



Space surveillance and tracking using radio methods

SDR-based multi-feed reception system for SST (SDR4SST) – phase I

ESA Contract No: 4000128680/19/D/CT

Ref.: AO/1-8856/16/NL/Cbi

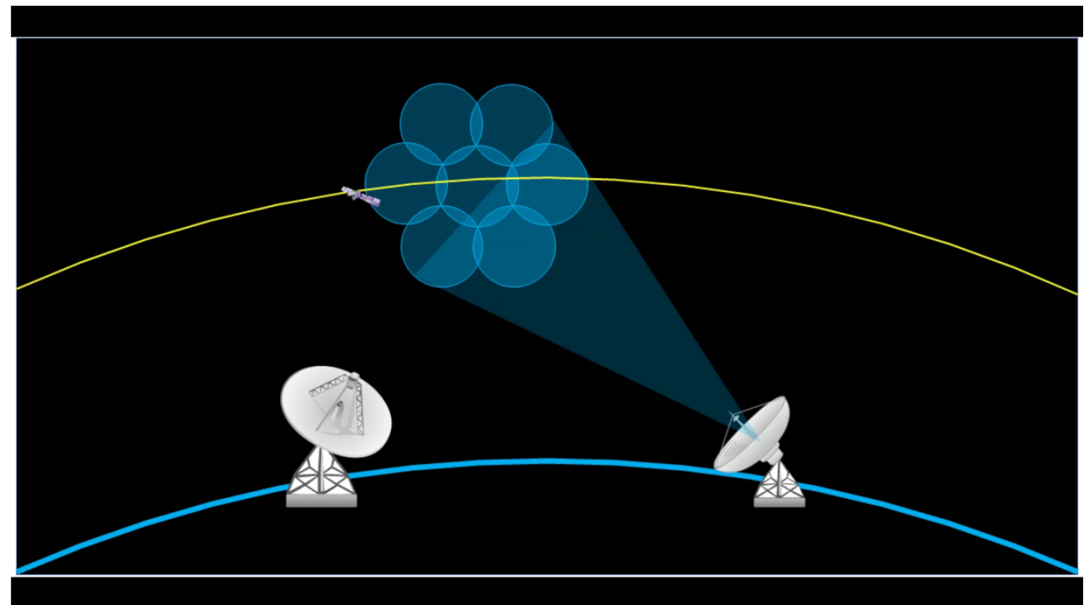
Category: ESA Express Procurement (EXPRO+) / Open-Competitive

Frame of the Call for Outline Proposals under the Romanian Industry Incentive Scheme

Implementation period: Dec. 2019 – Dec. 2021

Implementation team: TUC-N (coordinator) and BITNET CCSS (partner)

Scope: develop a solution that increases the radio detection probability (of a space object) by using multi-feed directive antennas and processing the incoming signals with SDRs



SDR-based multi-feed reception system for SST (SDR4SST) – phase I

Application:

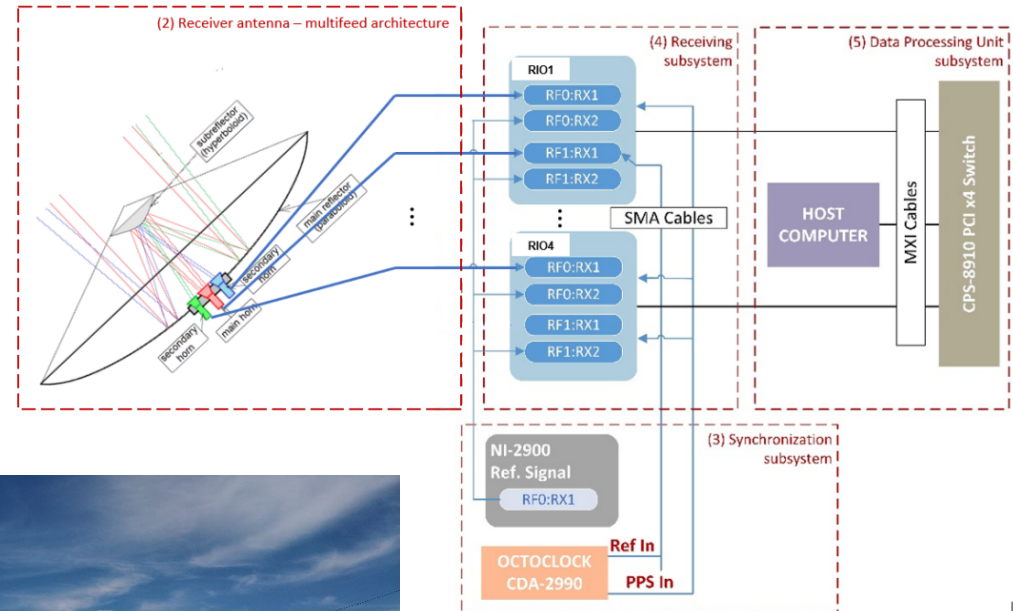
- Passive radar (cooperative targets)
- Bistatic/multistatic radar (non-cooperative targets)

