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INTA

2009 CUBESAT DEVELOPERS WORKSHOP

23RD APRIL 2008

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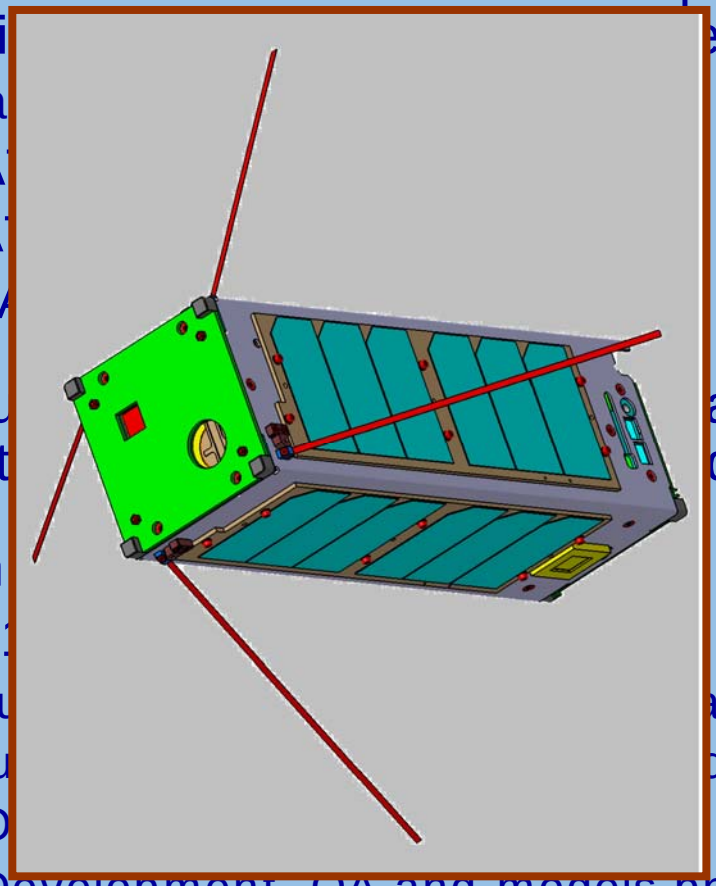
INTRO: WHY OPTOS

- INTA: National Institute for Aerospace Technology. Under supervi[illegible]e
  - Satellites la[illegible]
    - INTASA[illegible]
    - MINISA[illegible]
    - NANOSA[illegible]
- New line in cu[illegible]atform to provide "easy" acces t[illegible]development)
- First in the lin[illegible]
  - OPTOS (Q1[illegible]
    - 3U cu[illegible]ator ...
    - ... bu[illegible]d operational:
      - O[illegible]
      - Development, QA and models phylosophy



INTRO: WHY 2G OPTOS

- A SECOND GENERATION is implicit in the INTA Cubesat line
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- OPTOS is
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- OPTOS 2(
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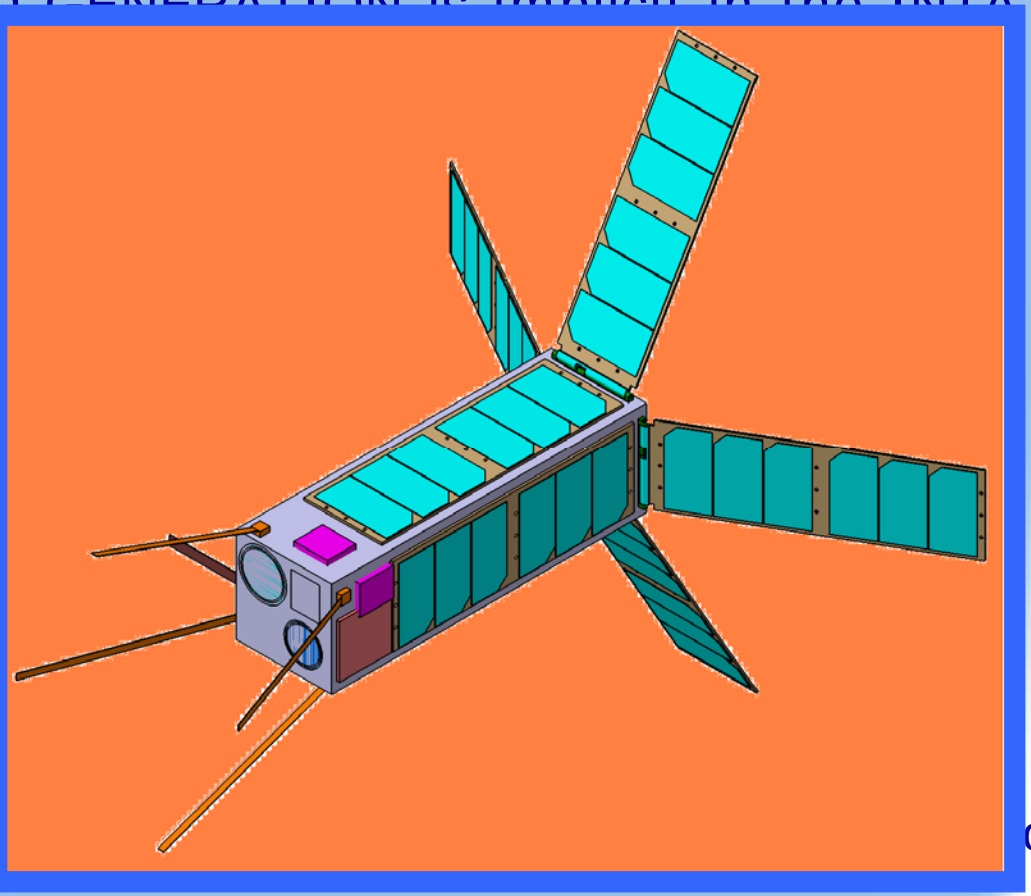
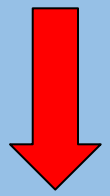
  - Lesson
  - Not de oads



