



TELESPAZIO VEGA

DEUTSCHLAND

A Finmeccanica / Thales Company

Mauro Bartesaghi

**The Cluster
Experience**

Successful Planning of a Space Mission
against the Challenges of an Ageing Fleet

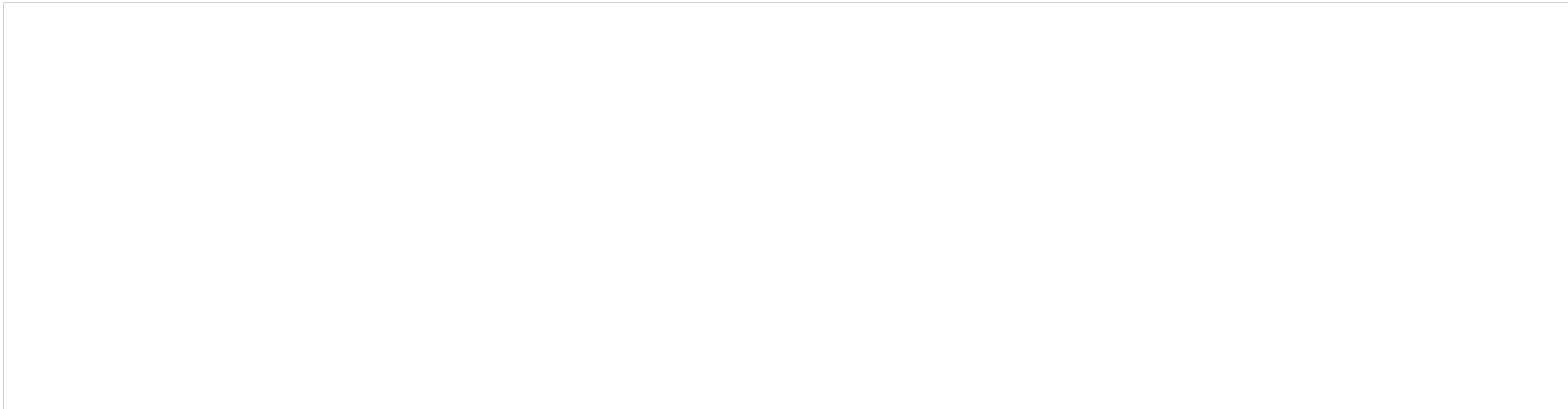
IWPSS 2013

NASA AMES Conference Centre