SDR4SST solution:

- 3.8m parabolic dish antenna
- seven C-band LNBS (@4GHz)
- an NI SDR-based prototyping platform
- LabVIEW and MATLAB for signal processing

Deployment site:

Remote location in Marisel
(50km from Cluj-Napoca)



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SDR-based reception system – NI platform

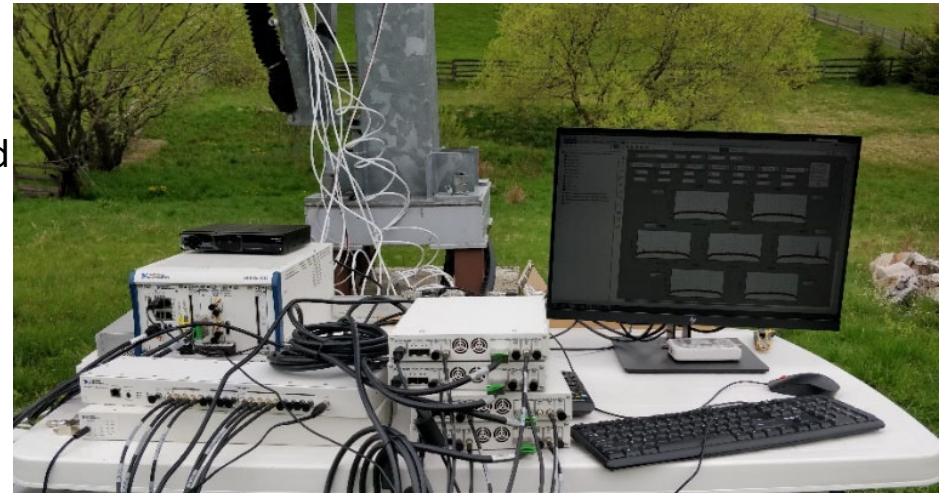
- 4 NI USRPs – each one has two RF input ports.
- The NI PXI-8880 processing unit – controls the USRPs and processes the data.
- The switch – connects the USRPs to the PXI unit.
- The CDA-2990 octoclock – synchronizes the USRPs.

LabVIEW

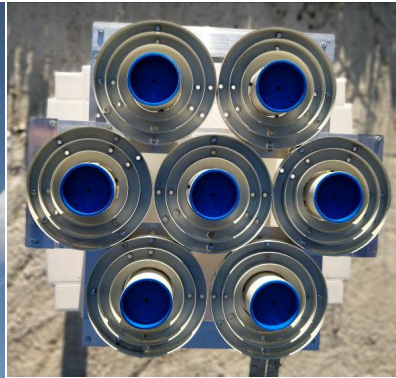
- Plots real-time spectrum on all 7 LNBS
- Indicates maximum level on each LNB
- Records spectrum data into .bin files

MATLAB

- Detects target
- Plots target amplitude variation in the FoV of the system
- Indicates a rough target trajectory



