DARMSTADT 41TH IADC
CNES AGENCY UPDATE

12/06/2023
Darmstadt

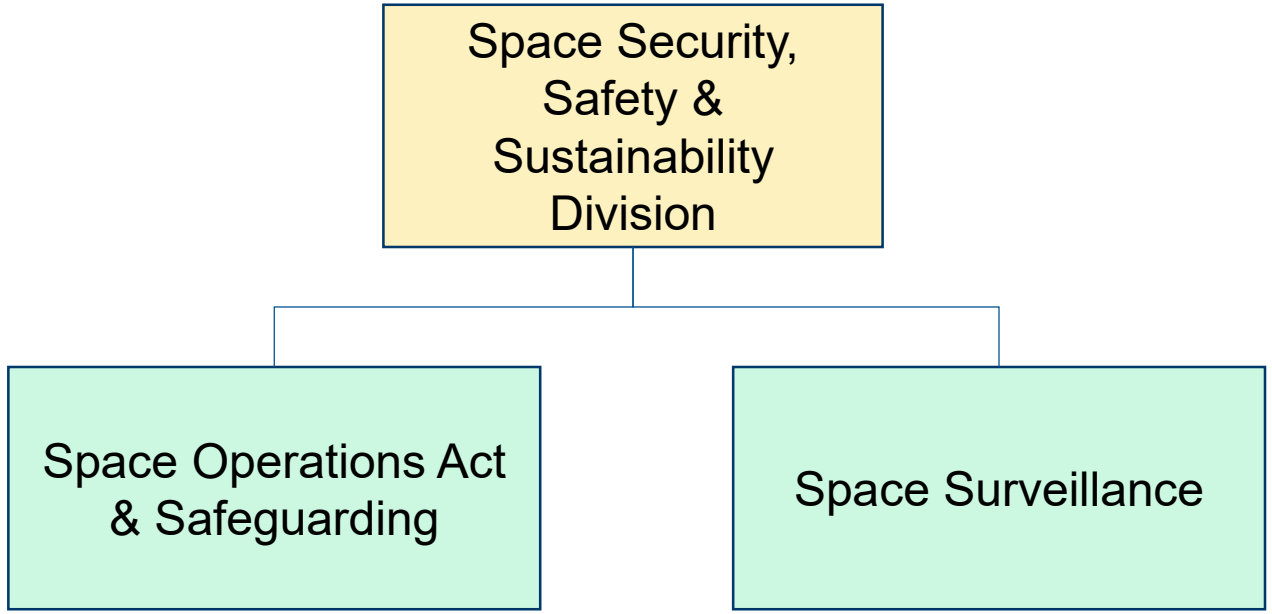
Pascal Richard, CNES

1

ORGANISATION

Organisation at CNES

- **In 2021: creation of the Cnes Space Surveillance Office**
  - consolidation of researh and development and operational teams
- **In 2022: creation of the Cnes Space Security, Safety & Sustainability Division**
  - Bringing Space Surveillance and French Space Operation Act teams together

