4th Year IT-IS-SW

# MANET vs VANET (Lecture 9)

## MANETs Characteristics

- Peer-to-peer and multi-hop transmission techniques
- No infrastructure and no base station
- Dynamic topologies
  - ✓ Network changes randomly based on MS movement
  - ✓ Routing challenges
- Bandwidth-constrained and variable capacity links
  - ✓ Lower capacity and bandwidth than cellular
  - ✓ More affected with noise, interference and fading
- Energy-constrained operation
  - ✓ All MS in MANET may rely on batteries
  - ✓ Need for design optimization of energy consumption
- Limited security
  - ✓ Spoofing, eavesdropping and denial of service threats increased in MANET than wireline networks

- **Challenges**
  - ✓ Routing
  - ✓ Heterogenous nodes
  - ✓ Time delay
  - ✓ Consume power
  - ✓ Symmetric (uplink - one way) Vs Asymmetric link (uplink - downlink)

## MANET Applications

- Defense applications
- Crisis-management applications
- Telemedicine
- Education via the Internet
- VANETs

## MANET Routing Goals

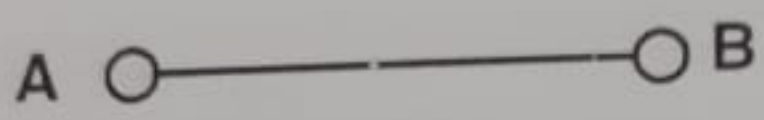
- Route computation must be **distributed**, because centralized routing in a dynamic network is impossible
- As **few nodes** as possible must be involved in route computation
- Each node must care only about the routes to its destination
- **Stale routes** must be either avoided or detected and eliminated quickly
- **Broadcasts** must be avoided as much as possible
- **Backup routes**

## VANETs (Vehicular Ad-hoc Networks)

- MANETs whose nodes are **vehicles**
- ***Goals*** are
  - ✓ Reduce accidents, congestion
  - ✓ Provide essential information
  - ✓ Increase mobility of humans and goods
  - ✓ Improve driving comfort

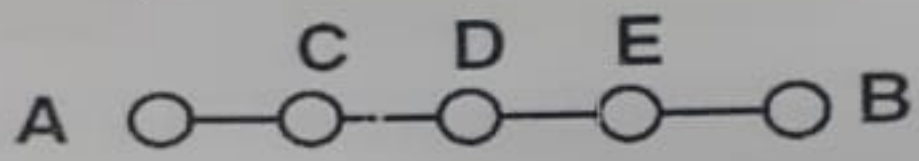
## Type of transmission

- Direct or single hop Transmission
  - Used in cellular network
  - Need strong power but decrease delay




(a) Direct transmission

- Multi-hop Transmission
  - Each hop like as router of pervious hop
  - Need power less than direct but increase delay