25/03/2013



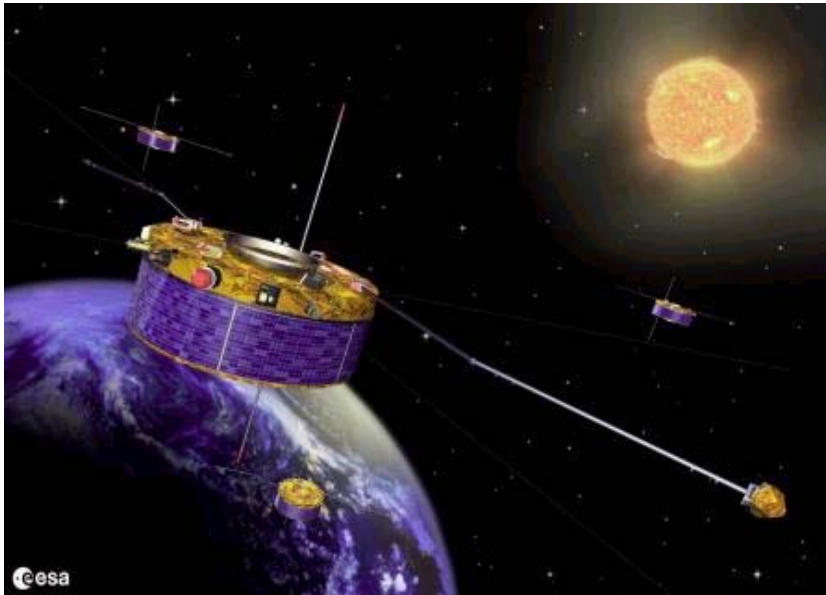
FOREWORD



MISSION OVERVIEW

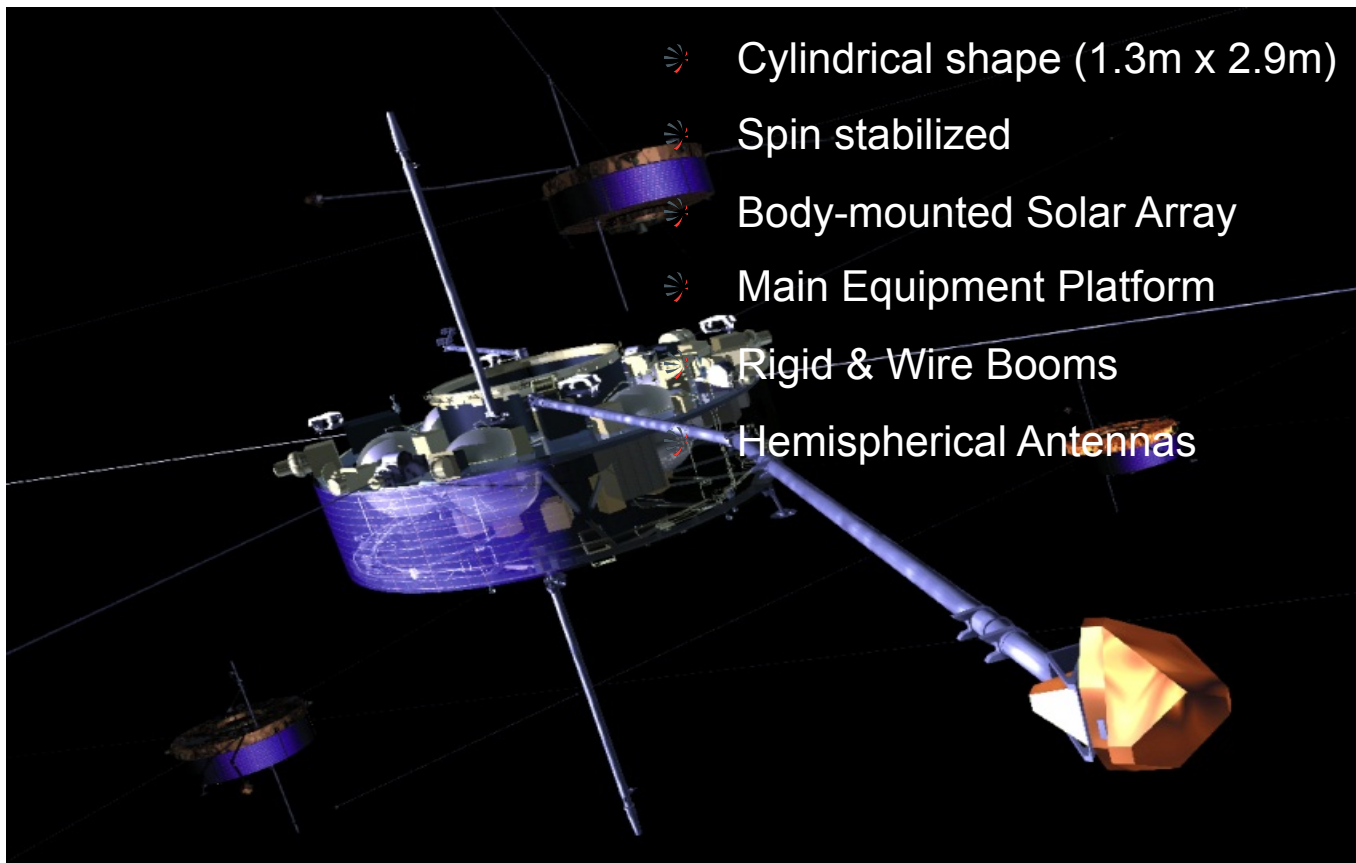
4 Spacecraft flying in Formation

- ✦ Earth's magnetosphere / solar wind interaction
- ✦ 3 D observations

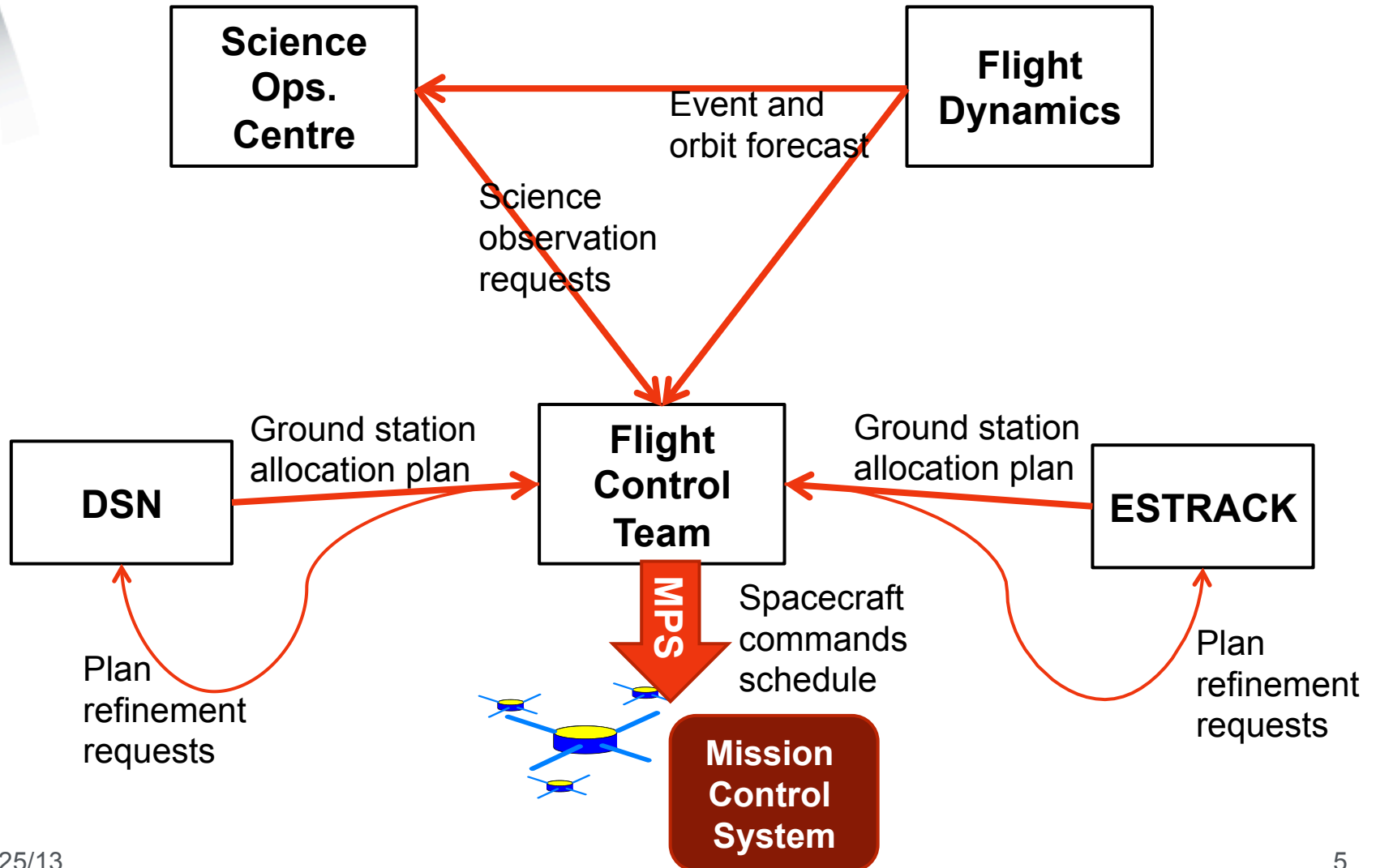


