2nd EU SST Webinar: Operations in Space Surveillance and Tracking

16 November 2020 – 14h CET

The EU SST activities received funding from the European Union programmes, notably from the Horizon 2020 research and innovation programme under grant agreements No 760459, No 785257, No 713630, No 713762 and No 634943, and the Copernicus and Galileo programme under grant agreements No 299/G/GRO/COPE/19/11109, No 237/GRO/COPE/16/8935 and No 203/G/GRO/COPE/15/7987. This Portal reflects only the SST Cooperation's actions and the European Commission and the Research Executive Agency are not responsible for any use that may be made of the information it contains.

2nd EU SST Webinar

Operations in Space Surveillance and Tracking

Speakers

- Pascal FAUCHER (CNES)

- María Antonia RAMOS (CDTI)

- Cristina PÉREZ (CDTI)

- Florian DELMAS (CNES)

- João ALVES (EU SatCen)

- Pier Luigi RIGHETTI (EUMETSAT)

- Lt. Moreno PERONI (IT MoD)

- Juan ESCALANTE (EC – DG ECHO)

- Christophe MORAND (EEAS)

- Rodolphe MUÑOZ (EC-DG DEFIS)

Agenda (1/2)

14h00-14h10:
Welcome to the 2nd EU SST Webinar
[Moderator: Mr Oliver Rajan (EU SatCen)]

14h10-14h50:
SST Support Framework: Safeguarding European space infrastructure
• Overview, governance model, security relevance and future perspectives
[SST Cooperation Chair: Dr Pascal Faucher (CNES)]

EU SST Architecture & Service Provision Model
• Sensors network
• Database and Catalogue precursor
• Services
[Chair of the SST Technical Committee: Ms María Antonia Ramos Prada (CDTI)]

14h50-15h30:
EU SST Operational Collision Avoidance service
• High Interest Events analysis and risk mitigation process
• Portal, metrics and users
[ES and FR Operations Centres: Ms Cristina Pérez (CDTI) and Mr Florian Delmas (CNES)]
[SST Front Desk: Mr João Alves (EU SatCen)]

EU SST services integration in EUMETSAT Conjunction Analysis Operations
[EUMETSAT: Mr Pier Luigi Righetti]

Agenda (2/2)

15h30-15h40: Break

15h40-16h20:
EU SST Operational Fragmentation and Re-entry analysis services
- Fragmentation detection and characterisation process
- Re-entry prediction process
- Portal, metrics and users

[IT Operations Centre: Lt Moreno Peroni (IT MoD) and SST Front Desk: Mr João Alves (EU SatCen)]

DG ECHO – EUSST User experience
[EC – DG ECHO: Mr Juan Escalante]

16h20-16h40:
Safety, Security and Sustainability of Outer Space (3SOS)
[EEAS – Space Task Force: speaker to be confirmed]

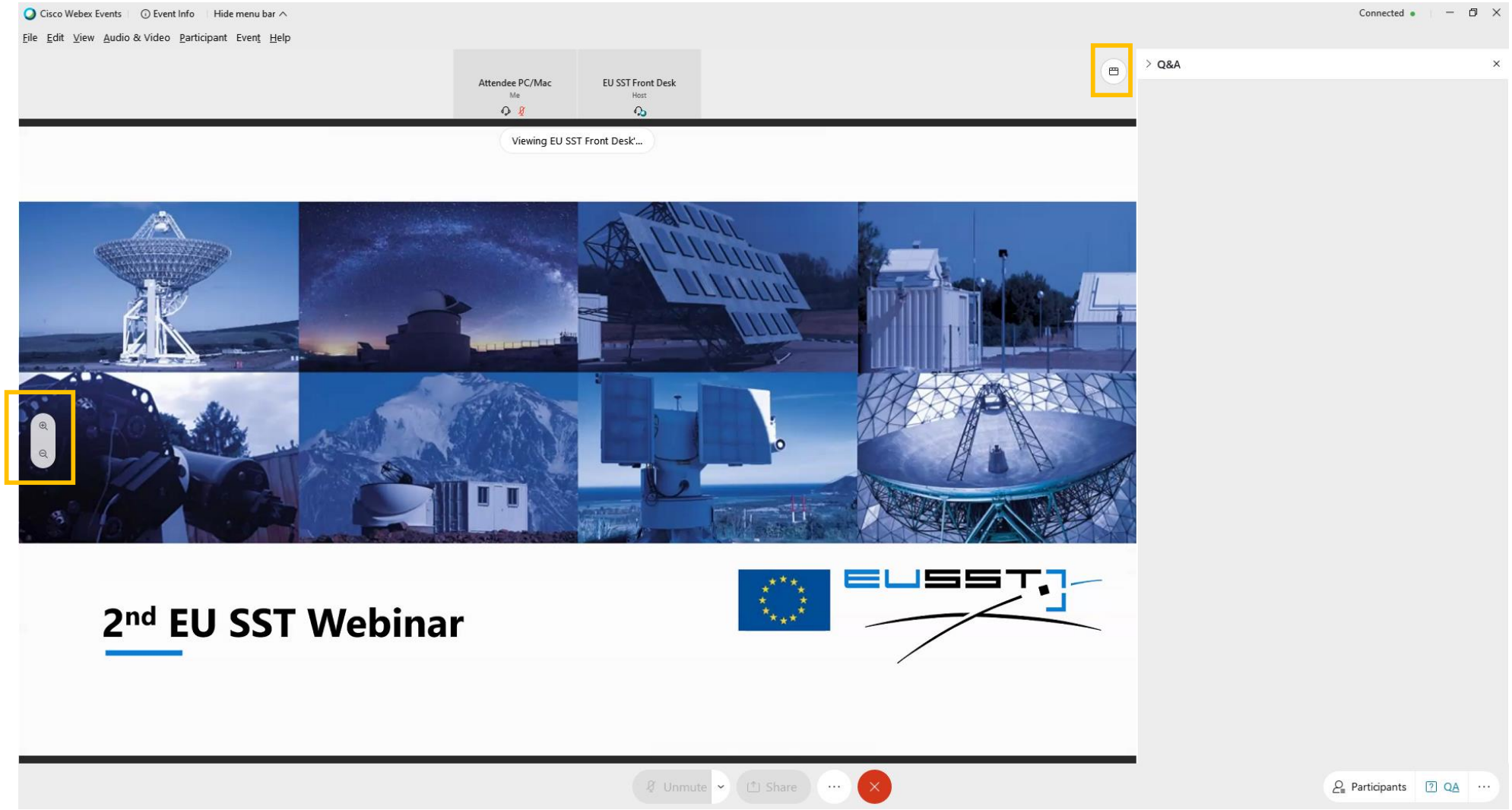
16h40-17h00:
From the SST Support Framework to the SSA component of the Space Regulation
[EC – DG DEFIS: Mr Rodolphe Muñoz]

Platform & Interaction mechanisms

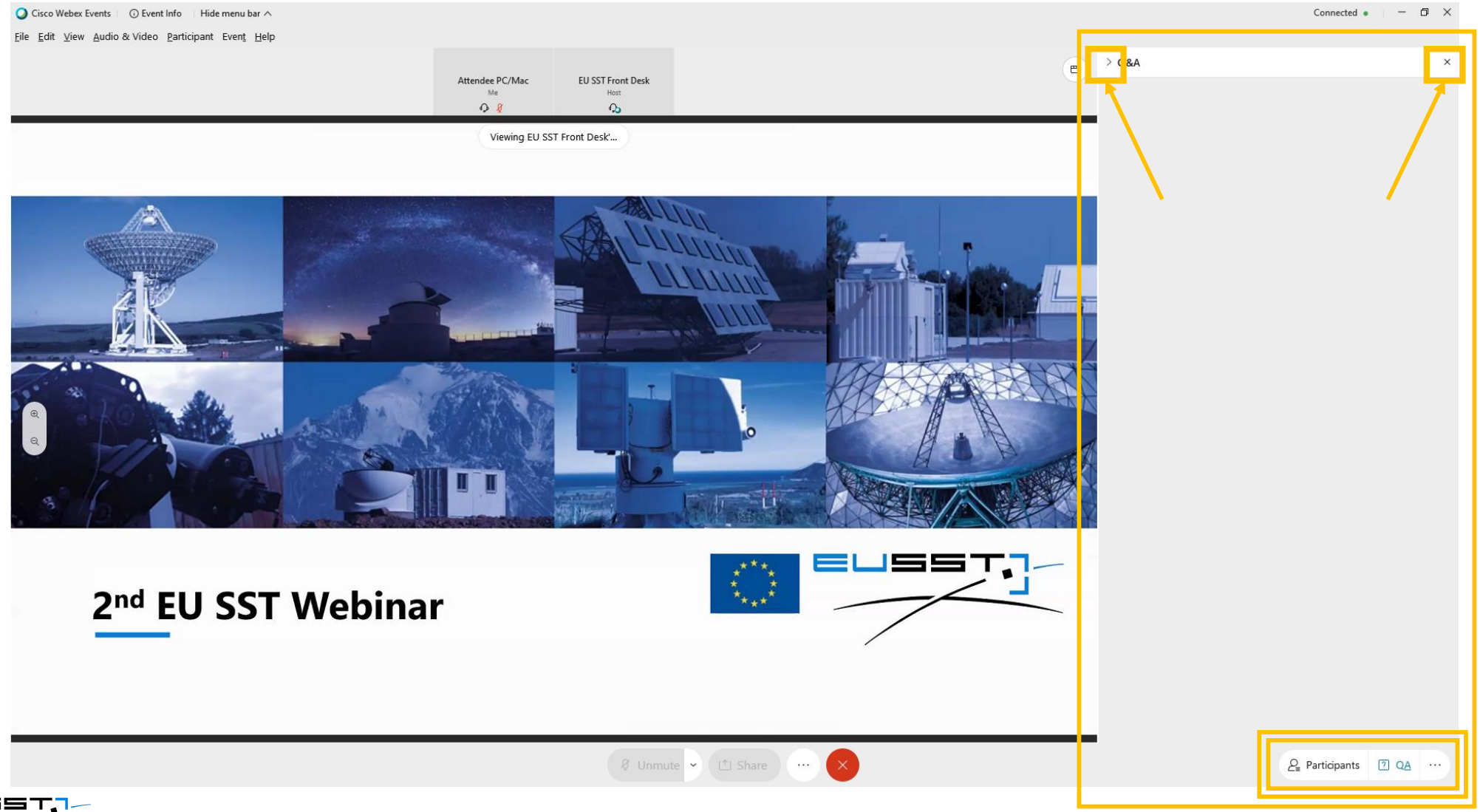
Virtual environment

- Webex Events platform
- Twitter live: **@EU_SST #EUSST #EUSSTWebinar**
- Email: sst.info@satcen.europa.eu

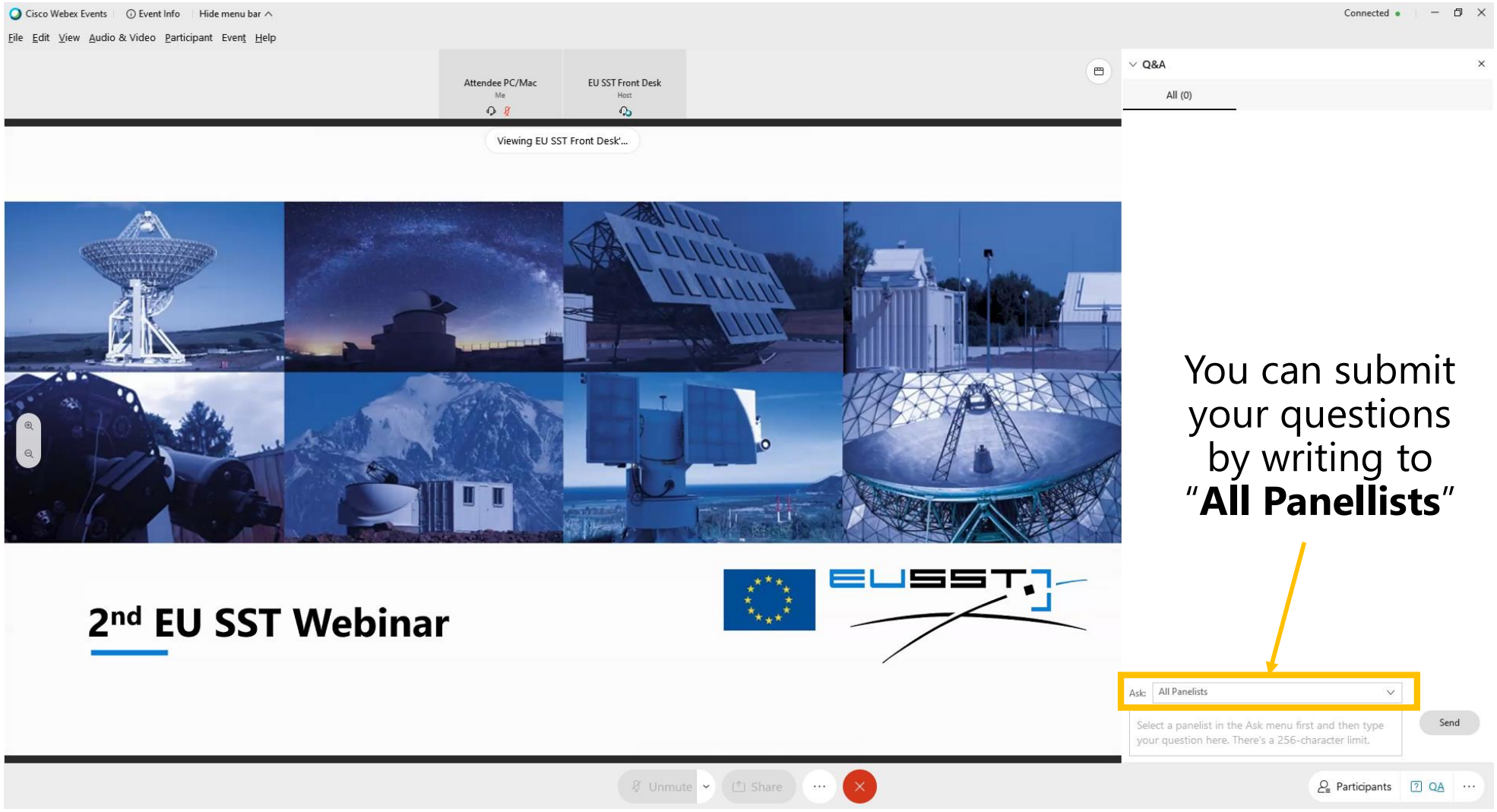
Webex Events: Dashboard setup



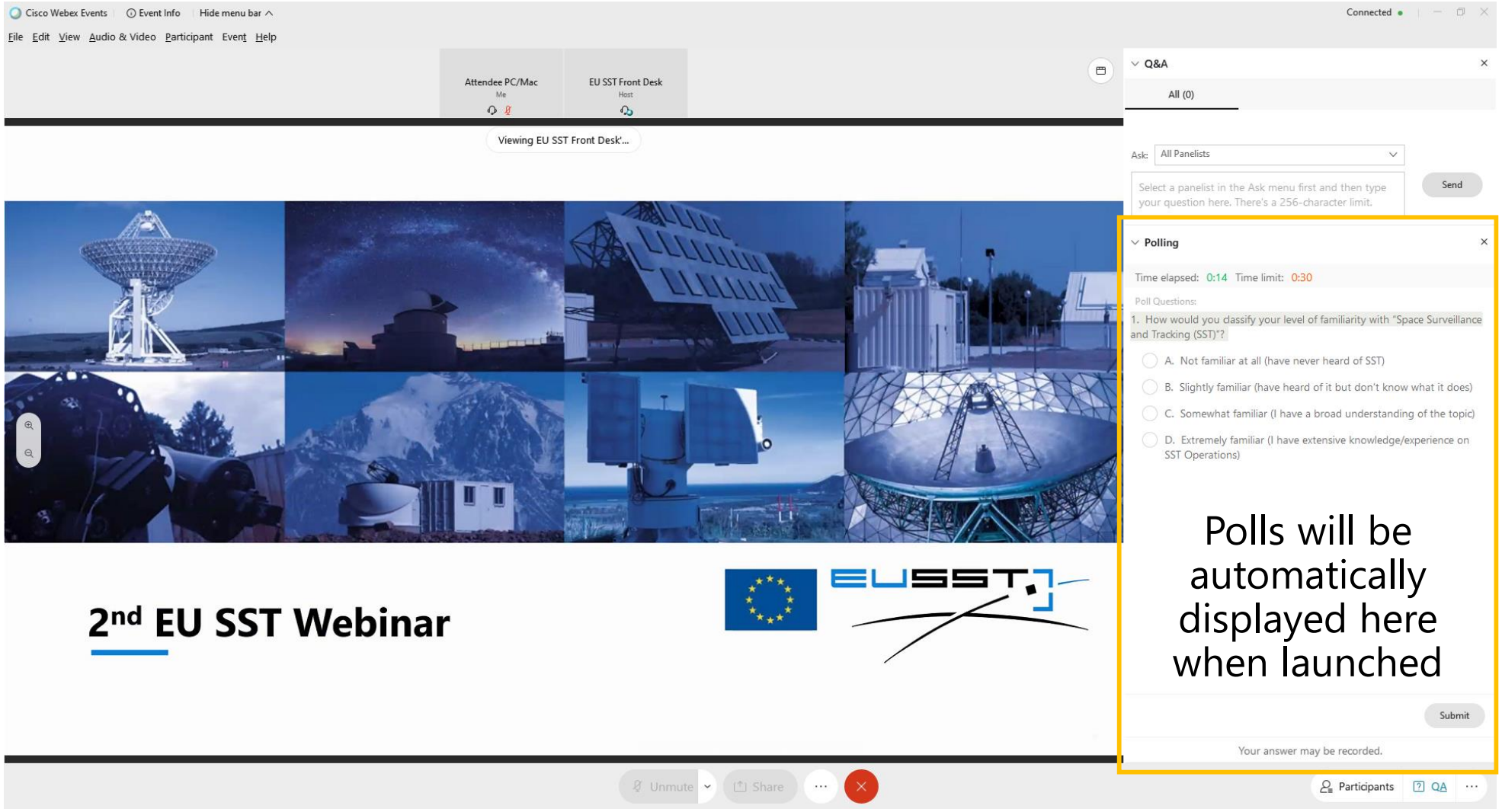
Webex Events: Panels



Webex Events: Q&A



Webex Events: Polling



Q1: How familiar are you with Space Surveillance and Tracking?

European Space Surveillance and Tracking

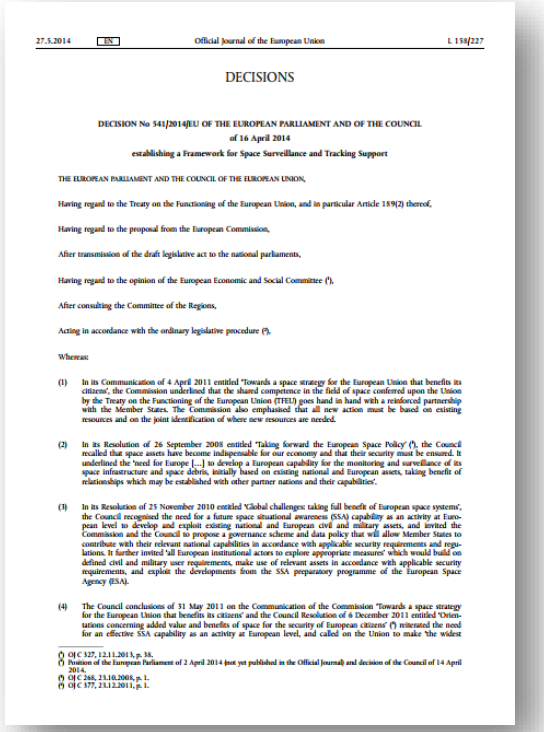
Dr. Pascal Faucher, Chairman EU SST Consortium (CNES)

16th November 2020

SST Support Framework ▪ Outline

- Overview
- Governance
- Security
- Perspectives

What is EU SST?



27.5.2014 EN Official Journal of the European Union L 158/227

DECISIONS

DECISION No 541/2014/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 16 April 2014
establishing a Framework for Space Surveillance and Tracking Support

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty on the Functioning of the European Union, and in particular Article 189(2) thereof,

Having regard to the proposal from the European Commission,

After transmission of the draft legislative act to the national parliaments,

Having regard to the opinion of the European Economic and Social Committee (1),

After consulting the Committee of the Regions,

Acting in accordance with the ordinary legislative procedure (2),

Whereas:

(1) In its Communication of 4 April 2011 entitled 'Towards a space strategy for the European Union that benefits its citizens', the Commission underlined that the shared competence in the field of space conferred upon the Union by the Treaty on the Functioning of the European Union (TFEU) goes hand in hand with a reinforced partnership with the Member States. The Commission also emphasised that all new action must be based on existing resources and on the joint identification of where new resources are needed.

(2) In its Resolution of 26 September 2008 entitled 'Taking forward the European Space Policy' (3), the Council recalled that space assets have become indispensable for our economy and that their security must be ensured. It underlined the 'need for Europe [...] to develop a European capability for the monitoring and surveillance of its space infrastructure and space debris, initially based on existing national and European assets, taking benefit of relationships which may be established with other partner nations and their capabilities'.

(3) In its Resolution of 25 November 2010 entitled 'Global challenges: taking full benefit of European space systems', the Council recognised the need for a future space situational awareness (SSA) capability as an activity at European level to develop and exploit existing national and European civil and military assets, and invited the Commission and the Council to propose a governance scheme and data policy that will allow Member States to contribute with their relevant national capabilities in accordance with applicable security requirements and regulations. It further invited 'all European institutional actors to explore appropriate measures' which would build on defined civil and military user requirements, make use of relevant assets in accordance with applicable security requirements, and exploit the developments from the SSA preparatory programme of the European Space Agency (ESA).

(4) The Council conclusions of 31 May 2011 on the Communication of the Commission 'Towards a space strategy for the European Union that benefits its citizens' and the Council Resolution of 6 December 2011 entitled 'Orientations concerning added value and benefits of space for the security of European citizens' (4) reiterated the need for an effective SSA capability as an activity at European level, and called on the Union to make 'the widest

(1) OJ C 327, 12.11.2013, p. 38.
(2) Position of the European Parliament of 2 April 2014 (not yet published in the Official Journal) and decision of the Council of 14 April 2014.
(3) OJ C 268, 23.10.2008, p. 1.
(4) OJ C 377, 23.12.2011, p. 1.

Decision of the European Parliament and of the Council of 16 April 2014 establishing a Support Framework for Space Surveillance and Tracking (Dec. 541)

Our goals:

- Ensure **resilience of European space infrastructures**
- Higher level of **strategic autonomy**
- Global **SSA** burden-sharing

We:

- are **operational**: sensor network, database, services, users
- perform **research and innovation** activities to improve the level of performance: upgrades of sensors, architecture studies, etc.
- are **security** relevant: security and data sharing
- mature and expand: **upcoming EU Space Programme**

Governance ▪ Consortium

EU SST Consortium:

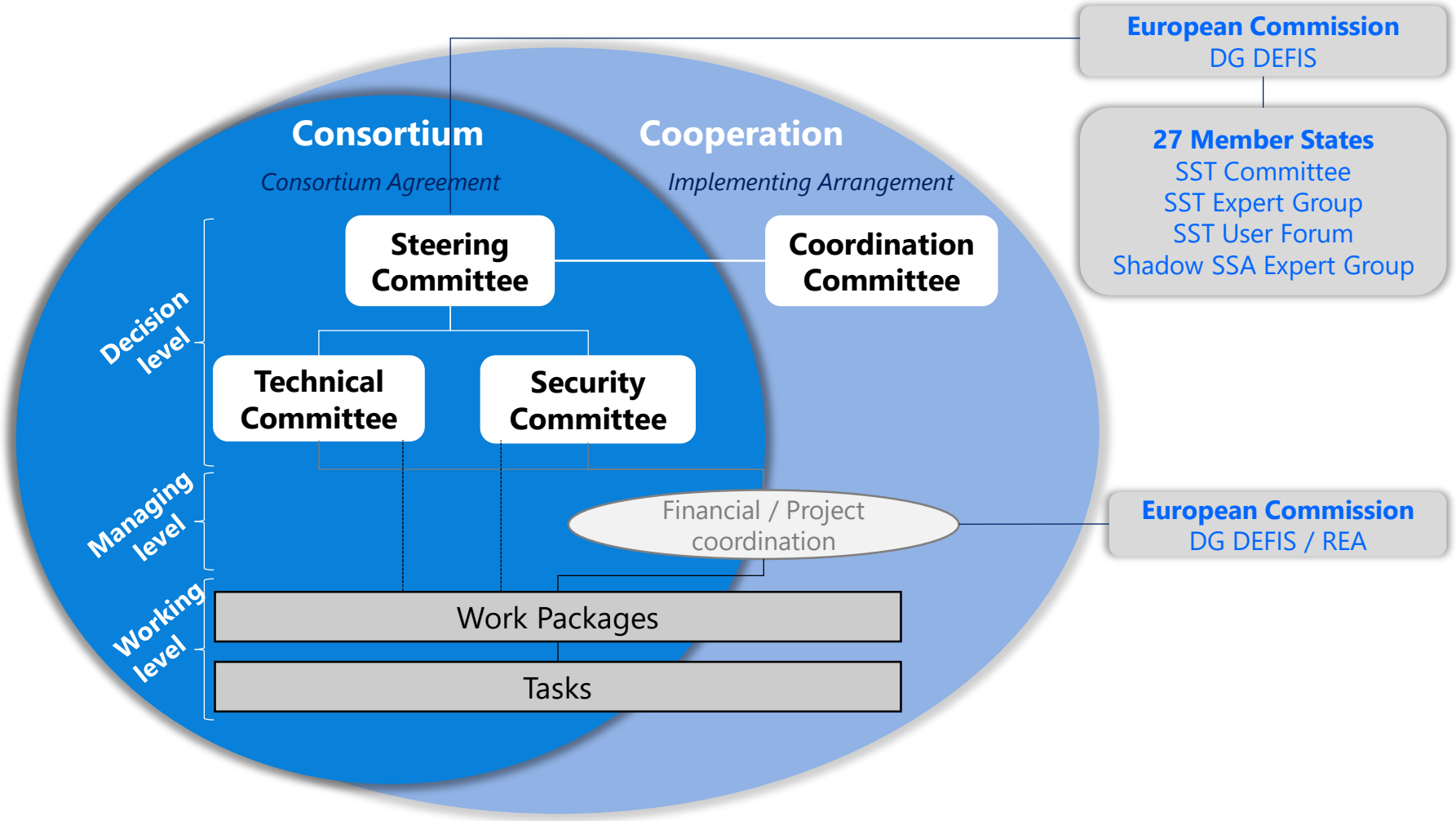
7 EU Member States

- France, Germany, Italy, Spain, Poland, Portugal, Romania

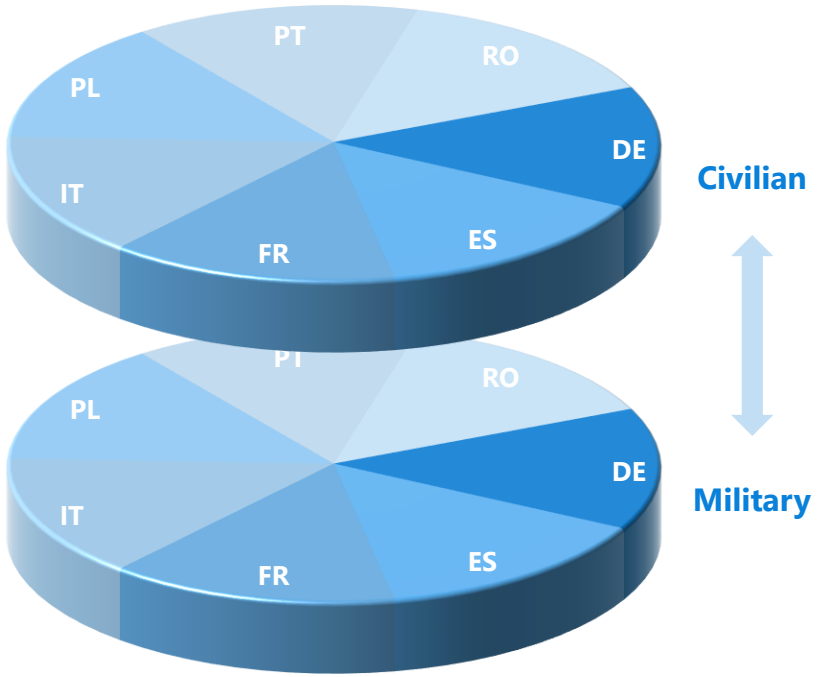
Cooperation with **EU SatCen** as Front Desk

Overseen by **European Commission**

Governance ▪ Consortium



Governance ▪ Security



- **Dual dimension** of SSA
- **Collaboration** between civilian, military and security actors
- Contributing **sensors remain under control of Member States**
- Precise information on the nature, specifications and location of certain space objects **may affect the security** of the EU, its Member States, or Third Countries

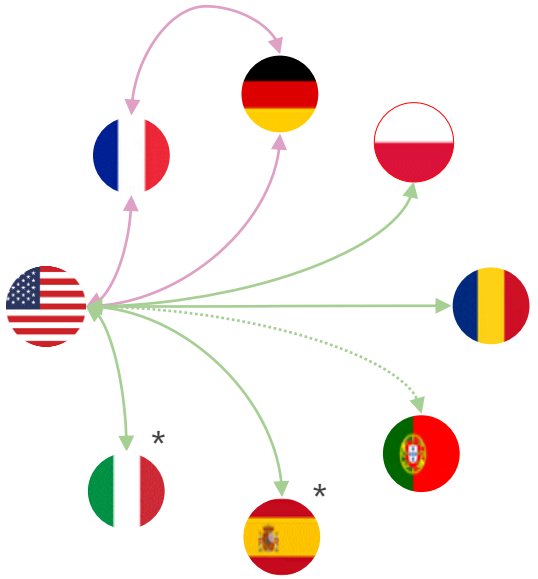
Security and Data Policy

- The Member States of the Consortium created a **Security Committee** that oversees all matters relating to data security and operational risk, and includes, inter alia, representatives from the ministries of defense and national security agencies

- In the absence of a comprehensive set of SSA data sharing agreements in Europe, **EU SST deals with the security interests of the respective partners and their allies** through an internal Data Policy

- The EU SST Security Committee provides classification guidance and develops security requirements that cover for instance how EU SST protects sensitive information such as data on allied space objects

Need to consider the existing architecture of bilateral SSA sharing agreements in Europe:



Classified & unclassified SSA and SST data

Unclassified SSA and SST data

* IT and ES are working on the MoD-DoD channel to update the current SSA data sharing agreement at classified level.

Perspective ▪ EU Space Programme

Following EU Space Strategy (2016), legislative proposal for an **EU space programme 2021-2027** (2018), agreed by Council and European Parliament (2019)

All EU activities in one programme:

- Galileo/EGNOS
- Copernicus
- **SSA (SST plus SWE, NEO)**
- GovSatCom

EU SST as…

- Working example of **multilateral cooperation** at the intersection of space safety and space security - **New SST partnership under construction with 16 EU MS**
- Important **R&D** activity to improve **performance** and **strategic autonomy** at European level
- New possible **services** to ensure the safety and sustainability of space operations
- Fundamental **operational** capability in Europe "…precursor of a **European Space Traffic Management system**" - Commissioner Thierry Breton*

*Closing Speech at the 12th Annual Space Conference on 22 January 2019


EUSST

European Space Surveillance and Tracking

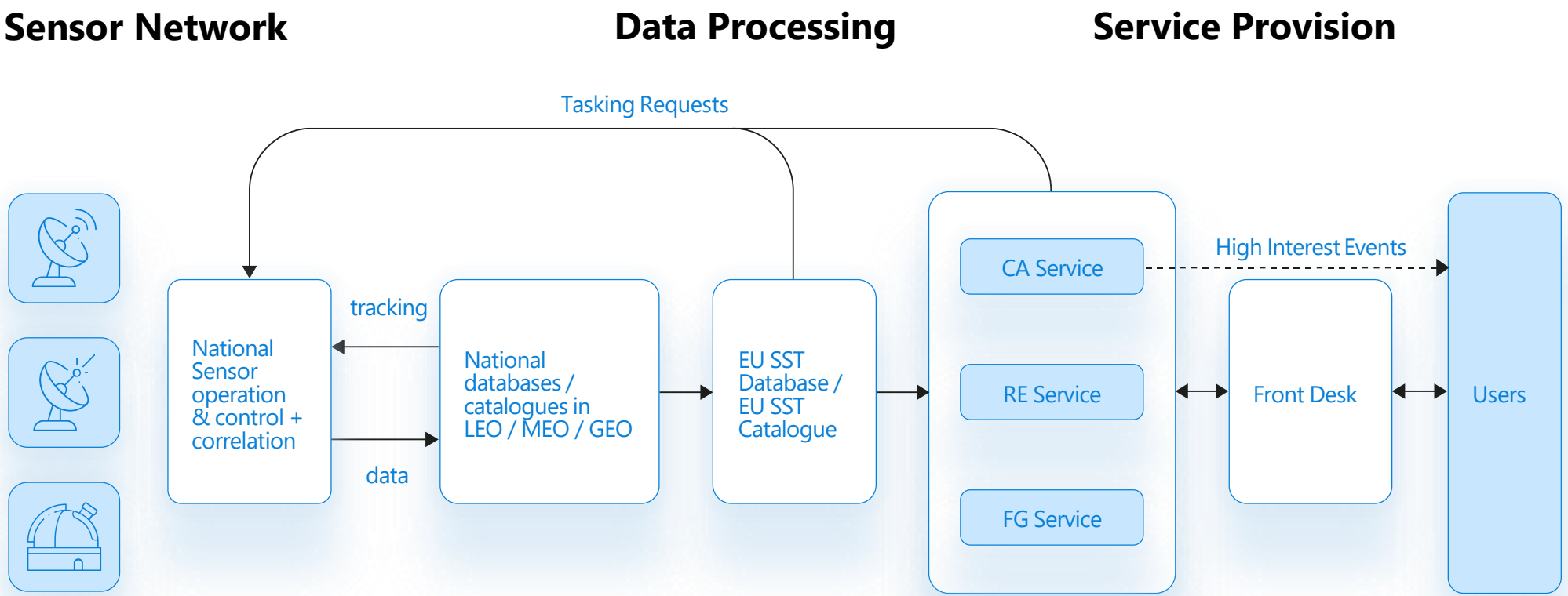
María Antonia Ramos Prada, Chair of the SST Technical Committee (CDTI)

16th November 2020

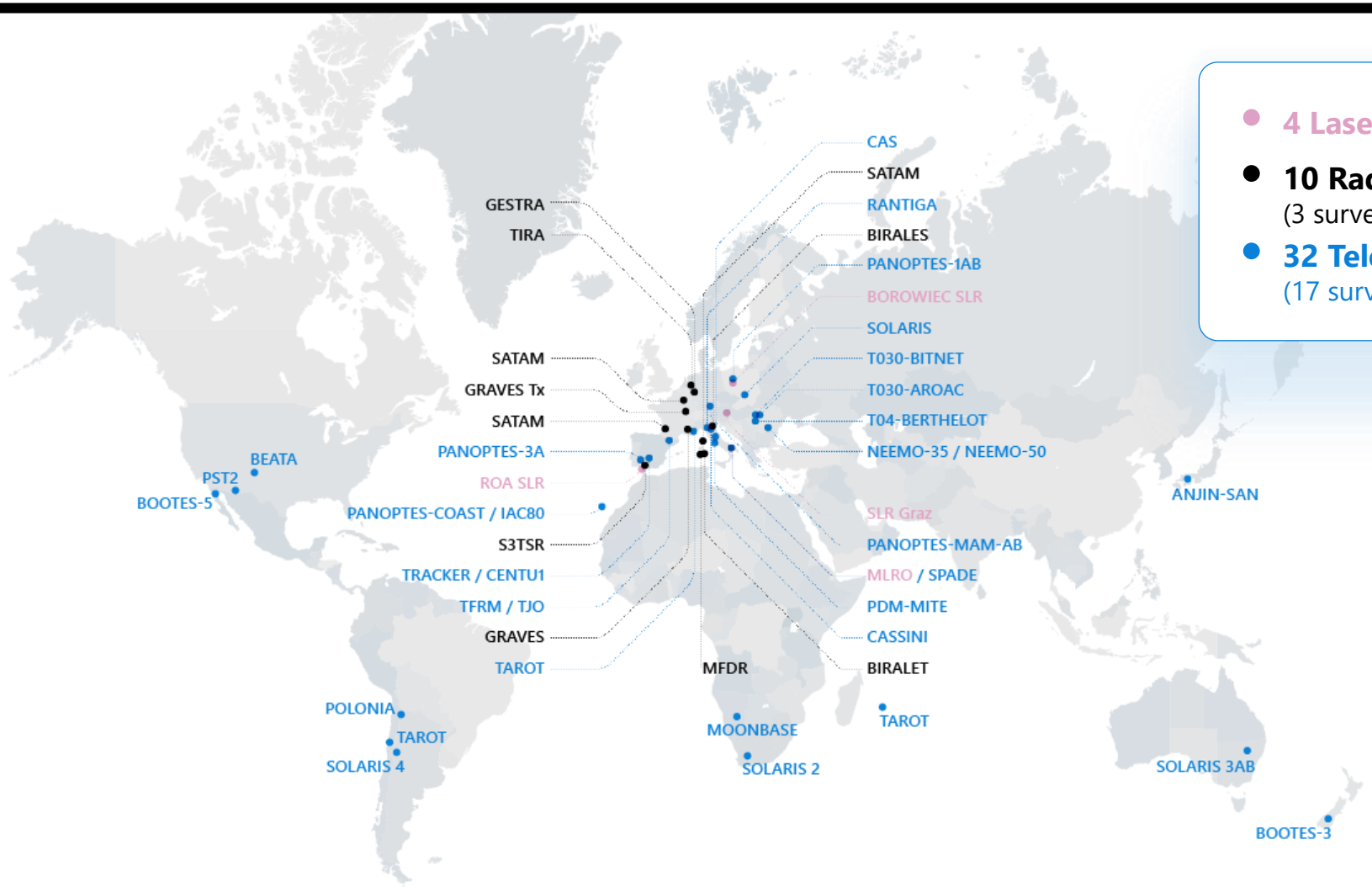
Architecture & Service Provision Model ▪ Outline

- Service Provision model
- Sensors network
- Database and Catalogue
- Service Provision
- KPIs Overview

Service Provision Model



Sensors Network



- 4 Lasers
- **10 Radars**
  (3 surveillance, 7 tracking)
- **32 Telescopes**
  (17 surveillance, 15 tracking)

Database and Catalogue

EU SST Database

Measurement Data

Joint platform for efficient data sharing and tasking requests

Operational since 1st April 2019

Database as starting point for catalogue building and maintenance

EU SST Catalogue Precursor

Measurement data from the Database will be pre-processed, analysed, and correlated

Correlated measurements will be used to determine and refine the orbit of objects

Initial development & operation from 2019 to Dec. 2021

Measurements from MS sensors

MS Operations Centres will use the EU SST Catalogue

Service provision ▪ 3 Operational Services

	Collision Avoidance (CA) **Risk assessment of collision and generation of collision avoidance alerts**	Fragmentation Analysis (FG) **Detection and characterisation of in-orbit fragmentations**	Re-entry Analysis (RE) **Risk assessment of space objects re-entry into the Earth's atmosphere**
Key features	▪ User-tailored service (SCD) ▪ Hot redundancy scheme involving ES (S3TOC) and FR (COO) with harmonised service level and single service provider per registered user ▪ Enhanced Analysis & Risk Mitigation support (e.g. covariance estimations, HBR estimations, PoC sensitivity analysis, CAM support)	▪ Short-term notification to confirm quickly an FG event ▪ Medium-term FG analysis based on the orbital parameters of the catalogued fragments e.g. Gabbard Diagram ▪ Long-term FG analysis (with simulations with breakup model)	▪ Long-term (within 30 days) re-entry predictions ▪ Short-term (a few days) overflight predictions with ground tracks over customizable areas of interest
Products	▪ Autonomous and enhanced CDMs ▪ CA Reports ▪ Monthly reports	▪ Short-term notification ▪ Medium-term report ▪ Long-term report ▪ Technical notes	▪ 30 days list ▪ RE reports ▪ Technical notes
Portal	▪ Download and upload information (API and web interface) ▪ Access documentation and configure notifications alerts. ▪ View evolution of key parameters e.g. PoC	▪ Download information (API and web interface) ▪ Access technical notes and dedicated content (e.g. fragments video)	▪ Download information (API and web interface) ▪ Configure notifications ▪ View evolution of re-entry window

Service provision ▪ SST Front Desk & User interaction

SST Consortium

Responsible for generating the SST services and their information

SST Front Desk

Interface for the delivery of the SST services in accordance with the Data and Information Policy

SST Portal
Delivery of the SST information and services

SST Helpdesk
User support

User Interaction
User needs, feedback and uptake

SatCen

SST Users

SST services to be provided to*:

- All Member States;
- the Council;
- the Commission;
- the EEAS;
- European public and private spacecraft owners and operators, and
- European public authorities concerned with civil protection.