(b) Multi-hop transmission

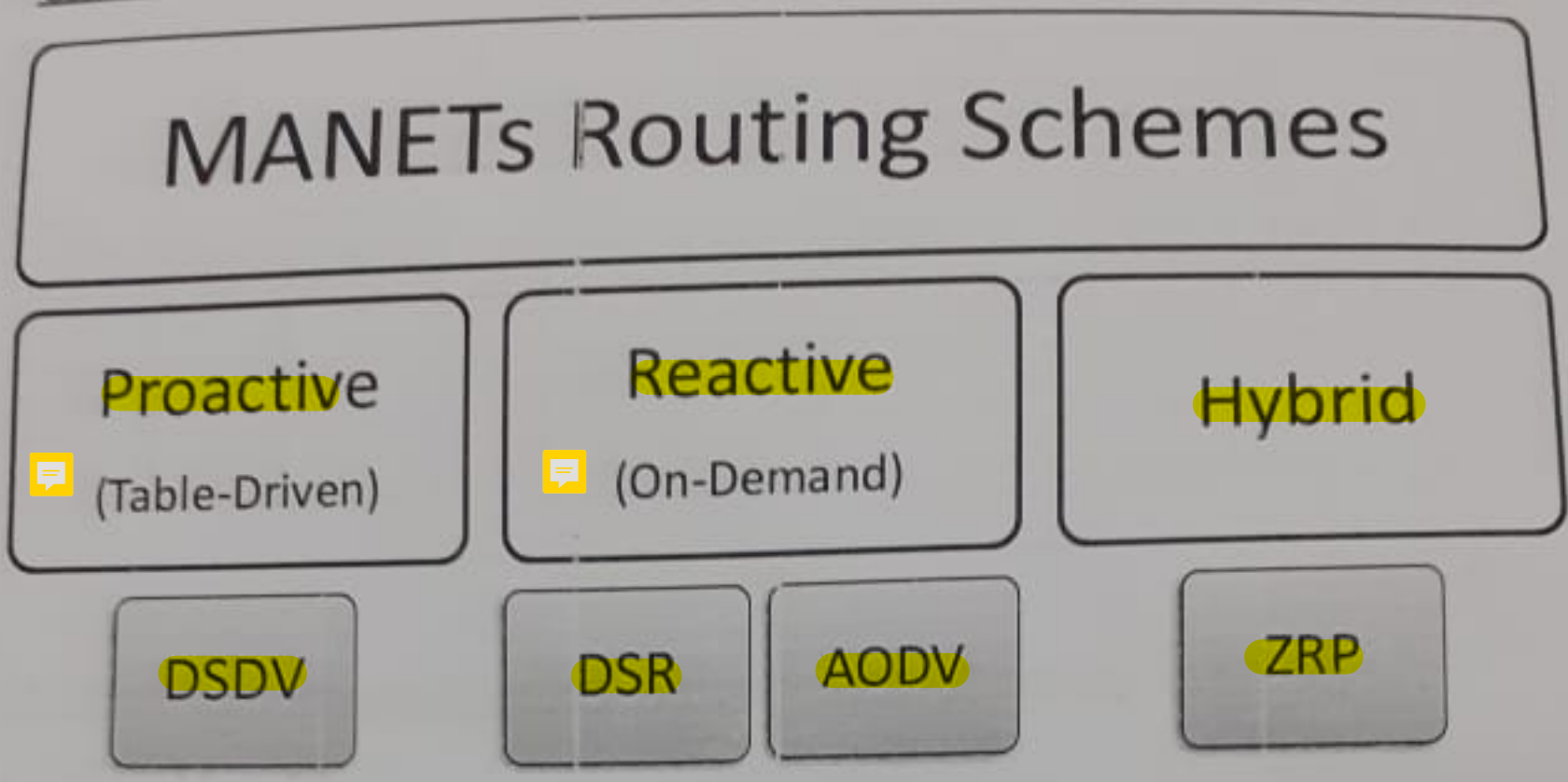
## Routing

- Find a path between two nodes through intermediate nodes
- **Routing finds the "optimal" path**

## Routing Process

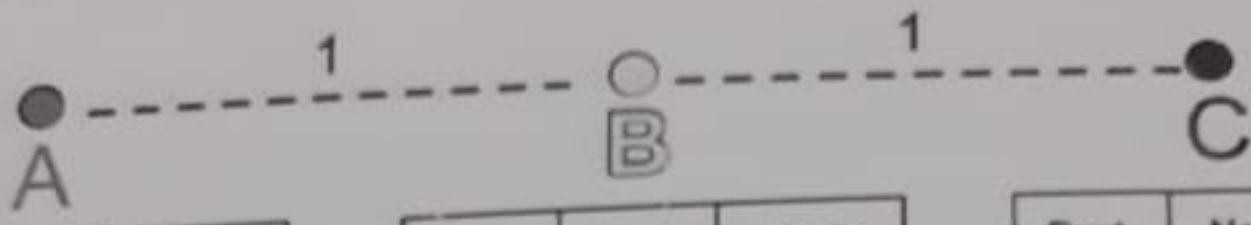
- Route Discovery
  - Find a route of potential routes between a source and a destination
- Route Selection
  - Pick the optimal path from set of routes that satisfies a given performance criteria
- Route Representation & Data Forwarding
  - Store route and perform data transfer