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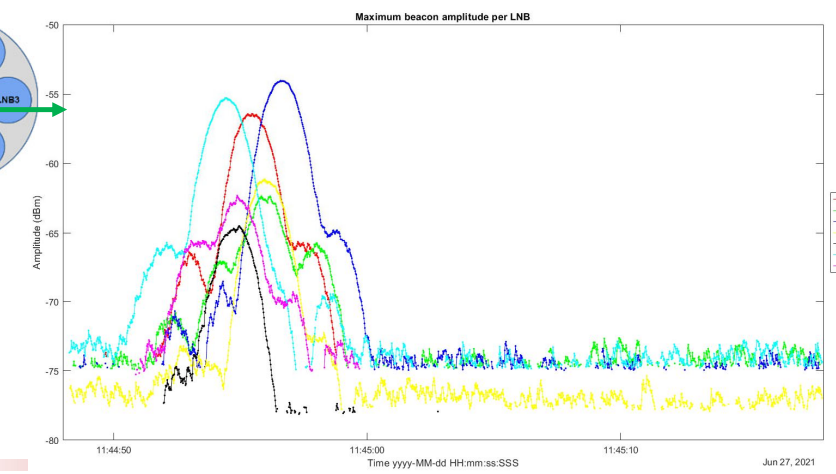
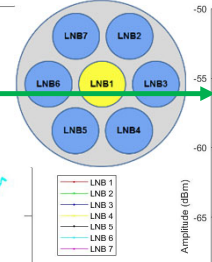
