

Niclas Larsson

N. Larsson, R. Lilja (OHB Sweden), M. Örth, S. Söderholm (ÅAC Microtec), J. Köhler, R. Lindberg (SNSB), J. Gumbel (MISU)



SATELLITE SYSTEMS

InnoSat and MATS – An Ingenious Spacecraft Platform applied to Mesospheric Tomography and Spectroscopy

Presentation outline

- Call for Ideas by Swedish National Space Board
- InnoSat platform consortium
- InnoSat concept and system design
- The first mission: MATS
- Summary and Conclusions

2011: Call for Ideas by Swedish National Space Board

- Low-cost, top science missions, made feasible by innovative approaches
- Long-term programme with very low total cost
- Swedish participation

InnoSat Platform Consortium



Small-sat systems integrator (Freja, Astrid 1 &2 , Odin, SMART-1, PRISMA)

Satellite operations (currently Odin and PRISMA)

AOCS and Propulsion subsystem provider for ESA and telecom missions



Provider of fault tolerant products, systems and solutions for small satellites

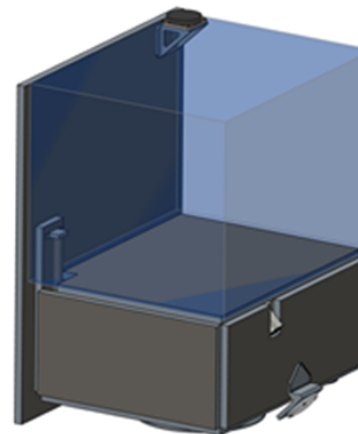
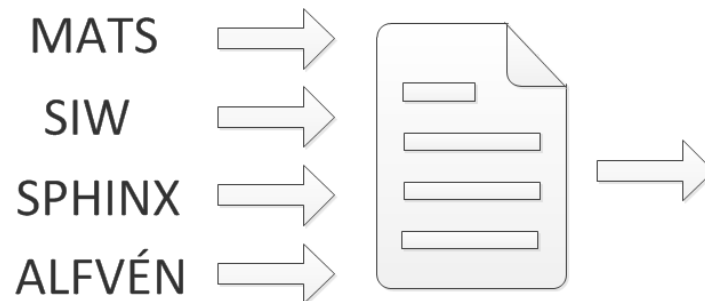
InnoSat Concept

- Only LEO missions considered
- Compatible with four proposed science missions
- 600 km dawn/dusk orbit assumed
- Optimized for piggyback launch

Four LEO
missions

Generic bus
specification

Generic
spacecraft bus



InnoSat Key Performance Factors

Mass: 40 kg

Size: 70x60x85 cm

Max payload size: 65x53x48 cm

Max payload mass: 15 kg

Max payload power: 40 W (orbit average)

Design lifetime: 2 years

Downlink bitrate: 3-5 Mbps

Stabilization: 3-axis with Star Tracker and RW

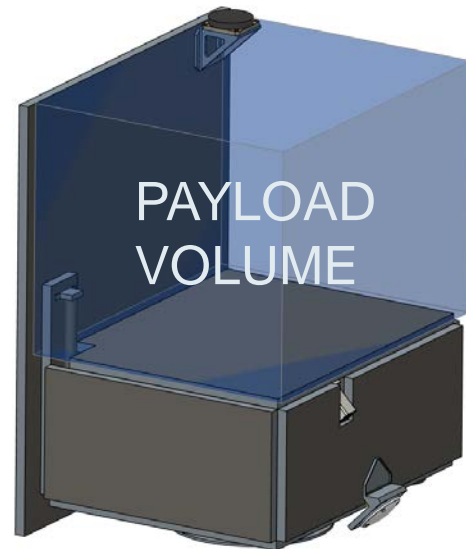
Pointing performance:

- Max 0.05 deg absolute pointing error

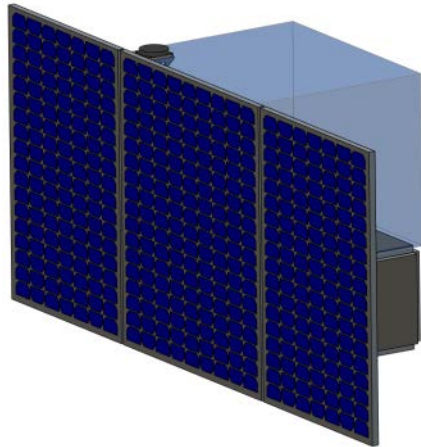
- Max 0.01 deg attitude reconstruction error

Orbit determination: On-board GPS

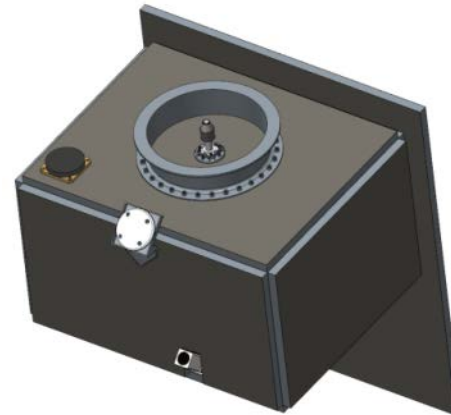
Payload can be Earth- or Space-facing



Possible extensions

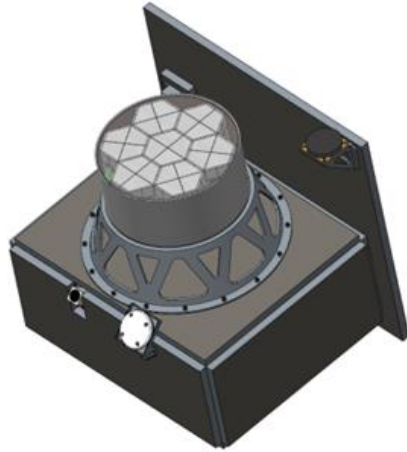


High power option

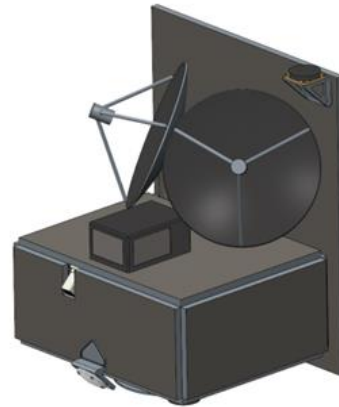


