

SARAL Project Overview



CNES Activities Progress Status

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ISRO/SAC Ahmedabad - India



SARAL Program



- **SARAL Program : joint mission conducted by ISRO and CNES**
 - ◆ Signature of SARAL and ARGOS-3/SARAL MoU on February 2007

- **Two missions on-board the SARAL satellite which is based on ISRO SSB (Small Satellite Bus) platform :**
 - ◆ ALTIKa mission
 - ◆ ARGOS-3 mission

} SARAL ⇔ Satellite with ARgos and ALtika

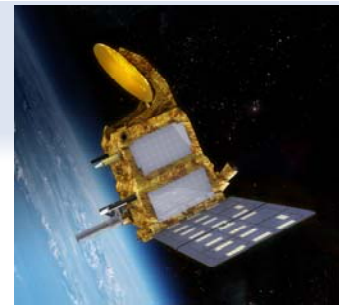
- **SARAL Orbit:**
 - ◆ **Polar (incl. = 98.55°) and Sun-Synchronous orbit**
 - local time at ascending/descending node : 6 am / 6 pm
 - ◆ **800 km altitude, low eccentricity – same orbit/ground-track as ENVISAT**
 - ◆ **Ground-track repetition period : 35 days**
 - Ground-track stability requirement: +/- 1 km

- **SARAL mission lifetime requirement : 5 years of exploitation,**
 - ◆ to be continued as long as the satellite and ground components will be operational
 - ◆ ARGOS-3/SARAL lifetime requirement: 5 years of operations, *objective : 7 years*
 - ◆ AltiKa/SARAL lifetime requirement: 3 years of operations, *objective : 5 years*



