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New needs in Ground Segment, GMV tools for GSaaS

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Abstract

The evolving space environment, characterized by smaller satellites and cube sats, demands simpler, reusable solutions with minimal adaptations for reduced mission durations and brief time-to-market. Compatibility with industry standards and scalability, particularly for growing satellite constellations, necessitates lights-out operations for managing over 100 satellites simultaneously. To meet these demands, our product line is transitioning to a service-based approach, offering companion services such as conjunction assessment, station calibration, and Flight Dynamics as a Service (FDaaS), with plans for Ground Segment as a Service (GSaaS). Our cloud-based systems feature major architecture enhancements, centralized message brokers, and API-based interfaces to support hands-off automated operations. The first demonstration of this approach is our flight dynamics solution, *Focussuite* as a service, operational from mid-2024, which includes a web-based dashboard for advanced reporting. SATELIOT, a Spanish new-space operator, has utilized our operations service since August 2024 for their four-satellite fleet. Our GSaaS, expected to be operational in 2025, will integrate industry-leading products and external ground segment elements, providing comprehensive ground system applications to meet diverse user needs.

Keywords: GSaaS, Cloud, Flight Dynamics, FDaaS

Acronyms/Abbreviations

API: Application Programming Interface
CCSDS: Consultative Committee for Space Data Systems
FDaaS: Flight Dynamics as a Service
GSaaS: Ground Segment as a Service
SOaaS: Satellite Operations as a Service

1. Introduction

New actors in the new space environment bring different needs and expectations compared to traditional operators. These new actors often utilize smaller satellites and cube sats, which typically have reduced mission durations and a brief time-to-market. This often necessitates simpler, reusable solutions with minimal adaptations from one mission to the next. The shift in mission nature and requirements is driven by the need for efficiency and rapid deployment, resulting in significant changes to the core of our ground segment products.

- **Compatibility and Scalability:** Efforts in compatibility with industry standards and reusability solutions are essential to meet the demands of these missions. Growing satellite constellations introduce their own specifications, focusing on scalability. This includes deployment using cloud-native technologies and operational constraints that require lights-out operations to manage over 100 satellites simultaneously. Scalability is crucial for ensuring that large constellations can be deployed and operated efficiently without manual intervention.

- **Product Line Evolution:** To satisfy the demands of the new ecosystem, our product line is evolving to adopt a new service approach. This includes providing companion services to our operational products, such as conjunction assessment (*Focusoc*) and station calibration services. Additionally, we are introducing FDaaS solutions, with plans to offer GSaaS in the near future. These services aim to enhance operational efficiency and provide comprehensive support to satellite operators.

- **System Enhancements:** Updates to our product are focused on reactive automation, service architecture and deployment, interfaces, and advanced reporting. These enhancements are necessary for constellation and new space operators, where scalability is a critical requirement. Reactive automation allows for real-time processing and response to events, while service architecture and deployment improvements ensure robust and efficient operations. Advanced reporting provides detailed insights and analytics to support decision-making.

- **Cloud-Based Systems:** Our new systems are cloud-based, featuring major architecture enhancements to support a service-based ground segment. By utilizing centralized message brokers and API-based interfaces, we can

eliminate the need for redundant file exchange and storage, thereby simplifying operations and deployments. This approach supports hands-off automated operations, with reactive applications processing events from any component in the ground system through centralized messaging systems. This ensures seamless and efficient communication and coordination across the entire system.

2. Demonstration and Features

The first demonstration of this approach is our flight dynamics solution, ***Focussuite*** as a service, which has been operational from mid-2024. This service includes a new web-based dashboard with advanced reporting, allowing users to monitor system status at a glance without needing to check individual functions. ***Focussuite*** as a service is also available as a software and operations solution, providing periodic updates and access to the system at any time, while relying on GMV-provided operations.

SATELIOT, a pioneering new-space operator deploying a 5G NB-IoT constellation in Low Earth Orbit (LEO), represents a real-world demonstration of the advantages offered by Flight Dynamics as a Service (FDaaS). Since August 2024, GMV has been providing SATELIOT with a fully managed, cloud-native flight dynamics service based on the ***Focussuite*** platform. This approach has enabled the customer to maintain high-precision orbit determination, manage conjunction risks, execute manoeuvres, and sustain operational autonomy with minimal overhead.

From the outset, SATELIOT encountered the typical challenges associated with rideshare launches – high satellite density, difficulty in early object identification, and limited initial telemetry due to restricted antenna visibility. By leveraging GMV's FDaaS capabilities, SATELIOT was able to overcome these limitations through early ingestion and filtering of GNSS measurements, enabling high-accuracy orbit determination using only a small number of observations. This was key to ensuring antenna contact in upcoming passes-critical during the first days in orbit.

