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SATELLITE SYSTEMS

THE PRISMA STORY:
Achievements and Final Escapades

SFFMT 2013, #4088

Presentation Outline

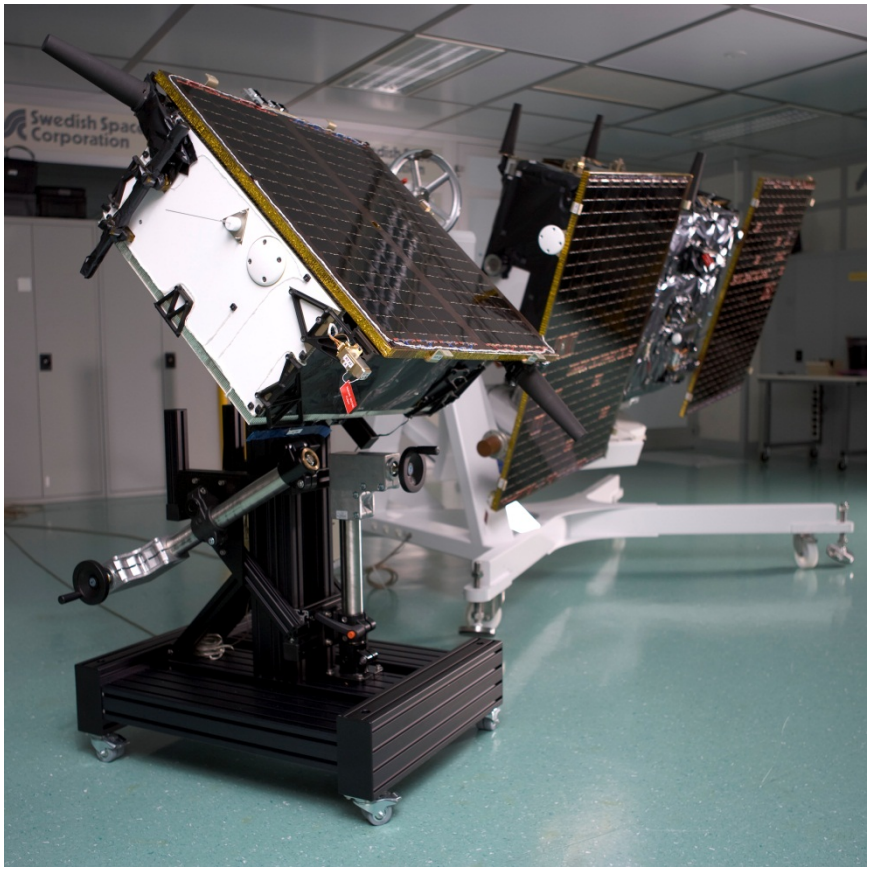
- Introduction
- Basic Operational Structure
- The Prisma Story
  - *Nominal Phase*
  - *Extended Phase*
  - *External Parties Phase*
  - *Final Phase*
- Conclusion

Introduction

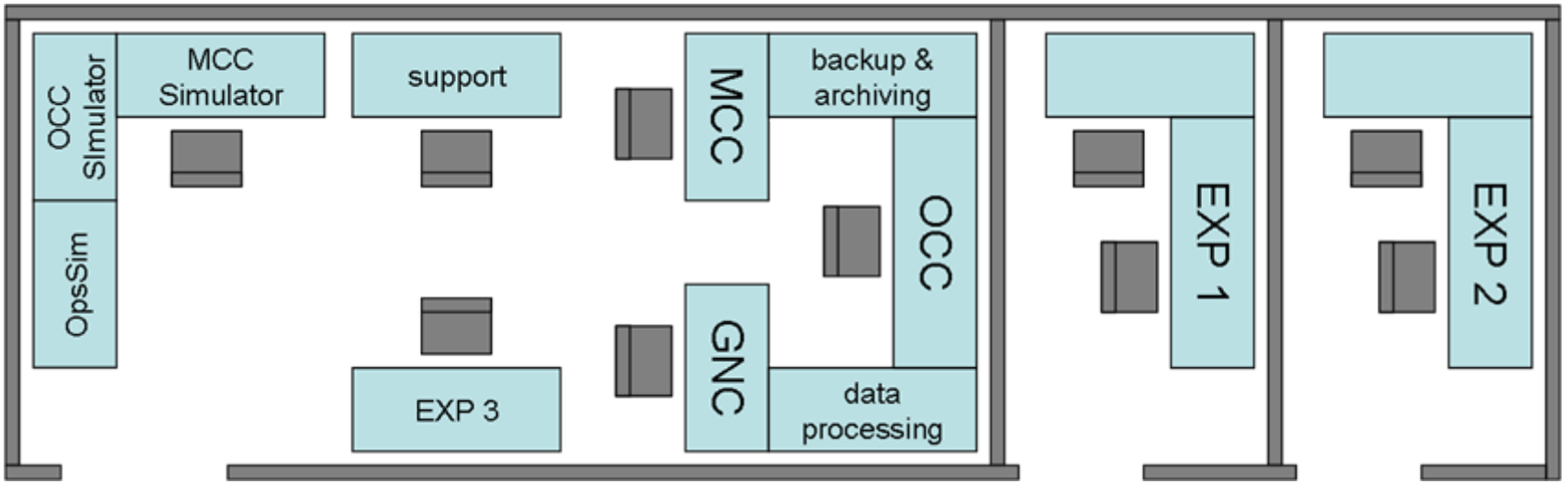
- Launched June 15th, 2010
- 750 km
- Sun-Synchronous Low-Earth Orbit
- LTAN at 06:00

