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Smart Grid Communication

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Abstract: *The evolution of modern power systems has introduced the concept of Smart Grids—intelligent networks that combine communication, control, and computational technologies to enhance energy distribution and reliability. Smart Grid Communication (SGC) is the key component that enables two-way data flow between power utilities and consumers. This paper discusses the architecture, technologies, and protocols of smart grid communication with a focus on reliability, scalability, and security. Furthermore, it highlights emerging trends such as the use of the Internet of Things (IoT), Artificial Intelligence (AI), and 5G for improving grid performance and real-time decision-making.*

Keywords: *Smart Grid, Communication Networks, IoT, 5G, Artificial Intelligence, Energy Efficiency*

I. INTRODUCTION

Energy demand is increasing rapidly due to population growth and the integration of renewable energy sources. The Smart Grid represents a digital transformation of the traditional power grid, allowing automated control, real-time monitoring, and bidirectional communication between all entities. Smart Grid Communication enables efficient energy management by connecting smart meters, substations, and control centers through secure and high-speed data networks. These systems improve operational efficiency, minimize power losses, and enhance service reliability for end users.

II. METHODOLOGY

Smart Grid Communication operates through hierarchical layers such as the Home Area Network (HAN), Neighborhood Area Network (NAN), and Wide Area Network (WAN). Each layer serves a specific purpose—HAN connects household devices and smart meters, NAN aggregates local data, and WAN links substations to control centers. Communication technologies such as Power Line Communication (PLC), ZigBee, Wi-Fi, and LTE are commonly used based on range and data requirements. Recently, 5G and IoT have emerged as promising solutions for enhancing latency, coverage, and scalability in smart grid systems.

III. RESULTS AND DISCUSSION

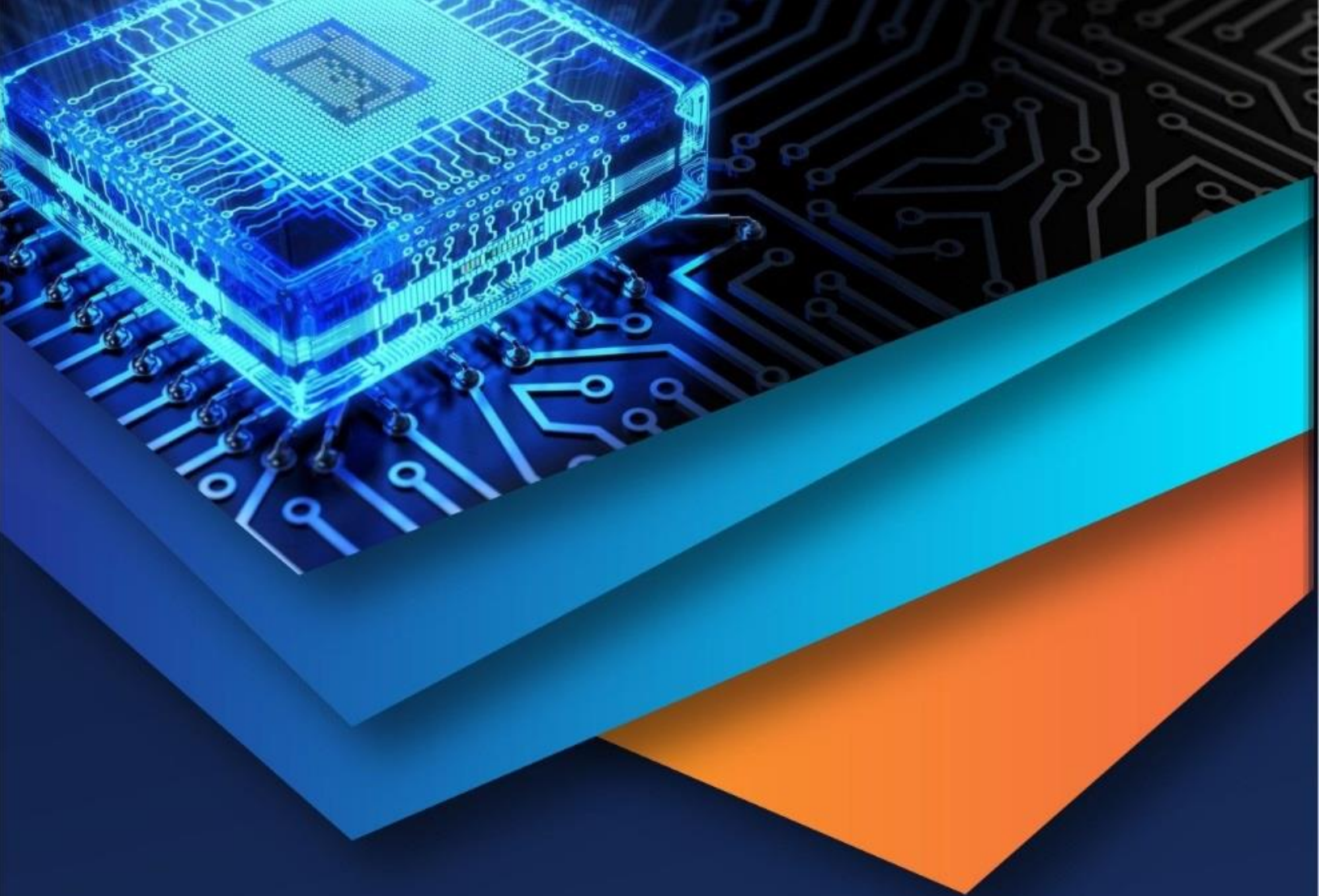
The integration of advanced communication systems in smart grids results in improved fault detection, reduced response time, and enhanced energy efficiency. IoT-based sensors and AI-driven analytics provide predictive insights for grid maintenance and stability. Despite these advantages, challenges such as cybersecurity threats, interoperability issues, and high deployment costs persist. The application of 5G networks and blockchain-based authentication can mitigate many of these challenges, paving the way for secure and resilient grid communication.

IV. CONCLUSION

Smart Grid Communication plays a critical role in transforming energy infrastructure into an intelligent and sustainable system. The integration of next-generation technologies such as AI, IoT, and 5G ensures efficient grid management and consumer engagement. Future research should focus on enhancing data security, standardizing communication protocols, and optimizing energy routing mechanisms for large-scale deployment.

REFERENCES

- [1] Ghasempour, "Internet of Things in Smart Grid: Architecture, Applications, Services, Key Technologies, and Challenges," IEEE Access, vol. 9, pp. 29614–29635, 2024.
- [2] M. Chen et al., "5G-Enabled Smart Grids: A Comprehensive Review," IEEE Transactions on Industrial Informatics, vol. 20, no. 3, pp. 1452–1465, 2025.
- [3] R. Gupta and S. Kumar, "Edge Computing Framework for Smart Grid Communication," IEEE Systems Journal, vol. 18, no. 1, pp. 550–560, 2024.



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