

Finnish Space Situational Awareness Center (FSSAC)

Ramp-up starting on 2-Dec, 2024

Prof. Ari-Matti Harri, FMI
BF / Space Business Forum 2.12.2024



1957



0 objects

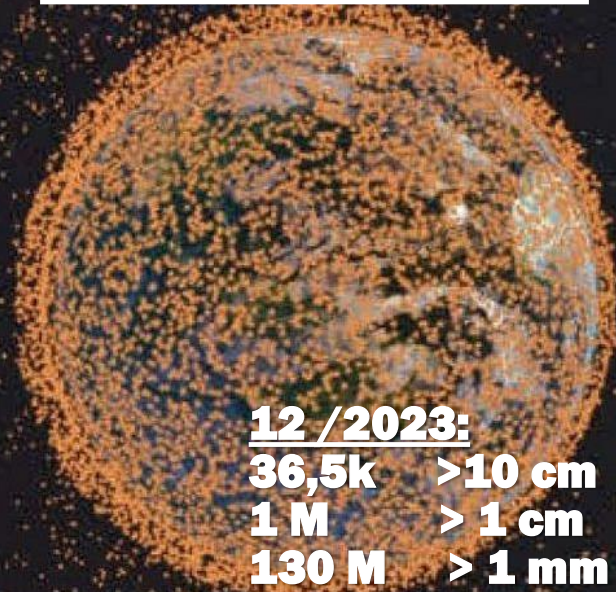
1990



**Around 6,000
trackable objects**

2020

More need for SST ...



12 / 2023:

36,5k >10 cm

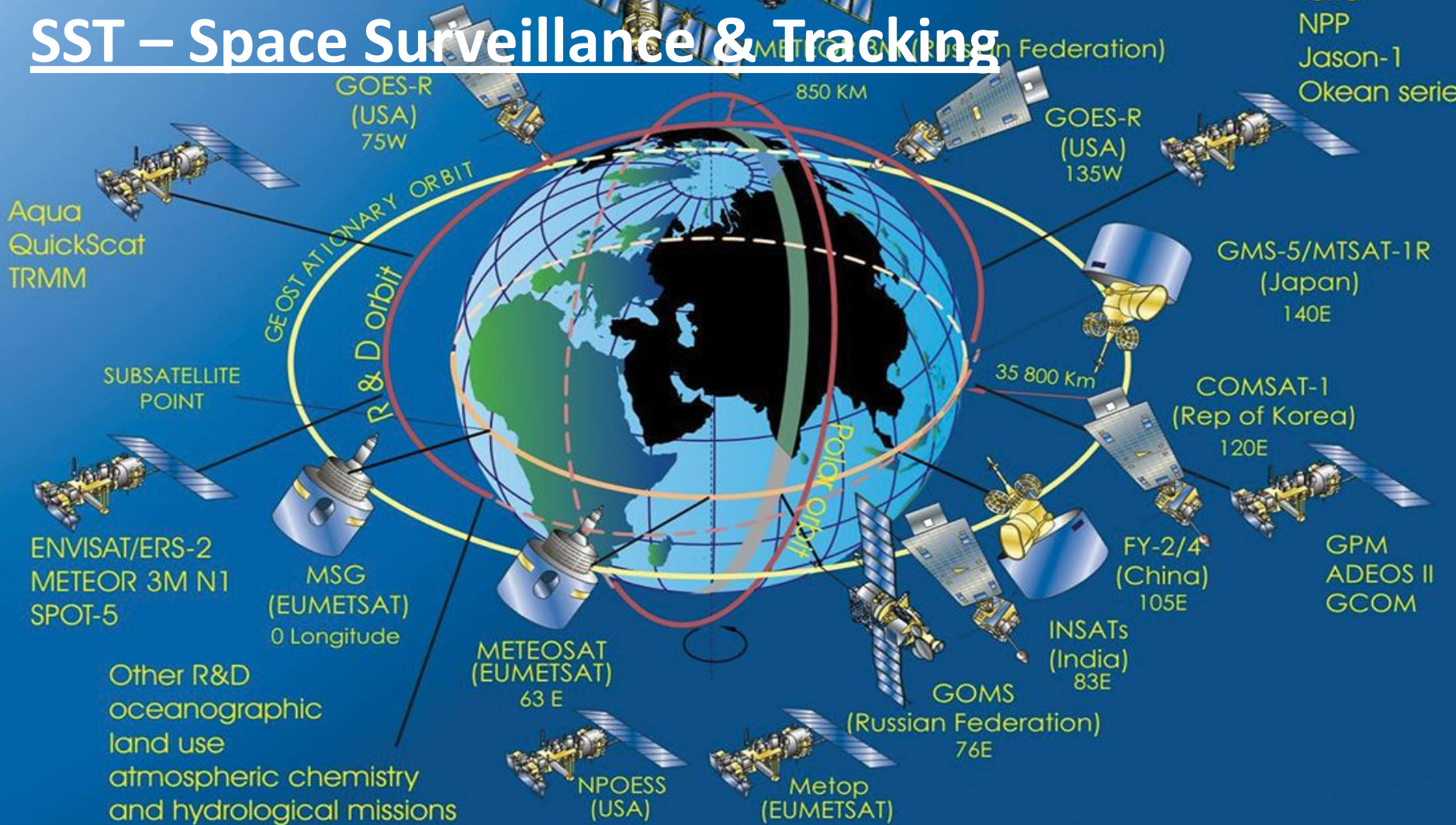
1 M > 1 cm

130 M > 1 mm

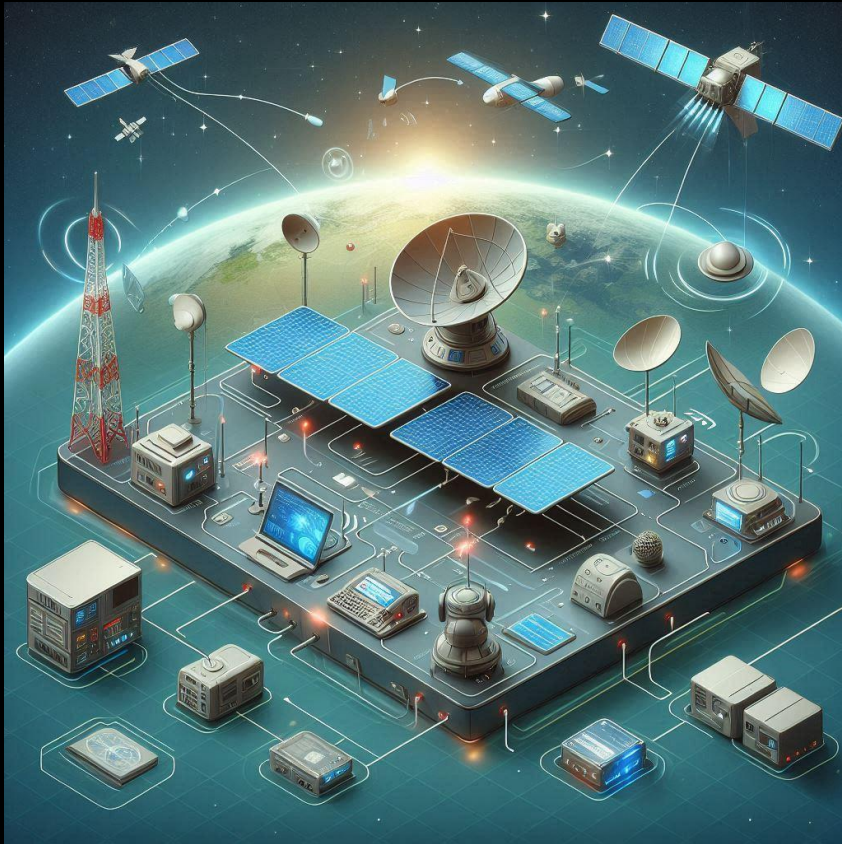
Tracked ~ 32,3 k

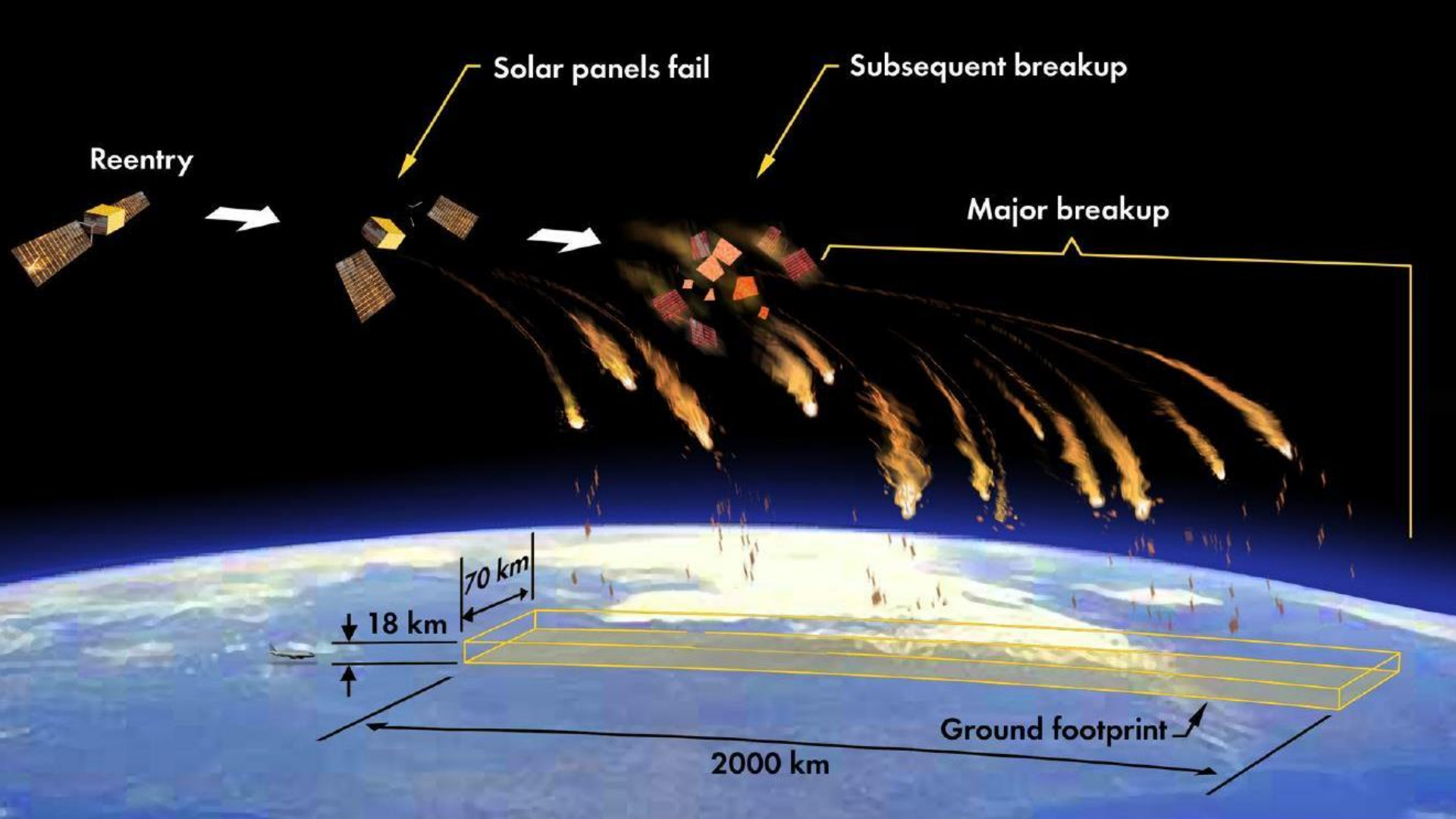