MISSION OVERVIEW

Spacecraft Architecture



MISSION PLANNING STAKEHOLDERS



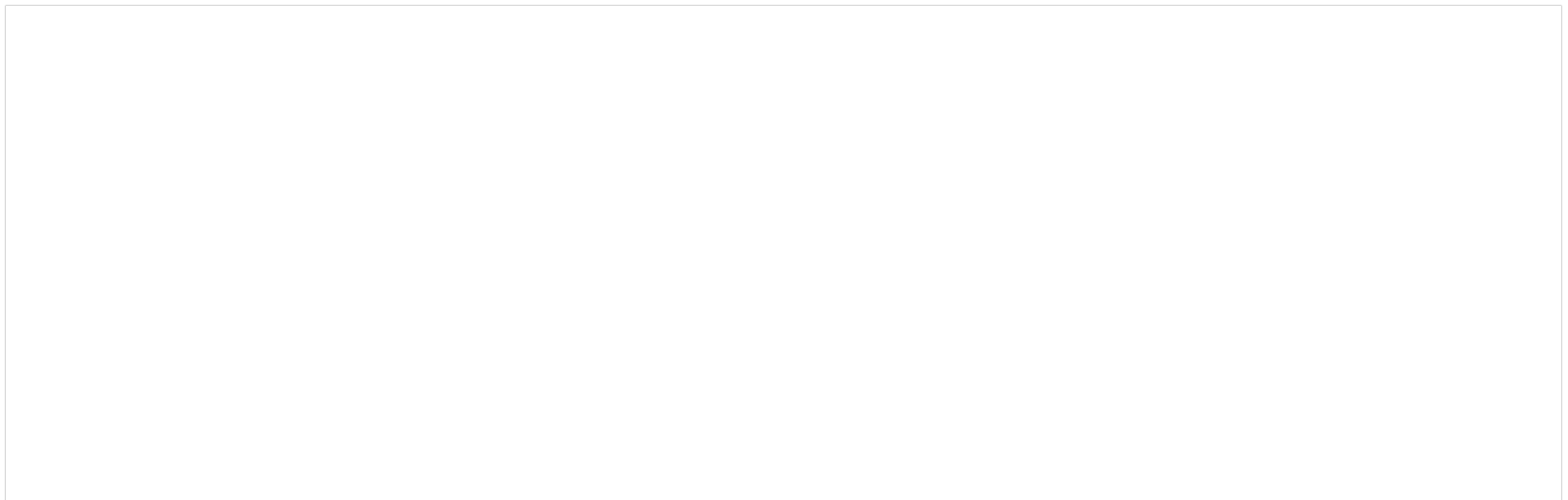
MISSION PLANNING STRATEGY

Non-Real Time Mission

- ✦ Housekeeping RAM memory = 40 hours telemetry
- ✦ On board time-tagged commands table = 2500 commands

