Architecting OneWeb's Massive Satellite Constellation Ground System

GROUND SEGMENT ARCHITECTURE WORKSHOP 2017

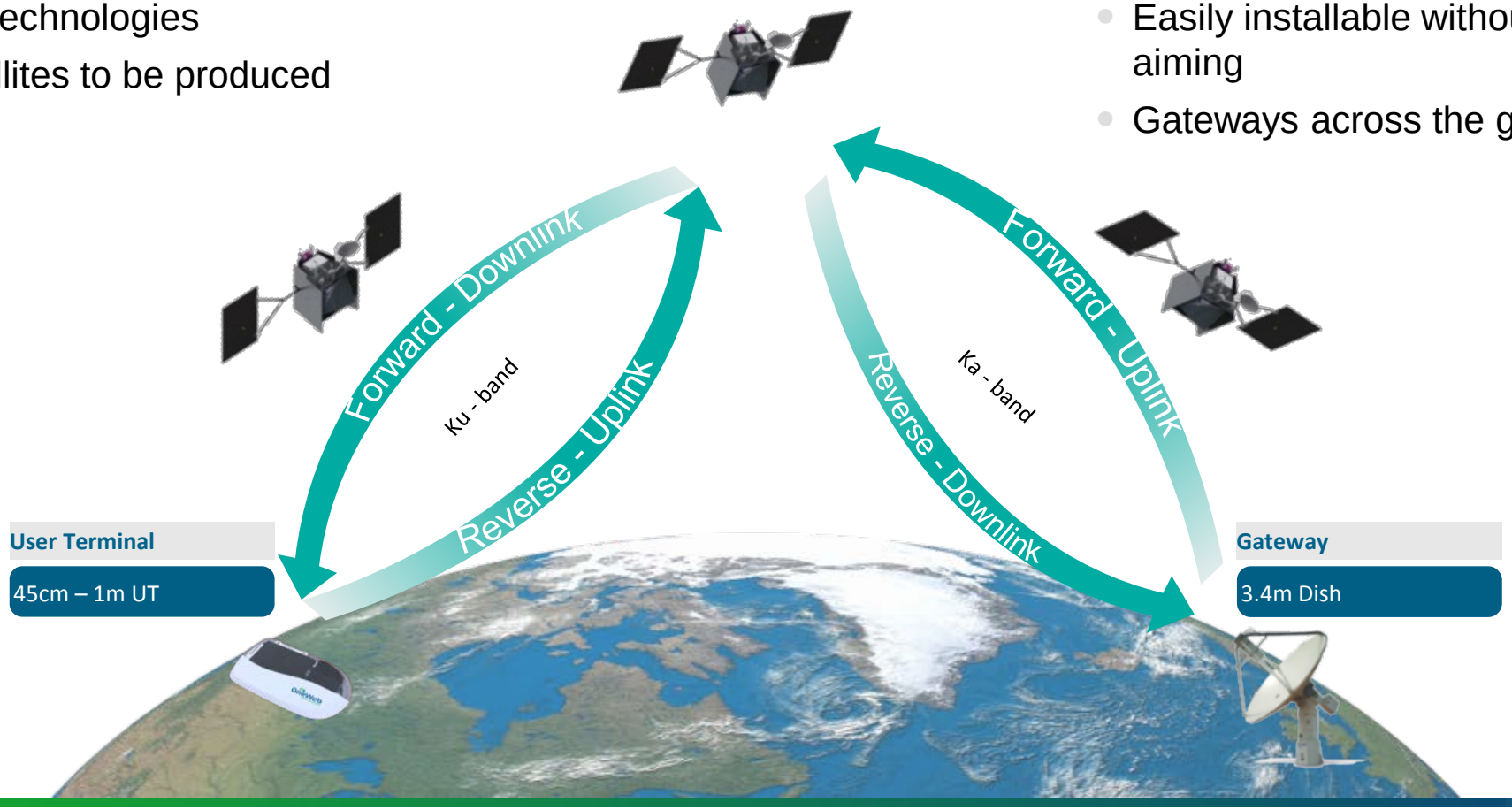
OneWeb System Overview

Constellation

- Innovative beam technology
- Small, inexpensive satellites using existing technologies
- 900 satellites to be produced

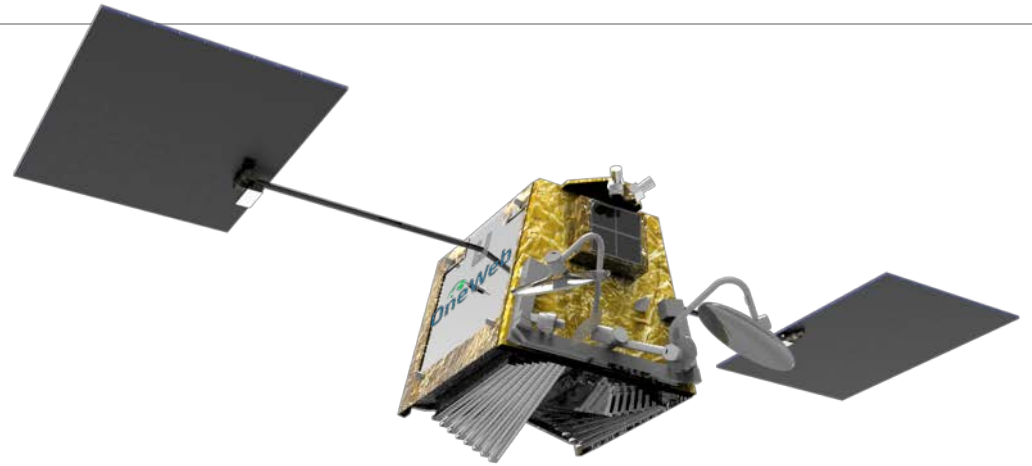
Ground

- Affordable, compact, multi-user access terminals
- Easily installable without position aiming
- Gateways across the globe



