



SATELLITE SYSTEMS

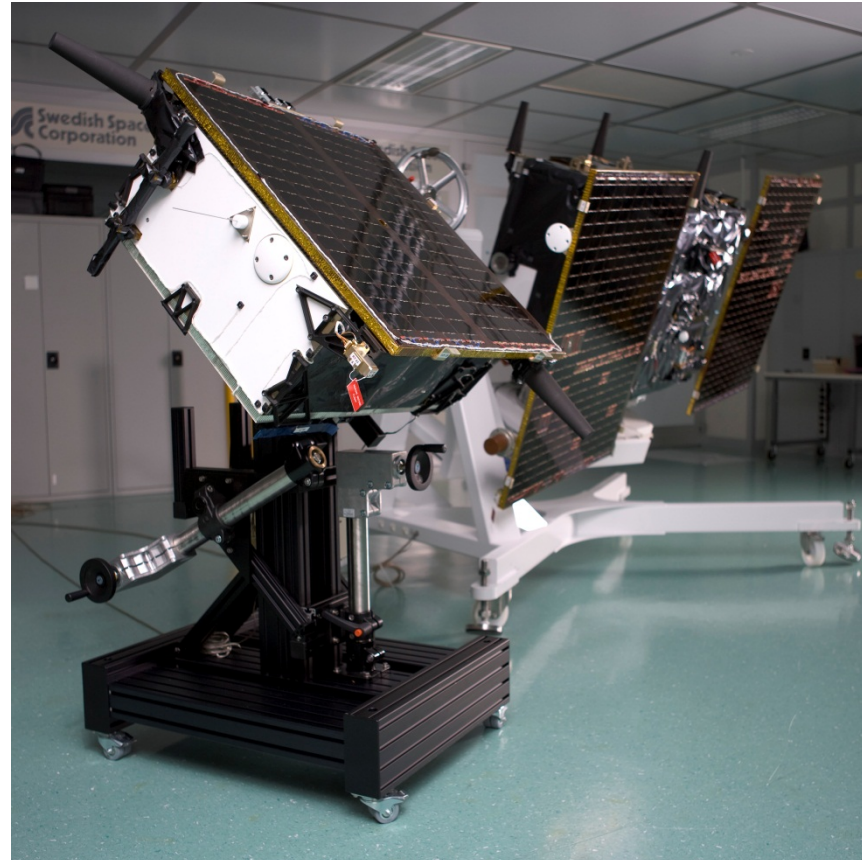
THE PRISMA STORY: Achievements and Final Escapades

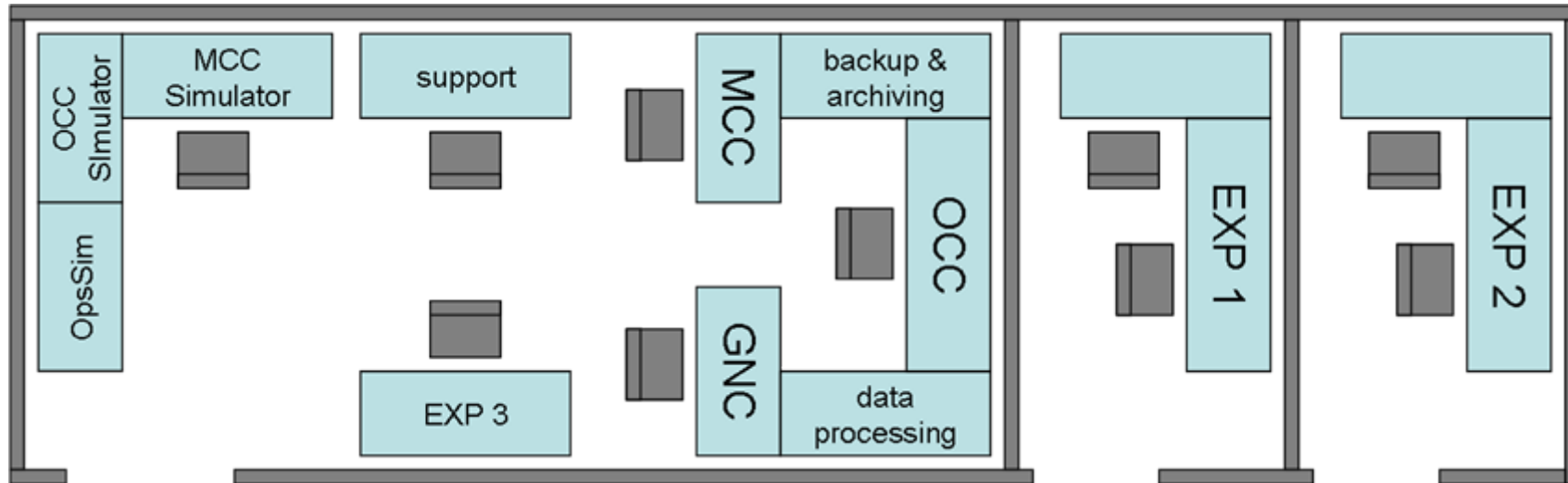
- Introduction
- Basic Operational Structure
- The Prisma Story
 - *Nominal Phase*
 - *Extended Phase*
 - *External Parties Phase*
 - *Final Phase*
- Conclusion