SPACECRAFT AGEING CONSEQUENCES

27 months design lifetime VS. 13 years in orbit



Major operational and planning concern

SPACECRAFT AGEING CONSEQUENCES

Batteries degradation

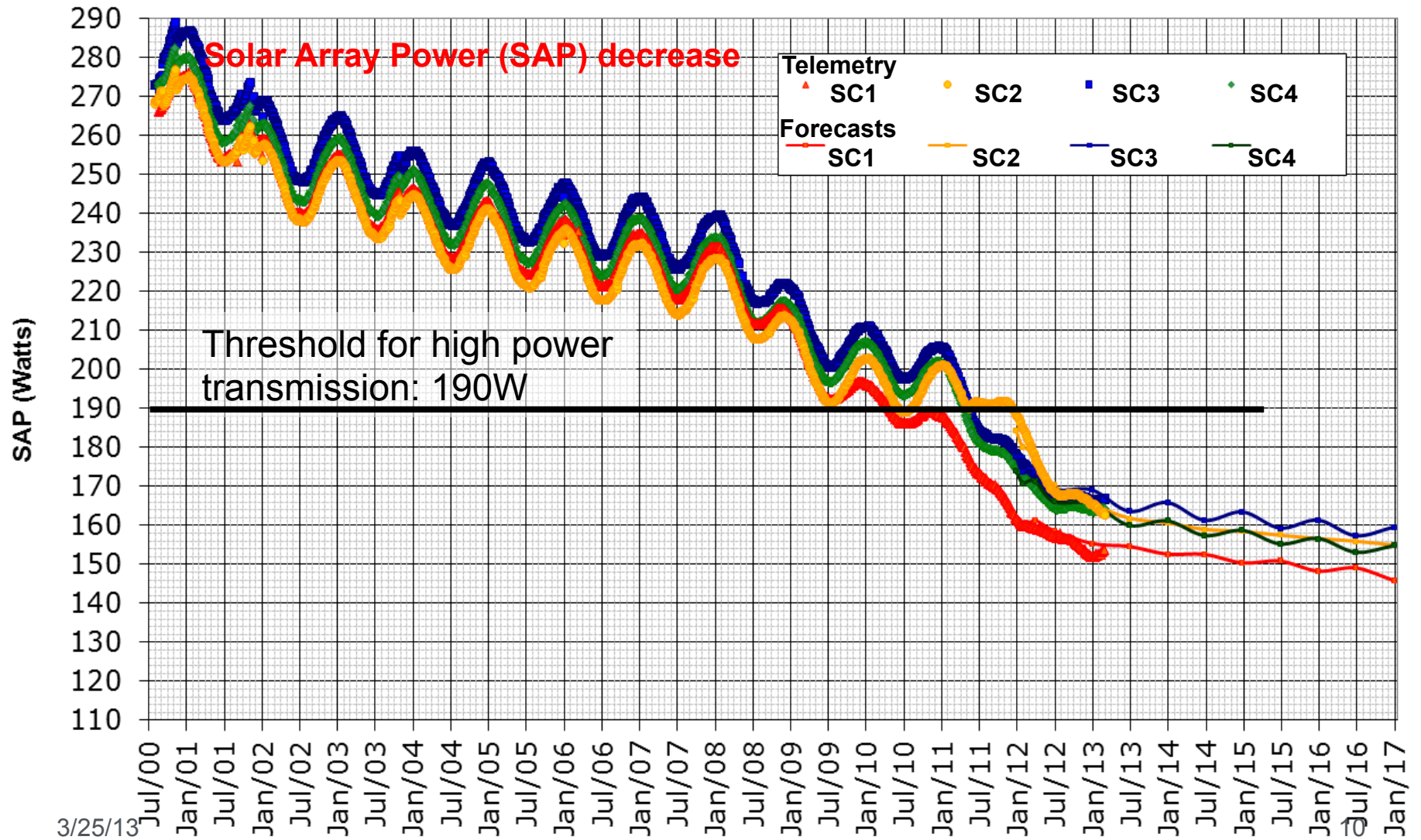
✦ AgCd Batteries → electromagnetic cleanliness

SPACECRAFT AGEING CONSEQUENCES

Eclipse operations with no batteries

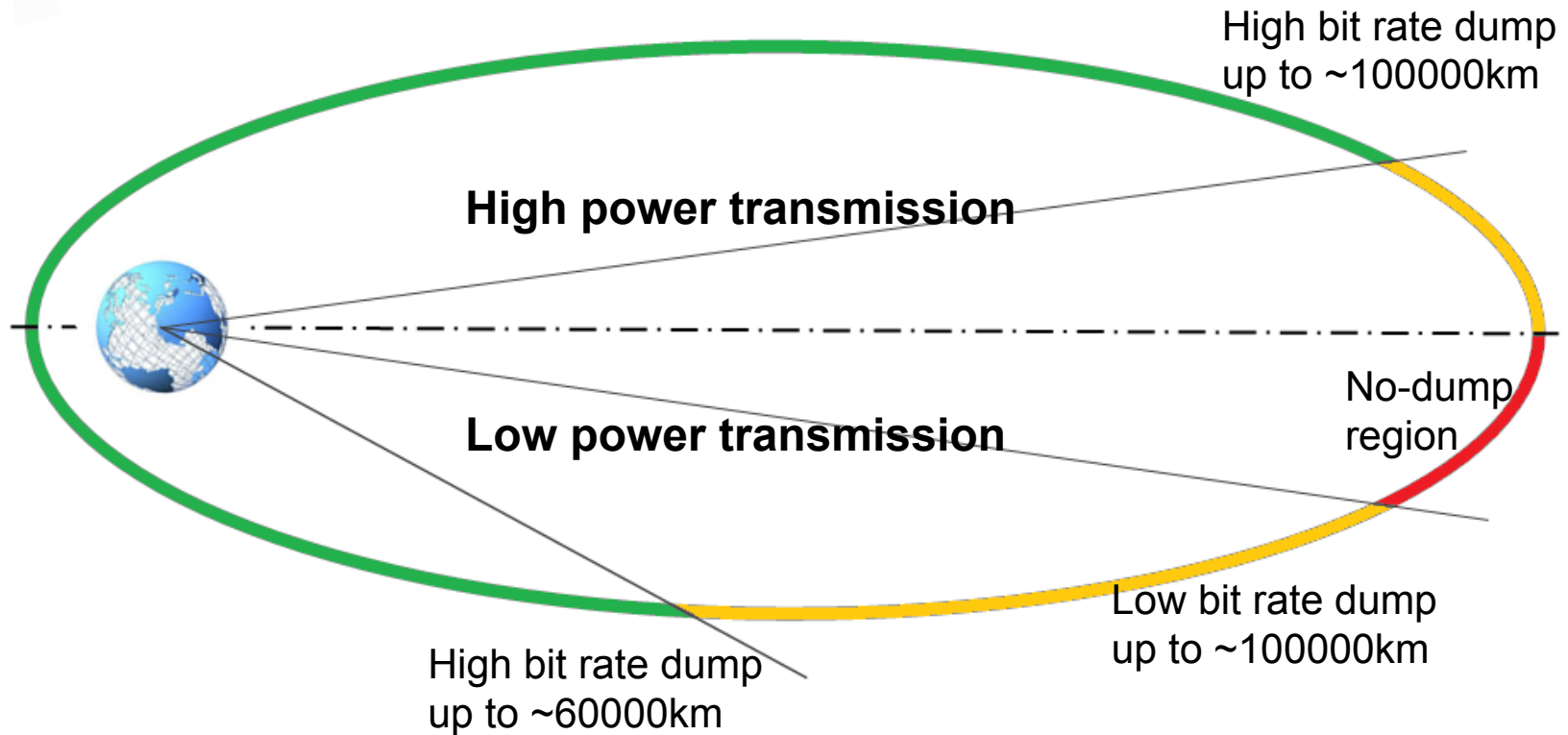
- ✦ Spin stabilization → no need for active attitude control
- ✦ Complete platform power off in umbra