- Mango
  - 140kg
  - 3-axis stabilized
  - 2 propulsion systems

- Tango
  - 50kg
  - 3-axis magnetic control
  - Separated August 2010



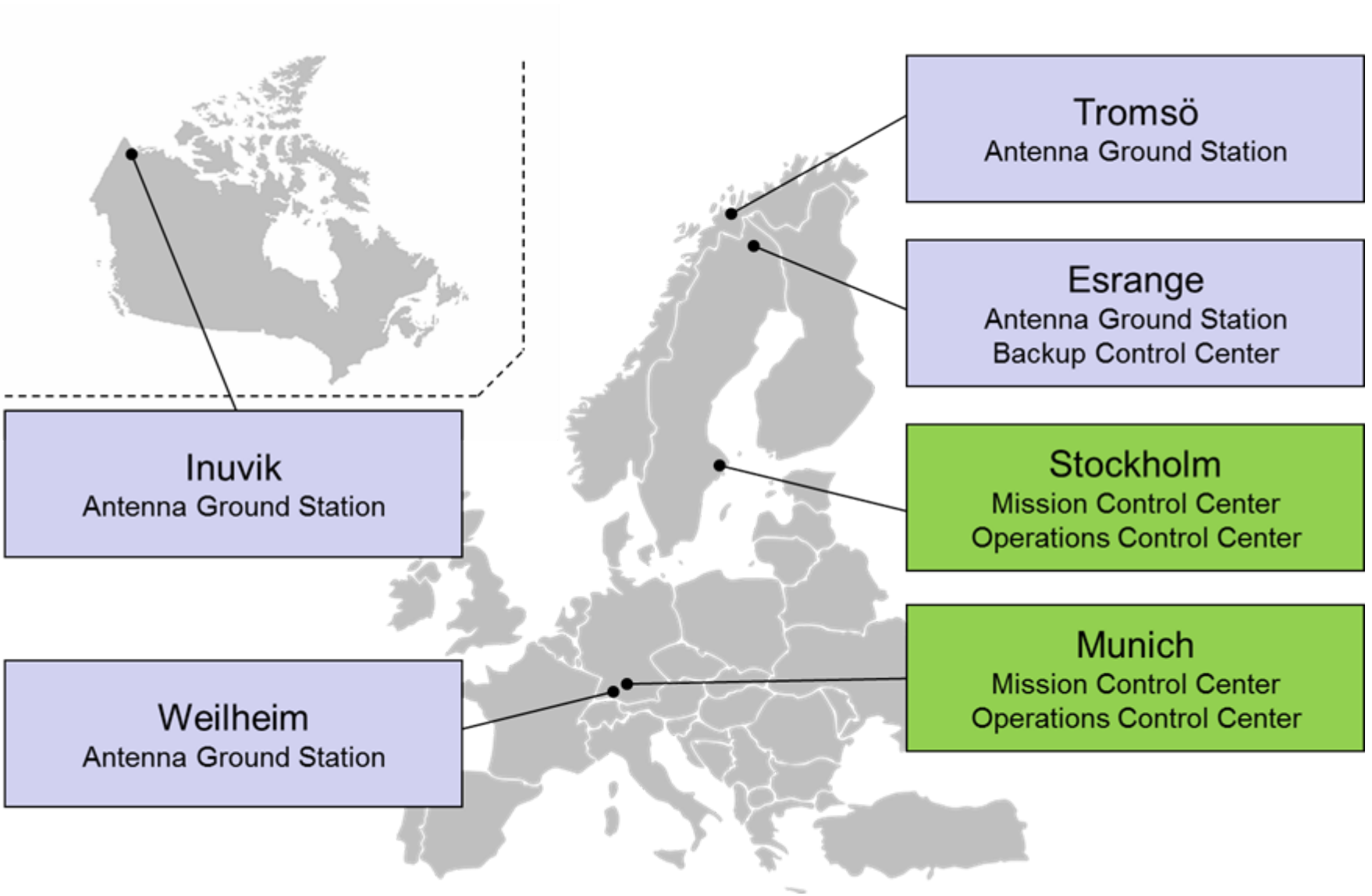
Basic Operational structure



- **Mission Control Center, core functions**
  - Simulator
  - Additional Support
  - Satellite Control
  - Experiment Control

