SST radar in Cheia

13.06.2018

RARTEL
TELESPAZIO
a LEONARDO and THALES company

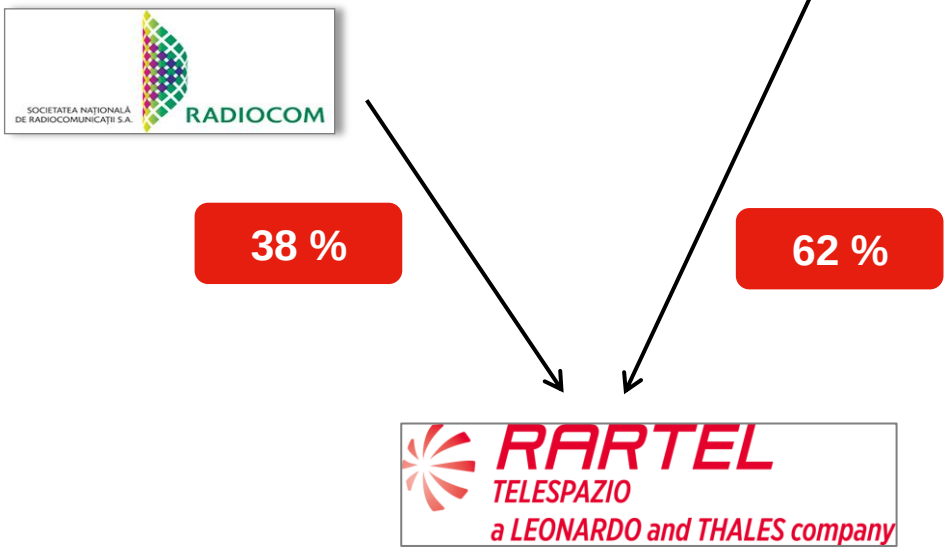
Summary:

- About Space Alliance, Telespazio & RARTEL;
- Participation of RARTEL in ESA projects;
- Cheia antenna retrofit project

RARTEL and the Space Alliance

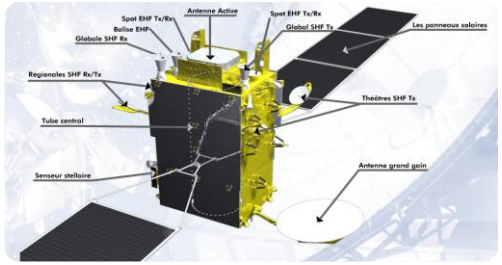
14,0 B€ revenues
62.000 employees

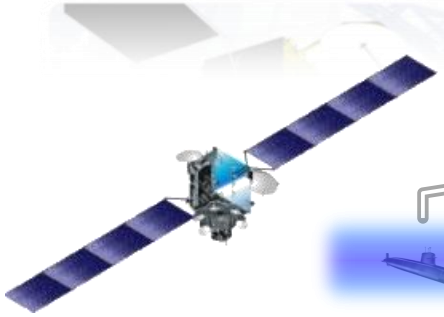
approx. **13,0 B€** revenues
over **47.000** employees

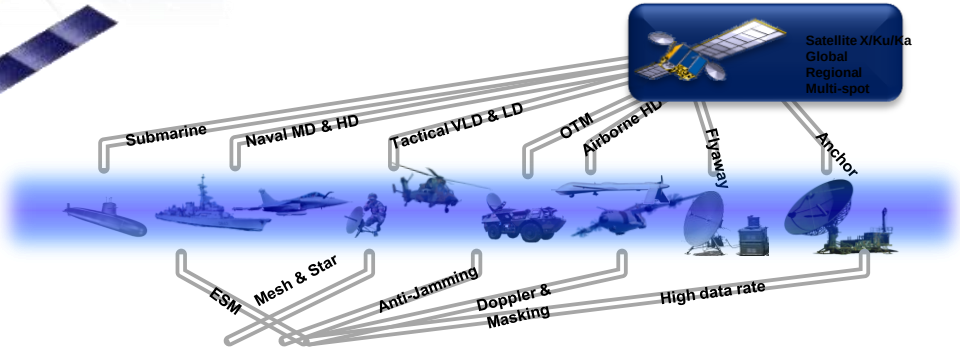


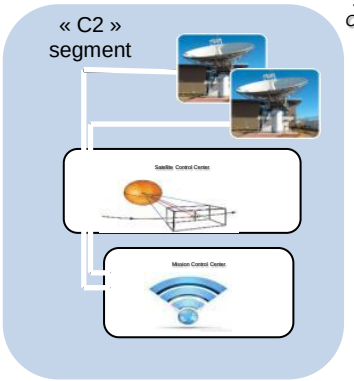
Space Alliance presence in the Space Value Chain

Systems Development			Operations Management		Systems Application	
Mission Definition	Satellite Production	Ground Equipment Production	Launch Management (*on behalf of customer*)	Satellite Control / Mission Control	Networks & Platforms	Applications & Services



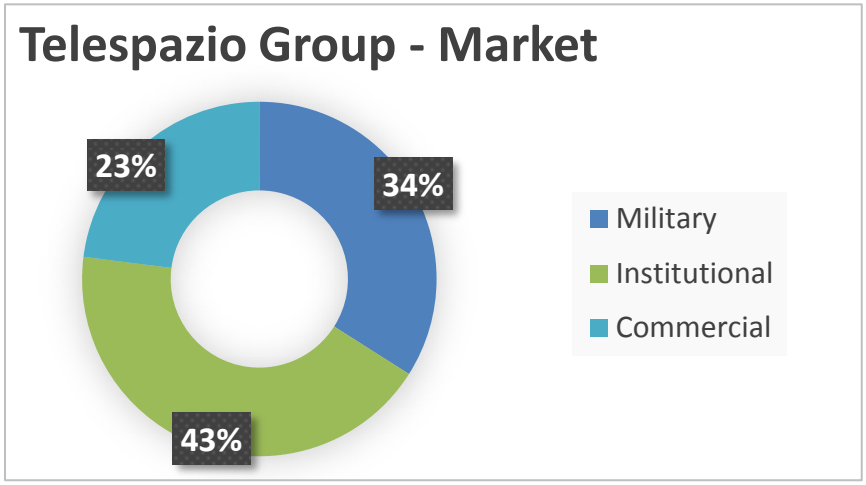


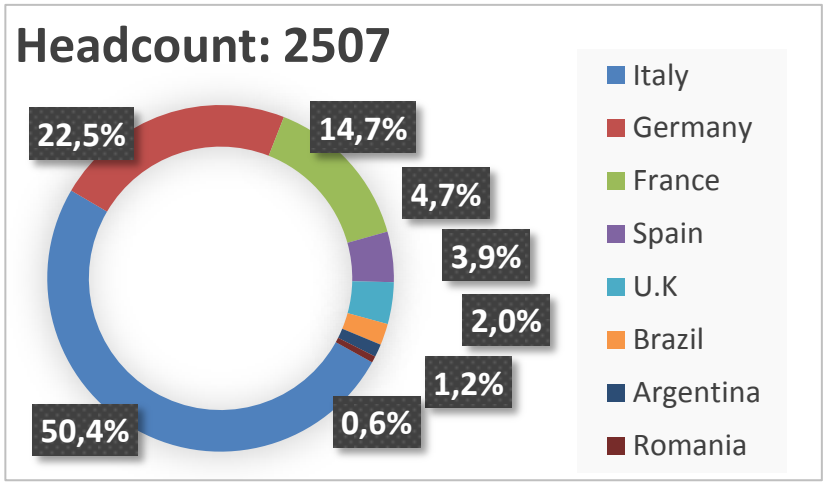




Telespazio Group

Revenues = 632 M€





International Presence

- Telespazio e-GEOS
- Telespazio France
- Telespazio VEGA Deutschland
- GAFAG spaceopal
- Telespazio VEGA United Kingdom
- Telespazio Ibérica
- Rartel
- Telespazio Brasil
- Telespazio Argentina

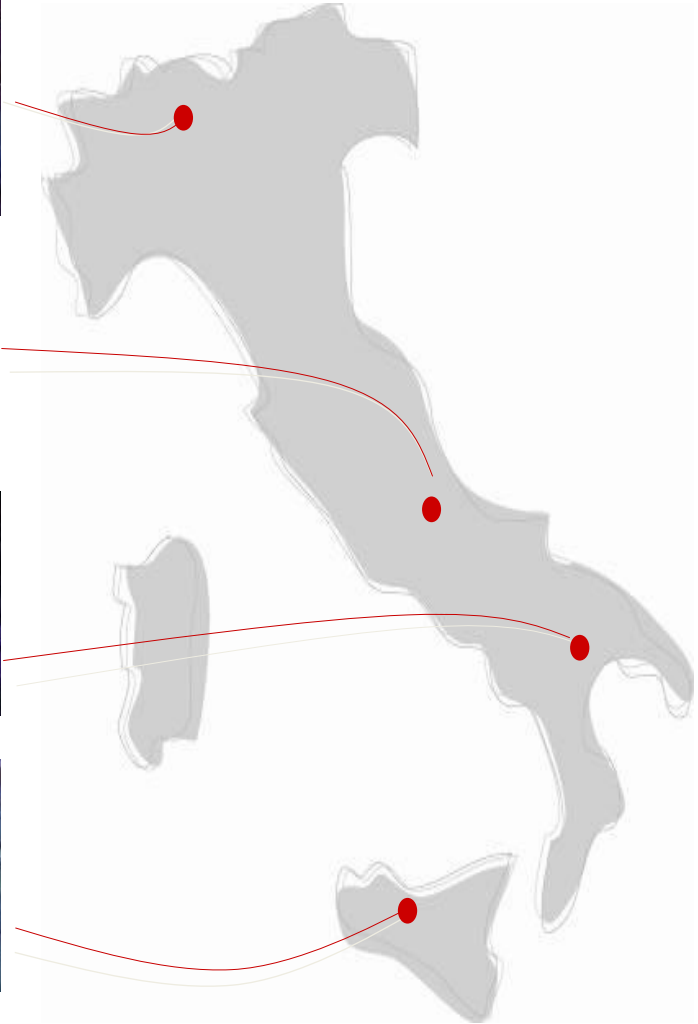
Italian Space Centres

LARIO
SPACE CENTRE

FUCINO
SPACE CENTRE

MATERA
SPACE CENTRE

SCANZANO
SPACE CENTRE



International Space Centres

ROMANIA

CHEIA

BRASIL

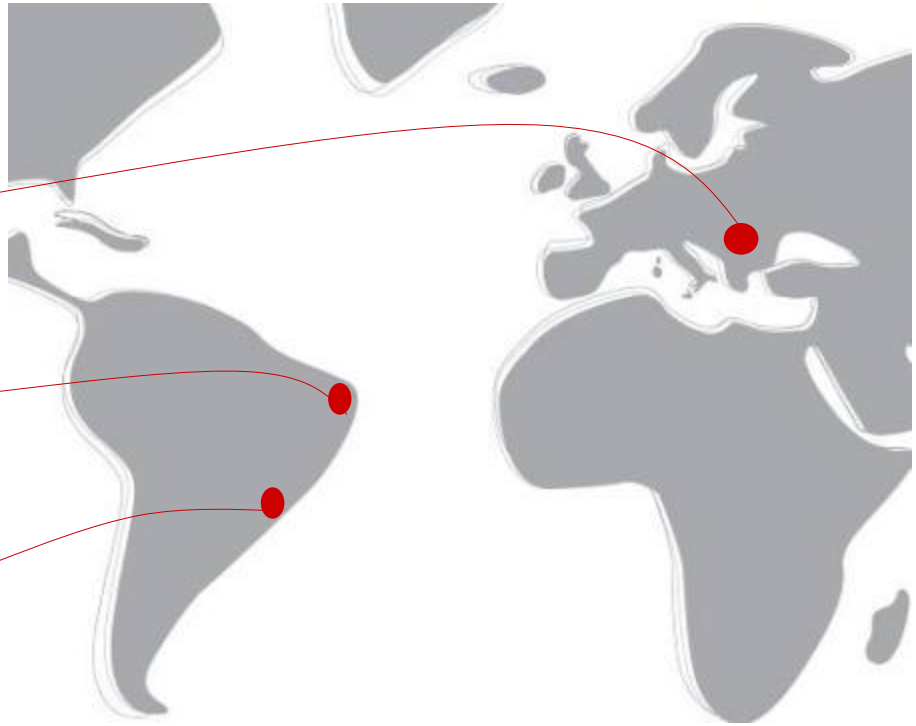
RIO DE JANEIRO

PORTO ALEGRE

ITABORAÍ

ARGENTINA

BUENOS AIRES



Participation of RARTEL in ESA Projects

Milestones:

22.12.2011 Romania become ESA member

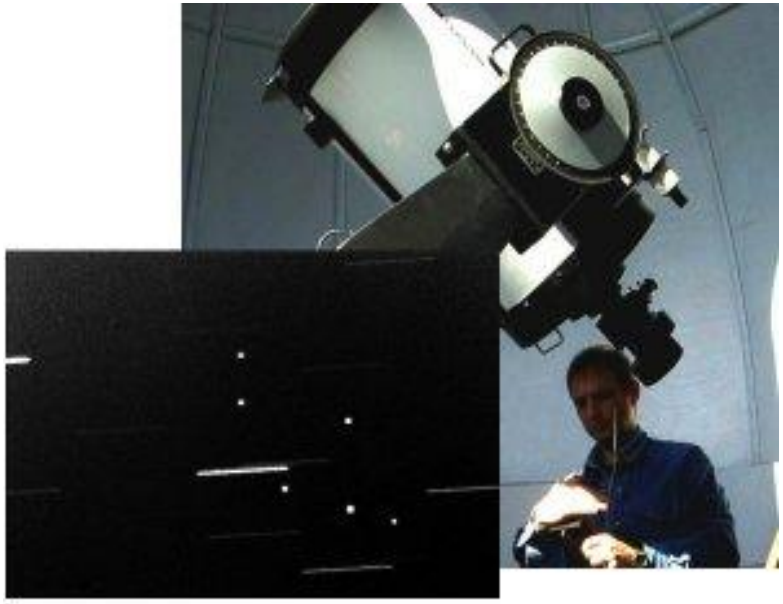
2013 – First ESA project won by Rartel

2013-2017 – More than 10 projects with ESA (prime and sub)

Relevant projects

SSA for Romania (Romanian Industry Incentive Scheme)
✓define infrastructure and existing equipment in Romania and their applicability within the ESA SSA program

✓give guidelines for future involvement of the Romanian institutions and space industry through ESA-SSA programs **(Ended 2015)**

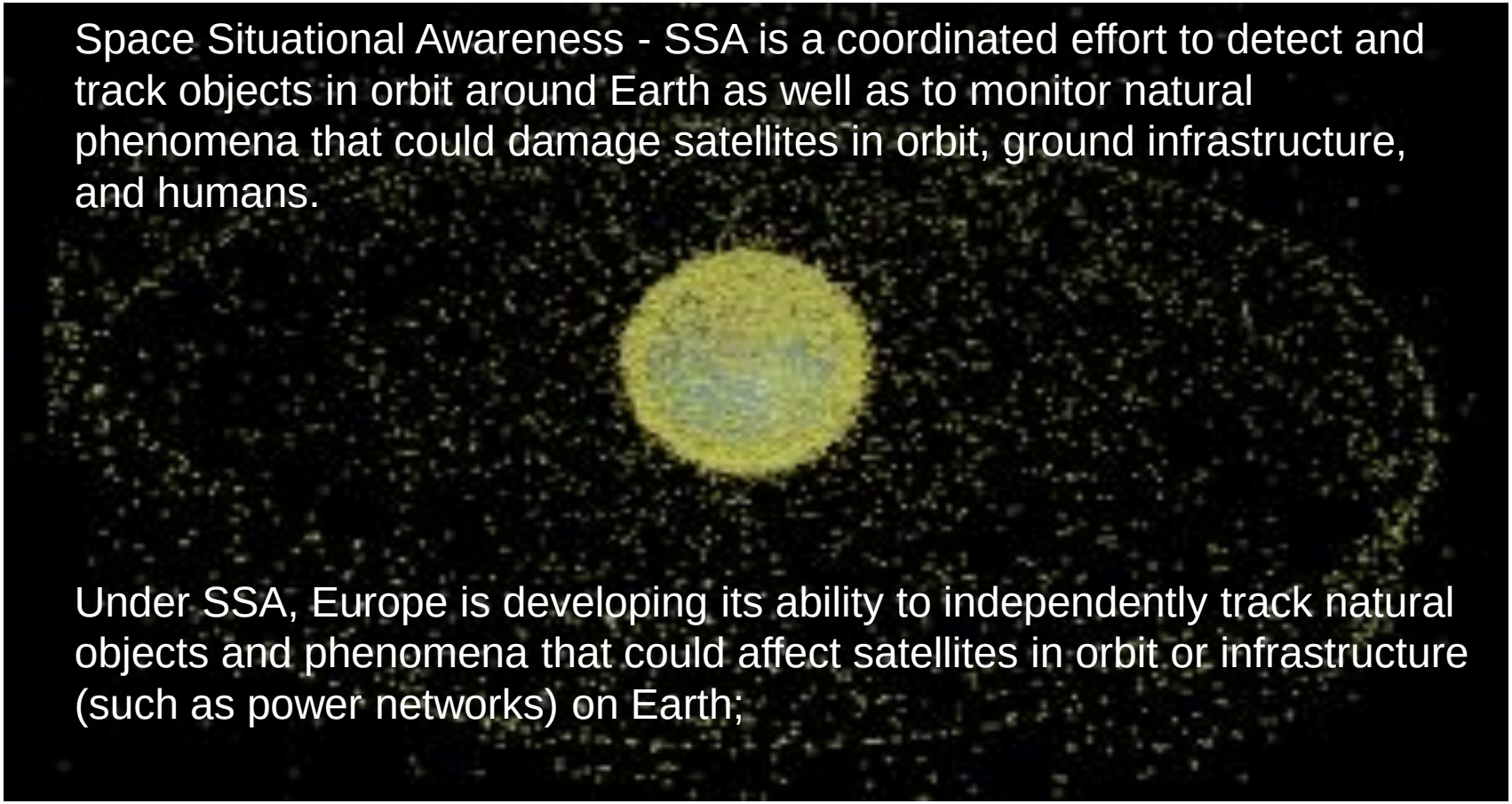


Relevant projects

Cheia antenna retrofit (RIIS)

✓ possible reutilization of the 32 meters antennas presently available at the Cheia Satellite Ground Station, in the context of SSA programme **(ongoing, phase 2).**

Space Situational Awareness

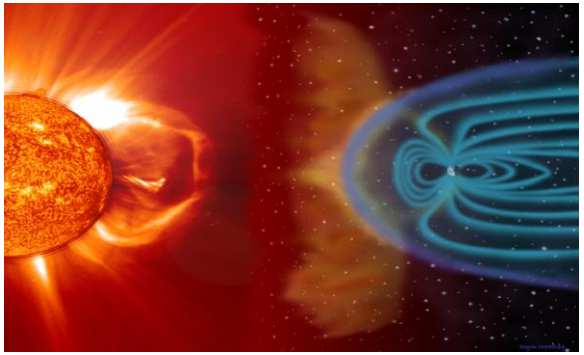


Space Situational Awareness - SSA is a coordinated effort to detect and track objects in orbit around Earth as well as to monitor natural phenomena that could damage satellites in orbit, ground infrastructure, and humans.

Under SSA, Europe is developing its ability to independently track natural objects and phenomena that could affect satellites in orbit or infrastructure (such as power networks) on Earth;

Romania’s involvement in SSA Programme

SWE - Space weather: Monitoring the conditions in the Sun, in the solar wind and Earth's magnetosphere, ionosphere and thermosphere, which can affect ground infrastructure or endanger human life or health;



NEO - Near-Earth Objects: Detecting spatial objects that may have a potential impact on Earth and cause damage;

SST - Space Surveillance and Tracking: Detecting and anticipating movements of "space waste" (decommissioned satellites, rocket components, etc.) in orbit around the Earth.

ESA-SST segment priorities for 2017–2020

✓ Further develop SST networking technologies and conduct additional qualifications of national assets**, including radars**, optical telescopes and laser-ranging systems

✓ SST data processing and application development, following a ‘community approach’ to the SST core software, which helps avoid duplication, ensure interoperability and reduce cost while allowing closed-source national tailoring according to specific needs

✓ **SST sensor development,** primarily on the ground, but also addressing further conceptualising of a space-based optical telescope as a hosted payload or a demo mission

✓ Simulate the performance of SST architectures and develop data exchange standards

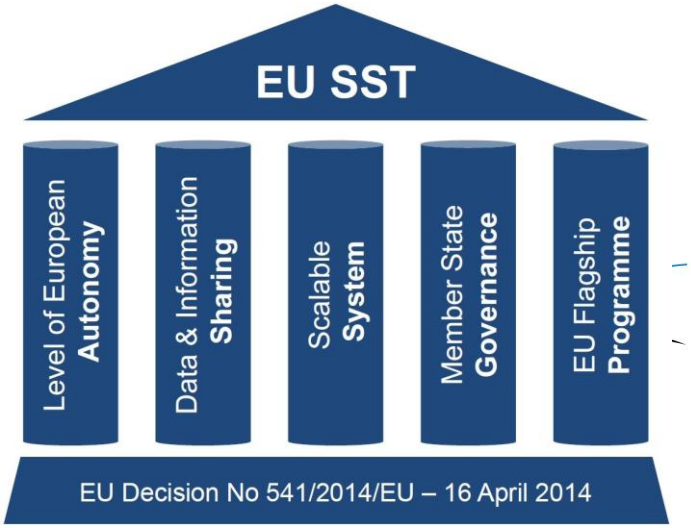
✓ Cooperation with the EU and international partners

Cheia antenna retrofit project

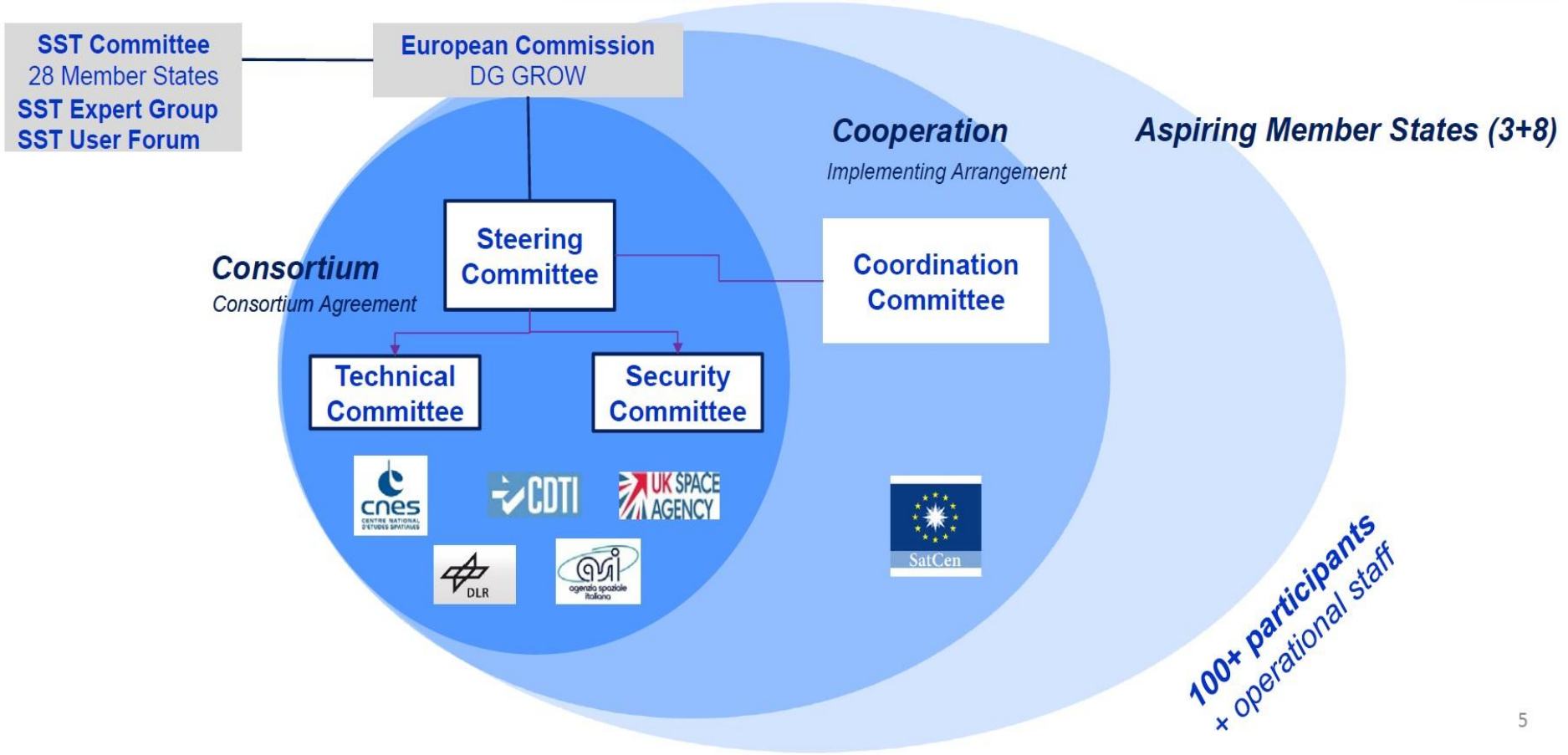
Idea: 2 existing 32-meter C-band antennas located in the Cheia Space Center (Romania, Prahova County), currently unused and with very limited prospects for re-use for telecommunication services, can be used as radar for detecting and tracking space objects.

Scope: design the radar by minimizing the changes to be made in order to achieve a good compromise between costs and radar surveillance / tracking capabilities

Another goal: Creating an infrastructure that could help Romania to join the European Consortium for Space Surveillance and Tracking (SST)



EUSST consortium



UPDATE: Few days ago Romania, Poland and Portugal joined the EUSST consortium!

Cheia antenna retrofit project consortium

RARTEL S.A.- BUCHAREST, ROMANIA

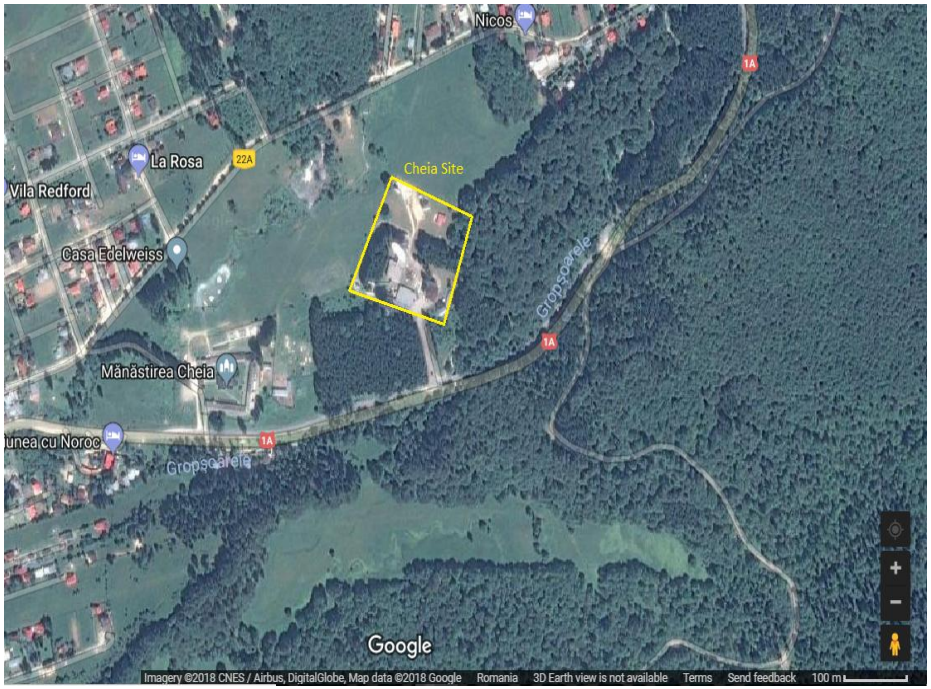
BITNET CCSS.- CLUJ, ROMANIA

VITROCISET S.p.A- ROME, ITALY

Project financed by

esa
European Space Agency

From where we started



- ✓ Two 32meter antennas
- ✓ In service from 1977 and 1979
- ✓ Produced by NEC Japan
- ✓ Purpose: Telecommunication services in C-band
- ✓ No longer in service (In conservation mode)

Facts established so far:

❑ 5 kW transmitted power
(with a power amplifier of 10 KW)

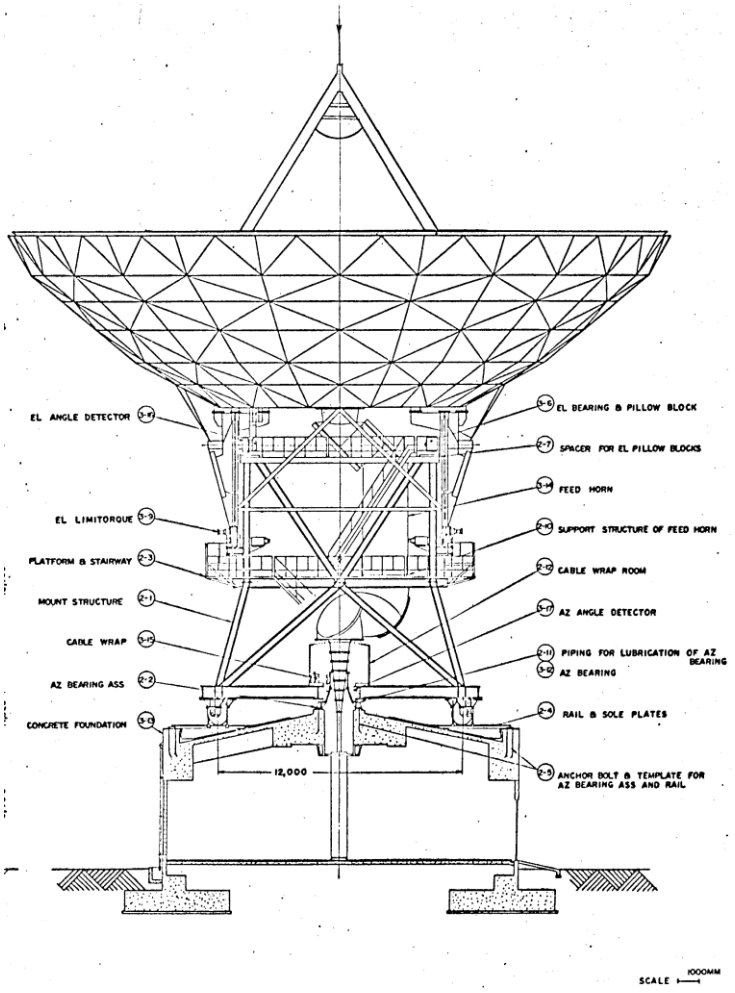
❑ Operation in the 5,845-5,850 GHz band
(Region 1, according to Radio Regulations, 2012 edition)

Possible usage:

❑ One transmitting only antenna for a bi-static / multi-static European system
or
❑ Quasi-mono-static stand-alone radar
= RX Che-2, TX Che-1

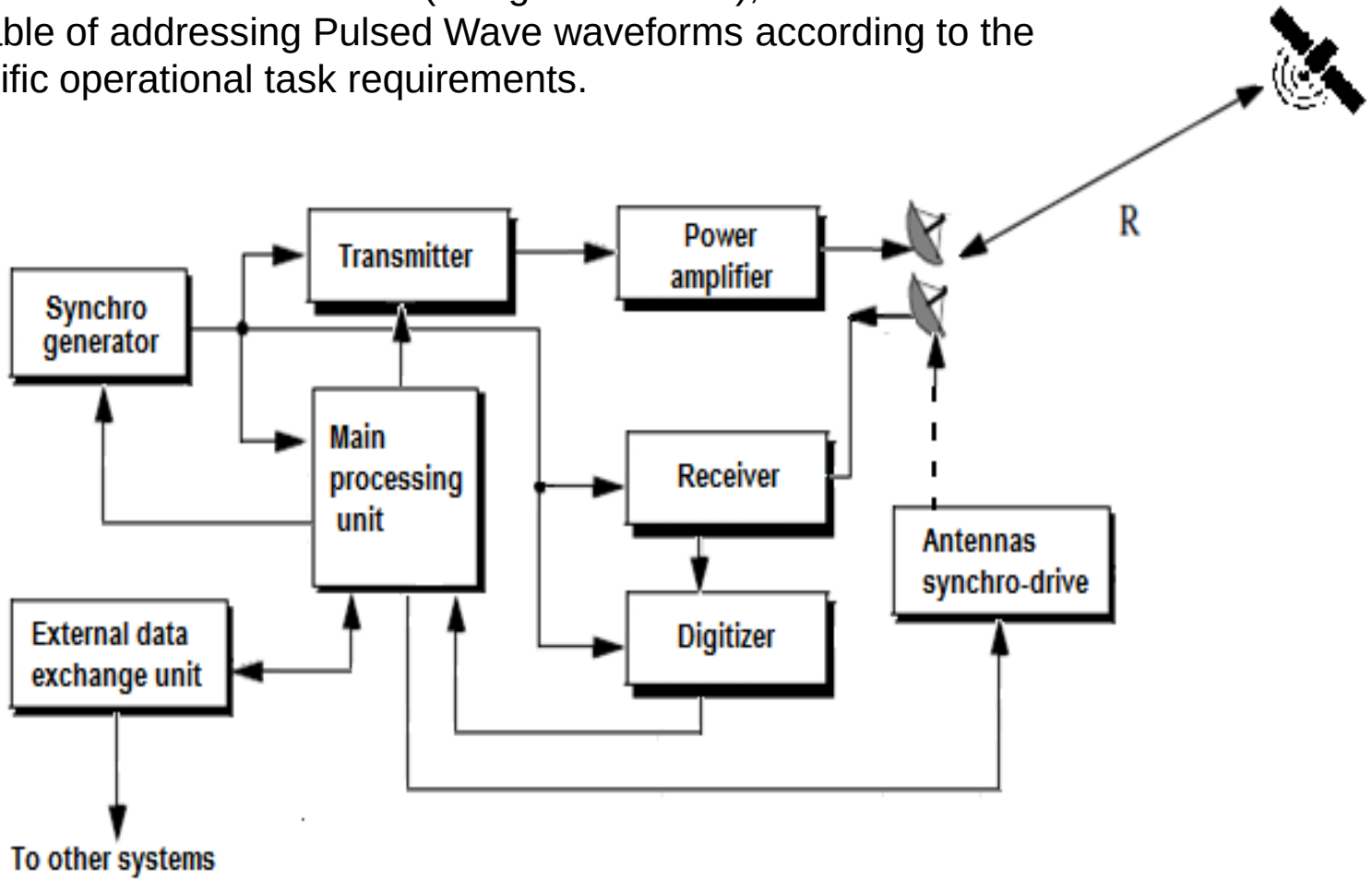
High flexibility

❑ Operating mode (CW, LFM Pulses)

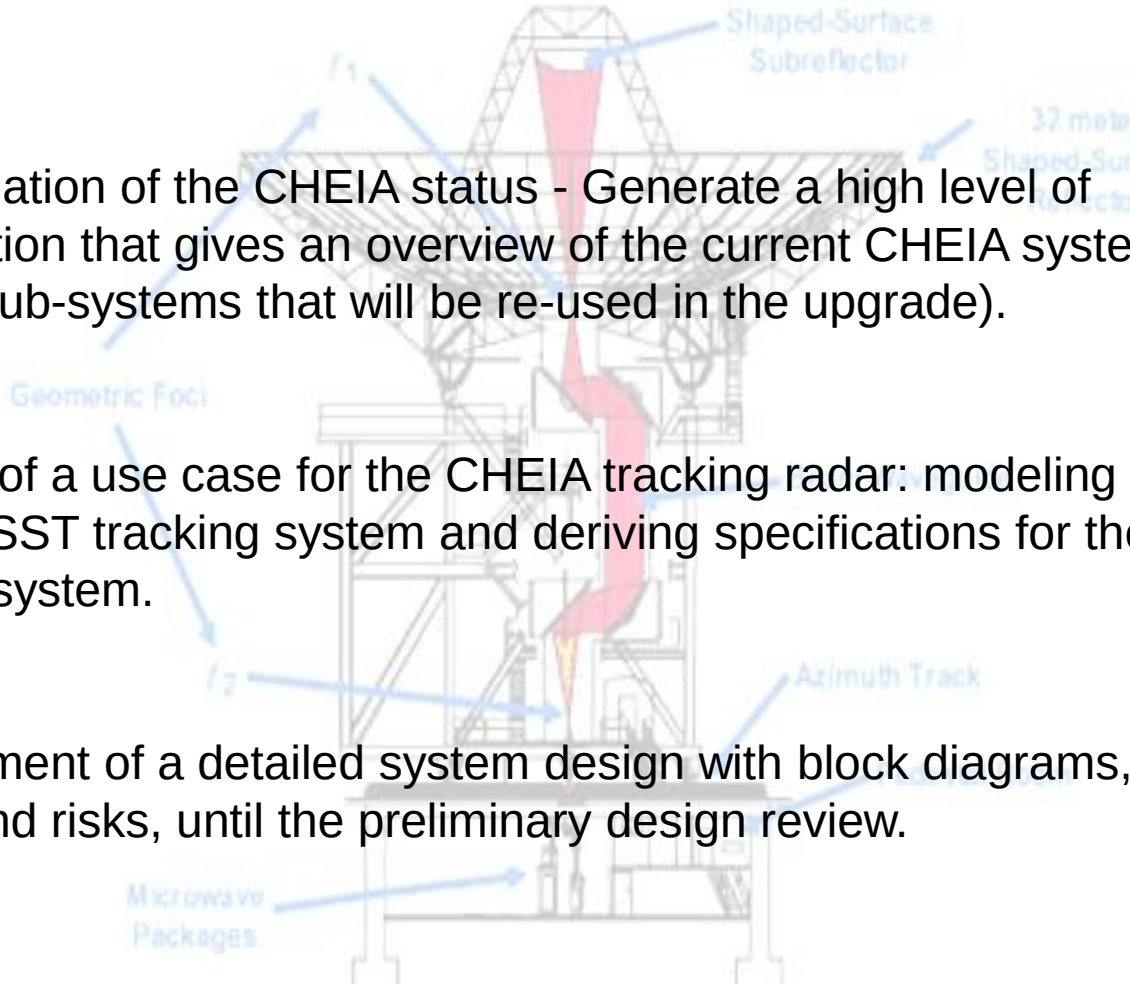


Block diagram

The proposed hybrid solution consists of a transmitter designed to operate in Continuous Wave (using 2 antennas), which is also capable of addressing Pulsed Wave waveforms according to the specific operational task requirements.



Preliminary design (ongoing activity)



- Determination of the CHEIA status - Generate a high level of documentation that gives an overview of the current CHEIA system status (limited to sub-systems that will be re-used in the upgrade).

- Analysis of a use case for the CHEIA tracking radar: modeling and use case of an SST tracking system and deriving specifications for the upgrade of the CHEIA system.

- Development of a detailed system design with block diagrams, costs, schedule and risks, until the preliminary design review.

Expected radar performance (preliminary figures)

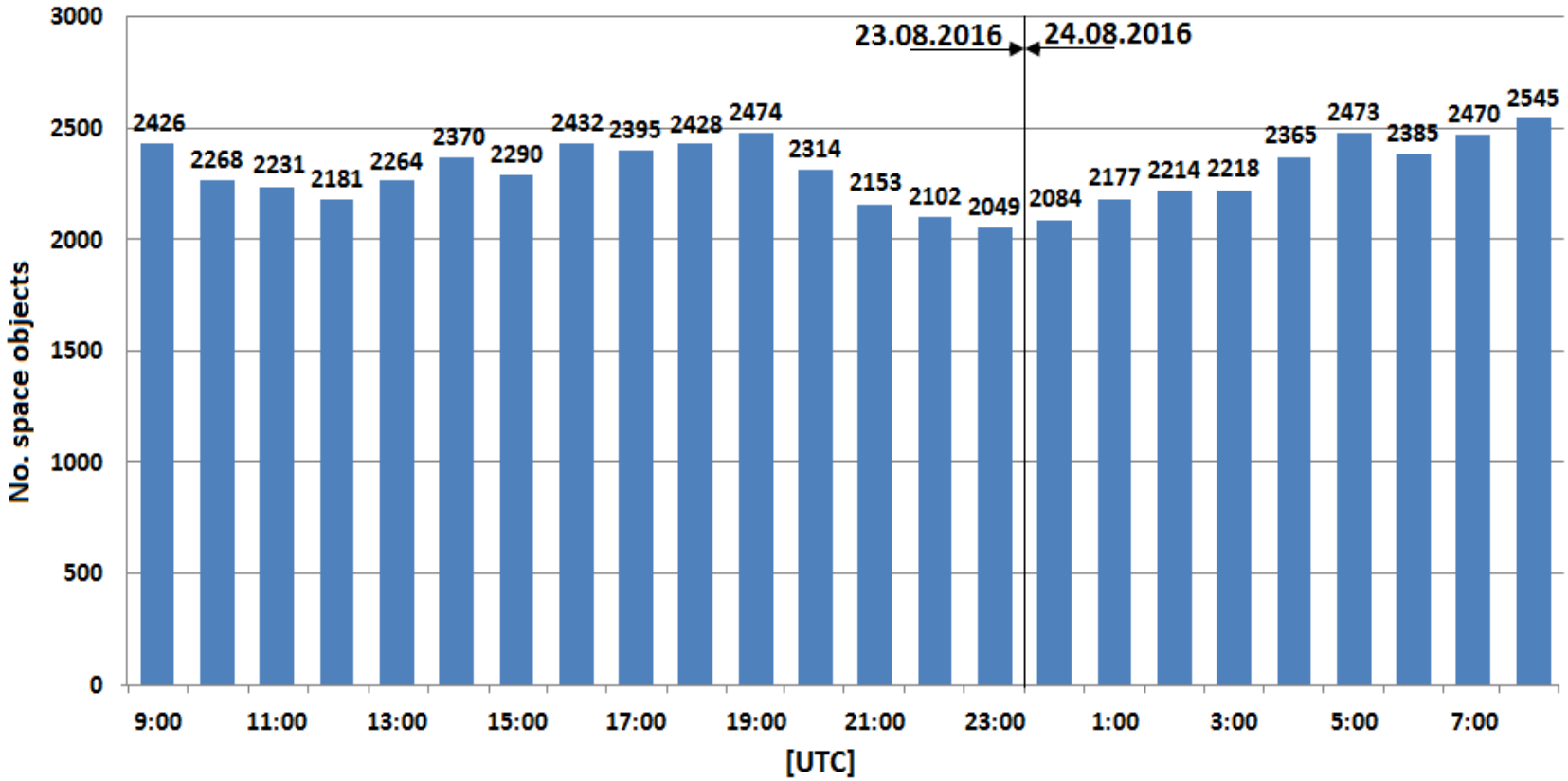
- Space Tracking (ST)

  ✓ LEO targets with RCS as small as 10^{-4} m^2
  - low LEOs (800 to1000 km orbital altitude) at low elevation angles (20° to 40°)
  - high LEOs (1000-2000 km orbital altitude) up to elevation angle of 90°

  ✓ GEO targets with RCS as small as 1 m^2

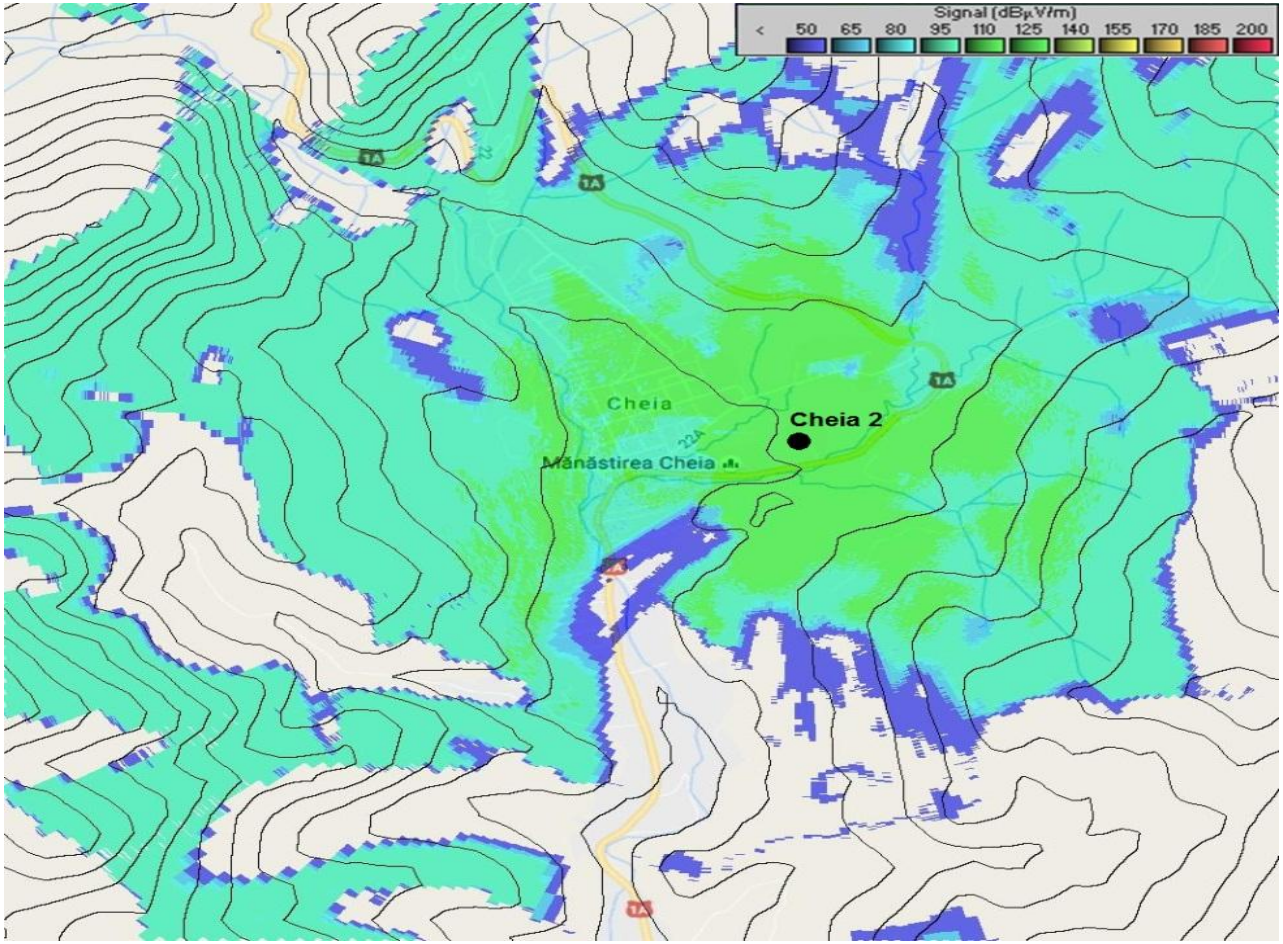
  ✓ NEO objects with RCS in the range of 4 to $2{,}2 \cdot 10^{+3}$ m^2 in the altitude range of 60.000 to 100.000 Km if CW mode is used.

Number of possible detections



Space objects passing over Cheia facility within one hour (elevation > 20°)

Environment (no significant impact)



Signal strength level evaluation for 10° elevation (worst case)

Actual status of the project (issues solved)

- ❑ Mechanical and structural testing of the antenna parameters ✔
- ❑ Command & control of the antenna positioning system ✔
- ❑ Electrical testing ✔
- ❑ Evaluation of the site‘s power supply capabilities ✔

Actual status of the project (issues ongoing)

- ❑ Simulation of antenna performances regarding number of space objects possible to be tracked (using of PROOF software)
- ❑ Evaluation of the antenna pattern
- ❑ Analysis of CHEIA tracking radar use case
- ❑ Analysis of different radar configurations
- ❑ Study on the impact of the different configurations on the key parameters

Advantages of Cheia antennas retrofitting

- The presence of 2 identical 32 meters antennas in the same site, provides a versatility uncommon to the majority of sites having only one antenna

- The most Eastern location in the EU
  - ✓ increase the window of visibility of a space object, esp toward East (out of EU and NATO bounderies)
  - ✓ increase the detection probability
  - ✓ increase the accuracy of orbit determination
  - ✓ detection of additional satellites (for instance on GEO) which cannot be detected from the west side of Europe
  - ✓ the radar sensor can certainly contribute to debris detection and tracking of large number of small objects to high altitude

Thank you for your attention!