**Over 22,000
trackable objects**

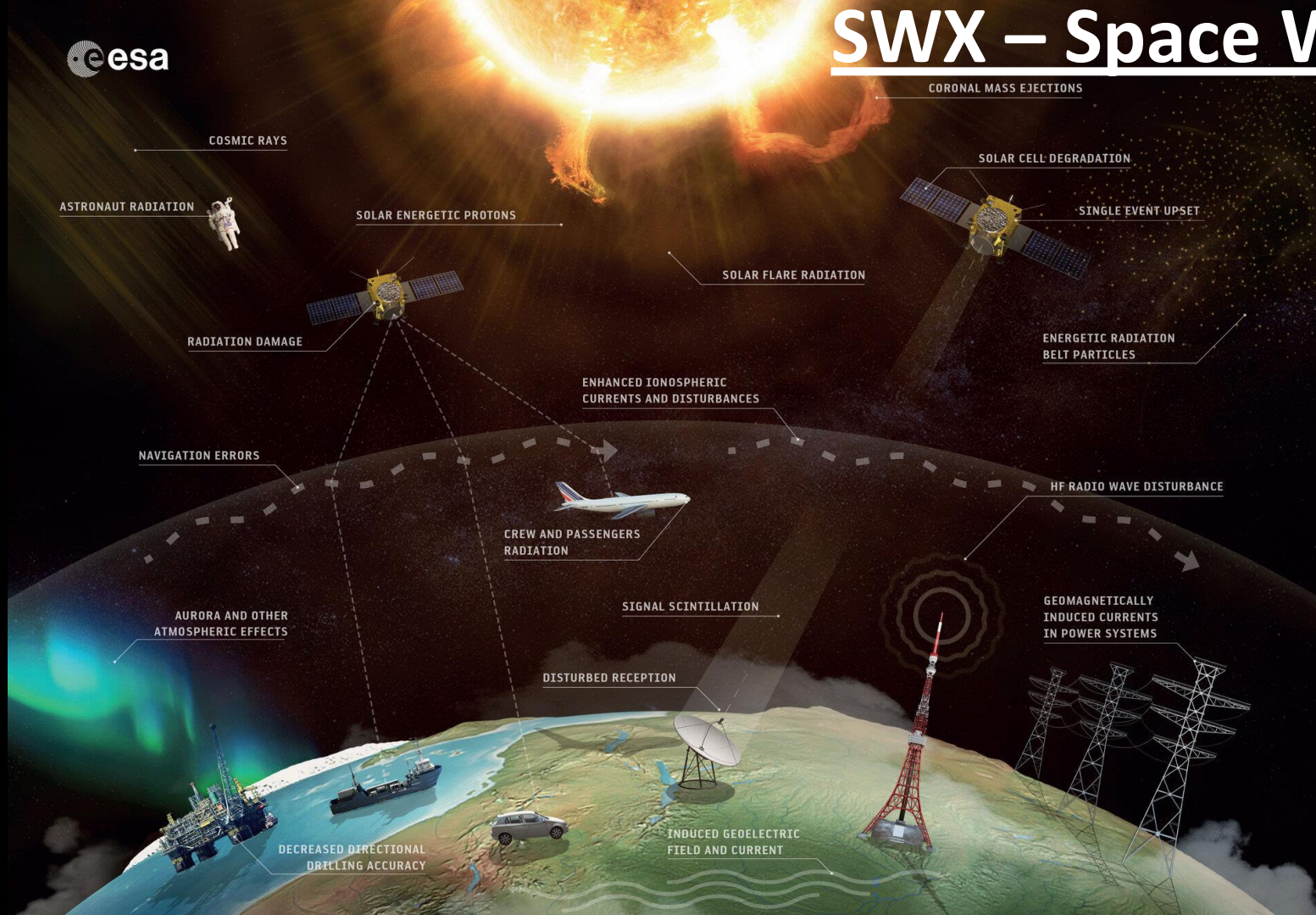
SST – Space Surveillance & Tracking



Cybersecurity: Data links (Op-GSE-Sat-GSE)