2G OPTOS CONCEPT (I)

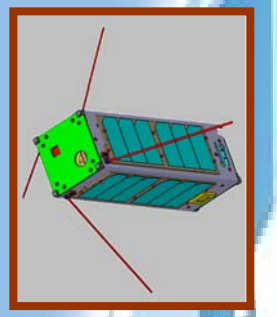
- **Main idea:** to continue the OPTOS 3U Cubesat line immediately
- Evaluate possible missions
- "What if"… :
  - Which tasks could a "better" OPTOS afford?



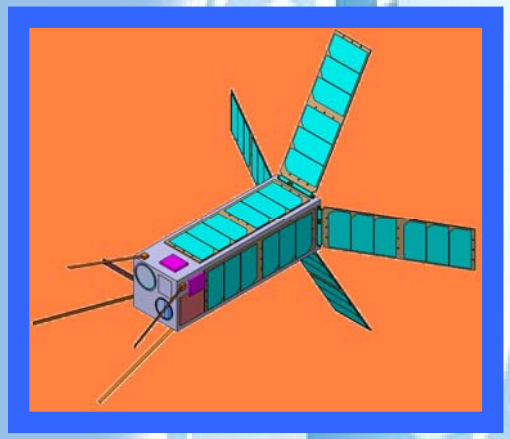
- Act as if a 2G mission is actually to be developed NOW
  - Generate actual documentation
  - Make and actual trade-off study
  - Considerate different alternatives

2G OPTOS CONCEPT (II)

- OPTOS 2G to carry out an specialized scientific / technical mission
  - Specialized and “professional” payload
  - Strong space requirements
  - Strong power requirements
  - Strong pointing requirements
  - Strong data budget requirements

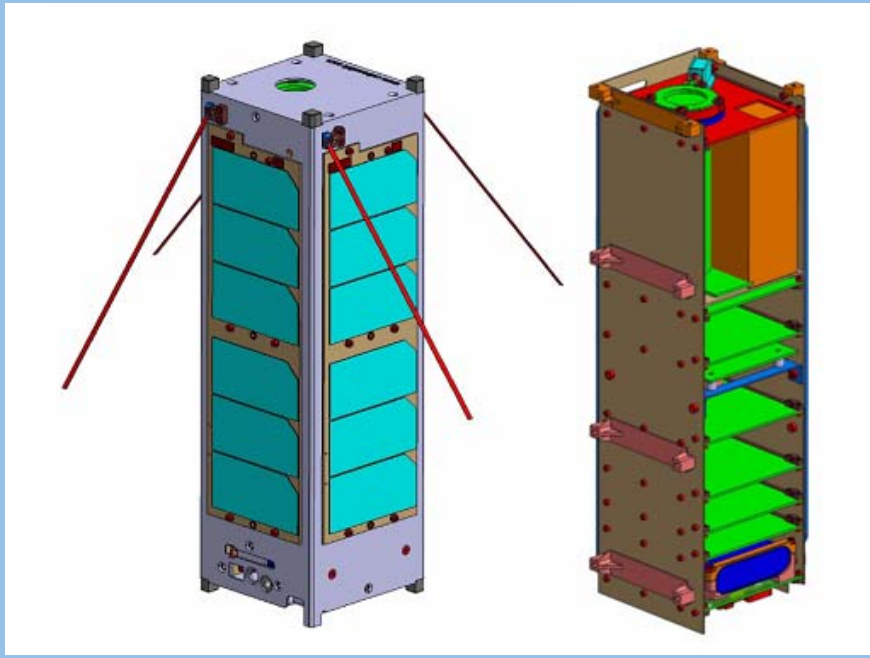


- OPTOS to be improved in:
  - Structure
  - Space optimization
  - Power generation
  - ADCS
  - TTC