## Classification of MANET Routing Protocols




| Proactive Routing Schemes | Reactive Routing Schemes |
|---|---|
| *Evaluate continuously the routes within the network* | Invoke route determination procedure only **on demand** |
| *when a packet needs to be forwarded, route is already known and can be immediately used* | when a route is needed, global search procedure is initiated |
| Exchange routing information between nodes and store in **routing table** | Discovery terminates when route is discovered or no route is found<br>**Use route request and route replay in search procedure** |
| Negligible delay | Increase delay |
| **E.g. Destination Sequenced Distance Vector Routing (DSDV)** | **E.g. Dynamic Source Routing (DSR)** |

## Creating Routing Table




| Dest. | Next | Metric |
|---|---|---|
| A | A | 0 |
| B | B | 1 |
| C | B | 2 |

| Dest. | Next | Metric |
|---|---|---|
| A | A | 1 |
| B | B | 0 |
| C | C | 1 |

| Dest. | Next | Metric |
|---|---|---|
| A | B | 2 |
| B | B | 1 |
| C | C | 0 |

## Destination Sequenced Distance Vector Routing (DSDV) - Proactive Scheme

- Each node maintains routing table
  - Table stores route to every possible destination + number of hops to destination (metrics) + next node to reach destination + sequence number
- Each node periodically sends its routing table to its direct neighbors
  - Node receives information from its neighbors, updates routing table
- If destination has multiple route entries, entry with most recent sequence # is used

## Dynamic Source Routing (DSR) - Reactive Scheme

- Each node maintains a cache
  - Maintain source routes and update if new routes are discovered

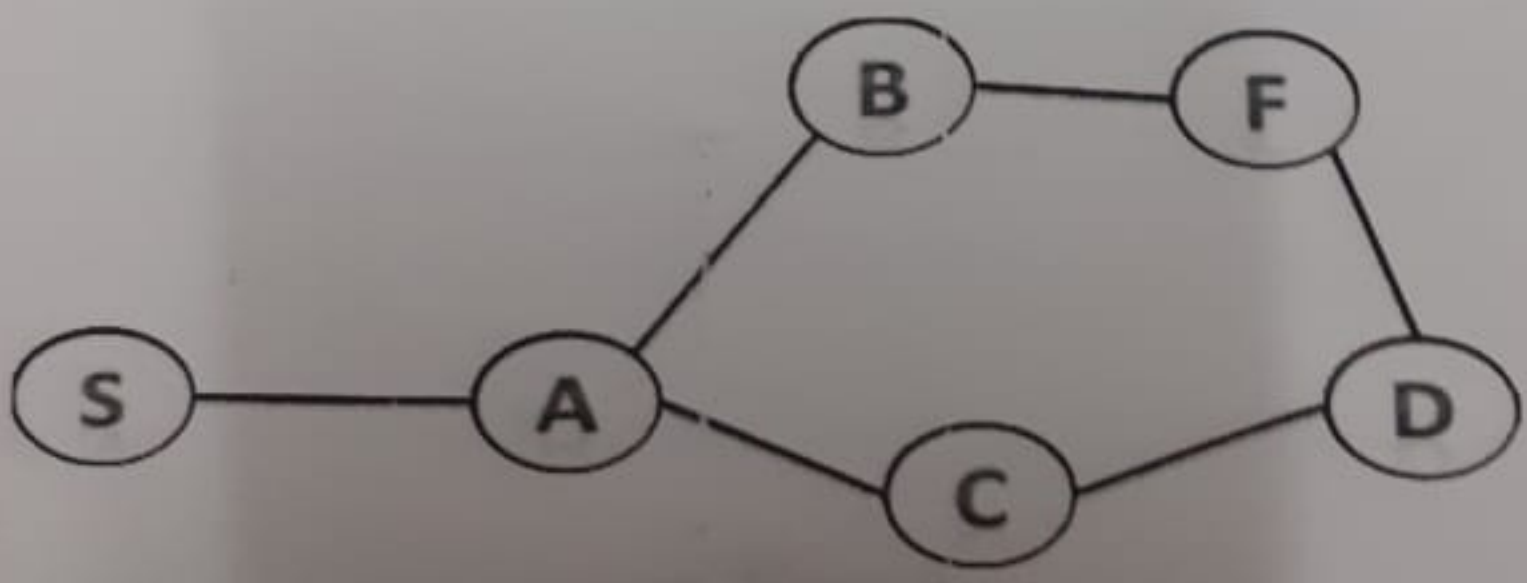
- When node has message to send, it uses cache
  - If there is a route to destination, use it
  - Else, initiate route discovery – broadcast **route request packet (src_addr, dst_addr, ID)**