- 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





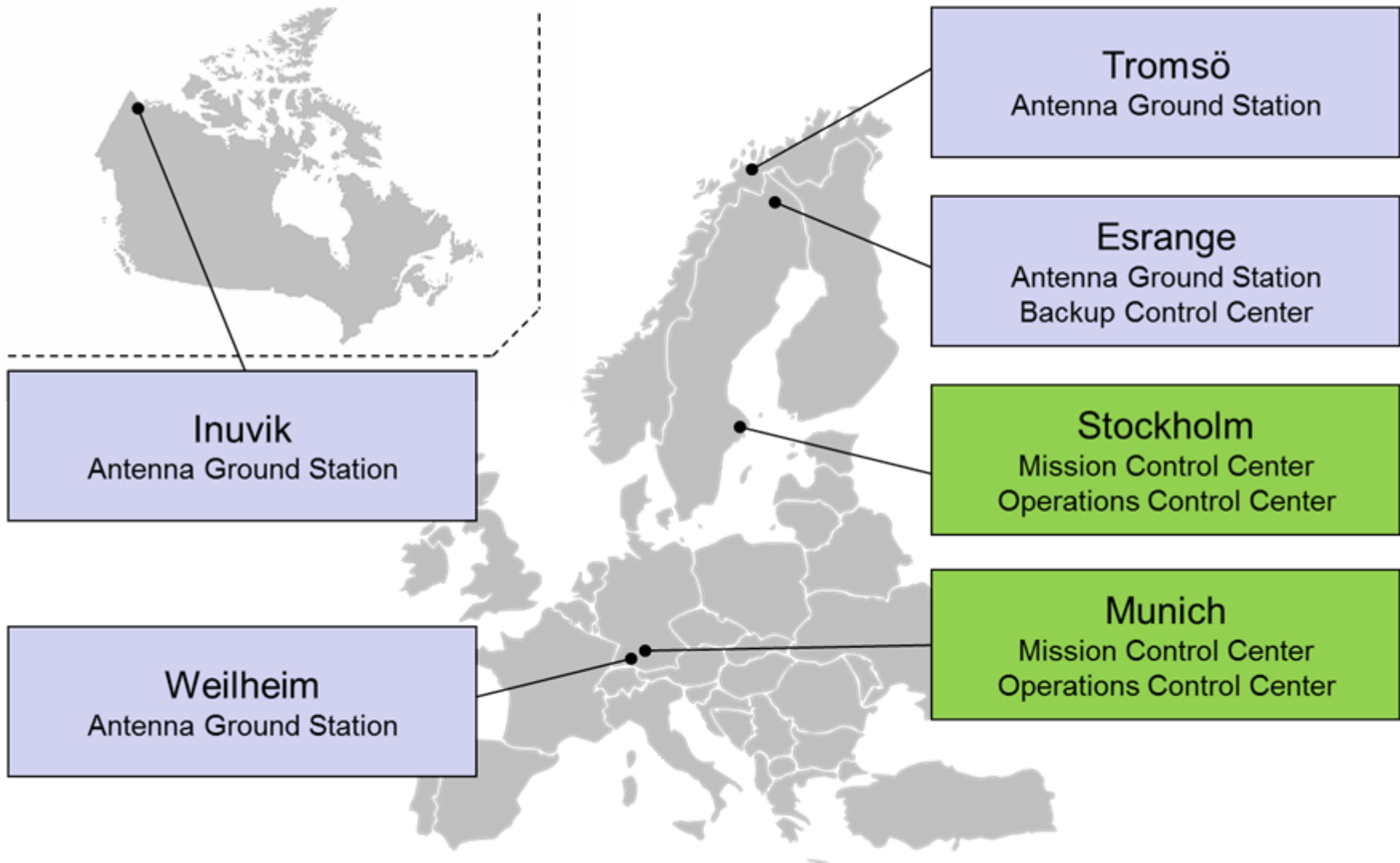
- **Mission Control Center, core functions**

