Mobile Ad-hoc and Wireless Sensor Networks

Lesson 04

Mobile Ad-hoc Network (MANET) Routing Algorithms– Part 1

Ad-hoc networks deployment

- For routing, target detection, and service discovery
- Routing protocols used for routing by MANET nodes

Dynamic Source Routing (DSR) Protocol

- Deploys source routing
- Source routing means that each data packet includes the routing-node addresses also

Reactive protocol feature of DSR

- Reacts to the changes and dynamically maintains only the routing addresses from source to destination, which are the active paths to a destination at a given instant
- Performs unicast routing
- Unicast means routing packets to a single destined address

DSR Nodes

- Each node *caches* the specified route to destination during source routing of a packet through that node
- This enables a node to provide route-specification when a packet source routes from that node

DSR Nodes

- Each node *deletes* the specified route to destination during routing of error packet in reverse path to the source in case of observing a disconnection during forward path to destination
- The deletion of link shown in a table or cache is called link reversal

Phase 1 in DSR Protocol

- Source node initiates a route discovery process
- It broadcasts the packets, each with a header
- It then expects return of acknowledgement from each destination
- The packets are called route request (RREQ) packets

Phase 1 in DSR Protocol

- DSR uses flooding (sends multiple RREQs
- A header for each route request packet has the unique request number and source and destination addresses
- This enables identification of request at each intermediate node in the request and acknowledged packet(s)

Phase 1 in DSR Protocol

- When the process starts, initially only the source address is given in the header
- When the packet reaches a neighbour, that is, any intermediate node, the node adds its own address in the header if it is able to successfully send the packet to its next neighbour

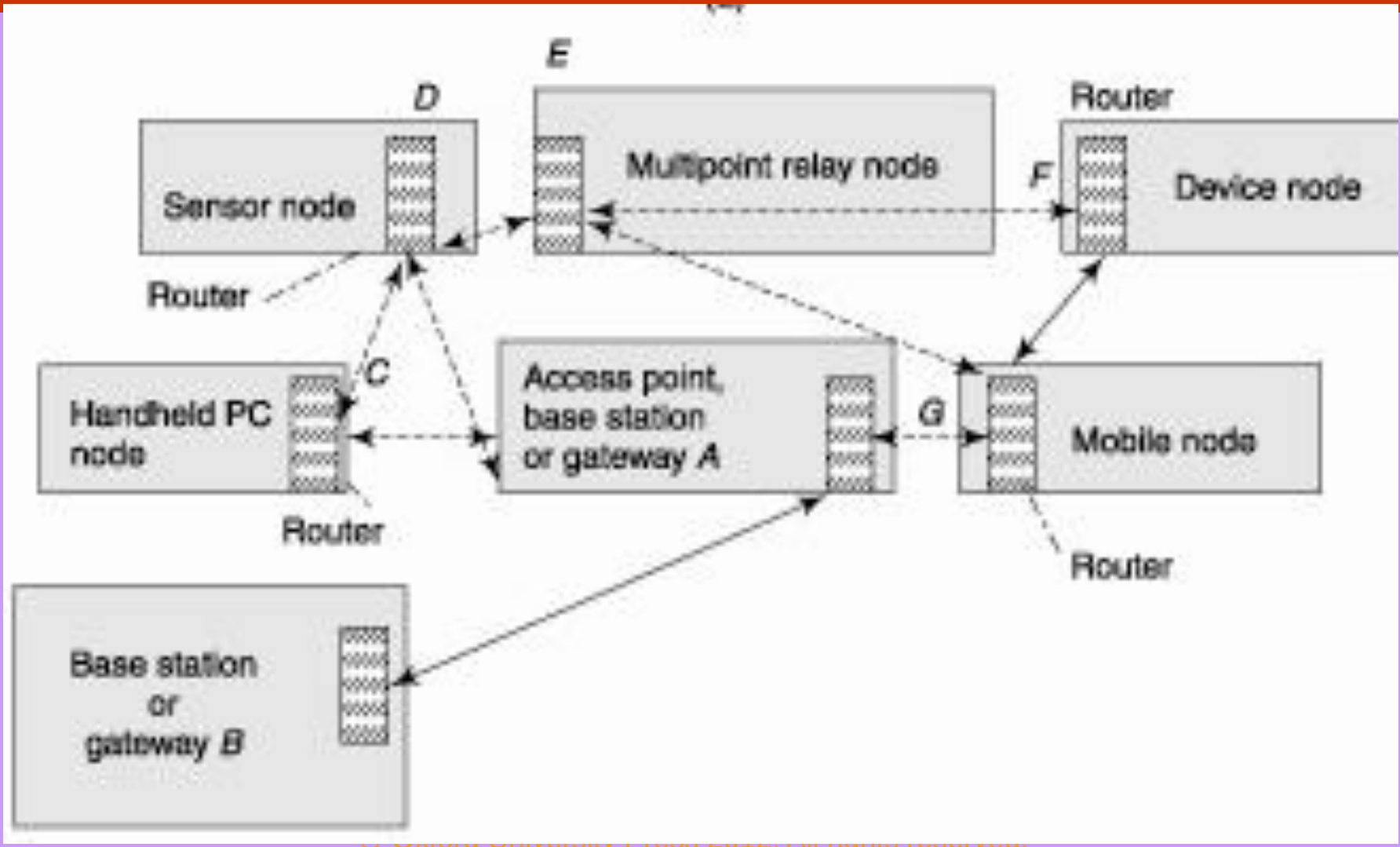
Phase 1 in DSR Protocol

- When the packet reaches the destined address, its header therefore has all addresses of the nodes in the path

Example

- Assume that node *D* is a source and *G* is a destination and the path *D—E—F—G* is not known. In such a case the path cannot be placed in the header.