- Node receiving route request packet and check its cache
  - If no route is found, it appends its address to route request packet and sends it to neighbors

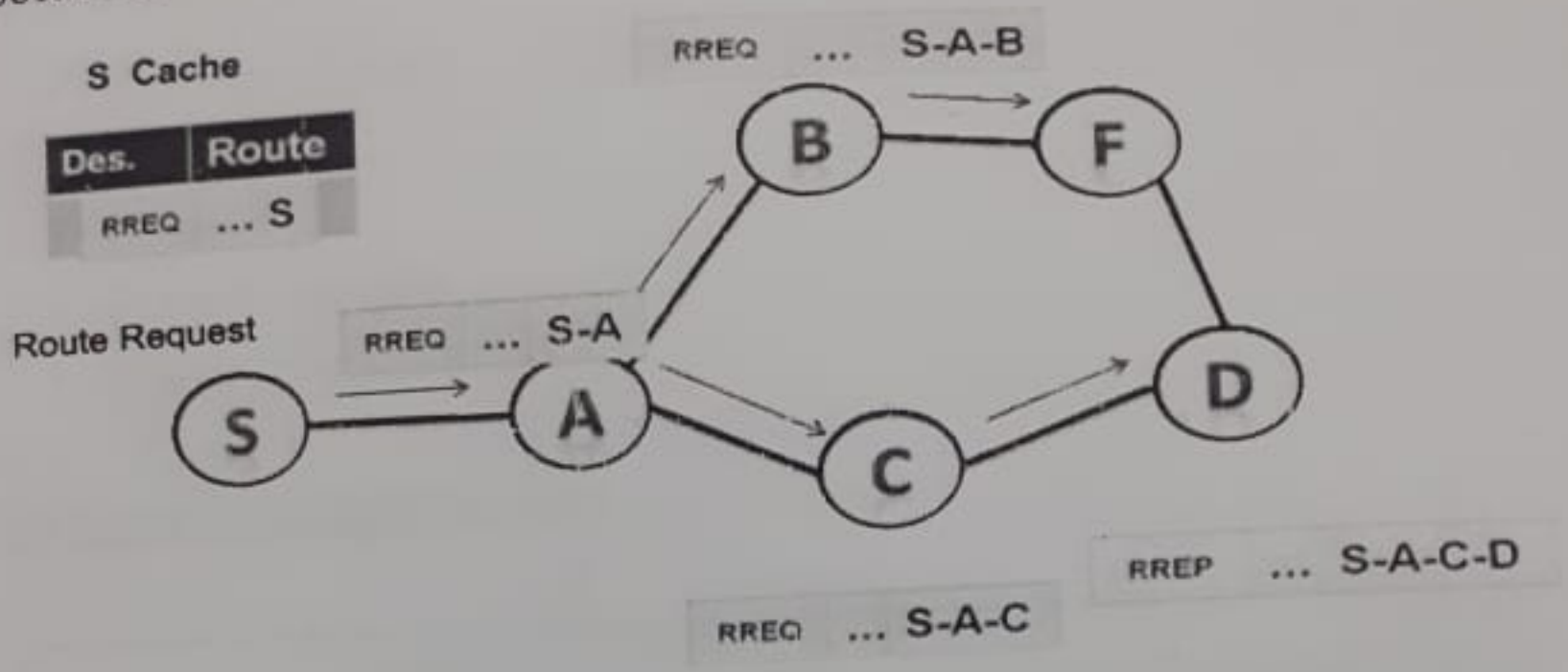
- Route record has information about all hops taken to destination