- 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

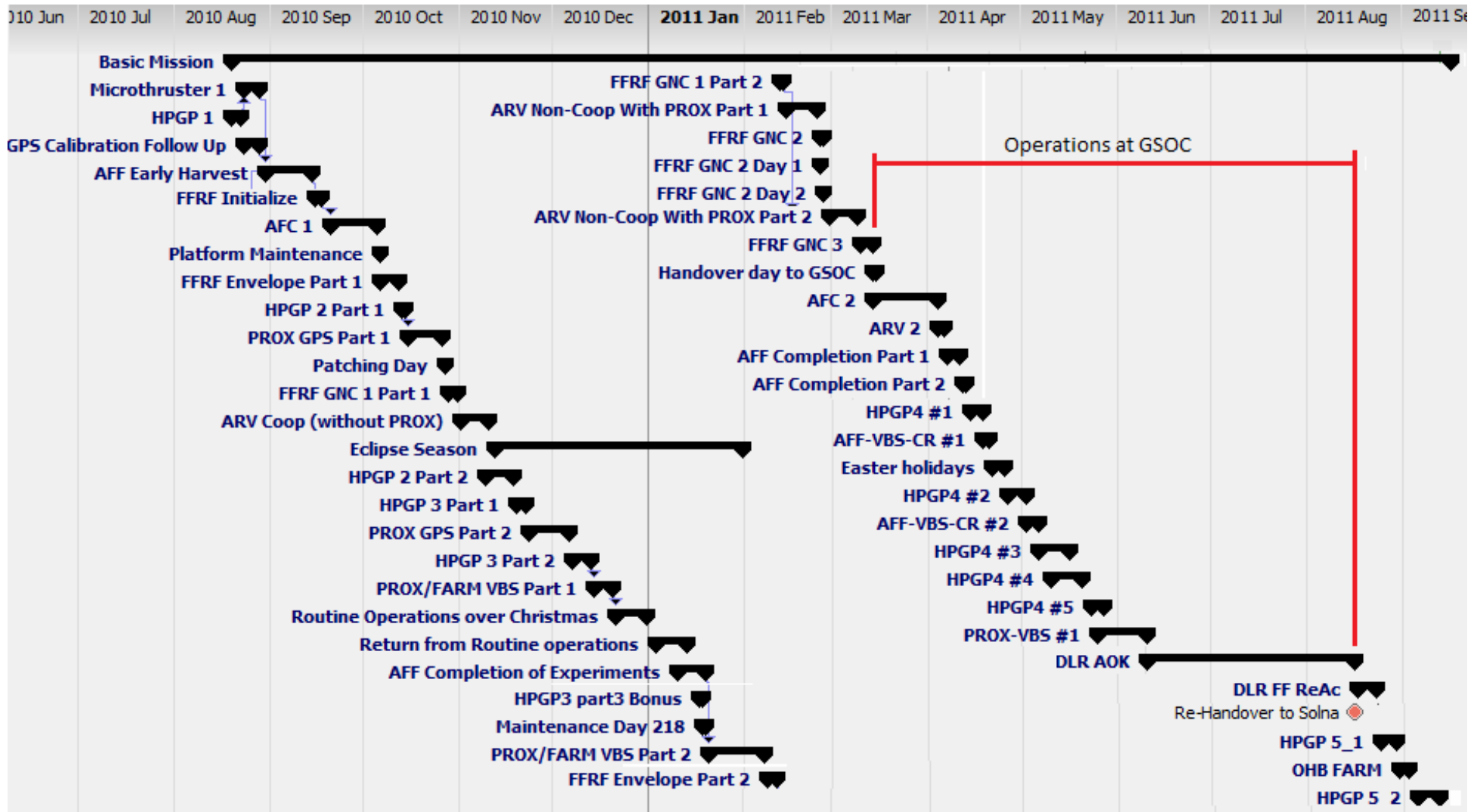


Mission phase	Start Date	Duration	Operator
Nominal mission	2010-06-15	273 days	OHB-SE (SSC)
Extended mission	2011-03-15	160 days	DLR/GSOC
External parties mission	2011-08-22	588 days	OHB-SE
Final mission	2013-04-01	Ongoing...	OHB-SE