- **RAMSES Ground System**
  - In-house built mission control system
  - Running on Microsoft Windows platform
  - Easily configurable and Modular
  - Fully CCSDS compatible
  - Used for test, integration and mission operations

Basic Operational Structure

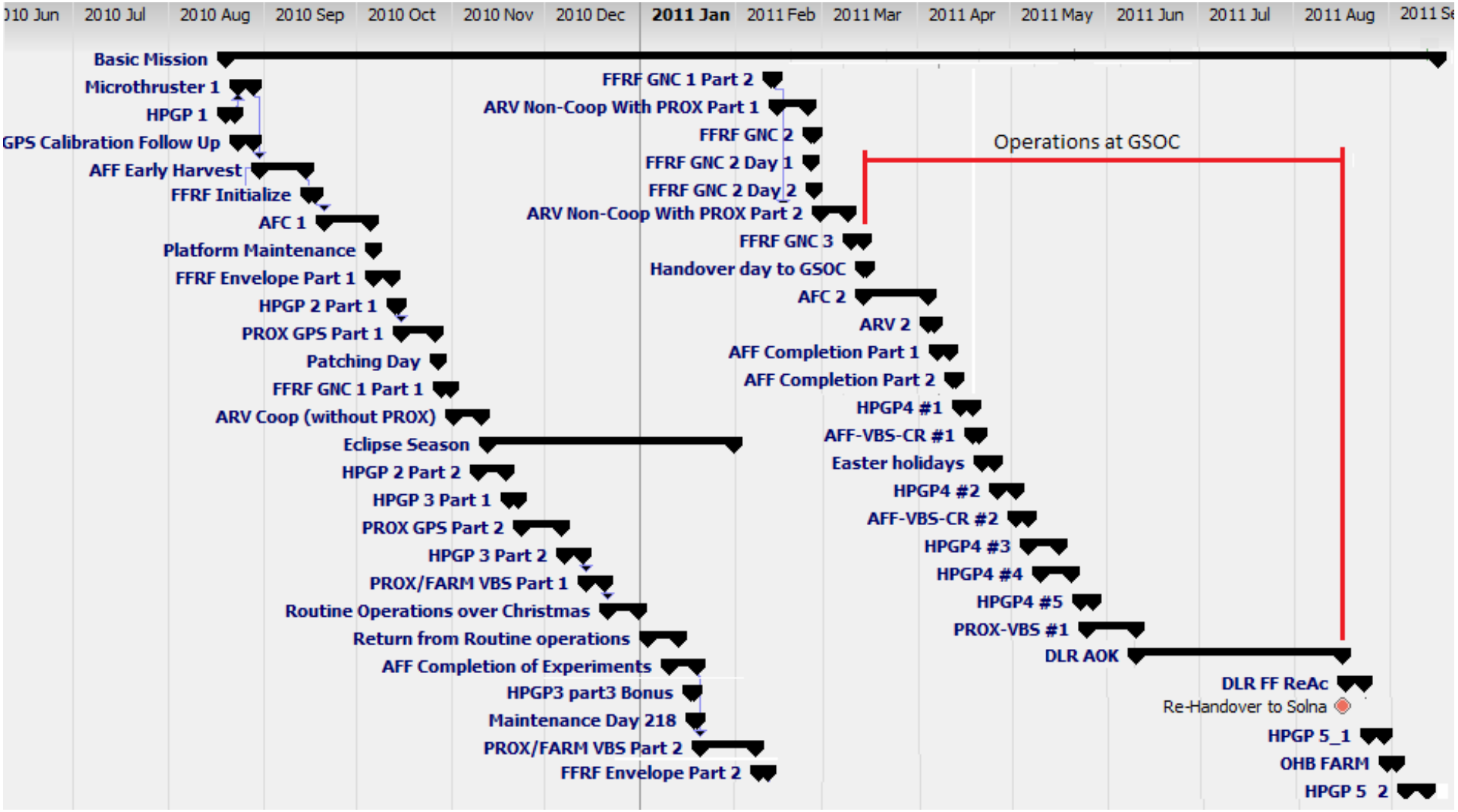


The Prisma Story

Mission phase	Start Date	Duration	Operator
Nominal mission	2010-06-15	273 days	OHB-SE (SSC)
Extended mission	2011-03-15	160 days	DLR/GSOC
External parties mission	2011-08-22	588 days	OHB-SE
Final mission	2013-04-01	Ongoing…	OHB-SE