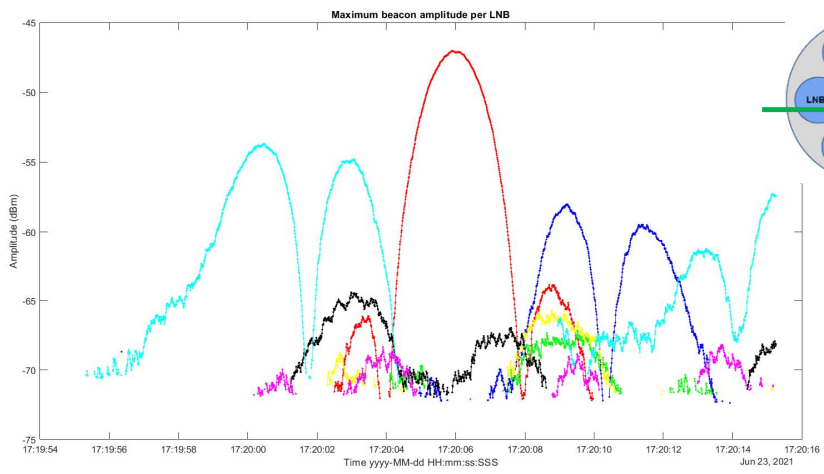
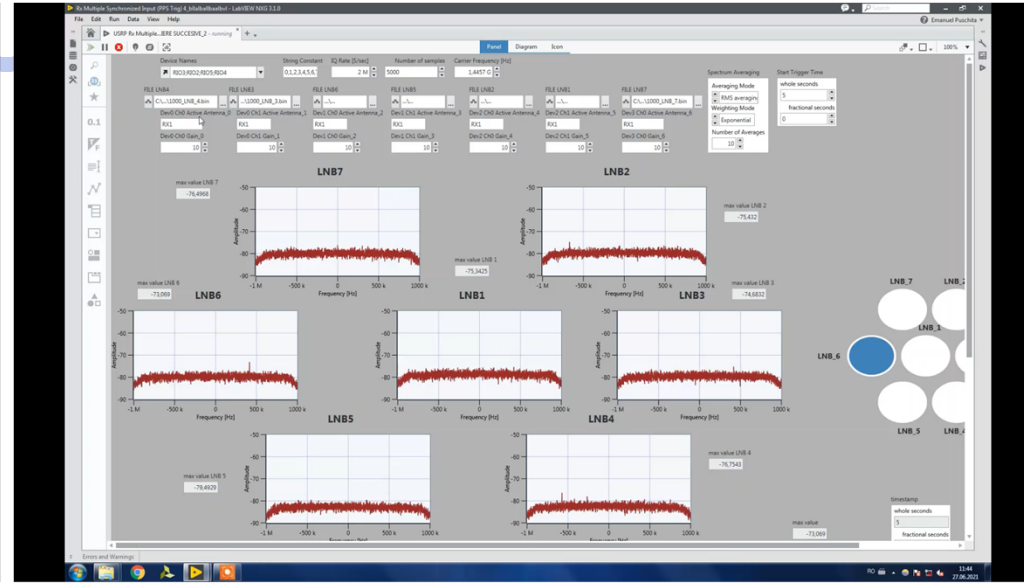
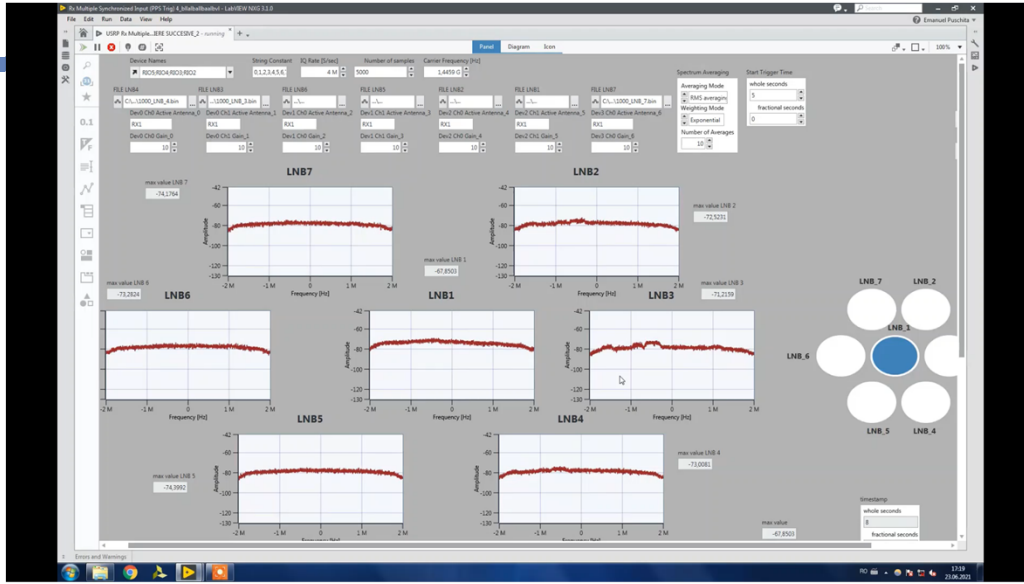
Prime-focus