One of the cornerstones of the FDaaS solution is the automated and continuous reporting system, which monitors system health, orbit determination quality, and data ingestion status. Any anomaly-such as lack of telemetry, deviation in orbital windows, or orbit degradation-is detected and reported in real time through the integrated dashboard, emails, and Microsoft Teams notifications. This enables early response, streamlines team coordination, and ensures uninterrupted service delivery.

Moreover, the system automatically generates and distributes orbital products such as OEM and TLEs, which can be sent directly to antenna providers to optimize satellite tracking and communication windows.

SATELIOT also benefits from automated TLE-to-satellite correlation using Space-Track data, enabling early object cataloguing and improved situational awareness—weeks ahead of the official Space-Track correlation release. The FDaaS platform is fully integrated with GMV's conjunction risk management system, ***Focusoc***, which continuously screens SATELIOT's operational orbits against an extended LEO object catalogue and supports both conjunction assessment and manoeuvre planning workflows.

In addition, ***Focussuite*** provides automated analysis of orbital events and station passes, offering valuable foresight for mission planning, satellite thermal management, and operations scheduling. This predictive capability is essential for ensuring robustness in dynamic environments and further reduces the operational burden on mission teams.

The successful deployment and operation of SATELIOT's initial constellation using GMV's FDaaS solution highlights the system's maturity, scalability, and readiness to support autonomous, responsive missions. This use case stands as a reference for future constellations aiming to reduce mission risk and costs, while ensuring operational agility and sustainability in increasingly congested orbital regimes.

3. Future Developments

As the next step in our service portfolio, our Ground Segment as a Service is built on the same basis as ***Focussuite*** as a service, offering seamless interactions and next-level automation. GSaaS features an integrated ground segment based on industry-leading products such as ***Hifly***, ***Focussuite***, and ***Flexplan***. It will also provide full integration with external ground segment elements, such as ground station networks and third-party services. Expected to be operational in 2025, GSaaS will offer the most comprehensive suite of ground system applications, catering to every user's needs and ensuring efficient and scalable operations.

Our GSaaS solution is embodied in what we have called Satellite Operations as a Service (SOaaS), addressing the critical operational challenge of efficiently managing an increasing number of heterogeneous satellite missions without proportionally scaling human resources or infrastructure. SOaaS shifts from the traditional model-built around single missions, dedicated teams, and exclusive infrastructure-to a cloud-native, modular, and multi-mission operational environment. Leveraging GMV's extensive expertise, SOaaS enables operators to manage diverse satellite fleets from different manufacturers, mission types, and orbital regimes, all from a unified, streamlined platform.

At the heart of SOaaS is the principle of maximum automation in nominal operations, significantly reducing the need for human intervention. Satellite status information is automatically ingested and processed through standardized

data pipelines, activating predefined operational workflows such as pass scheduling, telemetry monitoring, trend analysis, anomaly detection, and command planning. Human operators are engaged only during exceptional or non-nominal situations, optimizing resource use and enhancing operational efficiency.

During internal validation campaigns and early adopter programs, SOaaS has successfully demonstrated several key operational use cases:

- **Unattended daily operations**: Complete automation from pass reception through telemetry processing, satellite commanding, and operational report generation, providing continuous, 24/7 coverage without manual shifts.
- **Multi-satellite orchestration**: Through the intuitive *FleetDashboard* interface, operators can supervise satellite fleet status and performance in real time, with detailed drill-down capabilities into specific subsystems or anomaly events.
- **Agile mission planning**: Leveraging *Flexplan*, operators can rapidly create and adjust mission timelines, automatically integrating operational constraints, resource availability, external payload operator inputs, and orbital event data provided by *Focussuite*. The planning is triggered once new information is available.
- **Event-based operational automation**: A middleware-driven architecture enables instantaneous response to operational events such as eclipse entry, manoeuvre execution, data losses, or collision risks, automatically initiating corrective or preventive workflows.

SOaaS ensures seamless integration with a broad spectrum of ground segment elements, including third-party antenna networks and specialized payload operations centres. The service adheres to standard CCSDS protocols and APIs, ensuring robust and frictionless data exchange with external entities.

During internal validation campaigns and through collaboration with early adopter customers, SOaaS has demonstrated its ability to abstract away the complexity inherent to traditional ground control infrastructures, establishing a truly service-oriented, automation-centric operational paradigm. This innovative approach has allowed satellite operators to expand their constellations without encountering operational bottlenecks, enabling them to fully focus on payload mission objectives, with operational activities becoming a streamlined and effective means to mission success.