Low-Cost, Mass-Produced Satellites

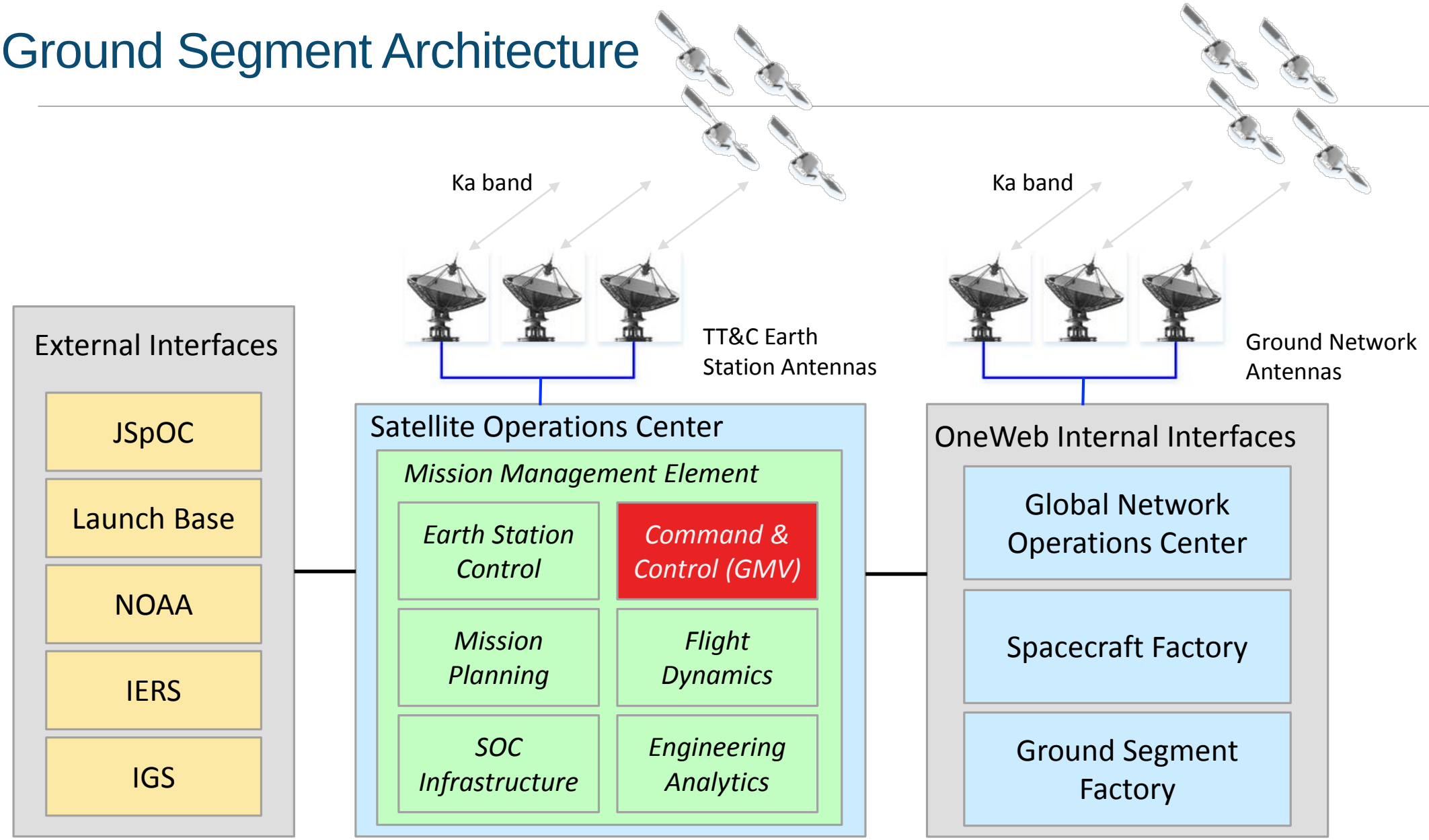
- Small, low mass satellites with modular design
- Produced in new manufacturing facility for high-rate and low-cost production
- Leverages existing and proven technology
- Unique modular design
- Strong industry participation



All Major Systems Designed

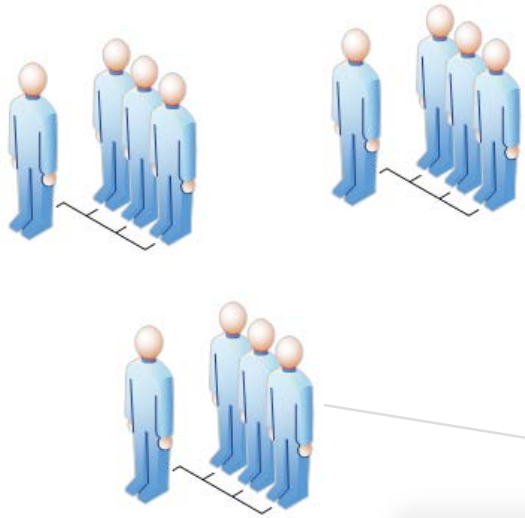
- Electric Propulsion
- Thermal Control
- Electrical Power
- Avionics and TT&C
- User Antenna
- Gateway Antenna
- Mechanical Systems
- Guidance, Navigation and Control

