Ad hoc On-Demand Distance Vector Routing

a routing protocol for mobile ad hoc networks

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Outline of the Presentation

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Establishing routes in mobile ad-hoc networks

AODV tackles the challenge of establishing routes in mobile ad-hoc networks (MANETs) and other wireless ad-hoc networks.

Problems with Traditional routing protocols

Traditional routing protocols, designed for static networks, wouldn't work well in mobile ad-hoc networks (MANETs). AODV, instead,

- uses a reactive approach to route discovery.
- (i.e.) finds a route when a source node needs to communicate with a specific destination node.
- doesn't maintaining unnecessary routes, i.e. conserves resources

It was jointly developed by **Charles Perkins** (Sun Microsystems) and **Elizabeth Royer** (University of California, Santa Barbara) and was first published in the ACM 2nd IEEE Workshop on Mobile Computing Systems and Applications (IEEE/WMCSA) in February 1999 [1].

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What is the solution/contribution

Efficient routing in MANETs unlocks a wide range of applications. These include:

- Sensor networks for environmental monitoring and disaster relief.
- Mobile communication in remote areas without fixed infrastructure.
- Collaborative computing among mobile devices.

Without effective routing, communication in these scenarios becomes unreliable or impossible. Delays and disruptions can severely limit the functionality and usefulness of MANETs

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Motivation/Importance

keeping communication flowing as the world becomes increasingly mobile and interconnected

- Efficient routing in MANETs is crucial for reliable communication in dynamic, mobile environments.
- It's not just about connectivity; it unlocks innovative applications like sensor networks and mobile collaboration.
- MANET routing mirrors a broader challenge in network design: keeping communication flowing as the world becomes increasingly mobile and interconnected.
- While AODV offers a solution, real-world complexities require further development.
- Solving this problem paves the way for a future where mobile devices seamlessly connect and collaborate, shaping a more dynamic and information-rich world.

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Model, Definitions

Formal definition of a Stochastic Process

Here are some key terms that you will be encountering throughout the report:

- Mobile Ad-Hoc Network (MANET): A temporary network formed by mobile devices without a central infrastructure.
- Routing Protocol: A set of rules that devices use to determine the path for data packets across a network.
- Proactive Routing: A routing protocol where nodes maintain routing information for all destinations continuously.
- Reactive Routing: A routing protocol where nodes only discover routes when communication with a specific destination is needed.

Background

- DSDV (Destination-Sequenced Distance Vector) [2] is a proactive routing protocol known for its loop-free paths and efficient route maintenance. However, its proactive nature can lead to high control overhead in dynamic MANETs.
- DYMO (Dynamic MANET On-Demand Routing) [3], another on-demand routing protocol, shares similarities with AODV. However, it utilizes a different route discovery mechanism based on source routing, where the entire route is included in the route request packet. This can increase packet size and overhead compared to AODV's hop-by-hop approach.
- OLSR (Optimized Link State Routing) [4] is a hybrid protocol that combines proactive and reactive elements. It maintains local link state information and periodically floods the network with control messages. While efficient for stable network topologies, OLSR might struggle with highly dynamic MANETs.

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Route Discovery

Major Results

Route discovery is the core functionality of AODV, initiated by a source node seeking a path to a destination. It involves two primary message types: Route Request (RREQ) and Route Reply (RREP)

- **Route Request (RREQ) Generation**: When a source node needs to send data to a destination for which it lacks a route entry, it generates an RREQ packet. This packet includes the source node's ID, a unique sequence number, the destination node's ID (if known), and the current hop count (initially set to 1).
- **RREQ Broadcasting**: The source node broadcasts the RREQ packet to its immediate neighbors
- **Route Establishment**: Upon receiving an RREP, the source node can initiate data transmission using the es- tablished route information. Nodes along the path update their routing tables with the next hop towards the destination

RREQ Forwarding Algorithm

Algorithm

RREQ Forwarding: Intermediate nodes receiving an RREQ process it as follows:

1. If the node is the destination, it unicasts an RREP back to the source node.
2. If the node has a fresh route entry for the destination (determined by sequence number), it unicasts an RREP back to the source node using the existing route information.
3. Otherwise, the node increments the hop count in the RREQ packet and rebroadcasts it to its neighbors (excluding the node from which it received the RREQ to avoid loops).