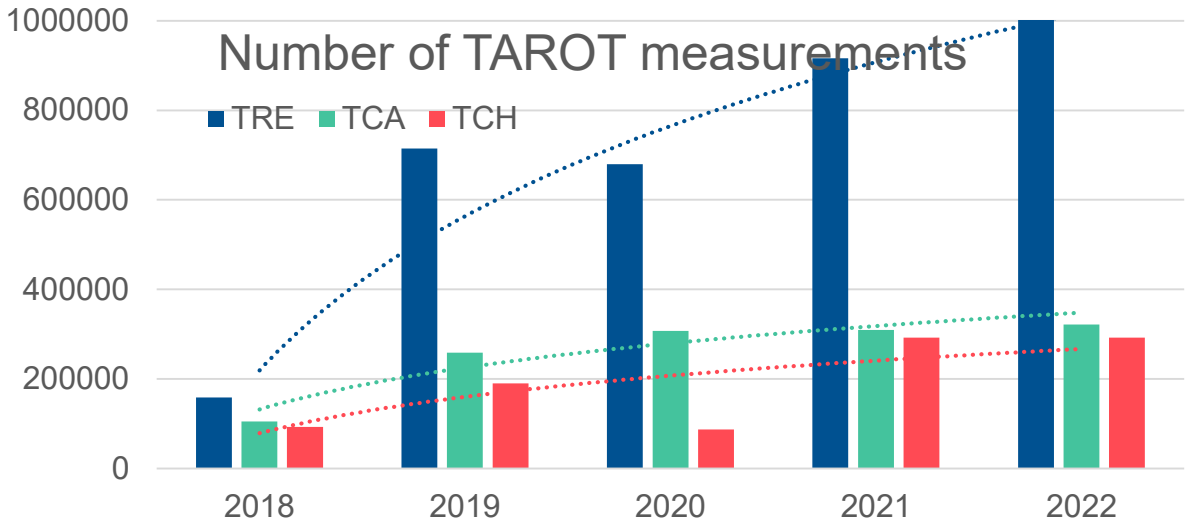


2

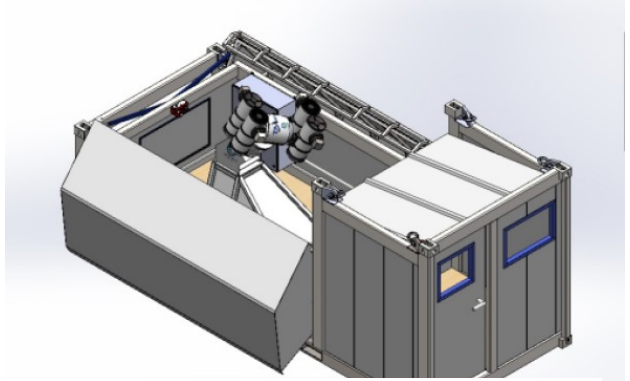
MEASUREMENTS PRODUCTION

Cnes telescopes update

- **Three TAROT telescopes + one in 2023**
- **Continued effort to improve the TAROT system**
- **Measurements are sent to:**
  - National space objects cataloguing system
  - European Union database for operational services
- **Major contributor to EUSST higher orbits observation**



TAROT telescopes



TAROT Nouvelle Calédonie

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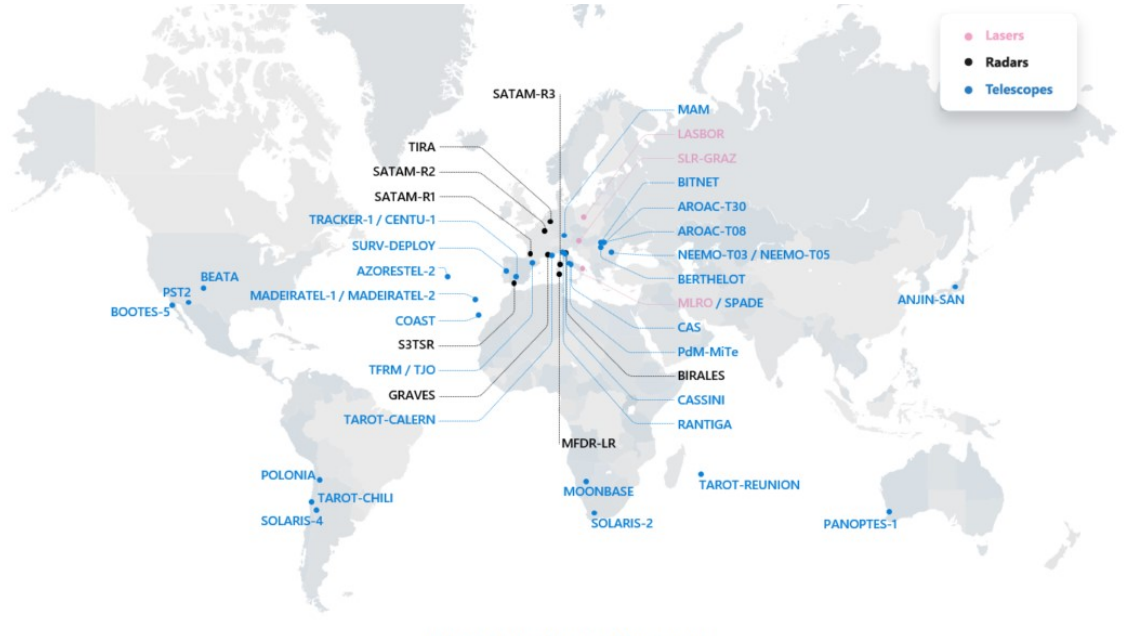
French army radars