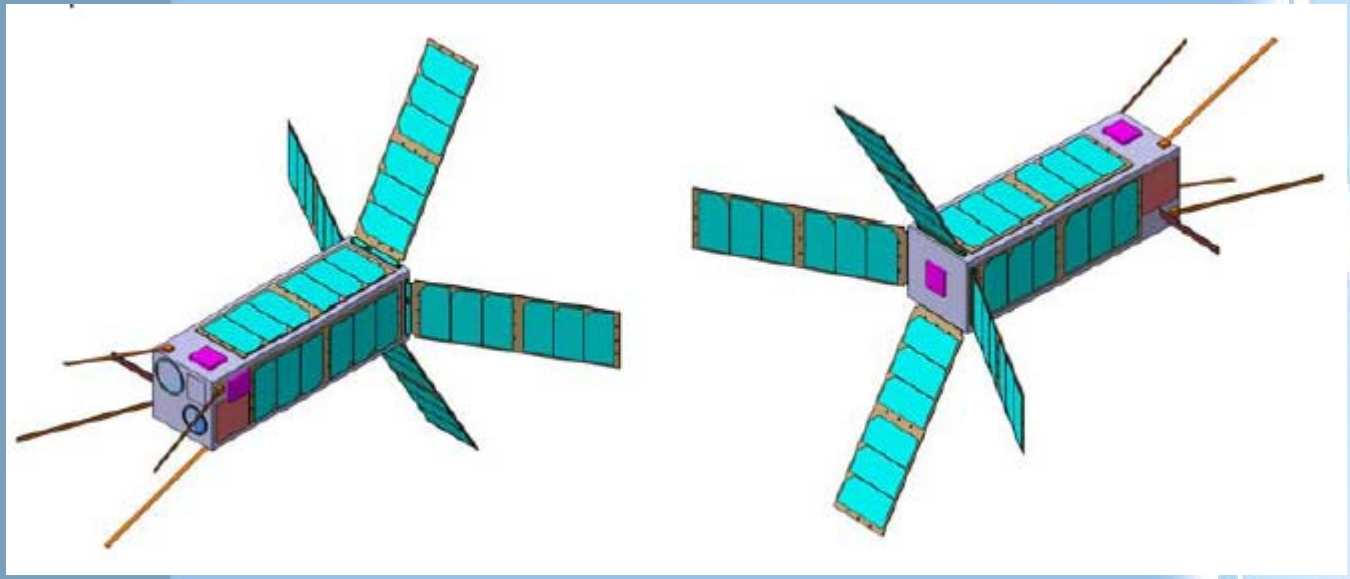
STRUCTURE IMPROVEMENT (I)

- OPTOS structure
  - External and internal structure
  - Subsystems and payloads in boards attached to the internal structure