- **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

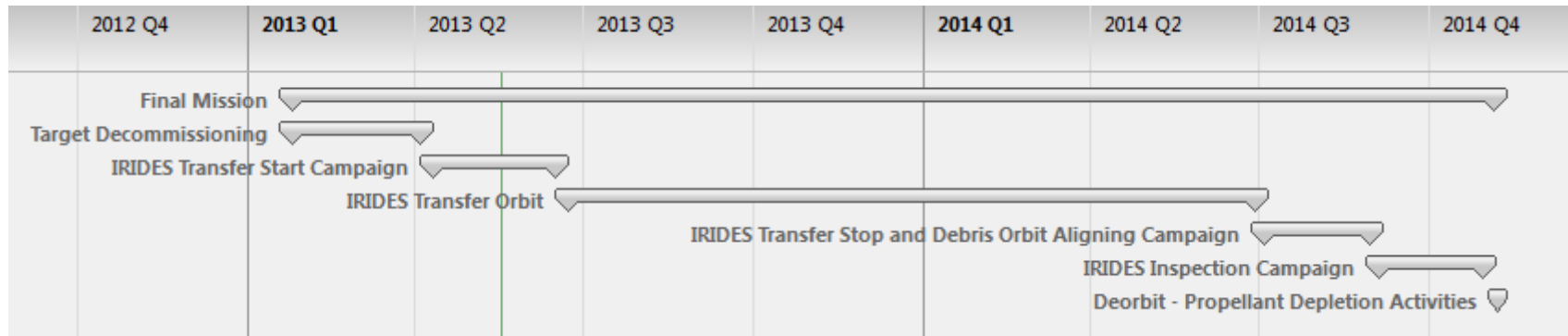


Organization	Experiment	Start Date	Duration
Space-SI	Interferometry, Space debris, Distributed instrument, Formation flying	2011-09-19	7 days
GMV	HARVD	2011-10-03	5 days
CNES	FFRF cont.	2011-10-10	23 days
DLR	ARGON	2012-04-16	5 days
CNES	μ NEAT	2012-09-19	3 days
ECAPS	HPGP6	2013-02-15	1 day

- **External Parties Phase**

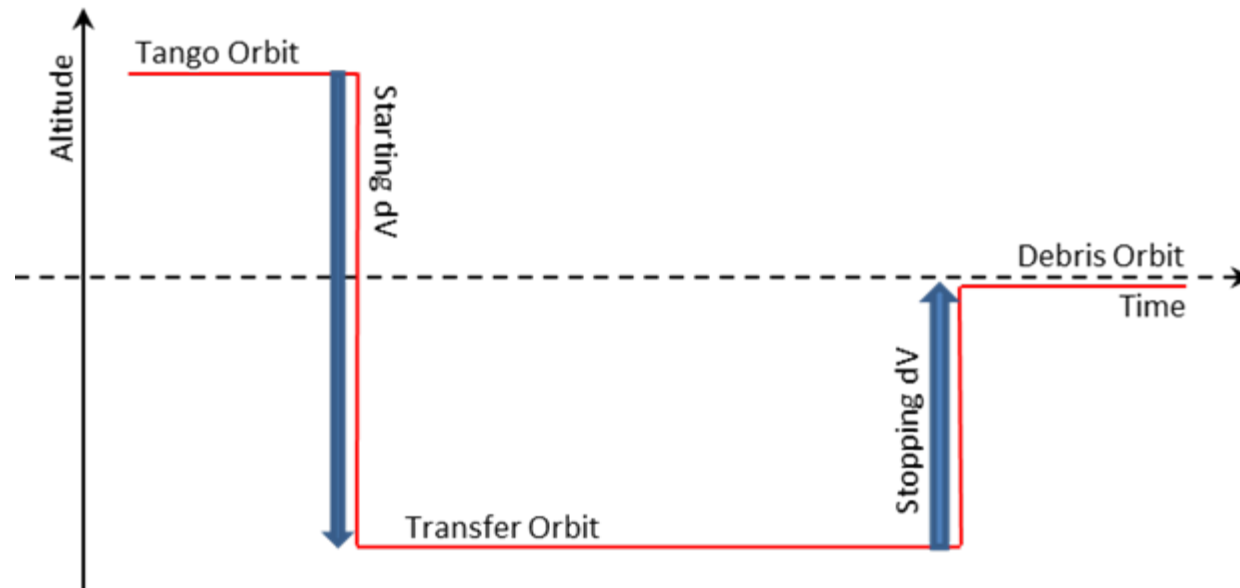
- New partners brought in new and challenging ideas
- Very hectic to begin with
- Idling for long periods
- The base for the final experiment was settled during the idle period