CORONAL MASS EJECTIONS

COSMIC RAYS

ASTRONAUT RADIATION

SOLAR ENERGETIC PROTONS

SOLAR CELL DEGRADATION

SINGLE EVENT UPSET

SOLAR FLARE RADIATION

RADIATION DAMAGE

ENERGETIC RADIATION
BELT PARTICLES

ENHANCED IONOSPHERIC
CURRENTS AND DISTURBANCES

NAVIGATION ERRORS

HF RADIO WAVE DISTURBANCE

CREW AND PASSENGERS
RADIATION

AURORA AND OTHER
ATMOSPHERIC EFFECTS

SIGNAL SCINTILLATION

GEOMAGNETICALLY
INDUCED CURRENTS
IN POWER SYSTEMS

DISTURBED RECEPTION

DECREASED DIRECTIONAL
DRILLING ACCURACY

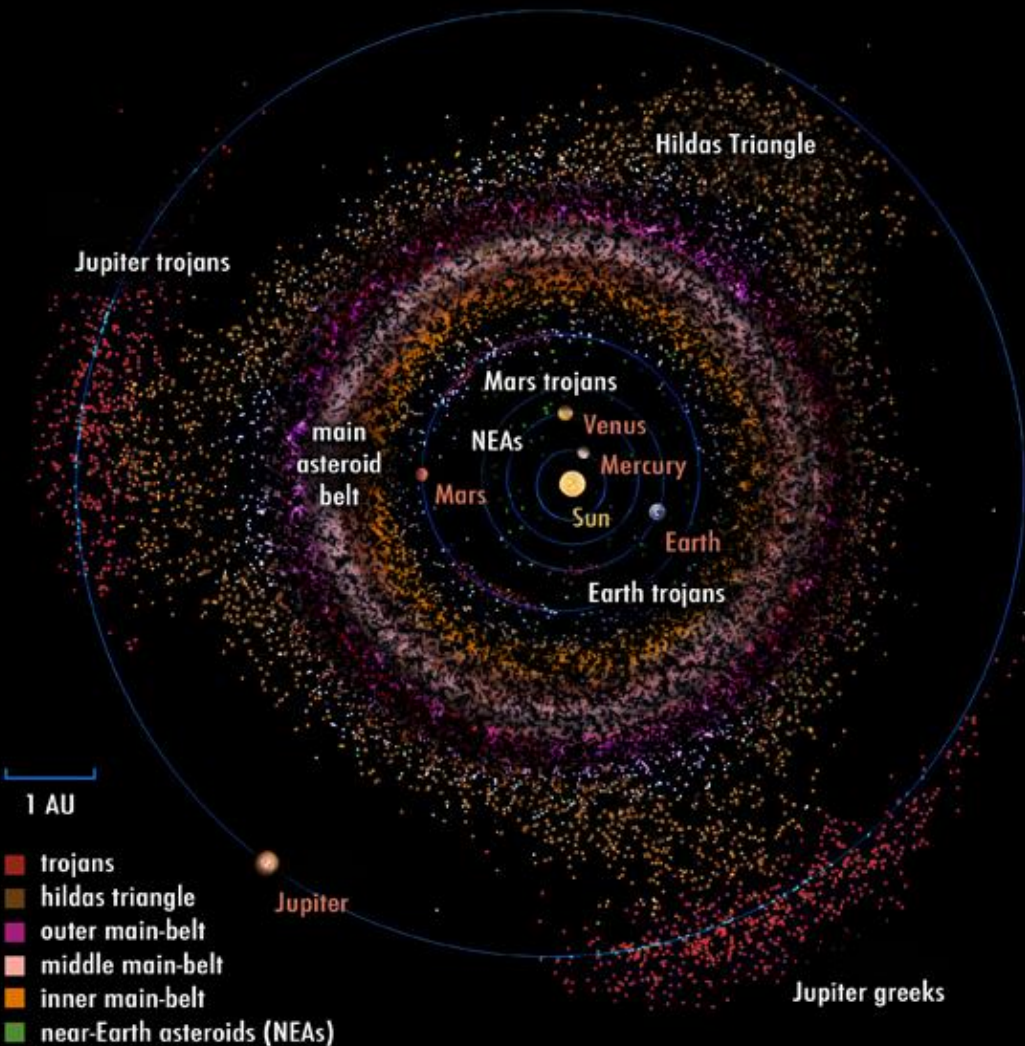
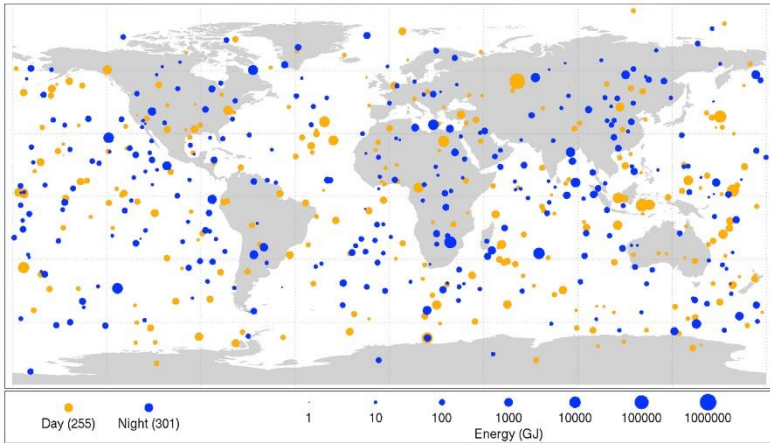
INDUCED GEOELECTRIC
FIELD AND CURRENT

NEO

(Near Earth Objects)

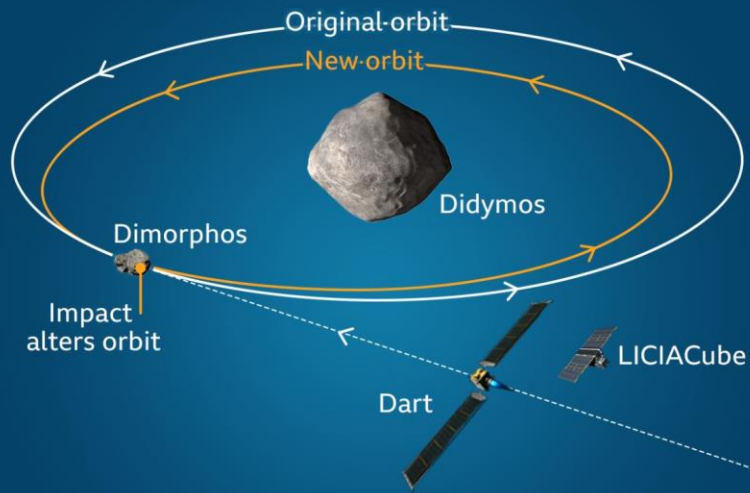
Bolide events 1994-2013

(Small asteroids that disintegrated in the Earth's atmosphere)



SSA / Planetary Defense

Nasa spacecraft will crash into asteroid's moon



1 was launched from [Planned collision site] orbit of asteroids when DART spacecraft was launched.

2 NOV 24: After separating from the Falcon 9 rocket, the spacecraft's solar array is deployed for power generation. A high-resolution imager and telescope will beam back images of asteroid targets, providing information for navigation and impact-targeting. Communications antenna. 60ft.

3 MID-SEPT 2022: A tiny camera called LICIAcube will detach from main spacecraft to send images of collision back to earth.

4 SEPT 26 - OCT 1, 2022: Spacecraft will collide with Dimorphos, in an attempt to alter the rock's orbit around Didymos by just 1 per cent.

