

# SMALL SATELLITES

*- AN OVERVIEW*

*- CNES' ROLE*

**Didier Vassaux**  
**CNES/DSP**

**Lift to Space**  
**February 5, 2015**



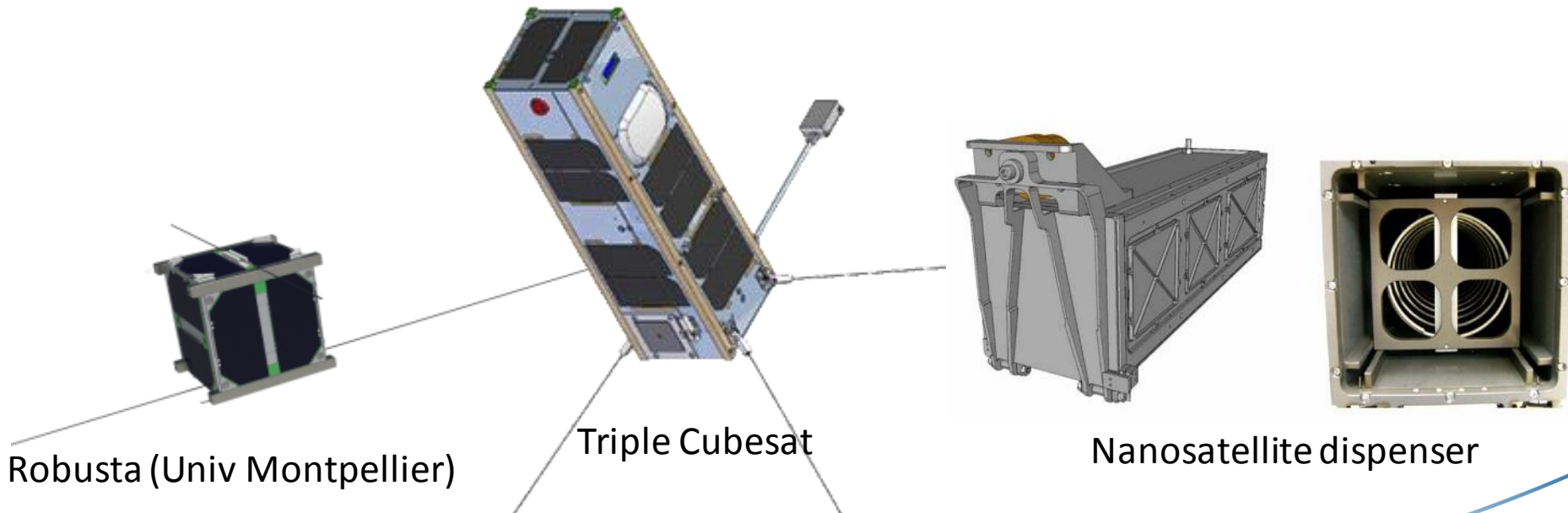
# DEFINITIONS

**Picosatellites** : Mass less than 1 Kg

**Nanosatellites** : Mass between 1Kg and 50 Kg.

The exemple of the Cubesats' concept :

Simple Cubesat :	10x10x10 cm <sup>3</sup>	1,33 kg
Double Cubesat :	10x10x20 cm <sup>3</sup>	2,66 kg
Triple Cubesat :	10x10x30 cm <sup>3</sup>	3,99 kg



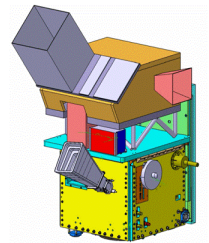
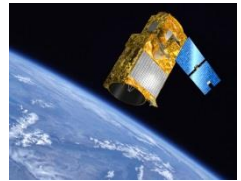
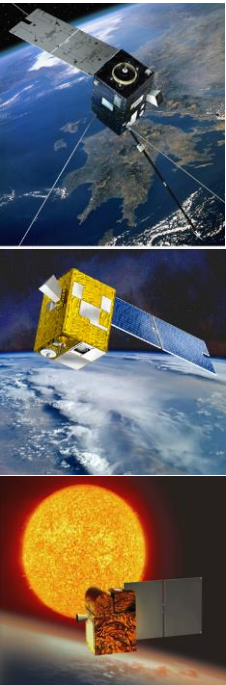
# DEFINITION MICROSATELLITES

Myriade Line of Product decided at the end of the 90's  
Developed in Partnership between CNES and Prime Contractors

Initial aim: access to space for scientific and probatory missions, with optimized costs and development length

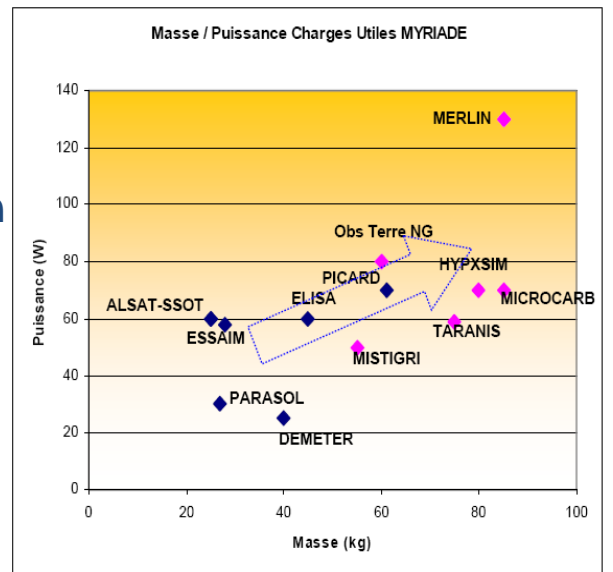
Beyond: Myriade efficiently used for earth observation export contracts and in the frame of military programs

More than 50 years lifetime gained in orbit  
15 satellites launched since 2004  
several satellites under development



Main lessons for the Myriade evolutions:

- The low cost objective has not so well been reached
- The evolution has driven Primes to look for higher performances for future missions in the field of EO export contrats

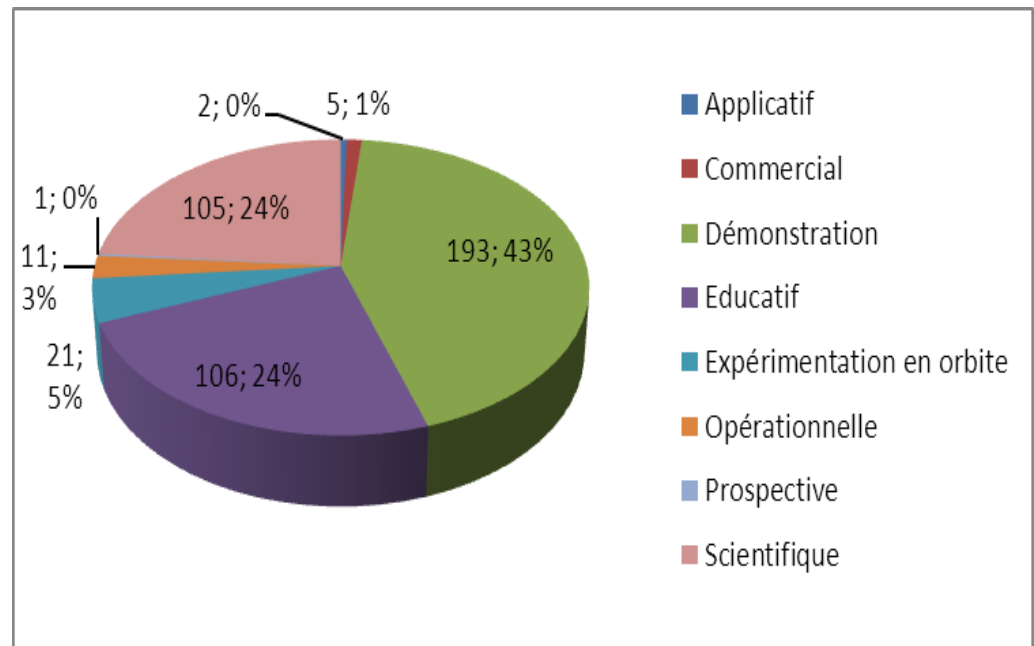


# GLOBAL OVERVIEW NANOSATS

- The Nanosat activities are already developed and in fast evolution
  - 315 missions and 500 satellites over 10 years,
  - 25 Nanosats (1 to 50 kg) per year from 2006
- Mostly based on institutional funding for achieving educational goals or for supporting technology demonstration
- The project management is up to now mainly based inside Universities
- The limited availability and the cost of the launch slows down the development of these activities

## ALL SPACE DOMAINS COVERED :

- Technology: Reduced costs and delays in flight validation
- Sciences: shorter time between the expression of the scientific goal and the publication of the results
- Commercial: data collection, Earth observation,
- Defense: Earth observation at low altitude, for tactical needs, local communications



# GLOBAL VIEW ON MICROSATELLITES

- The Microsatellites market (50 to 200 kg) has emerged in the 90s and is still growing (from Euroconsult)
  - 100 satellites from 2000 to 2008
  - 160 satellites from 2009 to 2017
- Mostly based on institutional funding
- The project management is up to now mainly based inside Industrial Primes
- The limited availability (and the cost of the launch) slows down the development of the market

## ALL SPACE DOMAINS COVERED :

- Sciences
- Navigation
- Commercial: Earth observation, Communications
- Defense: Earth observation at low altitude, for tactical needs, local communications

# LAUNCH SERVICES AND SPACE DEBRIS (LOS)

## □ THE LAUNCH SERVICES :

- piggyback opportunities onboard Dnepr, Atlas, Minotaur, PSLV, Soyouz H2A, VEGA.
  - A low cost solution but with constraints
- No dedicated launchers,
- For nanosats, only US studies and demos :
  - DARPA/ALASA (Airborne)
  - Space & Missile Defense Command (Multipurpose NanoMissile System)

## □ LAUNCH SERVICES COST :

- Piggyback: ~ 200 K€ for a triple Cubsat
- ALASA cost target : 1M\$ for 45kg in VLEO

## □ SPACE DEBRIS, LAW ON SPACE OPERATIONS :

- possible selection of orbits with the option of a non-controlled re-entry



## RECENT « PERTURBATIONS » IN SMALLSAT BUSINESS

---

- The emergence of very large constellations for Internet access and/or Earth observations
- Promoted mainly by actors of the Silicon Valley
- Figures are far from usual:
  - EO : Skybox (microsats, several tens) and PlanetLabs (nanosats, several tens)
  - Internet access : several hundreds of satellites operated simultaneously (promoted by SpaceX or Virgin)

### Potential impacts:

- Launchers
- Regulations (frequency, debris)
- Space industry

# CNES WAY FORWARD FOR SMALL SATELLITES

## □ SMALL SATS AND GROUND SYSTEMS

- To offer access to technical expertise on the Space technologies (when relevant !)
- To support R&T preliminary works (S et X RF, OBC, Avionics,...)
- To facilitate access to test and integrations facilities
- To support preliminary studies (phase 0 and phase A) and provide access to concurring engineering tools
- To make Nano primes sensitive to the Law on Space operations
  
- For applications development : to facilitate access to space data (from French missions)
- Janus: a project for supporting for Students Nanosats activities

## □ LAUNCHERS

- To evaluate the cost efficiency of dedicated nanolaunchers (150 kg in LEO)