Course Name:	MCAN Laboratory	Semester:	VI
Date of Performance:	24 / 03 / 2025	Batch No.:	B - 2
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Faculty Sign & Date:		Grade/Marks:	___ / 25

Experiment No.: 6
Title: Experiment on AODV Routing in MANET

Aim and Objective of the Experiment:

To analyze and evaluate the performance of AODV routing protocol in a Mobile Ad Hoc Network (MANET) through simulation.

COs to be achieved:

CO3: Understand the current topics in MANETs and WSNs, both from an industry and research point of views.

Books/Journals/Websites referred:

1. Netsim MANET manual

Tools required:

NetSim software

Theory:

AODV (Ad hoc On-Demand Distance Vector) is a reactive routing protocol designed for Mobile Ad Hoc Networks (MANETs). It establishes routes between nodes only as needed, which helps reduce control overhead and increases the efficiency of the network in highly dynamic environments.

AODV builds routes using a route discovery process that is initiated only when a source node desires to communicate with a destination node for which it does not already have a route.

Key Characteristics:

- **On-demand route establishment**: Routes are created only when required.
- **Sequence numbers**: Used to ensure the freshness of routing information and to avoid routing loops.
- **Maintains active routes**: Only routes that are actively being used are maintained in the routing table.

- **Loop-free routing**: Ensures that the route to a destination is loop-free by using destination sequence numbers.
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Route Discovery Process:

1. **Route Request (RREQ)**:
   - When a source node needs a route to a destination, it broadcasts a RREQ packet.
   - The RREQ contains the source and destination IP addresses, current sequence numbers, and a broadcast ID.
2. **Route Reply (RREP)**:
   - When the RREQ reaches the destination node or an intermediate node with a valid route to the destination, a RREP packet is generated.
   - The RREP is unicast back to the source node using the reverse path created during the RREQ propagation.
3. **Route Maintenance**:
   - If a link break is detected in an active route, a Route Error (RERR) message is sent to inform other nodes of the link failure.
   - The source node can initiate a new route discovery if communication is still required.

AODV ensures efficient utilization of network resources by minimizing the number of broadcasts and maintaining routes only while they are needed.

Implementation details:

1. **Enlist all the Steps followed and various options explored.**
   a. Selected AODV routing protocol as the focus for simulation in MANET.
   b. Used NS2/NS3/any network simulator to simulate network topology and node mobility.
   c. Defined simulation parameters: number of nodes, area size, simulation time, traffic type (CBR), and mobility model (Random Waypoint).
   d. Explored different routing protocols (e.g., DSDV, DSR) to compare performance with AODV.
   e. Configured AODV protocol and observed routing behavior such as route discovery, packet delivery, and route maintenance.
   f. Analyzed performance metrics like packet delivery ratio, end-to-end delay, and routing overhead.
   g. Visualized results using trace files or graphical tools (e.g., XGraph or NAM in NS2).

2. **Explain your program logic and methods used.**
   a. Implemented the simulation script using TCL (Tool Command Language) for NS2 or Python/C++ for NS3.
   b. Nodes were created and configured with mobility and traffic generation models.
   c. AODV protocol was set as the default routing agent using appropriate simulator commands.
   d. The simulation logic included:
      - Triggering Route Request (RREQ) messages when a node required a route.
      - Receiving Route Reply (RREP) from the destination or intermediate nodes.
      - Handling link breaks using Route Error (RERR) messages.

   e. Collected data from the output trace files for performance analysis.
   f. Used statistical and visual methods to compare the efficiency of AODV with other protocols under varying conditions.