SPACECRAFT AGEING CONSEQUENCES



SPACECRAFT AGEING CONSEQUENCES

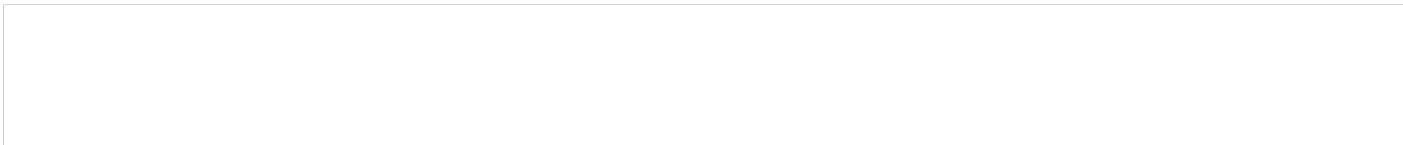
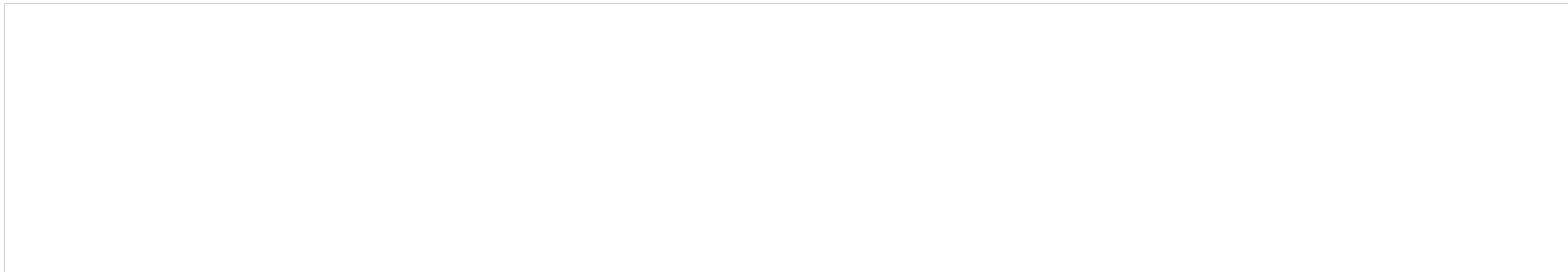
Link Budget: High power transmission VS. low power transmission