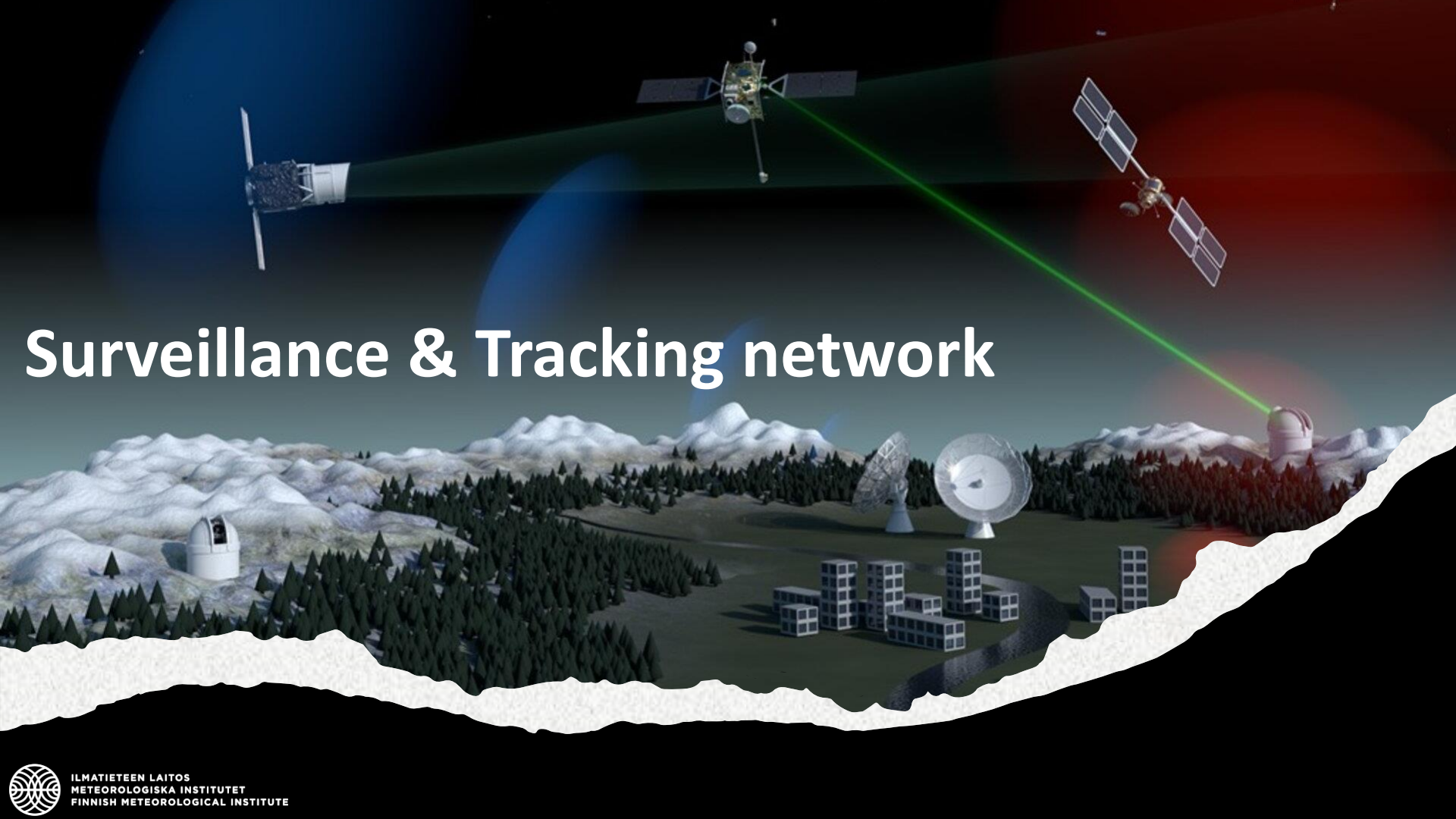
DIDYMOS asteroid
2,560ft in diameter

Orbiting around Didymos is ... **DIMORPHOS** the asteroid target

15,000MPH

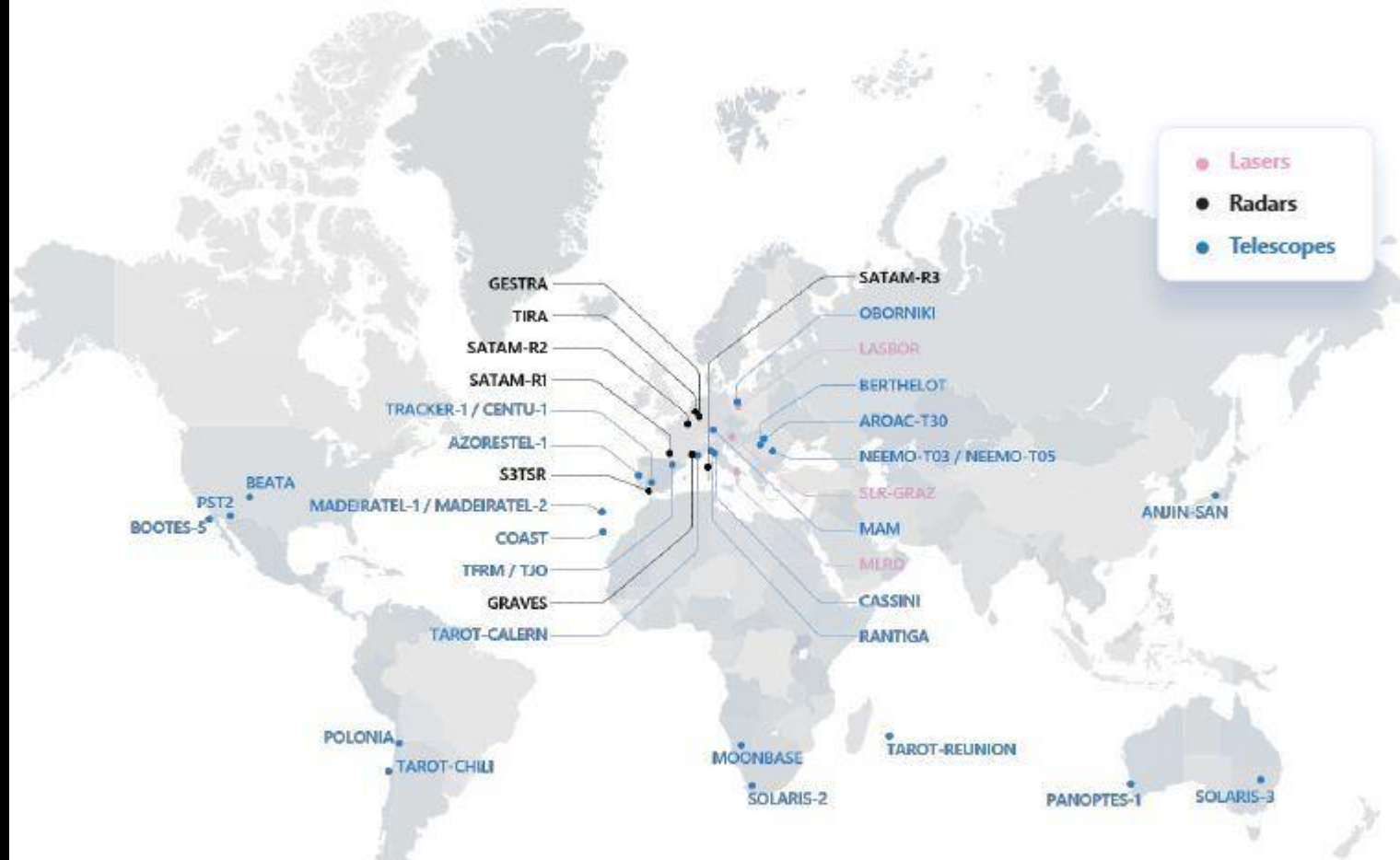
Source: NASA
Graphic by John Lawson





Surveillance & Tracking network





EU SST Sensors Network (Oct 2021)

The network of sensors is updated regularly based on calibration and integration procedures. Check the latest version on the EU SST website.

