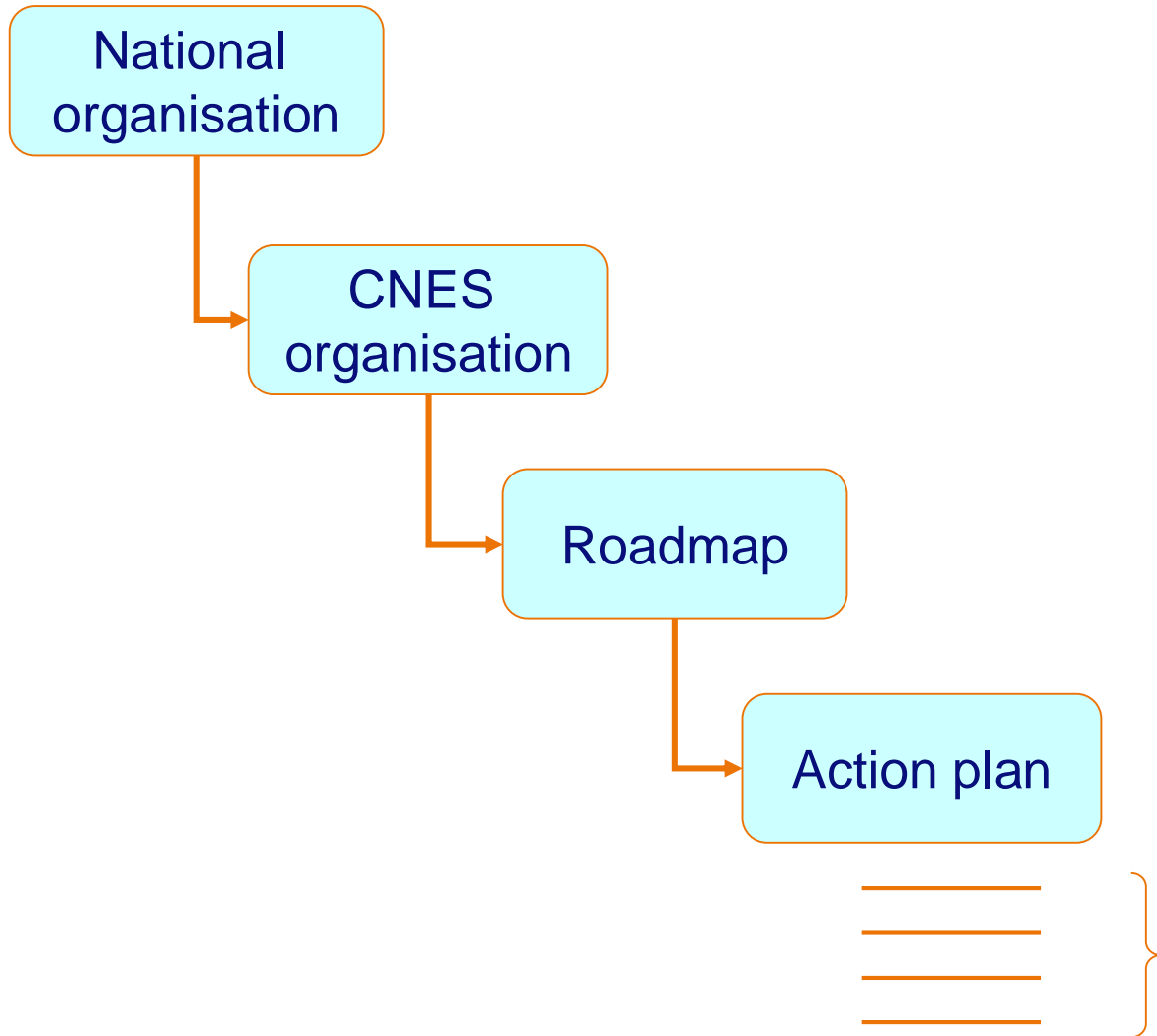


CNES STRATEGIC PLAN FOR SPACE TRAFFIC CONTROL

- Organisation
- Activity plan
- Traffic control

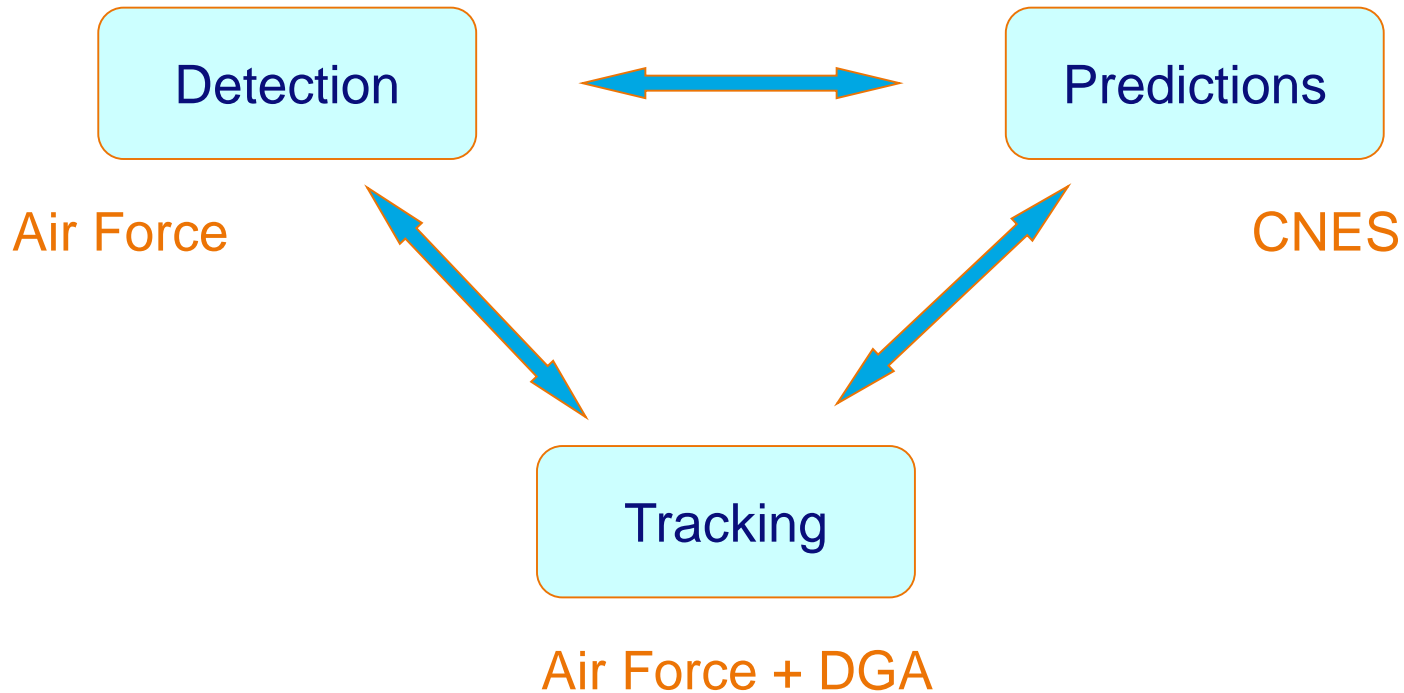
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INTRODUCTION



activities

NATIONAL ORGANISATION



- Dual activity
- Overall responsibility: Air Force
- Complementarity between CNES and Defence
- CNES depends on 2 Ministries: Research and Defence

CNES ORGANISATION

- ❑ Major strategy orientations defined by DSP (Planning, Strategy, Programmes, Valorisation and International Relations Directorate)
- ❑ Roadmaps prepared in cooperation with main partners
- ❑ Space debris and space surveillance roadmap
- ❑ Principal objectives are:
 - ❑ To protect operational space structures in-orbit
 - ❑ To mitigate risks on Earth
- ❑ Output of the roadmap: action plan SORO (Surveillance of Objects during Re-entry and in Orbit)
 - ❑ Sliding plan over 3 years
 - ❑ Updated every year
 - ❑ Identifies human and financial resources

SORO ACTION PLAN

Knowledge of the orbital population

- Long term evolution of the debris population
- Studying the debris population

Mitigation

- Mitigation rules, participation to IADC, COPUOS, ECSS/ISO
- Studying end-of-life operations
- Operational management of collision risks in orbit and at launch
- Support activities: modelling, mission analysis

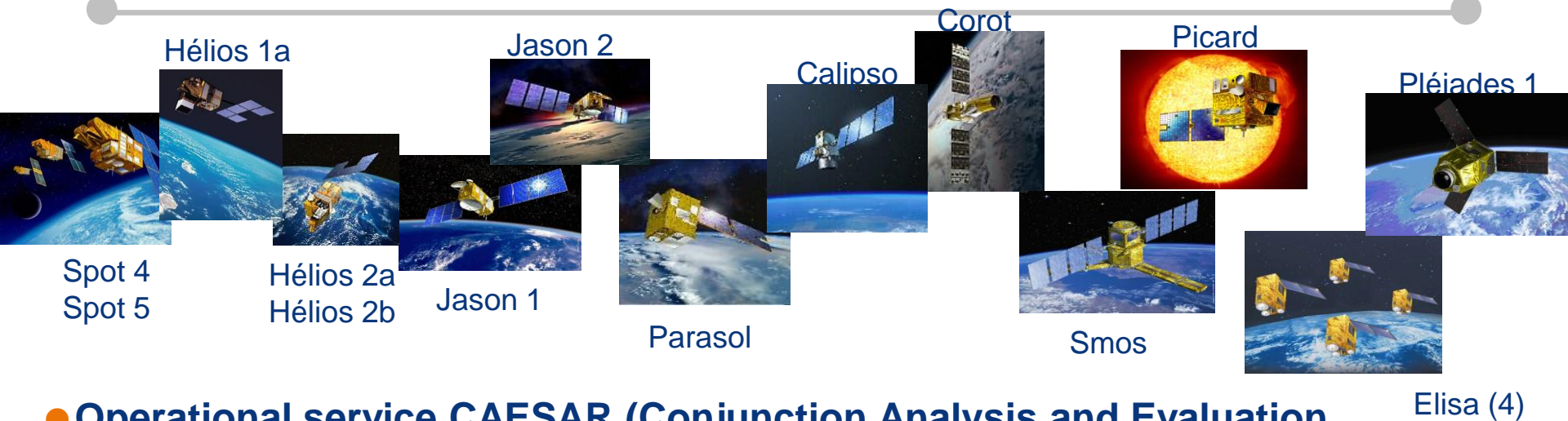
Observation and orbit determination capabilities

- Radar observation
- Optical observation

Monitoring atmospheric re-entries

- Operational tracking of re-entries
- Modelling atmospheric re-entries and the necessary tools

COLLISION RISK MONITORING



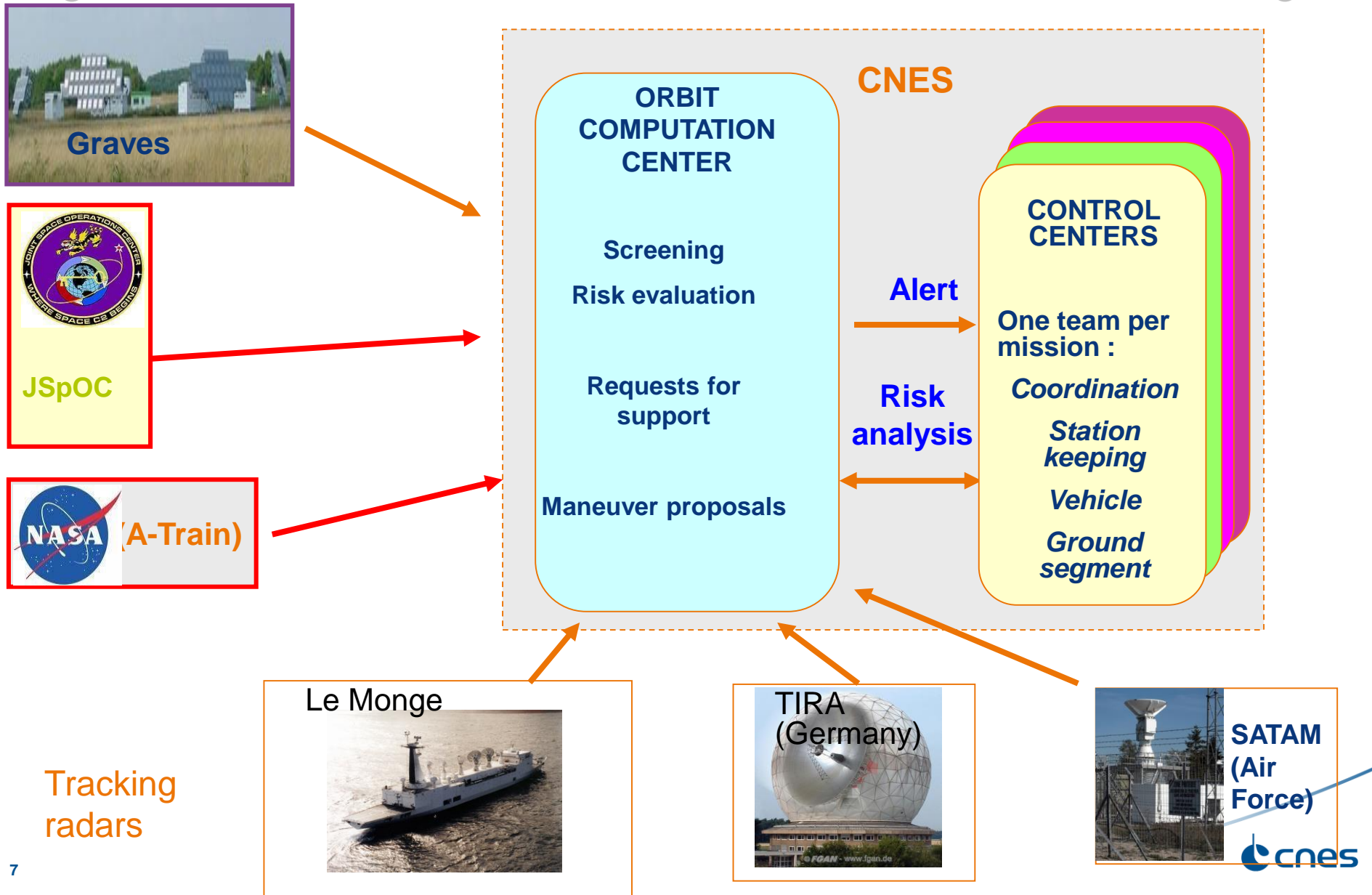
- **Operational service CAESAR (Conjunction Analysis and Evaluation, Alerts and Recommendations)**

- **Open to:**

- ◆ Satellites controlled by CNES (17)
- ◆ External customers (AstroTerra-Spot 6 for the time being)
- ◆ Additional customers expected in 2013



COLLISION RISK MONITORING

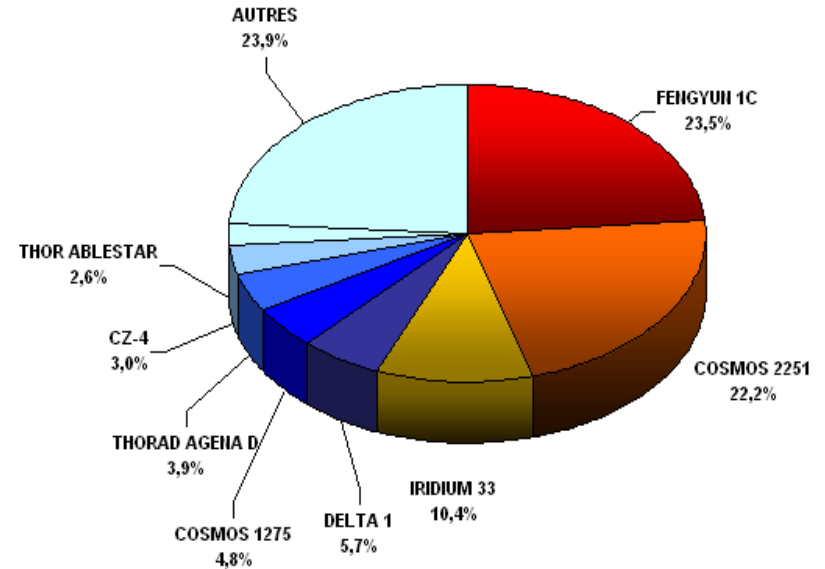


COLLISION RISK MONITORING

2012 synthesis:

- 18 satellites monitored
- 114 risks identified by the automatic process (probability of collision $> 10^{-4}$)
- 163 risks identified by JSpOC
- 9 support requests: JSpOC or radar tracking (probability of collision $> 10^{-3}$)
- 13 avoidance manoeuvres

Most dangerous debris



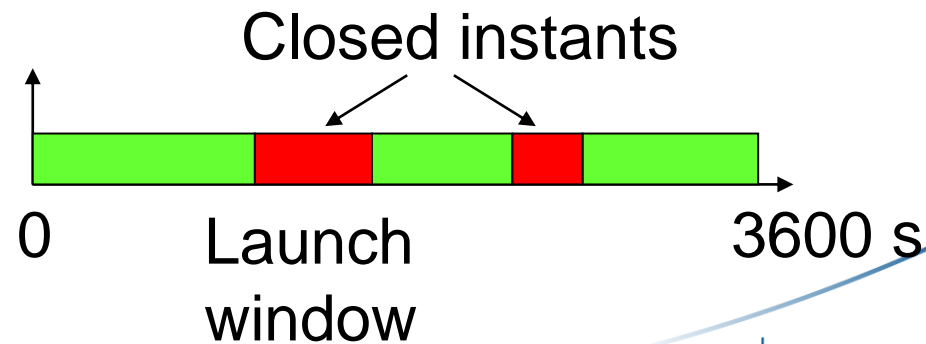
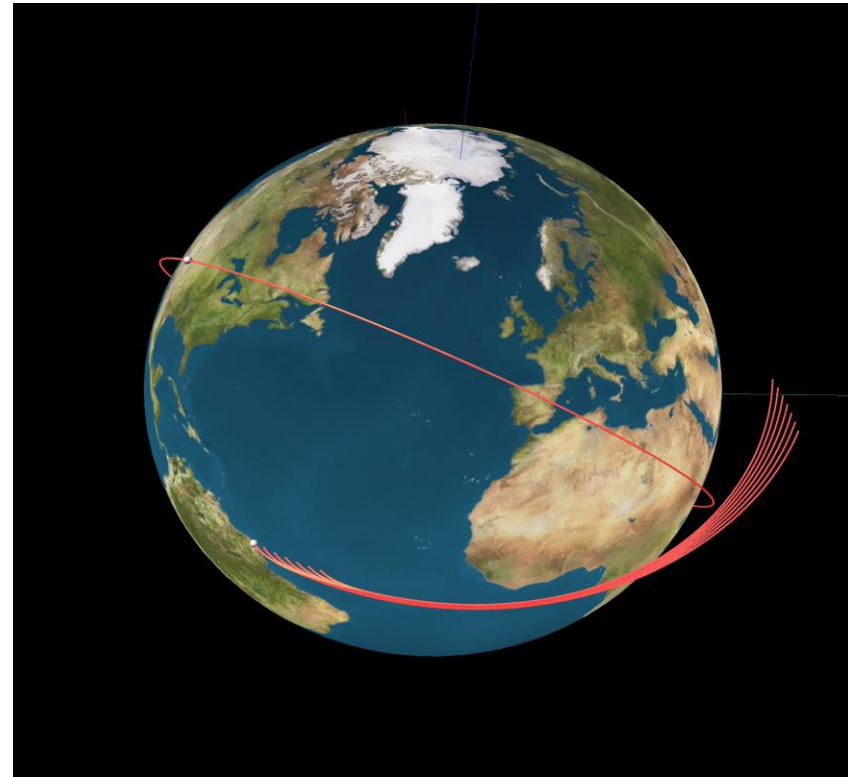
COLLISION RISK AT LAUNCH

■ Safety Regulations for operations conducted at the CSG:

- ◆ Manned space objects have to be protected during launch and during the 3 first days in orbit.
- ◆ After this period, they can assume their own security.

■ Size and shape of the dispersions imply new methods

■ Similar activities in support to DGA



ATMOSPHERIC REENTRIES MONITORING

● Objectives are to track:

- ◆ « French » objects whose debris could fall on foreign countries (Launching State responsibility)
- ◆ « Foreign » objects whose debris could fall on French territory

● Monitored objects:

- ◆ Launcher upper stages registered by France or ESA
- ◆ Satellites registered by France
- ◆ Satellites and upper stages registered by other countries:
 - » With a mass > 5T (TBC)
 - » Containing hazardous materials
- ◆ Any other object on request (IADC, Defence,...)

● Space debris not monitored



ATMOSPHERIC REENTRIES MONITORING

Step 1: routine surveillance

-Once a month
-Opera software
-Space Track and
Graves catalogs

Identification of objects
reentering within 2 months:
•French registered objects,
ESA upper stages
•Other dangerous objects

Monthly reentry
report

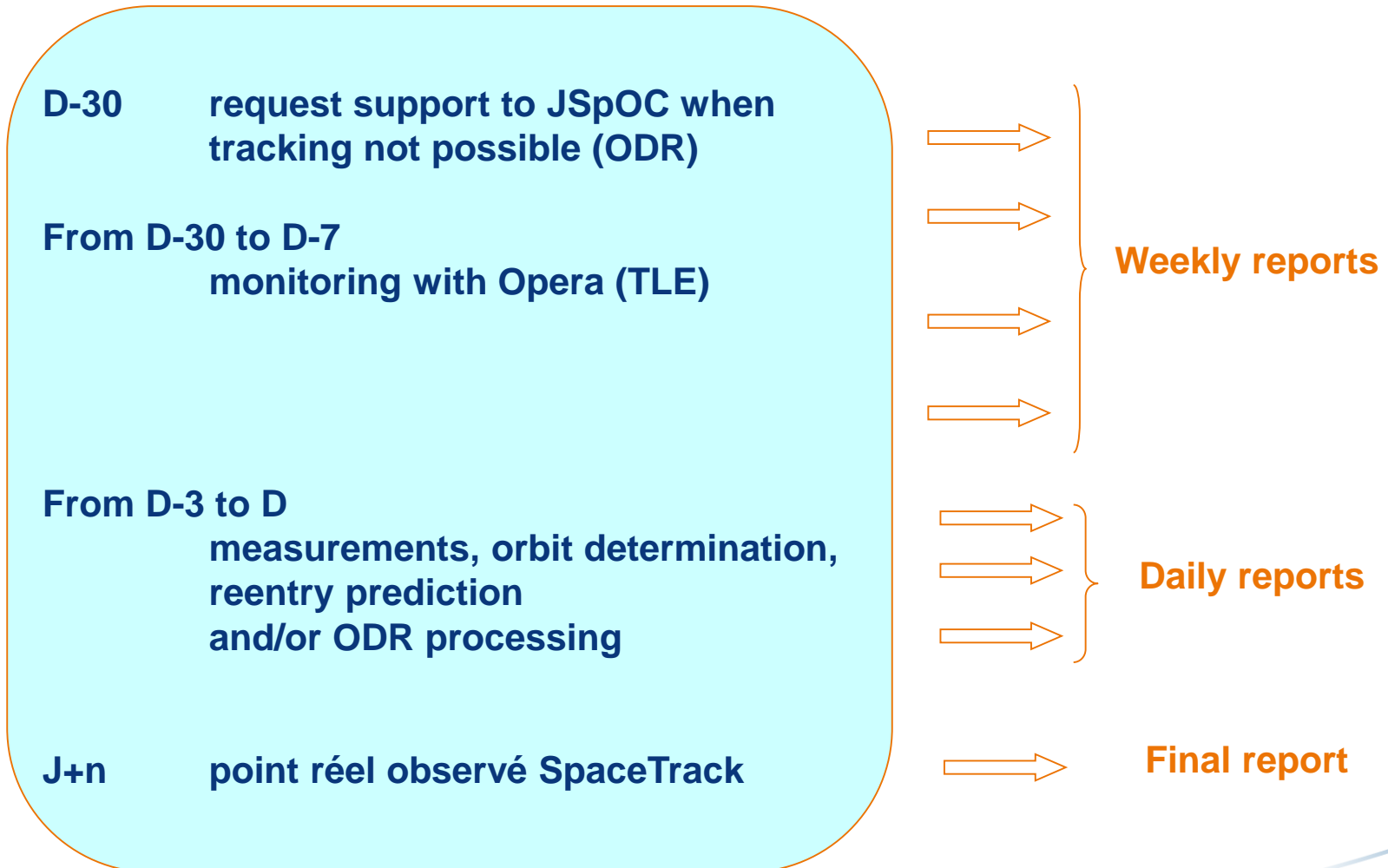
Object to monitor

Step 2

Alerts
CDAOA,
IADC

ATMOSPHERIC REENTRIES MONITORING

Step 2: monitoring of one object



ATMOSPHERIC REENTRIES MONITORING

Content of reports

monthly	<ul style="list-style-type: none">■ Number of French objects in the US catalogue■ List of French objects with perigee altitude < 200 km■ List of French objects due to reenter within 60 days■ List of french objects reentered during the last 30 days
weekly	<ul style="list-style-type: none">■ Name, number, launch date of the object■ Dimensions and mass, apogee, perigee and inclination■ Predicted fallback date, uncertainty interval■ Latitude band, risk level
daily	<ul style="list-style-type: none">■ Idem weekly reports +■ Orbit ground track with indication of uncertainty interval■ List of countries overflowed, risk level
final	<ul style="list-style-type: none">■ Date and location of the observed reentry point (80 km altitude)■ Comparison to the last prediction■ Estimation of the location at which the debris fell

EXEMPLE

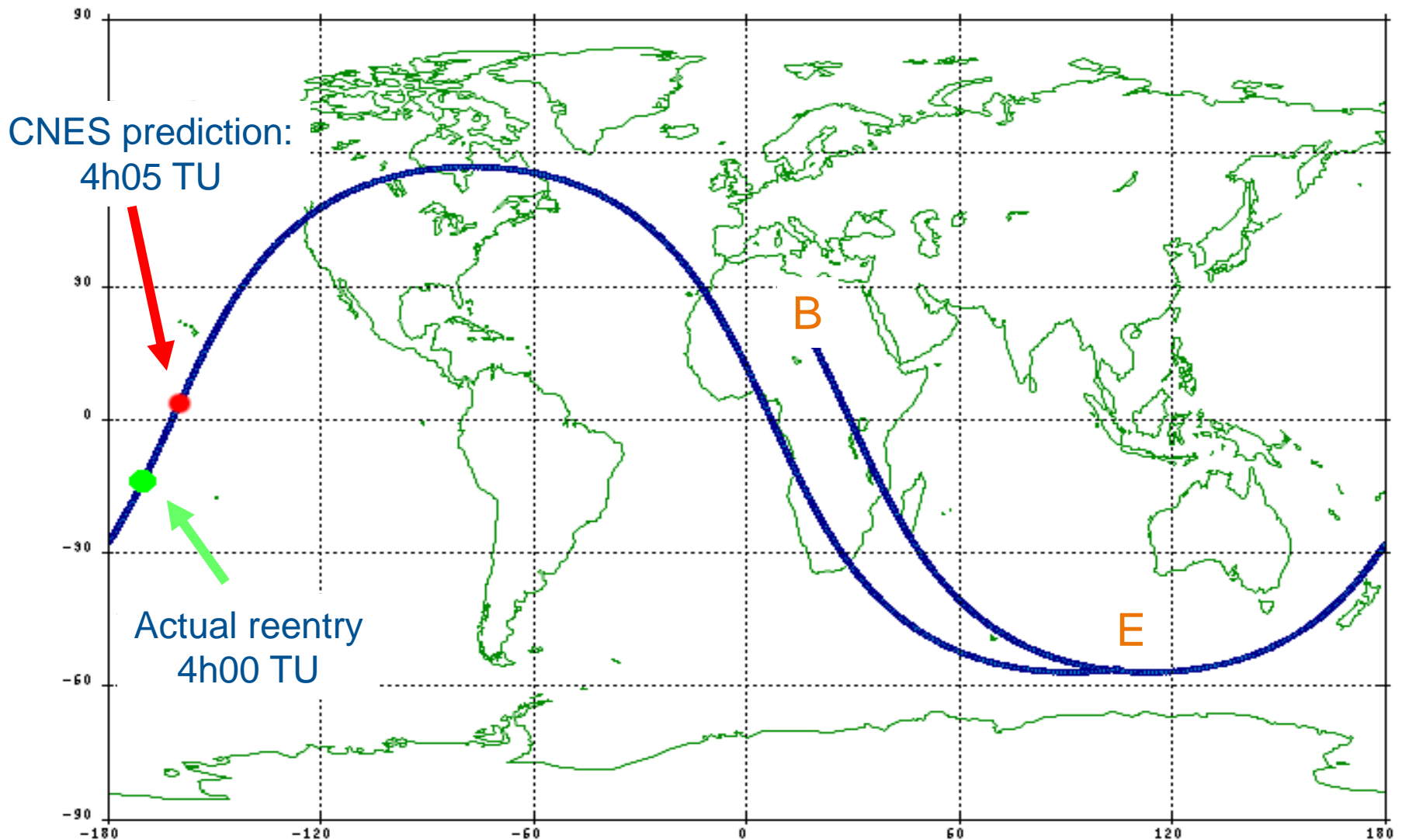
RENTREE UARS 24 SEPTEMBRE 2011

Centre d'orbitographie operationnelle

IADC - bul. res_j_norad_20110923_221519

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IADC - 2011 : TRAJECTOIRE DE RENTRÉE



SUMMARY

- ❑ **Complementarity between civilian and military expertise and facilities relative to space surveillance**
- ❑ **Close cooperation between Defence and CNES**
- ❑ **High level orientations defined in a roadmap on space debris and space surveillance**
- ❑ **Action plan (SORO) directly derived from the roadmap**
- ❑ **Several actions concern space traffic control, in particular:**
 - Collision risk monitoring
 - Atmospheric reentries monitoring
- ❑ **Important development of these activities over the last few years**