Ground Segment Architecture

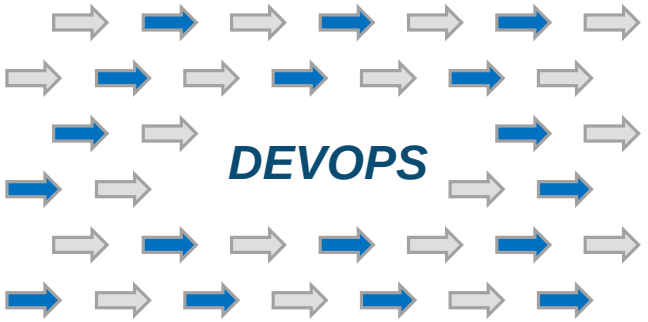


Distributed Engineering Using Proven COTS Software

Development Teams

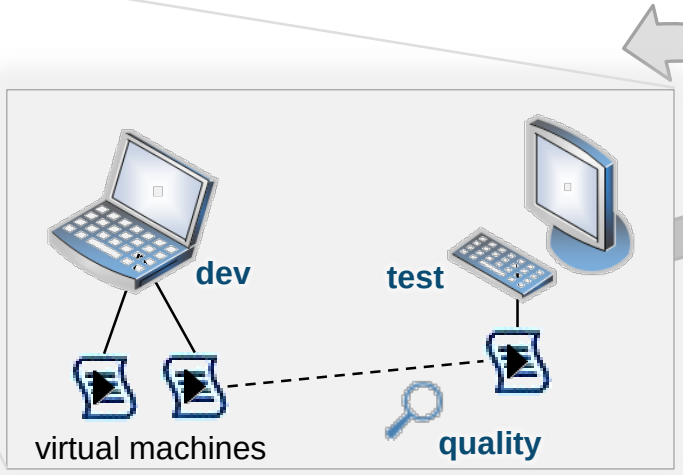


Software Releases



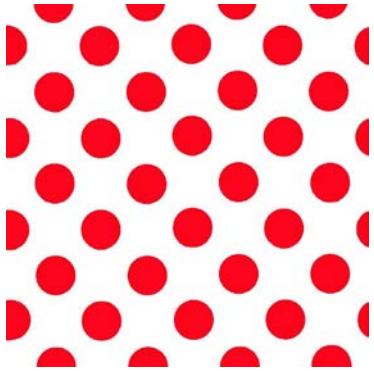
OneWeb DevLab

periodic integration



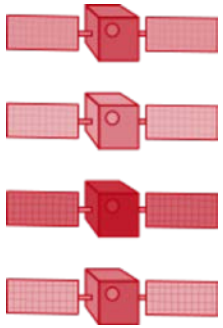
continuous integration

The CCE is based on ***hifly***, the GMV suite of COTS for satellite fleet monitoring and control



hifly largely unmodified, adaptations for: massive fleet support:

- Downsizing
- Fleet HMIs (groups of satellites)
- Massive fleets awareness (***fleetDashboard***)

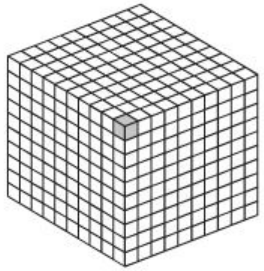


Grouping of satellites is essential: changing an out-of-limits definition for a set of satellites at the same time…

Consultative Committee for Space Data Systems

The satellites are CCSDS compliant: supported by ***hifly*** out-of-the-box

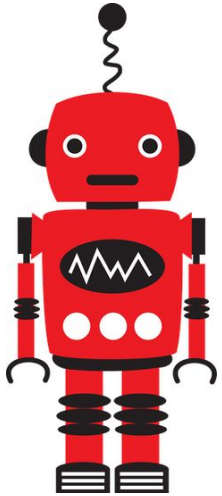
ONEWEB GROUND - CCE AUTOMATION



The deployment model is very simple:

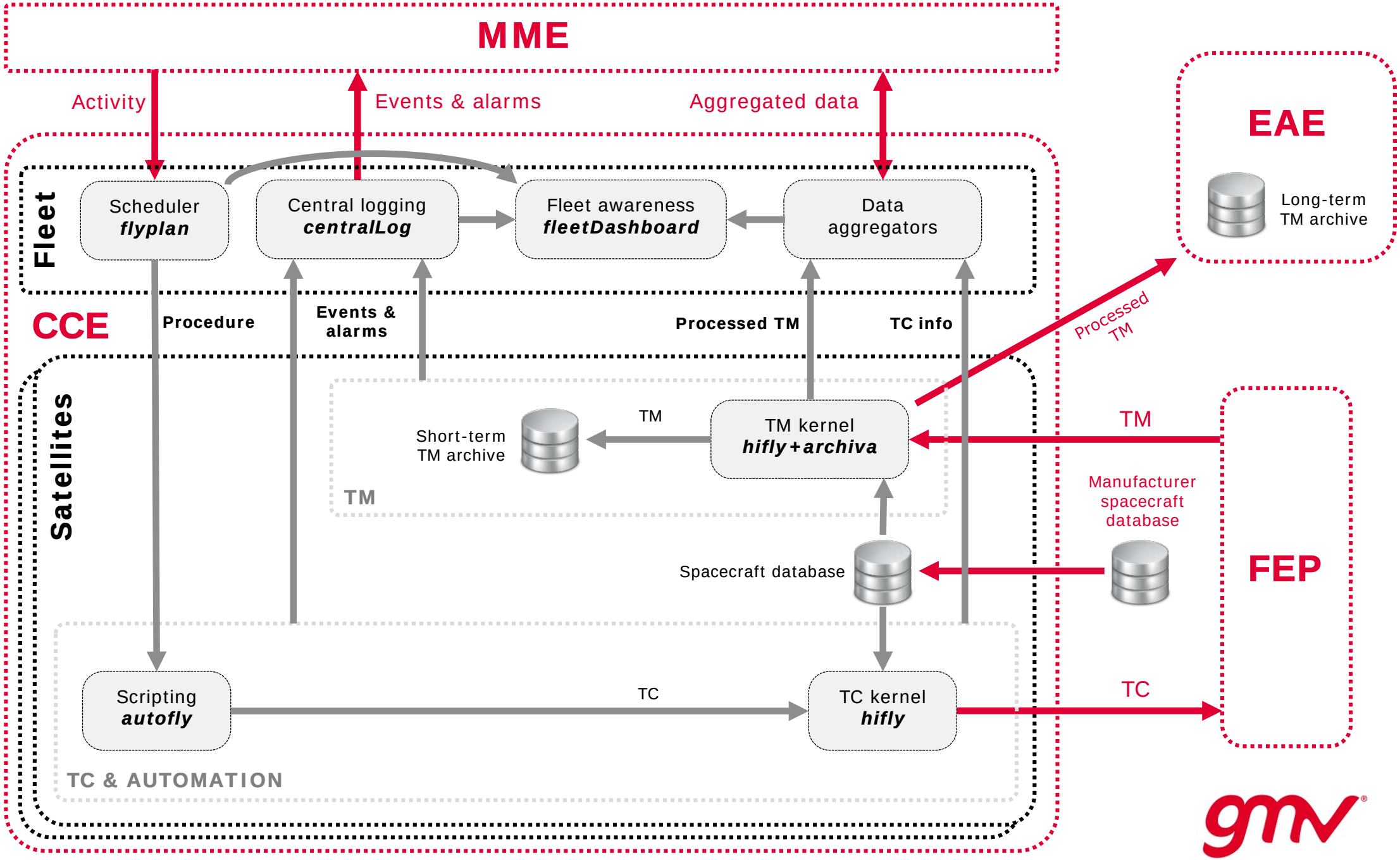
- One (redundant) ***hifly*** core instance per satellite
- One (redundant) set of fleet tools for the complete fleet