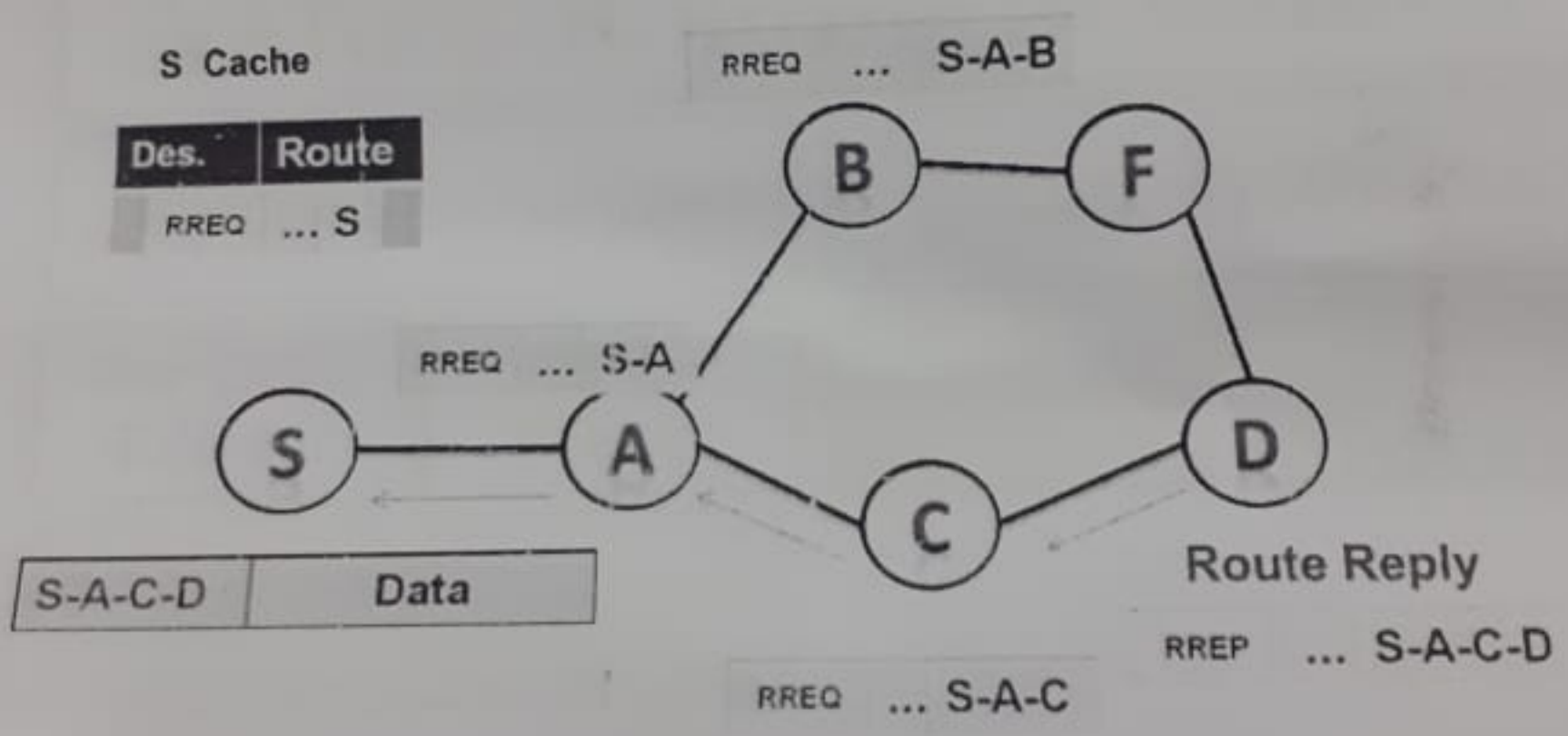
- If destination is receiver, it sends route record in a **route reply packet**