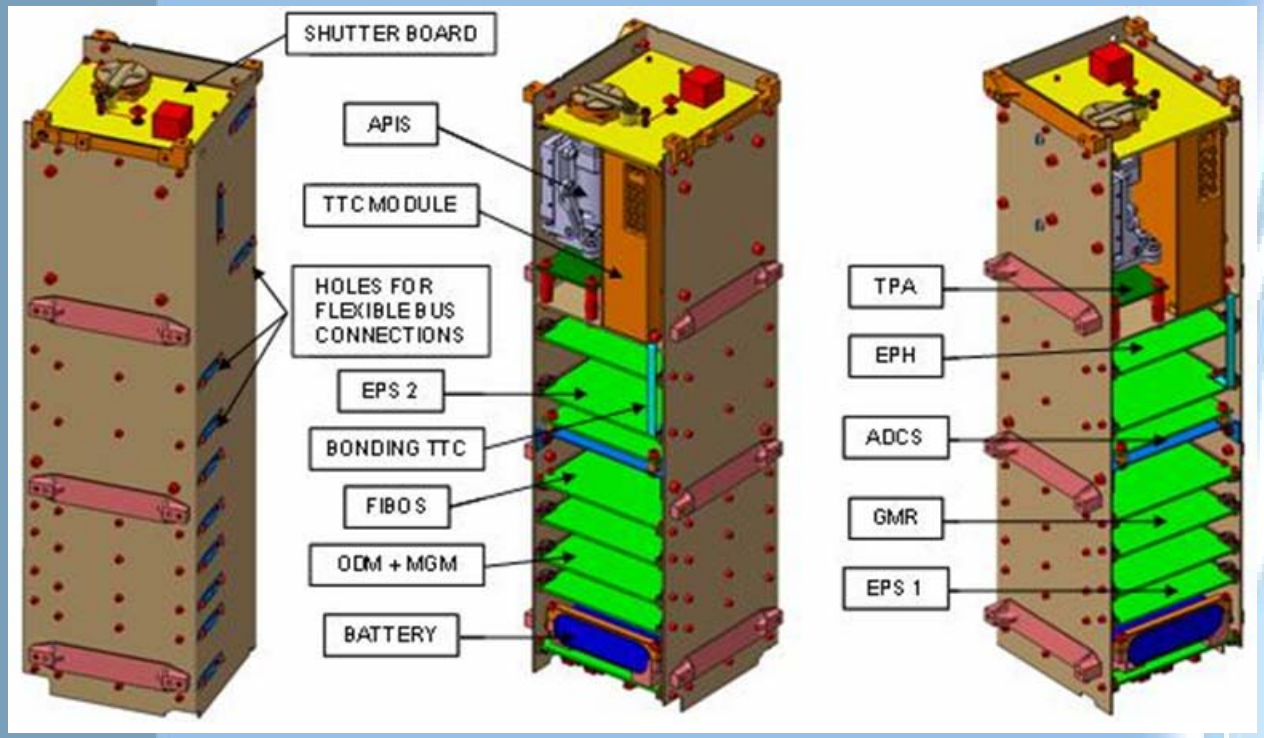
STRUCTURE IMPROVEMENT (II)

- 2G OPTOS structure
  - A lot of space is lost between internal – external OPTOS structure (maybe critical for “pro” payloads and subsystems)
  - A new “one body” structure under development



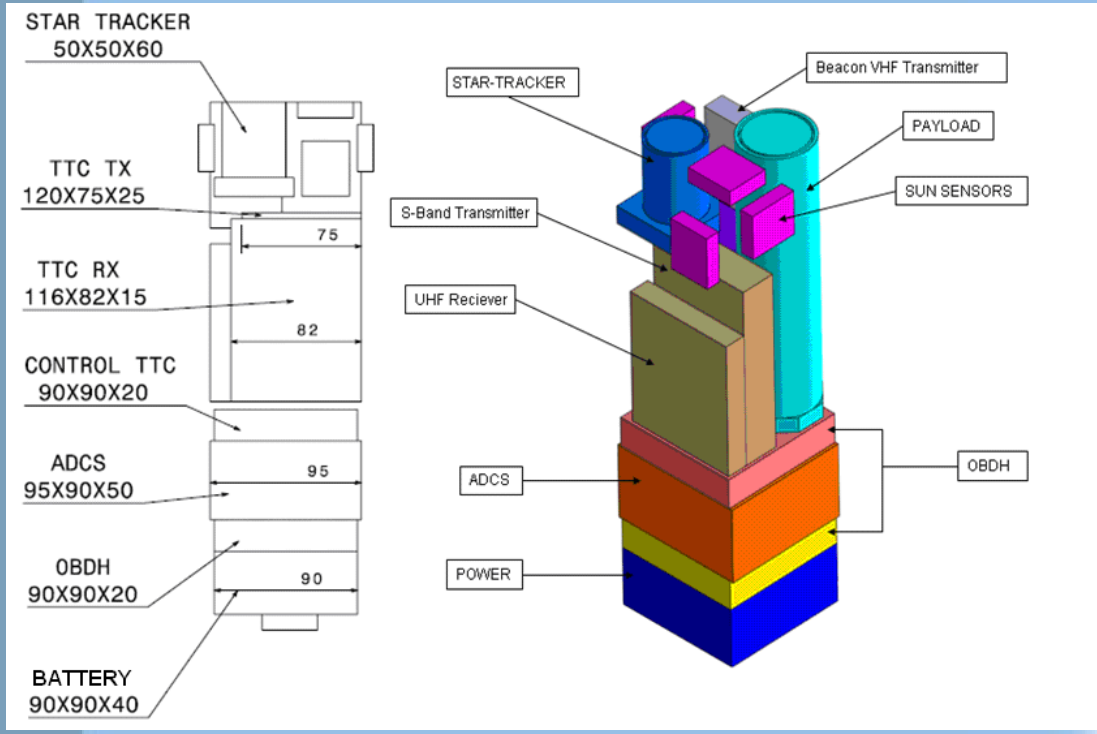
SPACE OPTIMIZ. IMPROVEMENT (I)