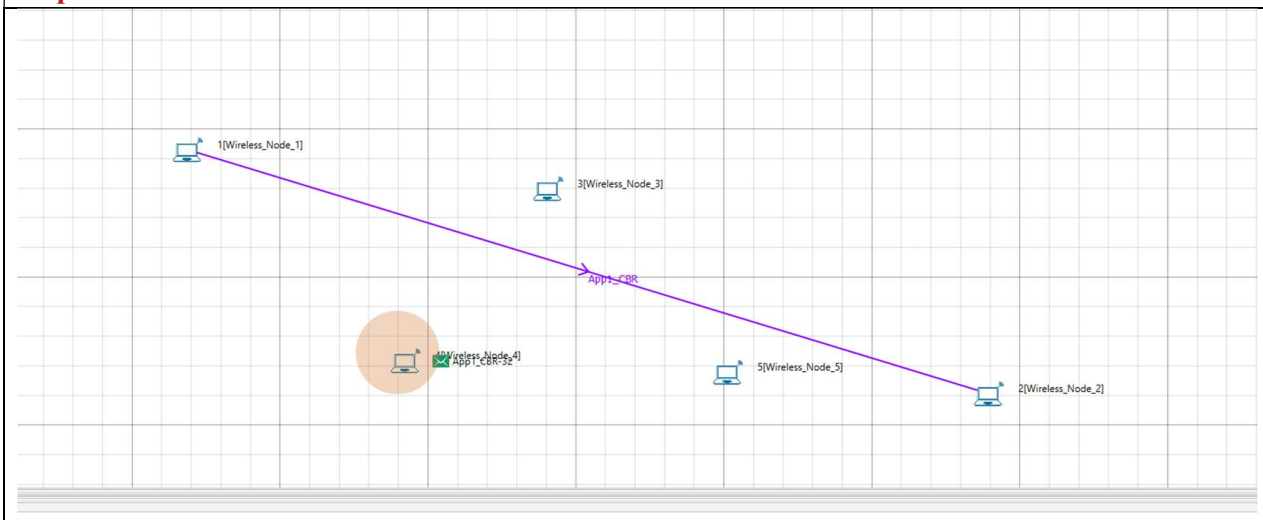
Procedure:

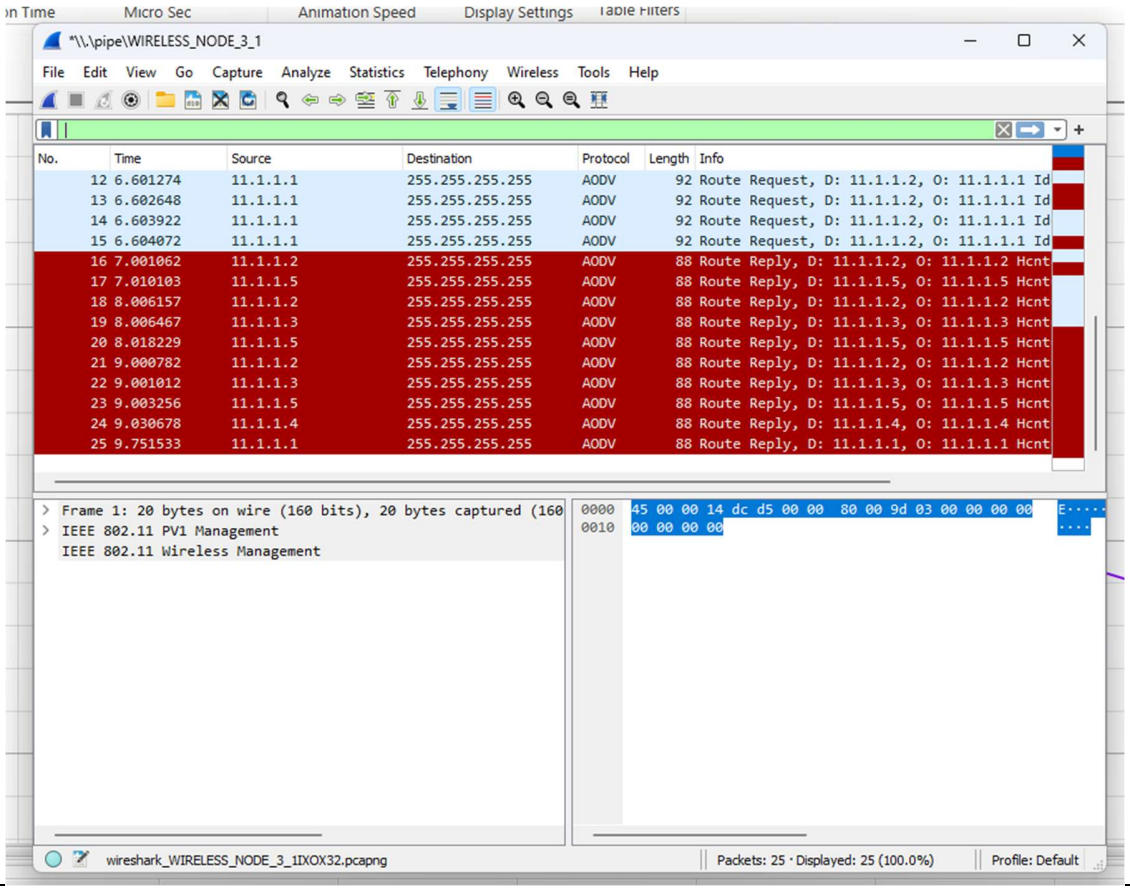
1. Selected AODV routing protocol as the focus for simulation in MANET.
2. Used NS2/NS3/any network simulator to simulate network topology and node mobility.
3. Defined simulation parameters: number of nodes, area size, simulation time, traffic type (CBR), and mobility model (Random Waypoint).
4. Explored different routing protocols (e.g., DSDV, DSR) to compare performance with AODV.
5. Configured AODV protocol and observed routing behavior such as route discovery, packet

