Recent achievements of the Algerian Space Program
the National Space Program (PSN) horizon 2020 planned to put in place space infrastructures, space systems and increase the specialized human resources in space technologies and their applications.

Among the space systems planned in the PSN (EO satellites : Alsat-2A, Alsat-2B, Alsat-1B, Alsat-3, Alsat-4, African Resources Management ARM, and the communication satellite Alcomsat-1), of which a significant number shall be partly or totally integrated in the Algerian Center for Satellite Development “CDS”.

CDS offers the technological environment for national competences to develop the future Algerian satellite systems.
Satellite Development Centre has been inaugurated on Thursday 23th of February 2012 by his excellency President of Republic Abdelaziz Bouteflika.
Main Missions of the CDS

**Missions:**

- Development of satellites (up to 1000 kg).
- Integration of space subsystems and solar panels (class 100.000).
- Integration of Space Optics (class 100).
- Functional and environmental tests.
- Quality insurance of the AIT and test activities on space systems.
- Regroup the national experts in the space technology fields;
- Give the adequate environment to experts to develop future space sub systems and systems planned in the PSN;
- Stimulate Algerian industries in the fields of mechanics, electronics, optics, Information Technology, ...
**CDS in the National Space Program**

**CDS comprises:**

- A satellite integration hall: clean room of 27m x 11m.
- A Satellite Environmental tests building.
- Rooms and Equipments for the components storage, cleaning, inspection, assembly and integration equipment, etc.
- ALSAT-2 S-band Antenna System & Control Ground Segment
- ALSAT-1B S/X band Antenna System & Control Ground Segment

The CDS is organized in 6 Departments:

- Space Systems and Missions,
- Satellite Engineering,
- Satellites AIT,
- Environment testing,
- Quality & Process,
- Research on Space Technology.

These departments house Mechanical & thermal, electrical, electronic and optics research and development laboratories.
The satellite integration building consists of a large clean room of class 100000, with four sub-areas dedicated to:

- Satellite integration
- Satellite Subsystems assembly
- Solar panels integration
- Sub-area for optical integration/alignment, class 100, on a seismic block.

These areas are separated by sliding curtains.
The Satellite Environmental tests building is also planned for the future. This building shall consist of:

– Anechoic chamber for EMC tests
– Thermal vacuum chamber
– Vibration test chamber
– Acoustic test chamber

The building shall also house a preparation area, a test control room, an EGSE room, a container area, a personnel Airlock and satellite equipment Airlock.

The level of cleanliness 100000.
Technological Infrastructures
Technological Infrastructures

- Salle de contrôle ALSAT-2, Oran
- Salle des baies CGS, Oran
- Station 1 bande X, CREIS
- Centre de contrôle et de commande, Ouargla
- Station bande S, Ouargla
- Station bande S, Oran
- Station 2 bande X, CREIS
- Station de réception et de contrôle, Oran
- Salle de contrôle ALSAT-1B, Oran
- Antenne ALSAT-1N, Oran
Surveillance and Security in CDS

Centralised Video Surveillance Control Office for HDI

Video Surveillance Control Office for CDS
Commodities in CDS

Conference Theatre

Meeting room
Human Potential in CDS

Active involvement in the manufacturing of Alsat-1B solar panels and other satellite electronic modules.
Human Potential in CDS

- AIT activities at CDS conducted by CDS/ASAL engineers
Human Potential in CDS

ALSAT-1 project Team (2002)

ALSAT-2 project team (2010)
Human Potential in CDS

Evolution since 2000

- Instrumentation Spatiale
- Mécanique Spatiale
- Ingénierie Satellites
- Assemblage Intégration et Tests
- Effectif total CDS
Engineering Activities

Space segments

Alsat-1B
Alsat-1N
Alsat-1B

Launched on September 26th, 2016
ALSAT-1B
Medium Resolution Earth Observation Mission with Know How Technology Transfer
Introduction

- Within the framework of Algerian Space Program ‘PSN 2020’ ASAL performed a Medium Resolution EO mission with KHTT program called Alsat-1B
- Key Objectives
  - Former Alsat-1 mission outcomes handover
  - Fulfill National users needs of space applications
  - Enhance national capabilities of Disaster monitoring
  - Reinforce National skills of space technology mastering
Alsat-1B Program Objectives

• Know how technology transfer
  – Training 18 Algerian engineers
  – Algerian-led program activities
  – Spacecraft AIT performed by Algerian engineers at CDS

• Academic Program
  – Surrey Space Centre of UniS (UK)
  – 18 Master & PhD ongoing in Space Technology

• Alsat-1N Cubesat Projet under an ASAL and UKSA Framework

• MicroSat Propulsion system development with SSTL support
  – Design by Algerian engineers
  – Manufacturing and test by Algerian engineers
ALSAT-1B Mission

Alsat-1B designed to provide:

- Imaging flexibility of any point
- Nadir and off pointing imaging of any point over Algeria and worldwide
- A Revisit time of any Algerian target optimised within 7 days maximum
### ALSAT-1B Mission Characteristics

<table>
<thead>
<tr>
<th>Mission and system</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Orbit</td>
<td>700km, heliosynchronous, LTDN 10:30</td>
</tr>
<tr>
<td>Lifetime (minimum)</td>
<td>5 years</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mission Product characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Smapling Distance</td>
<td>12m Panchromatic</td>
</tr>
<tr>
<td></td>
<td>24m Multispectral Nominal (Blue, Green, Red &amp; NIR)</td>
</tr>
<tr>
<td></td>
<td>12m Multispectral Enhanced</td>
</tr>
<tr>
<td>Swath</td>
<td>150 km</td>
</tr>
<tr>
<td>Signal to noise ratio (SNR)</td>
<td>PAN $\geq$ 100, MS $\geq$ 110</td>
</tr>
<tr>
<td>Modulation Transfert Function (MTF)</td>
<td>PAN $\geq$ 0.1, MS $\geq$ 0.3</td>
</tr>
<tr>
<td>Mosaïcking</td>
<td>140km x 140 (2100km), PAN, MS, PAN + MS</td>
</tr>
<tr>
<td>Imaging Capability</td>
<td>40 scenes per day (standard mode)</td>
</tr>
</tbody>
</table>

### ALSAT-1B Paylod

- **ALITE**: Algerian Imager Telescope
- Aluminium & Titanium barrel with lenses
- Focal plan assembly with 5 CCD
Alsat-1B AIT Set up at ASAL-CDS

- Nominal AIT set up deployment by ASAL engineers preparing the AIT phase at CDS-ASAL
Alsat-1B integration at ASAL-CDS (Oran)

- Within KHTT framework integration and testing activities led Algerian activities at CDS from September 2015 to February 2016.
Alsat-1B integration at ASAL-CDS (Oran)
ALSAT-1B EVT Testing with ASAL staff

- Effective ASAL engineers involvement in spacecraft environment testing
Alsat-1B Launch site activities

- Tank fuelling activities at launch site
Alsat-1B Launch site activities

- Satellite integrated to Multi-Satellite Adaptor at launch site
Alsat-1B Launch site activities

- Launch vehicle fairing closure preparation at launch site
Alsat-1B Project Main Phases

Mission conception & Definition
Sub systems manufacturing
Assembly & Integration
System End to End Testing
EVT testing
Launch
LEOP & routine operation
Image Product available to end user
Alsat-1B Ground Segment Facilities at CDS
First Alsat-1B images

- Bradenton / Florida (USA) and its surroundings

Full Alsat-1B scene (140x140 Km)
Bradenton (Est de la Floride / USA)
First Alsat-1B images

- Sarasota bay / Florida (USA) and its surroundings
First Alsat-1B images

- Tampa / Florida (USA) and its surroundings
Monts de l’Ougarta « Bechar » (12-05-2017)
Monts de l’Ougarta « Bechar » (12-05-2017)
Ville de Bousaada (02-02-2017)
Centrale solaire électrique mixte de Hassi R’mel (02- 02- 2017)
Port Charlotte (Cleveland / Floride –USA) Octobre 2016
Delta de l’Ebre « Espagne » (Octobre - 2016)
ALSAT-1N
ALSAT Nano Program - ALSAT-1N nano-satellite

- Joint Cubesat Mission development in cooperation with UK Space Agency (UKSA) and Surrey Space Centre (SSC) University of Surrey,
- Involving the training of 3 PhDs et 2 MSc’s from ASAL engineers.
ALSAT-1N Specifications

- Form factor: Cubesat 3U,
- Dimensions: 100x100x340 mm,
- Mass: 3,470 kg,
- Orbit: Sun-synchronous,
- Altitude: ~670 Km,
- Inclination: 98.16°
- Communication: VHF uplink / UHF downlink,
- Attitude control: 3 axis magnetorquer and 1 reaction wheel (Y-Thomson).

- 3 scientific and technology demonstration payloads:
  - Thin Film Solar Cells (TFSC): 4 solar cells
  - Compact CMOS Camera Demonstrator 2G (C3D2): including 3 cameras, 2 wide field imagers and 1 Narrow Field Imager.
  - Astrpotube Boom™: Deployable and retractable boom incorporating a RADFTET and a magnetometer.
Alsat 1N – Assembly Integration and Tests
Alsat-1N: Environnemental Tests

Environment Tests Team

EVT Tests Summary

- Random vibe (PFM + FM, 3-axis)
- Quasi-static/Sine vibe (PFM + FM, 3-axis)
- Thermal bake out (+50°C, 24 hours)
- Thermal Vacuum (-20°C to +50°C, 2 cycles)
- Ambient Thermal (0°C to +45°C, 10 cycles)
- Shock testing (SQM, 70g 2ms, 2x 3-axis)

Thermal Vacuum

Vibration Tests (sine+random)
Launch Campaign

- **FRR**
  - Visual check
  - Power-up & Functional Tests
  - Stow/Deploy Test
  - Startup Test
  - Battery Charging
  - Stowing
- **LRR**
  - Launcher Coupling

**Alsat 1N, Ready for Launch**

**Alsat 1N fitting on launcher**
Alsat 1N Ground Segment and Satellite Control Operations

UHF/VHF antennas - CDS

Ground Segment Development Process:
- Design
- Software setup and customization
- Procurement
- Hardware installation
- Commissioning & Validation

Payload Providers:
- OSS
- OU
- Glyndwr/SSC
- Radio Amateurs

Data Flow:
- ALGERIA: Data input
- UK: Payload Schedules/Data
- World: Uplink/Downlink Data and Coordination

Payload Schedules/Data Coordination:
- Uplink Data
- Downlink Data
Alsat 1N - Images

First boom image

First colour image - sunset

Daylight colour image

New Caledonia

Okhotsk Sea (RUS)
ALSAT-2B
High Resolution Earth Observation Mission
System Description
Grounds Segments Description
Space Segment Description

- Alsat-2 spacecraft is composed of high resolution optical payload including SiC Korsch telescope with high performance CCD detector incorporated inside a Front End Electronic.
- Payload services: Mass memory, High rate telemetry module TMHD and GPS function.
- Service module based on the Myriade platform architecture contains ADCS module for fine pointing and targeting, and standard spacecraft modules (power, thermal and communication)
Alsat-2 Development steps

- Assembly Integration & Tests
- Environnemental tests
- Launch campaign
- Launch LEOP & IOT
- Orbit life
Alsat-2B launch campaign team (SP2-B building)
The three Alsat Spacecraft and team at the launch pad
Launch phase and first acquisition

LIFT OFF TIME: 2016-09-26 03:42:00 (UTC)
Alsat-2 LEOP and IOT team at Oran Ground Segment
Image Alsat-2A in 2010
Image Alsat-2B in 2016
Vue générale de la partie centrale de la Baie, couverte par Alsat-2B La grande Mosquée d'Alger en cours de réalisation
Zoom sur le chantier de la grande Mosquée d’Alger, en cours de réalisation
Vue générale de la partie centrale de la Baie, couverte par Alsat-2B : « Les Sablettes » avec les aires de loisirs en cours d’aménagement.
Vue générale de la partie Sud de wilaya d’Alger, couverte par Alsat-2B : Aïn Naadja « Gué de Constantine » et le grand stade de Baraki en cours de réalisation.
Zoom sur le Stade de Baraki
En cours de réalisation
Béjaia et son port (24-01-2017)
Khemis El Khechna (Est d’Alger) (Janvier 2017)
Larbaatache / Est d'Alger (Janvier 2017)
Image Alsat-2B centrée autour du Royal Nairobi Golf Club / Kenya (Janvier 2015)
Image Alsat-2 centrée autour de la Cité Interdite et de la place Tiananmen : Pekin / China (Aout 2016)
Image Alsat-2B sur Dubai (EAU)

Bordj El Arab Al Jumeirah, avec ses 321 m

Hôtel Madinah Al Jumeirah

Umm Suqeim 3

Zoom autour du Bordj El Arab Al Jumeirah

Marina
Oran (Octobre 2016)
Annaba (septembre 2016)
Paris (Octobre 2016)
Image Alsat-2B du Vendredi 28/10/2016 Couvrant la Mecque et ses environs
Image Alsat-2B du Vendredi 28/10/2016, Couvrant la Mecque et ses environs
Zoom de l’Image Alsat-2B du Vendredi 28/10/2016 à 09h58 (UTC+3), sur la Mosquée Sacrée (Mesjid El Harâm)
Mina (la Mecque) / Arabie Saoudite