- OPTOS SS and PL internal distribution
  - Distributed through the whole satellite, at different levels (= boards)
  - All the internal space is occupied



SPACE OPTIMIZ. IMPROVEMENT (II)

- 2G OPTOS SS and PL internal distribution
  - SSs are grouped to occupy as minimum space as possible
  - A “big” space (200 x 50 x 50 mm) for a PL available
    (we expect to enlarge it even more –work in progress-)



POWER GEN. IMPROVEMENT (I)

- OPTOS power generation
  - 6-cells pannels mounted on the four larger sides of the satellite
  - Maximum power generated: 7W (for optimum Sun orientation)

OWER GEN. IMPROVEMENT (II)

2G OPTOS power generation (I)

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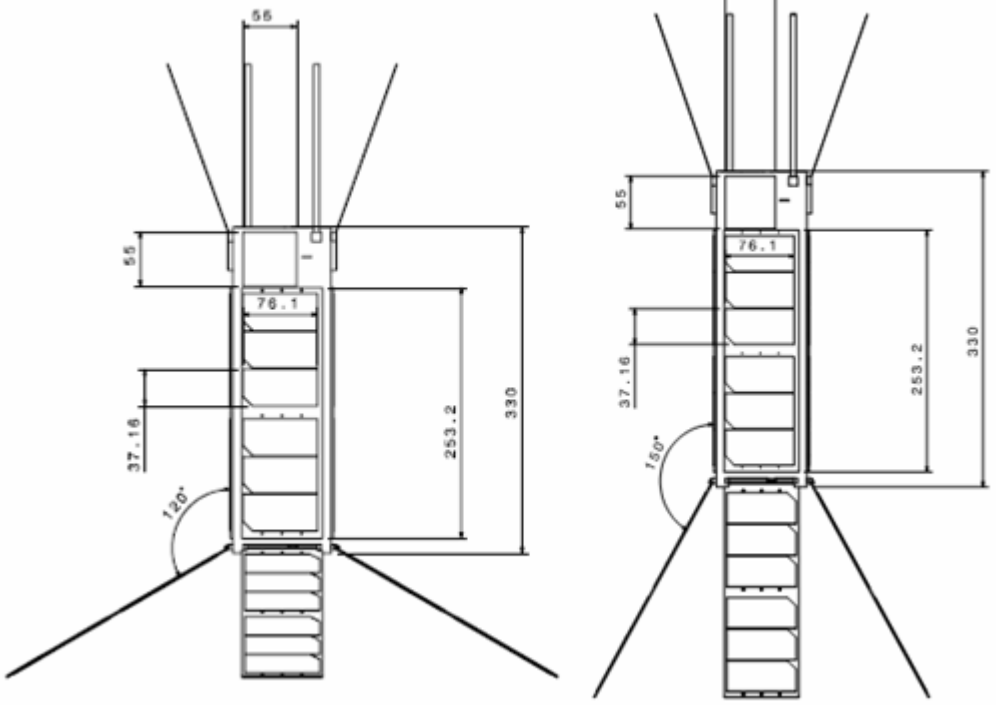
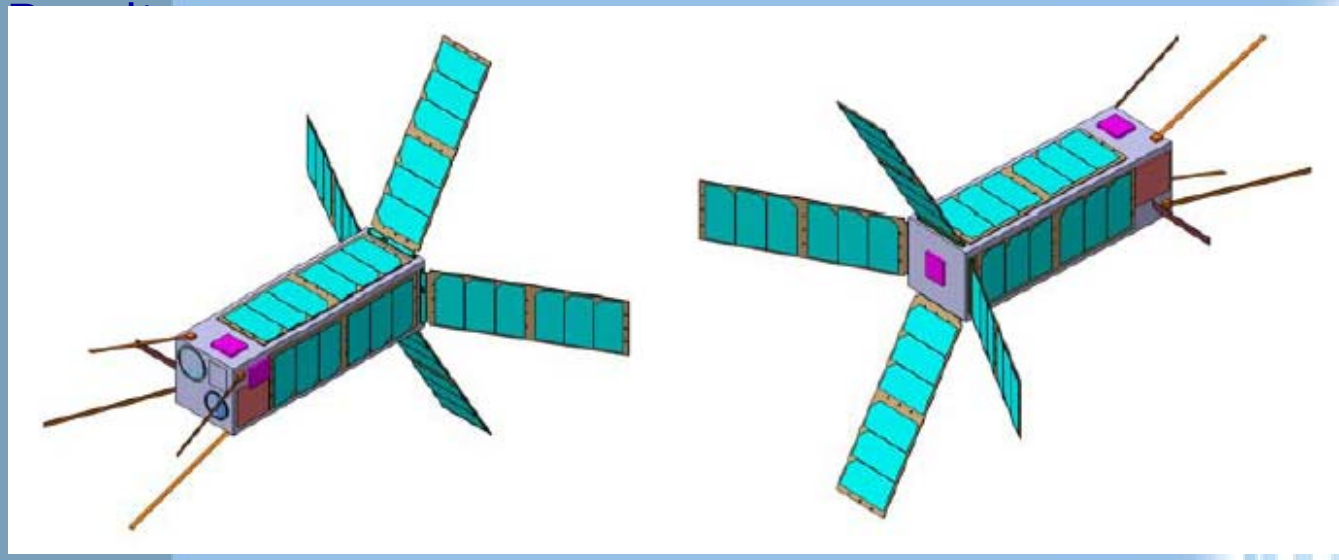