Example of MANET



Source Route Discovery Process

- Source header from *D* puts the sequence number *q* and source address *D* in the packet header and sends the packet to its next neighbour. When the packet reaches *E*, its header is (*q*, *D*)
- Assume that no route error packet bounced back from neighbour *E*

Source Route Discovery Process

- The packet is then transmitted to *F*
- When the packet reaches *F*, its header is (*q*, *D*, *E*). Assume that no route error packet bounced back from neighbour *F*

Source Route Discovery Process

- The packet is transmitted from *F* to *G*. Assume that no route error packet bounced back from neighbour *G*.
- When the packet reaches *G*, its header is (*q*, *D*, *E*, *F*)

Domain Specific rules for consistency

- When packet reaches the destination, a route reply (RREP) for the sequence used in RREQ is generated
- On return path, the route cache builds up at each intermediate node for deployment at a later instant of phase 2

Phase 2 in DSR

- When any source node desires to send a message, it first looks at its route cache
- If the required route is available in cache, the source node puts all the addresses of the nodes for the path to destination in the header

Source routing addresses in DSR

- Assuming that there is a message from a MANET node *D* in the network

Node	Destination	Cached Path
D	*A*	*D—C—A*
D	*B*	*D—C—A—B*
D	*F*	*D—E—F*
D	*G*	*D—E—F—G*

Ad-hoc On-demand Distance Vector (AODV) Routing protocol

- A reactive protocol
- Reacts to the changes and maintains only the active routes in the caches or tables for a pre-specified expiration time
- Routes that are found that are available at a given instant

AODV

- Performs unicast routing
- Distance vector means a set of distant nodes, which defines the path to destination

AODV

- *D—E—F—G* is a distance vector for source-destination pair *D* and *G*
- In AODV, a distance vector is provided on demand during forwarding of a packet to destination by a node in the path and not by the route cache providing path through the header in the source data packet [phase 2]

AODV

- Every node keeps a next-hop routing table, which contains the destinations to which it currently has a route
- A routing table entry expires if it has not been used or reactivated for a pre-specified expiration time
- AODV adopts the destination sequence number technique

AODV

- Does not deploy flooding (multiple RREQs)
- Stores the next hop routing information of the active routes in the routing caches (tables) at each node
- Therefore, has small header size and thus reduces the network traffic overhead

Phase 1 in AODV Protocol

- A node uses hello messages to notify its existence to its neighbours
- Therefore, the link status to the next hop in an active route is continuously monitored

Phase 1 in AODV Protocol

- When any node discovers a link disconnection, it broadcasts a route error (RERR) packet to its neighbors, who in turn propagate the RERR packet towards those nodes whose routes may be affected by the disconnected link
- Then, the affected source can be informed

Phase 2 in AODV Protocol

- Source node initiates a route discovery process if no route is available in the routing table
- It broadcasts the demand through the RREQ packets

Phase 2 in AODV Protocol

- Each RREQ has an ID and the addresses of the source and destination in its header
- It expects return acknowledgement from destination
- A node identifies the last observed sequence number of the destination from the ID

Phase 2 in AODV Protocol

- Each RREQ starts with a small TTL (time to live) value [Number of attempts]
- If the destination is not found during the TTL, the TTL is increased in subsequent RREQ packets
- The node also identifies sequence number of source node

Phase 2 in AODV Protocol

- Sequence numbers ensure loop-free and up-to-date routes.
- Loop-free means free from bouncing of a packet to a node after intermediate hops

Phase 2 in AODV Protocol

- Each node rejects the RREQ which it had observed before
- This reduces flooding which means it reduces too many RREQs present in the network at a given instant.

Route table in AODV

- Keep entries for a specified period and each node maintains a cache
- The cache saves the received RREQs
- Only the RREQ of highest sequence numbers are accepted and previous ones are discarded

Route table in AODV

- The cache also saves the return path for each RREQ source
- When a node having a route to the destination or the destined node receives the RREQ, it checks the destination sequence number it currently knows and the one specified in the RREQ

Route table in AODV

- RREP packet is created and forwarded back to the source only if the destination sequence number is equal to or greater than the one specified in RREQ
- It guarantees the up-dation of routing cache information

Summary

- DSR
- Deploys source routing
- Reacts to the changes and dynamically maintains only the routing addresses from source to destination, which are the active paths to a destination at a given instant

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...Summary

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- Routes that are found that are available at a given instant
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...Summary

- AODV adopts the destination sequence number technique

End of Lesson 04
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