- **Surveillance: Graves**
  - Graves refurbishment
    - Conducted by ONERA and its partner Degréane Horizon
    - Extension of performance
    - Extension of lifetime beyond 2030
    - Transmission evolutions achieved
    - Reception and processing site on line with schedule
    - No interruption of operations during refurbishment
- **Tracking: SATAM and Monge**

CNES telescopes and French MoD radars are part of EUSST sensors network

EUSST : European Union Space Surveillance and Tracking Program



EU SST Sensors Network (March 2022)

Up to 730.000 measurements shared daily, though the centralized European Database, in order to provide three high added value services

Figures from EUSST Service Portfolio (https://www.eusst.eu/services/)

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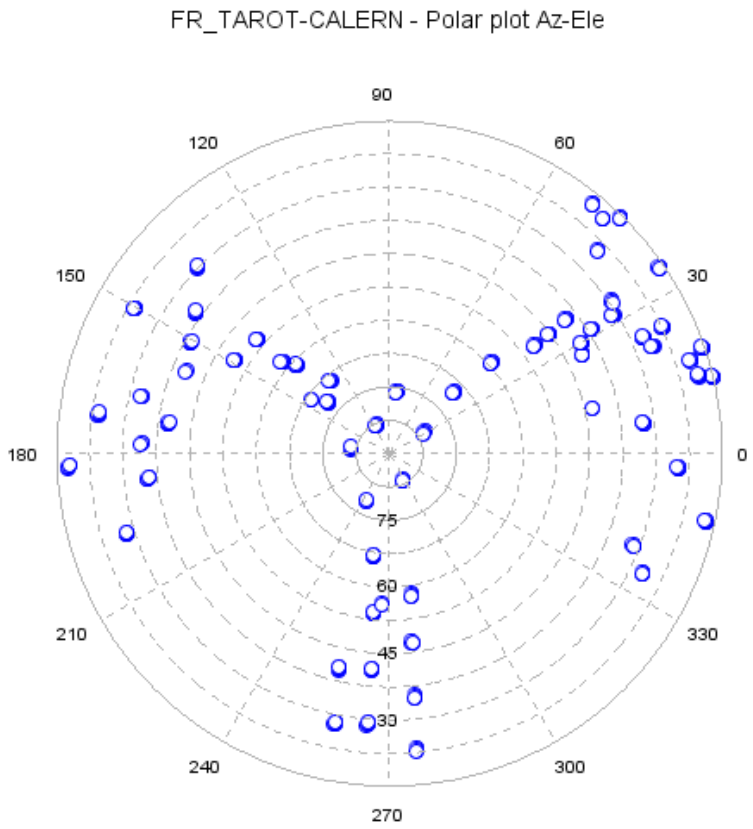
Calibration of sensors



TAROT_CALERN observation plan for latest calibration

Calibration campaigns of laser, telescopes, and radars :

- More than 30 sensors regularly calibrated (every 4 month)
- Telescopes calibrated wrt precise Galileo orbits
- Radars calibrated wrt precise altimetry satellites orbits