* Draft of future Space Regulation (next MFF) proposes services to be open also to non-EU users

Service provision ▪ Users

+90 ORGS
20 EU MS

Collision Avoidance
+25 ORGS

+140 Satellites

Fragmentation Analysis
+65 ORGS

Re-entry Analysis
+70 ORGS

Service provision ▪ Satellites registered for CA

147
Satellites

LEO

46

BIROS

SAR-LUPE 1, 2, 3, 4, 5

TET-1

TANDEM-X

TERRASAR-X

REAKTOR HW

DEIMOS 1, 2

METOP A, B, C

SENTINEL 1A, 1B, 2A, 2B, 3A, 3B, 5P

PAZ

UPMSat-2

ION-mk01 Lucas

CALIPSO

ELISA E12, E24, W11, W23

HELIOS 2A, 2B

JASON 3

PLEIADES 1A, 1B

SMOS

VENμS

BRITE PL-1,PL-2

CSO-1

EYESAT

ANGELS

FALCON EYE 2

ELO3

CHEOPS

TARANIS

MEO

30

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

O3B FM 15, 16, 14, 13

GEO

71

COMSATBW-1, 2

SICRAL 1, 1B, 2

XTAR-EUR

METEOSAT-8, 9, 10, 11

SPAINSAT

SES 4, 5

HYLAS 1, 2, 4

ATHENA-FIDUS

SYRACUSE 3A, 3B

HELLAS-SAT 2, 3, 4

INMARSAT 3F1, 3F2, 3F3, 3F5, 4F1, 4F2, 4F3, AF1, 5F1, 5F2, 5F3, 5F4, GX5

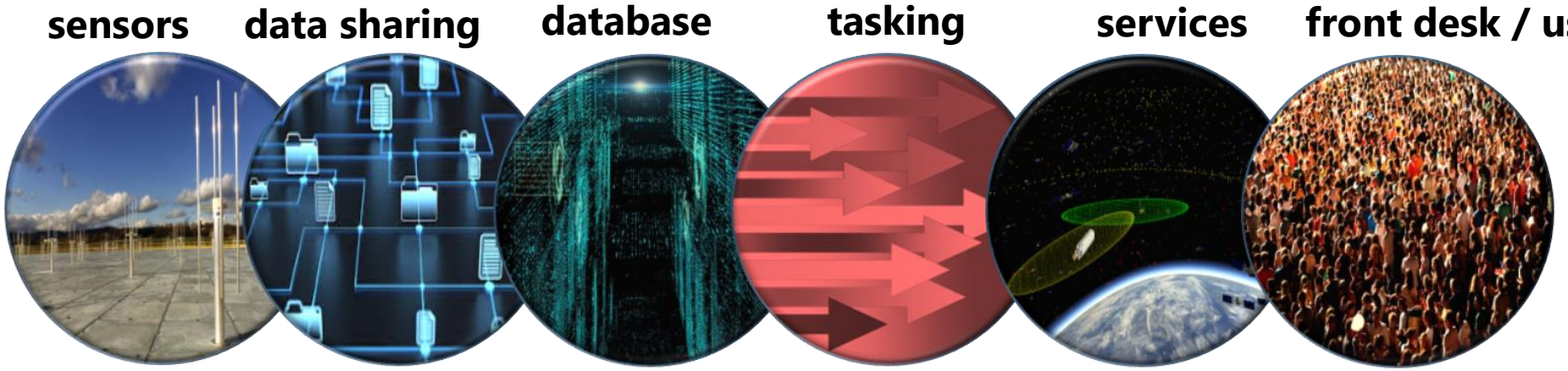
EUTELSAT 10A, 16A, 172A, 21B, 25B, 28A, 28B, 36A, 36B, 3B, 5WA, 65W, 7WA, 70B, 7A, 7B, 8WB, 9A, 9B, HB 13B, 13C, 13D,

KASAT 9A, 12WB, 172B, 7C,5 WEST B

ANASIS II

AMAZONAS 2, 3, 5, HISPASAT 30W-5, 30W-6, 36W-1, 74W-1, 143W-1

Key Perfomance Indicators Overview



Sensors & Calibration Campaigns (CC)	Number of sensors
	Declared & Real dedication
	Robustness to operate
	Sensors in CC
	Sensors sharing data in CC
	Sensors CC compliance
	Bias & Drift bias
	Noise of measurements
	Sensors with outlier data

Database	Space objects population
	Orbit regimes coverage
	Database availability

Data Sharing	Declared & Effective data sharing frequency
	Number of measurements
	Measurements rate
	Number of tracks
	Mean track duration
	Track noise
	Timeliness
	Measurements/tracks
	Number of orbits
	Number of distinct objects
	Number of distinct objects per hour
	Number of unique sourced objects per hour
	Revisiting time

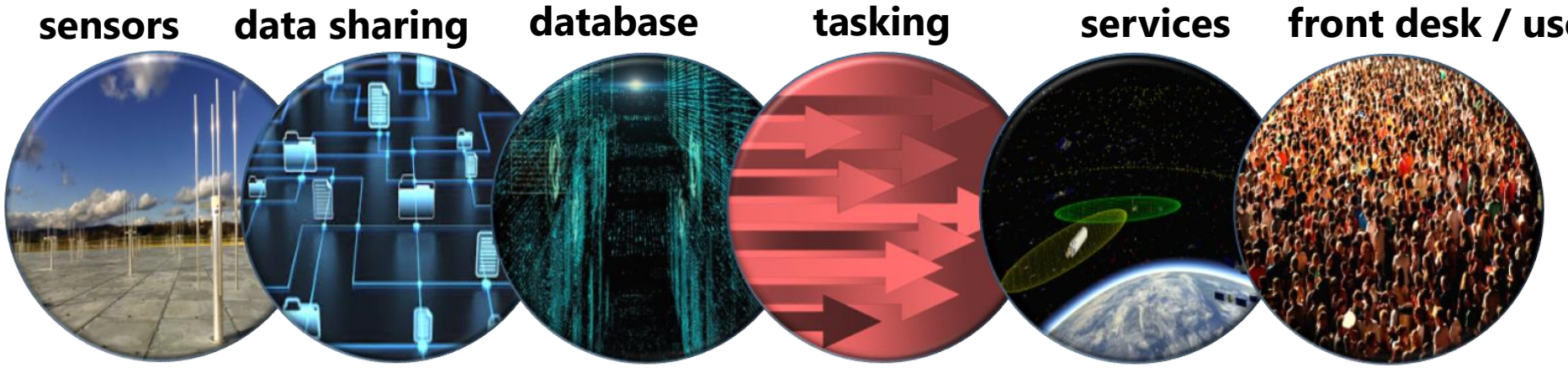
Tracking Requests	Number of tasking requests
	Tasking responses by types
	Successful tasking requests
	Tasking requests resolution time
	Responsiveness to tasking requests

Service Provision	Number of events reported
	Autonomous events
	Number of products
	Autonomous products
	Service specific requests
	Resolution time for service specific requests
	Products format deviations
	CA service configuration compliance
	Sensors service contribution
	Sensors contribution to autonomous products

Front Desk	Number of support requests
	Number of incidents
	Resolution time for support requests
	Resolution time for incidents
	Access to information
	Portal availability

Users	Potential users
	User uptake
	Number of new users
	Users accessing the Portal
	Number of user's uploads
	Number of approved spacecraft

Key Perfomance Indicators Overview



+7.7M measurements
+400.000 tracks
+1.1M TLEs

Apr-2019 – Mar-2020

~14.000 events reported
+16.000 autonomous products delivered

Jan-Sept 2020

Q&A session

Q2: How often would you say satellites are involved in potential collision events?

EU SST
Operational Collision Avoidance service

ES and FR Operations Centres: Ms Cristina Pérez (CDTI) and Mr Florian Delmas (CNES)

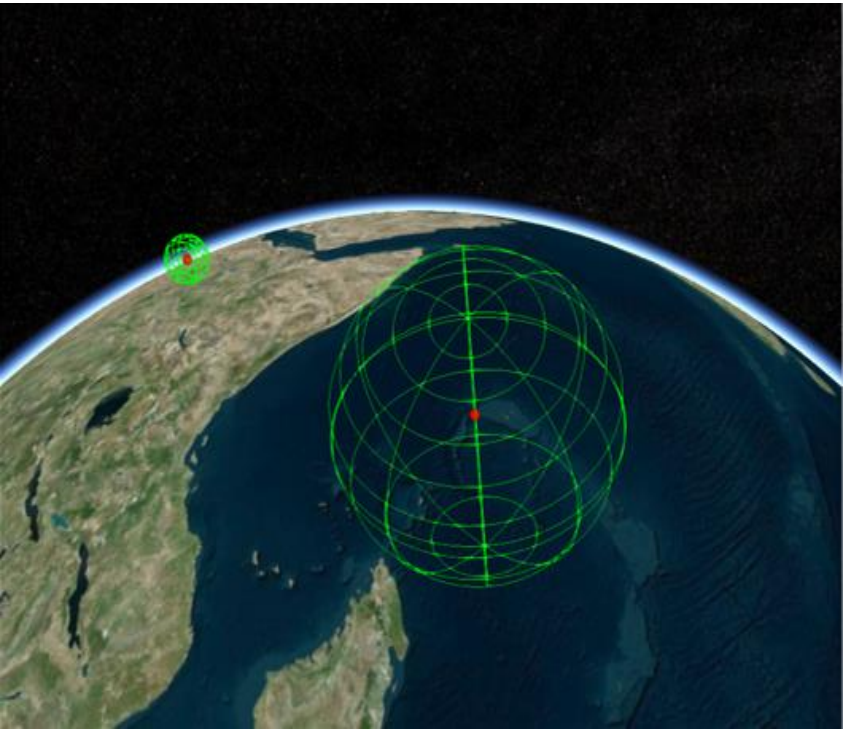
SST Front Desk: Mr João Alves (EU SatCen)

16th November 2020

Collision Avoidance Service ▪ Outline

- CA Service Overview
- Key features and products
- Operational flow
- Events
- Portal, metrics and Users

Collision Avoidance Service ▪ Overview



The Collision Avoidance (CA) service:

- Provides **risk assessment of collision between spacecraft and between spacecraft and space debris**, and generates collision avoidance alerts.
- It **analyses all available information** (e.g. EU SST contributing sensors data, external Conjunction Data Messages – CDMs) in order to detect close approaches with different levels of risk.
- **User-tailored service**, allowing the user to configure the thresholds for risk-level categorisation and advice on Collision Avoidance Manoeuvres - CAMs, based on geometrical, probabilistic and time variables.
- **Hot redundancy scheme,** involving the French and Spanish OCs (COO and S3TOC), whereby two different OCs are ready to provide the services as a single service provider (the nominal OC). The **hot-redundant work simultaneously with the nominal OC** (though without contact with the O/O), seeing O/O inputs, nominal OC products and direct dialogue. Takes the lead only in case of nominal OC failover.

Collision Avoidance Service ▪ Overview

Different close approaches are detected:

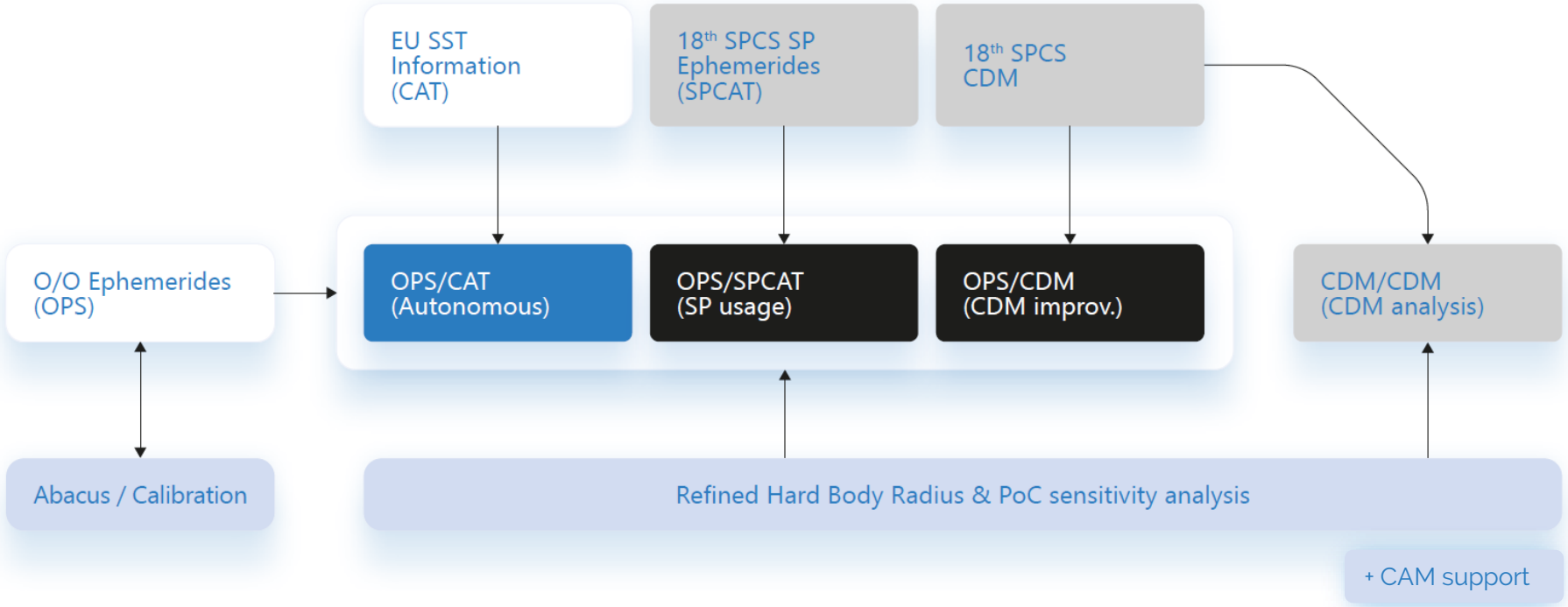
Info Events (INFOs): close approaches with a low level of risk;

Interest Events (IEs): close approaches that require further analysis due to the level of risk, and

High-Interest Events (HIEs): close approaches with a high level of risk, potentially requiring Collision Avoidance Manoeuvres (CAMs) to be performed by the Owner/Operator (O/O).

When HIEs are detected, tasking requests are sent to all sensors contributing to EU SST. Finally, a set of products are provided to the O/O. In case of need, direct dialogue can be established with the OC, **24/7**, to help the O/O to better understand the event, discuss the products provided and enable the OC to propose CAMs based on the O/O constraints.

Collision Avoidance Service ▪ Key features

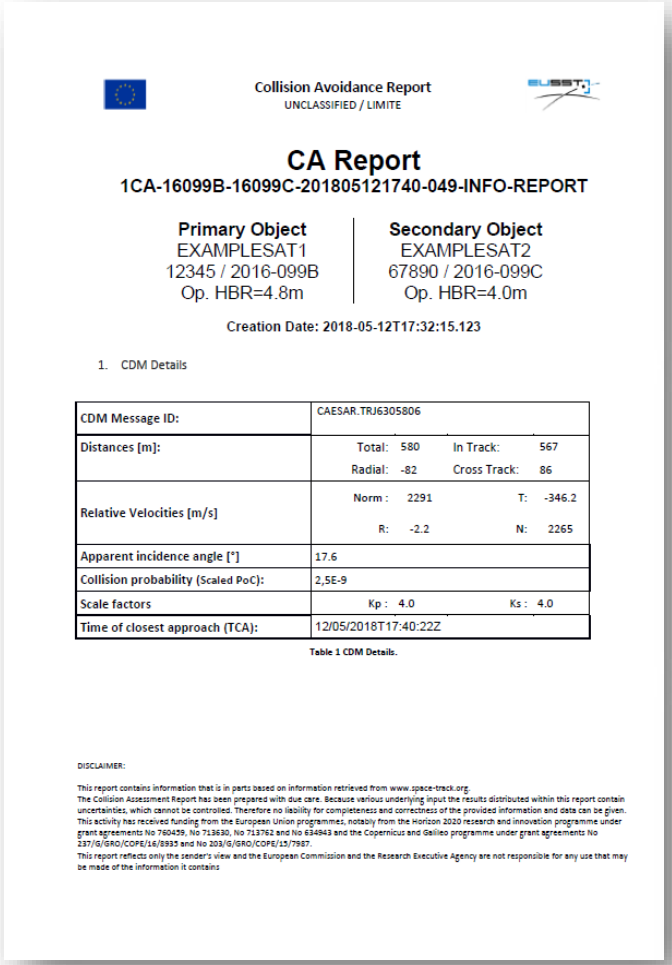


Collision Avoidance Service ▪ Products

- **CDM:** standard message exchanging spacecraft conjunction information between OCs and satellite O/Os. The source of orbit information is included.

- **Collision Avoidance Report:** complements each CDM delivered, containing a detailed analysis of the event with supporting information; e.g. risk level, scaled PoC, and different plots such as conjunction plane and risk evolution.

- **Monthly reports**: provide summary information to each O/O on all the close approaches analysed.



Collision Avoidance Report
UNCLASSIFIED / LIMITE

CA Report
1CA-16099B-16099C-201805121740-049-INFO-REPORT

Primary Object	Secondary Object
EXAMPLESAT1	EXAMPLESAT2
12345 / 2016-099B	67890 / 2016-099C
Op. HBR=4.8m	Op. HBR=4.0m

Creation Date: 2018-05-12T17:32:15.123

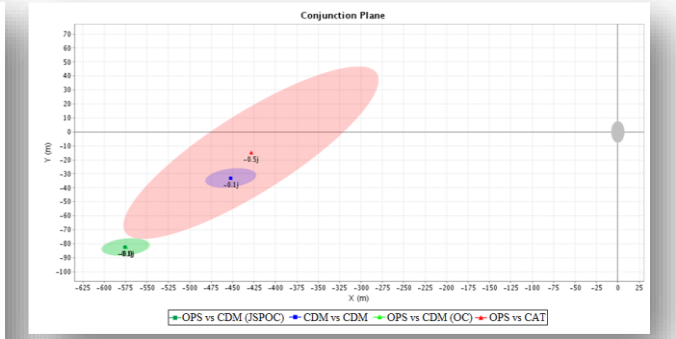
1. CDM Details

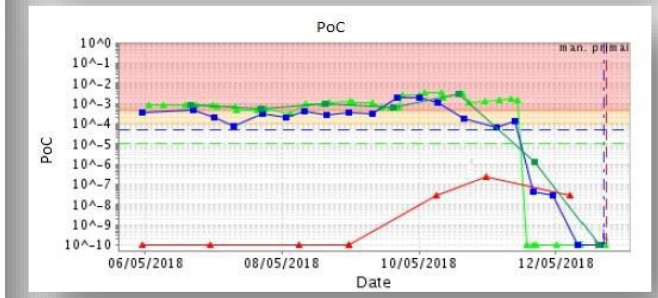
CDM Message ID:	CAESAR.TRJ6305806
Distances [m]:	Total: 580 In Track: 567 Radial: -82 Cross Track: 86
Relative Velocities [m/s]	Norm : 2291 T: -346.2 R: -2.2 N: 2265
Apparent incidence angle [°]	17.6
Collision probability (Scaled PoC):	2,5E-9
Scale factors	Kp : 4.0 Ks : 4.0
Time of closest approach (TCA):	12/05/2018T17:40:22Z

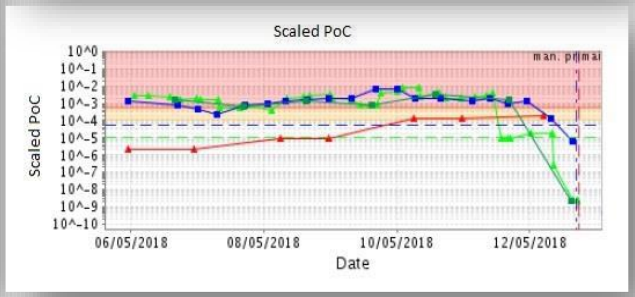
Table 1 CDM Details.

DISCLAIMER:

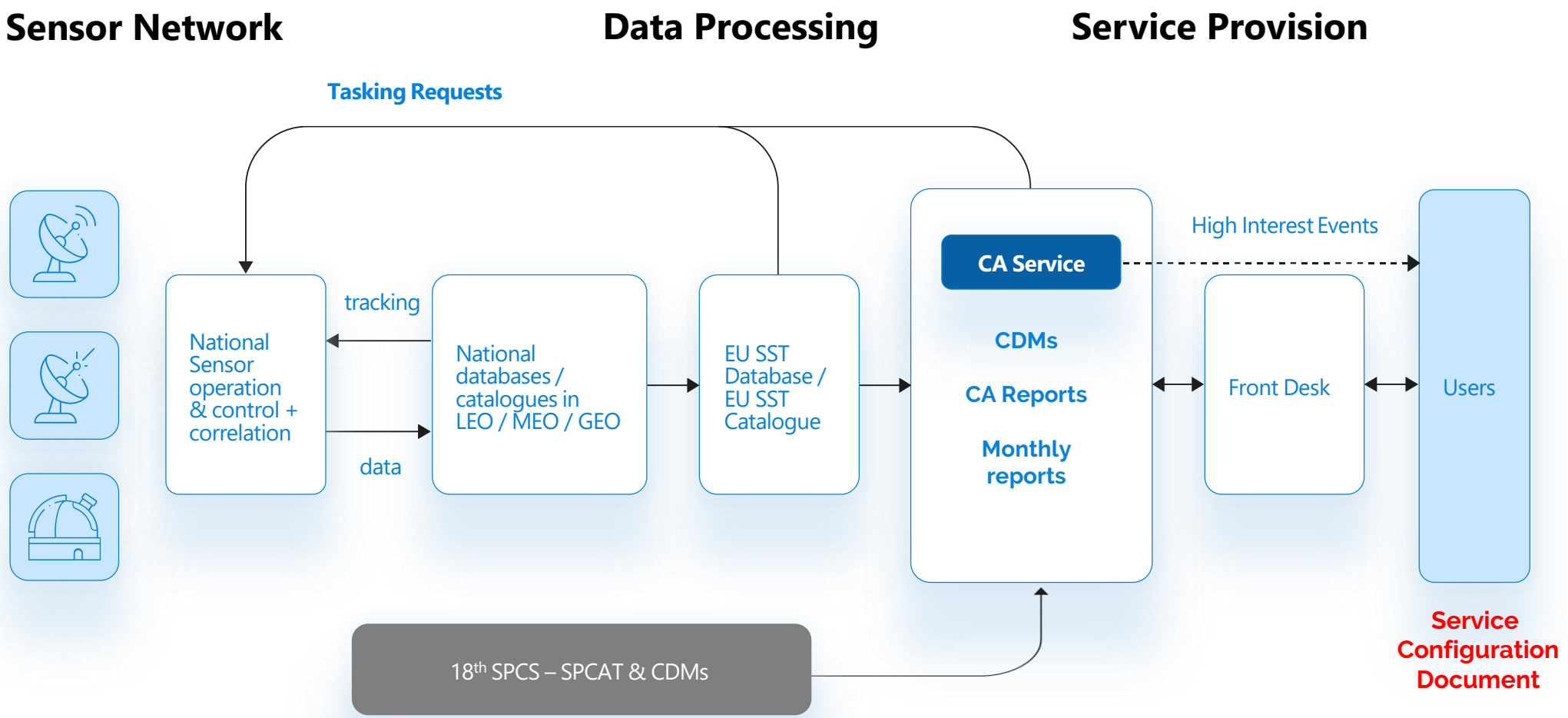
This report contains information that is in parts based on information retrieved from www.space-track.org.
The Collision Assessment Report has been prepared with due care. Because various underlying input the results distributed within this report contain uncertainties, which cannot be controlled. Therefore no liability for completeness and correctness of the provided information and data can be given.
This activity has received funding from the European Union programmes, notably from the Horizon 2020 research and innovation programme under grant agreements No 760459, No 713630, No 713762 and No 634943 and the Copernicus and Galileo programme under grant agreements No 237/G/GRO/COPE/16/8993 and No 203/G/GRO/COPE/15/7987.
This report reflects only the sender's view and the European Commission and the Research Executive Agency are not responsible for any use that may be made of the information it contains







Collision Avoidance Service ▪ Operational Flow



For EU SST CA Users!

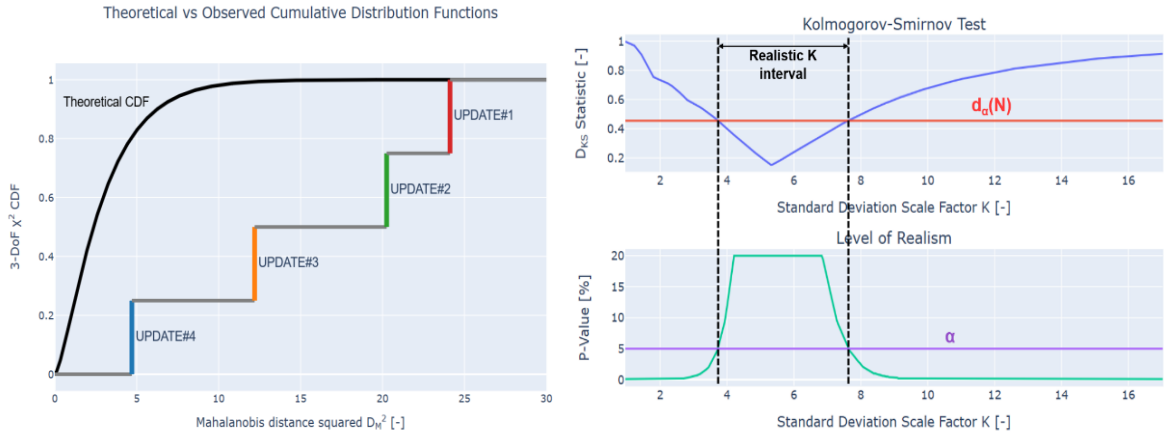
Collision Avoidance Service ▪ News!

Last update of Space-Track Handbook for operators

Table 6: Advanced Reporting Criteria

	Space-Track Criteria	Emergency Criteria	Emergency Phone Call Criteria
Notification Method	**Conjunction Data Message (CDM)**	**Conjunction Data Message (CDM) & Close Approach Notification (CAN) email**	**CDM, CAN email & phone call**
Deep Space HAC	TCA ≤ 10 days & all results w/in 5km x 5km x 5km	TCA ≤ 3 days & Overall miss ≤ 5km	TCA ≤ 3 days & Overall miss ≤ 500 m
Deep Space O/O Ephemeris	TCA ≤ 10 days & all results w/in 20km x 20km x 20km	TCA ≤ 3 days & Overall miss ≤ 5km	N/A
Near Earth (LEO 1-4) HAC	TCA ≤ 5 days & Probability of Collision ≥ e^-7 w/in HAC screening volumes	TCA ≤ 3 days & Overall miss ≤ 1km & Probability of Collision ≥ e^-4	TCA ≤ 3 days & Overall miss ≤ 1km & Probability of Collision ≥ e^-2
Near Earth (LEO 1-4) O/O Ephemeris	TCA ≤ 7 days & all results w/in 2km x 25km x 25km	TCA ≤ 3 days and Overall miss ≤ 1km & Probability of Collision ≥ e^-4	N/A

Automatic detection of Scaled PoC Factors intervals



Consequences:

-**Less CDMs received than before**

-Ephemeris have to be shared if possible to ensure all relevant CDM are received.

→ For users unable to share them, OCs will perform a screening against the SP catalogue to ensure that **no risk is missed**.

Detection of IE and HIE is based on Scaled PoC and geometry.

-Intervals of Scales factors are [0,25 ; 4] by default for both objects

-In order to provide the **best assessment of the situation**, these intervals have to be shrunk in order to provide the Scaled PoC which is the most representative of the situation.

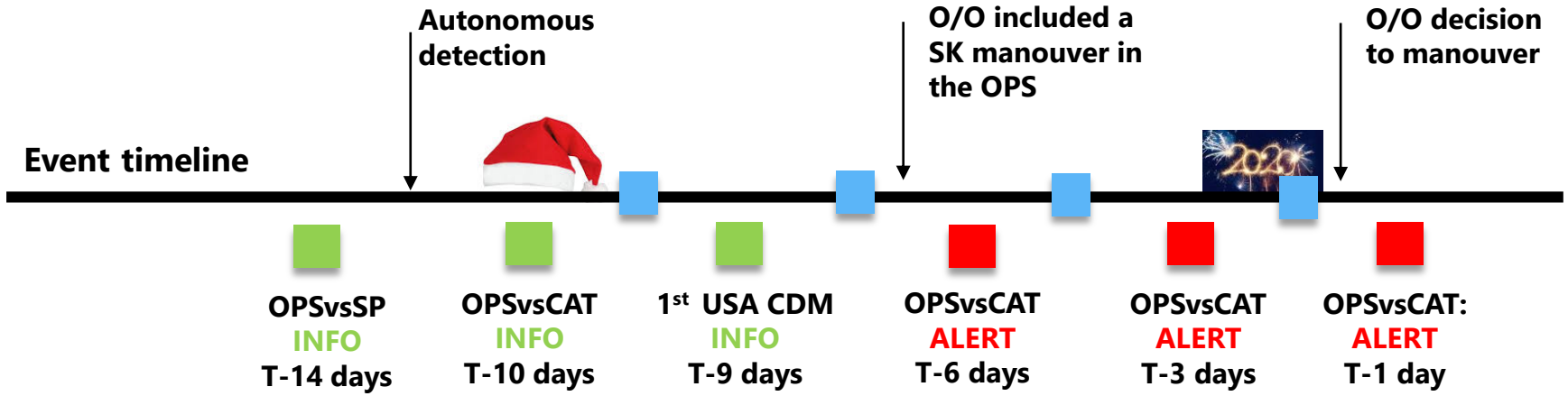
-**Tools are in place to automatically compute them**

Collision Avoidance Service ▪ Events – GEO

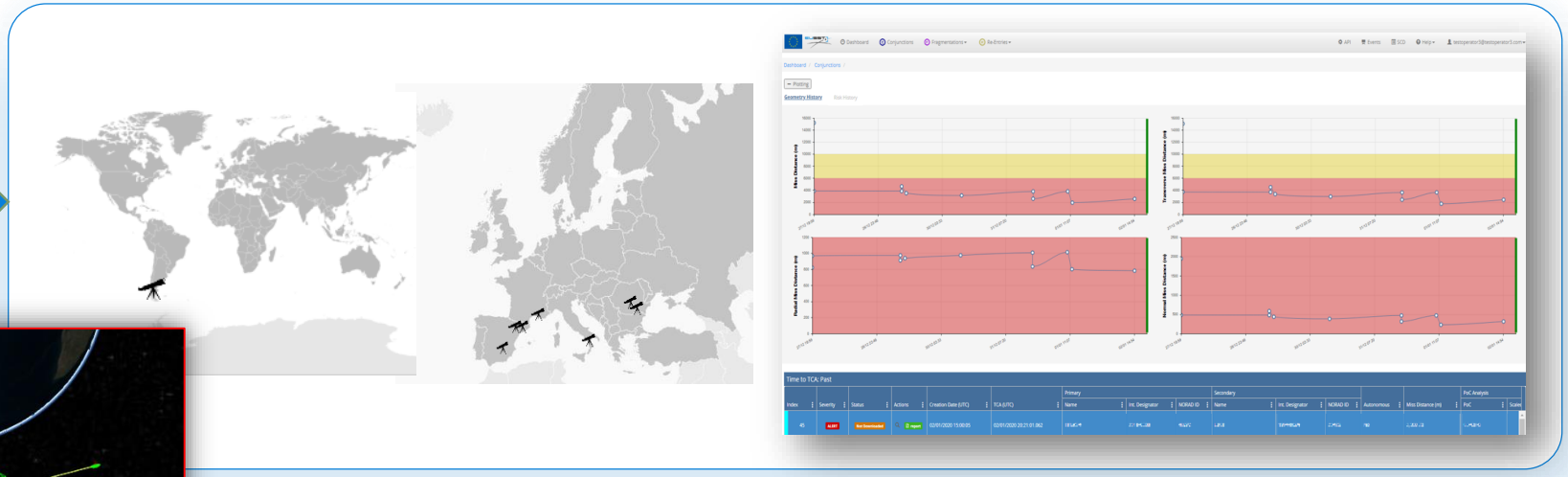
HIE when SK man plan

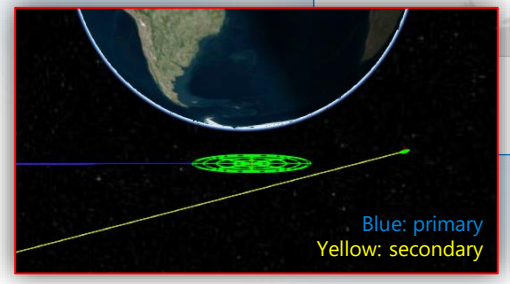
GEO SAT vs GEO Large DEB

MD=2.56km
RD=0.78Km
Very low Scaled PoC



O/O is the sole responsible for deciding whether or not to implement an avoidance action





Collision Avoidance Service ▪ Events – MEO

IE with autonomous products

MEO SAT vs R/B

Eccentric GTO:
35510 apo x 2902 peri

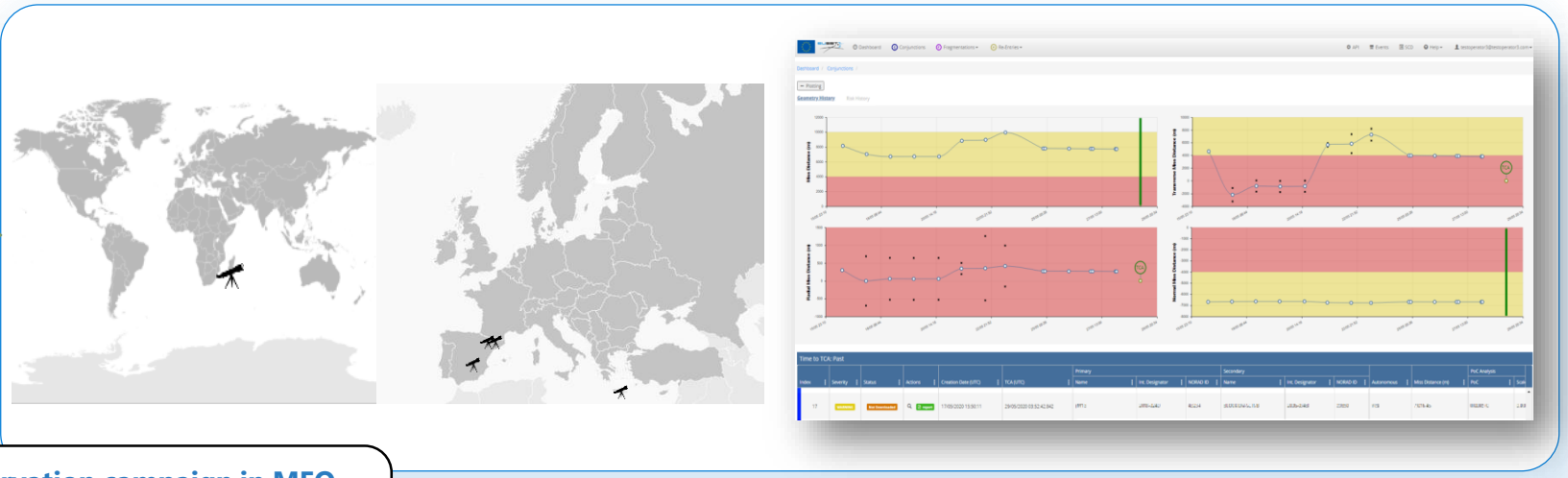
Data usage from the EU SST contributing sensors

Event timeline

OPSvsSP	OPSvsCAT	OPSvsCAT	OPSvsCAT	OPSvsCAT	OPSvsCDM
IE	IE	IE	IE	IE	INFO
WARNING	WARNING	WARNING	WARNING	WARNING	

Few events to analyse and the most dangerous ones against eccentric objects (difficult to observe)

Sensor network ← **EU SST Database** ← **S3TOC COO & SatCen** →



Upcoming EU SST observation campaign in MEO

Collision Avoidance Service ▪ Events – LEO 1

HIE with CAM support

MD: 285m

Scaled PoC ~ 2.5E-3

Event timeline

User warned by OC

CAM recommended

CAM computed by user

Screening against the whole catalogue

CAM performed half an orbit before TCA

1st CDM: No risk Detected T-115h

2nd CDM: IE WARNING T-88h

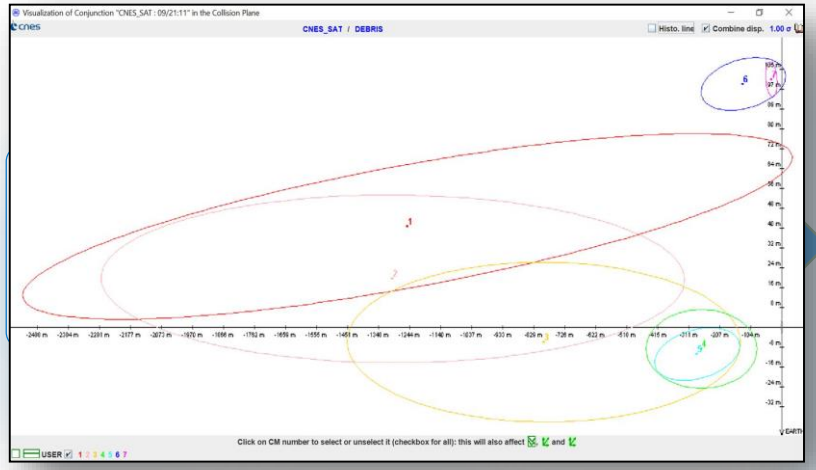
3rd CDM: HIE ALERT T-64h

4th CDM: HIE ALERT T-30h

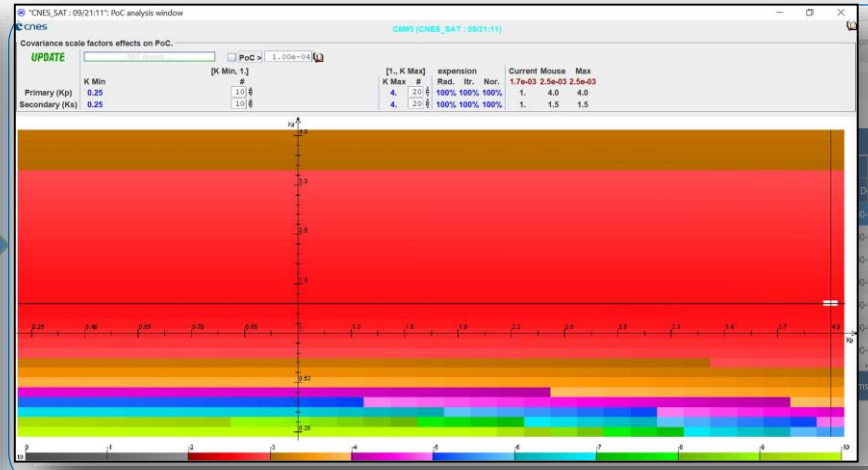
5th CDM: HIE ALERT T-24h

6th CDM: INFO Predicted T-8h

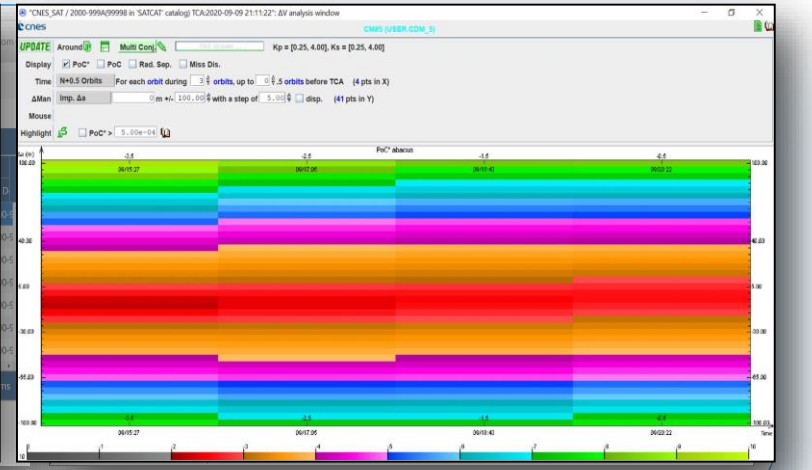
7th CDM: INFO Predicted T-3h



Conjunction Plane



PoC Analysis



CAM Analysis

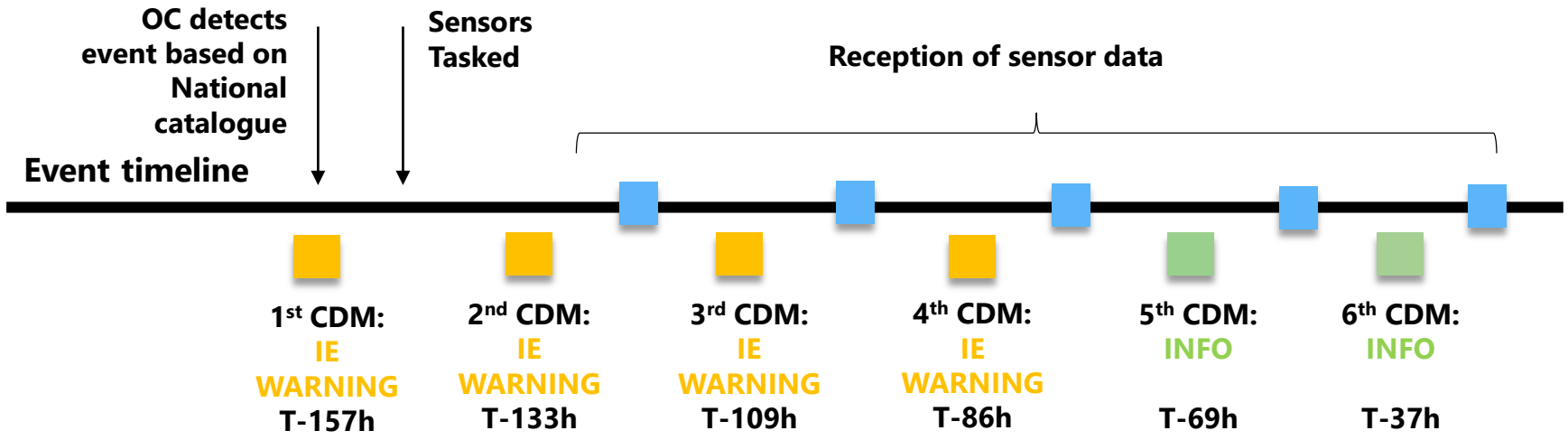
Collision Avoidance Service ▪ Events – LEO 2

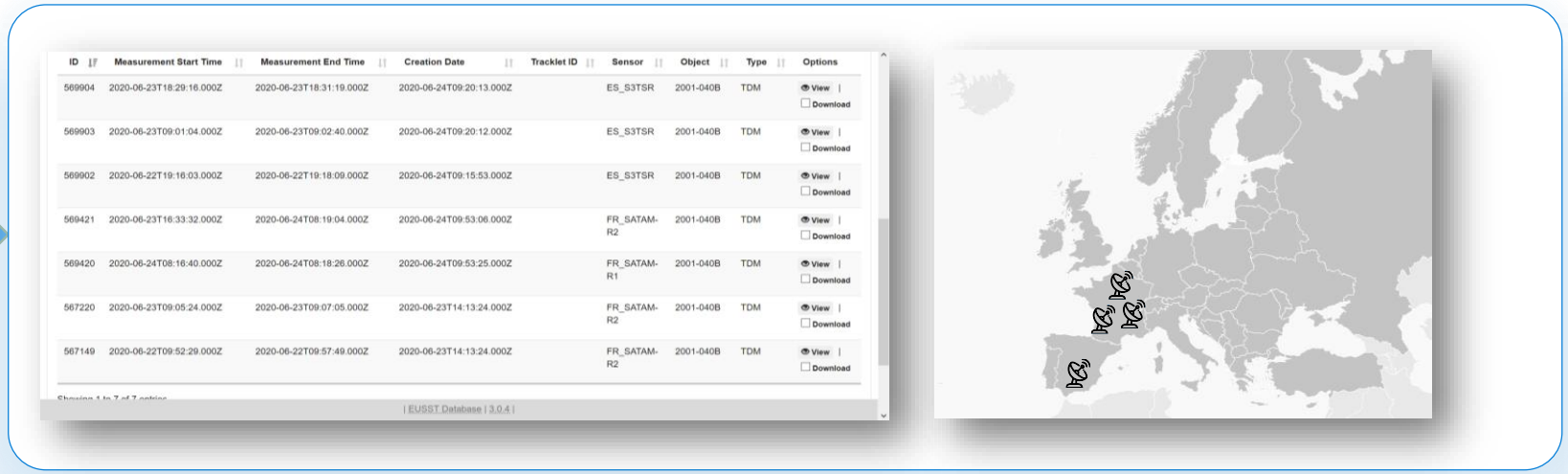
IE fully Autonomous

SMOS vs R/B

Scaled PoC ~ 2E-4

Conjunction against large object absent from the public US catalogue



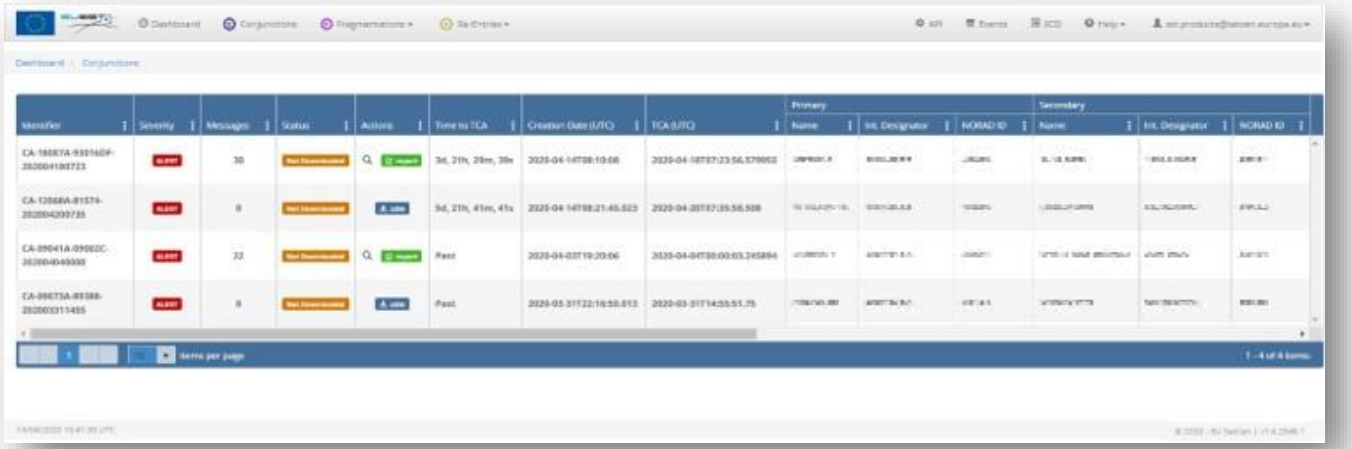



EUSST

Collision Avoidance Service ▪ Portal

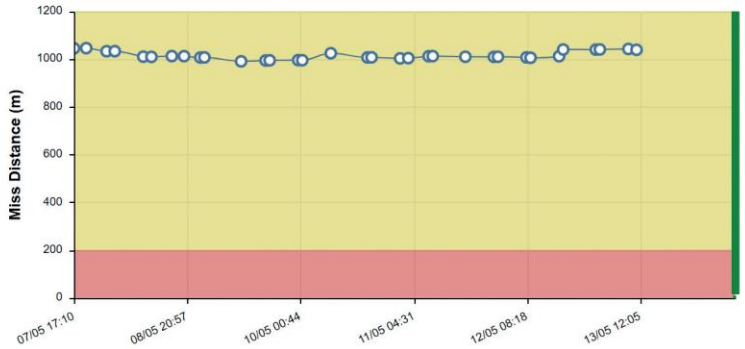
EU SST Service Provision Portal, enables users to:

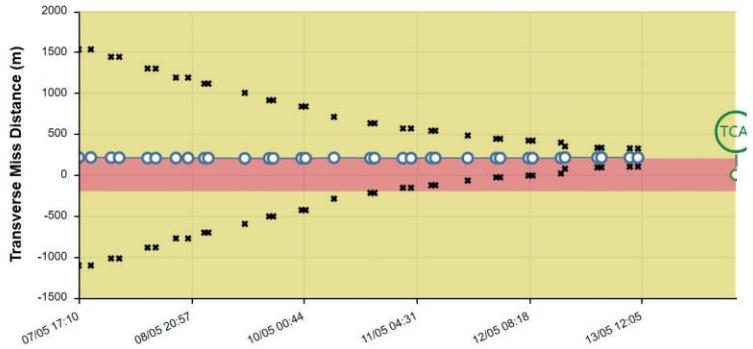
- download and access the CA products, either through the REST **API** or through the **web interface**;
- upload **O/O ephemerides and manoeuvre information** (or any other type of file), either through the REST API or through the web interface;
- view the **evolution** of conjunctions (i.e. PoC, scaled PoC, and miss distances);
- download the applicable CA **Service Configuration** Document and its template document;
- customise the email **notifications** configuration, and
- access the CA service monthly **statistical** report.

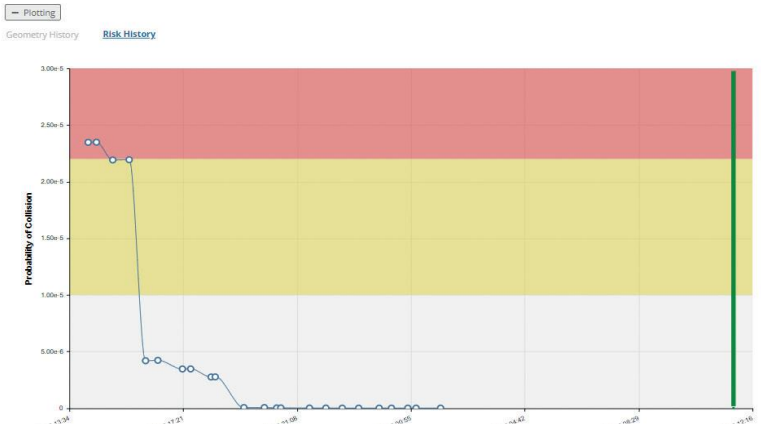


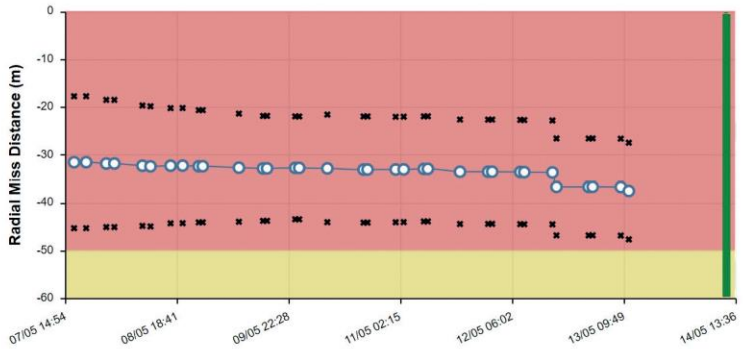
Collision Avoidance Service ▪ Portal

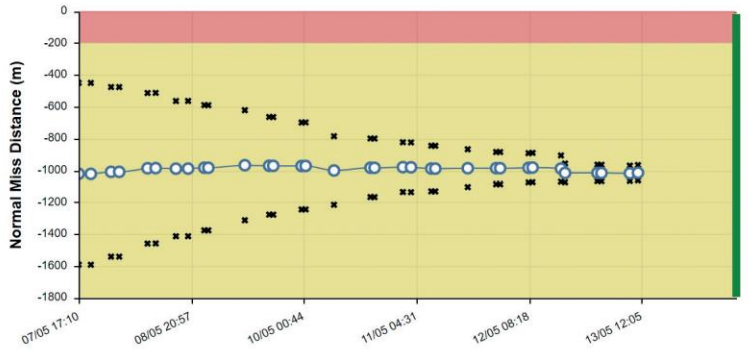
Evolution plots (miss distances and PoCs):

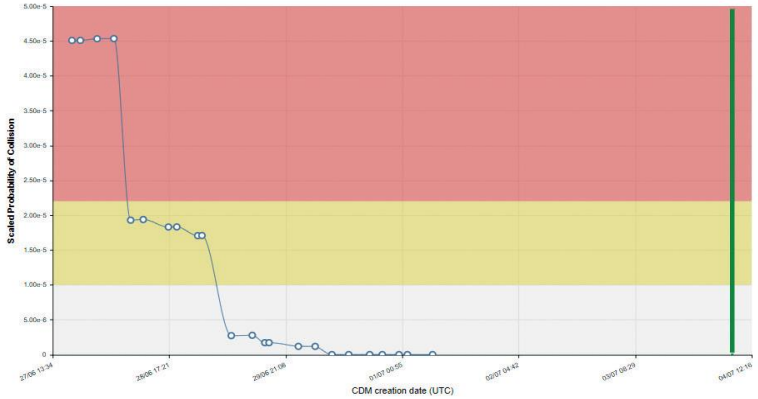








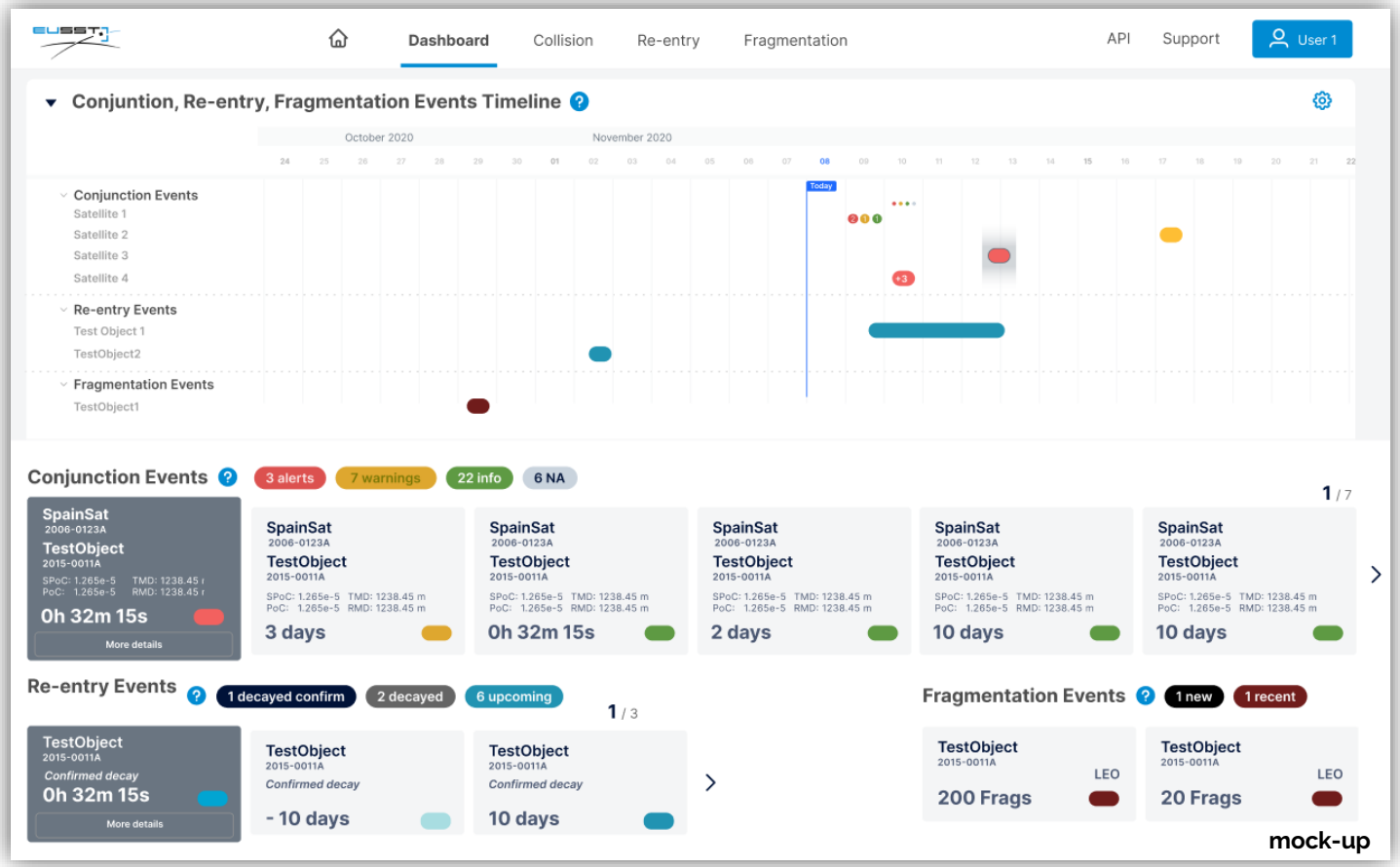




Collision Avoidance Service ▪ Portal

NEW EU SST Portal

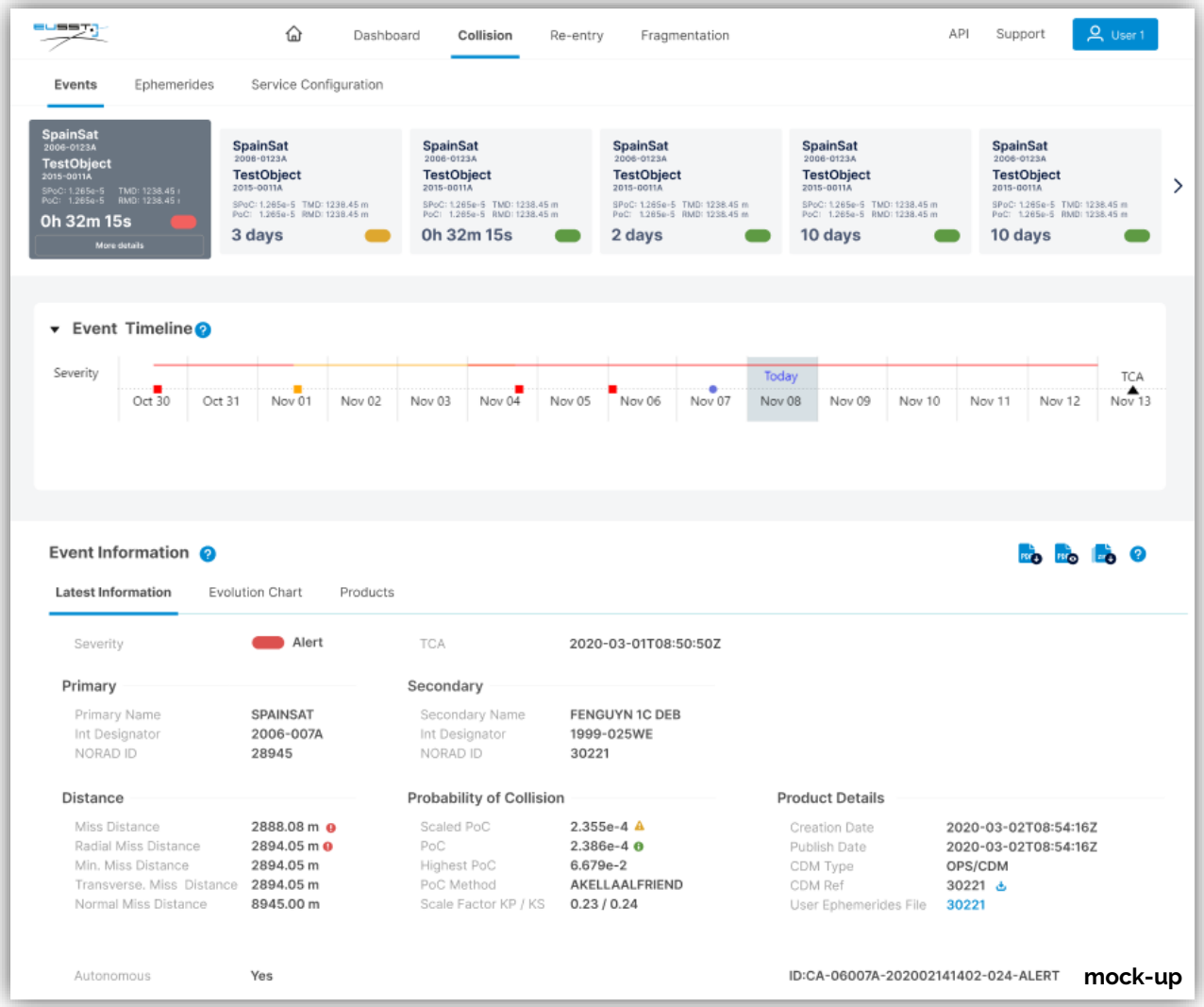
- **new modern UI** being developed with a new dashboard, timeline and many back-end improvements;
- services products are being **integrated** in the Portal e.g. conjunction plane plots;
- **email notifications** are being improved (content, filtering);
- **feedback** mechanisms to be in place.



Collision Avoidance Service ▪ Portal

NEW EU SST Portal

- new **event page** (timeline, latest information update, evolution charts, products);
- **ephemerides** upload will be processed (by spacecraft), and shared amongst all organization users;
- **user thresholds'** (SPoC, miss distance, radial miss distance) severity visible and configuration available to be consulted;
- operators will be able to **manage** their fleets/constellations **access** among their FDS teams.



Collision Avoidance Service ▪ Users

Collision Avoidance

+25 ORGS

+140 Satellites

50% satellites governmental/institutional

Collision Avoidance Service ▪ Satellites

147
Satellites

LEO

46

BIROS
SAR-LUPE 1, 2, 3, 4, 5
TET-1
TANDEM-X
TERRASAR-X
REAKTOR HW
DEIMOS 1, 2
METOP A, B, C
SENTINEL 1A, 1B, 2A, 2B, 3A, 3B, 5P
PAZ
UPMSat-2
ION-mk01 Lucas
CALIPSO
ELISA E12, E24, W11, W23
HELIOS 2A, 2B
JASON 3
PLEIADES 1A, 1B
SMOS
VENμS
BRITE PL-1,PL-2
CSO-1
EYESAT
ANGELS
FALCON EYE 2
ELO3
CHEOPS
TARANIS

MEO

30

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

O3B FM 15, 16, 14, 13

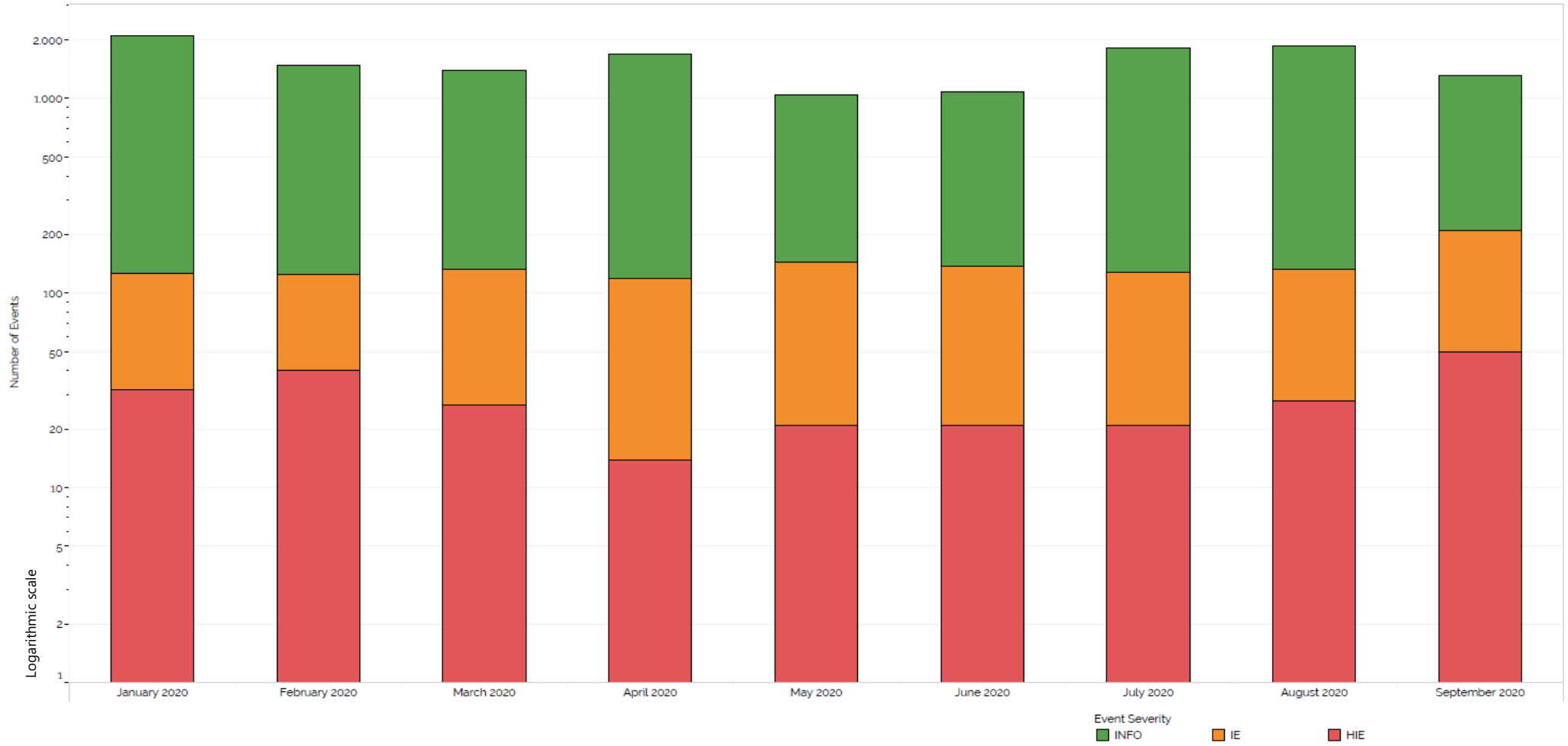
GEO

71

COMSATBW-1, 2
SICRAL 1, 1B, 2
XTAR-EUR
METEOSAT-8, 9, 10, 11
SPAINSAT
SES 4, 5
HYLAS 1, 2, 4
ATHENA-FIDUS
SYRACUSE 3A, 3B
HELLAS-SAT 2, 3, 4
INMARSAT 3F1, 3F2, 3F3, 3F5, 4F1, 4F2, 4F3, AF1, 5F1, 5F2, 5F3, 5F4, GX5
ANASIS II
EUTELSAT 10A, 16A, 172A, 21B, 25B, 28A, 28B, 36A, 36B, 3B, 5WA, 65W, 7WA, 70B, 7A, 7B, 8WB, 9A, 9B, HB 13B, 13C, 13D,
KASAT 9A, 12WB, 172B, 7C,5 WEST B
AMAZONAS 2, 3, 5, HISPASAT 30W-5, 30W-6, 36W-1, 74W-1, 143W-1

Collision Avoidance Service ▪ Metrics

Number of CA Events

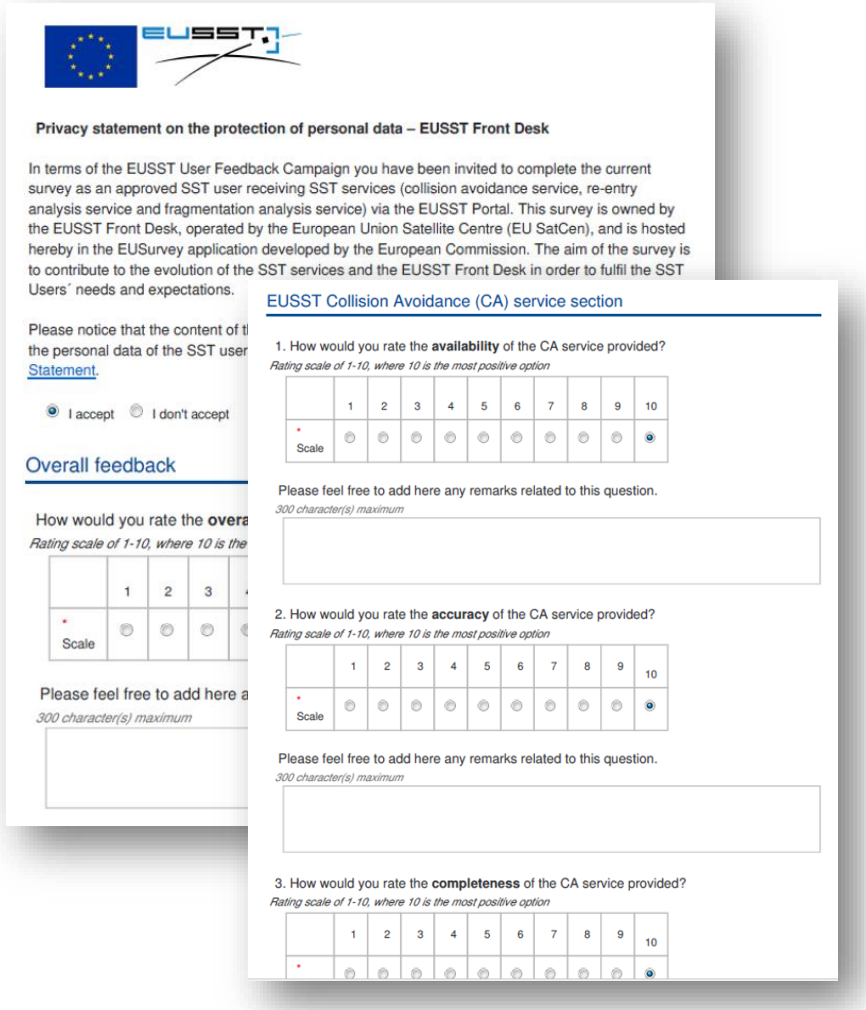


On average practically a **HIE** every day.

+16,000 autonomous products (with EU SST sensors data)

Collision Avoidance Service ▪ 3rd User Feedback Campaign

- Next user feedback campaign **starts in the next weeks!**
- Objective: identifying **key strengths and** areas for **improvement**
- Addressed to **existing users** of the Collision Avoidance (CA) service
- **Your feedback is very important** to keep improving our services



Privacy statement on the protection of personal data – EUSST Front Desk

In terms of the EUSST User Feedback Campaign you have been invited to complete the current survey as an approved SST user receiving SST services (collision avoidance service, re-entry analysis service and fragmentation analysis service) via the EUSST Portal. This survey is owned by the EUSST Front Desk, operated by the European Union Satellite Centre (EU SatCen), and is hosted hereby in the EUSurvey application developed by the European Commission. The aim of the survey is to contribute to the evolution of the SST services and the EUSST Front Desk in order to fulfil the SST Users´ needs and expectations.

Please notice that the content of t
the personal data of the SST user
Statement.

I accept I don't accept

Overall feedback

How would you rate the overa
Rating scale of 1-10, where 10 is the

	1	2	3
* Scale			

Please feel free to add here a
300 character(s) maximum

EUSST Collision Avoidance (CA) service section

1. How would you rate the **availability** of the CA service provided?
Rating scale of 1-10, where 10 is the most positive option

	1	2	3	4	5	6	7	8	9	10
* Scale										

Please feel free to add here any remarks related to this question.
300 character(s) maximum

2. How would you rate the **accuracy** of the CA service provided?
Rating scale of 1-10, where 10 is the most positive option

	1	2	3	4	5	6	7	8	9	10
* Scale										

Please feel free to add here any remarks related to this question.
300 character(s) maximum

3. How would you rate the **completeness** of the CA service provided?
Rating scale of 1-10, where 10 is the most positive option

	1	2	3	4	5	6	7	8	9	10
*										

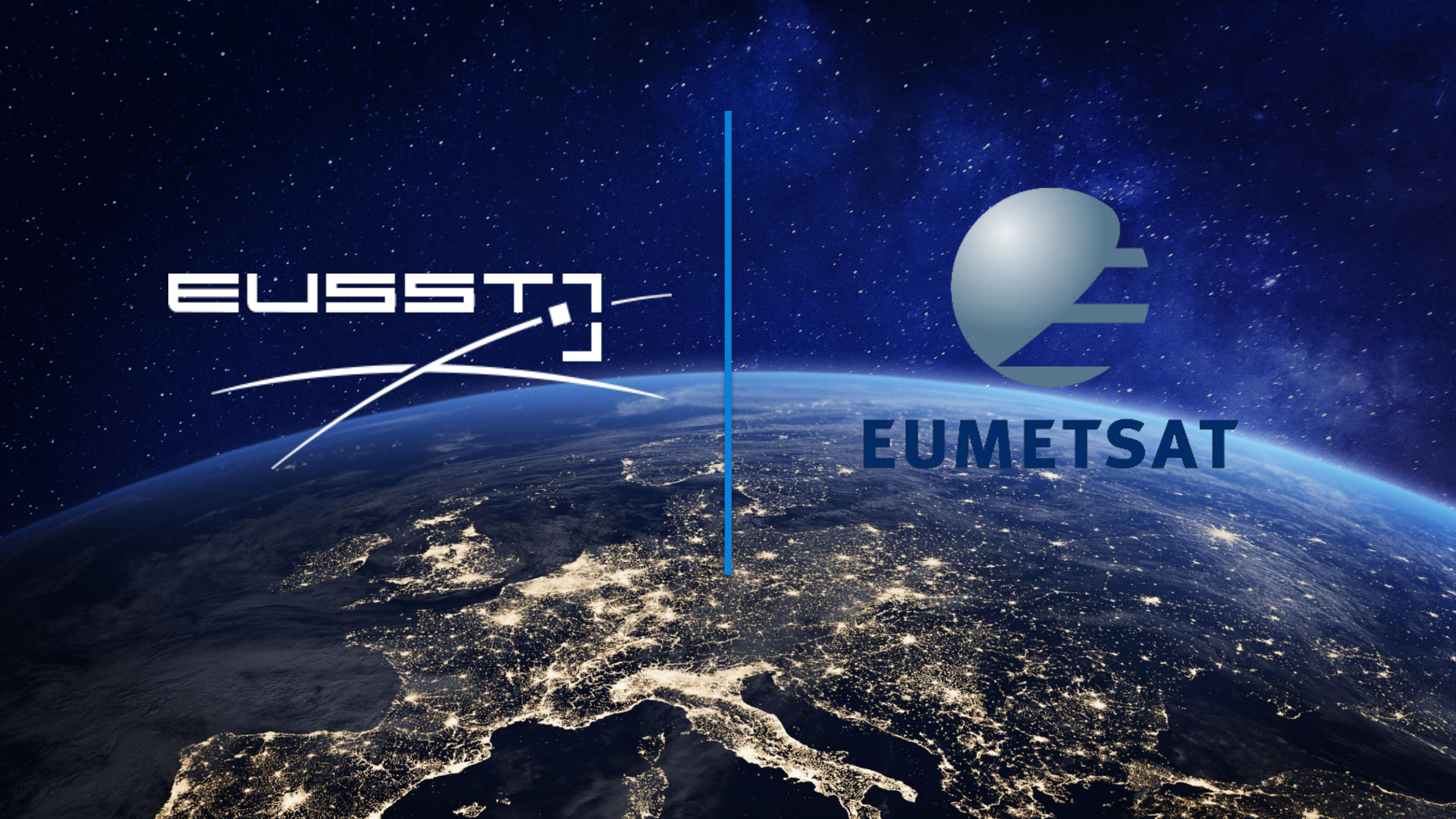
Accuracy

Timeliness in delivery

Completeness

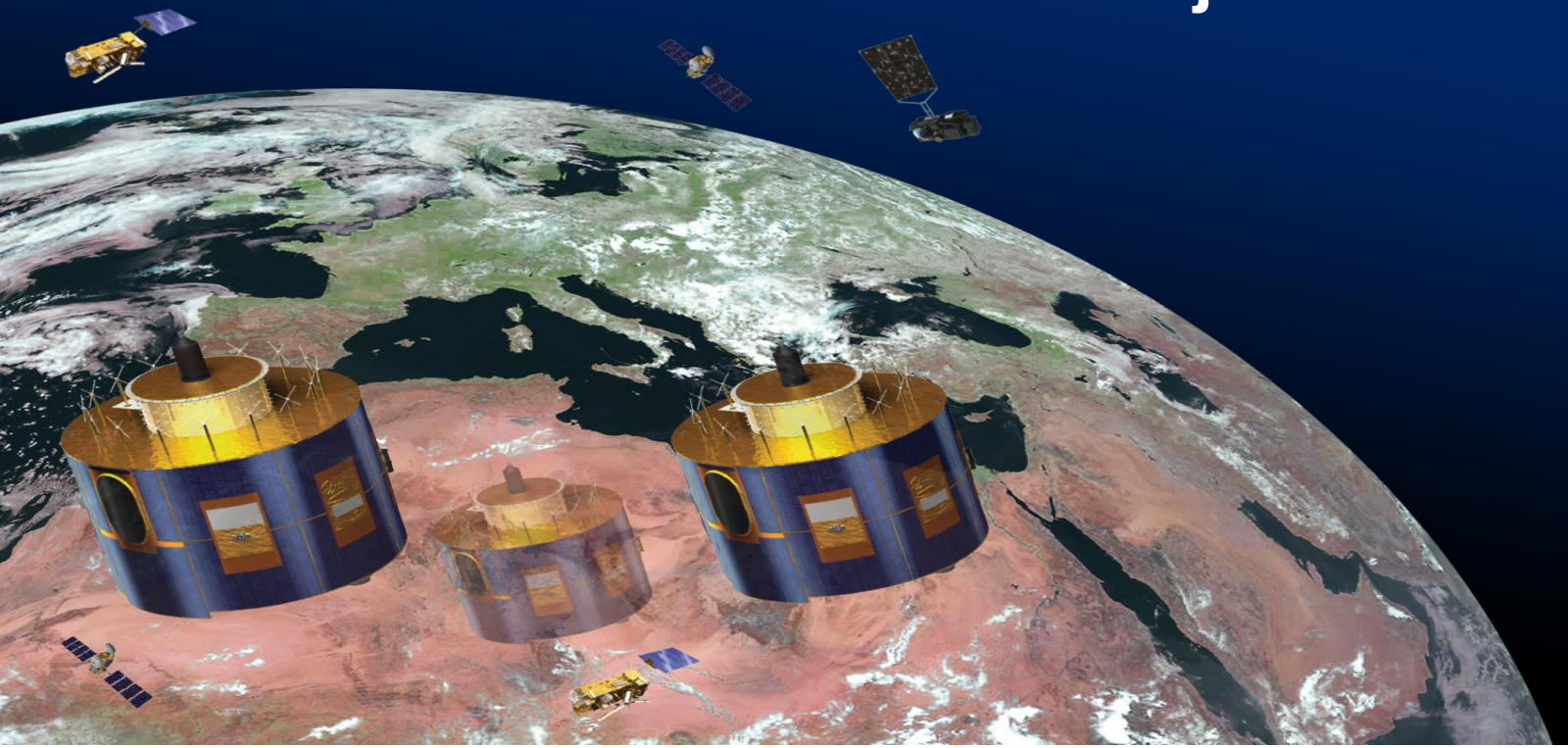
Availability

Evolution


EUSST
EUMETSAT

EUSST services integration in EUMETSAT Conjunction Analysis Operations

Pier Luigi Righetti



EUMETSAT and EUSST…

1. EUMETSAT
2. Brief history of CA in EUMETSAT
3. EUSST integration in EUMETSAT CA operations
4. Some operational cases:
   a. Metop-C CAM on 24 July 2020
   b. MSG-1 CAM on 12 December 2017
   c. Few other interesting cases…
5. Future EUSST support to EUMETSAT Copernicus missions (Sentinel-6/Sentinel-3)
6. Future evolutions and possible improvements

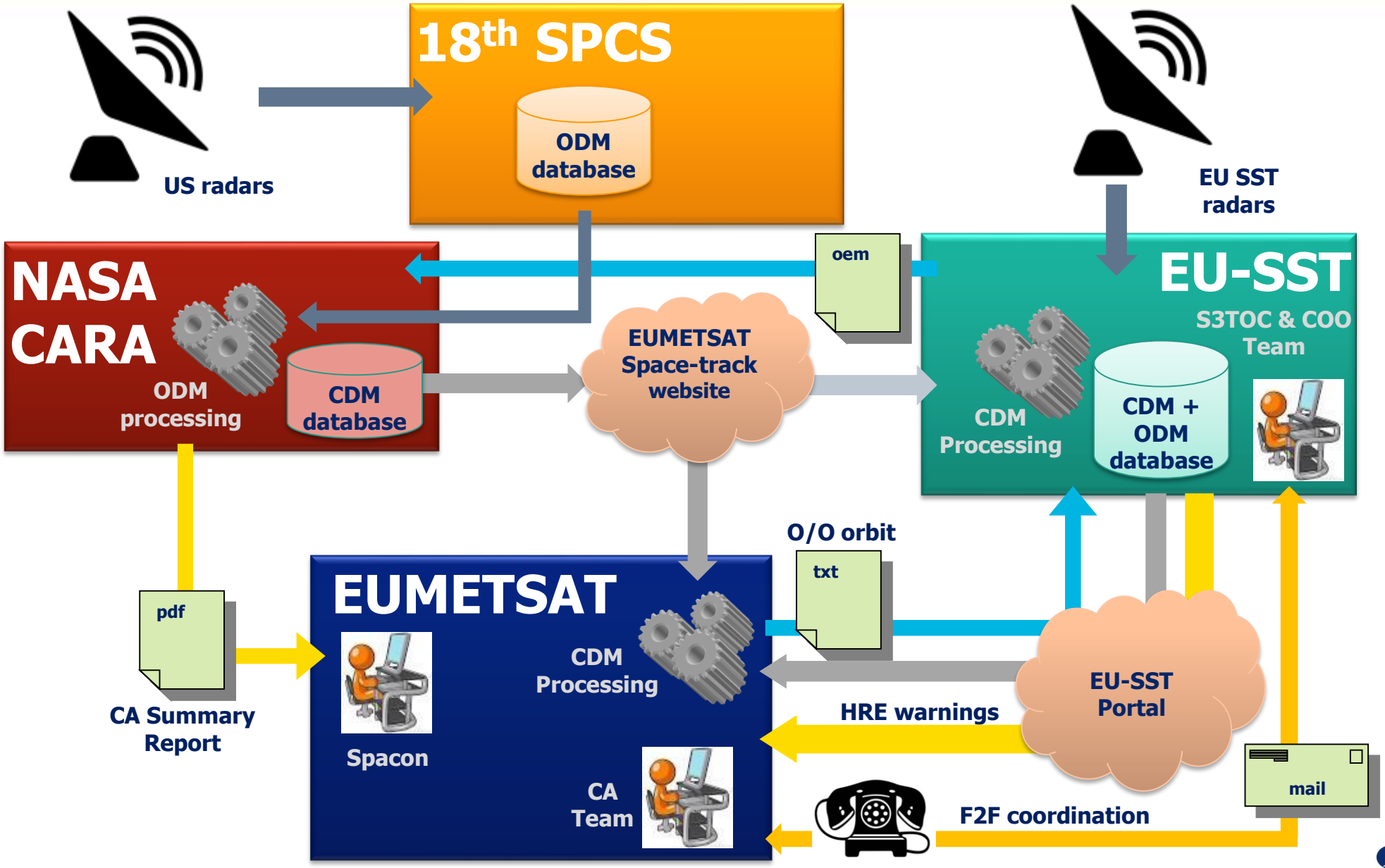
EUMETSAT

- EUMETSAT is the European Organisation for the Exploitation of Meteorological Satellites
  - Intergovernmental organisation (30 Member States) founded in 1986
  - Supplying weather and climate-related satellite data, images and products to the National Meteorological Services of our Member States
    … in real time, 24 hours a day, 365 days a year, during decades
  - Operating a fleet of satellites in Geostationary (4 MSG)
    and Low Earth Orbit (3 Metop and 2 Sentinel-3)
  - Developing next generation of satellites (MTG, EPS-SG, Sentinel-6, …)

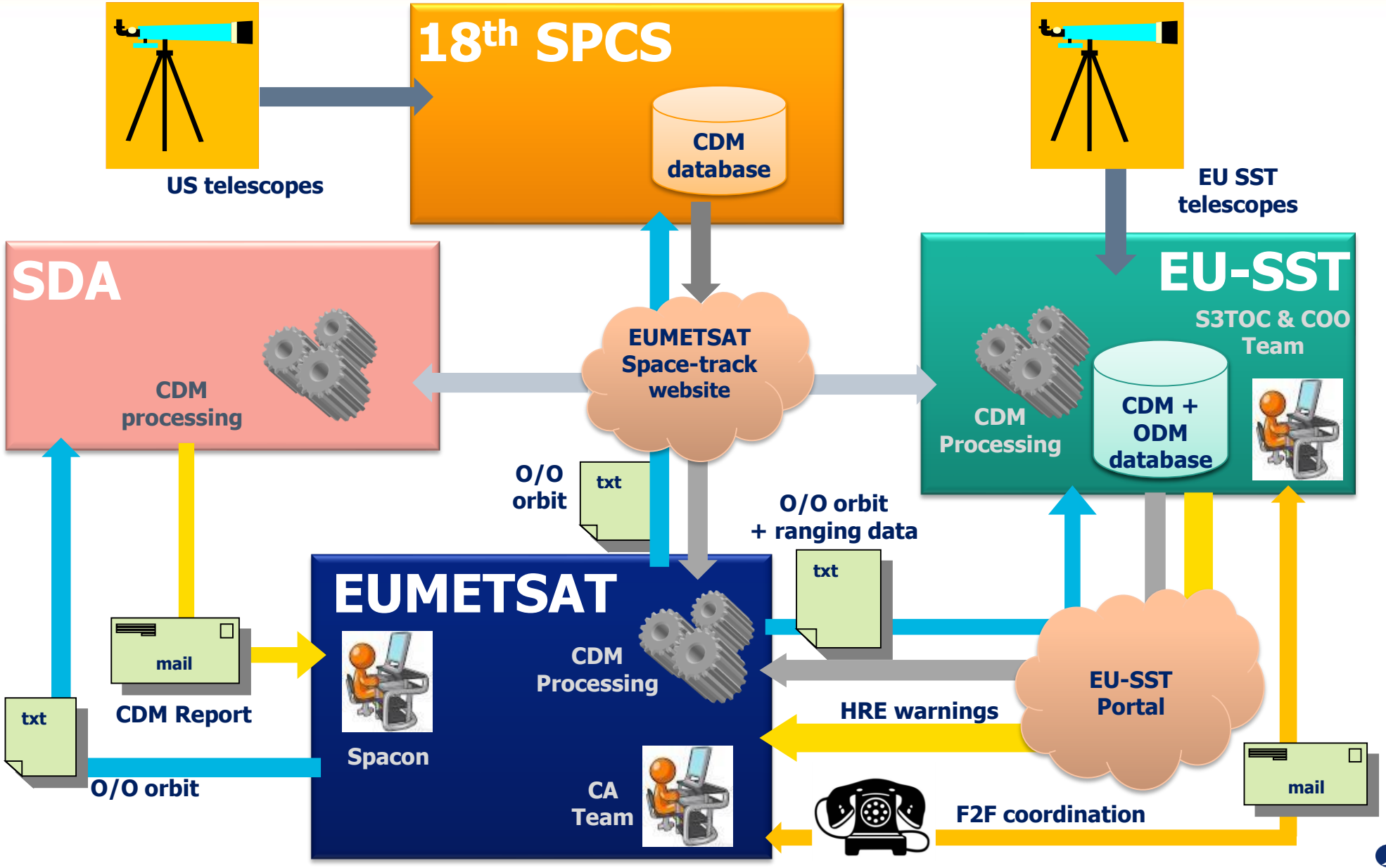
Brief history of CA in EUMETSAT

- First emergency conjunction message received from JSpOC (via ESOC) on 24 December 2008 (with only radial covariance information)
  PoC computed manually!
- Conjunctions warnings via NOAA (e-mail) from March 2009
  + OCM (including full covariance information) for high interest events
  EUM CA prototype (VB in Excel) developed
- JSpOC delivery of CSM (on Space-Track) from September 2010
  EUM CA SW (based of FD libraries) developed
- First CAM executed on first May 2011 (Metop-A)
  16 CAM executed in total (one on Meteosat, one on S-3, all other on Metop)
- SDA support from February 2013 (for GEO only); O/O vs O/O events provided
- CARA support from February 2013 (for Metop only);
  CDM (on Space-Track) and Conjunction Summary Reports (e-mail) provided
- CAESAR support from 2015 (trial in 2014)
  CNES JAC SW integrated in EUM CA infrastructure
- EUSST services starting on September 2016
  Nominal Operation Centres: CAESAR for Metop, S3TOC for MSG
- S3TOC taking over as EUSST nominal OC on June 2018; CAESAR backup OC

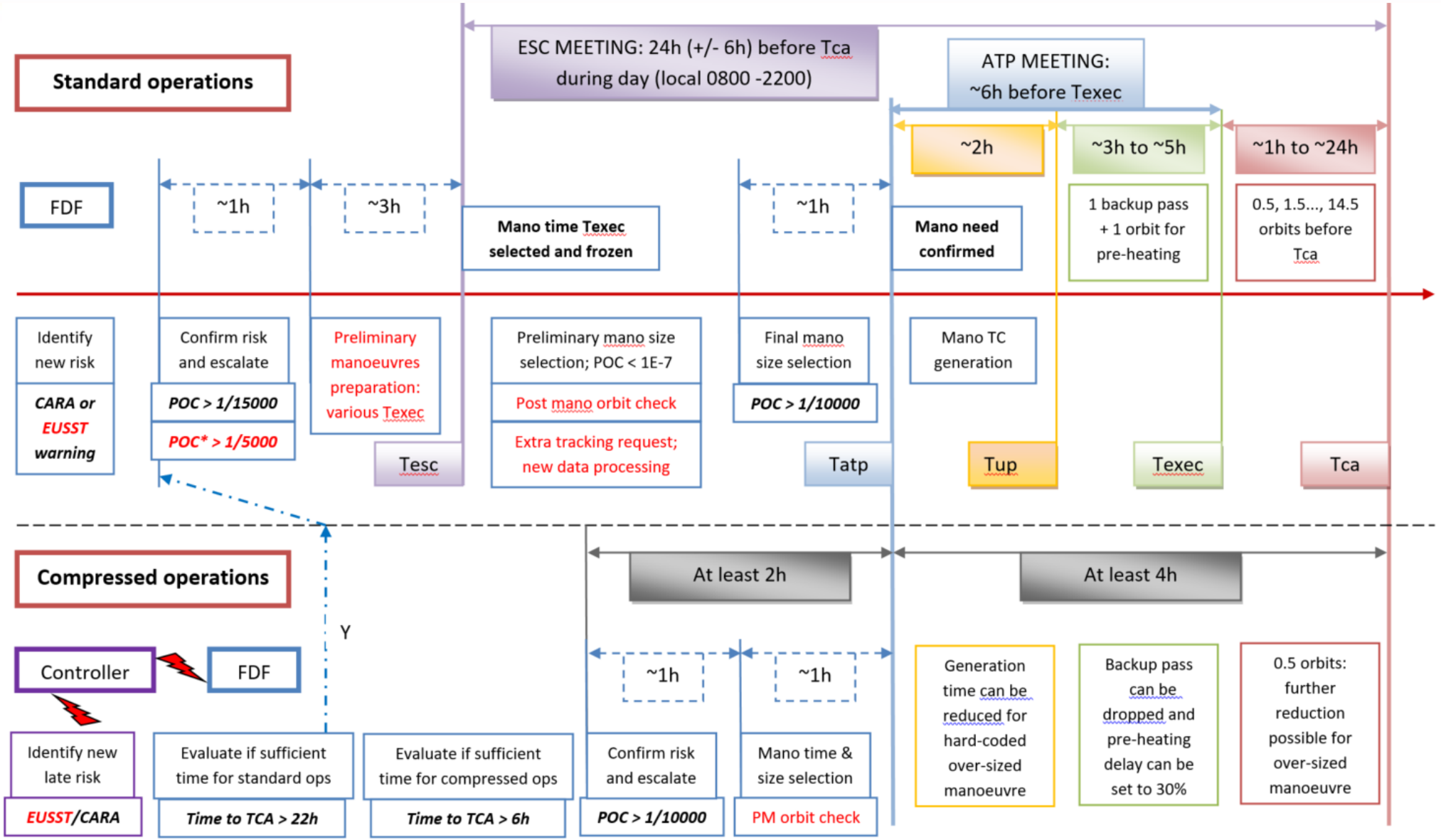
EUSST integration in CA operations (Metop)



EUSST integration in CA operations (MSG)



EUSST integration in CA operations (Metop Timeline)

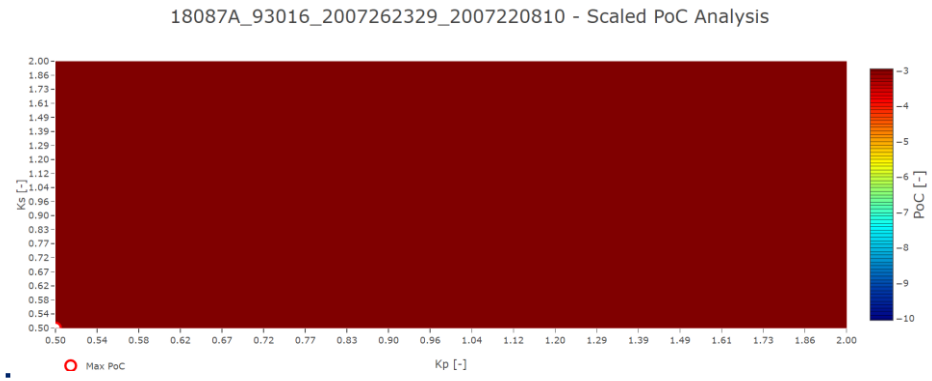


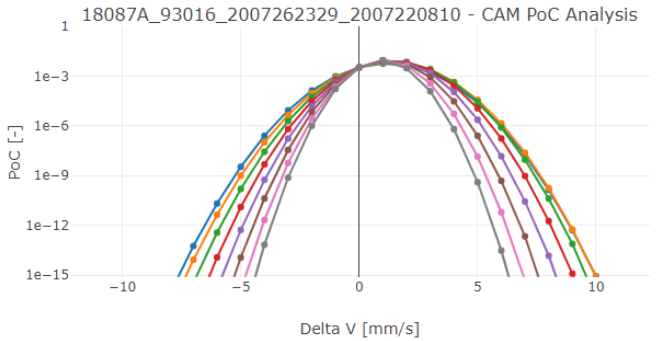
EUSST integration in CA operations (summary)

- EUSST alerts to EUMETSAT CA team in case of high risk event (via portal, via e-mail, via phone)
- Risk estimation using different approach (scaled PoC, PoC*): risk consolidation versus standard PoC and earlier risk detection
- Support to consolidation of risk mitigation strategy (reduction of risk depending on selected CAM)
- Possibility to trigger available European tracking assets (radars for LEO, telescope for GEO) to improve knowledge of debris orbit
- Analysis of post CAM status (versus existing CDM)
- Integration with CARA (Metop ephemeris delivery)
- Possibility to access independent MSG orbit for CA and GS calibration (from own optical measurement and ranging data from EUMETSAT)
- Support special operations thanks to Special Perturbation catalogue access (MSG relocation in 2018, for instance; Metop-A EOL soon)

Operational case: Metop-C vs UNKNOWN (#81537)
TCA on 26 July 2020 @ 23:29:54 UTC

- First alert from S3TOC on 22 July;
  PoC 1/350
  PoC* 1/290 (for kp/ks 0.5)
- Preparation of CAM recommended;
  Mitigation options provided by S3TOC
- PoC* suggests situation may degrade in time;
  Confirmed by EUM PoC prediction tool;
  Debris with good covariance and well behaving
- Escalation anticipated to Thursday 23 July PM;
  CAM execution time on Friday 24 July 11:50
  (before week-end, as TCA on Sunday late)
- -10mm/s CAM size selected;
  Bring satellite toward the centre of the dead-band;
  Avoid secondary risk appearing at around -5mm/s;
  SP screening performed by S3TOC (large DV, DT)
- Last estimated PoC before uplink: 1/150
  Post event PoC, assuming no mitigation: 1/130





TCA-(0/1+0.50)*T : 2020/07/26-22:39:20.191
TCA-(1/1+0.50)*T : 2020/07/26-20:58:12.931
TCA-(2/1+0.50)*T : 2020/07/26-19:17:05.672
TCA-(3/1+0.50)*T : 2020/07/26-17:35:58.412
TCA-(4/1+0.50)*T : 2020/07/26-15:54:51.152
TCA-(5/1+0.50)*T : 2020/07/26-14:13:43.893
TCA-(6/1+0.50)*T : 2020/07/26-12:32:36.633
TCA-(7/1+0.50)*T : 2020/07/26-10:51:29.373

Operational case: MSG-1 vs NIGCOMSAT 1 (#31395)
TCA on 15 December 2017 @ 06:10:36 UTC

- First alert from S3TOC on 04 December (more than 10 days before);
  PoC 1/136000
  PoC* 1/3100
  Miss Distance 230m, 200m in radial

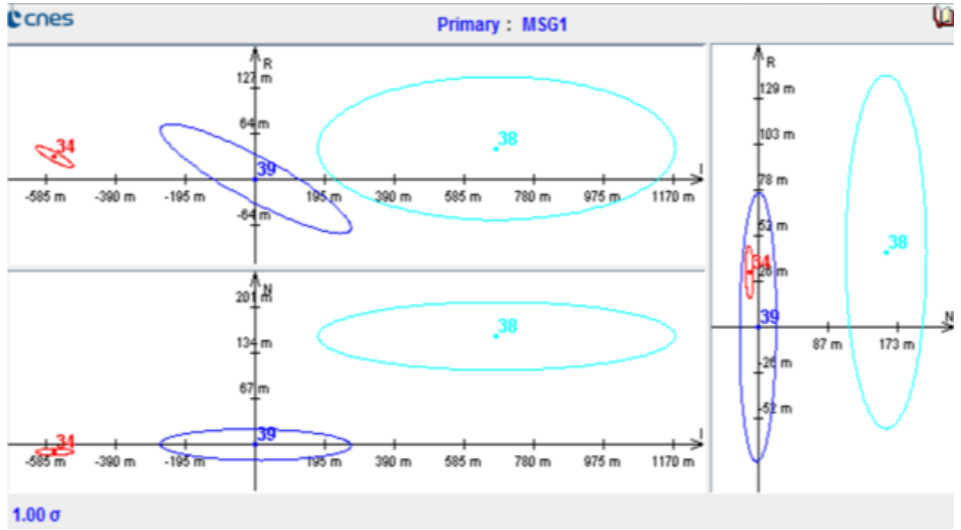
- Highest risk ever observed in GEO;
  Quite big defunct communication satellite (5200kg, 360sqm);
  Multiple conjunctions, due to inclination:
  2 per day from 08 to 20 December

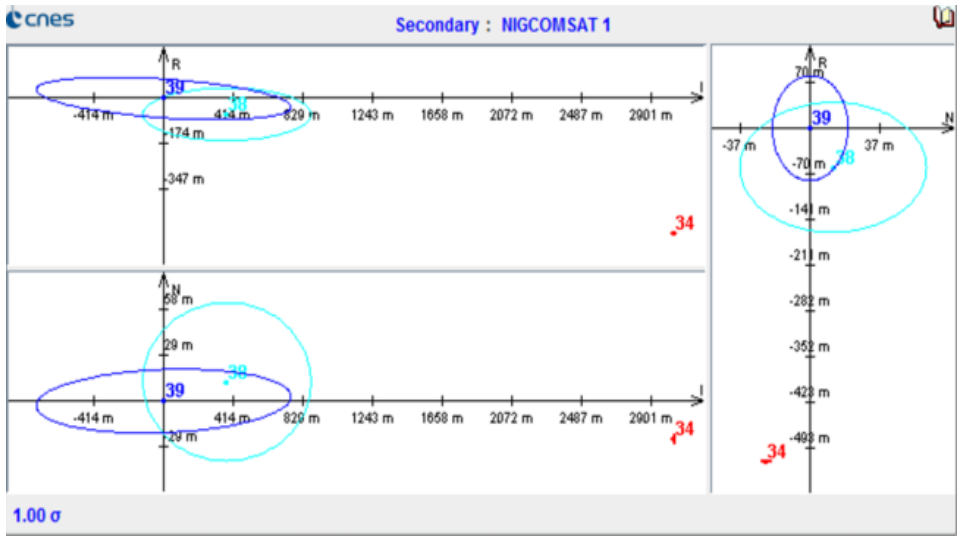
- Reliability of received warning checked with dedicated optical tracking from both CAESAR (38) and S3TOC (34)

- Partial implementation of EWSK foreseen on 03 January 2018 proposed as CAM

- Mitigation of all conjunctions confirmed

- 40mm/s CAM executed on 13 December;
  Backup opportunity kept on following day





EUMETSAT

Few other interesting cases…

- **Metop-A vs NOAA-16 debris (#41259) TCA on 17 May 2019 @ 02:21:19 UTC**
  - First warning from S3TOC on 13 May: PoC* 1/32000, while PoC 1/90000
  - First alert from S3TOC on 16 May: PoC* 1/2000, while PoC only 1/12500
  - PoC* quite credible and PoC trend (from EUM PoC prediction tool) quite worrying
  - CAM executed on 16 May at 15:22 (anticipation of routine manoeuvre)

  S3TOC warning/alert based on PoC* permitted to observe a risk which may have gone unnoticed

- **Metop-B vs Fenyun 1C Debris (#37435) TCA on 23 August 2019 @ 03:10:22 UTC**
  - First warning from S3TOC on 19 August: PoC* 1/25000, while PoC 1/70000
  - PoC* reported by S3TOC on 22 August raising to 1/7500, for ks=2, while PoC still 1/27000
  - No mitigation action considered needed (ks value considered not credible)
  - Latest CDM before TCA delivered at 23:40 (3.5 hours before event); **PoC rocketing to 1/5200**
  - Would it have been possible to observe the risk earlier with better tracking / orbit prediction?
  - Would it have been possible to predict that with the available data? 20% probability from EUM PoC predTool

  Operator to be ready to react faster in similar cases (night shift), to reduce further the CAM preparation time

- **Metop-C vs Fenyun 1C Debris (#37041), TCA on 09 September 2020 @ 20:03:12 UTC**
  - First warning from CARA on 04 September: PoC 1/2000 for 20m HBR, 1/50000 for 4m
  - No further update on secondary received
  - Nothing could be done

  A dedicated LEO tracking service could have provided the needed data (applicable also to the previous case)

Future EUSST support to EUMETSAT Copernicus missions (Sentinel-6/Sentinel-3)

- **Sentinel-6**
  - Launch foreseen on 21 November 2020 (next Saturday)
  - EUSST and CARA will support CA operations (as for Metop)
  - Dedicated S6 user created on EUSST and on Space-Track
  - EUM CA SW migrated into a Multi-Mission offline operational platform
  - Delivery of orbit to from EUM to EUSST successfully tested
  - Delivery of orbit from EUSST to CARA successfully tested
  - Generation of CDM based on EUM orbit successfully tested
  - Delivery of CDM via Space-Track will be activated during LEOP
  - **All green for launch**

- **Sentinel-3**
  - CA support currently provided by ESOC/SDO with EUSST support
  - End of ESOC/SDO CA support foreseen in 2021
  - Support will be taken fully over by EUSST
  - CDM are provided by the 18th SPCS (as for MSG)
  - Similar preparation as for S-6 needed

Space Fence Impacts

- Improved accuracy of CDM is observed, probably due to the new space-fence
  - Better observability than in the past for objects already catalogued
    Clearer decision process in case of high risk
  - Large jumps on risk computed with consecutive CDM still observed
    Often due to limitations in the solar-activity prediction
    Sometimes due to reduced risk prediction capabilities

- Not many new objects in the catalogue… yet
  - Accuracy of new smaller objects to be analyzed, when available
    Decision process in case of high risk may become foggy again
  - Significantly larger number of high risk evens expected
    New criteria may need to be developed to prioritize them
    Operational impact of a collision could be considered, on top of its probability
  - Standard mitigation strategy may become ineffective and require review
    Global reduction of the total observed risk (posed by several events) to target

Future evolutions and possible improvements

- Network of sensors contributing to EUSST
  - EUSST telescope network (for GEO) mature for operations
  - Larger set of objects seen by EUSST radar (for LEO) for the future ?

- Still little need of O/O vs O/O coordination in LEO
  - Observed conjunctions are mostly with debris (very few exceptions observed)
    Situation may change significantly with the new super-constellations

Thanks to all…
Any question?

Q&A session

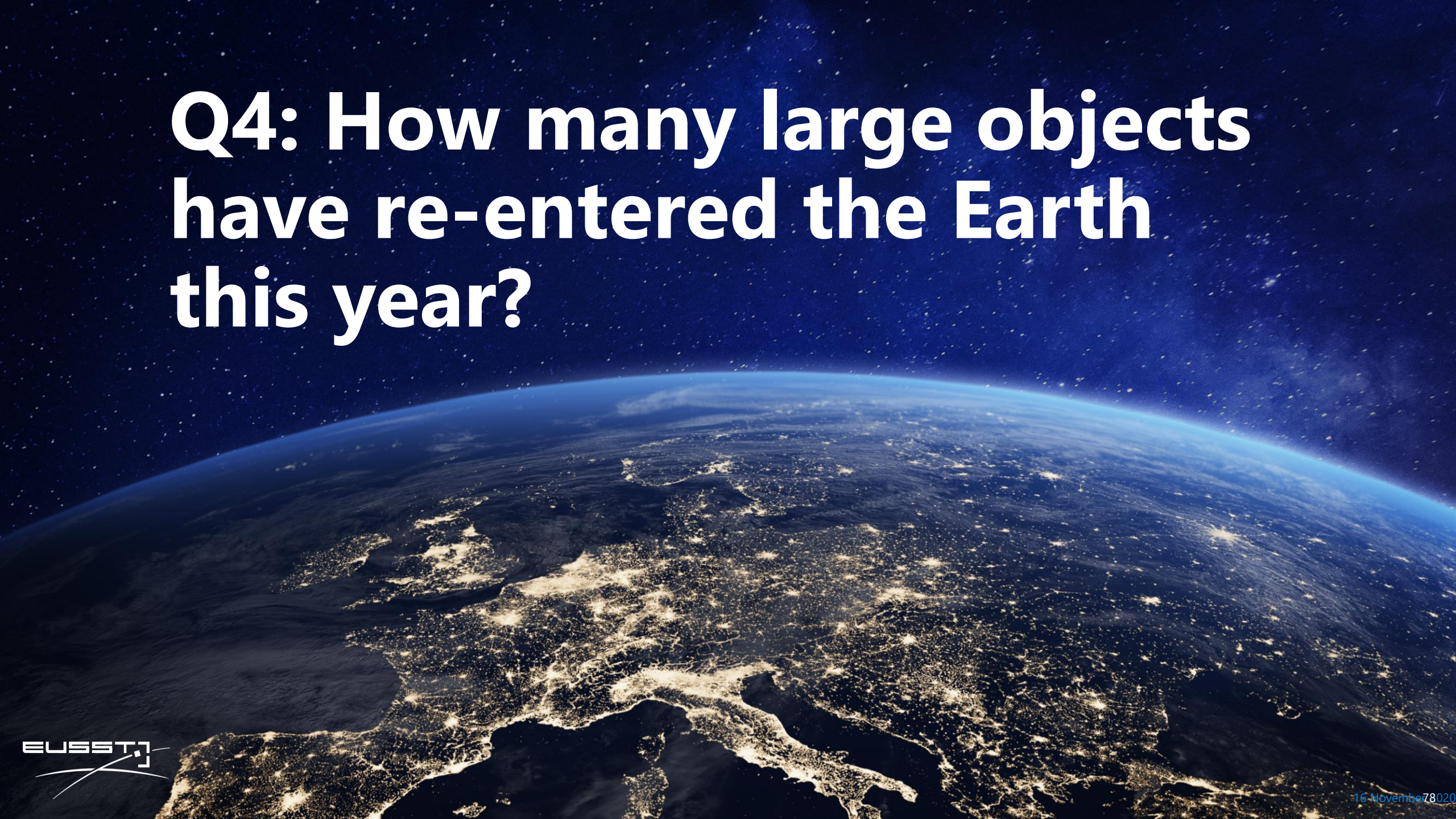
Break

We'll be back soon!


EUSST

Q3: How often would you say a fragmentation event in space occurs?

Q4: How many large objects have re-entered the Earth this year?



EU SST Operational Fragmentation and Re-entry analysis services

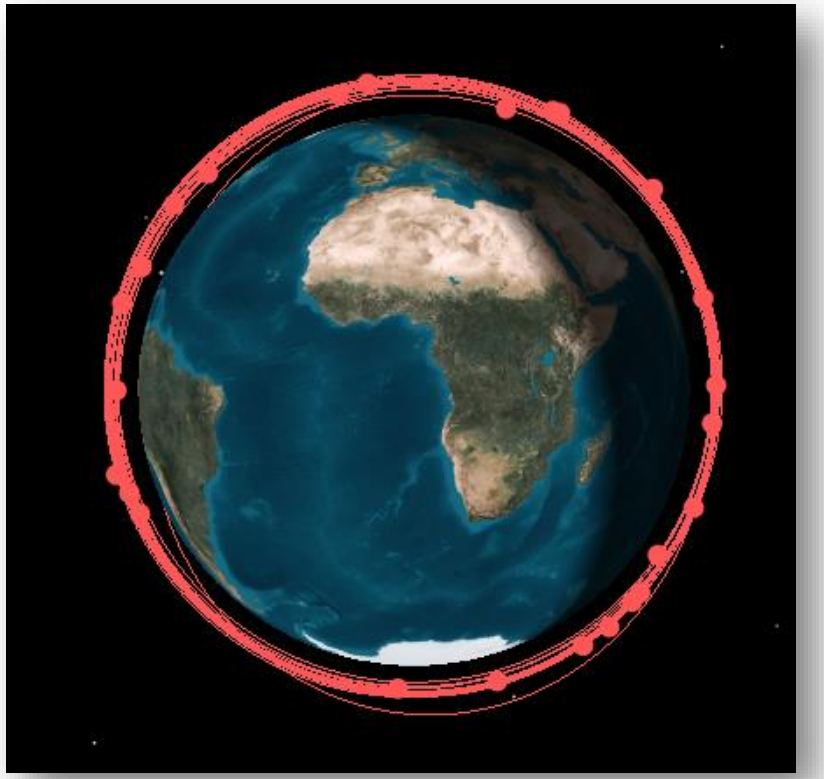
IT Operations Centre: Lt Moreno Peroni (IT MoD) and SST Front Desk: Mr João Alves (EU SatCen)

16th November 2020

FG Analysis Service ▪ Outline

- Fragmentation Analysis Service Overview
- Key features and products
- Operational flow
- Events
- Portal, metrics and Users

Fragmentation Analysis Service ▪ Overview



The Fragmentation Analysis (FG) Service:

- provides the **detection and characterization of in-orbit fragmentations, break-ups or collisions**.
- analyses all available information regarding the object(s) involved in the event.

Fragmentation Analysis Service - Key features

The content of the FG Service is provided in 3 types of products:

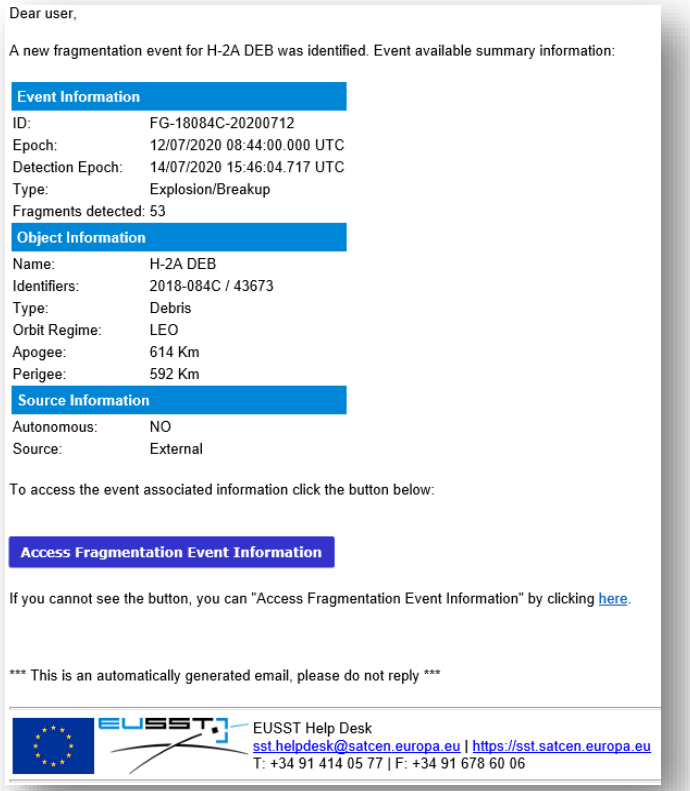
1. **Short-term notification;**
2. **Medium-term report;**
3. **Long-term report.**

Multiple reports based on available information

Contribution of all relevant sensors operated under EU SST is requested for all fragmentation events.
In addition, dedicated event pages are created for mediatic events (e.g. Microsat-R)

Fragmentation Analysis Service - Products

- The Short-term product is provided as an email containing basic information regarding the FG event. It includes:
  - **type of fragmentation** (i.e. explosion/breakup, collision, release of fragments, ASAT, other, unknown)
  - **object type** (i.e. satellite/payload, rocket body)
  - **apogee/perigee** of parent object/s with their **orbital regime** (LEO, MEO, GEO, other)
  - **number of detected fragments** if this information is available to the OC.



Dear user,

A new fragmentation event for H-2A DEB was identified. Event available summary information:

Event Information	
ID:	FG-18084C-20200712
Epoch:	12/07/2020 08:44:00.000 UTC
Detection Epoch:	14/07/2020 15:46:04.717 UTC
Type:	Explosion/Breakup
Fragments detected:	53

Object Information	
Name:	H-2A DEB
Identifiers:	2018-084C / 43673
Type:	Debris
Orbit Regime:	LEO
Apogee:	614 Km
Perigee:	592 Km

Source Information	
Autonomous:	NO
Source:	External

To access the event associated information click the button below:

Access Fragmentation Event Information

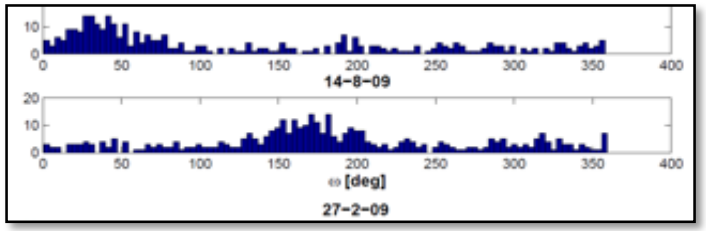
If you cannot see the button, you can "Access Fragmentation Event Information" by clicking here.

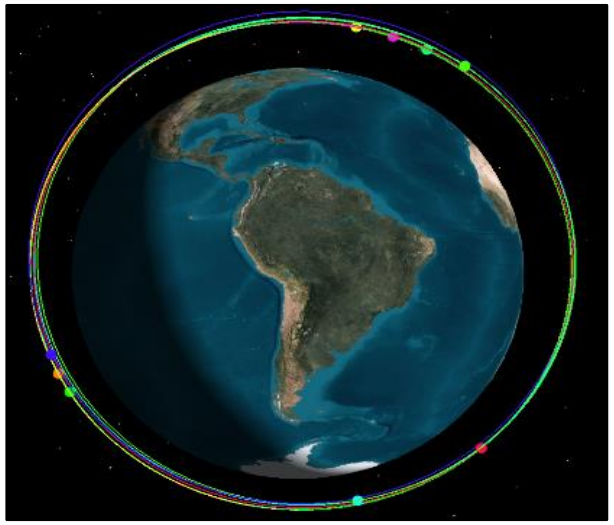
*** This is an automatically generated email, please do not reply ***

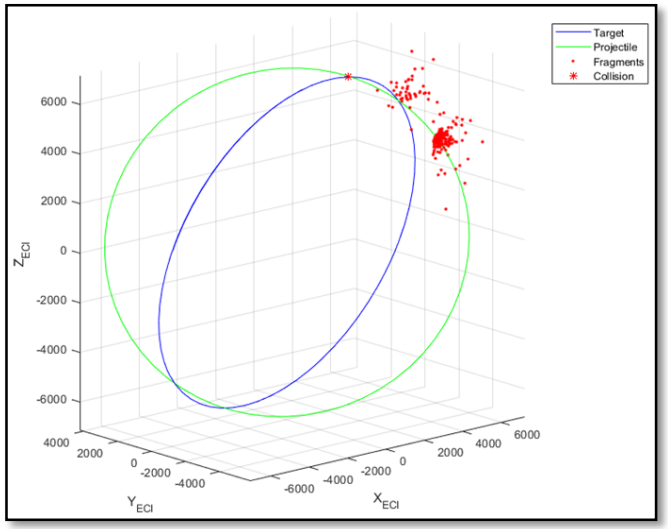
EUSST Help Desk
sst.helpdesk@satcen.europa.eu | https://sst.satcen.europa.eu
T: +34 91 414 05 77 | F: +34 91 678 60 06

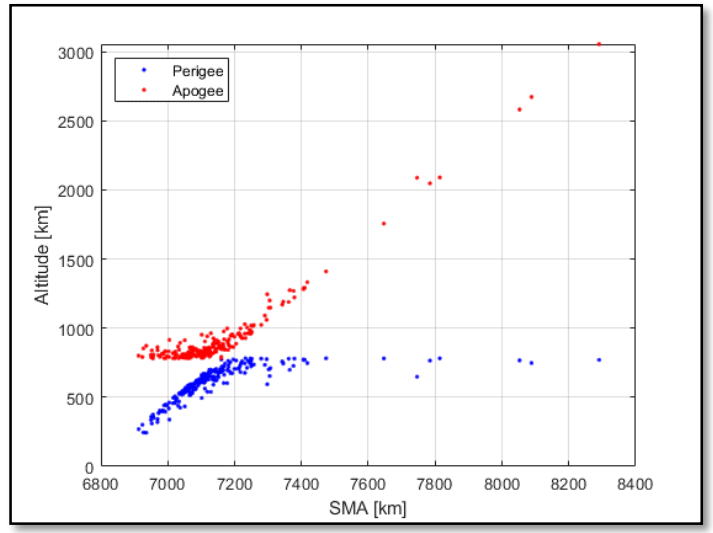
Fragmentation Analysis Service - Products

- The Medium-term report provides updates of the event with the following information:
  - Fragments distribution (e.g. Gabbard diagram)
  - 3D graph of the position of the object/s
  - 3D cloud evolution of the fragments
  - Dispersion of the orbital parameters of the fragments



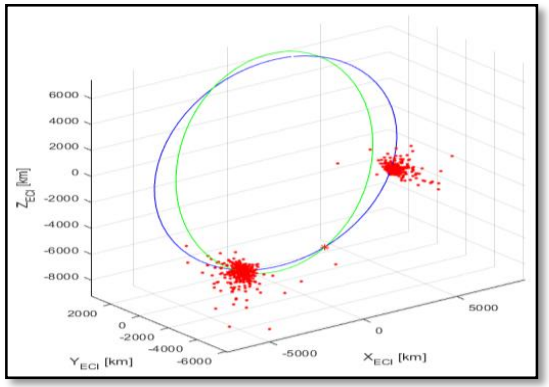


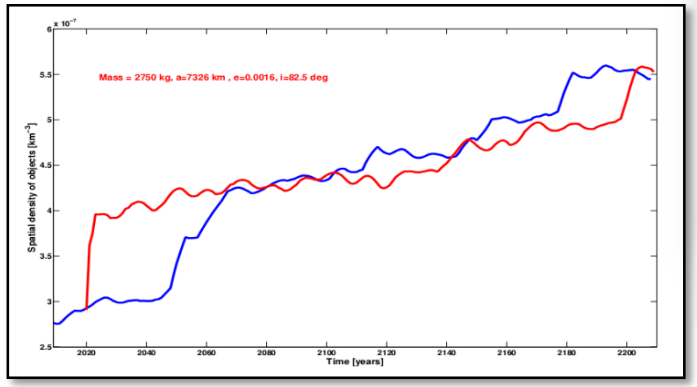




Fragmentation Analysis Service ▪ Products

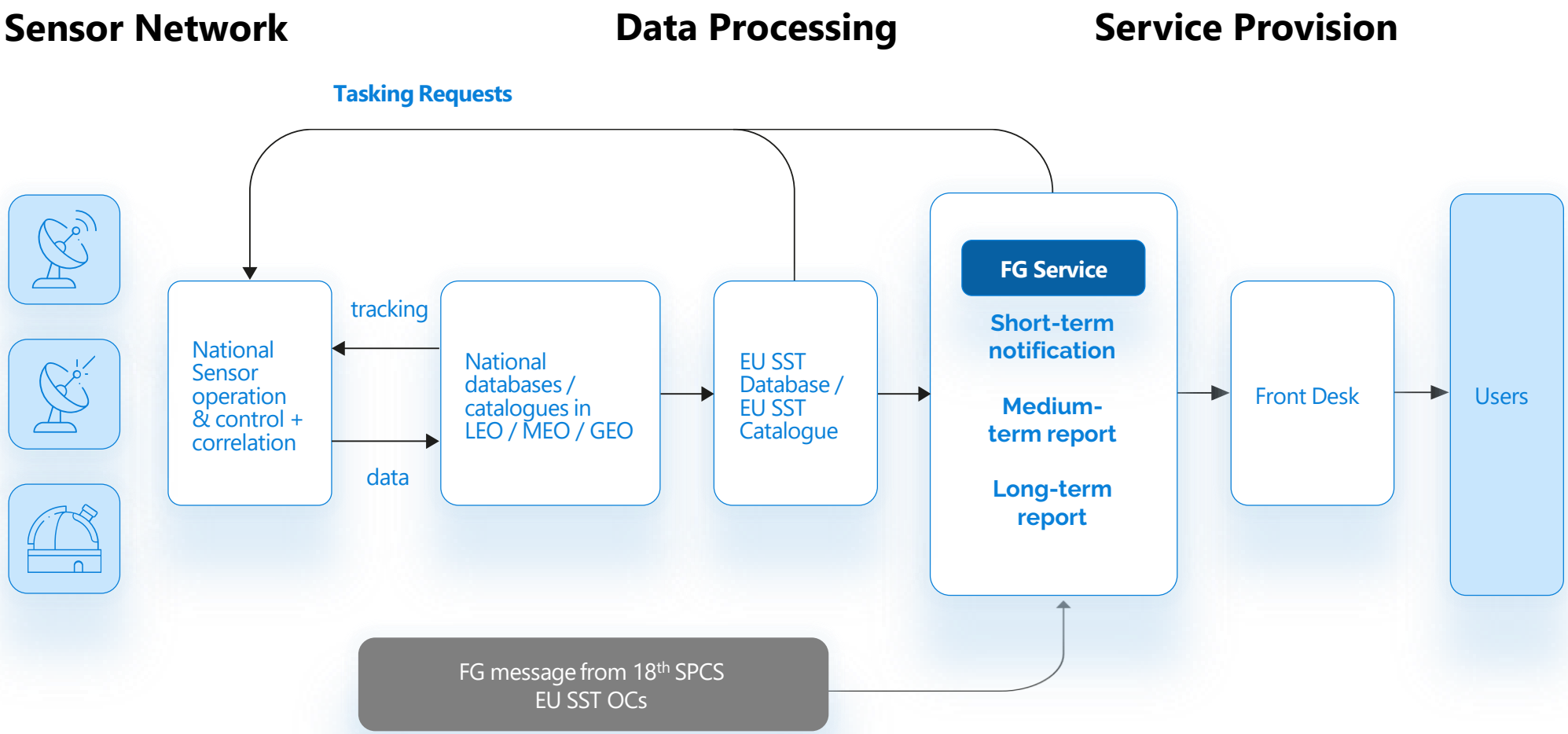
- Long-term report provides updates of the event with the following information:
  - Simulations of the event using an adequate breakup, collision model;
  - Area to Mass ratio distribution;
  - Delta Velocity distribution;
  - Objects' spatial density evolution;
  - Number of fragments expected greater than a given size.





Potential fragmentations are simulated as to prepare for events follow-up

Fragmentation Analysis Service - Operational flow



Fragmentation Analysis Service – Event

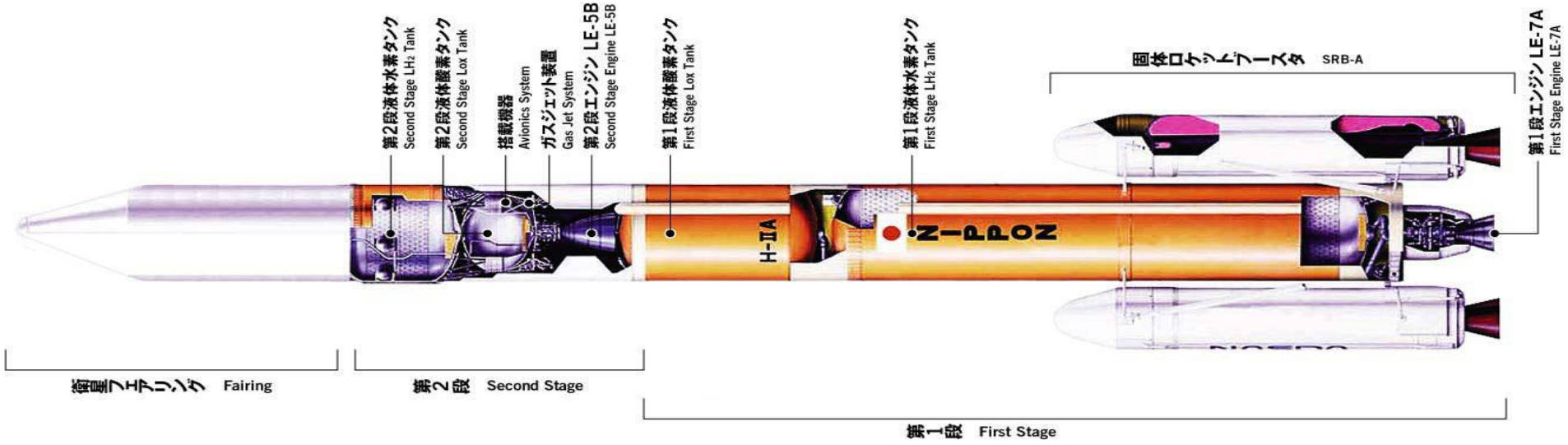
H-2A DEB

July 2020

LEO

53 Fragments

- It was most likely a fairing section of the H-2A, a Japanese rocket launched on October 2018
- Object orbital regime (almost circular orbit 614 x 591 km, 97.9 deg) was a potential hazard for operational satellites in LEO



Credits: JAXA

Fragmentation Analysis Service - Event

H-2A DEB

July 2020

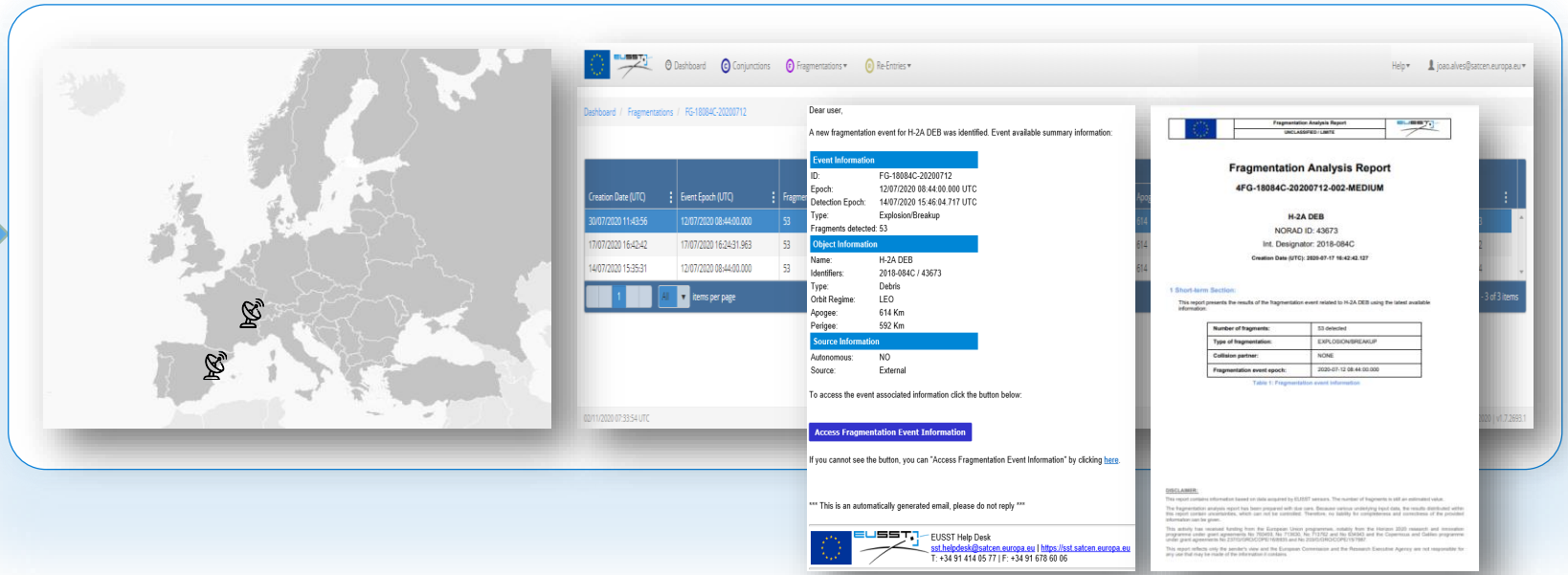
LEO

53 Fragments

Event timeline

- **Event Detection**
- **Event notification**
  Sensors Tasking
- **1st Medium**
  FG Report
- **Medium**
  FG Report
  Update

Sensor network ← **EU SST Database** ← **ISOC & SatCen** →



Fragmentation Analysis Service - Event

H-2A DEB

Fragmentation Analysis Report
UNCLASSIFIED / LIMITE

Fragmentation Analysis Report

4FG-18084C-20200712-003-MEDIUM

H-2A DEB

NORAD ID: 43673

Int. Designator: 2018-084C

Creation Date (UTC): 2020-07-30 11:43:56.683

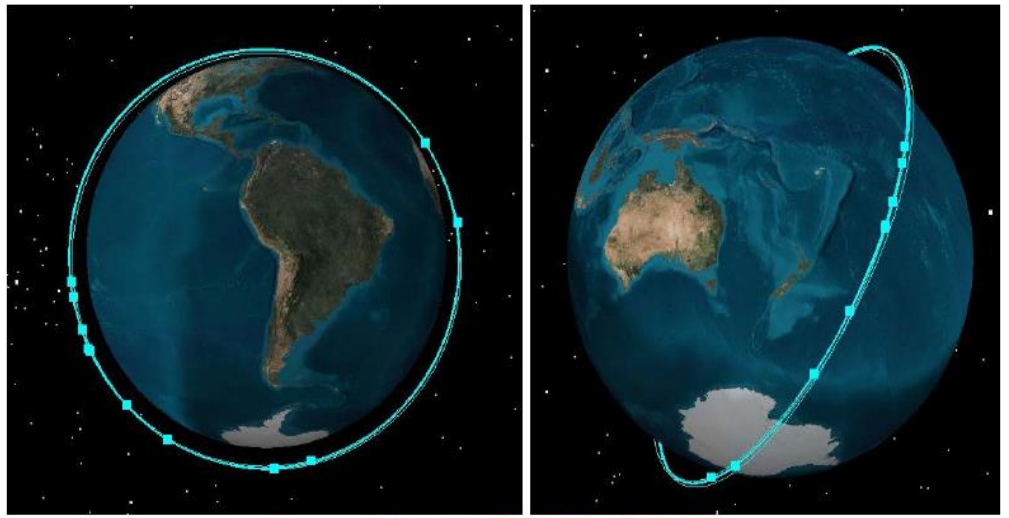
1 Short-term Section:

This report presents the results of the fragmentation event related to H-2A DEB using the latest available information:

Number of fragments:	53 detected
Type of fragmentation:	EXPLOSION/BREAKUP
Collision partner:	NONE
Fragmentation event epoch:	2020-07-12 08:44:00.000

Table 1: Fragmentation event information

c. Fragments cloud evolution:

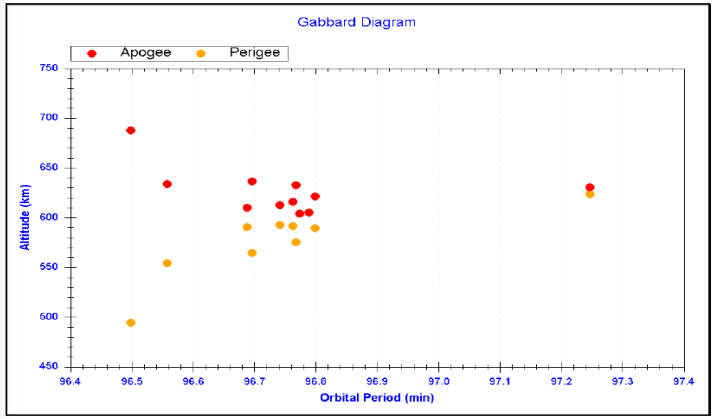


Fragments cloud as at 2020-07-30 11:43:56.683

2 Medium-term Section:

At the time of writing, no fragment is present in the public catalogue related to this fragmentation event, hence no orbital information is available for these 53 objects. However, 11 fragments have been detected and tracked by EUSST sensors. For these fragments, the distribution and the cloud evolution are provided in the following.

a. Fragments distribution (Gabbard diagram)

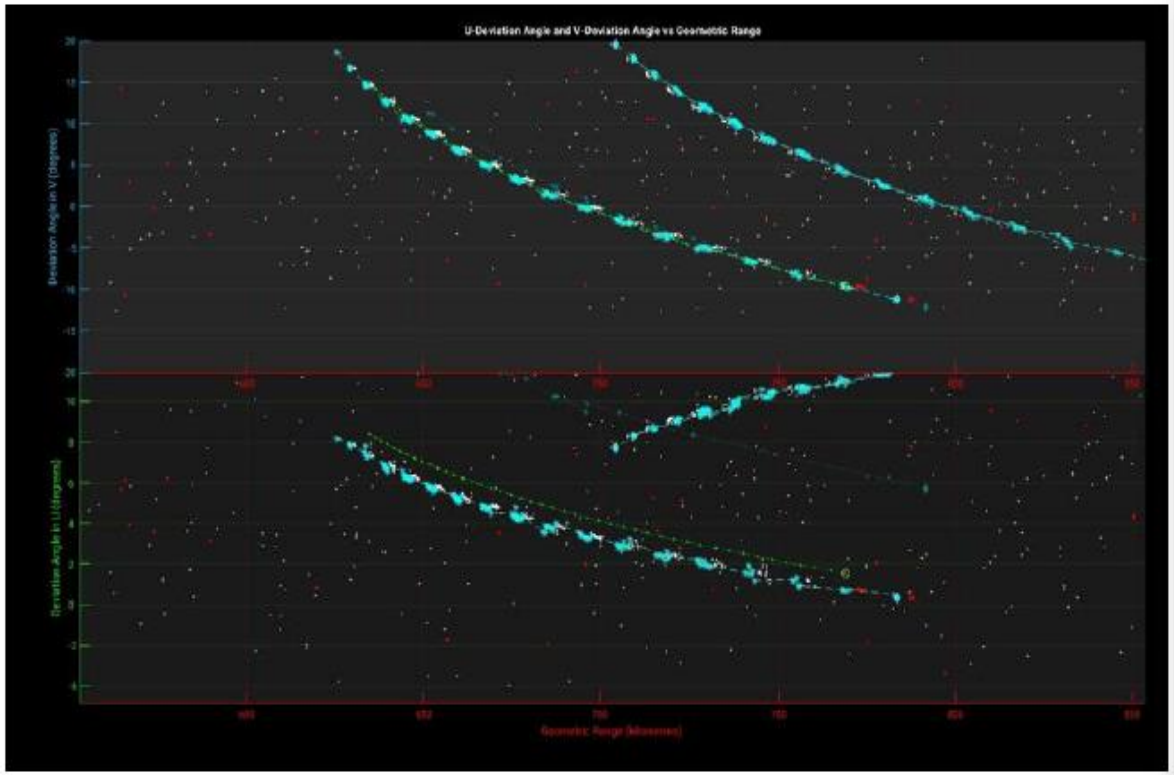


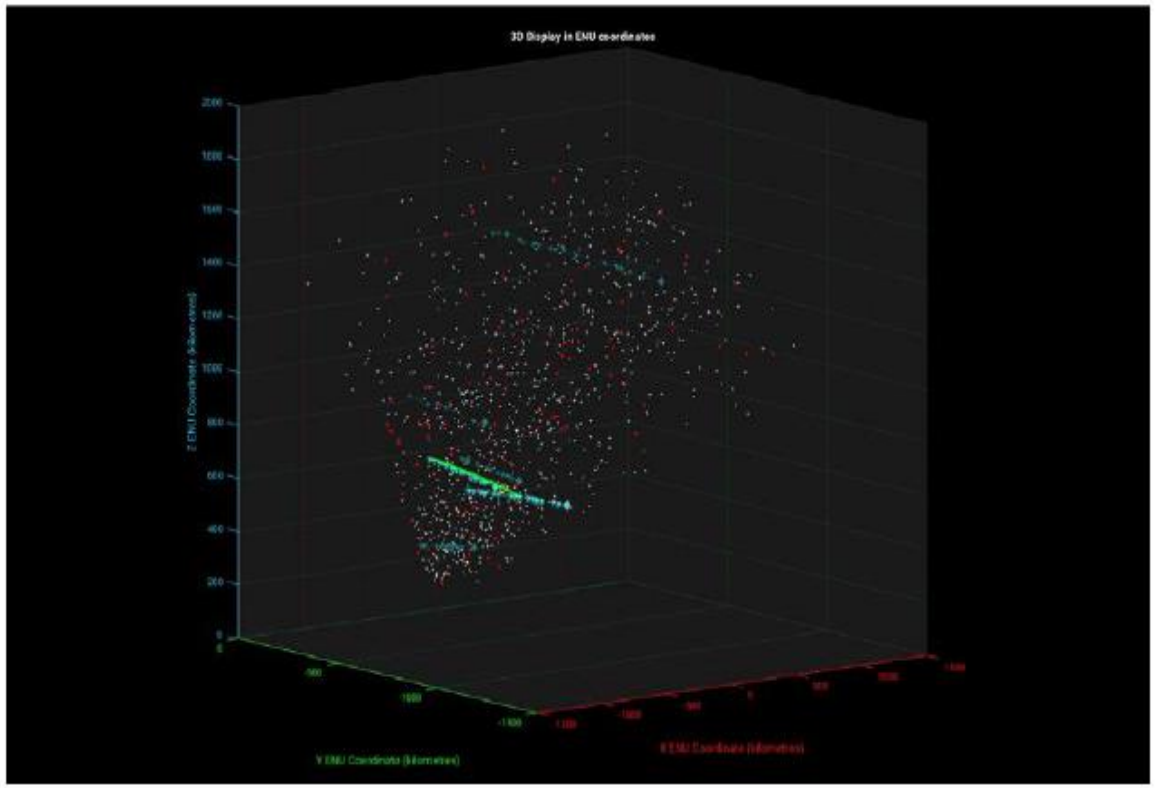
b. Fragments' orbital parameters source: EUSST data propagated at 2020-07-30 11:43:56.683

Fragmentation Analysis Service - Event

H-2A DEB

Fragments pass over EU SST Survey Radar





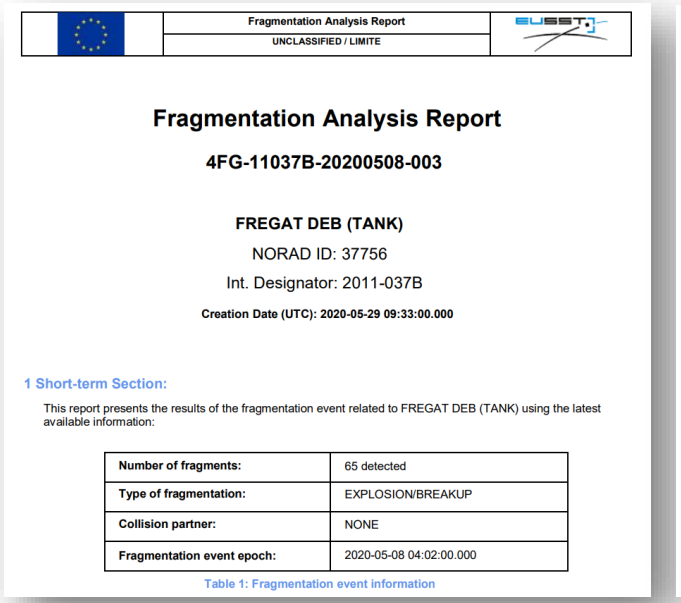
Fragmentation Analysis Service - Event

FREGAT DEB (TANK)

July 2020

65 Fragments

- It was most likely the separable fuel/oxidizer tank discarded by the Fregat upper stage, which already fragmented in 2015 and produced 24 fragments
- Object orbital regime (**elliptical orbit 422 x 3606 km, 51.5 deg**) was a potential hazard for operational satellites in LEO



Fragmentation Analysis Report
UNCLASSIFIED / LIMITE

Fragmentation Analysis Report

4FG-11037B-20200508-003

FREGAT DEB (TANK)

NORAD ID: 37756

Int. Designator: 2011-037B

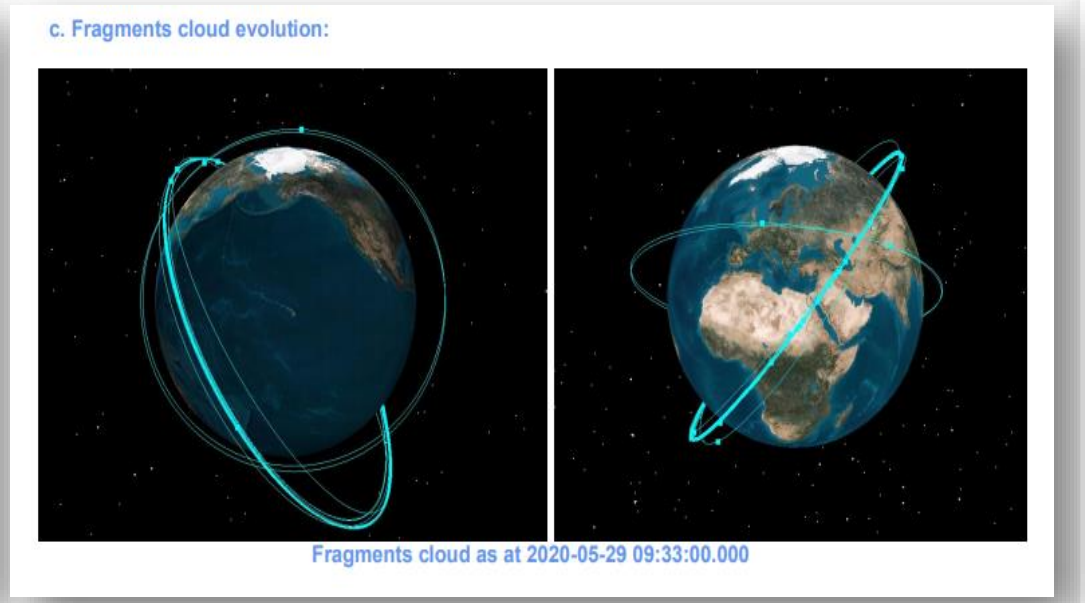
Creation Date (UTC): 2020-05-29 09:33:00.000

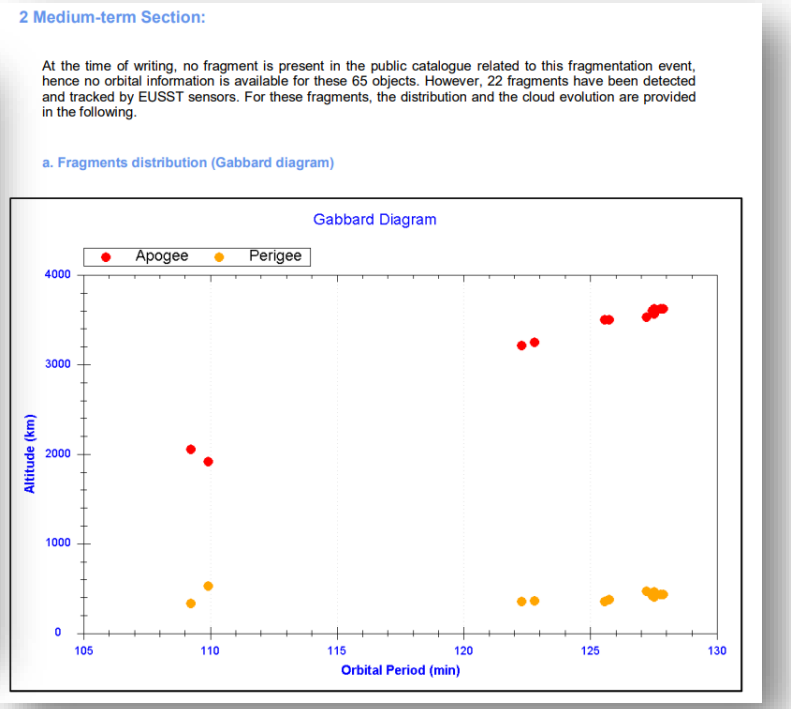
1 Short-term Section:

This report presents the results of the fragmentation event related to FREGAT DEB (TANK) using the latest available information:

Number of fragments:	65 detected
Type of fragmentation:	EXPLOSION/BREAKUP
Collision partner:	NONE
Fragmentation event epoch:	2020-05-08 04:02:00.000

Table 1: Fragmentation event information

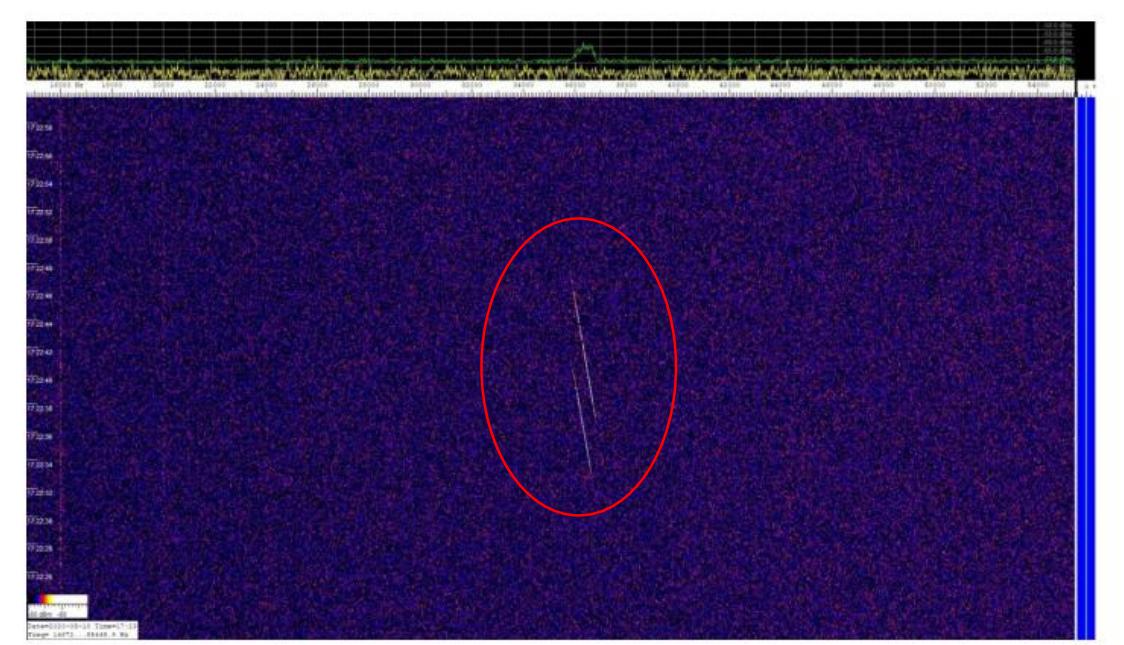




Fragmentation Analysis Service - Event

FREGAT DEB (TANK)

Fragments detected by a Bi-static Radar and a Telescope of EU SST network

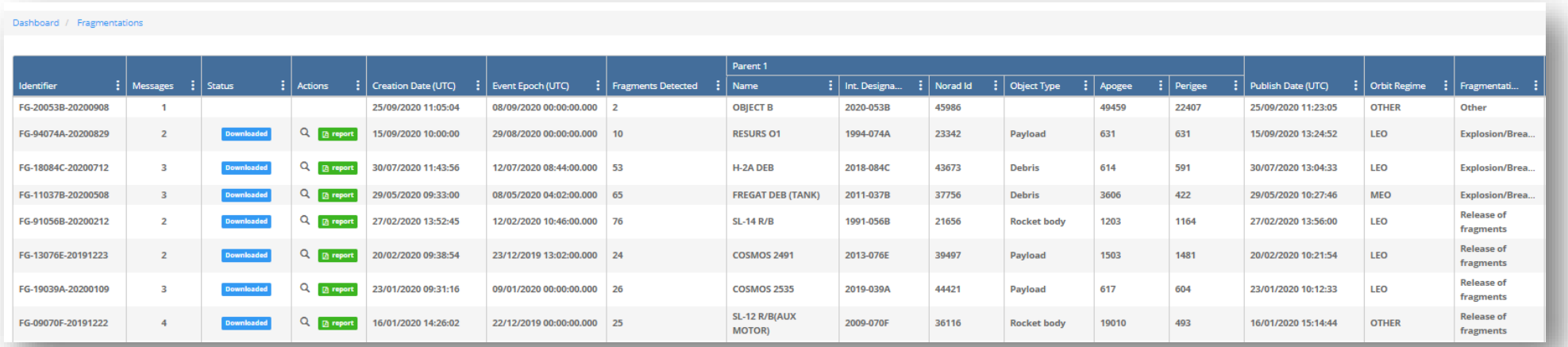



EUSST

Fragmentation Analysis Service - Portal

EU SST Service Provision Portal, enables users to:

- download and access the FG products, either through the REST **API** or through the **web interface**;
- access the **technical notes** and dedicated content produced for events of high media interest;
- receive email **notifications** when new FG products are available;
- access the FG service monthly **statistical** report.

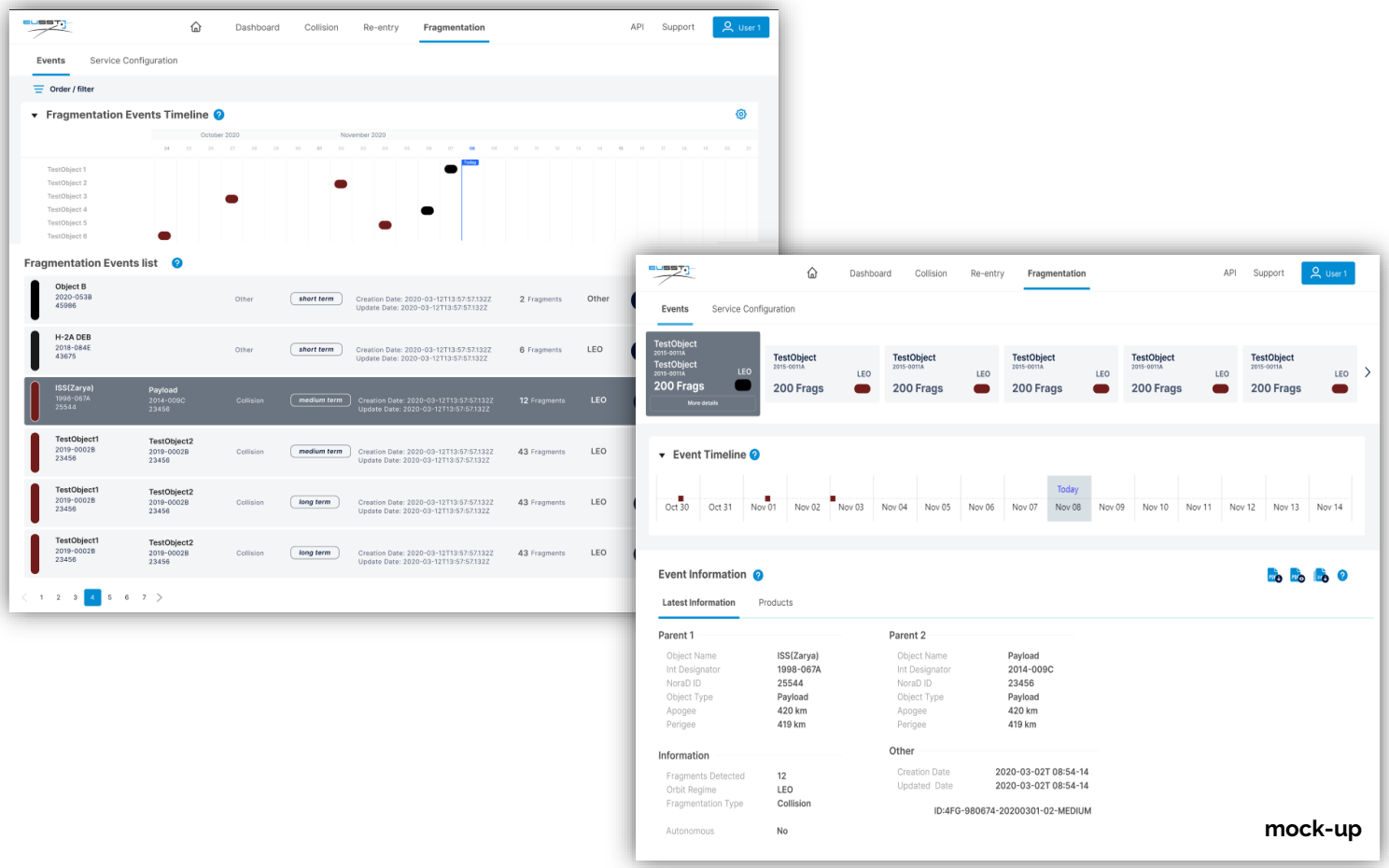


Identifier	Messages	Status	Actions	Creation Date (UTC)	Event Epoch (UTC)	Fragments Detected	Parent 1 Name	Parent 1 Int. Designa...	Parent 1 Norad Id	Parent 1 Object Type	Parent 1 Apogee	Parent 1 Perigee	Publish Date (UTC)	Orbit Regime	Fragmentati...
FG-20053B-20200908	1			25/09/2020 11:05:04	08/09/2020 00:00:00.000	2	OBJECT B	2020-053B	45986		49459	22407	25/09/2020 11:23:05	OTHER	Other
FG-94074A-20200829	2	Downloaded	report	15/09/2020 10:00:00	29/08/2020 00:00:00.000	10	RESURS O1	1994-074A	23342	Payload	631	631	15/09/2020 13:24:52	LEO	Explosion/Brea...
FG-18084C-20200712	3	Downloaded	report	30/07/2020 11:43:56	12/07/2020 08:44:00.000	53	H-2A DEB	2018-084C	43673	Debris	614	591	30/07/2020 13:04:33	LEO	Explosion/Brea...
FG-11037B-20200508	3	Downloaded	report	29/05/2020 09:33:00	08/05/2020 04:02:00.000	65	FREGAT DEB (TANK)	2011-037B	37756	Debris	3606	422	29/05/2020 10:27:46	MEO	Explosion/Brea...
FG-91056B-20200212	2	Downloaded	report	27/02/2020 13:52:45	12/02/2020 10:46:00.000	76	SL-14 R/B	1991-056B	21656	Rocket body	1203	1164	27/02/2020 13:56:00	LEO	Release of fragments
FG-13076E-20191223	2	Downloaded	report	20/02/2020 09:38:54	23/12/2019 13:02:00.000	24	COSMOS 2491	2013-076E	39497	Payload	1503	1481	20/02/2020 10:21:54	LEO	Release of fragments
FG-19039A-20200109	3	Downloaded	report	23/01/2020 09:31:16	09/01/2020 00:00:00.000	26	COSMOS 2535	2019-039A	44421	Payload	617	604	23/01/2020 10:12:33	LEO	Release of fragments
FG-09070F-20191222	4	Downloaded	report	16/01/2020 14:26:02	22/12/2019 00:00:00.000	25	SL-12 R/B(AUX MOTOR)	2009-070F	36116	Rocket body	19010	493	16/01/2020 15:14:44	OTHER	Release of fragments

Fragmentation Analysis Service - Portal

NEW EU SST Portal

- New **integrated** service provision view (events information, service configuration, products download);
- New event page (**timeline,** latest information update, **Gabbard** diagram, fragments **cloud evolution**, products).



Fragmentation Analysis Service ▪ Users

Fragmentation Analysis

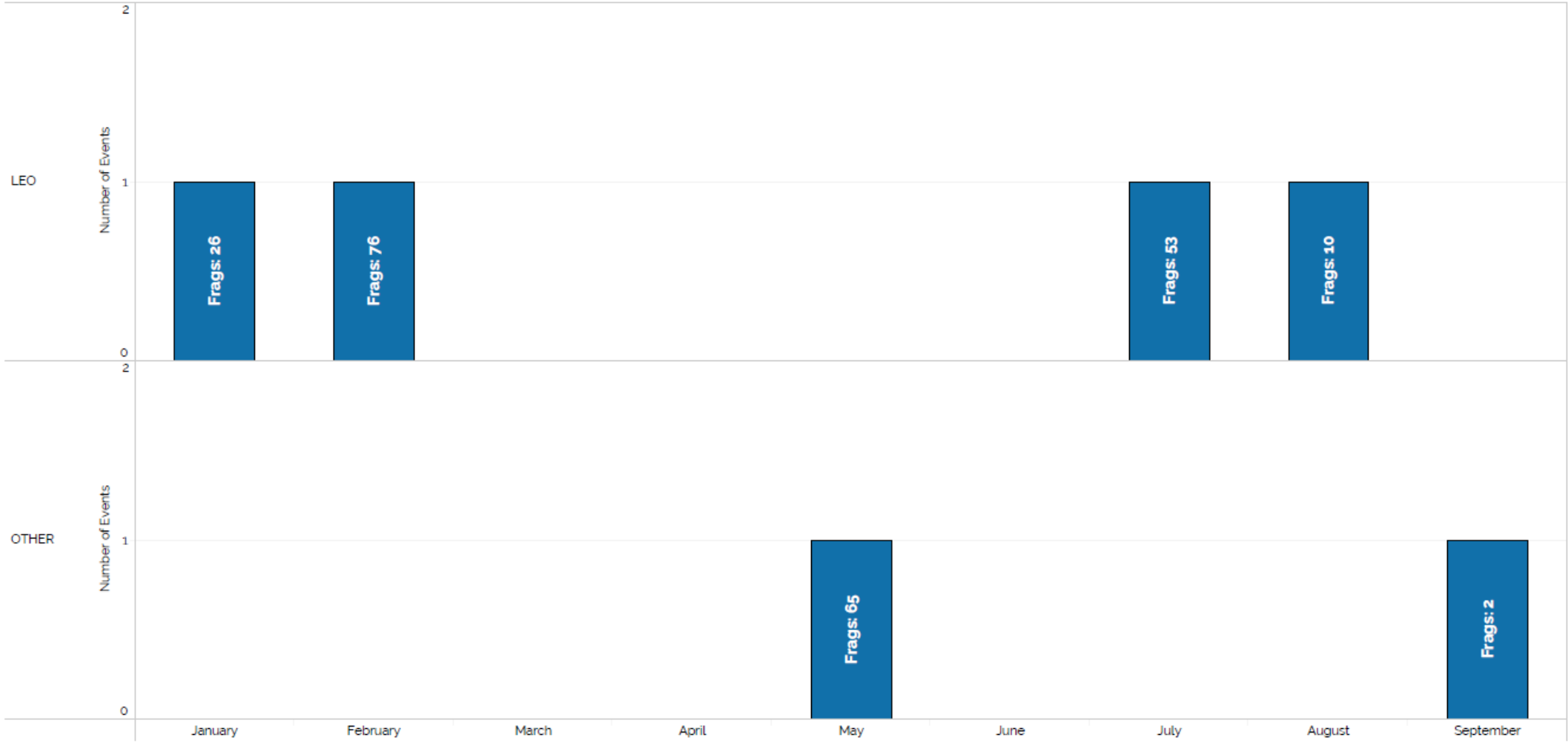
+70
ORGS

20%
Governmental

30%
Industry

20%
Academy

Fragmentation Analysis Service - Metrics



One event every 1-2 months

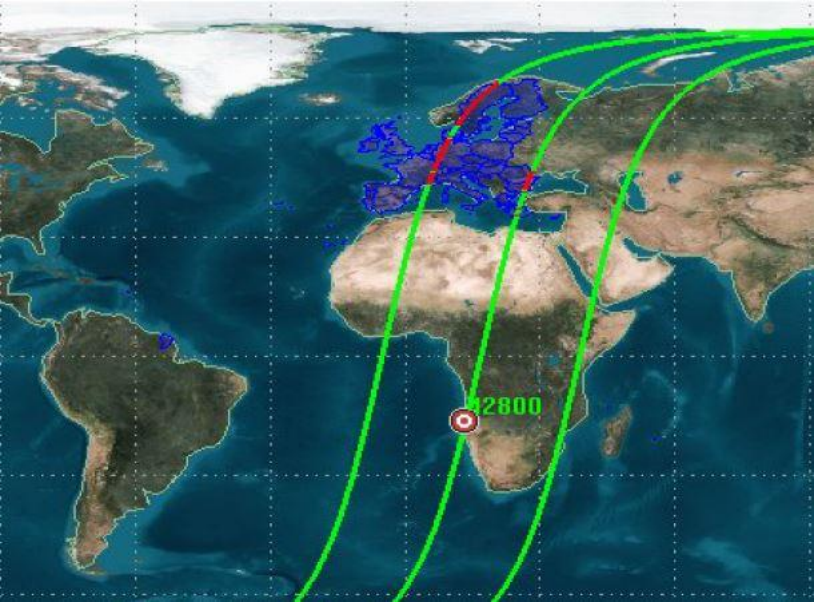
8 autonomous products (with EU SST sensors data)


EUSST

RE Analysis Service ▪ Outline

- Re-entry Analysis Service Overview
- Key features and products
- Operational flow
- Events
- Portal, metrics and Users

Re-entry Analysis Service ▪ Overview



The Re-entry Analysis (RE) Service:

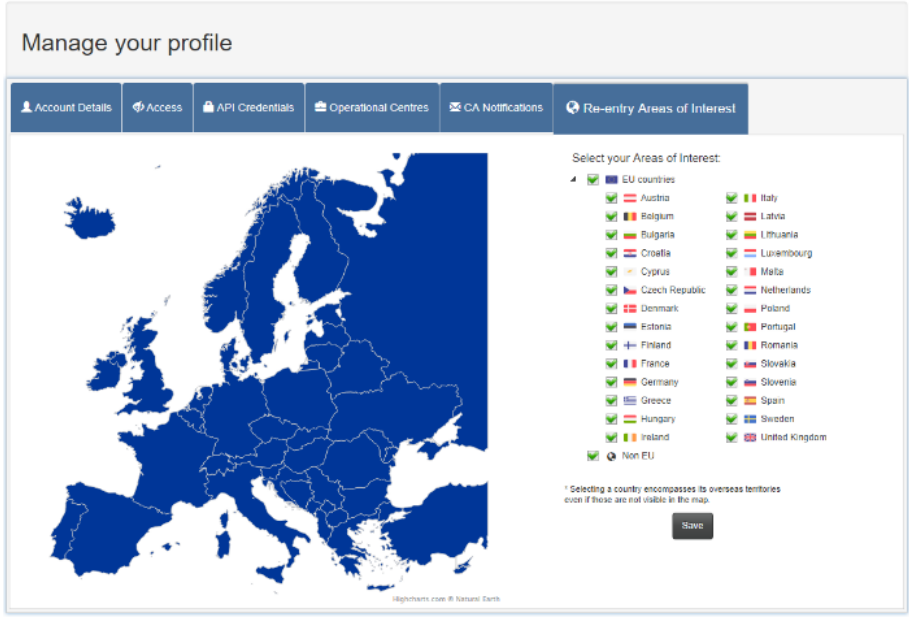
- provides the **risk assessment of the uncontrolled re-entry** of man-made space objects and space debris into the Earth's atmosphere and the generation of related information.
- analyses all available information regarding the uncontrolled re-entries within 30 days.

Re-entry Analysis Service ▪ Key features

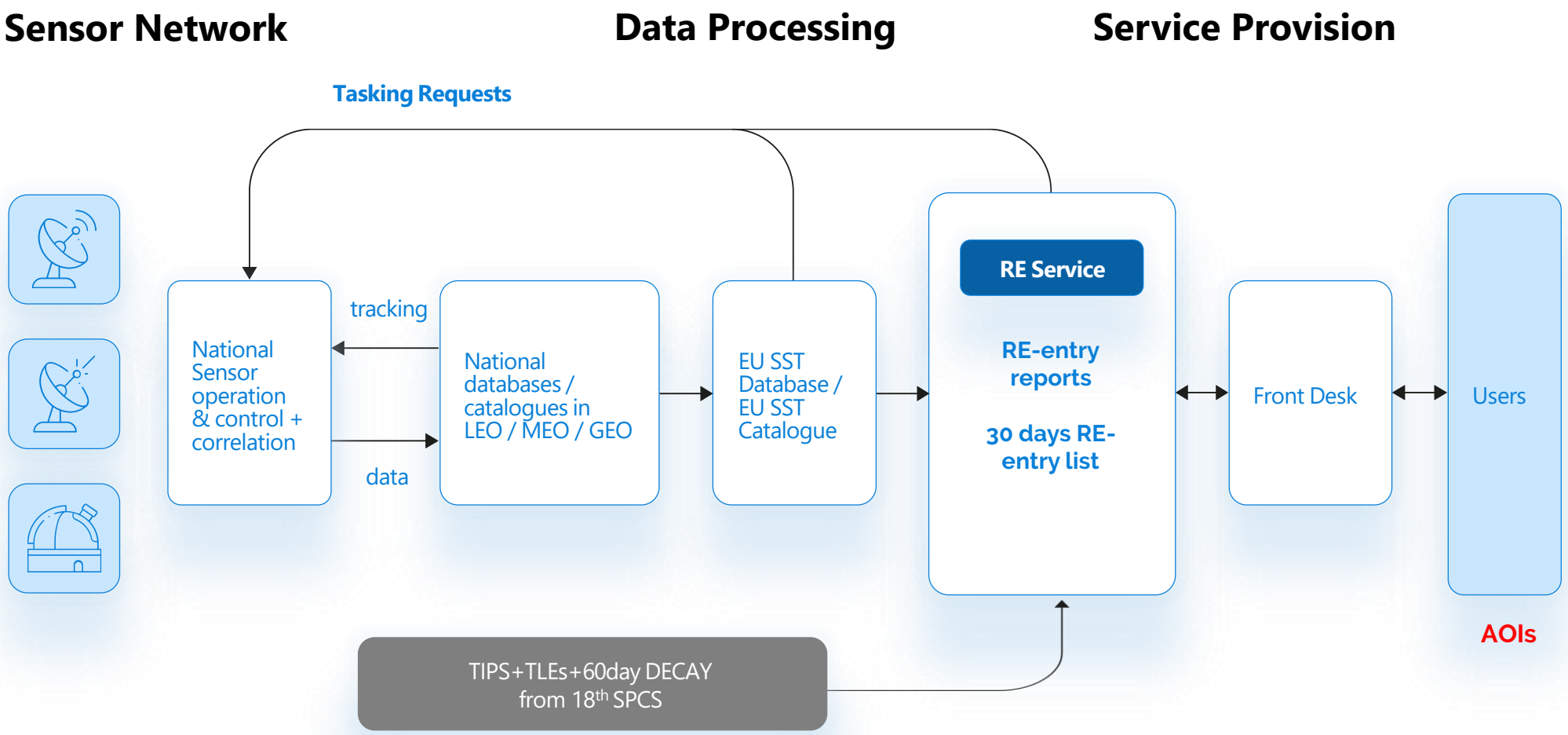
- The **criteria** applied for the objects to be reported is:
  - mass greater than 2.000 kg (if known);
  - *or* Radar Cross Section (RCS) larger than 1m²;
  - *and* all rocket bodies (R/B).

- Tasking requests are sent to all sensors contributing to EU SST, in order to acquire additional data and **improve the accuracy of predictions**, generating autonomous products, if possible.

- Re-entry information provided in accordance with users' personalised geographical **Areas of Interest (AoIs).**



Re-entry Analysis Service ▪ Operational flow

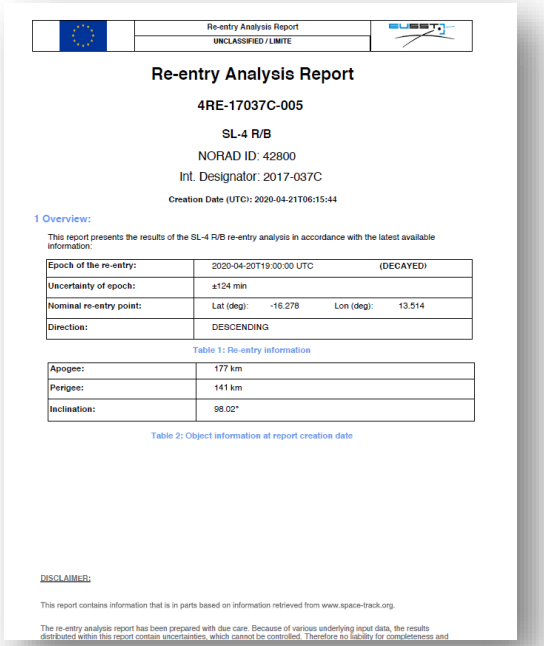


Re-entry Analysis Service ▪ Products

- The content of the EU SST products includes:
  - Object identification and characterization;
  - Object orbital information;
  - Re-entry prediction information.

- Content is provided to users as:
  - 30 Days Re-entry List;
  - Re-entry Report;

- In addition, dedicated event pages are created for specific events (e.g. Tiangong-1)



Re-entry Analysis Report
UNCLASSIFIED / LIMITE

Re-entry Analysis Report

4RE-17037C-005

SL-4 R/B

NORAD ID: 42800

Int. Designator: 2017-037C

Creation Date (UTC): 2020-04-21T06:15:44

1 Overview:

This report presents the results of the SL-4 R/B re-entry analysis in accordance with the latest available information:

Epoch of the re-entry:	2020-04-20T19:00:00 UTC		(DECAYED)
Uncertainty of epoch:	±124 min		
Nominal re-entry point:	Lat (deg): -16.278	Lon (deg):	13.514
Direction:	DESCENDING		

Table 1: Re-entry information

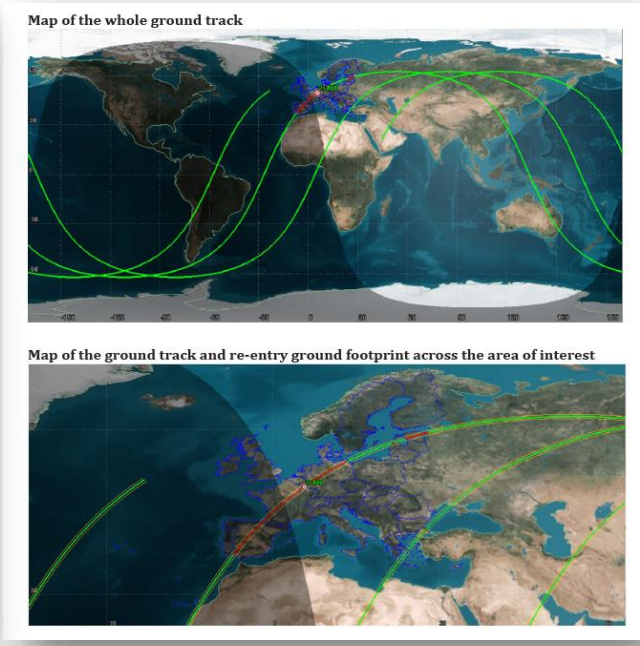
Apogee:	177 km
Perigee:	141 km
Inclination:	98.02°

Table 2: Object information at report creation date

DISCLAIMER:

This report contains information that is in parts based on information retrieved from www.space-track.org.

The re-entry analysis report has been prepared with due care. Because of various underlying input data, the results distributed within this report contain uncertainties, which cannot be controlled. Therefore no liability for completeness and



Map of the whole ground track

Map of the ground track and re-entry ground footprint across the area of interest

30 Days Re-Entry List

Product ID: **4-RE30DRL-11112019**
Creation Date (UTC): **11/11/2019 12:45:00**
Publish Date (UTC): **11/11/2019 12:49:43**

Object Name	Int. Designator	Object Type	Max. Latitude (deg.)	Mass (Kg.)	Size	Window Start	Window End
PSLV DEB	**2010-035G**	Debris	98.04		Large	17/11/2019	21/11/2019
CZ-3B DEB	**2012-018C**	Debris	54.7		Large	16/11/2019	18/11/2019
ATLAS 5 CENTAUR R/B	**2017-004B**	RocketBody	22.5		Large	15/11/2019	18/11/2019

1 | 20 items per page | 1 - 3 of 3 items

Re-entry Analysis Service ▪ Event

CZ-5B Long March R/B

- Long March 5B rocket launched a prototype crewed spacecraft on May 5th 2020 from the Wenchang Satellite Launch Center/Hainan, demonstrating the launcher's capability to carry space station modules to LEO
- One of the most massive object (17-20 tons) to reenter on Earth
- Launcher is a variant of the standard Long March 5: CZ-5B lacks the second stage
- Core stage of the rocket measures around 30 meters long and 5 meters wide
- Currently the most powerful member of the Long March rocket family
- Two villages in Cote d'Ivoire have reported finding what they believe to be debris from the fallen rocket stage

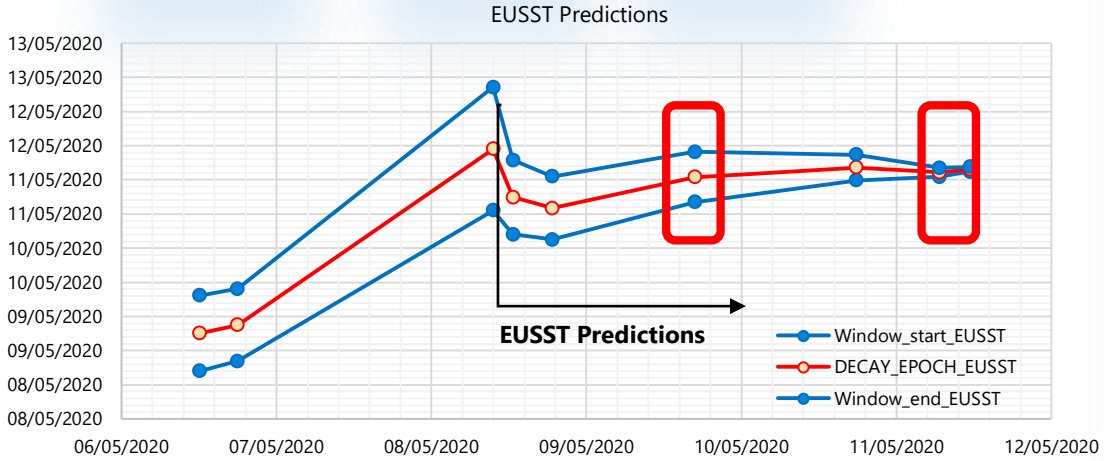
Image by Aminata24 via Jonathan McDowell on Twitter

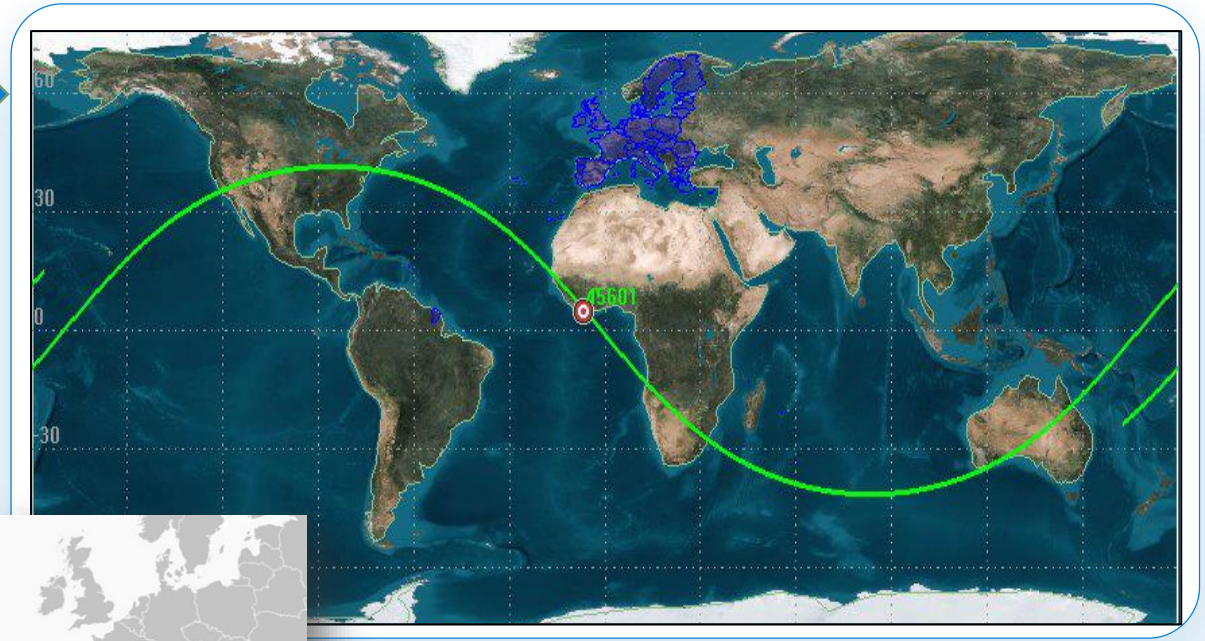
Re-entry Analysis Service ▪ Event

CZ-5B Long March R/B

Event timeline

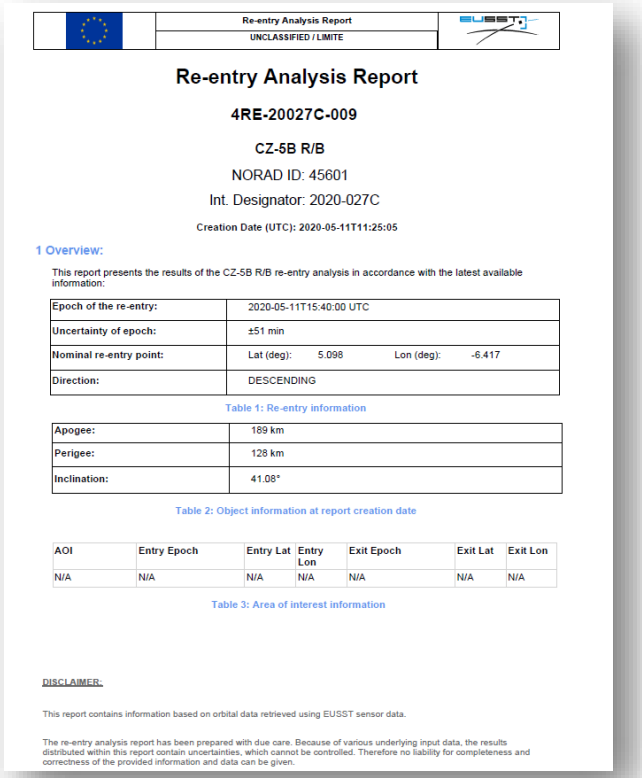
- **Sensors Tasking**
- **1st Prediction T-120h**
- **1st EU SST Prediction T-72h**
- **Final EU SST Prediction T-4h**





Re-entry Analysis Service ▪ Event

CZ-5B Long March R/B



Re-entry Analysis Report
UNCLASSIFIED / LIMITE

Re-entry Analysis Report

4RE-20027C-009

CZ-5B R/B

NORAD ID: 45601

Int. Designator: 2020-027C

Creation Date (UTC): 2020-05-11T11:25:05

1 Overview:

This report presents the results of the CZ-5B R/B re-entry analysis in accordance with the latest available information:

Epoch of the re-entry:	2020-05-11T15:40:00 UTC
Uncertainty of epoch:	±51 min
Nominal re-entry point:	Lat (deg): 5.098 Lon (deg): -6.417
Direction:	DESCENDING

Table 1: Re-entry information

Apogee:	189 km
Perigee:	128 km
Inclination:	41.08°

Table 2: Object information at report creation date

AOI	Entry Epoch	Entry Lat	Entry Lon	Exit Epoch	Exit Lat	Exit Lon
N/A	N/A	N/A	N/A	N/A	N/A	N/A

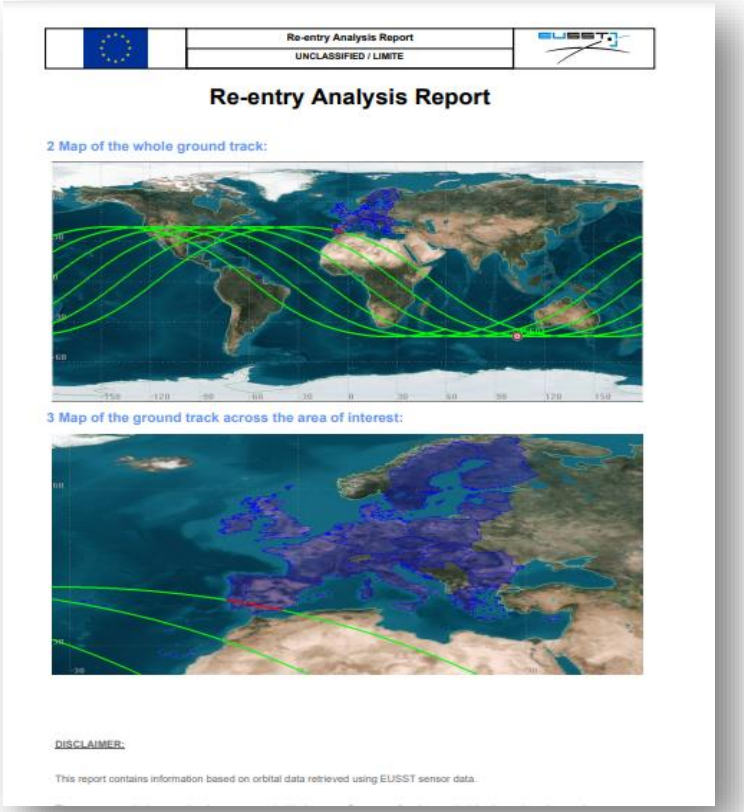
Table 3: Area of interest information

DISCLAIMER:

This report contains information based on orbital data retrieved using EUSST sensor data.

The re-entry analysis report has been prepared with due care. Because of various underlying input data, the results distributed within this report contain uncertainties, which cannot be controlled. Therefore no liability for completeness and correctness of the provided information and data can be given.

10 Reports



Re-entry Analysis Report
UNCLASSIFIED / LIMITE

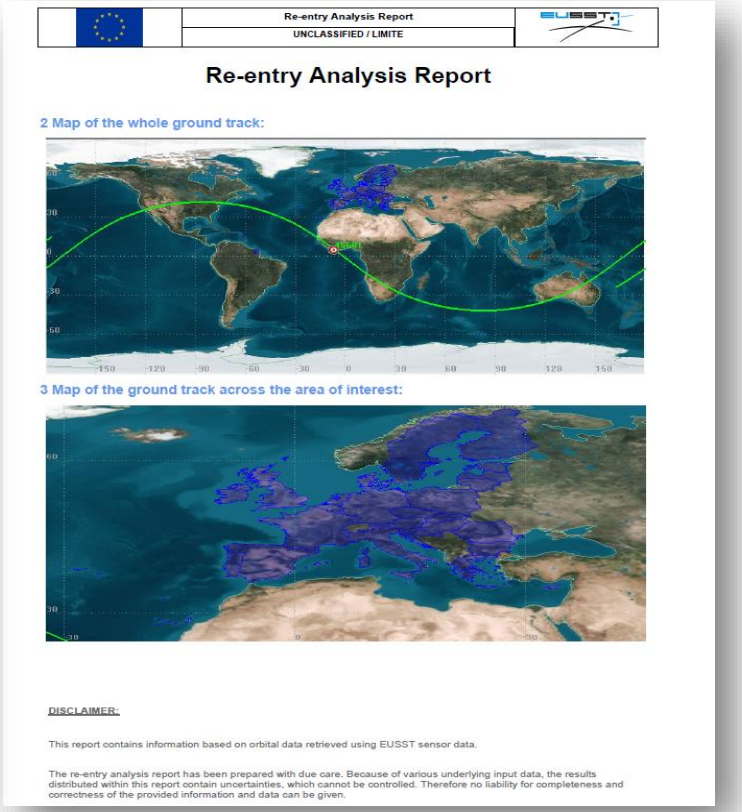
Re-entry Analysis Report

2 Map of the whole ground track:

3 Map of the ground track across the area of interest:

DISCLAIMER:

This report contains information based on orbital data retrieved using EUSST sensor data.



Re-entry Analysis Report
UNCLASSIFIED / LIMITE

Re-entry Analysis Report

2 Map of the whole ground track:

3 Map of the ground track across the area of interest:

DISCLAIMER:

This report contains information based on orbital data retrieved using EUSST sensor data.

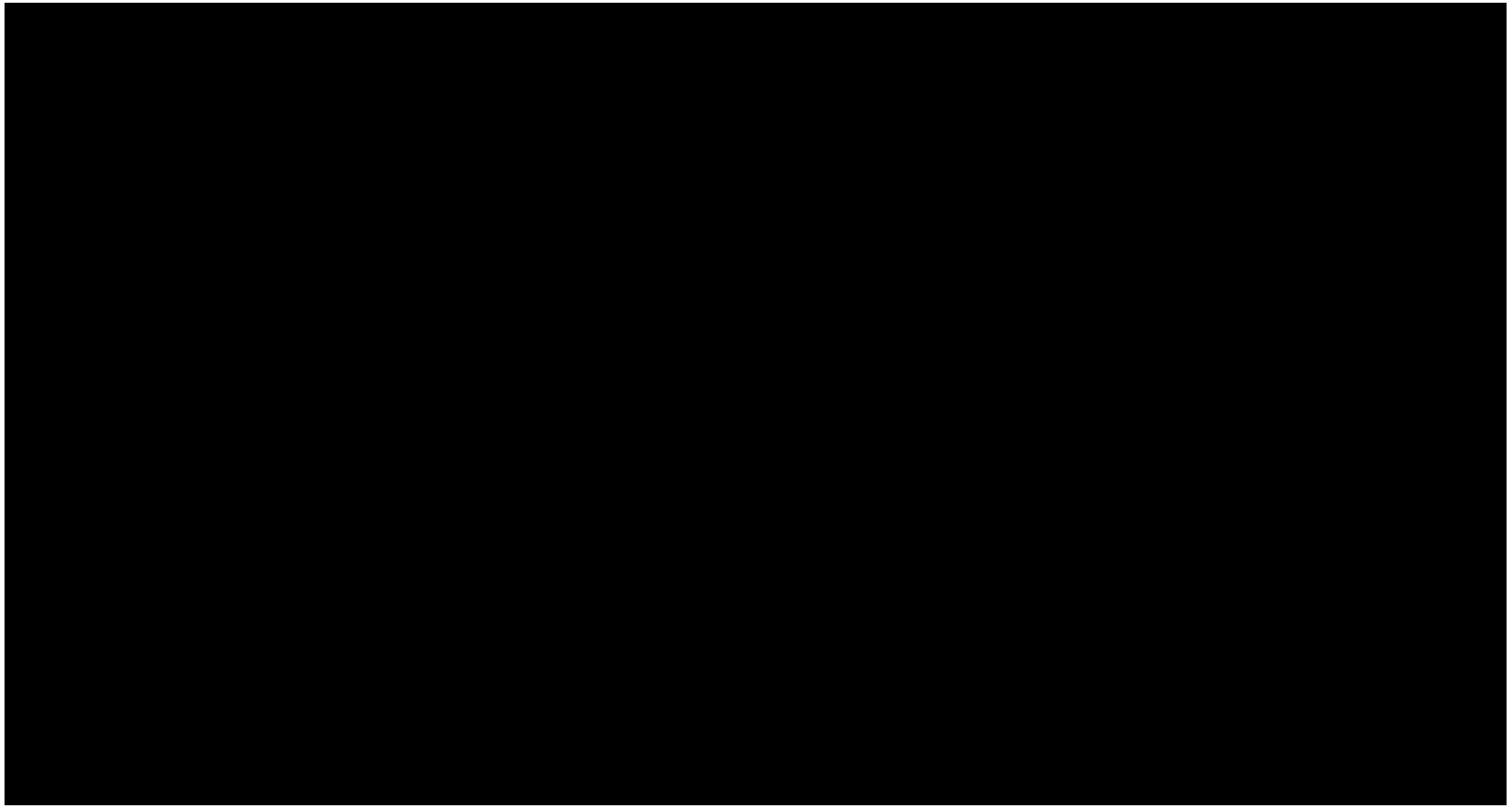
The re-entry analysis report has been prepared with due care. Because of various underlying input data, the results distributed within this report contain uncertainties, which cannot be controlled. Therefore no liability for completeness and correctness of the provided information and data can be given.

5 Autonomous Reports based on data from 4 EU SST contributing sensors

Re-entry Analysis Service ▪ Event

CZ-5B Long March R/B

Simulated Re-entry Trajectory up to 80km altitude



Re-entry Analysis Service ▪ Event

FALCON 9 R/B

- Launched October 6th
- Re-entered on October 30th

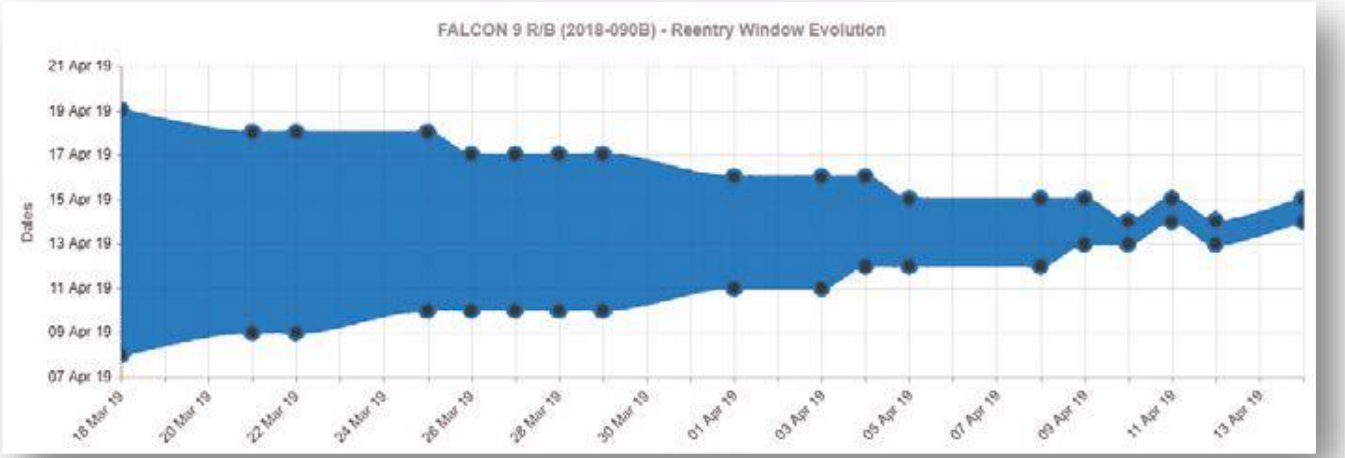
Optical video from a camera mounted on a EU SST Doppler Radar


EUSST

Re-entry Analysis Service ▪ Portal

EU SST Service Provision Portal, enables users to:

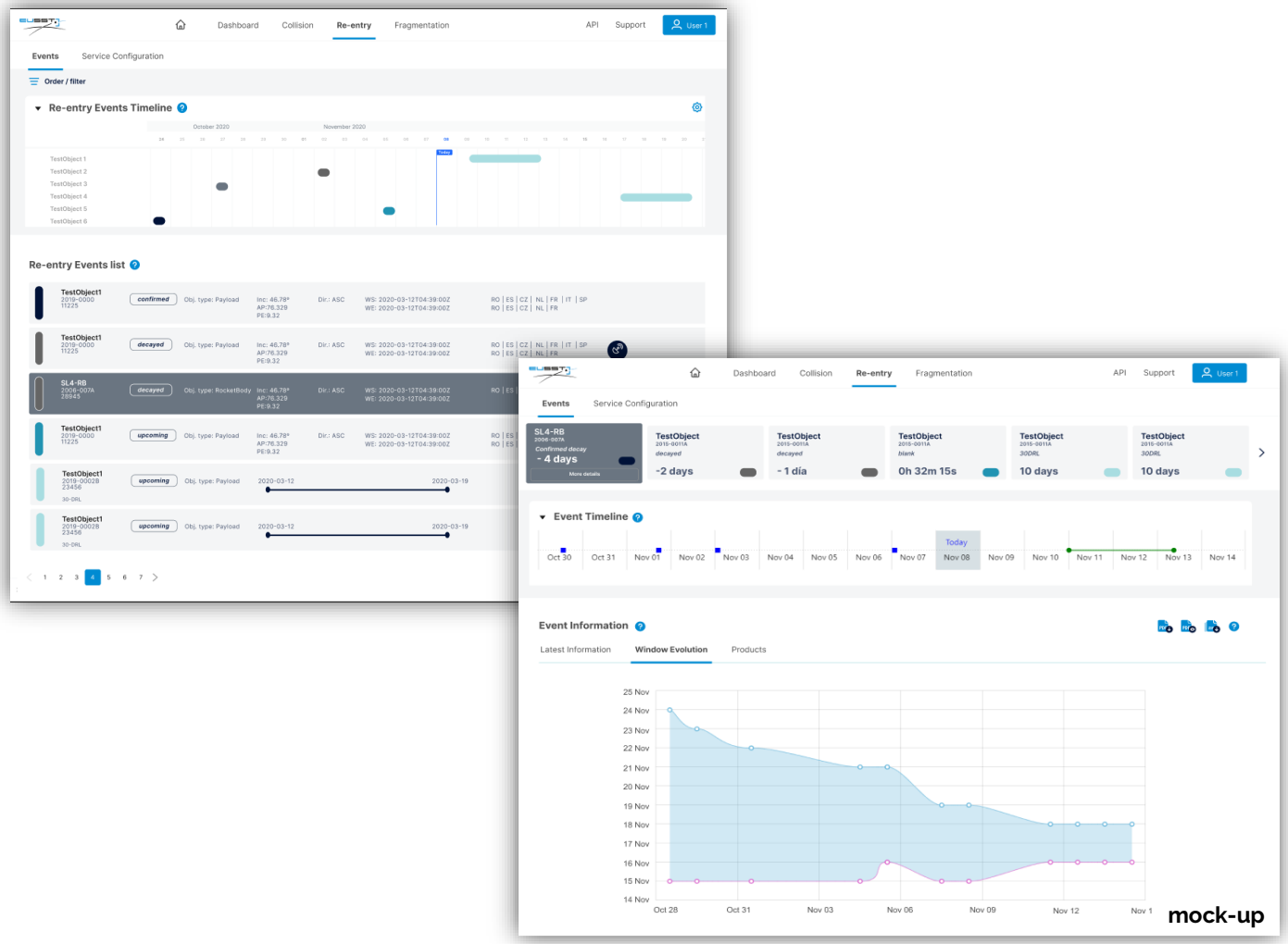
- download and access the RE products, either through the REST **API** or through the **web interface**;
- view the re-entry prediction **evolution** of an object in the 30 days' re-entry list;
- access the **technical notes** produced for events of high-media interest;
- select the re-entry **Areas of Interest**;
- select the 30 days' re-entry list email **notifications**, and
- access the RE service monthly **statistical** report.



Re-entry Analysis Service - Portal

NEW EU SST Portal

- **Overall view** of the re-entry events combining information from 30 days re-entry list and from reports;
- New **integrated** service provision view (events information, service configuration, products download);
- New event page (**timeline,** latest update, window evolution, **ground track**, products).



Re-entry Analysis Service ▪ Users

Re-entry Analysis

+80
ORGS

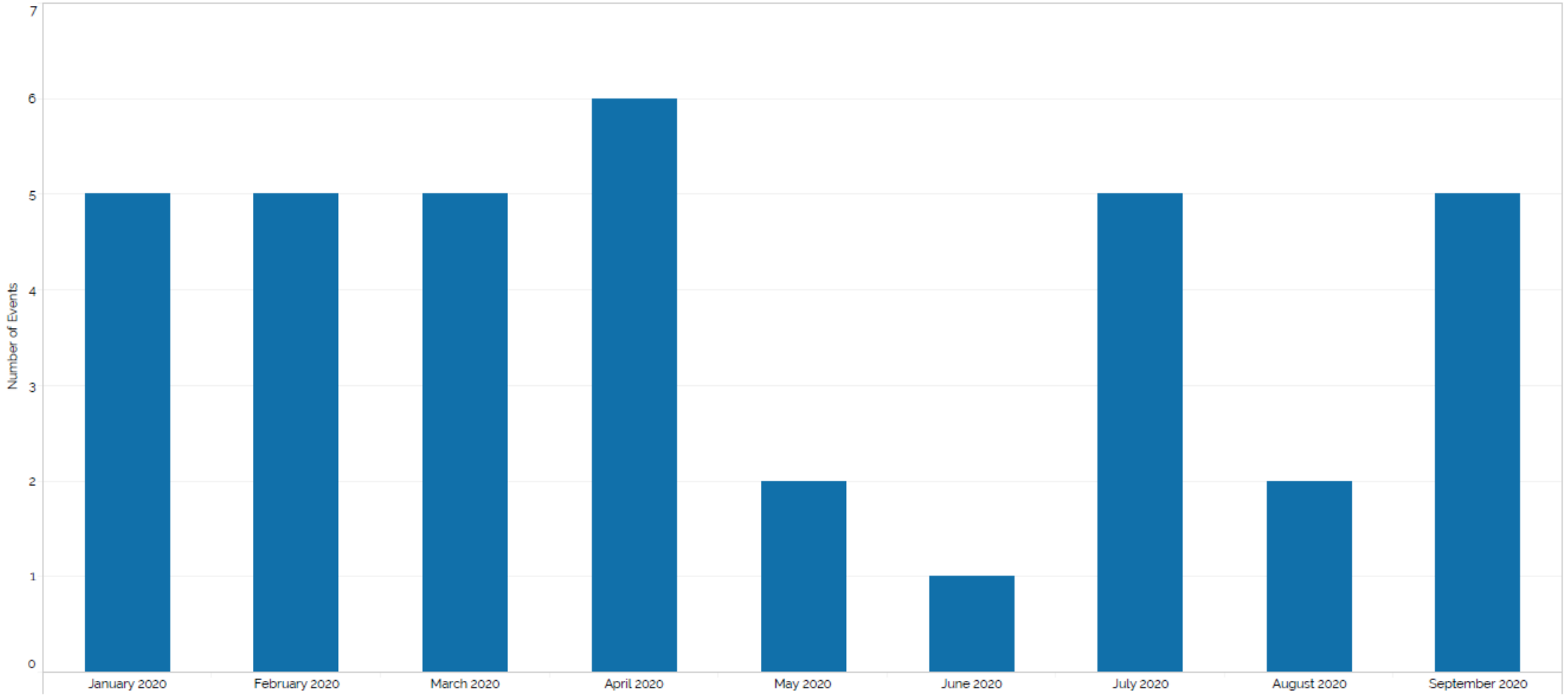
6%
Civil Protection

30%
Governmental

30%
Industry

20%
Academy

Re-entry Analysis Service ▪ Metrics

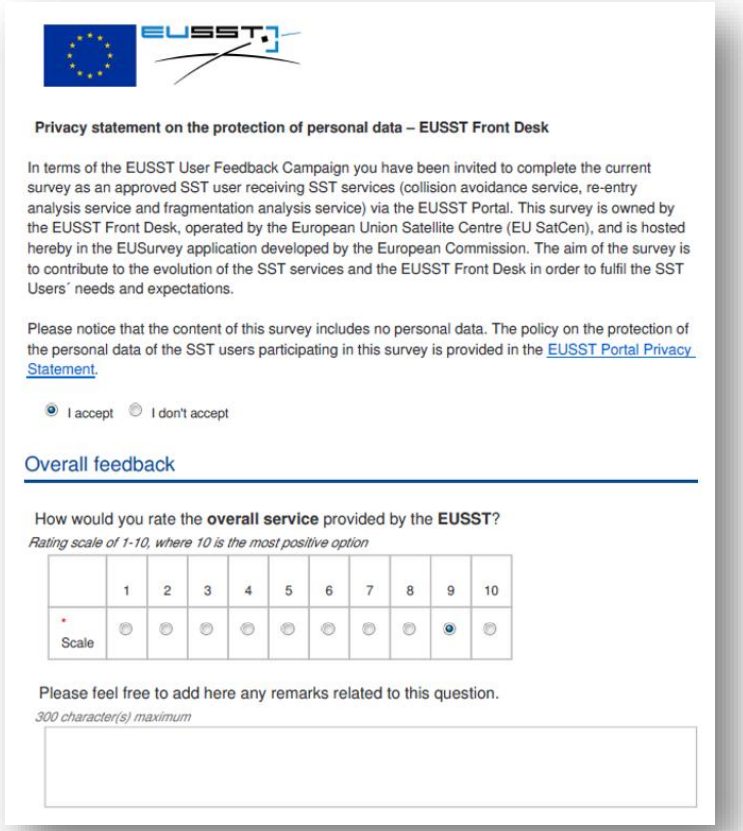


4-5 events per month

22 autonomous products (with EU SST sensors data)

3rd User Feedback Campaign

- Next user feedback campaign **starts in the next weeks!**
- Objective: identifying **key strengths and** areas for **improvement**
- Addressed to **existing users** of the Fragmentation (FG) and Re-entry Analysis (RE) services
- **Your feedback is very important** to keep improving our services



Privacy statement on the protection of personal data – EUSST Front Desk

In terms of the EUSST User Feedback Campaign you have been invited to complete the current survey as an approved SST user receiving SST services (collision avoidance service, re-entry analysis service and fragmentation analysis service) via the EUSST Portal. This survey is owned by the EUSST Front Desk, operated by the European Union Satellite Centre (EU SatCen), and is hosted hereby in the EUSurvey application developed by the European Commission. The aim of the survey is to contribute to the evolution of the SST services and the EUSST Front Desk in order to fulfil the SST Users´ needs and expectations.

Please notice that the content of this survey includes no personal data. The policy on the protection of the personal data of the SST users participating in this survey is provided in the EUSST Portal Privacy Statement.

I accept I don't accept

Overall feedback

How would you rate the **overall service** provided by the **EUSST**?

Rating scale of 1-10, where 10 is the most positive option

	1	2	3	4	5	6	7	8	9	10
* Scale										

Please feel free to add here any remarks related to this question.

300 character(s) maximum

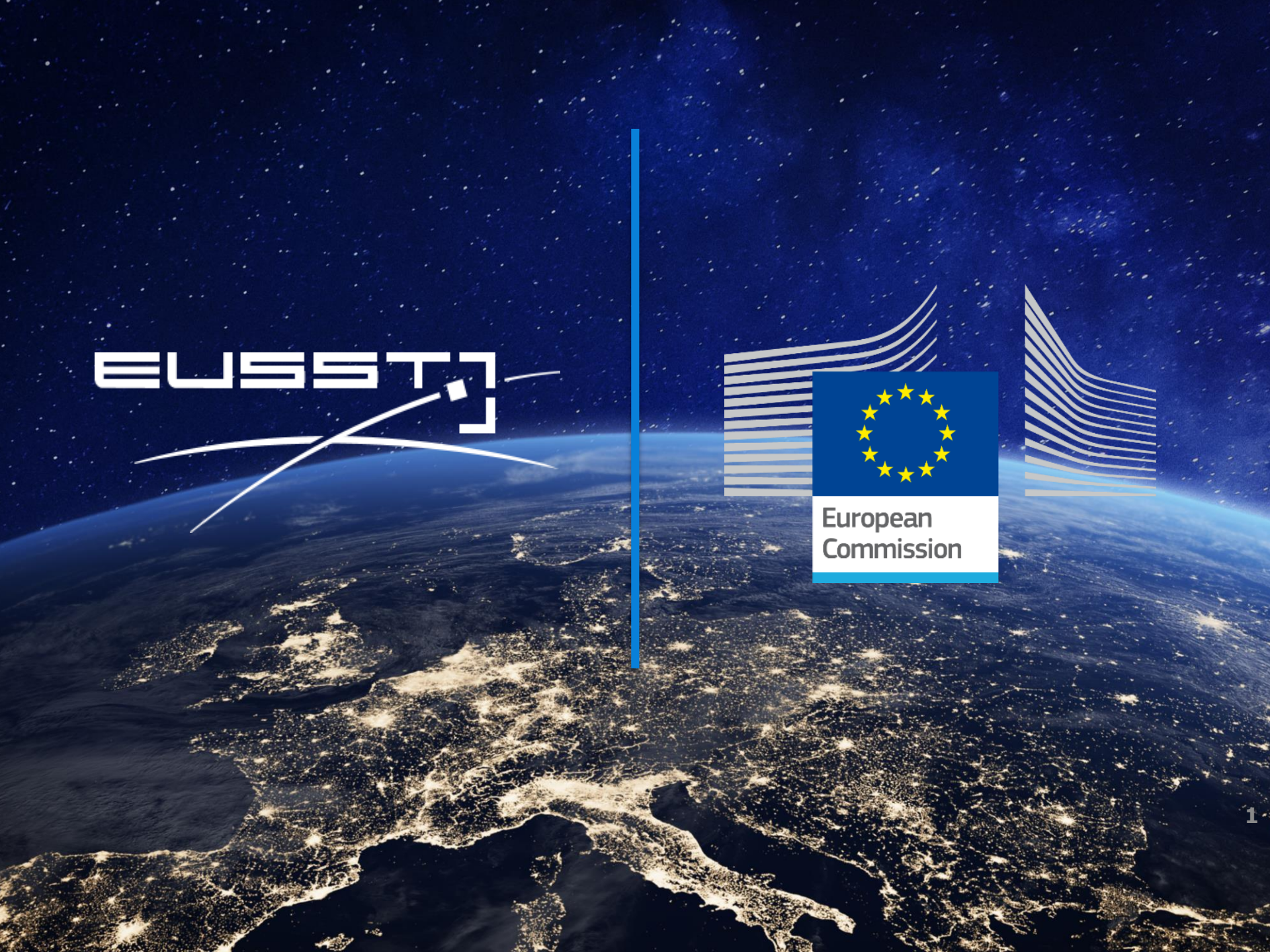
Accuracy

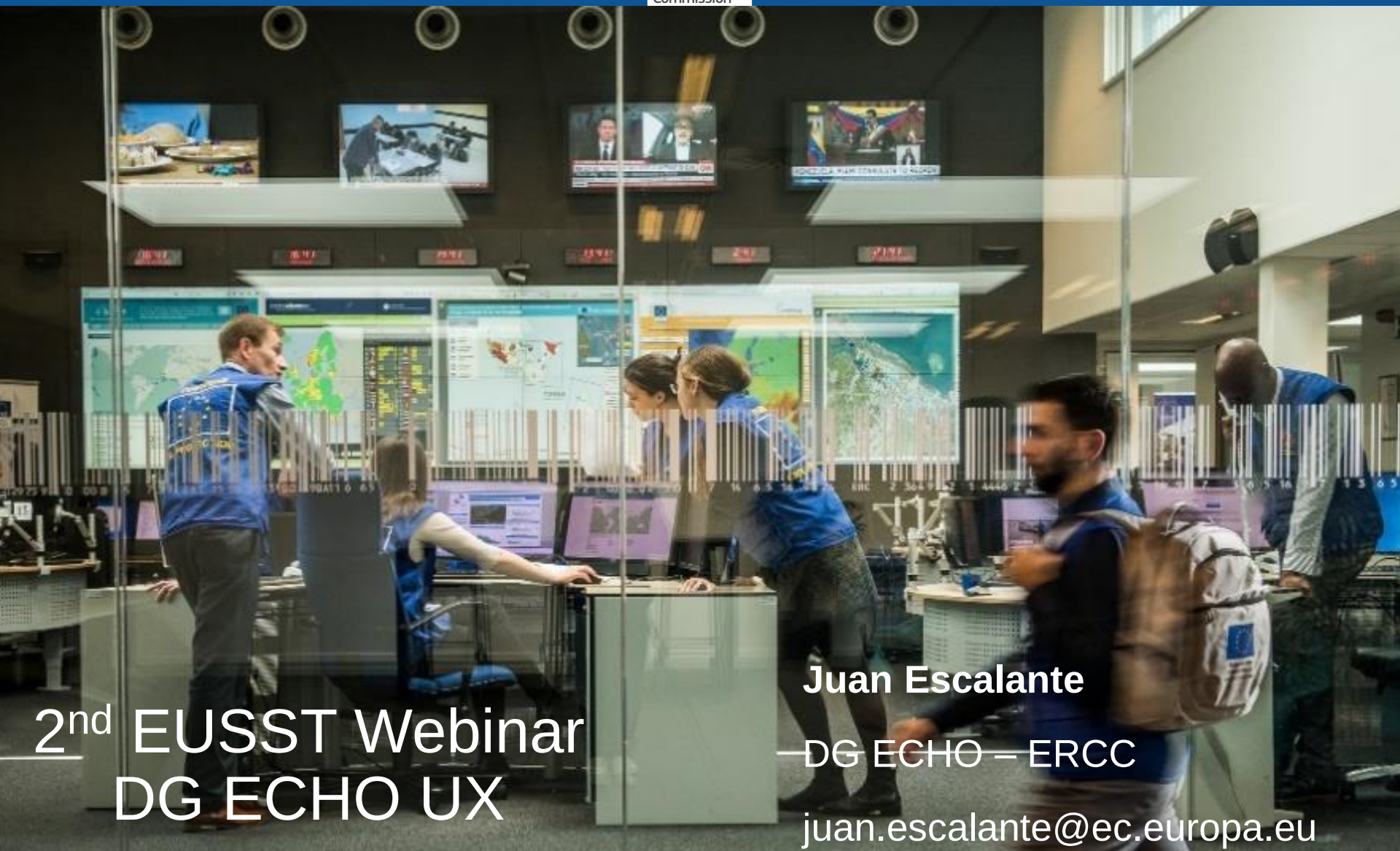
Timeliness in delivery

Completeness

Availability

Evolution


EUSST
European
Commission



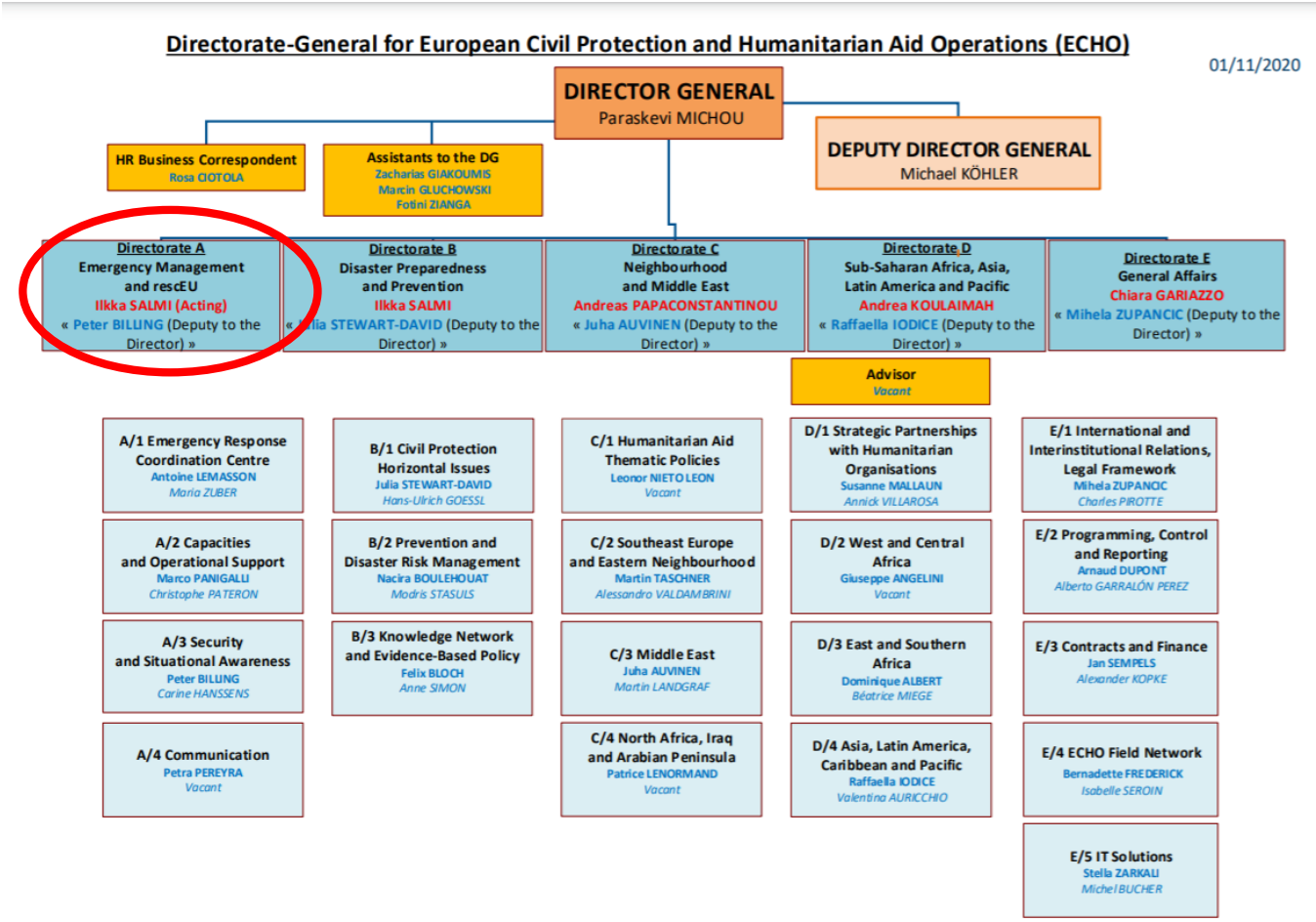
2nd EUSST Webinar
DG ECHO UX

Juan Escalante

DG ECHO – ERCC

juan.escalante@ec.europa.eu

DG ECHO structure



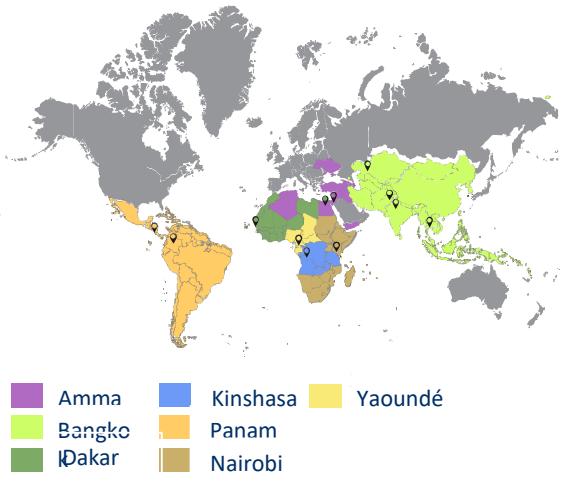
European Commission

Janez Lenarčič

Commissioner for Crisis Management
European Emergency Response Coordinator

European Commission

Our aid delivery is only possible thanks to our **strong presence in the field**



7 Regional Offices

153 international humanitarian experts

300 national staff members

Field offices in **40+** countries

European Commission

Our aid delivery is only possible thanks to:

Our close cooperation with our global network of

over 200 humanitarian partners

ranging from large UN agencies to small NGOs

UNHCR The UN Refugee Agency

ICRC

International Rescue Committee

OCHA

unicef

International Medical Corps

WFP World Food Programme wfp.org

ACTION AGAINST HUNGER

European Commission

Emergency Response Coordination Centre

Monitors disasters around the globe **24/7**

Maps disaster risks

Provides real-time information

Coordinates joint European response operations

Figures:

24 ERCC Duty officers
3 ERCC Coordinators
8 Extra staff on stand-by
10 Communication officers
16 Management on stand-by

European Commission

When an emergency overwhelms national response capacities, the **EU Civil Protection Mechanism** enables a coordinated assistance by

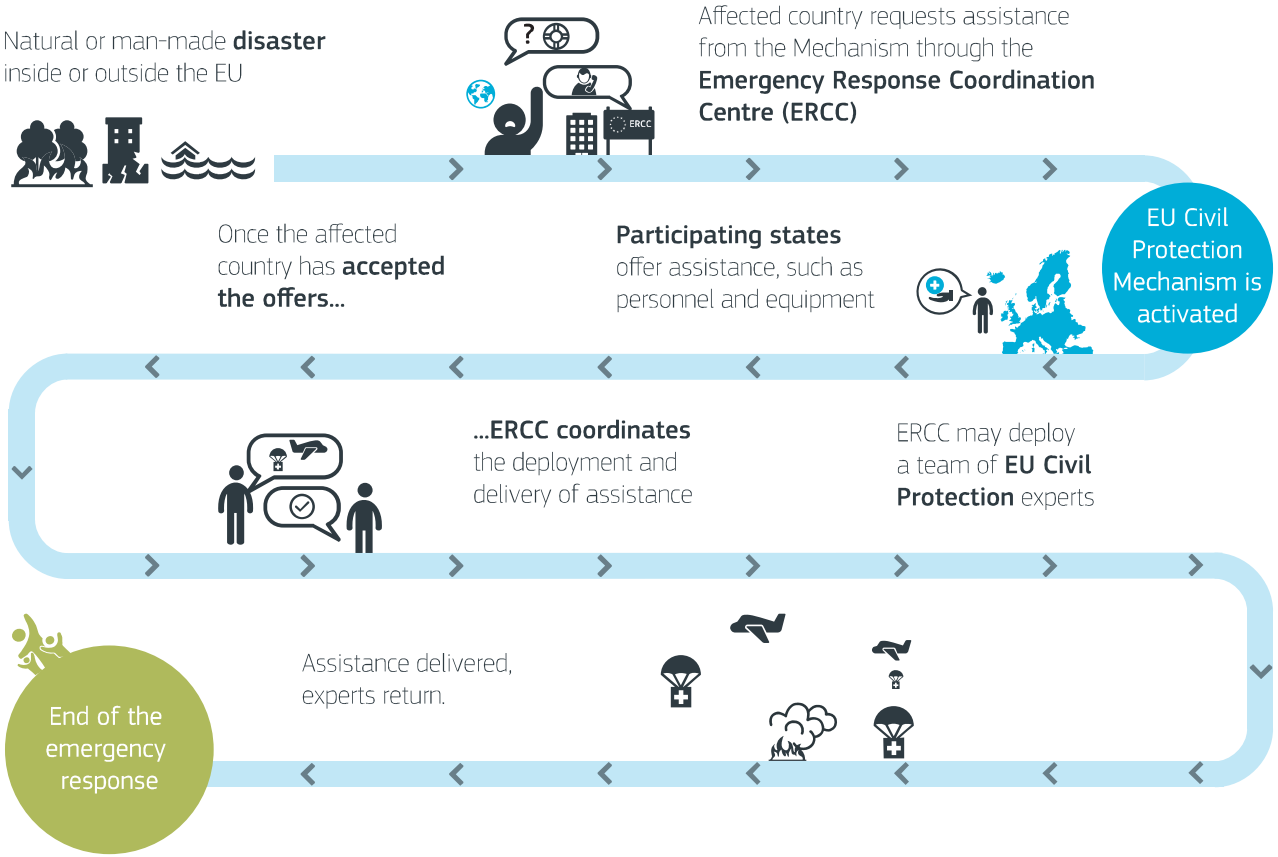
all EU Member States

✚

6 Participating States

European Commission

EU Civil Protection Mechanism activation



European Commission

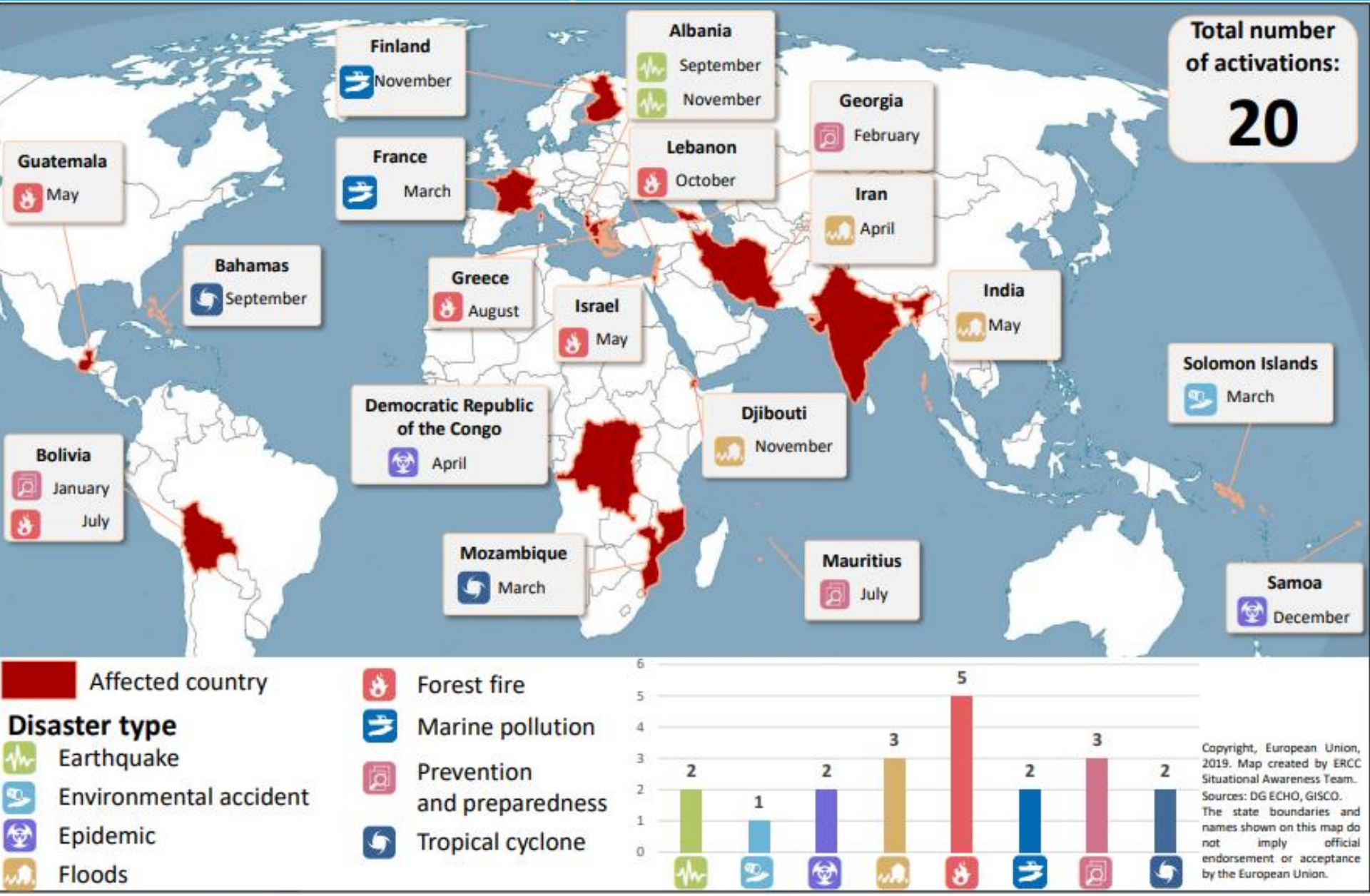
2. DELIVERY

- Offers of assistance
- Deployment of experts
- Transport co-financing

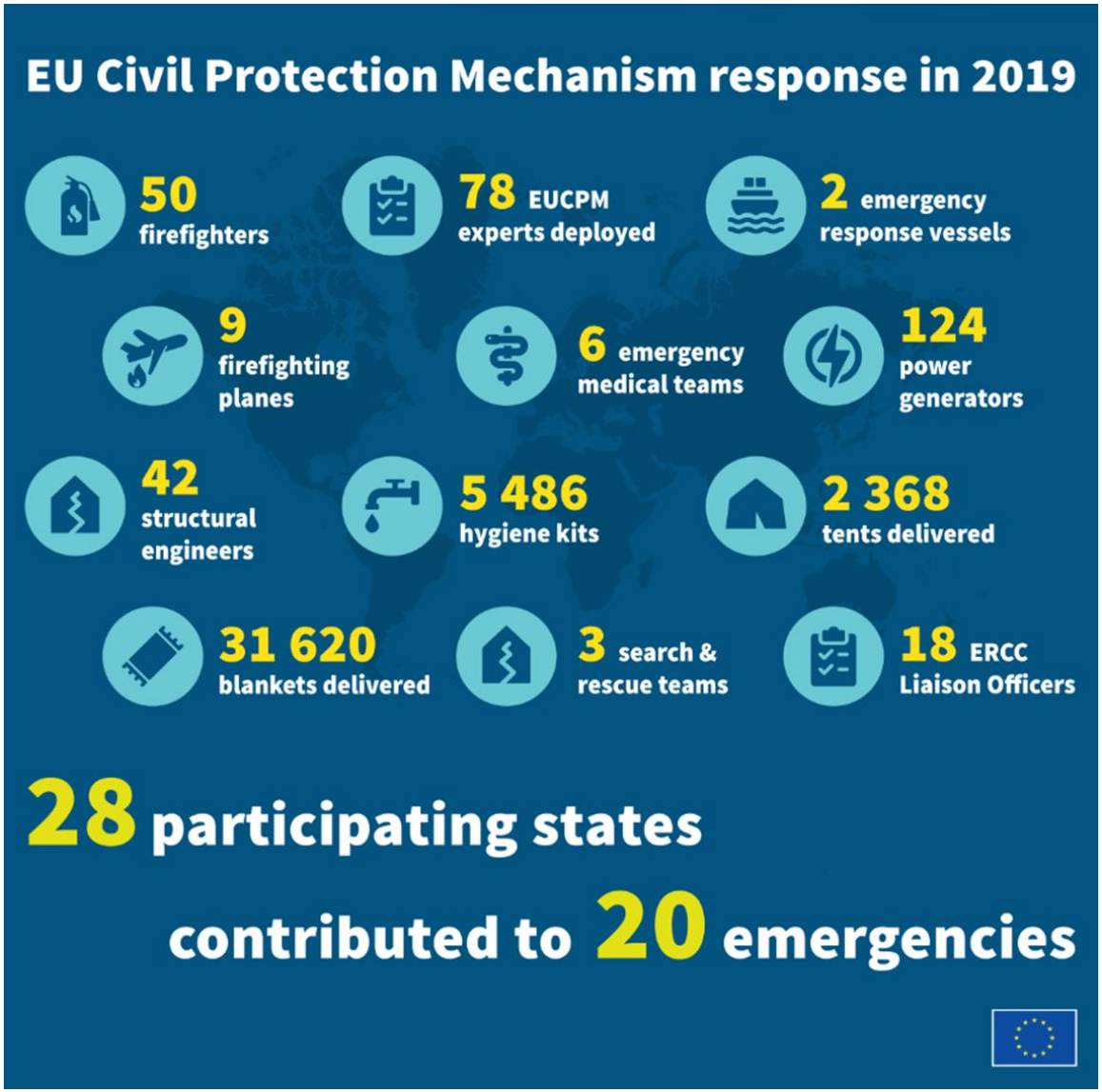
Emergency Response Coordination Centre (ERCC) | DG ECHO Daily Map | 03/01/2020

EU Civil Protection Mechanism - Requests for Assistance in 2019

European Commission



Sources: DG ECHO, GISCO.
The state boundaries and names shown on this map do not imply official endorsement or acceptance by the European Union.

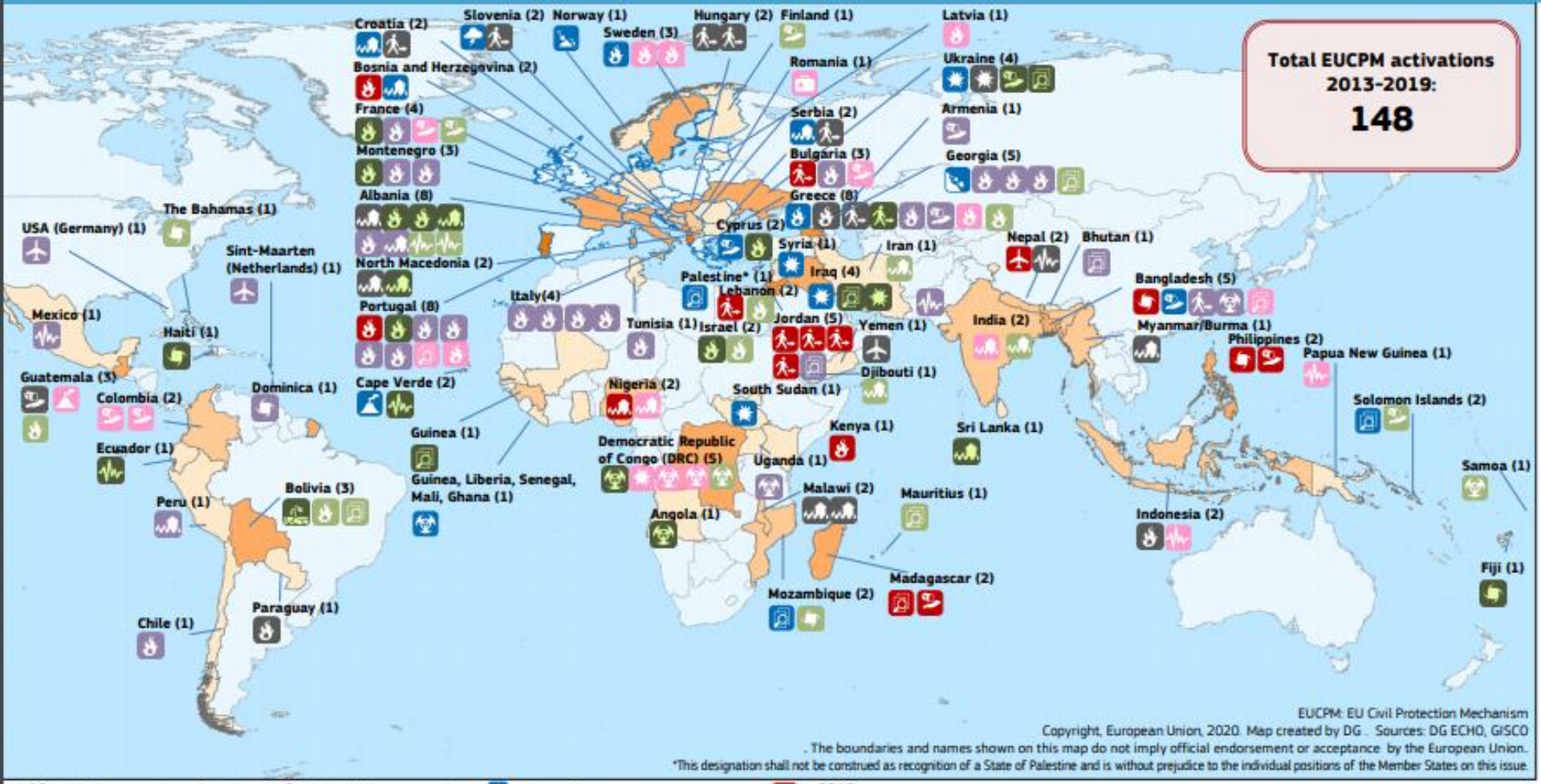


European Commission

Emergency Response Coordination Centre (ERCC) | DG ECHO Daily Map | 21/02/2020

EUCPM Requests for Assistance: 2013 - 2019

European Commission



EUCPM: EU Civil Protection Mechanism

Affected country

Total activations

1
2
3 - 4
5 - 6
7 - 8

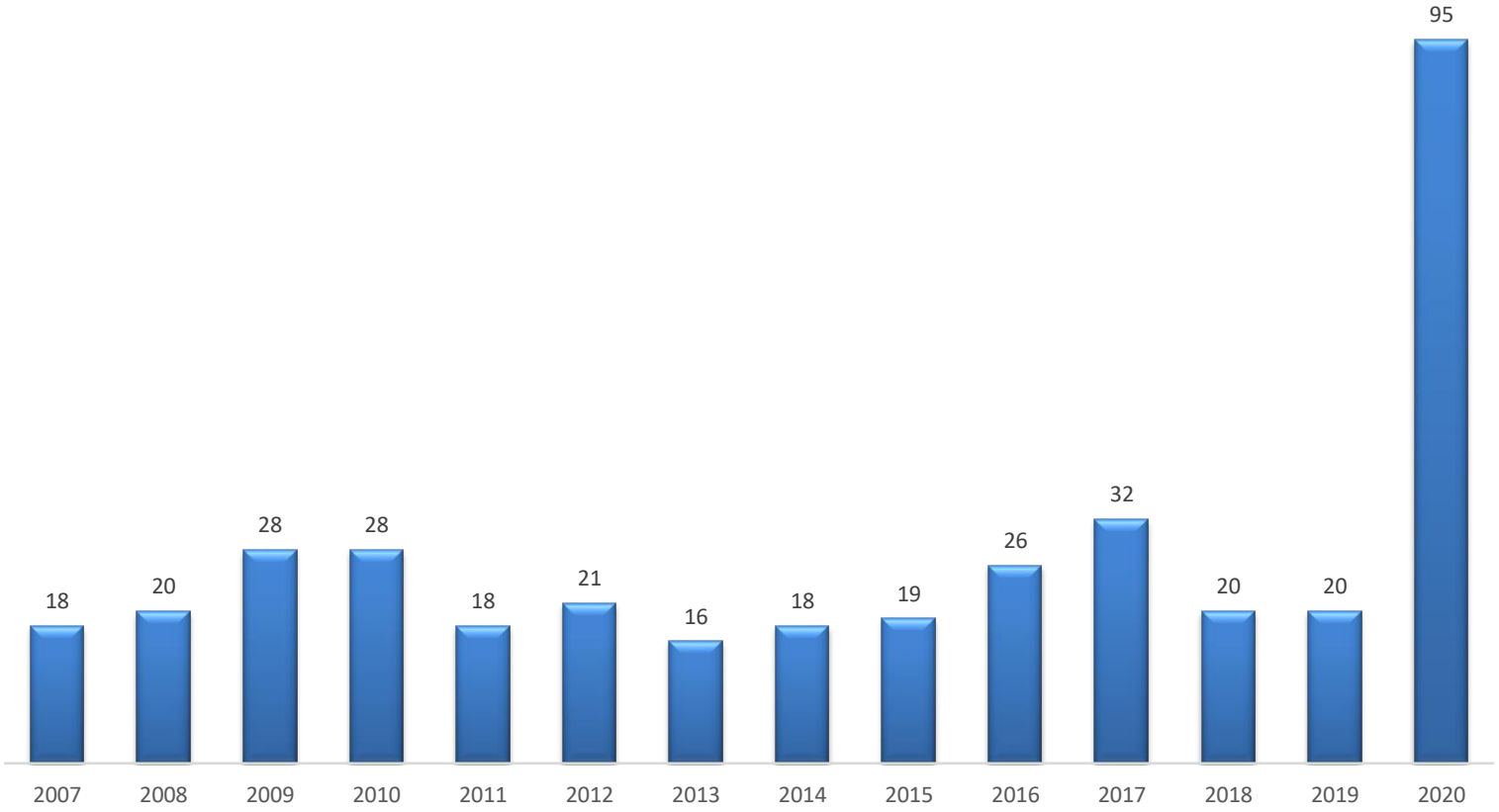
Nature of EUCPM request

- Disaster Preparedness Mission
- Conflict
- Forest fire
- Cave diving accident
- Environmental accident
- Epidemic
- Population displacement
- Consular support
- Drought
- Earthquake
- Flood
- Landslide
- Severe weather
- Tropical cyclone
- Volcano activity
- Medical

2013
2014
2015
2016
2017
2018
2019

Activations per year

EUCPM activations 2007 - 2020



European Commission

Emergency Response Coordination Centre

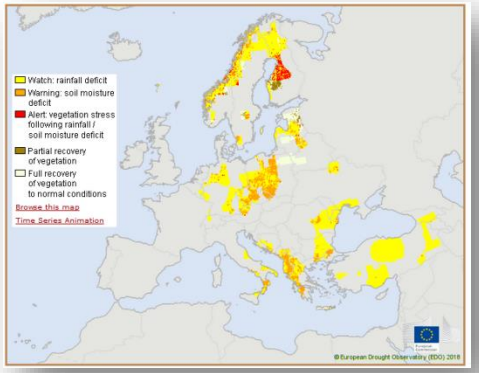
How does ERCC build its situational awareness?

- Copernicus Emergency Management Service (satellite maps)
- ECHO Offices and EU Delegations
- EU Civil Protection Teams
- Early Warning Systems (e.g. GDACS, EFAS, EFFIS)
- and EU SST!
- Scientific advice (e.g. ARISTOTLE, JRC)
- External reports (UN Agencies, Regional Agencies, National authorities)
- Situation Awareness Team products
- Media

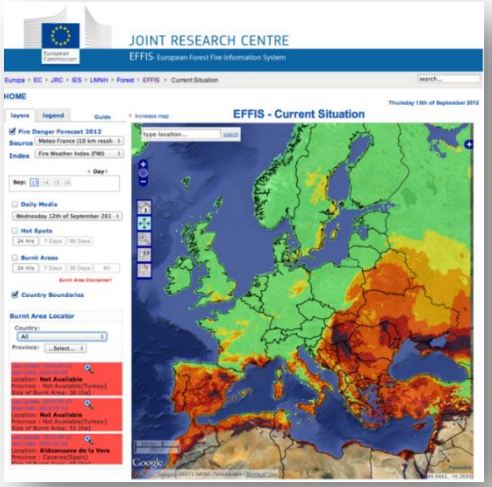
European Commission

Early warning systems

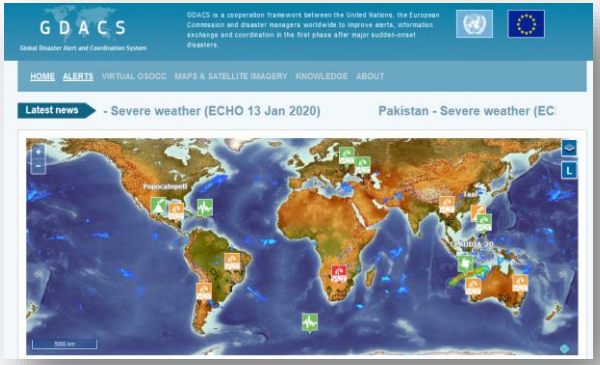
European Drought Observatory
http://edo.jrc.e.europa.eu



European Forest Fire System
http://forest.jrc.ec.europa.eu/effis

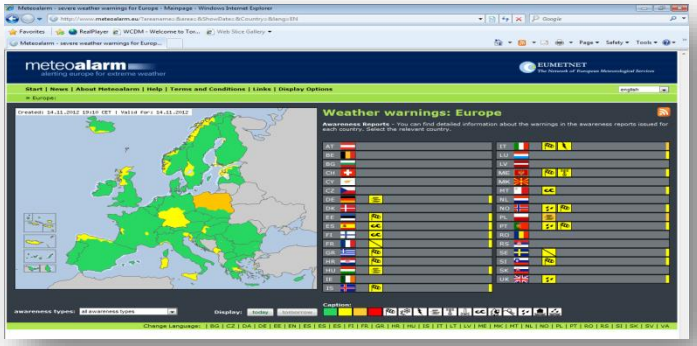


GDACS



European Flood Awareness System
https://www.efas.eu

Meteoalarm -
http://www.meteoalarm.eu



And…

European Commission

EU SST: DG ECHO UX

- Re-entry monitoring of TIANGONG 1 in 2018
- Many re-entry events reported in 2020

European Commission

EU SST: DG ECHO UX

- Less is more
- Make it simple
- Operational efficiency
- Adaptable/tailor made

European Commission

Thank you!!

European Commission

Q&A session


EUSST

European Union
EXTERNAL ACTION

2nd EU SST Webinar: Operations in Space Surveillance and Tracking

16 November 2020

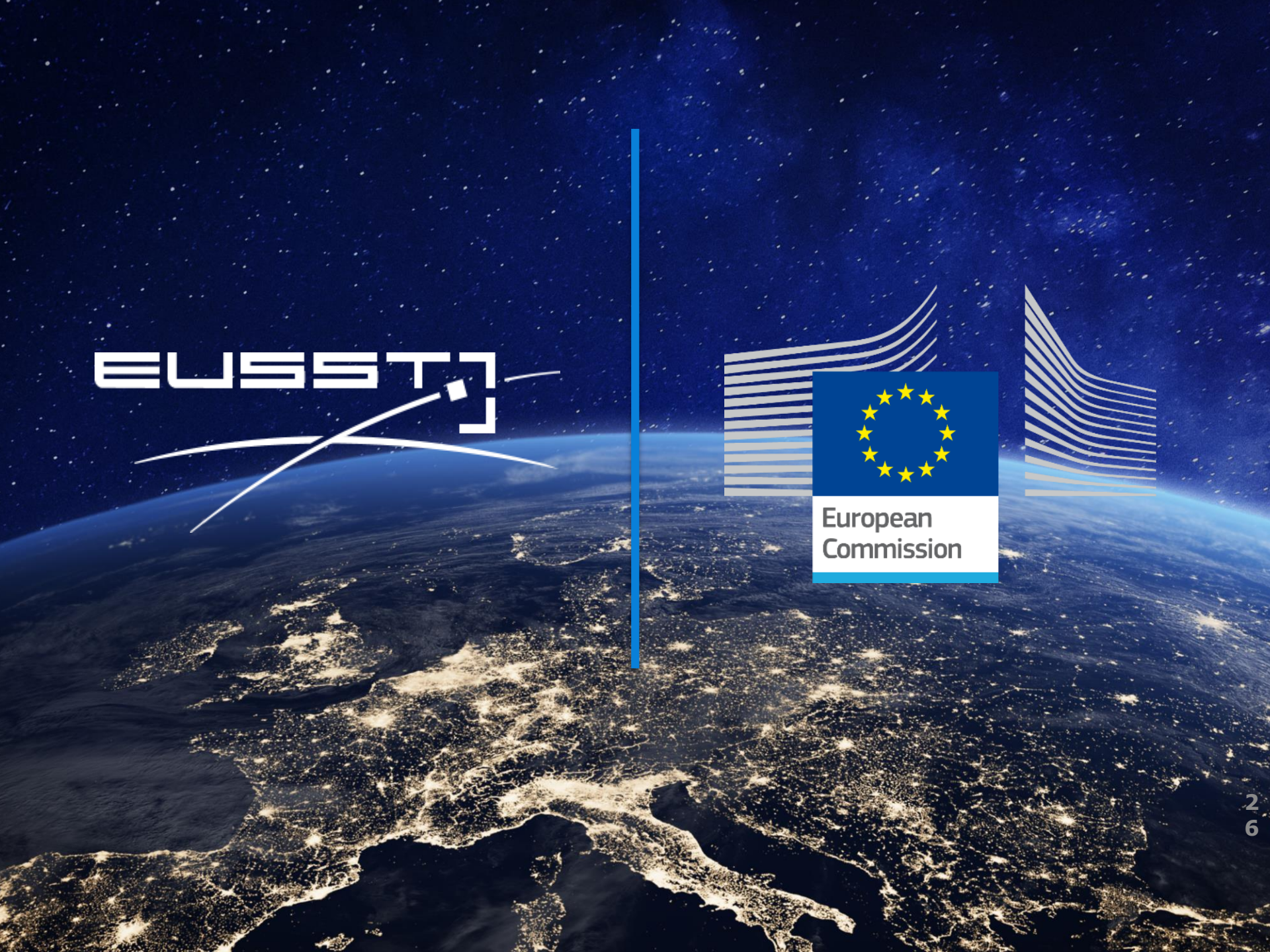
European Union
EXTERNAL ACTION

3 SOS

- The EU **S**afety, **S**ecurity and **S**ustainability of **O**uter **S**pace (3 SOS) is a public diplomacy campaign promoting a sustainable approach to space by avoiding collisions, reducing the creation of long lived orbital debris and promoting transparency and confidence-building measures.

European Union
EXTERNAL ACTION

Q&A session


EUSST
European
Commission

From the SST Support Framework to the SSA component of the Space Regulation

European Commission
DG DEFIS
Unit B1
Rodolphe Muñoz

The achievements of the SST Support Framework

- **The SST Support Framework**
- 2014: adoption (Decision 2014/541)
- 2015: establishment of the governance (EUSST Consortium & Cooperation)
- 2016: delivery of the first EUSST services (CA, FG and RE)
- 2018: enlargement of the SST Consortium

The achievements of the SST Support Framework

- **The main achievements**

- Protection of the 2 EU flagships programs (Galileo and Copernicus) and EU Member States space infrastructure
- Networking of 46 sensors coming from 7 Member States
- Development of a database and future European catalogue of space objects
- Provision of added value services
- A steady increase in the number of users
- 147 European satellites protected
- Preparing the future with system architecture studies

Proposal of the European Commission June 2018

Proposal for a Regulation of the European Parliament and of the Council establishing the space programme of the Union and the European Union Agency for the Space Programme and repealing Regulations (EU) No 912/2010, (EU) No 1285/2013, (EU) No 377/2014 and Decision 541/2014/EU

Proposal of the European Commission

Still discussed

by the Council and the European Parliament

The final content will be decided by:

the Council

and

the European Parliament

Space Situational Awareness (SSA)

It is a holistic approach towards the main space hazards, encompassing collision between satellites and space debris, space weather phenomena, and near earth objects

Space Surveillance and Tracking (SST)

A network of ground-based and space based sensors based on Member States capacities capable of surveying and tracking space objects, together with processing capabilities aiming to provide data, information and services on space objects that orbit around the Earth

Space Weather (SWE)

Space Weather services in order to provide ready to use services

Near Earth Objects (NEOs)

Map and Network Member States NEO capacities, and put in place procedures to coordinate actions in case of NEO

Space Regulation Continuity

The services

- *Collision Avoidance*
- *Re-entry*
- *Fragmentation*

The Governance

- *From a Consortium to a Partnership*

SST
New developments

SSA is a component of the Space Regulation

New Services

- *space debris mitigation in order to reduce their generation*
- *space debris remediation by managing the existing space debris.*

New Users

- *Possibility to have users from outside the EU*

Expert Teams

Thank you for your attention

rodolphe.munoz@ec.europa.eu

Q&A session

Survey

Thank You!

@EU_SST

linkedin.com/
company/eusst

EU Space Surveillance and
Tracking EUSST