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| **Course Name:** | **MCAN Laboratory** | **Semester:** | **VI** |
| **Date of Performance:** | **21 / 04 / 2025** | **Batch No.:** | **B - 2** |
| **Faculty Name:** | **Dr. Rajashree Daryapurkar** | **Roll No.:** | **16014022050** |
| **Faculty Sign & Date:** |  | **Grade / Marks:** | **\_\_\_ / 25** |

**Experiment No.: 9**

**Title: Experiment on Power model in MANET**

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| **Aim and Objective of the Experiment:** |
| To study and analyze the effect of the power model on the performance of a MANET using NetSim. |

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| **COs to be achieved:** |
| **CO3: Understand the current topics in MANETs and WSNs, both from an industry and research point of views.**  **CO4: Analyze how proactive routing protocols function and their implications on data transmission delay and bandwidth consumption.** |

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| **Books/Journals/Websites referred:** |
| NetSim User Manual |

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| **Tools required:** |
| NetSim software |

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| **Theory:** |
| Mobile Ad hoc Networks (MANETs) are self-configuring wireless networks made up of mobile nodes that communicate with each other without relying on any fixed infrastructure or centralized access points. Each node in a MANET function not only as an end device but also as a router, forwarding data packets to other nodes. One of the most critical constraints in a MANET environment is **limited energy availability**, as nodes usually operate on battery power. Hence, **energy efficiency** becomes a major design concern for any MANET protocol or system.  To evaluate and improve the energy performance of a MANET, **power models** are integrated into simulations. A power model describes how much energy is consumed by a node when it performs different functions such as transmitting, receiving, remaining idle, or entering sleep mode. Each of these activities has a corresponding **power consumption rate** measured in milliwatts (mW), and the total energy usage is calculated based on how long the node remains in each state.  The **four main energy states** in a power model are:   1. **Transmit mode**: The node consumes the highest energy when actively sending data. 2. **Receive mode**: Energy is consumed while listening and receiving incoming packets. 3. **Idle mode**: Even when not transmitting or receiving, a node still consumes some power while monitoring the channel. 4. **Sleep mode**: The lowest power state, used to conserve energy when the node is inactive.   In a dynamic MANET, nodes are constantly moving, which leads to frequent topology changes. This causes route updates and retransmissions, leading to further energy consumption. Over time, the batteries of nodes deplete, which may lead to **network partitioning** or **loss of connectivity** when certain nodes die. Therefore, analyzing the **battery behavior** and energy efficiency of the network under different configurations becomes essential for designing robust and long-lasting MANET systems.  By using a simulation platform like **NetSim**, researchers can simulate realistic MANET scenarios and apply power models to each node. NetSim provides detailed control over energy parameters such as **initial battery capacity**, **power consumption rates for each state**, and **thresholds** for battery warnings. After simulation, NetSim offers **battery statistics** such as energy consumed per node, remaining battery life, time spent in each state (Tx, Rx, Idle, Sleep), and more.  Studying these metrics allows users to better understand how power consumption affects routing performance, throughput, node longevity, and overall network health. This also helps in evaluating **energy-aware protocols** or strategies such as **sleep scheduling**, **low-power routing**, or **adaptive transmission** based on energy levels.  Thus, the **power model experiment** in MANET serves as an essential step toward energy-efficient wireless networking and helps simulate real-world constraints faced by mobile battery-operated devices. |

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| **Procedure:** |
| 1. Open NetSim and select the MANET simulation environment. 2. Create the network topology:    * Drag and drop multiple wireless nodes (like 10–20 nodes) into the workspace. 3. Configure node properties:    * Set Mobility Models (e.g., Random Waypoint).    * Configure Power Model parameters:      1. Transmit Power (mW)      2. Receive Power (mW)      3. Idle Power (mW)      4. Sleep Power (mW)      5. Initial Battery Capacity (mAh) 4. Set Application Traffic:    * Define applications like CBR (Constant Bit Rate) between selected nodes. 5. Run the simulation:    * Set simulation time (e.g., 100–300 seconds).    * Start the simulation and observe node movement, battery depletion, and network behavior. 6. Analyze the results:    * Check the Battery Metrics report to view power consumption, battery levels, and energy usage states (Tx, Rx, Idle, Sleep).    * Study how mobility and traffic affect node battery drain. |

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| **Output/ results after execution:** |
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| **Post Lab Questions:** |
| 1. **Explain power/energy aware routing in MANETs.**   Power or energy-aware routing in Mobile Ad hoc Networks (MANETs) refers to a class of routing protocols that are specifically designed to extend the lifetime of the network by minimizing energy consumption during communication. Since nodes in a MANET are typically battery-powered, efficient use of energy is crucial to maintain network connectivity and avoid early node failures. Traditional routing protocols generally focus on finding the shortest or fastest path between source and destination, without considering the energy status of the participating nodes. In contrast, energy-aware routing protocols consider metrics such as residual battery power, energy consumption per route, transmission power levels, and load balancing among nodes to make routing decisions.  The goal of energy-aware routing is not just to deliver packets efficiently but also to balance energy usage across the network so that no single node is overburdened and drained quickly. Some protocols may avoid nodes with low battery levels or prefer routes with nodes that have higher energy reserves. Others may dynamically adjust transmission power or switch routes to save energy. Examples of such protocols include Minimum Total Transmission Power Routing (MTPR), Minimum Battery Cost Routing (MBCR), and Energy-Aware Routing (EAR). These approaches help reduce packet drops due to node failures, maintain network performance for longer durations, and improve the overall sustainability of MANET operations. |

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| **Conclusion:** |
| The experiment on the power model in MANET helps us understand the importance of energy consumption in mobile wireless networks. By configuring and analyzing power parameters such as transmit, receive, idle, and sleep modes in NetSim, we observe how battery usage impacts node performance and network lifetime. |

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| **Signature of faculty in-charge with Date:** |