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White Paper: Enhancing Satellite Monitoring with Grafana

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Abstract

Efficient satellite monitoring is paramount in ensuring optimal satellite performance and mission success. This paper explores MEASAT's innovative use of Grafana, an open-source data visualization platform, to revolutionize satellite monitoring processes. By enabling real-time visualization of critical satellite data, supporting trend analysis for proactive decision-making, and facilitating rapid historical telemetry retrieval, Grafana has significantly enhanced MEASAT's operational efficiency. Practical examples, such as battery cell voltage monitoring and eclipse season trend analysis, demonstrate Grafana's impact in improving situational awareness, issue identification, and overall satellite performance monitoring. These advancements highlight the broader potential for Grafana in complex monitoring environments

1. Introduction

Satellite operations demand precise and continuous monitoring of telemetry data to maintain system performance and mission integrity. MEASAT, a leading satellite operator in Asia, recognized the growing challenges of handling increasingly complex data and ensuring timely decisions in critical scenarios. To address these challenges, MEASAT sought a robust, flexible, and efficient tool to enhance its satellite monitoring processes.

Grafana, an open-source platform renowned for its powerful data visualization and monitoring capabilities, emerged as the ideal solution. Known for its customizable dashboards, real-time insights, and compatibility with diverse data sources, Grafana allows organizations to streamline data analysis and improve decision-making. By implementing Grafana, MEASAT has transformed its satellite monitoring framework, achieving unprecedented efficiency in visualizing critical parameters, analysing trends, and retrieving historical telemetry data. This paper details the integration of Grafana into MEASAT's operations and showcases its impact on monitoring satellite performance. This white paper discusses how Grafana has significantly improved MEASAT's satellite monitoring operations by effectively visualizing critical satellite data, enabling trend analysis for informed decision-making, and providing quick historical telemetry retrieval for analysis.

2. Enhancing Satellite Monitoring with Grafana

2.1. Effective Visualization of Critical Satellite Data

Satellite monitoring necessitates the real-time visualization of numerous critical data points. Grafana has revolutionized the way MEASAT monitors its satellite fleet by providing an intuitive and flexible platform to visualize essential data. This has replaced the traditional method of relying on static plots and charts, which could be time-consuming and resource-intensive.

Example: Monitoring Battery Cell Voltage Divergence

One example of Grafana's impact on MEASAT's satellite monitoring is the efficient visualization of battery cell voltage divergence on satellite. Traditionally, this involved plotting 22 different parameters, which was not only time-consuming but also resource intensive. With Grafana, these parameters can be plotted in a matter of minutes, even when spanning extended time periods, such as 30 days to years. This rapid visualization is achieved with minimal server memory consumption.

Grafana offers mathematical calculation functions, allowing MEASAT to convert values from volts (V) to millivolts (mV) and calculate the mean cell voltage minus the minimum cell voltage, yielding the cell voltage divergence values. The dashboard can trigger alerts when these values approach the fault recognition and response system trigger limits, ensuring timely response to potential issues.

2.2. Trend Analysis for Informed Decision Making

Understanding trends in satellite telemetry data is crucial for making informed decisions and optimizing satellite performance. Grafana facilitates trend analysis by providing historical data at your fingertips. This capability allows MEASAT to identify patterns and anticipate potential issues proactively.

Example: Monitoring Vital Parameters During Eclipse Season

MEASAT has created a specific Grafana dashboard to monitor vital parameters during the satellite eclipse season. This dashboard not only provides an overview of key Electrical Power System (EPS) parameters but also allows real-time monitoring and trend analysis.

By utilizing Grafana's features, MEASAT can detect trends in EPS parameters that may be indicative of potential issues, enabling the team to make informed decisions and take preventative measures. This proactive approach ensures optimal satellite performance and mission success.

3.Results

The adoption of Grafana for satellite monitoring at MEASAT has resulted in numerous benefits:

3.1. Enhanced Situational Awareness

Grafana provides a real-time, comprehensive view of satellite data, enabling operators to maintain a clear understanding of the satellite's health and performance. This heightened situational awareness is essential for making timely and informed decisions.

3.2. Quick Identification of Potential Issues

With Grafana, potential issues can be identified swiftly, thanks to rapid data visualization, trend analysis, and alerting capabilities. This allows MEASAT to take corrective actions before minor issues escalate into critical problems.

3.3. Improved Satellite Parameters Monitoring

The detailed visualization and analysis of key parameters have improved MEASAT's satellite monitoring. The ability to monitor and analyse this critical data efficiently is essential for ensuring the satellite's electrical systems operate optimally.

4.Conclusion

MEASAT has successfully harnessed the power of Grafana to enhance its satellite monitoring operations. By effectively visualizing critical data, enabling trend analysis, and facilitating quick historical telemetry retrieval for analysis, MEASAT has achieved improved situational awareness, timely issue identification, and optimized satellite parameters monitoring. This case study serves as a testament to the potential benefits of using Grafana for satellite operators and other organizations requiring advanced data visualization and monitoring capabilities in complex environments.