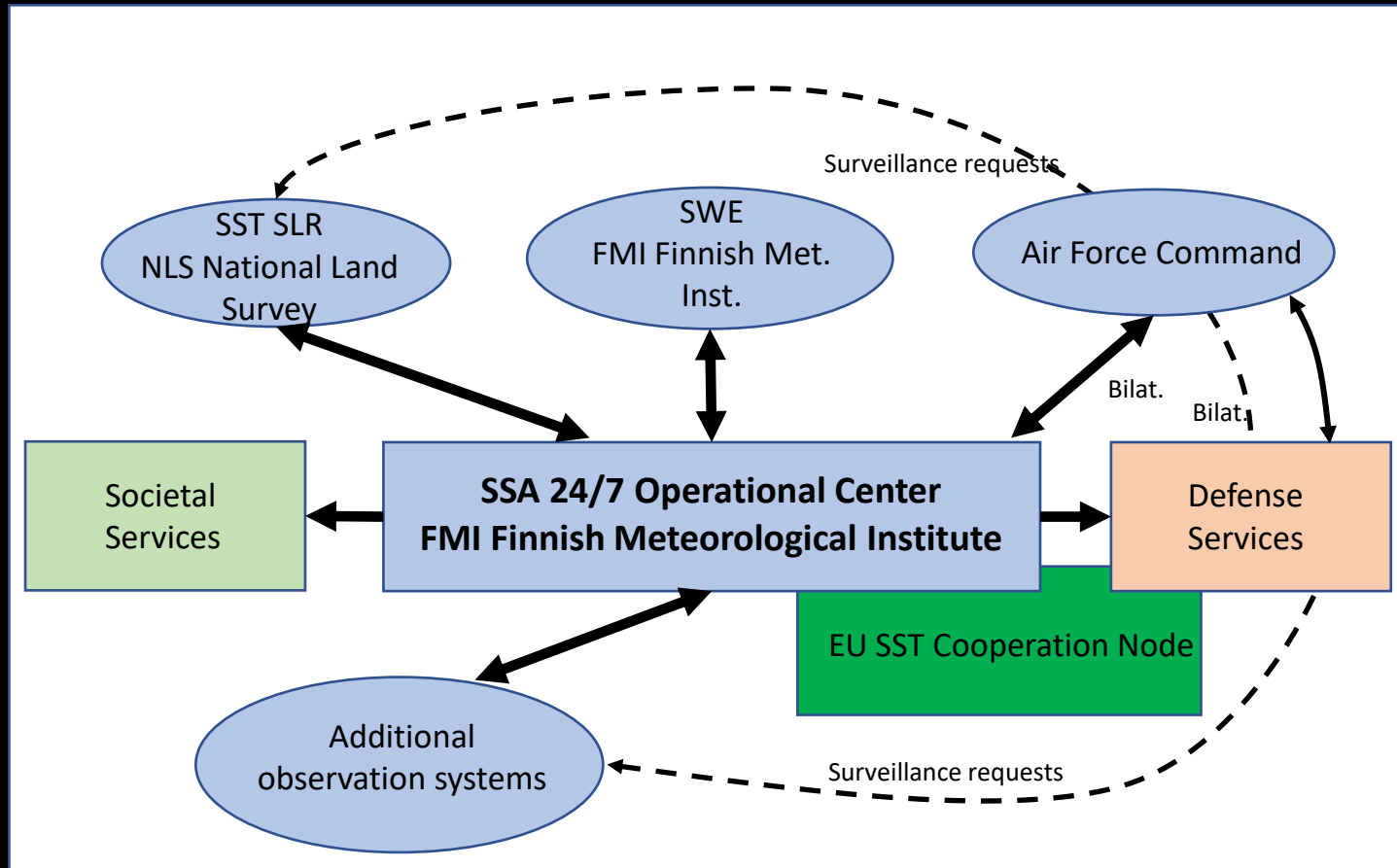


Finnish Space Situational Awareness Center (FSSAC)

- Configuration -

Finnish Space Situational Awareness Center (FSSAC)

- ❑ To be built on the FMI-LUOVA / Space Weather Service (& PECASUS Global Space Weather) platform.
- ❑ NLS SLR is expected to be SST-ready by 2024-2025.
- ❑ Operational platform with 24/7 service. Space researchers are available 24/7.
- ❑ FSSAC: operational services in 2027



