F learns route [F,J,D] to node D
- When node E forwards Data [S,E,F,J,D] it learns route [E,F,J,D] to node D
- A node may also learn a route when it overhears Data packets

Use of Route Caching

- When node S learns that a route to node D is broken, it uses another route from its local cache, if such a route to D exists in its cache. Otherwise, node S initiates route discovery by sending a route request
- Node X on receiving a Route Request for some node D can send a Route Reply if node X knows a route to node D
- Use of route cache
  - can speed up route discovery
  - can reduce propagation of route requests

Dynamic Source Routing: Advantages

- Routes maintained only between nodes who need to communicate
  - reduces overhead of route maintenance
- Route caching can further reduce route discovery overhead
- A single route discovery may yield many routes to the destination, due to intermediate nodes replying from local caches

Dynamic Source Routing: Disadvantages

- Packet header size grows with route length due to source routing
- Flood of route requests may potentially reach all nodes in the network
- Care must be taken to avoid collisions between route requests propagated by neighboring nodes
  - insertion of random delays before forwarding RREQ
- Increased contention if too many route replies come back due to nodes replying using their local cache
  - Route Reply Storm problem
  - Reply storm may be eased by preventing a node from sending RREP if it hears another RREP with a shorter route

Dynamic Source Routing: Disadvantages

- An intermediate node may send Route Reply using a stale cached route, thus polluting other caches
- This problem can be eased if some mechanism to purge (potentially) invalid cached routes is incorporated.