SPACECRAFT AGEING CONSEQUENCES

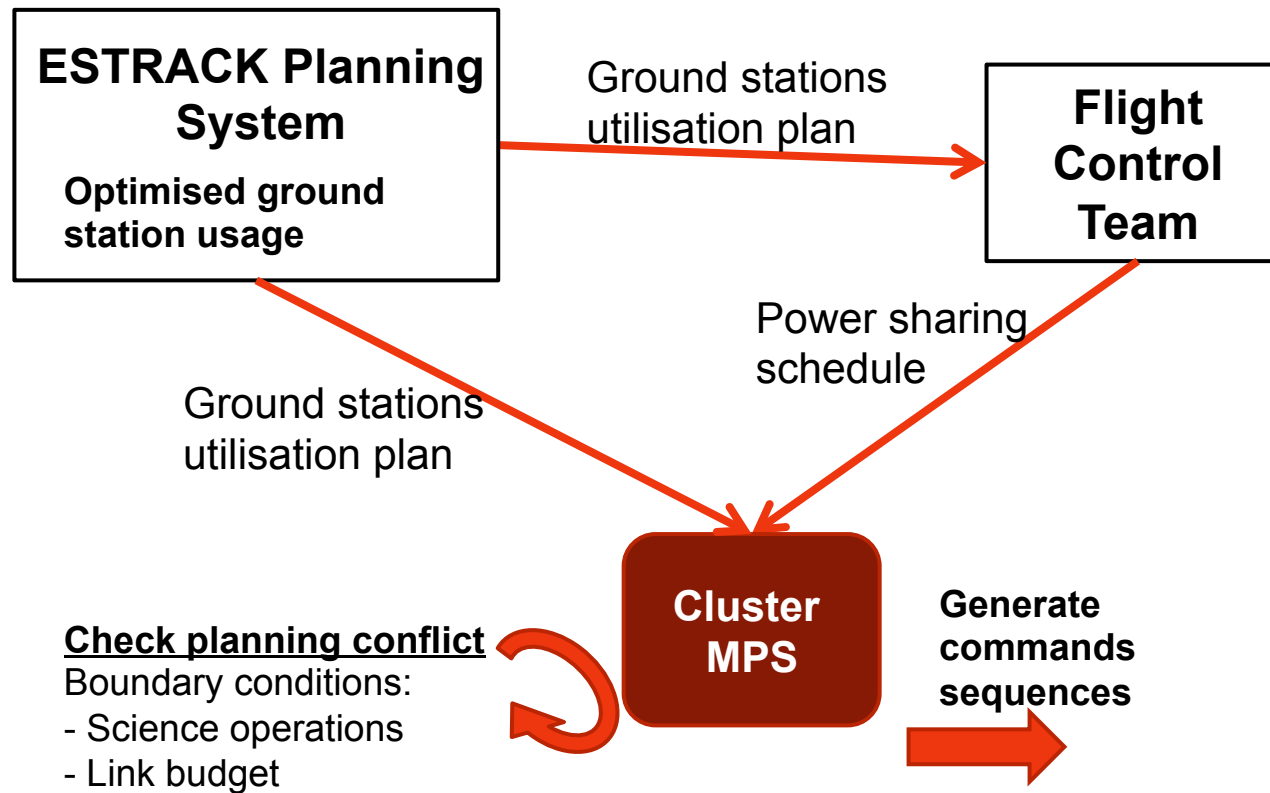
Link Budget: High power transmission VS. low power transmission

- ⇒ Low power mode transmission
 - ⇒ Smaller portion of the orbit can be used for dump
 - ⇒ Most data dump in Low Bit Rate

