**Project Report: Simplified Implementation of NOMA in 5G Networks**

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| **Section** | **(01)** |

**Abstract**

**In this project, we investigate the potential of Non-Orthogonal Multiple Access (NOMA) to enhance bandwidth efficiency in 5G networks compared to Orthogonal Multiple Access (OMA). Using MATLAB and Python, we simulated various transmission scenarios, integrated Machine Learning (ML) for throughput prediction, and stored results on Firebase for enhanced visualization. The findings demonstrate the superiority of NOMA in bandwidth utilization under low-noise conditions while highlighting its sensitivity to increased user density and noise levels**

**Keyword**

NOMA, OMA, 5G Networks, Machine Learning, Throughput, SINR, MATLAB, Firebase

**I. Introduction**

With the proliferation of connected devices and Internet of Things (IoT) applications, efficient bandwidth management has become critical. Traditional access techniques, such as OMA, often fail to optimize spectrum usage in dense networks. NOMA, leveraging power domain separation, offers a promising solution. This project explores the implementation and efficiency of NOMA compared to OMA, focusing on throughput under varying noise conditions and user densities.

**II. Objectives**

1. **Simulate and compare the performance of NOMA and OMA in 5G networks.**
2. **Integrate Machine Learning to predict throughput under varying noise conditions.**
3. **Utilize cloud platforms for systematic result storage and analysis.**

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**III. Problem Statement**

**The increasing demand for wireless bandwidth necessitates advanced solutions to optimize resource allocation. This project examines how NOMA can address these challenges by improving spectrum efficiency, especially in noisy environments and high user densities**

**IV. Components and Tools**

**1. Software**

* **MATLAB: Simulations, user interface design, and regression model training.**
* **Python: Data visualization and cloud integration with Firebase.**

**2. Cloud Platforms**

* **Firebase Realtime Database: Storing and analyzing simulation results.**

**V. Methodology**

**Step 1: Study NOMA Concepts**

* **Researched power domain separation and user pairing.**
* **Analyzed SINR (Signal-to-Interference-plus-Noise Ratio) and throughput equations.**

**Step 2: Simulation Creation**

* **Developed MATLAB code to simulate NOMA and OMA with adjustable parameters:**
  + **User count.**
  + **Noise power levels.**
  + **Throughput visualization.**

**Step 3: UI Development**

* **Designed a MATLAB dashboard with:**
  + **Sliders for real-time adjustments of user count and noise power.**
  + **Graphs showing NOMA vs. OMA throughput and noise impact analysis.**

**Step 4: Result Storage**

* **Connected MATLAB to Firebase for systematic storage of simulation parameters and results.**

**Step 5: AI Integration**

* **Trained a regression model using MATLAB’s Machine Learning Toolbox.**
* **Features: Noise levels, user count, and throughput.**
* **Validated the model with simulation results.**

**Step 6: Testing with Noise**

* **Conducted simulations across noise levels (0.001, 0.01, 0.05, 0.1).**
* **Observed NOMA’s performance under varying conditions**

**VI. Results and Observations**

**1. Simulation Dashboard**

* **Interactive dashboard visualizing NOMA and OMA throughput.**

**2. Firebase Integration**

* **Results stored systematically with parameters (e.g., user count, noise levels).**

**3. Observations**

* **NOMA Throughput: Declined with increased user count and noise power but remained efficient under low-noise conditions.**
* **OMA Throughput: Remained stable but consistently lower than NOMA under optimal conditions.**
* **AI Predictions: Closely matched simulated values, validating model reliability.**

**4. Analysis**

* **NOMA performance is influenced by power allocation and interference, leading to lower SINR as user density or noise increases**

**VII. Improvements and Future Work**

**1. Enhancements Made**

* **Integrated a regression model for predicting throughput.**
* **Automated data storage using Firebase.**
* **Developed an intuitive MATLAB UI for real-time adjustments.**

**2. Potential Improvements**

* **Incorporate SDR hardware for real-world validation.**
* **Add diverse noise models (e.g., Gaussian, impulsive) for robustness.**
* **Optimize power allocation strategies for improved fairness in NOMA**

**VIII. Conclusion**

**This project successfully demonstrated the efficiency of NOMA over OMA in 5G networks. By integrating AI and cloud platforms, we provided a robust framework for analyzing and visualizing performance metrics. Future work will focus on real-world testing and refining AI models with larger datasets**

**Acknowledgments**

**We extend our gratitude to Dr. Abdullah Albuali for his guidance throughout this project**

**References**

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