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| **Course Name:** | **MCAN Laboratory** | **Semester:** | **VI** |
| **Date of Performance:** | **17 / 03 / 2025** | **Batch No.:** | **B - 2** |
| **Faculty Name:** | **Dr. Rajashree Daryapurkar** | **Roll No.:** | **16014022050** |
| **Faculty Sign & Date:** |  | **Grade / Marks:** | **\_\_\_ / 25** |

**Experiment No.: 5**

**Title: Experiment on 802.16 WMAN (LTE)**

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| **Aim and Objective of the Experiment:** |
| To simulate and analyze the impact of SISO (Single Input Single Output) and MIMO (Multiple Input Multiple Output) transmission modes on the throughput of LTE networks using NetSim software. |

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| **COs to be achieved:** |
| **CO1:** Compare different types of wireless networks used in MANET. |

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

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

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| **Theory:** |
| MIMO (Multiple Input, Multiple Output) technology improves network performance by utilizing multiple antennas at both the transmitter (eNB) and receiver (UE) ends, allowing the system to transmit multiple data streams simultaneously. This leads to better spectral efficiency and higher data rates compared to traditional SISO (Single Input, Single Output) systems, which use a single antenna at both ends. The results from the simulation highlight the effectiveness of MIMO in optimizing LTE network throughput, especially in terms of increasing capacity and reducing interference. |

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| **Implementation details:** |
| **Enlist all the Steps followed and various options explored.** Step 1: Opening the LTE MIMO Example Configuration  * Open NetSim. * Select Examples > LTE and LTE-A > LTE MIMO from the home screen. * Click on the tile in the middle panel to load the example.  Step 2: Modifying Wired Link Speeds  * Right-click the wired link between the eNB and the EPC and select Properties. * Set Max\_Uplink\_Speed (Mbps) and Max\_Downlink\_Speed (Mbps) to 1000 for both uplink and downlink. * Set Uplink and Downlink BER to 0.0000001. * Click OK. * Repeat the same steps for the other wired links (EPC to router, router to wired node).  Step 3: Configuring Unicast Application  * Click the Application icon in the toolbar to open the Configure Application window. * Configure Application1:   + Set Source\_ID to 5.   + Set Destination\_ID to 3.   + Set Application Start Time to 1 second.   + Set Packet Size to 1460 bytes.   + Set Transport Protocol to UDP.   + Set Inter-arrival Time to 129.78 microseconds. * Click OK.   **Explain your program logic and methods used.**  Network Setup:   * The network consists of key components: eNB (evolved NodeB), EPC (Evolved Packet Core), UE (User Equipment), a router, and a wired node. The unicast application running on the wired node transmits data to the UE. * Wired link speeds and the network configuration are set up to ensure proper communication between all elements, with the speed set to 1000 Mbps for each link.   Application Configuration:   * A unicast application is configured with specific parameters like source and destination IDs, packet size, transport protocol (UDP), and inter-arrival time between packets. The objective is to generate a consistent flow of data from the source to the destination.   eNB Configuration:   * The eNB's physical layer settings are adjusted to simulate the MIMO setup. This includes setting the DL:UL ratio, bandwidth, and the number of antennas on both the transmitter (eNB) and receiver (UE). * Additionally, various propagation models and parameters like pathloss, shadow fading, and line-of-sight probability are configured to simulate realistic transmission conditions.   Simulation Execution:   * The simulation is run for a duration of 2 seconds. The results focus on the throughput of the application being transmitted over the LTE network with MIMO transmission technology in place. |

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| **Procedure:** |
| 1. **Open NetSim and select Examples > LTE and LTE-A > LTE MIMO.** 2. **Configure wired link speeds to 1000 Mbps and set BER to 0.0000001 for all wired links.** 3. **Set up the unicast application with specified parameters:**    * **Source ID: 5**    * **Destination ID: 3**    * **Transport protocol: UDP**    * **Packet size: 1460 bytes**    * **Inter-arrival time: 129.78 microseconds** 4. **Adjust eNB physical layer settings:**    * **Bandwidth: 5 MHz and 10 MHz**    * **DL: UL Ratio: 4:1**    * **Set appropriate antenna configurations for SISO (1x1) and MIMO (2x2, 4x1, 2x4).** 5. **Run the simulation for 2 seconds.** 6. **Analyze the results using the Application Metrics table.** |

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| **Output/ results after execution:** |
| * + - 1. **See that by default, NetSim has created unicast applications and specified some default settings.**   **LTE MIMO 1x1 1x1**      **LTE MIMO 2x2 2x2**      **LTE MIMO 4x1 2x4**  C:\Users\Admin\Downloads\image.png  C:\Users\Admin\Downloads\image (1).png   |  |  | | --- | --- | | Number of Tx and Rx Antennas | Application Throughput | | **LTE MIMO 1x1 1x1** | 33.11 | | **LTE MIMO 2x2 2x2** | 52.92 | | **LTE MIMO 4x1 2x4** | 89.19 | |

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| **Conclusion:** |
| In this experiment we learnt that the simulation shows that using MIMO technology with multiple transmit and receive antennas significantly enhances throughput. The throughput value for Application\_1 in this simulation is 33.11 Mbps, which reflects the improved performance when MIMO is utilized. |

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