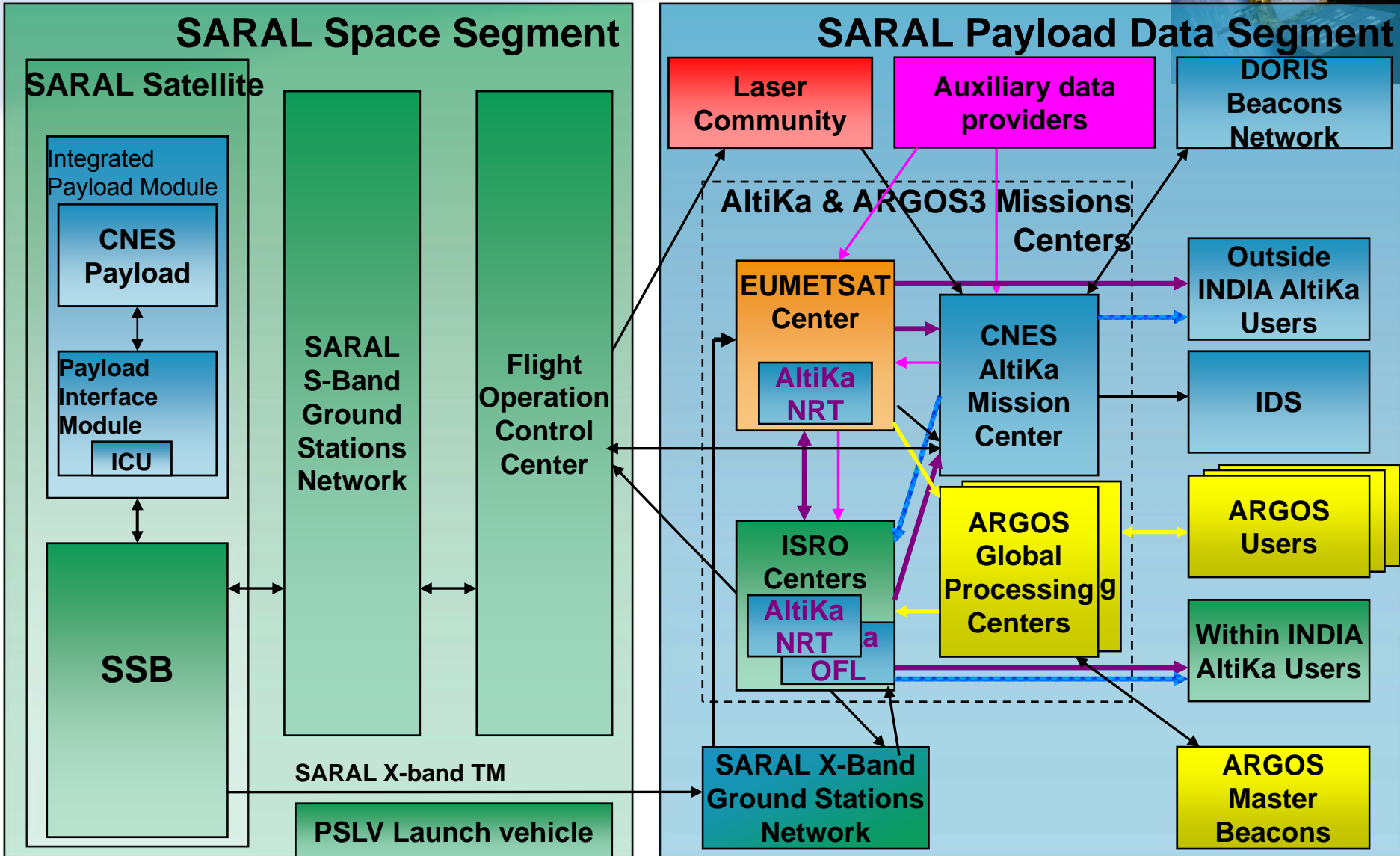
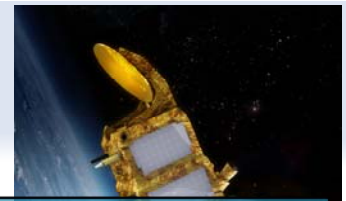
- **Need expressed by scientific oceanography community (IGOS, GODAE, OSTST,...) since 2000:** « *Continuity of high accuracy, high resolution near-real time observations of the ocean surface topography is required. At least, 2 simultaneous altimetry missions are required (including one of the Jason reference class) »*
- **→ That requires to prepare a post-ENVISAT mission that would fly at the same time as JASON2 (launched on June 2008), to fill the gap between JASON1&2/ENVISAT and JASON3/SENTINEL3A (2013)**
 - ◆ **Lisbon Fall'10 OSTST recommendation :** “ *to launch SARAL as soon as possible in 2011*”
- **ALTIKa mission**
 - ◆ **Approved by CNES Governors Board on December, 2005**
 - ◆ **Research oriented altimetry mission but with operational products:**
 - new instrument, higher frequency (**Ka-band**), enhanced performances
 - but with a consolidated architecture : conventional **nadir** altimeter
 - **Operational** products: Near Real Time (Met. Agencies) and Off-line products (Science)
 - **new potential applications** on ice, land, coastal areas, rain, clouds
 - ◆ **AltiKa scientific objectives**
 - Ocean meso-scale variability studies with an improvement in vertical and spatial measurement resolution thanks to Ka-band altimeter
 - Data assimilation in a global ocean model
 - contribution to :
 - coastal altimetry, continental waters and inland ice sheet monitoring, light rainfall and clouds climatology,
 - Geodetic reference system determination thanks to Doris and a Laser Retro-reflector Array

ARGOS-3 mission

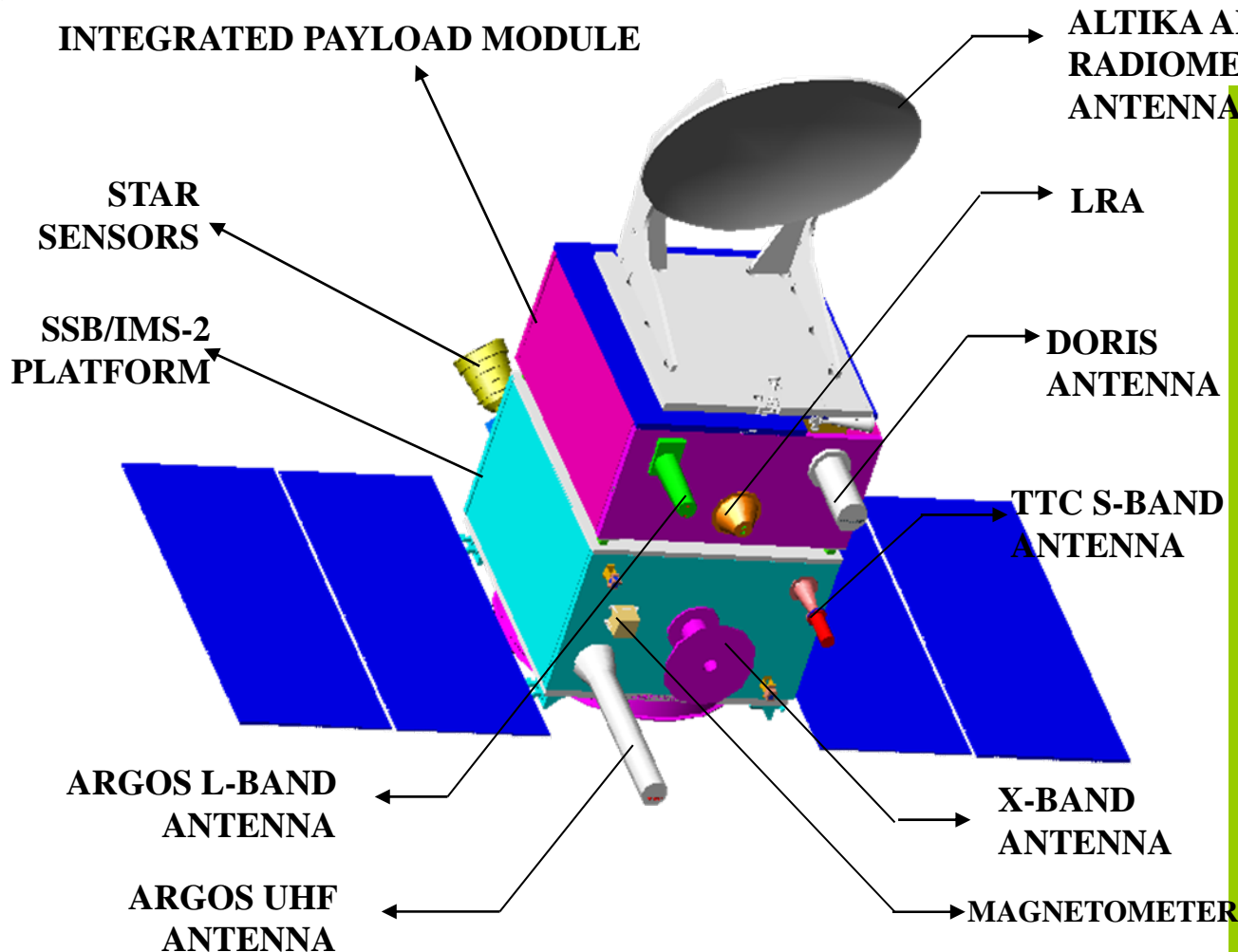
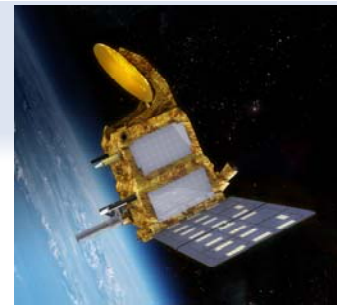


■ ARGOS-3/SARAL mission

- ◆ Opportunity for the ARGOS-3 payload to flight on-board the SARAL satellite has been agreed by ISRO and CNES in 2006
- ◆ to improve and to expand the capabilities (availability, performance) of the ARGOS Data Collection System
- ◆ in order to minimize the mean time delay and the data latency for a user to access to its ARGOS data product
 - ARGOS-3/SARAL will add to ARGOS-3 constellation formed with ARGOS-3 payloads on board METOP-A (launched in Oct. 2006) and NOAA N' (Feb. 2009)
 - ARGOS-3 payloads are also embarked on-board METOP-B (2012) and METOP-C (2016)
 - ARGOS users segment : ~ 20 000 beacons spread all over the world



AltiKa & Argos-3 payloads accommodation on SSB/IMS-2 platform : SARAL satellite



SARAL sat. characteristics

Mass : < 400 kg

- SSB platform : ~215kg
- Payload Module : ~163 kg
- Argos UHF antenna: ~5 kg

#Power : 850W / 720W (BOL / EOL)

- SSB platform: ~ 200W
- Payload Module:

typical consumption <250 W
(max consumption < 350 W)

Size

- ~ 1m x ~1m x 2.7 m
- Solar panels :
2 wings of 1.2m x 1.62m

Payload Integrated Module Progress Status



■ PIM Definition and Design Reviews

◆ CNES/ISRO PIM PDR held in Toulouse on December 2008

- after CNES/THALES (PIM Industrial Prime) PIM PDR held in October 2008,
- and followed by CNES/THALES PIM CDR held in June/July 2009

■ Flight models of AltiKa, Doris and ARGOS-3 payloads have been delivered to THALES PIM AIT team on August/September 2009

- Qualification of AltiKa instrument FM has been formally pronounced by CNES Steering Board in Dec. 2009

■ ICU equipments (PIM electrical Interface Control Units) delivered to PIM AIT team on November 2009 (AAIU) and on December 2009 (PDU)

- ◆ LRA FM delivered to CNES on Dec.' 09, then to THALES AIT on Feb.'10

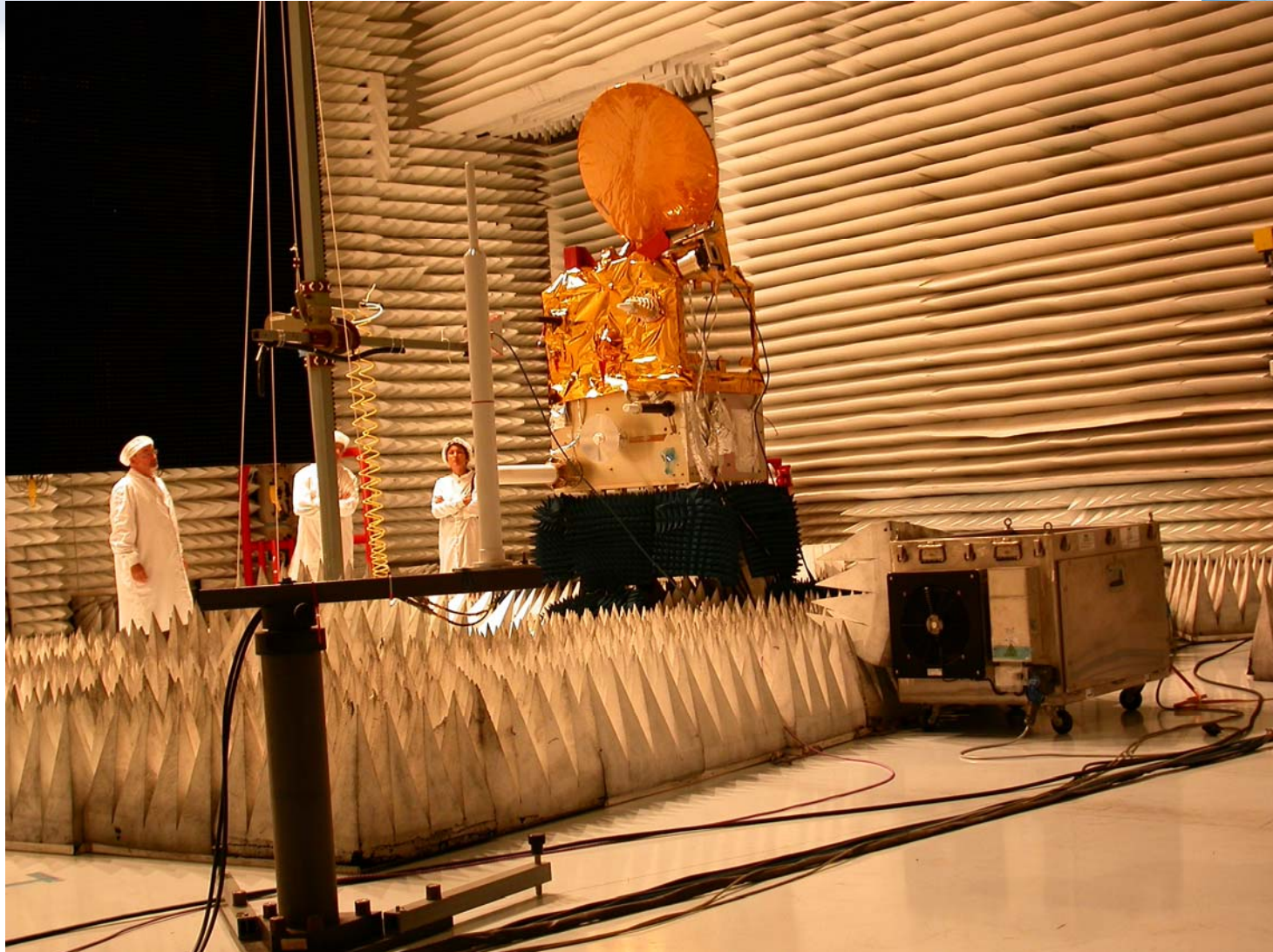
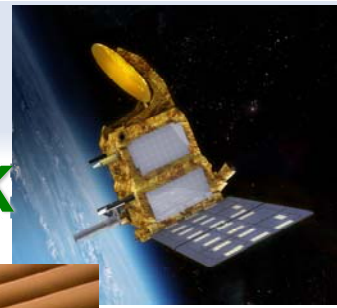
■ Integration of all electrical equipments completed by end of December 2009

- ◆ Jan. / Feb 2010 : completion of PIM initial electrical reference tests:
integrated payloads functional and performances validation tests
- ◆ 1st half of March 2010 : completion of EMC/EMI CE/CS tests at PIM level
- ◆ 2nd half of March 2010 : integration of AltiKa antenna sub-assembly,
integration of Doris & ARGOS-3 L-band antennas and of LRA
- ◆ April 2010 : MLI and ESD/RF shields installation - Altika antenna alignment
- ◆ 1st half of May 2010: Shipment of PIM and associated test means to THALES/Cannes facilities to perform the environmental qualification tests.

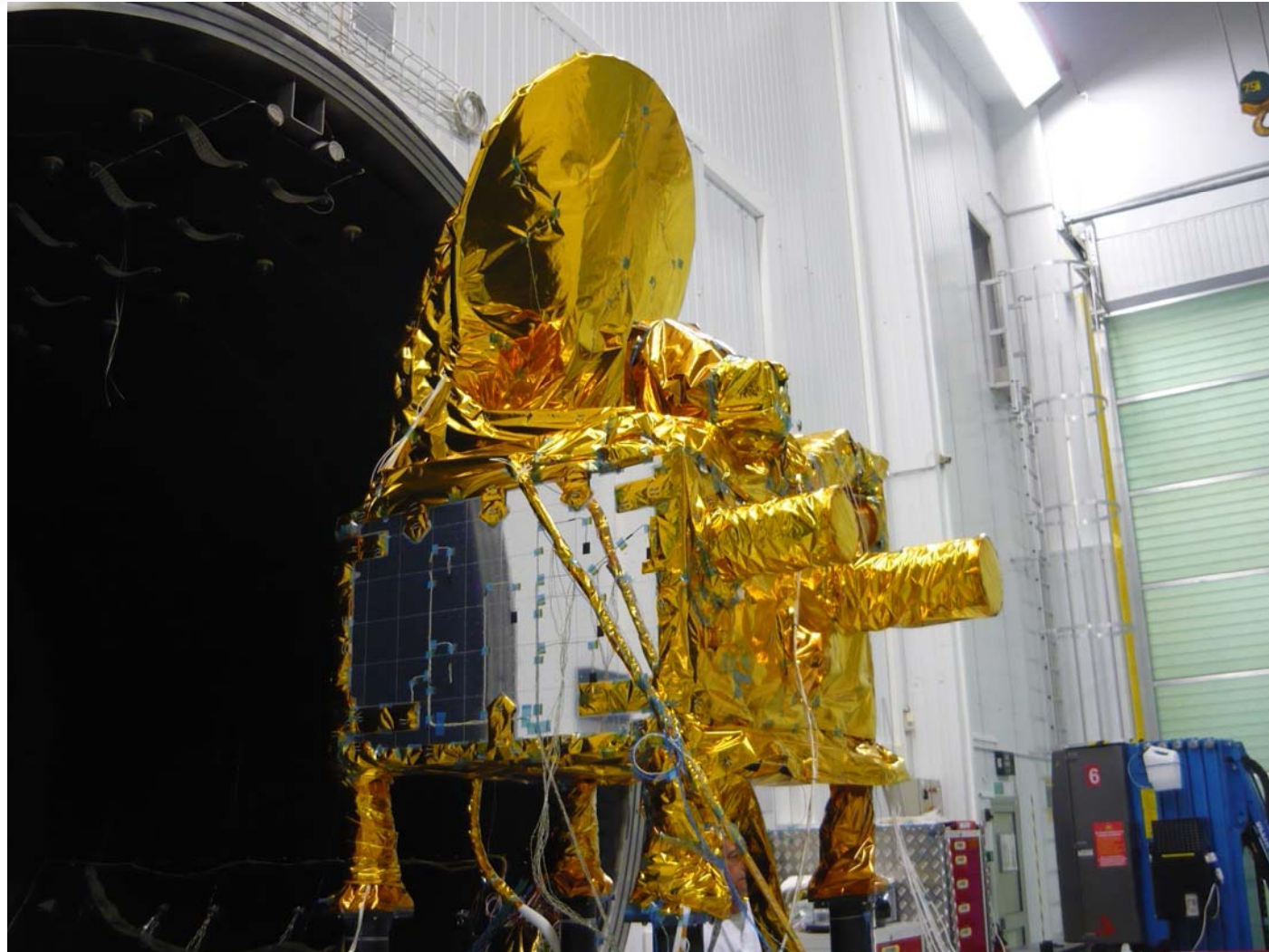
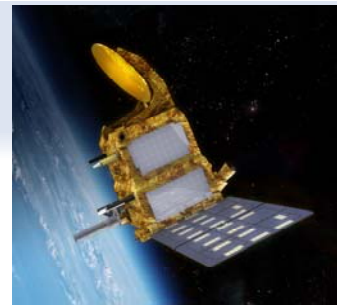
Mechanical Qualification tests (sine vibrations, acoustics, shocks) successfully passed in the 1st half of June 2010



 **cn**es In August 2010, EMC/EMI RE/RS tests including PIM RF self-compatibility test: **OK**



1st half of September 2010, Thermal Vacuum test including PIM Thermal Balance: **OK**

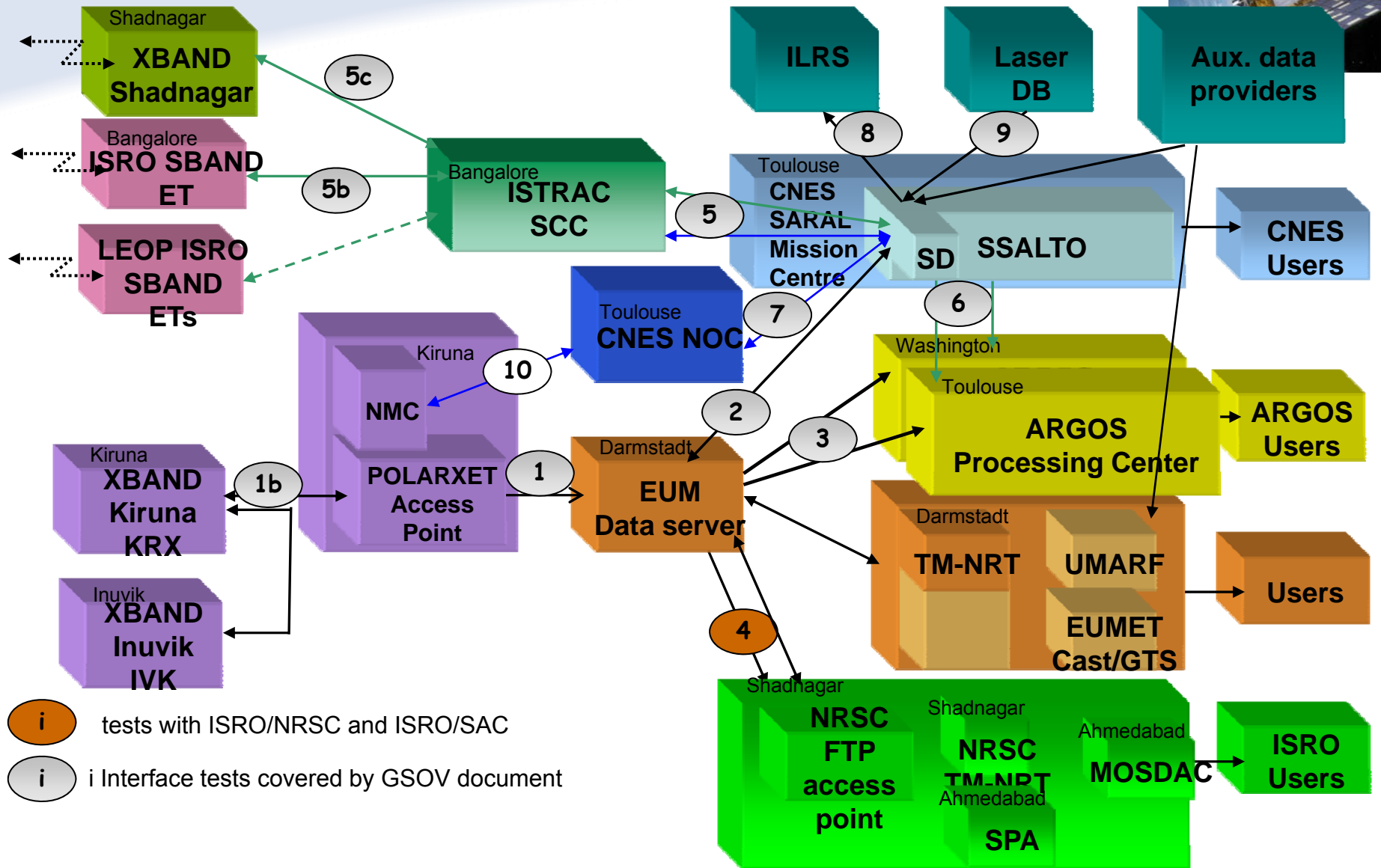
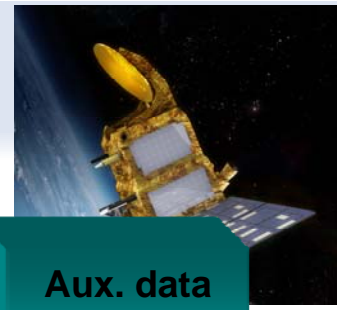


PIM Final Electrical Reference tests sequence *final functional and performances validation tests*



- In October 2010, a formal « electronic part alert » was raised by THALES because of some failures observed on some other programs
 - ◆ Failures were due to an excess of coating on some particular parts (KSO components) during PCB manufacturing process
 - No anomaly was observed on SARAL equipments
 - ◆ Nevertheless, as a precautionary measure, we decided to retrofit three PIM equipments (AAIU, PDU and AltiKa ARFU) which could be affected.
- These 3 equipments have been retrofitted and post-retrofit qualification tests have been performed by the end of 2010.
- PDU and AltiKa ARFU have been re-integrated inside PIM in January 2011
AAIU has been re-integrated in February 2011.
- PIM final functional and performances reference tests are currently being done in THALES/Toulouse facilities
- CNES/THALES Qualification Review is planned to be held on April/May '11.
- PIM ready to be shipped to India: end of 2nd Quarter of 2011.

SARAL Ground Segment





- **October 2009** : CNES/ISRO/EUMETSAT SARAL System Interfaces, Performances and Validation Review

SALP/SSALTO (CNES altimetry multi-missions Center)

- **March 2010** : SSALTO/AltiKa upgrade V2 Integration/Validation achieved for system tests
 - ◆ Payload Command & Control
 - ◆ Orbitography : MOE / POE processing
 - ◆ Altimetry/radiometry : OGDR / IGDR / GDR processing
- **April 2010** :
 - ◆ → installation of TM_NRT software in EUMETSAT facility
- **June 2010** :
 - ◆ → installation of TM_NRT system in ISRO/NRSC Shadnagar facility
 - ◆ → installation of OFL system in ISRO/SAC Ahmedabad facility
- **November 2010** : End of “SSALTO/AltiKa upgrade V2” Acceptance
 - ◆ → Scientific validation completed → identification of processing algorithms tuning
 - ◆ → Ground files and parameters processing review
- **May 2011** : End of “SSALTO/AltiKa upgrade V3” Acceptance
 - ◆ Trend analysis functions (IMIS)
 - ◆ Algorithm/parametrization tuning (Files review output)
 - ◆ → final versions of SPA and TM-NRT ready for installation in EUMETSAT and ISRO/SAC and ISRO/NRSC facilities for the Long Term Routine tests and System Operational Qualification



X-band Polar Ground Stations : Kiruna (Sweden) & Inuvik (Canada)

- **Sept 15, 2010** : establishment of the data link (2 Mb/sec) between Esrange Space Center and EUMETSAT/Darmstadt Center
- **Sept. 2010** : IT-1 global test
- **Dec 2010** : IVK Partnership Polar Station Technical Qualification & establishment of the data link (2 Mb/sec) between Inuvik and Esrange Space Center
- **From Jan 2011** : KRX Partnership Polar Station Technical Qualification in progress

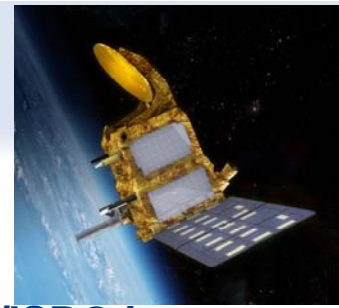
EUMPC

- **Dec 2010** : System Integration and Verification completion
- **Dec 2010** : DCN between EUMETSAT and NRSC Shadnagar : link exists, via Svalbard, using the high data rate link set up between EUMETSAT and ISRO according to both agencies agreement (Oceansat2, ...)

Satellite Control Center (SCC) and S-band stations

- **ISRO presentation**

System and Ground Segment forthcoming activities



- **DCN between CNES/SSALTO in Toulouse and SARAL SCC in ISTRAC/ISRO in Bangalore**
 - ◆ Still to be discussed between CNES and ISRO (CNES proposes to use Internet with secured protocol)

- **Completion of Ground Segment Overall Validation (GSOV) & Mission System tests**
 - ◆ **GSOV Integration tests : interfaces compatibility tests between all GS elements**
→ achieved for all Payload Data segment IFs; pending the Satellite Control Center availability

 - ◆ **GSOV Technical Validation tests : Realistic scenarios and maximising the use of operational interfaces, hardware and software**
 - GSOV-VT : SARAL GS VALIDATION TESTS
 - MIS-VT : MISSION SYSTEM VERIFICATION TEST (with payloads-S/C-SCC-SSALTO)

 - ◆ **System Operational Qualification tests**
 - LTR : LONG TERM ROUTINE TESTS
 - DR : Launch DRESS REHEARSALS (ISRO definition)

 - ◆ **Will be concluded by the SARAL System Operational Readiness Review (ORR)**

Archive – Dissemination – Users services in operational phase



- **ISRO** : NRT and OFL products archive and dissemination to users within India (except for DORIS products), and corresponding Users services
- **EUMETSAT** : NRT processing, archive and dissemination to users outside India, and corresponding Users services
 - ◆ **User Service Helpdesk:**
 - ◆ Web : www.eumetsat.int
 - ◆ e-mail : ops@eumetsat.int
- **CNES** : OFL processing, archive and dissemination to users outside India, and corresponding Users services
 - ◆ **User Service Helpdesk:**
 - ◆ **AVISO Altimetry**
 - ◆ Web : www.aviso.oceanobs.com
 - ◆ e-mail : aviso@oceanobs.com
- **Science Data policy** : all OSS data products will be made available to WMO users on a free basis and without any restriction either geographical or temporal
- **Archive for at least 10 years after the end of the SARAL operations**



