Ad Hoc On-Demand Distance-Vector Protocol (AODV)

Lecture 1 : The basic ideas behind the AODV protocol.

Lecture 2 : Detailed explanations for the AODV protocol.

Unicasting

- The routing we have discussed so far is mainly point-to-point routing.
- A source node wants to send a message to a destination node.

Multicasting

- However, in many situations a node wants to send a message to a group of nodes in the network.
- This is called multicasting and the group is called a multicast group.

Broadcasting

- Broadcasting is a special case of multicasting when all the nodes in the network is in the multicast group.

Multicasting Support

- DSDV and DSR mainly support unicast routing.
- If multicasting is required, a node must establish unicast routes to each node in the multicast group.
- A more efficient approach will maintain multicast routing trees for each multicast group.

Non-uniform Packet Size in DSR

- Though DSR is a reactive or on-demand routing protocol, a major problem with DSR is its non-uniform packet size.
- When a source node S sends a packet to a destination node D, S should send the entire route to D along with the packet.
- This is necessary for the intermediate nodes to forward the packet.

Problem with Non-uniform Packet Size

- Usually all media support packets of uniform size. If a packet is large, it has to be split into smaller packets.
- This may cause problems in the wireless medium as packets that are split into smaller parts may not arrive in correct order.
- Intermediate nodes may not be able to forward packets correctly.

Main Features of the AODV Protocol (I)

- The Ad hoc On-Demand Distance Vector protocol is both an on-demand and a table-driven protocol.
- The packet size in AODV is uniform unlike DSR. Unlike DSDV, there is no need for system-wide broadcasts due to local changes.
- AODV supports multicasting and unicasting within a uniform framework.

Main Features of the AODV Protocol (II)

- Each route has a lifetime after which the route expires if it is not used.
- A route is maintained only when it is used and hence old and expired routes are never used.
- Unlike DSR, AODV maintains only one route between a source-destination pair.

Unicast Route Establishment

- Unicast route is a route from a source node to a destination node.
- Like DSR, we use two types of messages, route request (RREQ) and route reply (RREP).
- Like DSDV, we use sequence numbers to keep track of recent routes. Every time a node sends a new message, it uses a new sequence number which increases monotonically.

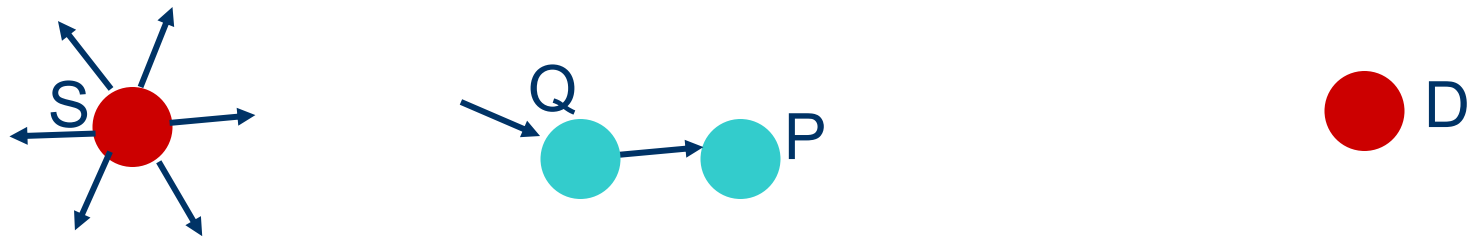
Route Request (RREQ) Message

- When node S wants to send a message to node D, S searches its route table for a route to D.
- If there is no route, S initiates a RREQ message with the following components :
  - The IP addresses of S and D
  - The current sequence number of S and the last known sequence number of D
  - A broadcast ID from S. This broadcast ID is incremented each time S sends a RREQ message.

Processing a RREQ Message (I)

- The <broadcast ID, IP address> pair of the source S forms a unique identifier for the RREQ.
- Suppose a node P receives the RREQ from S. P first checks whether it has received this RREQ before.
- Each node stores the <broadcast ID, IPaddress> pairs for all the recent RREQs it has received.