120º, with panels (as

150º, with olar panels

OWER GEN. IMPROVEMENT (III)

2G OPTOS power generation (II)

- 

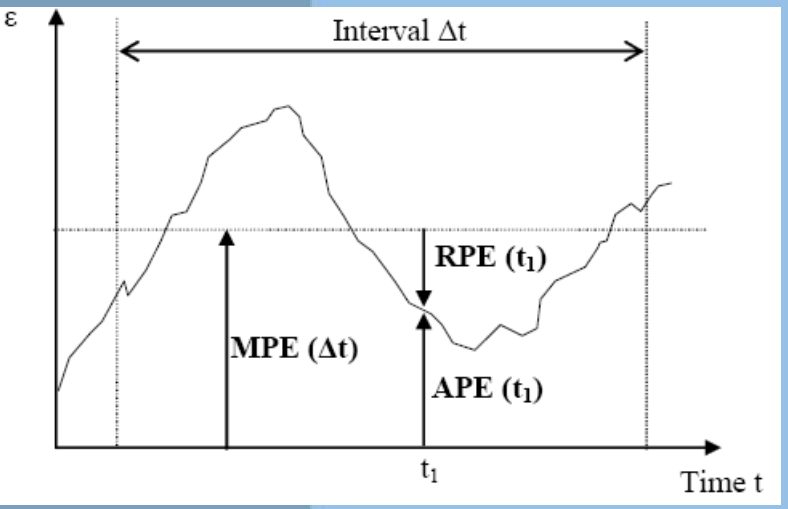
- Configuration 1 is the most efficient:
  - 3 x number of panels in OPTOS
  - "Tethraedron" configuration → completely symmetrical → no matter Sun direction (isotropic configuration)

    (suitable for a wide range of missions, no matter the needed orientation)

ADCS IMPROVEMENT (I)

OPTOS ADCS

- SENSORS:
  - 2 Sun Sensors
  - 1 Magnetometer
  - 1 Solar Presence detector
- ACTUATORS:
  - 1 Reaction Wheel
  - 5 Magnetotorquers



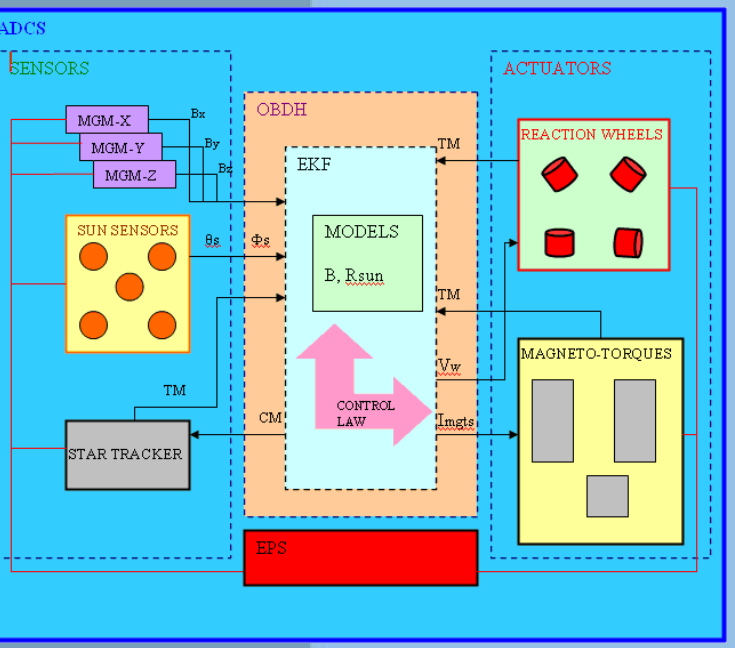
ACHIEVED PERFORMANCE:

- MPE: 5 deg (att. knowledge)
- APE: 15 deg (att. control)
- RPE: 20 arcsec (att. stability)

ADCS IMPROVEMENT (II)

2G OPTOS ADCS

- The same than OPTOS, plus...
  - 2 Sun Sensors (OPTOS) → 5 Sun Sensors (2G)
  - 1 Reaction Wheel (OPTOS) → 4 Actuation Wheels (2G)
    (3 axis + auxiliar plane)
  - 1 Star Tracker (2G)



ACHIEVED PERFORMANCE:

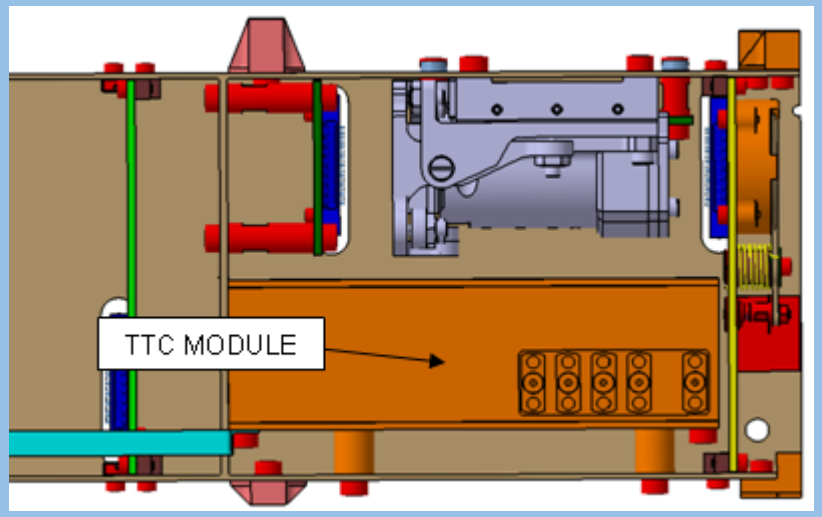
- MPE: 10 arcsec (att. knowledge)
- APE: 1 deg (att. control)
- RPE: 20 arcsec (att. stability)

This performance would be enough for high-precission astronomical picture taking

TC IMPROVEMENT (I)

OPTOS TTC

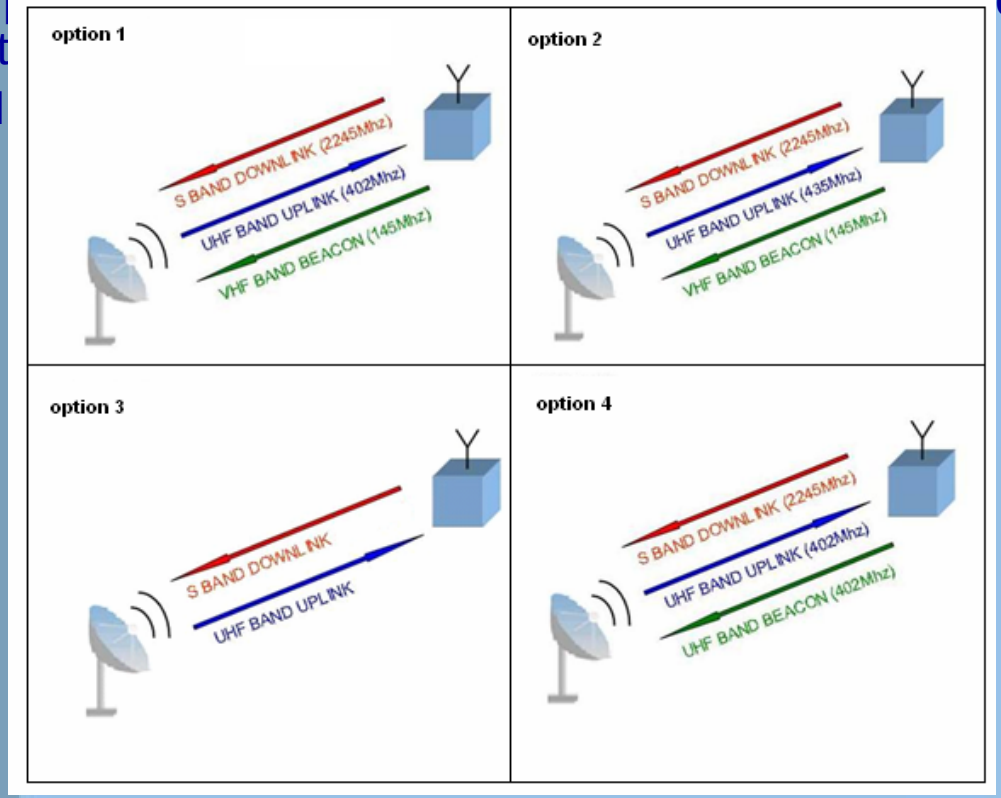
- Half-duplex transceiver + 4 monopoles (18 cm)
- UHF 402 MHz
- Bit-rate: 4 kbps uplink / 5 kbps downlink
- TC, TM, HK and Payload data use the same transceiver