The Prisma Story – Final Phase



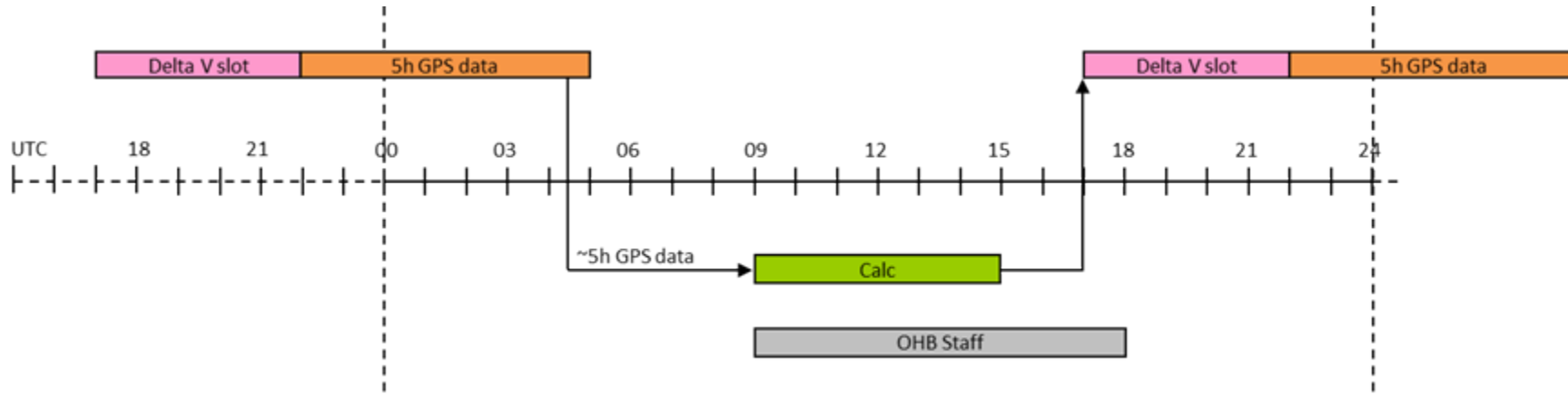
- **Goal of the Final Phase - IRIDES**

- Rendezvous with non-cooperative space debris object
- Establish a safe relative orbit [~200km, ~3km, ~3km] (*based on absolute 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



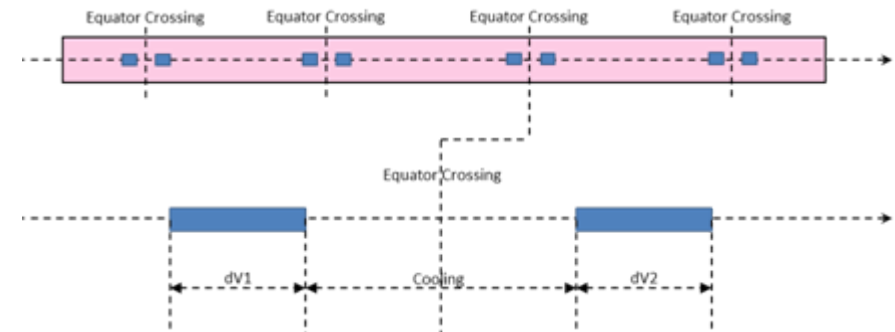
- **Starting dV campaign**
 - Fire a single thruster to achieve both an in-track and out-of-plane component
 - Achieve decrease of semi-major axis
 - Achieve increase of inclination (although debris has lower inclination)
 - Fire at ascending node only to increase eccentricity
- **Transfer Orbit**
 -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



- **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 achieved many autonomous 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-cooperative space debris object**
 - Transfer to and inspecting an inorbit space debris object

Thank you and thanks to:

Prisma
Satellites