FSSAC Operational Services

FMI General Space Weather & PECASUS

Hazards



FSSAC / 24/7 platform



Auroras



Security Duty Officer



Space Weather Officer



Alerts and Warnings

Tailored guidance



@FMIspace

FSSAC Mission

- ❑ FSSAC will analyze and produce SSA information and alerts (STM) in **int'l co-operation** including SST, SWE, NEO
 - ❑ Analyzes and predicts events affecting space-based systems and informs about possible degradation in quality of services (national POC for information)
 - ❑ Monitors conditions in near-Earth space – **space weather** – that can deteriorate the functioning of critical space-based services (GNSS, HF communication, air traffic, GIC)
 - ❑ Delivers status-info of critical space-based societal services
 - ❑ Informs about falling space debris and near-Earth objects (NEO)
- ❑ **Int. coop. provides a basic SSA image, which is enhanced by national actions.**
- ❑ **FSSAC will produce SSA information and advisories for governmental, public and private organizations and citizens.**
24/7 service / ISO9000 / crises-resilient operations

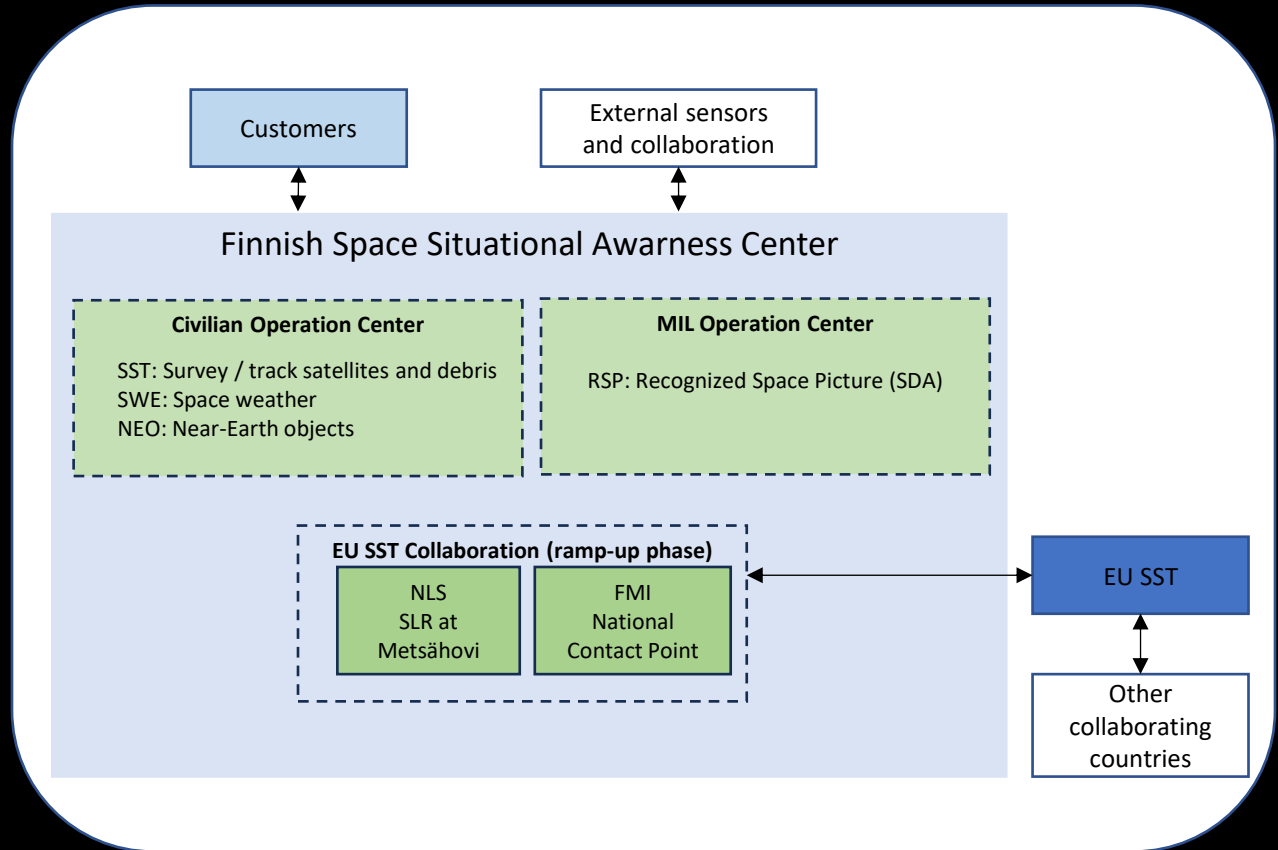
FSSAC Use Cases - Examples

- Delivering orbital information of specific objects
- Space object re-entry /entry
- Space weather impact on infrastructures (satellite orbit/status, Ground segment, GIC-effects)
- NEO information and alerts
- Authorities: status of critical space-based infrastructures (e.g. GNSS, communications,)

- Research on SSA -topics
- STM development with international partners

EU SST & FSSAC

- ❑ FMI signed the EU SST agreement as the representative of Finland on September 8, 2022, and serves as the national EU SST entity.
- ❑ Finland's EU SST contribution consists of FMI's 24/7 operational system (ISO9000) and SLR (NLS/Metsähovi)
- ❑ The established EU SST Center at FMI is the first stage of the FSSAC.