Propulsion

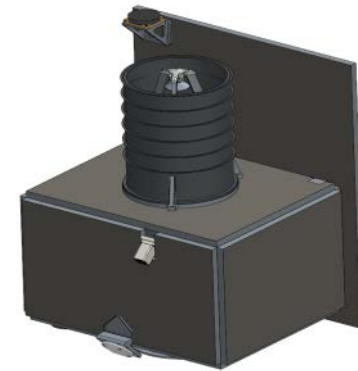
Possible payload accommodation



X-ray physics

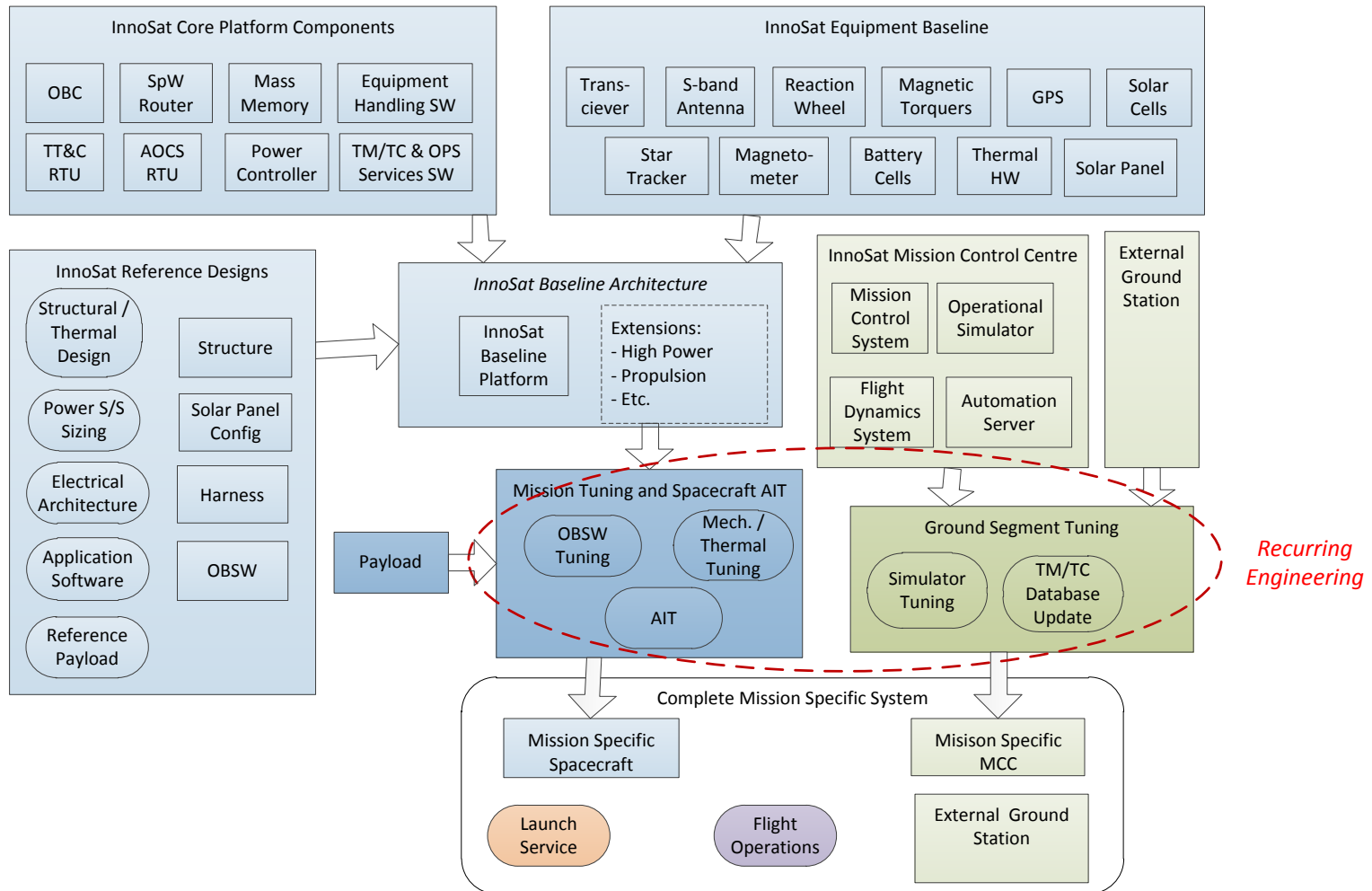


Submillimeter radiometry



High resolution imaging

System architecture and re-use approach



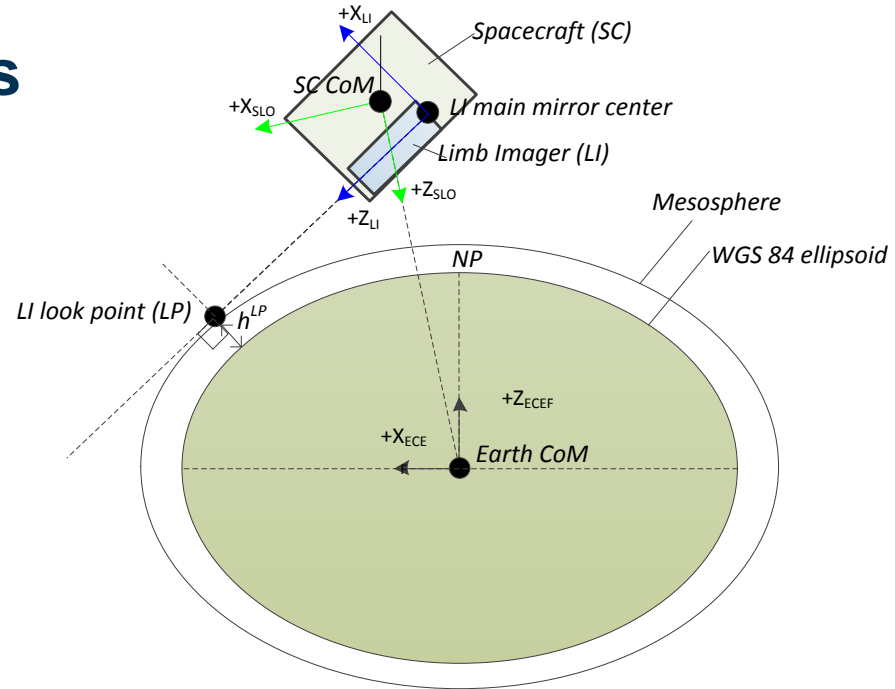
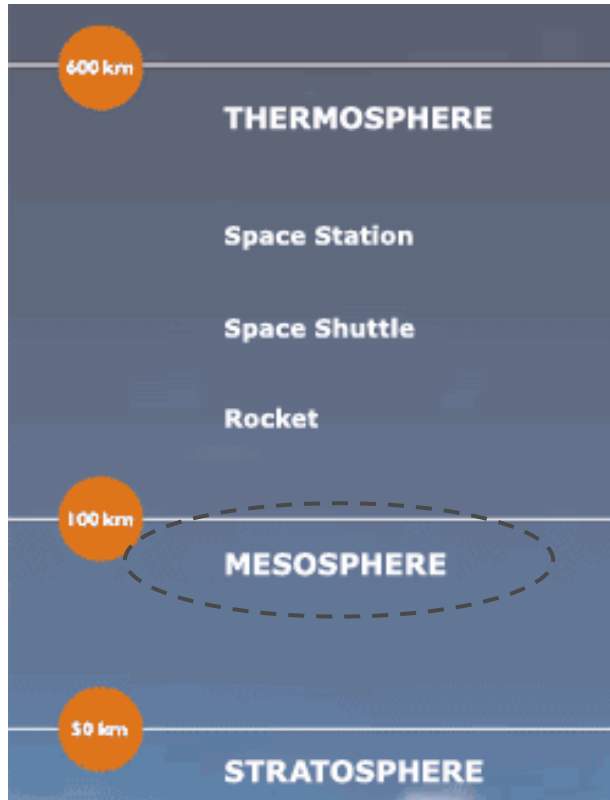
Key satellite design items

- High performance data handling system (ÅAC Microtec)
- High-efficiency power distribution unit (ÅAC Microtec)
- SPARTAN software framework with PUS protocol stack (OHB Sweden)
- Autocoded AOCS software based on PRISMA GNC software (OHB Sweden)
- RAMSES Mission Control Centre (OHB Sweden)
- New all-soft System Simulator (OHB Sweden)