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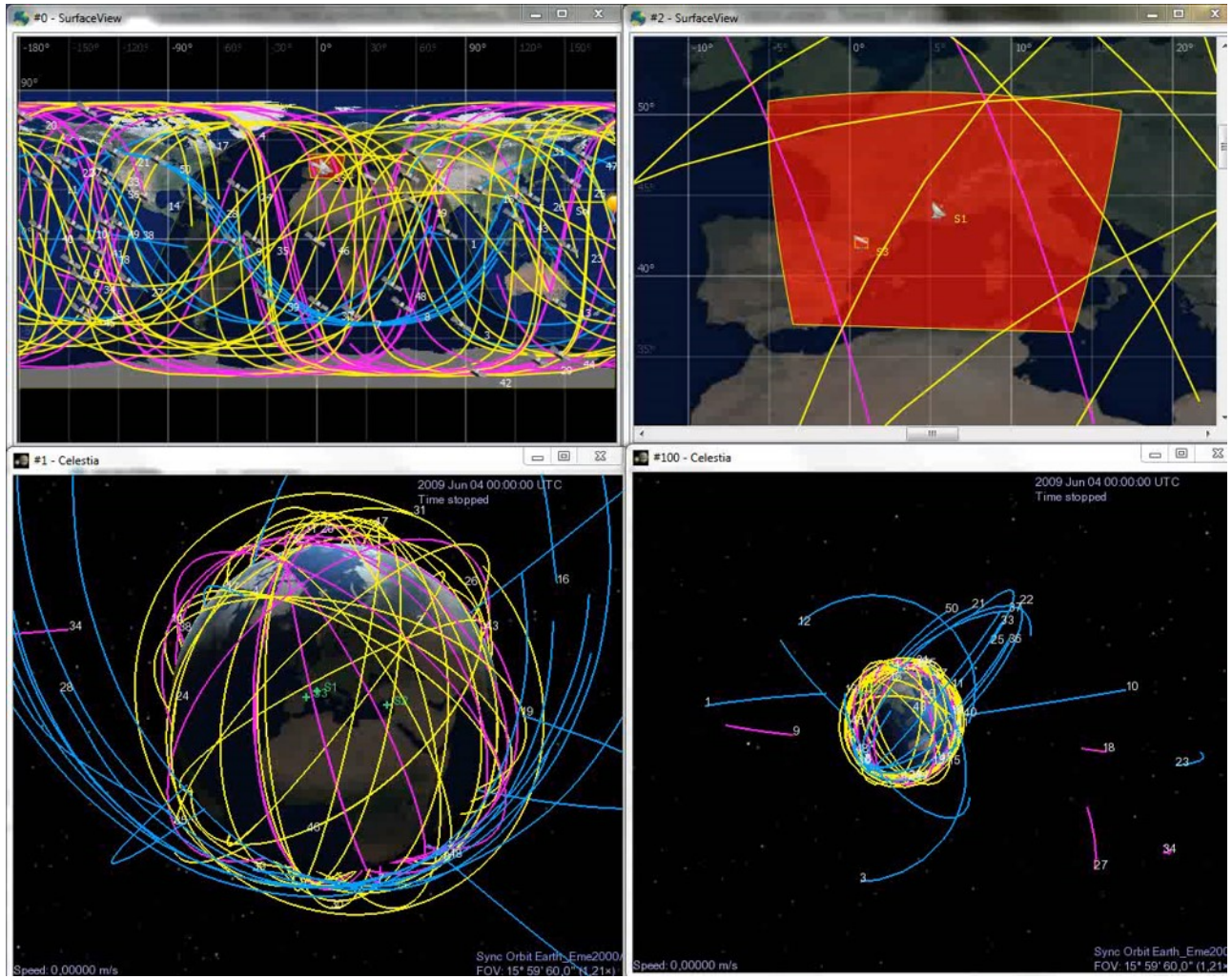
3

