Improving Ground Station Systems through Smart Software and Automation: A Review

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Abstract:

Ground station systems are evolving from hardware-centric architectures to flexible, software-defined platforms capable of handling real-time data acquisition, autonomous decision-making, and secure communication. With increasing mission demands, ground systems must now support intelligent fault detection, virtualized infrastructure, and seamless scalability across multi-satellite environments. Recent advancements have introduced software-driven methods for performance evaluation, AI-assisted monitoring, encrypted remote operations, and shared resource management using SDN. This paper synthesizes multiple approaches focused on optimizing these functions to enhance system reliability and responsiveness. By examining diverse implementations—from predictive maintenance frameworks to secure tunneling protocols and centralized web-based control—this review identifies common technological trends and practical outcomes. The study highlights how modular design, intelligent automation, and network resilience are becoming foundational pillars in the next generation of ground station architecture, setting the direction for future development and integration in complex satellite communication networks.

Keywords:

Intelligent Fault Detection, Real-Time Monitoring and Control, Satellite Ground Stations, Ground Station Virtualization.