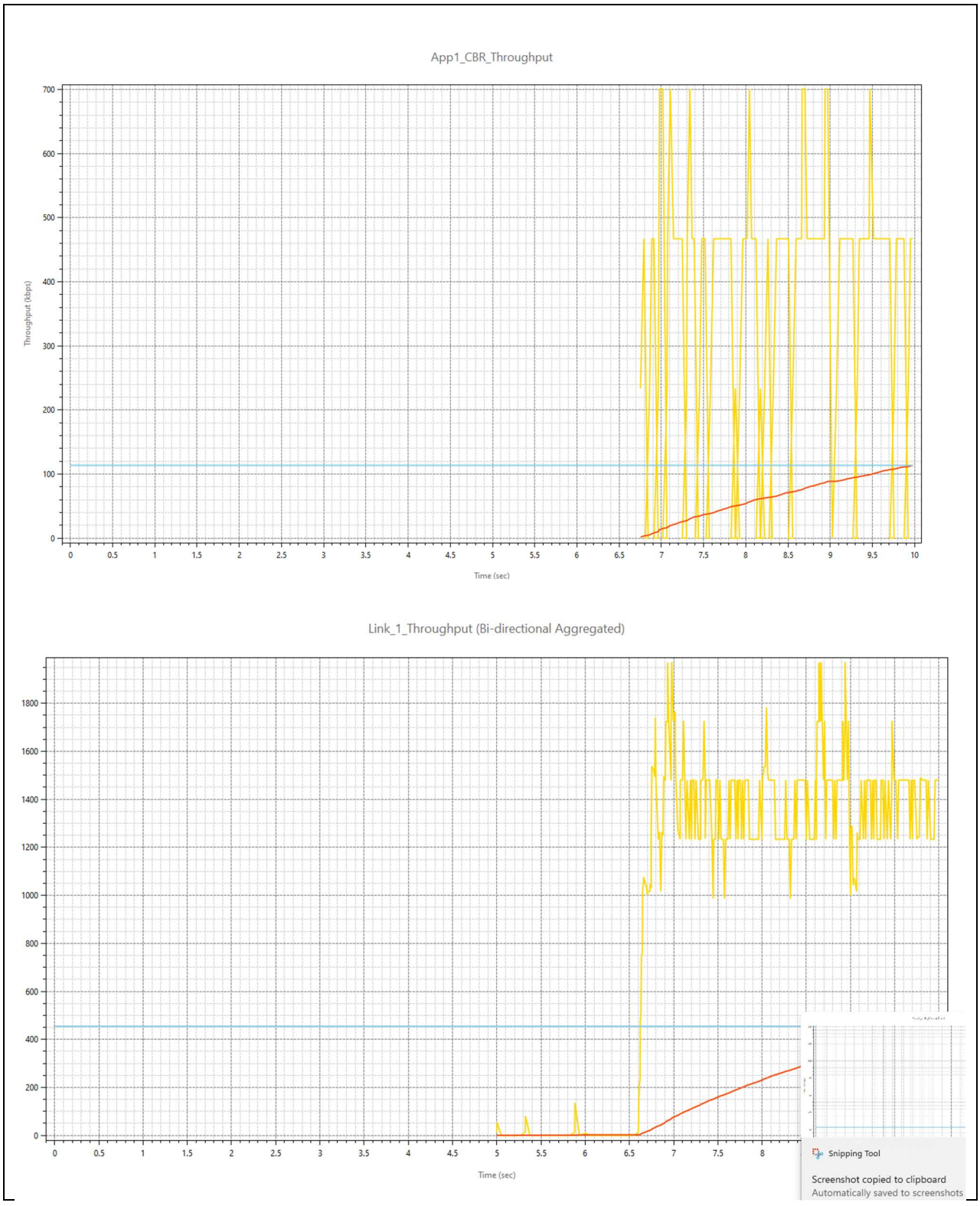
delivery, and route maintenance.