- **The Prisma Story**
  - Orbiting the Earth more than 1000 days
  - Only the first two phases were planned at launch, to be operated by OHB Sweden
  - Handover to DLR/GSOC for the Extended Phase
  - At Rehandover, External parties were invited
  - Final mission recently started to rendezvous with a non-cooperative space debris object

The Prisma Story – Nominal/Extended Phase



The Prisma Story – External Parties Phase

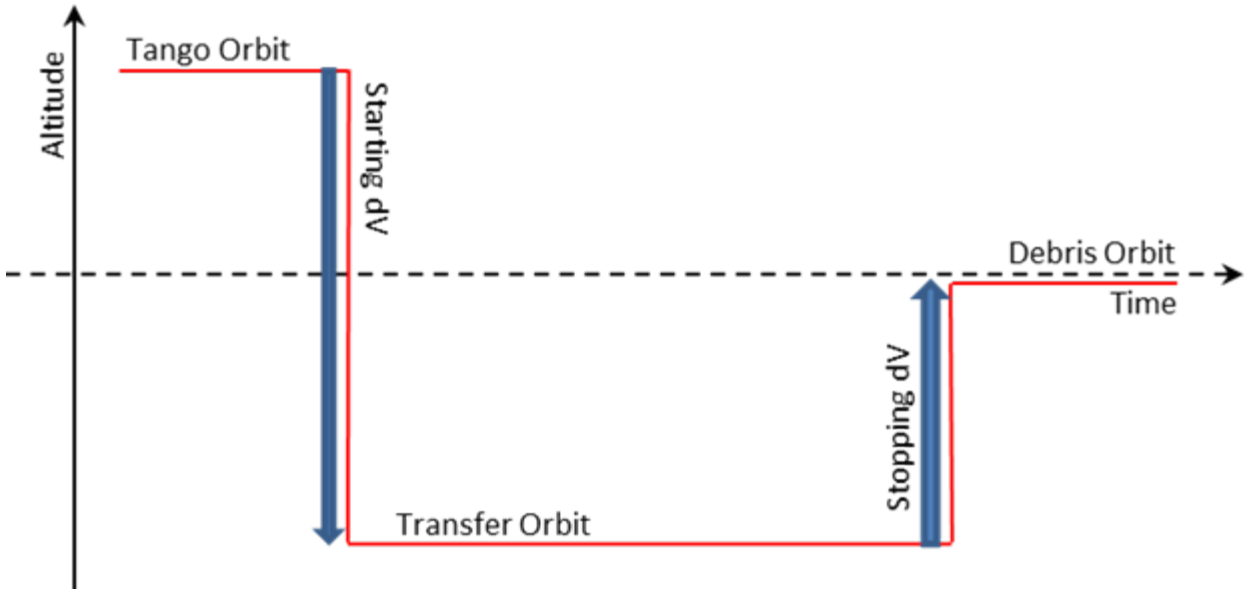
Organization	Experiment	Start Date	Duration
Space-SI	Interferometry, Space debris, Distributed instrument, Formation flying	2011-09-19	7 days
GMV	HARVD	2011-10-03	5 days
CNES	FFRF cont.	2011-10-10	23 days
DLR	ARGON	2012-04-16	5 days
CNES	µNEAT	2012-09-19	3 days
ECAPS	HPGP6	2013-02-15	1 day

- **External Parties Phase**
  - New partners brought in new and challenging ideas
  - Very hectic to begin with
  - Idling for long periods
  - The base for the final experiment was settled during the idle period

The Prisma Story – Final Phase

- **Goal of the Final Phase - IRIDES**
  - Rendezvous with non-coperative space debris object
  - Establish a safe relative orbit [~200km, ~3km, ~3km] *(based on absolut GPS, TLE and visual relative information)*
  - Set Mango target pointing based on VBS
  - Introduce small along-track drift to start inspection while circling around debris in the safe orbit
  - When at the same relative distance but on the opposite side, stop drift
  - Reduce cross-track and radial components while far away
  - Introduce drift back to starting point, but now at a closer distance
  - Repeat until safety can no longer be guaranteed