Route Maintenance

Explain the Significance of the Results

AODV employs a mechanism to maintain route validity due to the dynamic nature of MANETs.

1. **Route Timeout**: Each route entry in a node's routing table has an associated timer. If no data packets are sent on a particular route within the timeout period, the entry is considered stale and marked as invalid.
2. **Route Invalidation**: When a node detects a broken link (e.g., a neighbor moves out of range), it initiates route invalidation. It sends a Route Error (RERR) packet upstream towards the source node using the existing route (if possible). The RERR packet carries information about the broken link, allowing nodes to remove the affected route from their tables.
3. **Route Re-establishment**: Once a route is invalidated, the source node can initiate a new route discovery process using an RREQ to find an alternate path to the destination.

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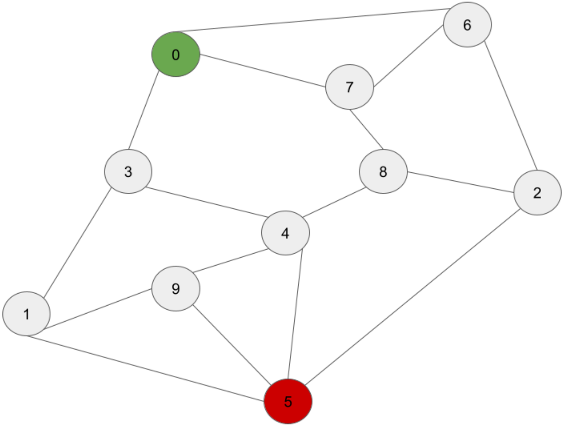
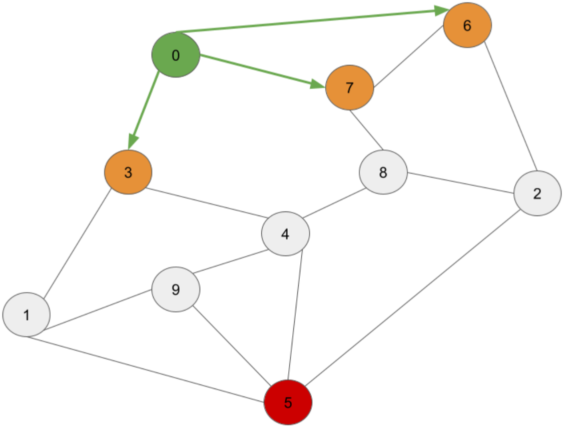
Sending RREQ from 0 to 5

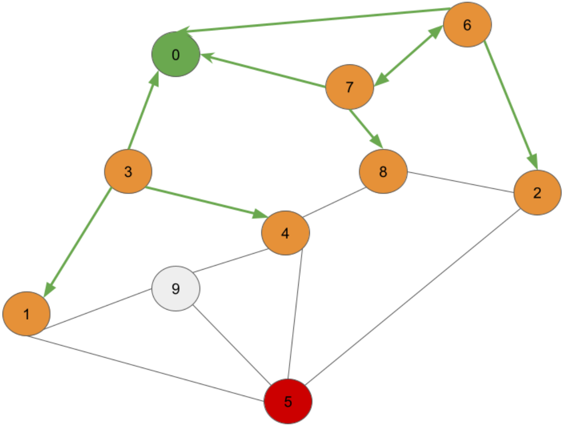


Nodes 3, 7, 6 are notified



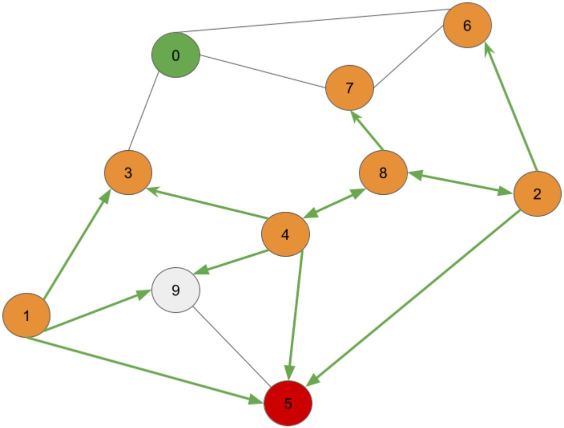
Since they are not destination, and their sequence number is less then that of message, they propagate RREQ

