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This study investigates the impact of environmental conditions, multi-GNSS satellite signal strength, and battery levels on smartphone power consumption during location-based services (LBS). Using data collected from three Android smartphones under varying conditions (Open Sky and Urban Canopy), we examine the relationship between GNSS signal quality, positional accuracy, and battery drain. Result... [Show More](#)

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# Impact of Multi-GNSS Signal Strength on Smartphone Battery Consumption

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## Abstract

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- I. Introduction
- II. Carrier to Noise Ratio (C/N0)
- III. Basic Formula of Mobile Power Consumption due to LBA
- IV. Experimental setup and data monitoring plan
- V. Results and Discussion

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## Abstract:

This study investigates the impact of environmental conditions, multi-GNSS satellite signal strength, and battery levels on smartphone power consumption during location-based services (LBS). Using data collected from three Android smartphones under varying conditions (Open Sky and Urban Canopy), we examine the relationship between GNSS signal quality, positional accuracy, and battery drain. Results show that signal strength remains relatively stable across different battery levels in both environments, with urban areas experiencing weaker signals due to obstructions. Interestingly, some satellite constellations, like BeiDou and QZSS, exhibit stable or improved signal strength as battery levels decrease, suggesting optimizations in the GNSS chipsets. Power consumption was higher in open sky conditions, where stronger signals required continuous GNSS sensor activity. In contrast, urban environments saw lower power drain as the device struggled to maintain connections. Significant variations in power drain were observed across devices, with more efficient smartphones like Vivo V23e 5G and ASUS MAX PRO consuming less power. The study highlights the potential for optimizing GNSS systems to reduce battery drain without sacrificing accuracy, contributing to more energy-efficient LBS applications in smartphones.

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## I. Introduction

In the era of smartphones, location-based services (LBS) have become an integral part of everyday life, offering users a wide range of functionalities, including navigation, geolocation-based recommendations, and real-time tracking. These services are driven by the power of Global Navigation Satellite Systems (GNSS), which enable smartphones to capture the user's position, coordinates, velocity, and orientation [1]–[6]. The widespread use of LBS in applications such as ride-sharing services, and fitness trackers highlights their significance in modern mobile computing. However, despite the obvious utility of these services, they are also notorious for their substantial power consumption, which presents a significant challenge in

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