Citizens and the press

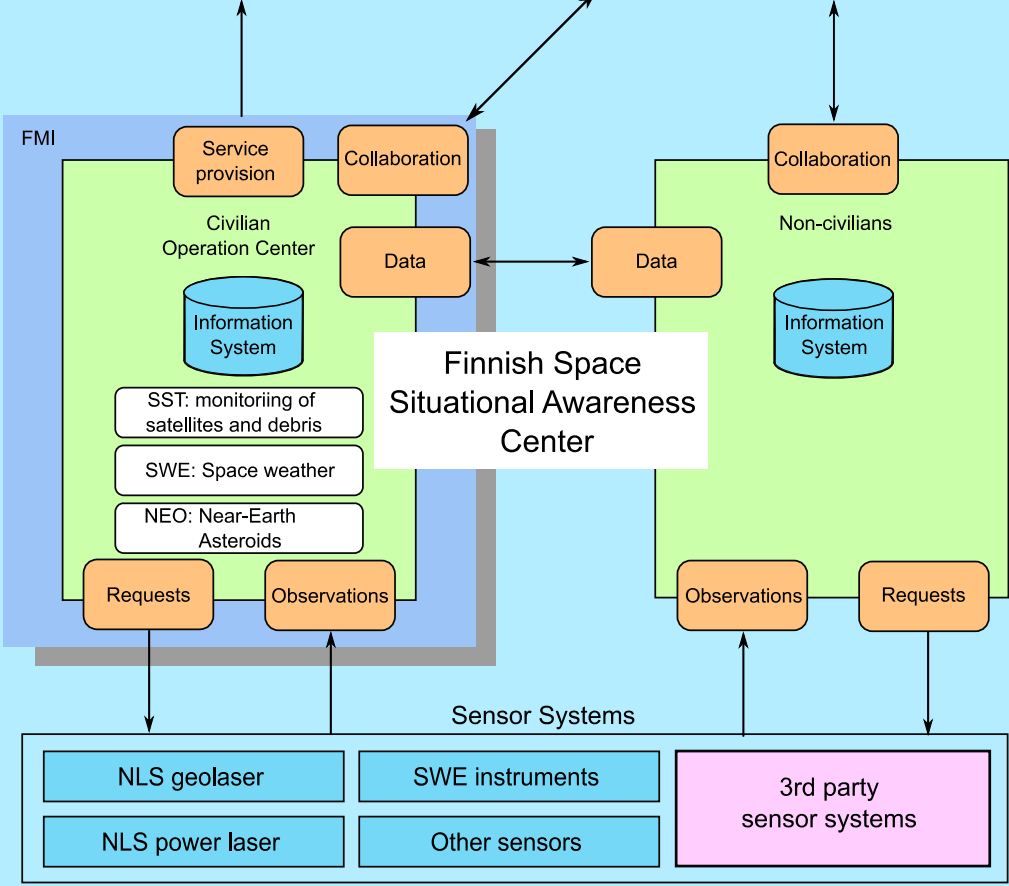
Government actors

Satellite operators

EU SST

Space-Track TraCSS

FSSAC Users & Data sources



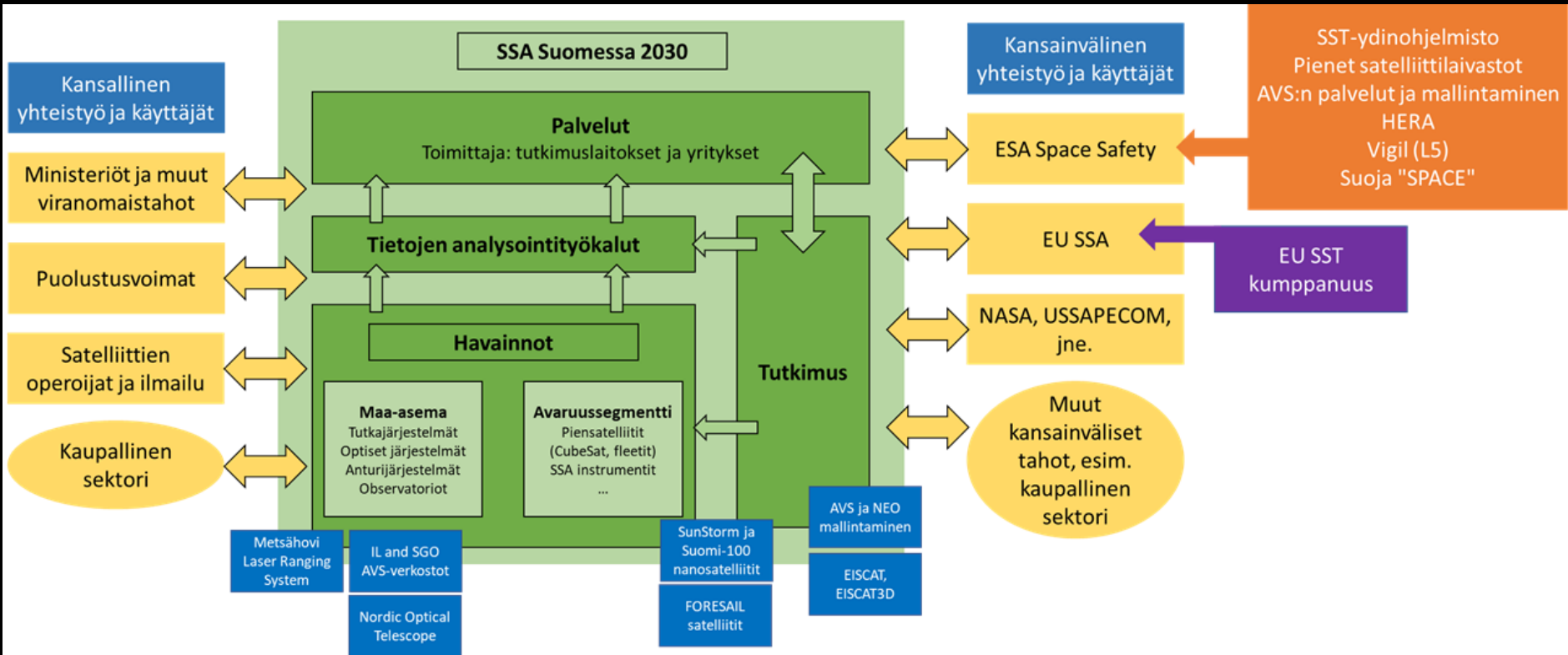
- Customers
 - Authorities
 - Governmental entities
 - Public organizations
 - Private companies
 - General public and media
- Data sources
 - EUSST
 - Own observations
 - Space-Track / TraCSS
 - SWPC
 - ESA
 - Minor Planets Center

Satellite Laser Ranging facility (NLS, Metsähovi)

- ❑ Satellite Laser Ranging facility (NLS, Metsähovi, 532/1064 nm) with geodetic capabilities
- ❑ Participant in the International Laser Ranging System (ILRS)
- ❑ SLR facility's measurement accuracy approximately 1 mm
- ❑ A power laser procurement is under way to take the vacant laser slot of the SLR telescope → dark objects



FSSAC – Avaruustilannekeskuksen peruselementit ja taustalla toimivat tietolähteet





Thank you!

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