Nodes 1, 4, 8, 2 are notified



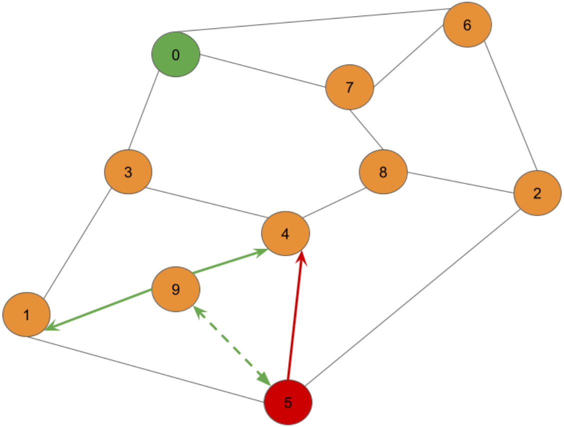
RREQ messages back to Node 1 will have no effect

Nodes 5 and 9 are notified



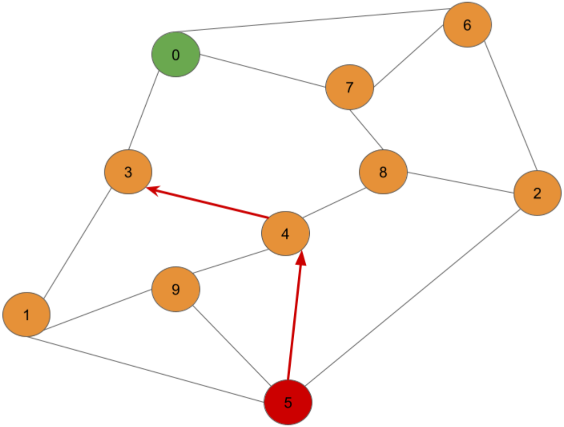
RREQ messages back to notified zone will have no effect due to their sequence number

RREP to Node 4



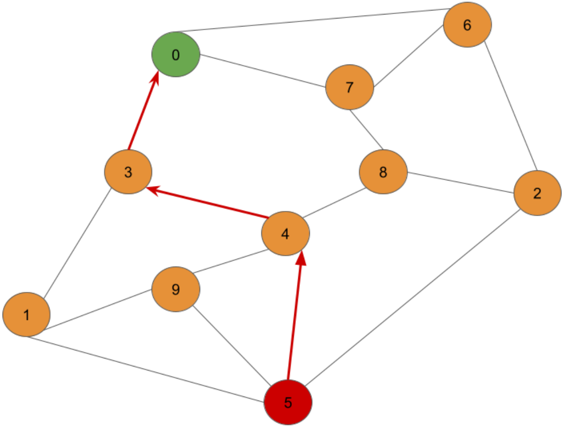
Next Hop from 5 to 0 is 4

RREP to Node 3



Next Hop from 4 to 0 is 3

RREP to Node 1



Next Hop from 3 to 0 is 0

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Conclusions

Hindsight is Clearer than Foresight

Advices come from

- cycle-free
- doesn't flood all the time
- Indicate that your Talk is Over

References

[1] C. Perkins and E. Royer, “Ad-hoc on-demand distance vector routing,” in *Proceedings WMCSA'99. Second IEEE Workshop on Mobile Computing Systems and Applications*, 1999, pp. 90–100.

[2] G. He, “Destination-sequenced distance vector (dsdv) protocol,” 2002. [Online]. Available: https://api.semanticscholar.org/CorpusID:12383459

[3] S. Ratliff, J. J. Dowdell, and C. E. Perkins, “Dynamic manet on-demand (aodvv2) routing,” 2013. [Online]. Available: https://api.semanticscholar.org/CorpusID:63975969

[4] T. H. Clausen and P. Jacquet, “Optimized link state routing protocol (olsr),” *RFC*, vol. 3626, pp. 1–75, 2003. [Online]. Available: https://api.semanticscholar.org/CorpusID:44711941

Questions

THANK YOU

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