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A Comparative Study of HF, VHF, and UHF Band Efficiency in Amateur Radio Communication

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Abstract: *Amateur radio communication spans a diverse range of frequency bands, each possessing unique characteristics that influence their operational efficiency across different environments and use cases. This study presents a comparative analysis of the High Frequency (HF: 3–30 MHz), Very High Frequency (VHF: 30–300 MHz), and Ultra High Frequency (UHF: 300 MHz–3 GHz) bands, focusing on their signal propagation behaviors, environmental interactions, and suitability for various modes of amateur communication. Through empirical measurements, simulation models, and literature review, we evaluate performance metrics including range, signal stability, antenna requirements, noise susceptibility, and data bandwidth. The findings highlight that HF bands excel in long-distance communication via ionospheric reflection, VHF offers robust regional coverage especially in mobile setups, while UHF provides superior penetration in urban and indoor conditions, favoring digital modes. This comparative framework aids in optimizing band selection for specific amateur radio applications, enhancing efficiency, and fostering adaptive strategies for future advancements in amateur radio technology.*

Keywords: Amateur Radio, HF Band, VHF Band, UHF Band, Radio Frequency Propagation, Signal Efficiency, Band Comparison, Communication Range

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