Nominal operations are fully automated; (known) anomaly recovery will also be automated as mission evolves

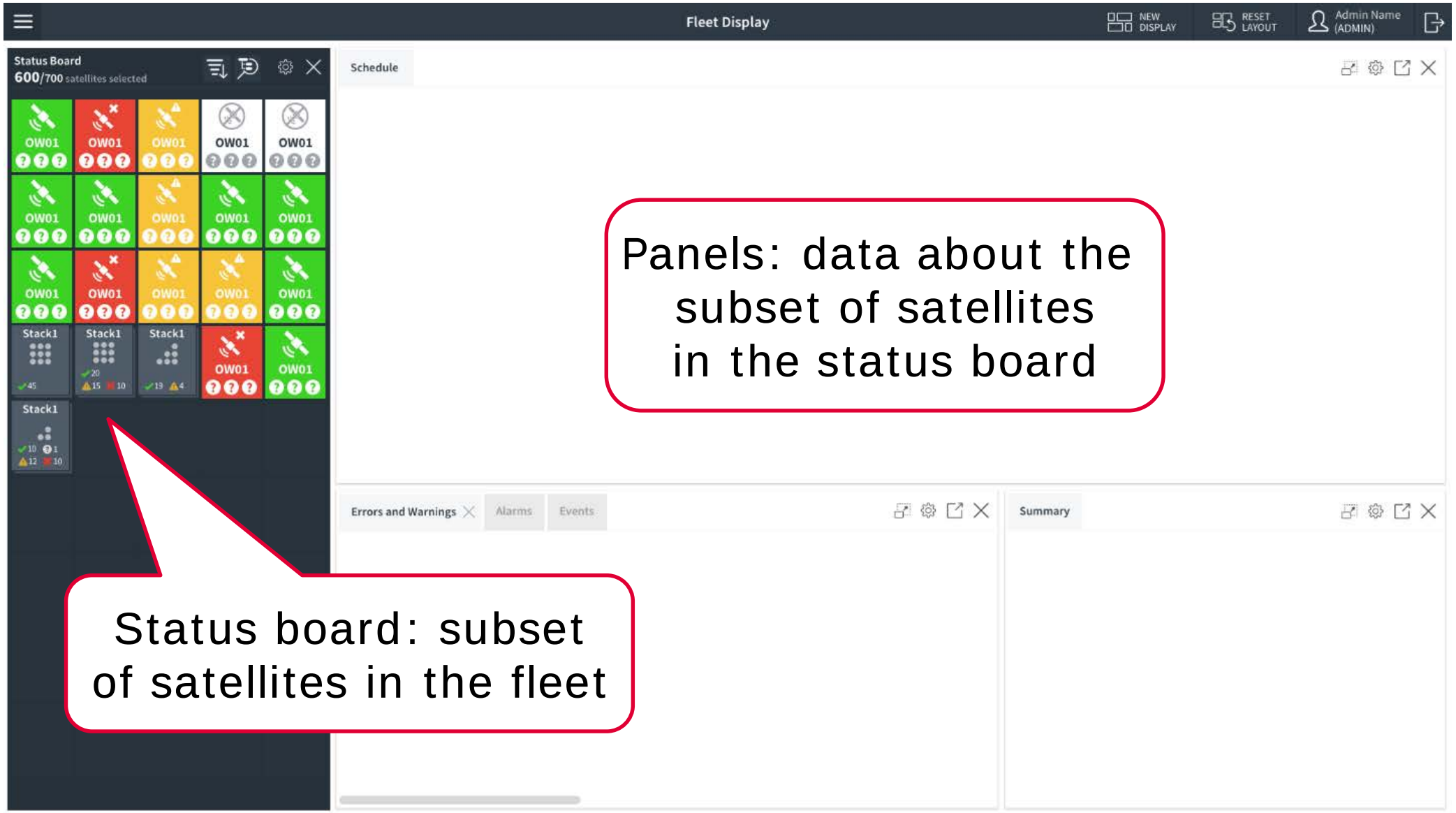


CCE is aimed for real-time operations: its archive is short-term only (say 1 month). Processed TM is forwarded to Engineering Analytics for long-term archive