**Example** if S need to send packet to D



## Solution

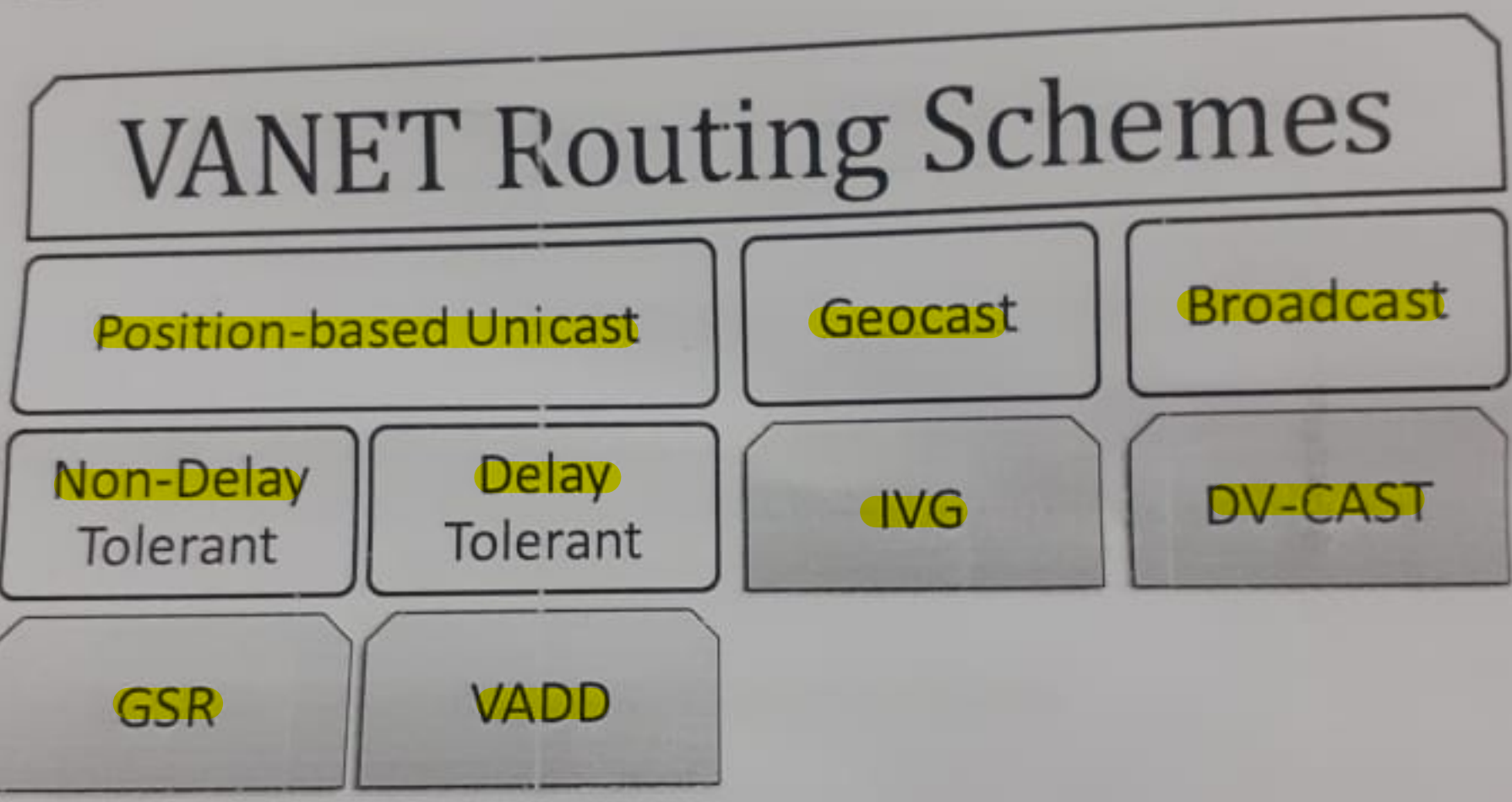

S Cache
Des. Route
RREQ ... S
Route Request
RREQ ... S-A
RREQ ... S-A-B
RREQ ... S-A-C
RREP ... S-A-C-D
S
A
B
C
D
F


S Cache
Des. Route
RREQ ... S
RREQ ... S-A-B
RREQ ... S-A
RREQ ... S-A-C
S
A
B
C
D
F
S-A-C-D Data
Route Reply
RREP ... S-A-C-D

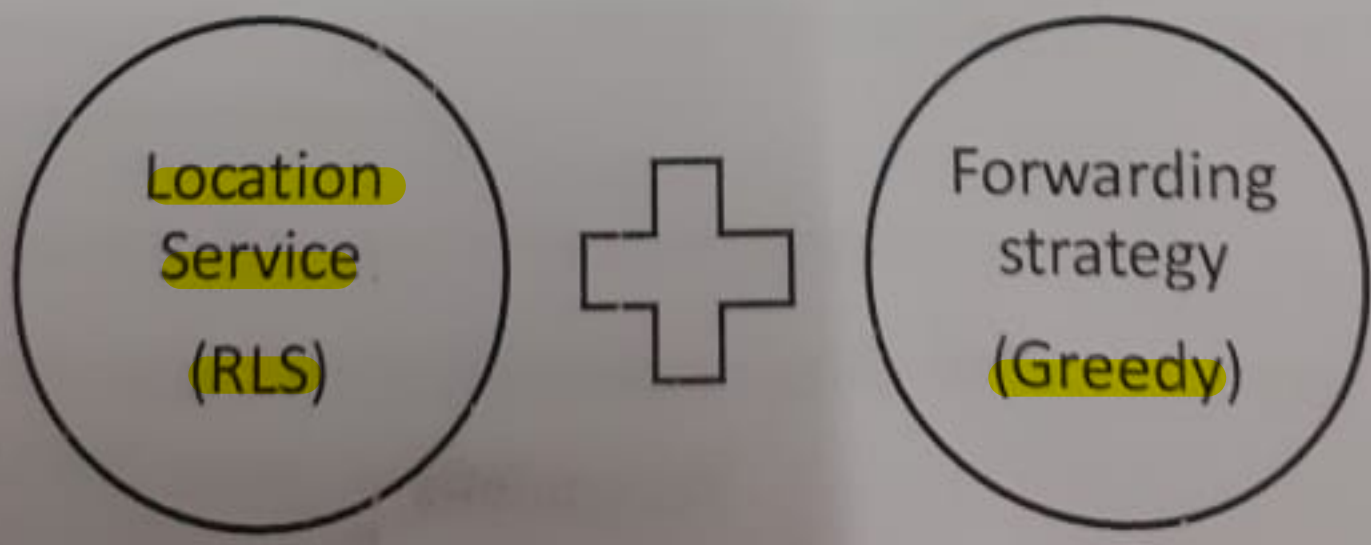
## Routing Metrics

- Number of hops
- Distance
- Delay
- Packet loss rate
- Energy consumption

## VANETs Routing Schemes




## Position-based Unicast Routing Operations



1. Reactive Location Service (RLS)
   - ✓ A node querying the geographical position of a certain node issues a **location query packet**,
   - ✓ Packet floods network until it reaches destination or TTL expires
   - ✓ When destination receive query packet, it creates a **location replay** packet with querying node ID and location

2. Greedy Forwarding
   - ✓ When an intermediate node receives a packet, it forwards the packet to a neighbor lying in the general direction of the recipient.