The Prisma Story – Final Phase

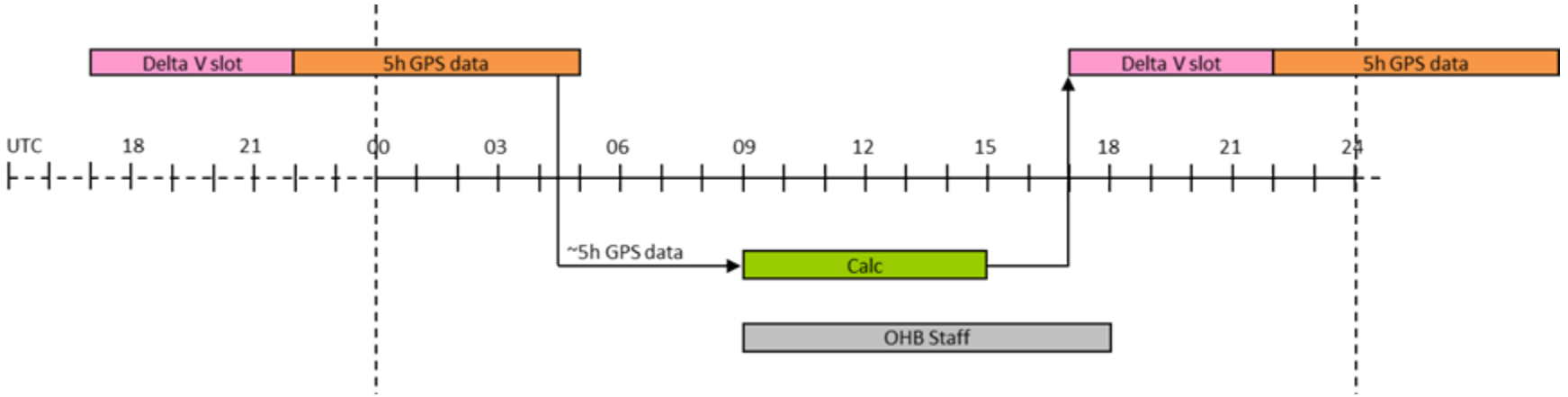


- **Starting dV campaign**
  - Fire a single thruster to achieve both an in-track and out-of-plane component
  - Achive decrease of semi-major axis
  - Achieve inrease of inclination (although debris has lower inclination)
  - Fire at ascending node only to increase eccentricity

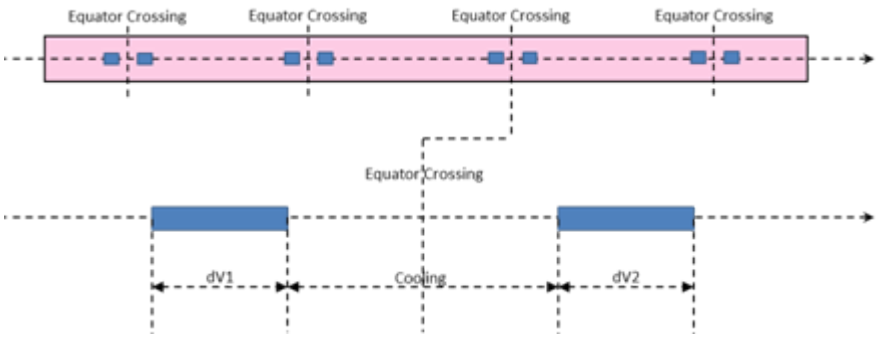
- **Transfer Orbit**
  - Lower altitude and higher inclination and eccentricity than debris object
  - This creates a drift where Mango approaches the target debris object

- **Stopping dV campaign**
  - Reverse action of starting campaign and at the same time phase into IRIDES starting point

The Prisma Story – Final Phase



- **Daily calculation cycle**
  - Fire thruster during yesterdays dV slot
  - Collect GPS data during non-dV period
  - Automatically download TM
  - Determine post burn orbit and equator crossings
  - Plan new dV maneuvers for the next night
  - Upload and release maneuvers



Conclusion

- **The mission has been very demanding but successful**
  - Utilized two different operating organisations
  - Almost no routine operations
  - Utilized two locations for mission control
  - Utilized four different antenna ground stations

- **The mission has achived many autonomuos experiments**
  - Autonomous Formation Flying
  - Autonomous Rendezvous Manuevers
  - Autonomous Proximity operations
  - Autonomous Final approach and Recede Manuevers
  - Autonomous Formation Keeping
  - Autonomous Orbit Keeping

- **The mission is currently performing a rendezvous with a non-coopertive space debris object**
  - Transfer to and inspecting an inorbit space debris object

Thank you and thanks to:

Prisma Satellites