ONEWEB GROUND - CCE ARCHITECTURE



ONEWEB GROUND - CCE
FLEET AWARENESS

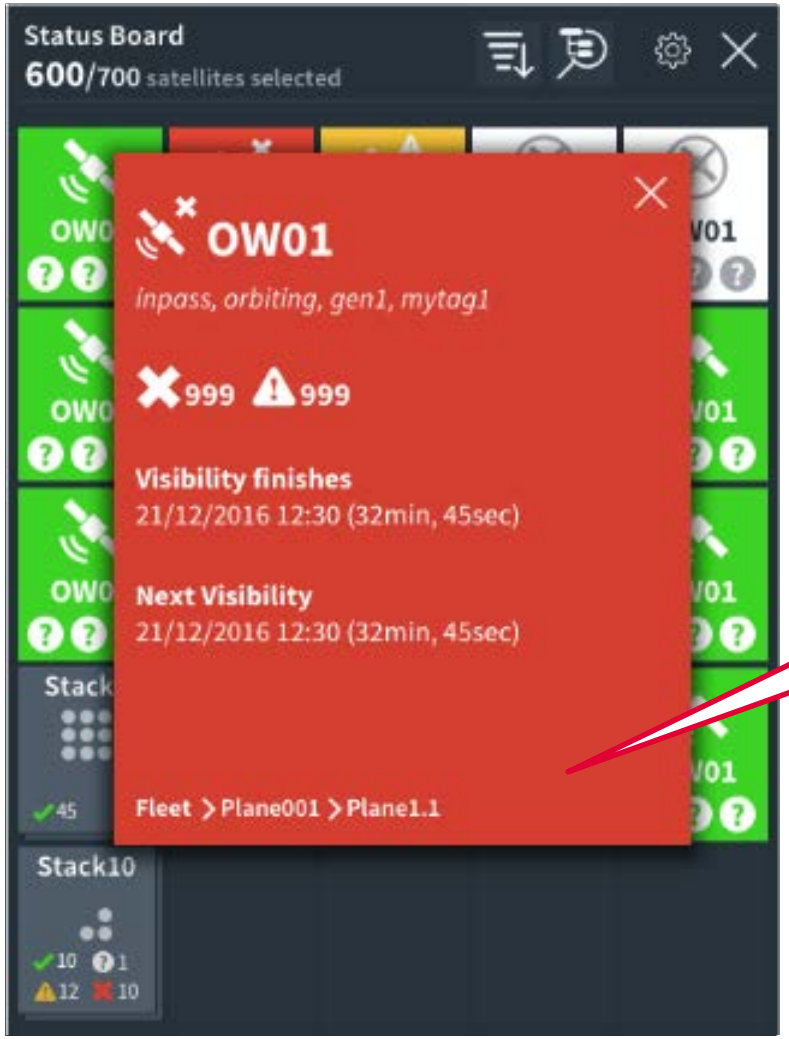


ONEWEB GROUND - CCE STATUS BOARD

Cards are individual satellites...

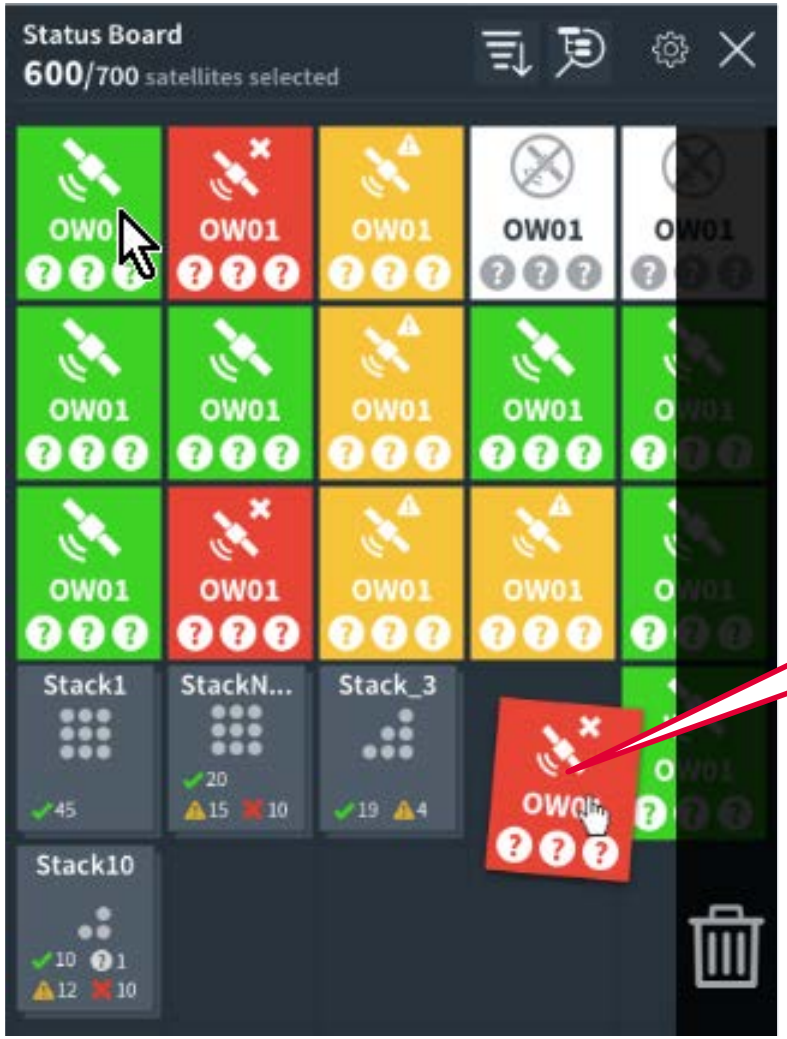
...and can be stacked

ONEWEB GROUND - CCE STATUS BOARD



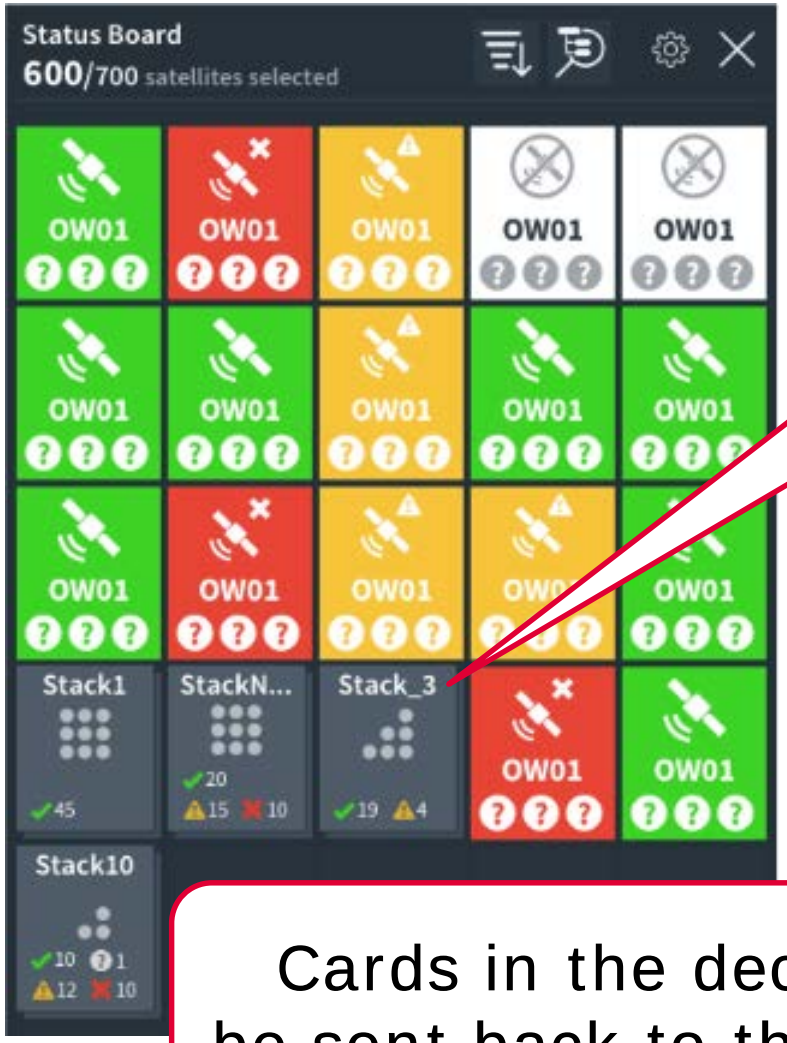
Cards can be flipped for further information