SENSORS NETWORK SIMULATION

Space Surveillance and Tracking - System Design



- Sensor Detection
- Measure generation
- Correlation
- IOD
- OD
- Sensor Tasking – Scheduling
- Catalogue Build-up and Maintenance
- Simulation of re-entry and collision avoidance services

➔ **Sensor network detection capability estimation**

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4

OPERATIONAL SERVICES

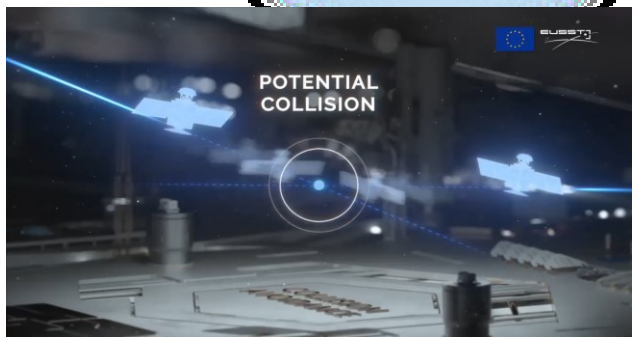
COLLISION AVOIDANCE

REENTRY PREDICTION

FRAGMENTATION ANALYSIS

Collision avoidance service (provided by CNES)

307 Satellites



LEO — 128

EROS
SAR-LUPE 1, 2, 3, 4, 5
TET-1
TANDEM-X
TERRASAR-X
REAKTOR HW, Sunstorm, W-CUBE
DEIMOS 1, 2
METOP B, C
SENTINEL 1A, 1B, 2A, 2B, 3A, 3B, 5P, 6A
PAZ
UPMSat-2
ION-SCV 1, 2, 3, 4, 5
CHEOPS
TRISAT
Brik-II
NEPT-1
FossaSat 2E1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Suomi-100
Platform 1, 2, Spartan
VENμS
SARAL
CSO-1, 2
CALIPSO
JASON 3
PLEIADES 1A, 1B
SMOS
BRITE PL-1,PL-2
EYESAT
ANGELS
NESS
CERES 1,2,3
ELO3
XR-1, ICEYE-X1, 2, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 24
GMS-T, Odin
GomX-4A. 4B
Robusta 1B
NEMO-HD
YAM-2, 3
Globalstar M065, M066, M069, M070, M071, M072, M073, M074, M075, M076, M077, M078, M079, M080, M081, M082, M083, M084, M085, M086, M088, M089, M090, M091, M092, M093, M094, M095, M096, M097

MEO — 58

GSAT / Galileo 0101, 0102, 0103, 0104, 0201, 0202, 0203, 0204, 0205, 0206, 0208, 0209, 0210, 0211, 0207, 0212, 0213, 0214, 0215, 0216, 0217, 0218, 0219, 0220, 0221, 0222, 0223, 0224
O3B PFM, O3B FM 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, mPower 1, 2, 3, 4, 5, 6
MT-Cube-2, CELESTA
ALPHA
TRISAT-R

GEO — 121

COMSATBW-1, 2
XTAR-EUR
SPAINSAT
METEOSAT-8, 9, 10, 11
HYLAS 1, 2, 4
ASTRA 1KR, 1L, 1M, 1N, 1G, 2A, 2C, 2D, 2E, 2F, 2G, 3A,,3B, 5B
AMC 1, 3, 4, 6, 8, 11, 15, 18, 21
SES 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11,12, 14, 15 , 16/Govsat-1, 17, 18, 19, 20, 21, 22
NSS 6, 7, 9, 10, 11, 12
SIRIUS 4, QUETZSAT 1, CIEL 2
EDRS-C
ATHENA-FIDUS
SYRACUSE 3A, 3B, 4A
HELLAS-SAT 2, 3
INMARSAT 3F1, 3F2, 3F3, 3F5, 4F1, 4F2, 4F3, AF1, 5F1, 5F2, 5F3, 5F4, GX5, 6F1
EUTELSAT 10A, 16A, 172A, 21B, 25B, 28A, 28B, 36B, 3B, 5WA, 65W, 7WA, 70B, 7A, 7B, 8WB, 9A, 9B, HB 13B, 13C, 13D, KASAT 9A, 12WB, 172B, 7C, 5 WEST B, Konnect, Quantum, KVHTS
BULGARIASAT-1
AMAZONAS 2, 3, 5, HISPASAT 30W-5, 30W-6, 36W-1, 74W-1