Processing a RREQ Message (II)



- If P has seen this RREQ from S already, P discards the RREQ. Otherwise, P processes the RREQ :
- P sets up a reverse route entry in its route table for the source S.
- This entry contains the IP address and current sequence number of S, number of hops to S and the address of the neighbour from whom P got the RREQ.

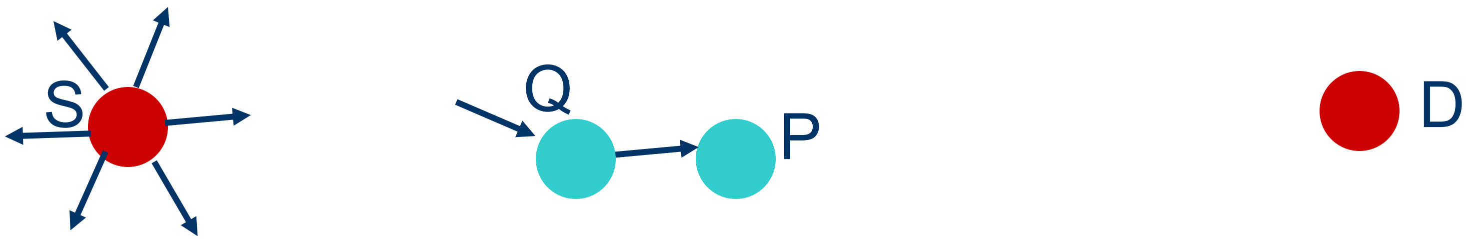
Lifetime of a Route-Table Entry

- A lifetime is associated with the entry in the route table.

- This is an important feature of AODV. If a route entry is not used within the specified lifetime, it is deleted.

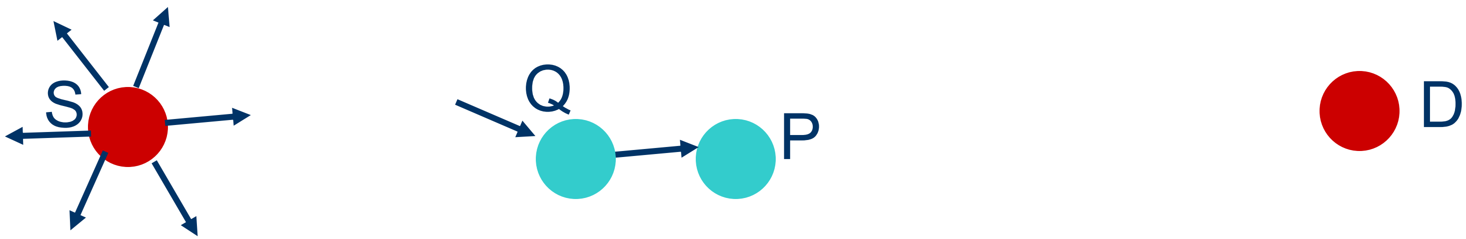
- A route is maintained only when it is used. A route that is unused for a long time is assumed to be stale.

Responding to a RREQ



- P can respond to the RREQ from S if P has an unexpired entry for D in its route table.
- Moreover, the sequence number from D that P has must not be less than the sequence number of D that was in the RREQ from S.
- This ensures that there is no loop in the route.
- If P satisfies both of these requirements, it unicasts a RREP message back to S.

Responding to a RREQ



- If P cannot reply to the RREQ from S,
- P increments the hop-count of the RREQ and broadcasts it to its neighbours.
- Naturally, the destination node D is always able to send a RREP since it has the highest sequence number.
- If the RREQ is lost, the source node S can try the route discovery a fixed number of times.

Expanding Ring Search

- For route discovery, a source node broadcasts a RREQ across the network. This may create a lot of messages in a large network.
- A source node uses an expanding ring search strategy. With a ring diameter K, a RREQ dies after its hop-count exceeds K.
- If a RREQ fails, the source node increases the value of K incrementally.