TC IMPROVEMENT (II)

2G OPTOS TTC

- Considered options:
  - Improve bit rate in order to manage "professional" payload dat
  - Ful



TC IMPROVEMENT (III)

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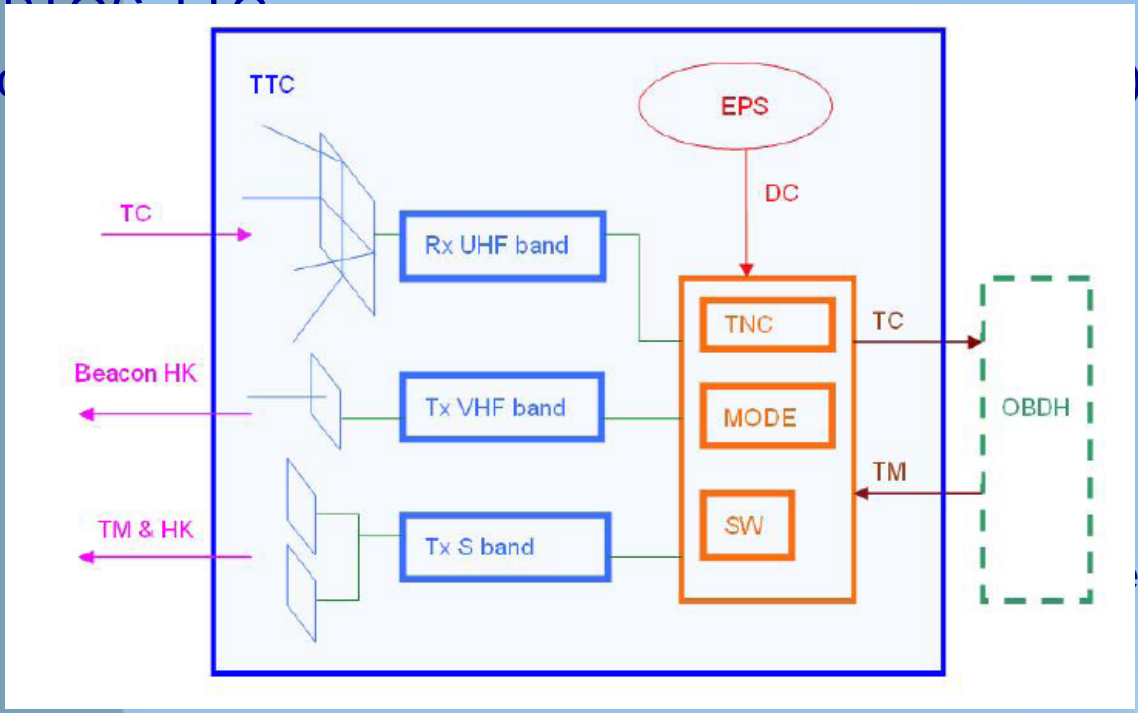

POSSIBLE REDUNDANCY UNDER FAILURE

OUTRO: CONCLUSIONS AND BEYOND

2G OPTOS suitable for specialized and “professional” purposes (as a “big” satellite)

- Industrial-level and professional Payloads
  - (Earth observation: resolutions up to 30m possible)
  - Any other possible scientific / technical PL under study

Other possible improvements to be studied in the future:

- Orbital control (ionic propulssion, tether propulsion)
- Formation Flight / Constellations
  - Cheap, fast and easy to create complex constellations
  - Cheap, fast and easy to replace “dead” components (= to maintain the constellation alive)
  - Earth observation, Navigation systems, forest fires control…
- … and **beyond?**