Commercial	Govern./IGOs	Military	Universities / Research
216	63	20	8

SURVEILLANCE & TRAFFIC COORDINATION

	LEO 2022	MEO 2022	GEO 2022
Monitored spacecraft	121	55	120
CDM managed	~ 3.5M	~1000	~ 100 000
Conjunctions	~ 350 000	<100	~ 15 000
Avoidance Maneuver	14	0	5

COLLISION ALERT & COORDINATION

ATMOSPHERIC REENTRIES

French objects decayed in 2022: **9**

6 Ariane 5 SYLDA, 3 s/c fragment

Atmospheric reentries monitored by CNES in 2022 : **26**

25 R/B, 1 S/C (IADC Exercise)

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5

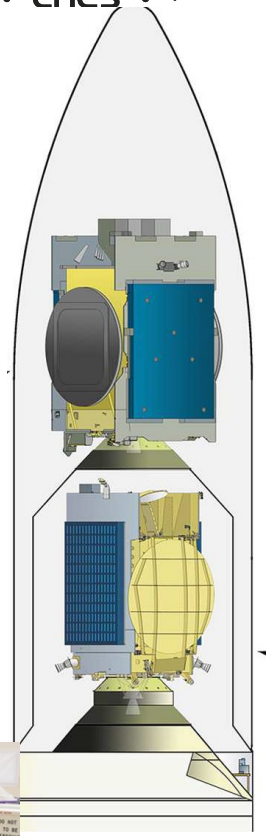
LAUNCHERS

Launches from Guiana Space Center in 2022 and 2023

Date	Launcher	Payloads
February 10, 2022	Soyuz ST-B VS 27	34 One-Web
June 22, 2022	Ariane 5 ECA VA257 #	Measat-3D – Gsat-24
July 13, 2022	Vega-C VV21 *	LARES 2 + 6 cubesats
September 7, 2022	Ariane 5 ECA VA 258	Eutelsat Konnect VHTS
December 13, 2022	Ariane 5 ECA VA259 #	MTG-11 – Galaxy 35 & 36
December 20, 2022	Vega-C VV22	Pleiades NEO 5 & 6 (failure)
April 14, 2023	Ariane 5 ECA VA260 *	JUICE

Soyuz VS27

A5 ECA VA257



Vega VV21

** ESA Mission* *# Sylda* *Figures courtesy Arianespace*

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Launcher Statistics

8 launches from French Guiana Space Center in 2022 and 2023 (ESA or Arianespace flights)

- 3 Ariane 5-ECA to GTO, Perigee altitude 250 km, respectively 3 to 6°
- 1 Ariane 5-ECA to Lagrange L2
- 1 Soyuz-ST to MEO 23,522 km 57°
- 1 Vega to SSO (failure)
- 1 Vega to highly inclined LEO at 1450 km, 71.5°

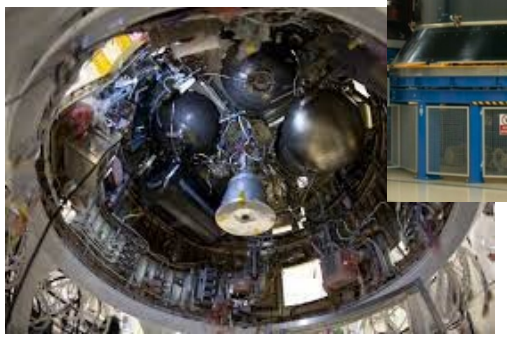
6 Natural reentries in 2022:

- 6 Ariane 5 Sylda

4 Natural reentries in 2023:

- 4 Ariane 5 Sylda

- All 7 upper stages completely passivated
- Direct controlled reentry for the AVUM Vega
- 10 objects launcher related remaining in orbit



- 3 A5 ESCA upper stage left in orbit, > 25 years but compliant to FSOA *
- 1 A5 ESCA upper stage left in Heliocentric orbit, compliant to FSOA
- 2 A5-ECA Sylda compliant with 25-year rule and FSOA
- 1 Soyuz-Fregat upper stage outside protected zone
- 1 AVUM-Vega deorbited in controlled way as per FSOA

** A5-ECA to be replaced by Ariane 6 by end-2023 with direct controlled reentry*

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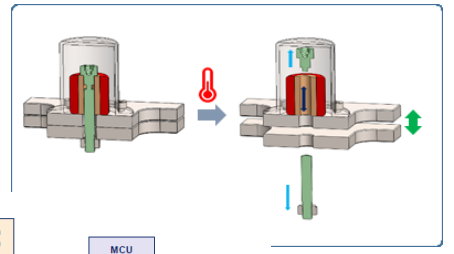
6

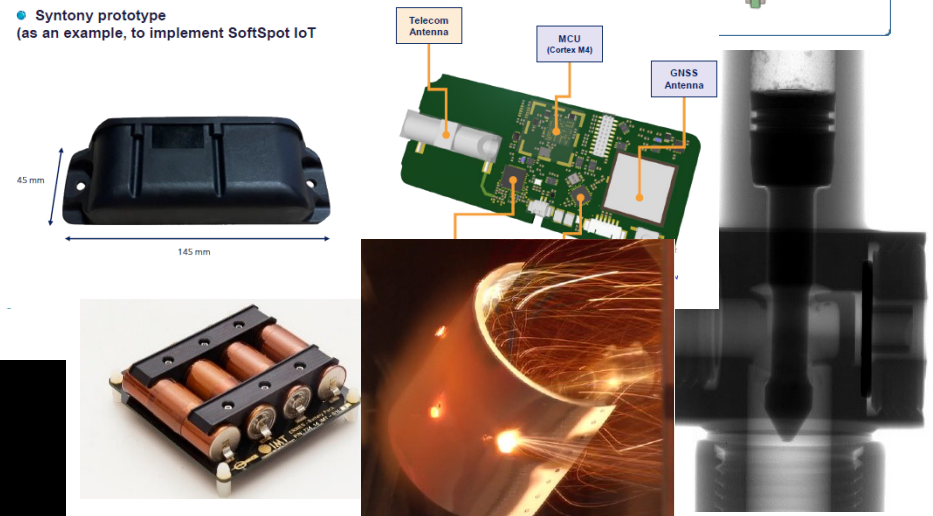
TECHS FOR SPACE CARE

TECHNOLOGY : Tech4SpaceCare

Tech4SpaceCare Initiative aiming to develop technological elements for orbital systems to ensure the sustainable use of space and the safety of space operations **without compromising competitiveness**

- **T4SC-1 : Increase SSA measurement accuracy**
- **T4SC-2 : Improving satellite passivation at end of life**
- **T4SC-3 : Protection against High velocity impacts**
- **T4SC-4 : Prepare spacecraft to ADR/IOS**
- **T4SC-5 : Decrease orbit duration after EoL**
- **T4SC-6 : Minimize risk during reentries**
- **T4SC-7 : Developing onboard anti-collision**
- **T4SC-8 : Improve missions extension and failures detection**
- **T4SC-9 : Darkening of satellites in low Earth orbit**





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