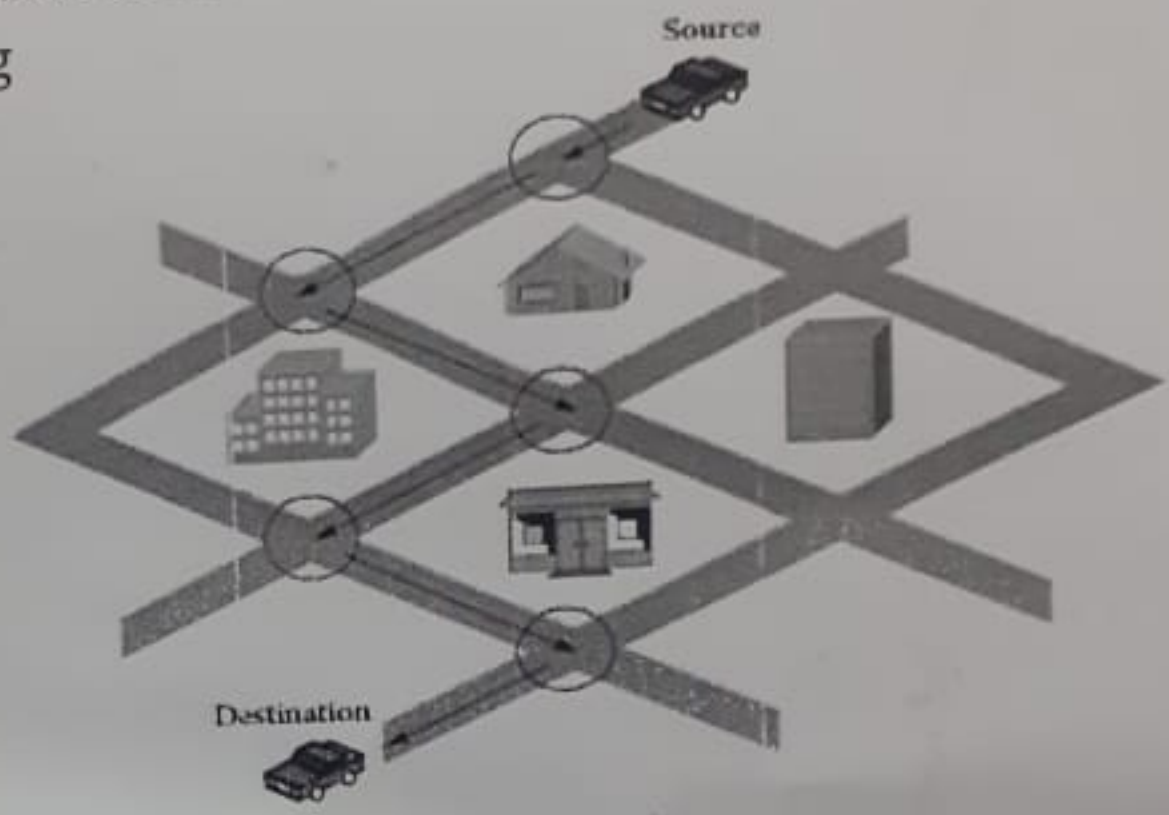
**Non-Delay Tolerant Position-based Routing**

- deliver packets as soon as possible
- *works best in city environments* where high traffic and there's *plenty of nodes*
- *Example:* **Geographic Source Routing (GSR)**

***Steps of Geographic Source Routing (GSR)***

- Use street map to compute path to destination in terms of junctions (intersections)
- Sender uses *RLS* to get destination's position
- Node computes path to destination using streets map and **Dijkstra's** shortest path algorithm

- Sender computes a sequence of junctions on the path that the packet has to traverse in order to reach the destination
- Sequence of junctions is either put into the packet header
- Forwarding a packet between two successive junctions is done by greedy forwarding




**GSR Problem**

- *If the connectivity between vehicles is low many packets could be dropped*