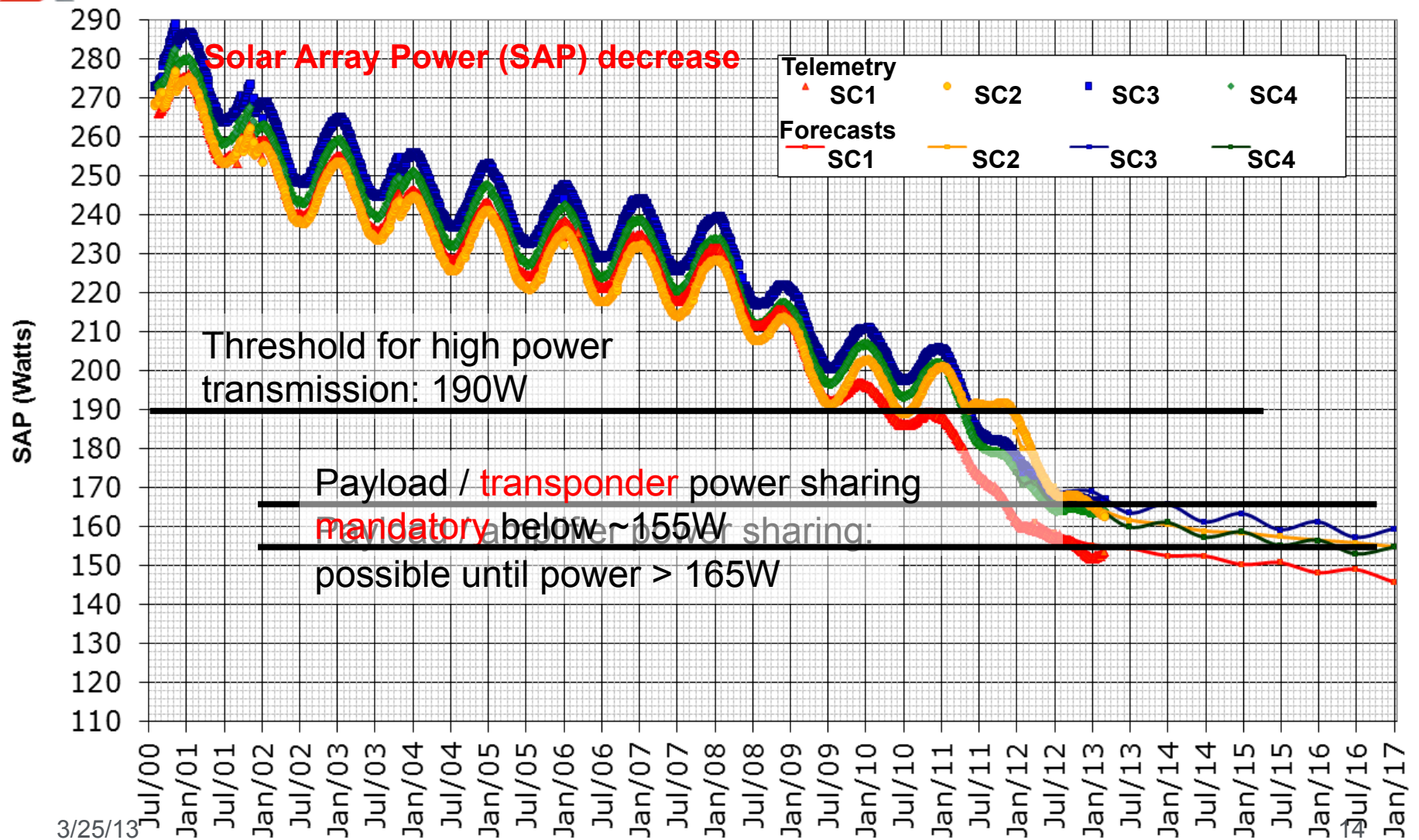


PAYLOAD-AMPLIFIER POWER SHARING

A three-steps process

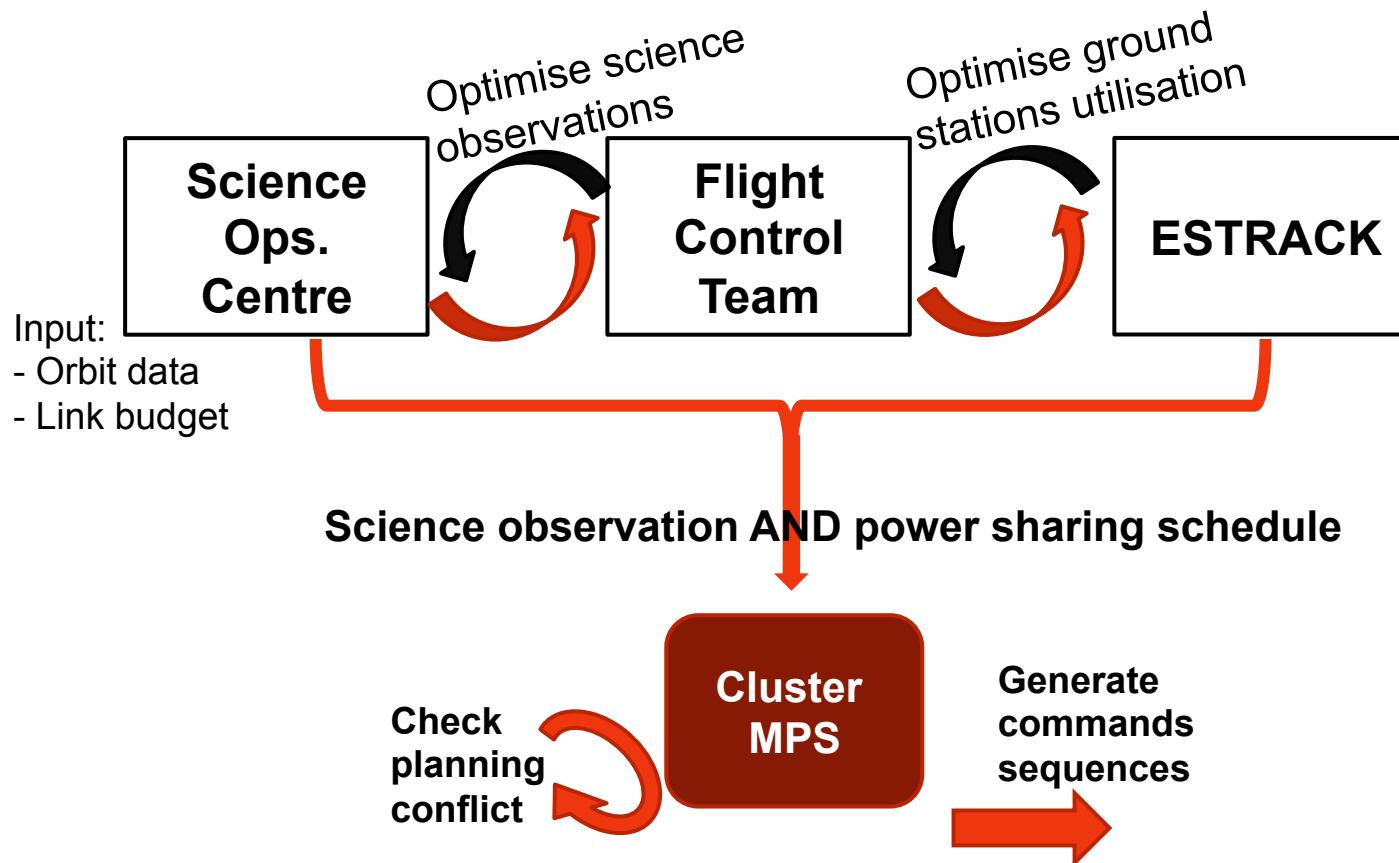


SPACECRAFT AGEING CONSEQUENCES



PAYLOAD-TRANSPONDER POWER SHARING

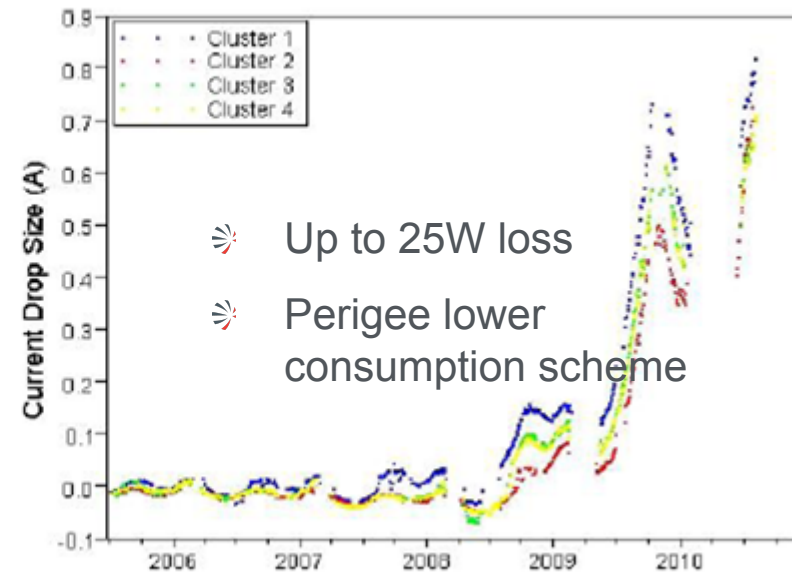
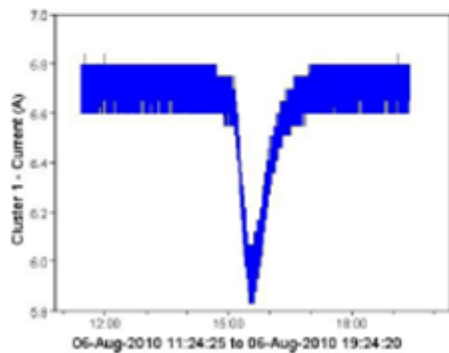
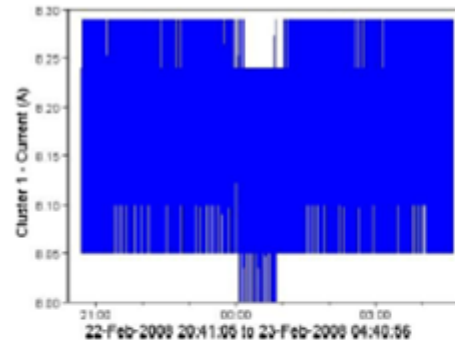
A science-driven plan



SPACECRAFT AGEING CONSEQUENCES

Perigee power drop

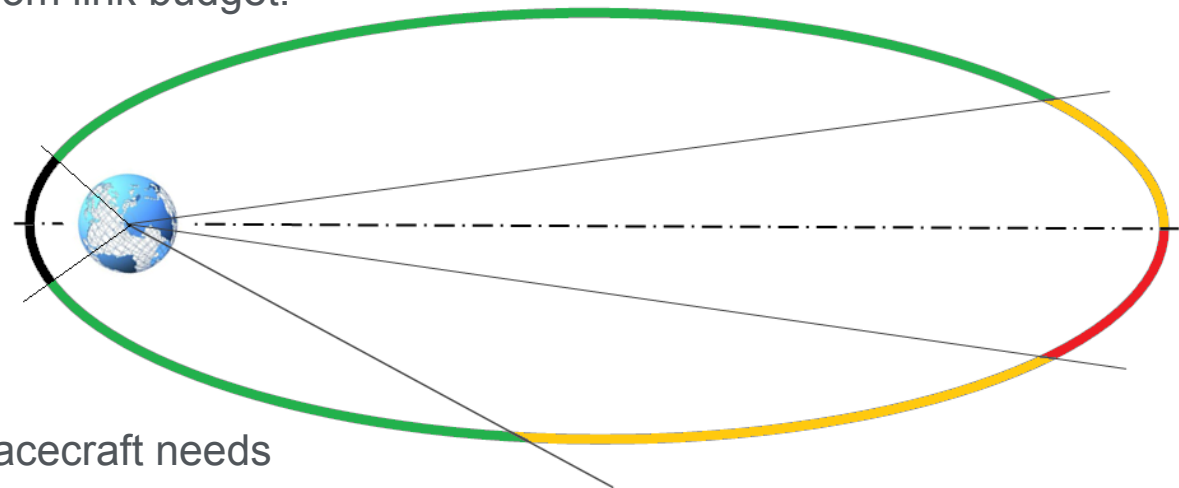
- ☼ Increasing Earth albedo
- ☼ Changing solar cells thermal properties



SPACECRAFT AGEING CONSEQUENCES

Link Budget: no transmission at perigee

- ✦ Independent from link budget!



- ✦ Tailored on spacecraft needs
 - ✦ Spacecraft 1: 90 minutes transponder off
 - ✦ Spacecraft 2: 60 minutes transponder off
 - ✦ Spacecraft 3 and 4: still no need for transponder off

CONCLUSIONS

Cluster's lessons learned

- ✦ Hard to forecast operational scenarios for a mission extended largely beyond its design lifetime
- ✦ Address the problems by exploiting existing design features in a new, unforeseen way
- ✦ Define clear, general strategy
 - ✦ Tailor it to the specific present needs
 - ✦ Have it ready for the upcoming challenges
 - ✦ Develop mission planning tools to fit the new needs

THANK YOU

Questions?

THE CLUSTER EXPERIENCE
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