ONEWEB GROUND - CCE
STATUS BOARD



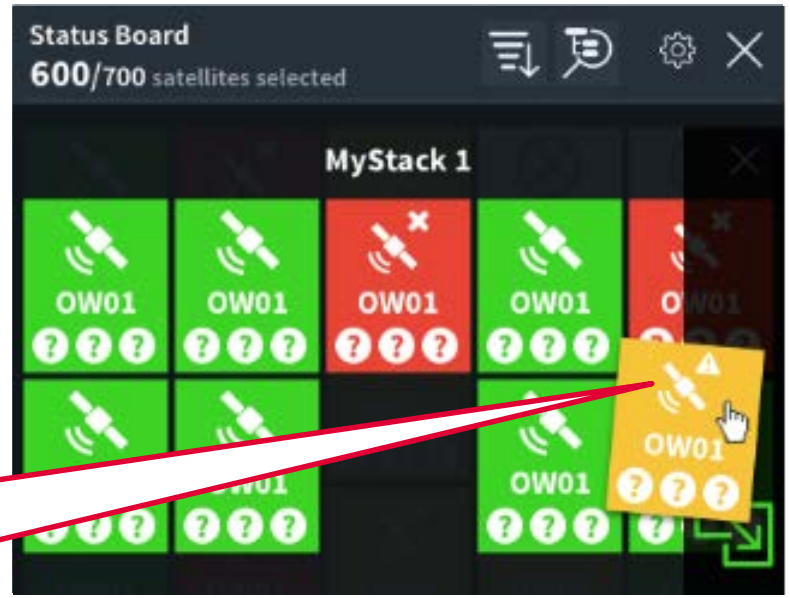
Cards can be dragged onto the trash bin

ONEWEB GROUND - CCE
STATUS BOARD



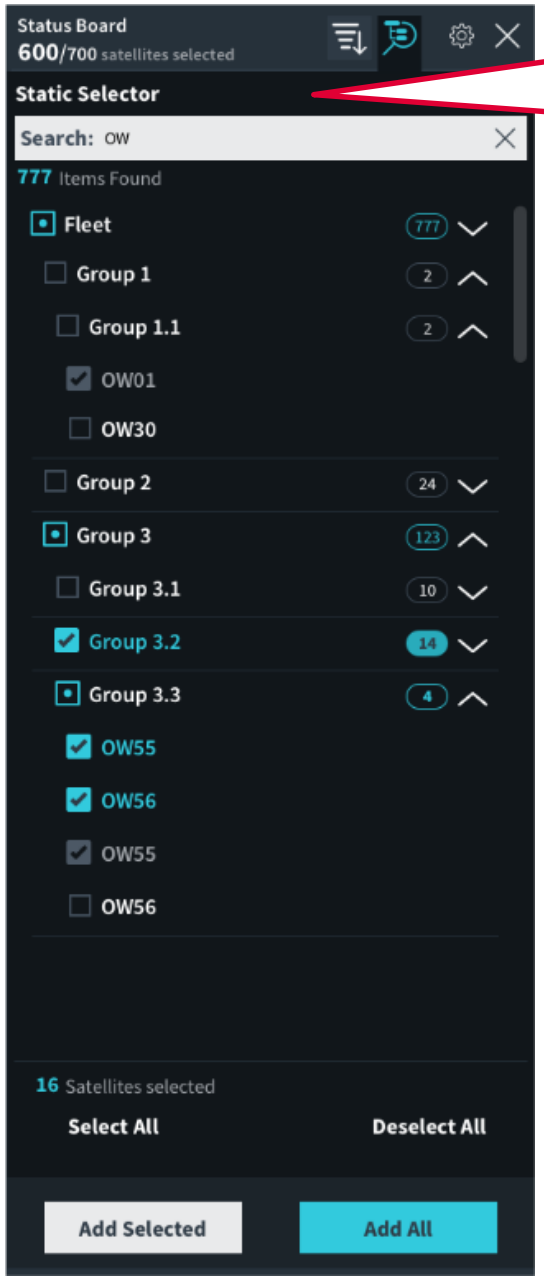
Acting upon a card deck...