6. Analyzed performance metrics like packet delivery ratio, end-to-end delay, and routing overhead.

Implementation Screenshots:






App1_CBR_Throughput
Throughput (kbps)
Time (sec)
Link_1_Throughput (Bi-directional Aggregated)
Time (sec)
Snipping Tool
Screenshot copied to clipboard
Automatically saved to screenshots

Post Lab Questions:

1. **What are the characteristics of an Ideal Routing Protocols for Adhoc Wireless Network?**

   An ideal routing protocol for ad hoc wireless networks should possess the following characteristics:

   - Distributed Operation: The protocol must operate in a fully distributed manner without relying on any central node.
   - Loop-Free Routes: Must ensure loop-free routing to avoid routing errors and unnecessary bandwidth usage.
   - Minimal Control Overhead: Should reduce the number of control messages to conserve bandwidth and energy.
   - Adaptive to Topology Changes: Must quickly adapt to frequent and unpredictable topology changes due to node mobility.
   - Scalability: Should perform well as the number of nodes in the network increases.

2. **How Route maintenance is carried out in AODV protocol? Give advantages and disadvantages of AODV.**

   In AODV, route maintenance is carried out through the following mechanisms:

   - Hello messages: Periodically sent by nodes to detect link status with neighbors.
   - Route Error (RERR) Messages:
     - When a node detects a link break to the next hop in an active route (e.g., due to mobility), it generates a RERR message.
     - The RERR is sent to all affected source nodes using that route.
   - Route Table Update:
     - Upon receiving a RERR, source nodes delete the broken route from their routing tables.
     - If communication is still needed, the source initiates a new route discovery process.

   Advantages:

   - On-Demand Route Discovery: Reduces unnecessary overhead by establishing routes only when needed.
   - Loop-Free Routes: Ensures data is not trapped in cycles.
   - Quick Adaptation: Responds efficiently to topology changes.
   - Lower Control Overhead: Compared to proactive protocols, control packets are fewer.

   Disadvantages:

   - High Latency in Route Discovery: Delay occurs during initial route discovery.
   - Route Inconsistency: Temporary inconsistencies may occur due to mobility and delayed updates.
   - Overhead from Control Packets: Though minimized, frequent route discovery in highly mobile networks can still generate considerable overhead.

Conclusion:
The AODV routing protocol efficiently establishes routes on-demand in dynamic ad hoc wireless networks. It balances low overhead with reliable route maintenance, making it suitable for mobile environments.

Signature of faculty in-charge with Date: