

SDM Requirements from the point of view of the private EO operator:

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DEIMOS within ELECNOR



ELECNOR

- Founded in 1958, listed on the Madrid Stock Market
- Main numbers: 13,000 staff , 33 countries; 2,500 M\$ turnover, 340 M\$ EBITDA

Engineering and deployment of infrastructure projects in energy, environment and telecommunication.

Promotion, development and Management of major concessions projects.



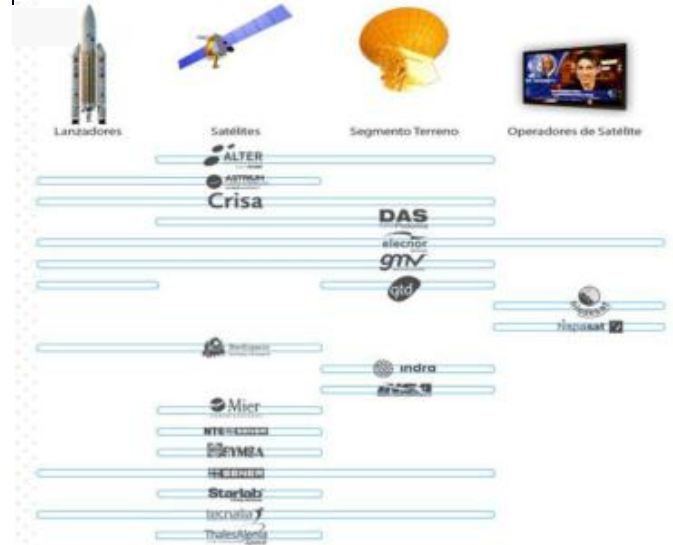
Technology solutions for aerospace, defence, transport, energy, environment, telecommunications and security.



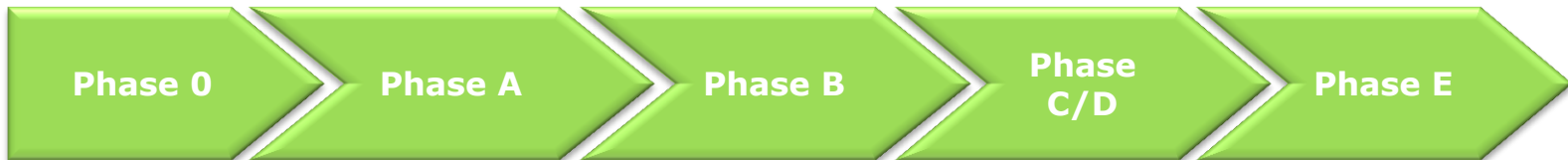
Promotion, development and management of projects in renewable energy

ELECNOR DEIMOS activities

- **ELECNOR DEIMOS is a relevant actor in the European space scenario:**
 - More than **500 contracts** won for ESA, NASA (JPL) and other agencies
 - More than **60 missions** incorporate somehow DEIMOS technology
- **Only Spanish company involved in all segments of a space mission**
- **Significant involvement in all ESA programs**



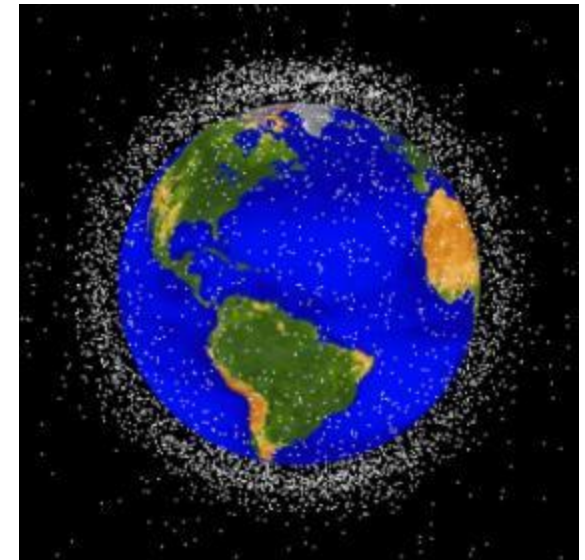
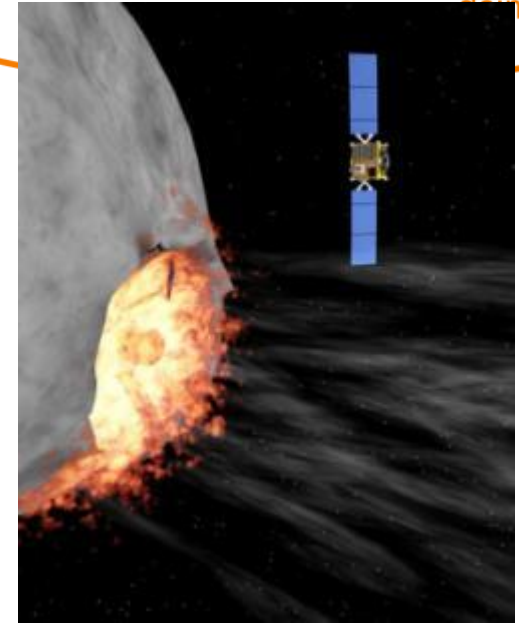
- **Participation in all phases of a space project**



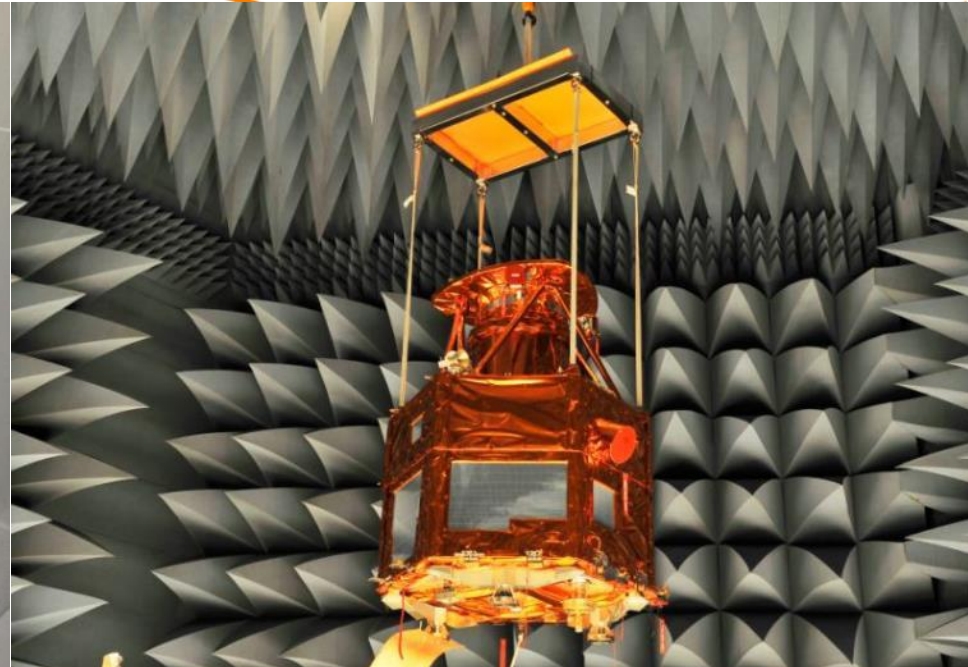
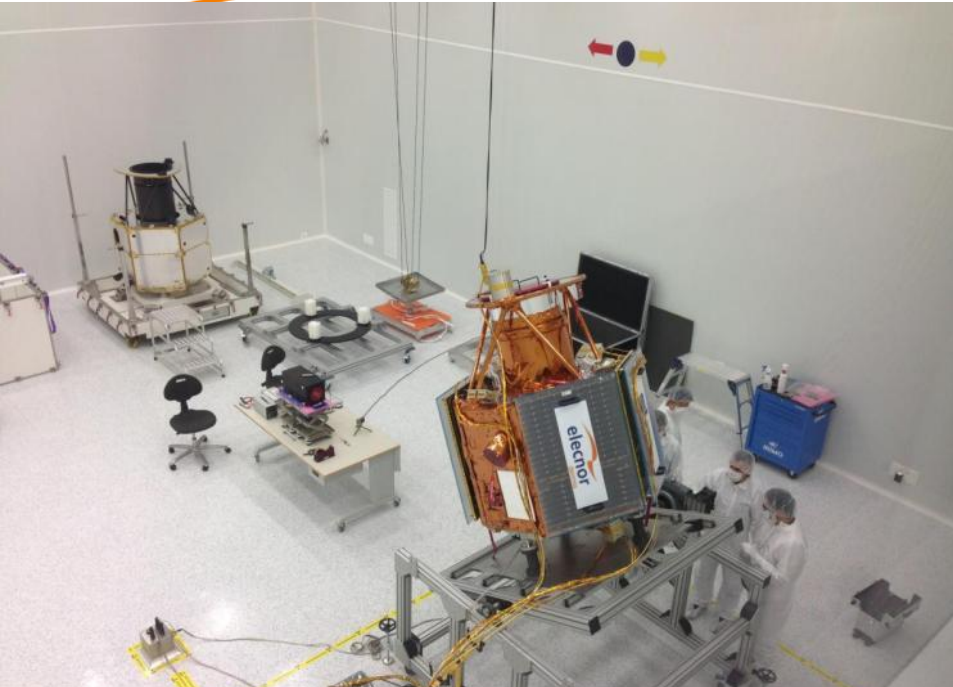
ELECNOR DEIMOS in SSA



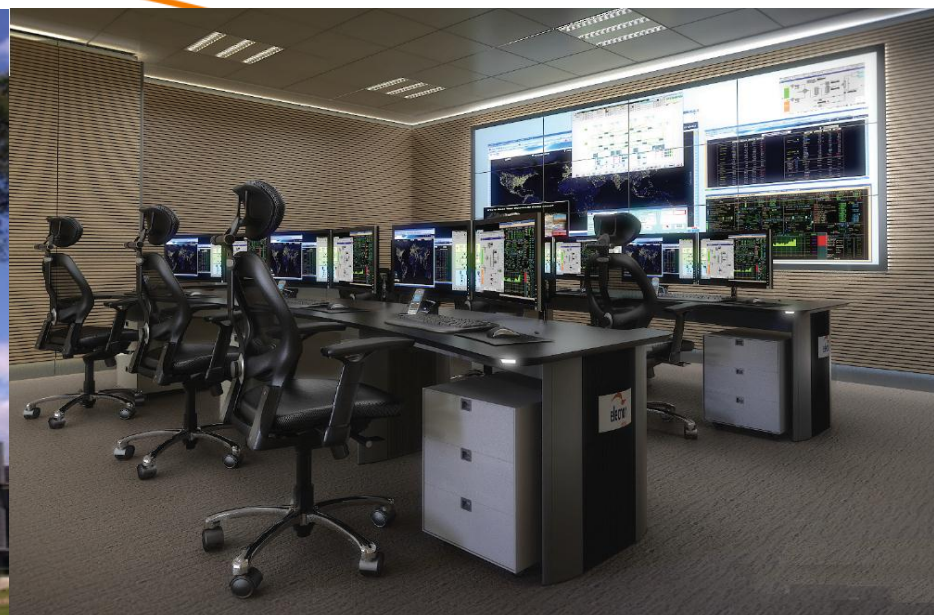
- **ELECNOR DEIMOS is a leader company in the development of the SSA program in its 3 aspects:**
 - Risk of asteroid impact
 - Risk of space weather
 - Risk of collision with space junk
- **In impact of asteroids:**
 - Asteroid collision warning service won by DEIMOS (SN V)
 - Don Quijote: ESA project to divert asteroids, proposed and won by DEIMOS in competition with 23 offers
- **SEISOP, the European system for protection from space weather events (solar storms) has been developed by DEIMOS**
- **Contracts won by DEIMOS for the protection system against "space debris":**
 - System architecture (CO II)
 - MEDEA: strategy of graveyard orbits
 - Simulator and prototype of chain process to avoid collisions (DCII)
 - DISCOS: ESA Space Debris Database



Satellite Systems Integration



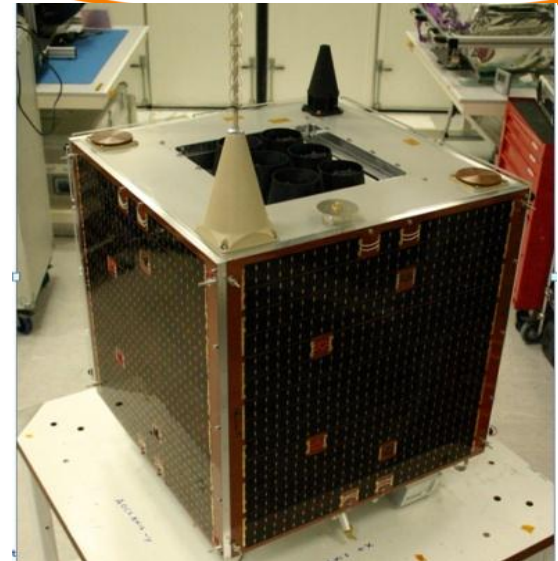
Satellite Operations



ELECNOR DEIMOS owned satellites



- Medium resolution 20 m EO mission, three spectral bands (R, G, NIR @ 10 bits)
- 650 km swath width
- 80 Kg Platform
- Hot gas thruster (80 mN)
- Launched: July 2009. Expected lifetime 10 years (design > 5 yrs)



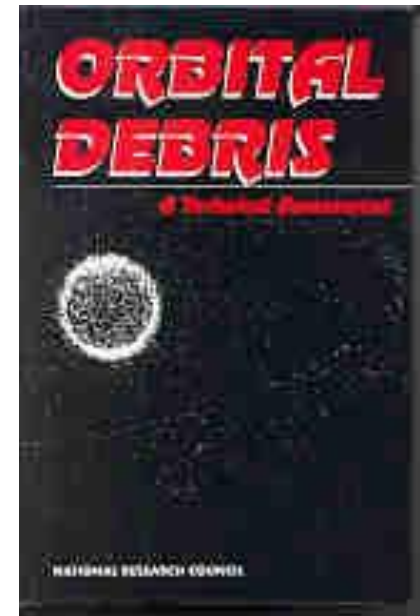
- High resolution EO mission, (1m GSD 75 cm pan-sharpened) 5 spectral bands (R, G, B, NIR, PAN @ 10 bits)
- 300kg Platform
- Swath width 12/24 km
- Hall effect thruster (10 mN)
- Launched: June 2014. Design lifetime > 7 years

Both expected to comply with 25yr. rule / debris release / break-up / disposal / casulaty risk

CleanSpace look back and ahead

WE ARE HERE BECAUSE WE DO BELIEVE IN SDM... BUT LET'S TAKE A LOOK AT PAST AND FUTURE AND BE A LITTLE PROVOCATIVE AND SKEPTICAL

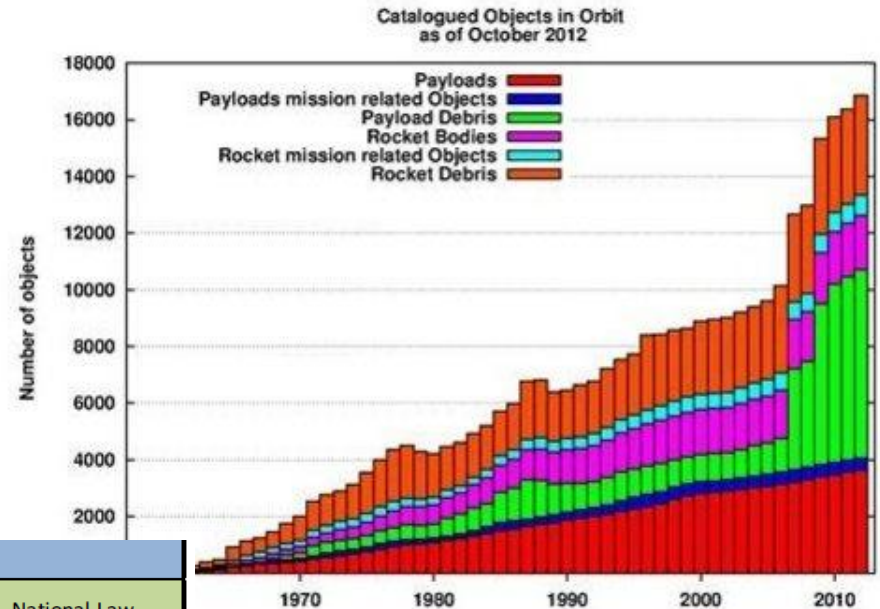
- **1993: FIRST EUROPEAN SPACE DEBRIS, main conclusions:**
 - 7000 Tracked Objects. LEO and GEO the most critical orbits
 - Clean up is technically and economically difficult, better preventing the creation of debris (passivation, graveyard for GEO, lower LEO)
 - The space debris problem can only effectively be solved by international cooperation



CleanSpace look back and ahead

MORE THAT 20 YEARS LATER

- (-) No relevant new ideas nor deployed technologies
- (-) Important degradation of the real situation (18,000 objects and growing fast)



| European Mandatory Requirements | | | | | | |
|---------------------------------|-------------|------|----------------------------|-----------|-----------------|------------------------------------|
| | | IADC | UN Space Debris Guidelines | ISO 24113 | Code of Conduct | National Law |
| Countries | Austria | ✓ | ✓ | | | |
| | Belgium | ✓ | ✓ | ✓ | | |
| | France | | | | | LOS |
| | Germany | ✓ | | | | TKG |
| | UK | | ✓ | ✓ | | |
| Institutions | ASI | | | | ✓ | |
| | ESA | | | ✓ | | IPOL |
| | CNES | | | | | LOS |
| | DLR | ✓ | | | | |
| European Voluntary Requirements | | | | | | |
| Countries | Netherlands | | | | | Claim to be Compliant to UN Copous |
| | Spain | | ✓ | | ✓ | |
| | Switzerland | ✓ | | ✓ | | |
| | Slovakia | | ✓ | ✓ | | |
| | Poland | | | ✓ | | |
| | Italy | ✓ | | | | |

- (+) Consciousness
- (+) Standards
- (+) Some recommendations and laws in some countries, Still laws are not generally enforced, not even in Europe
- (+) CLEAN SPACE initiative

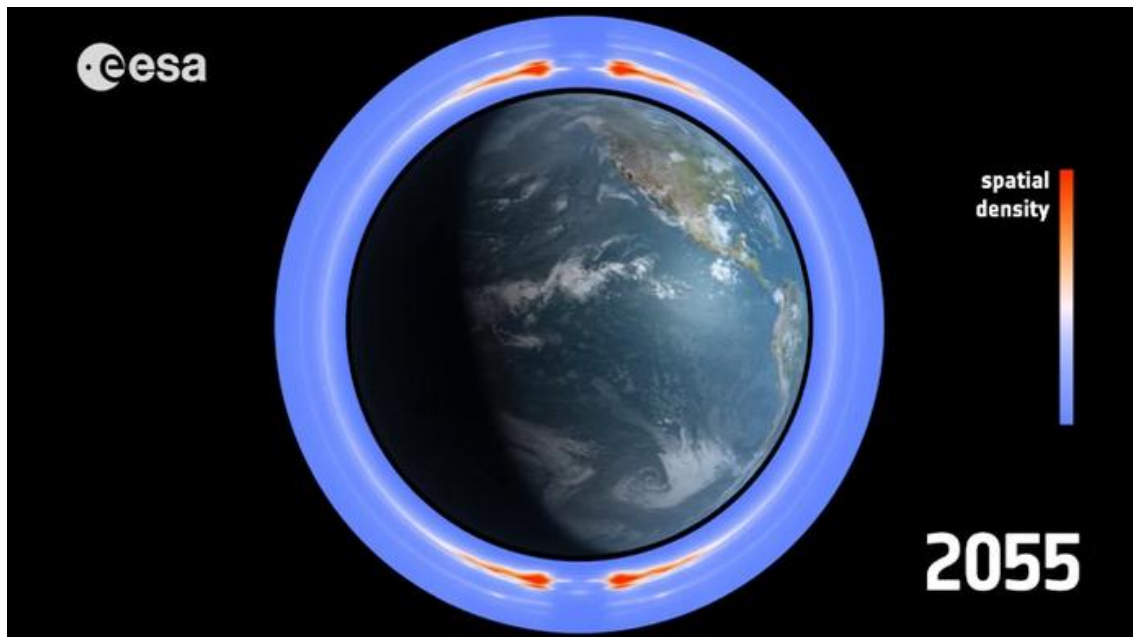
CleanSpace look back and ahead

- **CLEAN SPACE Initiative**

1. Design to minimize environment impacts
2. Green Technologies
3. Remove **a** large piece of space junk →
4. Safely remove satellites at their EOL



Is it realistic to revert the trend? Are we doomed to the cascade effect before a serious international reaction is put into practice?

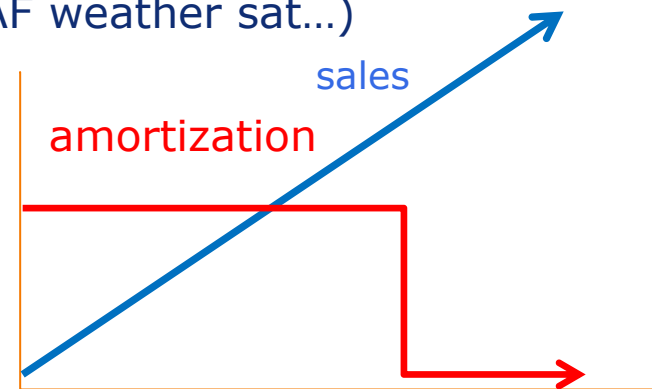
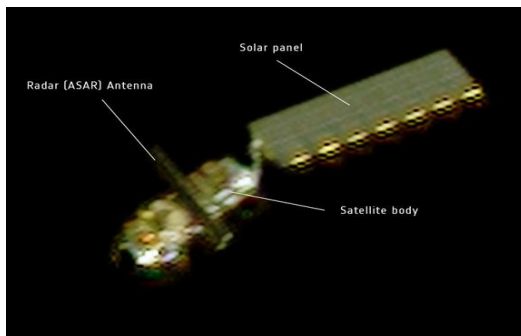


Private Satellite Operators

THERE IS A WILD WORLD OUTSIDE ESA

- **FULLY PRIVATE commercial Spacecraft operators**

- Profit and not science or solidarity is the driver.
- Profit increases at EOL this prevents decision makers to demise a satellite that is still healthy (e.g. ENVISAT, USAF weather sat...)

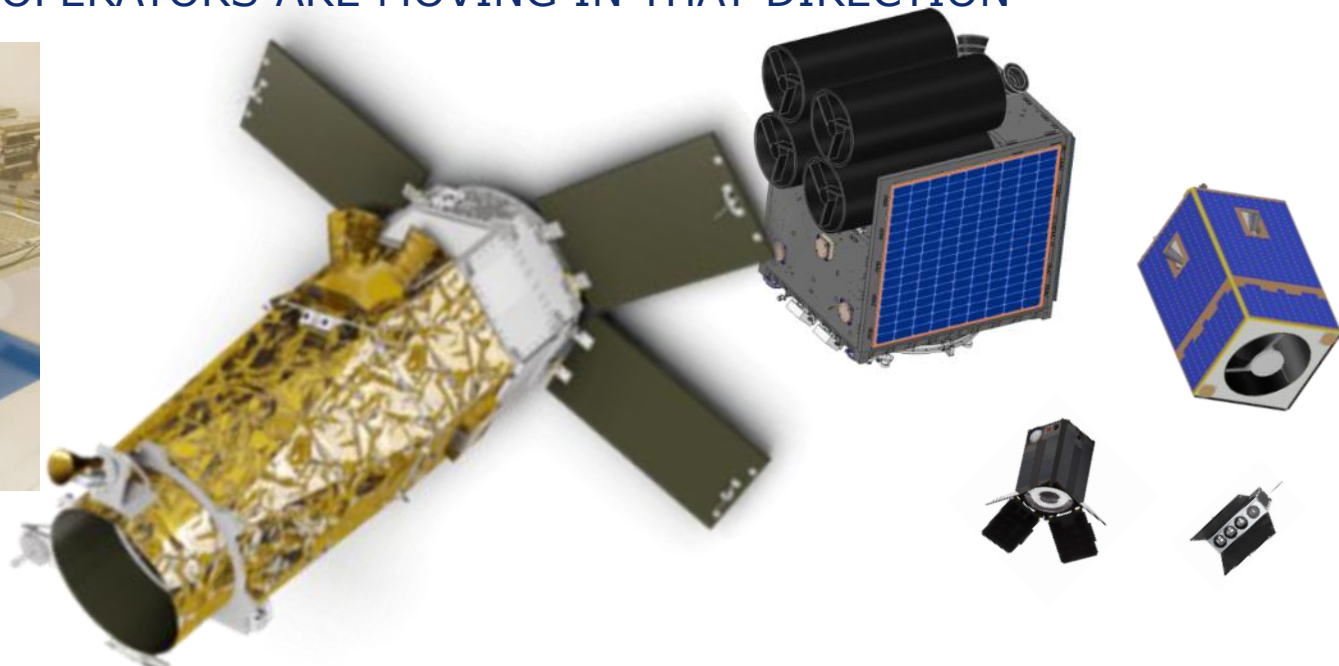
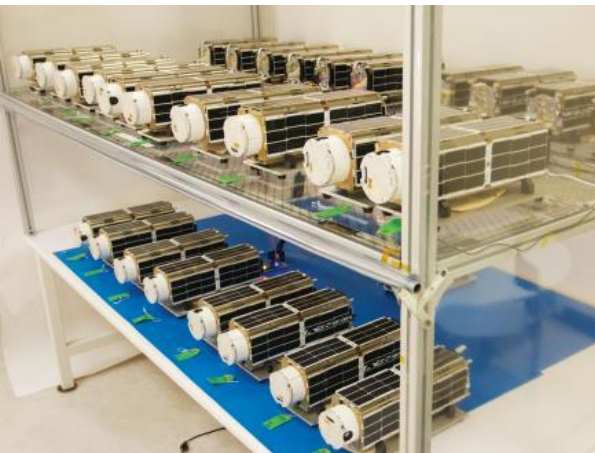


- Risks are insured (space debris risk included). Quantify risk (1/10,000th of 20M€ is merely 2k€).
- Responsibilities are unclear and long term time (50 yrs?)
- Operation costs are a burden (e.g. collision avoidance manoeuvres). No reliable catalog, only service JSpOC
- Incentives needed, [positive and negative] e.g. *grants, certifications of platforms, laws, reputation, black lists*



The "New Space"

- **Arrival of the "NEW SPACE"**
 - Small satellites, little redundancy (mostly no propulsion)
 - Low price (construction and launch)
 - Large numbers (*OneWeb, Google+SpaceX 700/1000 into 900/1,200 km orbit!*)
 - Plenty of venture capital (bubble?)
 - Questionable business models, new, perhaps ephemeral companies, big competition
 - The access to space has been "democratized", New Space and nanoSats are here to stay, they are not just toys or simply space debris, there are plenty of users of the new paradigm
 - PRIVATE SPACE OPERATORS ARE MOVING IN THAT DIRECTION



SUMMARY

- Space debris solutions are progressing, but in our view, too slowly
- Clean Space is a determined and extremely interesting initiative
- Initiatives that intends to involve the private operators should:
 - address also the “New Space” stakeholders: small, many, cheap, private, rapidly developed satellites, not only the large, traditional and institutional ones
 - Be internacional, global, mandatory
 - Provide standards, tools and technologies as inexpensive and available as possible and with proven effectiveness
 - Create incentives for its application
- This situation is similar e.g. to global warming control initiatives (Kyoto) and possibly with similar difficulties to succeed