...expands the deck



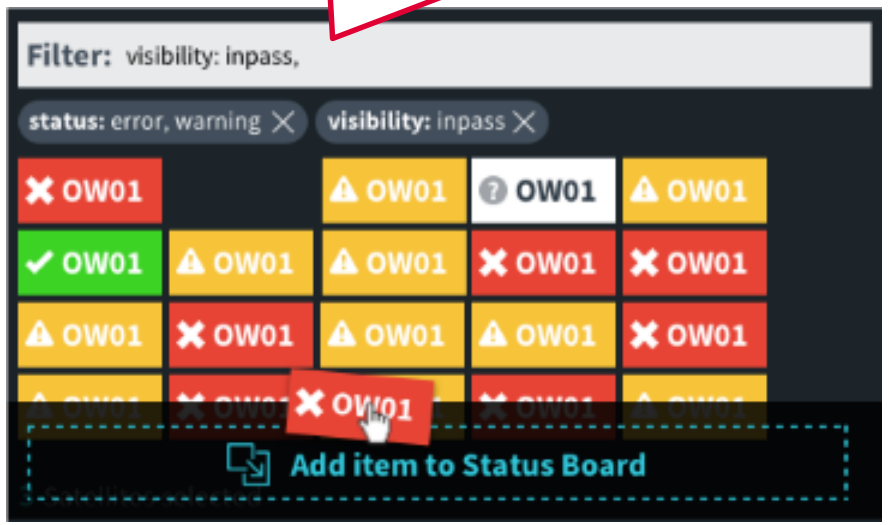
Cards in the deck can be sent back to the board

ONEWEB GROUND - CCE
STATUS BOARD



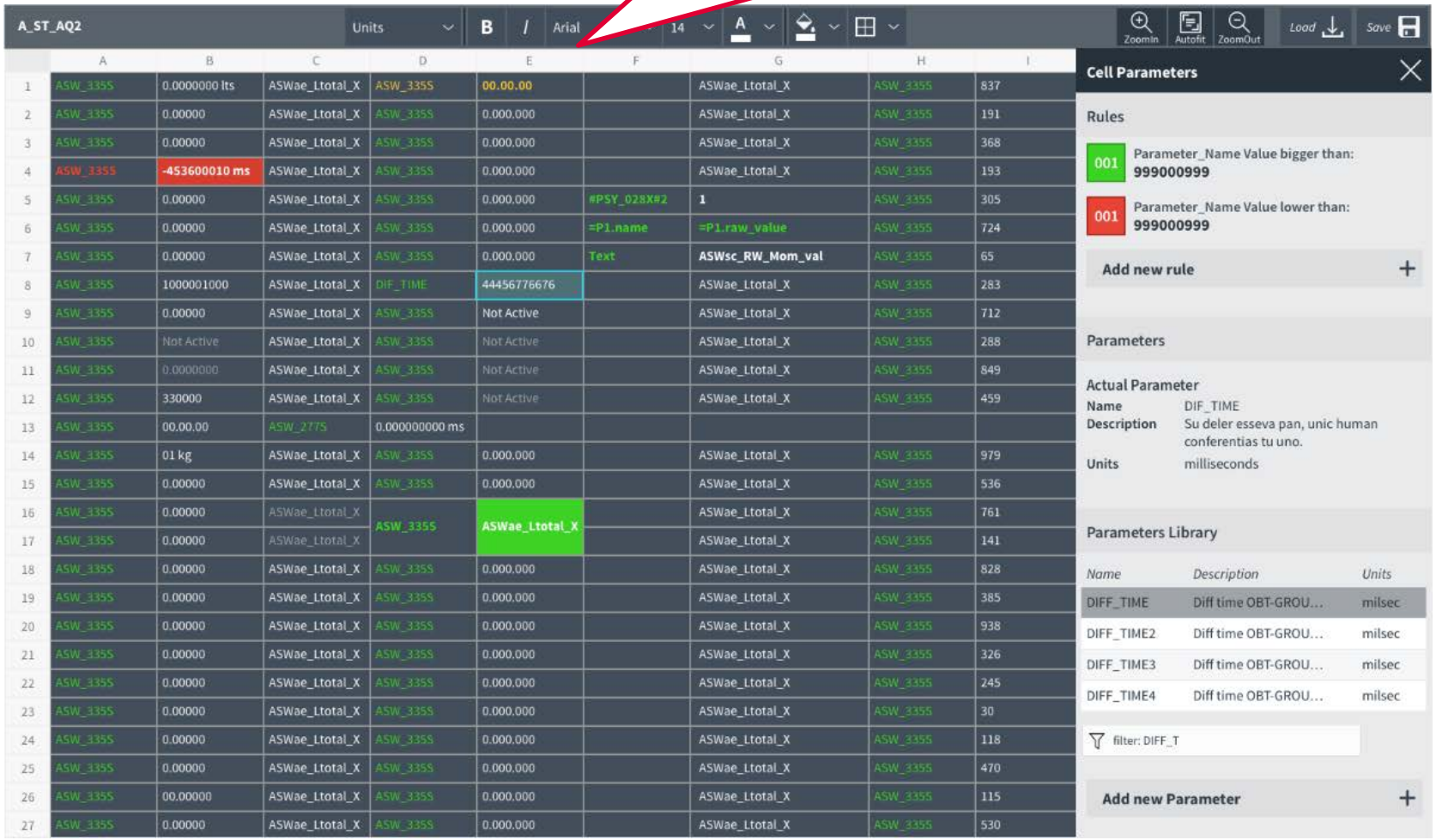
Satellites can be added to the board with a static selector...

... or with a dynamic one ("show satellites in pass")