First mission: MATS

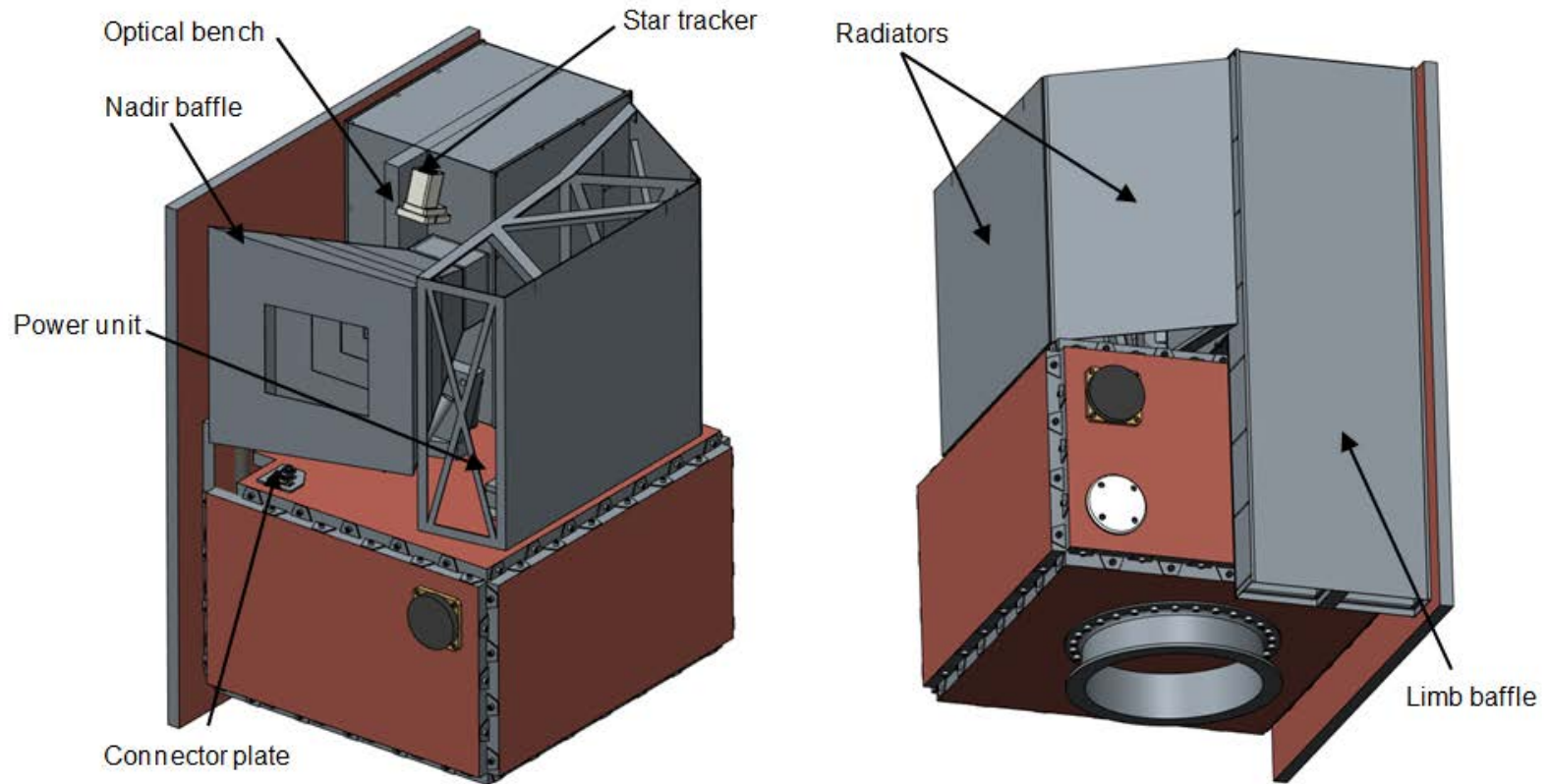
- Mission prime: MISU @ Stockholm University
- Instrument prime: Omnisys (Gothenburg)
- MATS: Mesospheric Airglow/Aerosol Tomography and Spectroscopy
- Two instruments: Limb viewer and Nadir viewer
- The Limb viewer will look into the mesosphere and acquire a continuous image sequence that can be used to construct tomographic images.
- The Nadir viewer will take images of noctilucent clouds
- The objective is to study atmospheric structures and wave patterns to gain a better understanding of the coupling between the mesosphere and other atmospheric layers.

Scientific observations



Noctilucent clouds over Stockholm

MATS payload accommodation



Platform summary for MATS

InnoSat baseline configuration, plus:

- Minor structural modification
- Improved AOCS with fiber-optic gyros (needed to fulfil the pointing stability requirements, 30 arcsec over 5 seconds)

Satellite will be ready for launch in 2018

Conclusions / InnoSat Summary

System Specification: Provides the performance envelope to the science teams and eliminates high non-recurring costs for each mission

Optimized for Science: 3-axis stabilized platform with high power and data downlink capabilities. Large, un-obstructed payload accommodation volume.

Affordable Launch Solution: The satellite is designed to fit several rideshare launch options.

Maximum Heritage Re-use: Plug and play electronics from AAC Microtec, application software and mission control system from OHB Sweden.

Microsat COTS FM hardware: Now available thanks to many other low-cost missions

Extendible: The current baseline configuration is only one of several possible reference designs.