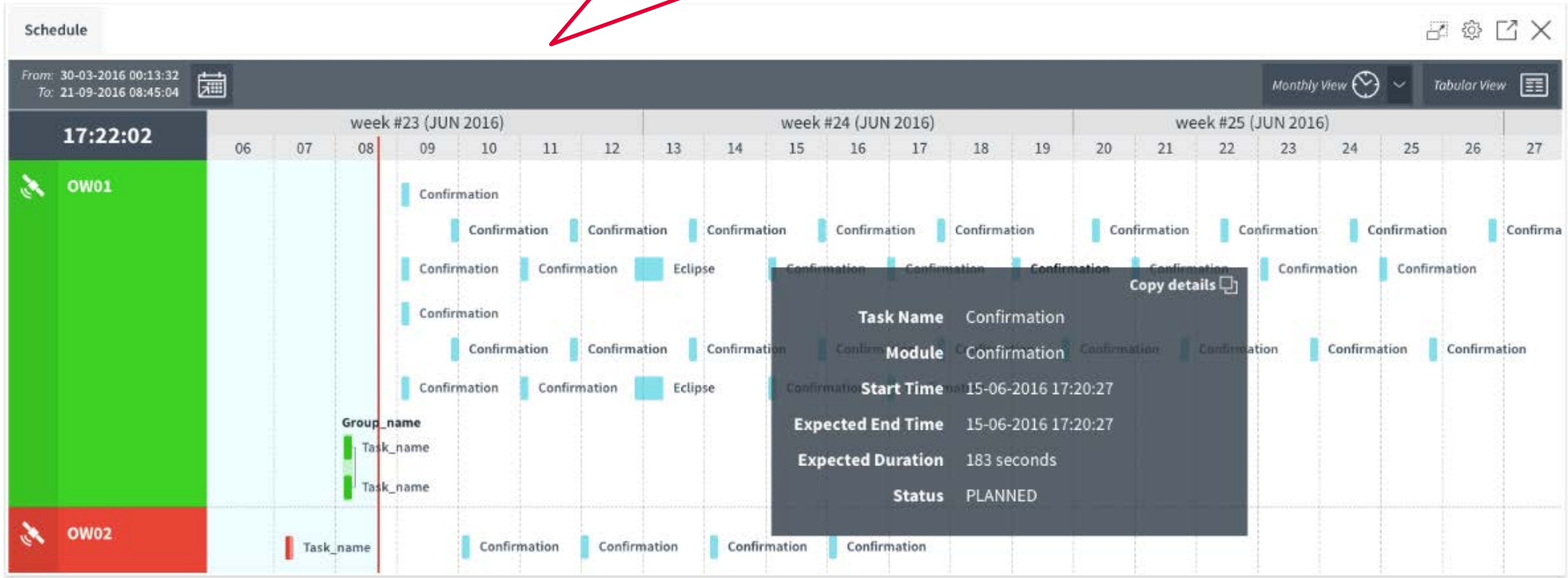


ONEWEB GROUND - CCE PANELS

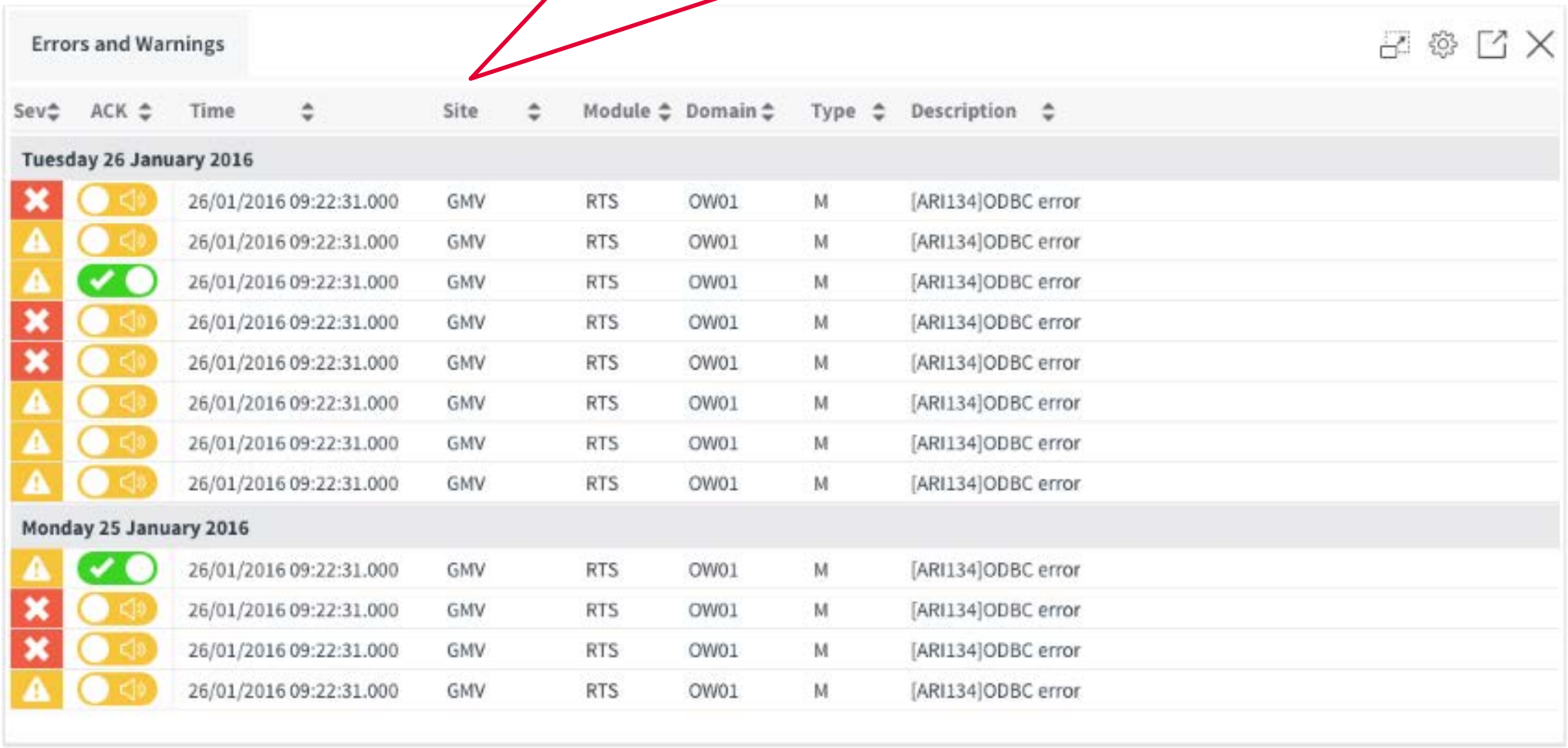
Spreadsheet panel: satellite and aggregated telemetry



Scheduler panel: satellite operations Gantt chart



Events & alarms panel: satellite Operations Gantt chart



Technology and Fleet-Focused ConOps Enable Massive Scaling

- Many technical challenges remain due to the shear scale of our mission
- Innovation and focus on **operating the fleet** drives our Concept of Operations
- Low risk core components such as Hifly enable this shift in thinking
- Take advantage of technologies and practices drawn from the advent of Cloud Computing