Cassegrain

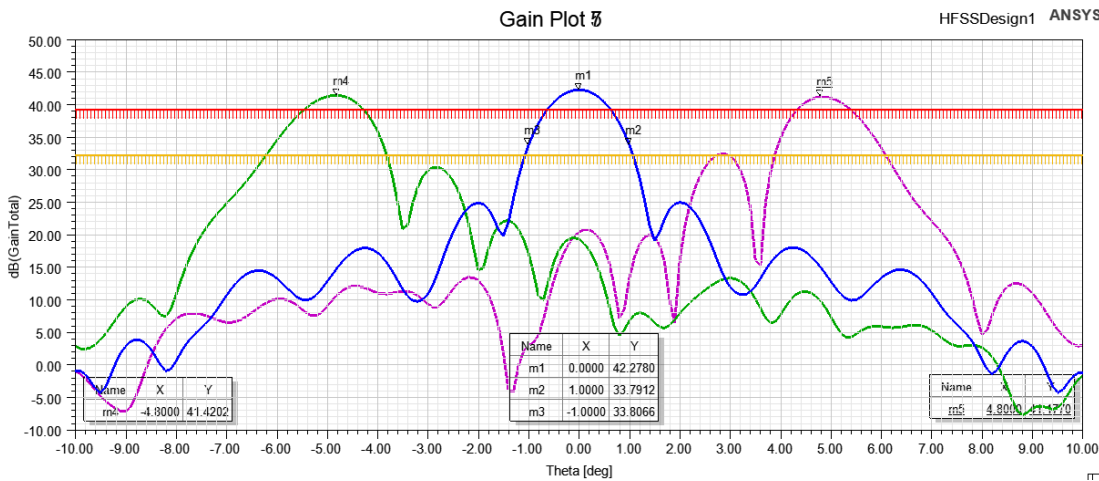


Prime focus

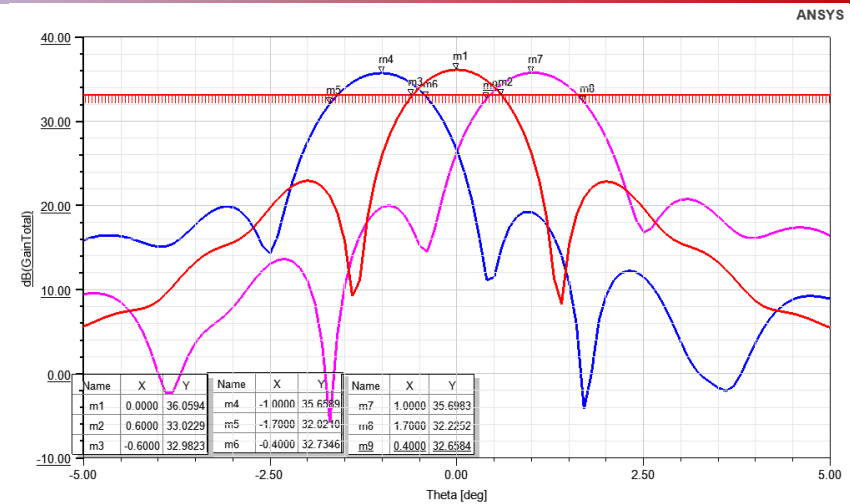
Cassegrain



SDR-based multi-feed reception system for SST (SDR4SST) – phase I



Prime-focus



Cassegrain

Parameter	Single feed	Prime-focus multifeed	Cassegrain multifeed
Gain (simulation)	44.16 dB	42.27 dB	36.05 dB
FoV - simulation	1.1°	14°	3.5°
Maximum level	-66 dBm	-47 dBm	-55 dBm or -57dBm
FoV - measurements	1.5°	13.5°	3.8°
Observation	Only R&S analyzer	Analyzer + USRPs	USRPs



SDR-based multi-feed reception system for SST (SDR4SST) – phase II

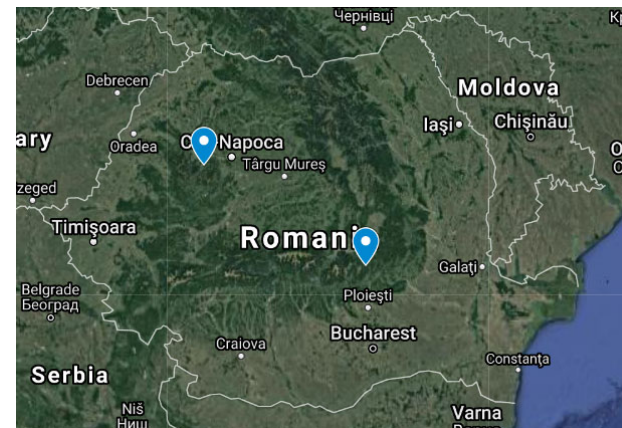
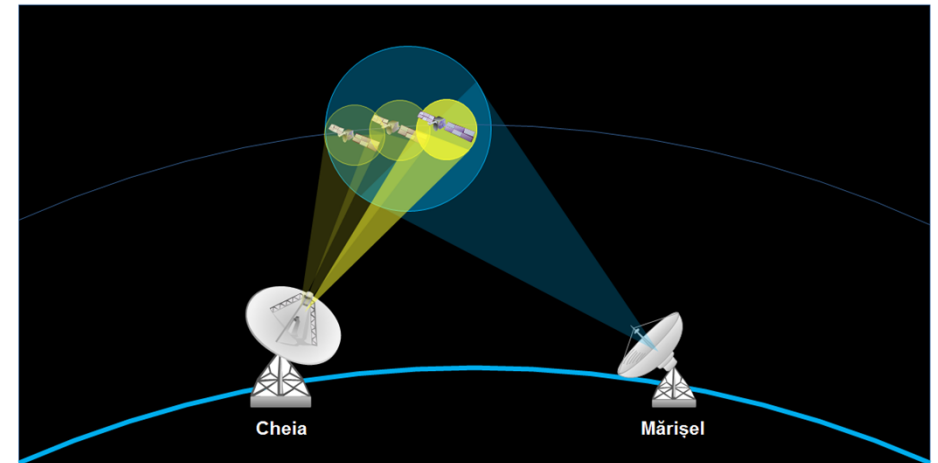
Considering the promising results obtained with the SDR-based reception system, ESA asked for a system upgrade suitable for tests with the Cheia radar (CCN No: 02/21)

SDR4SST phase II

- Operating frequency: 6GHz
- System: prime-focus, single-feed
- FMCW receiver with range estimation

Cheia radar

- Currently being adapted for radar applications
- 32m diameter parabolic antenna
- HPBW of 0.11°
- Tracking capabilities



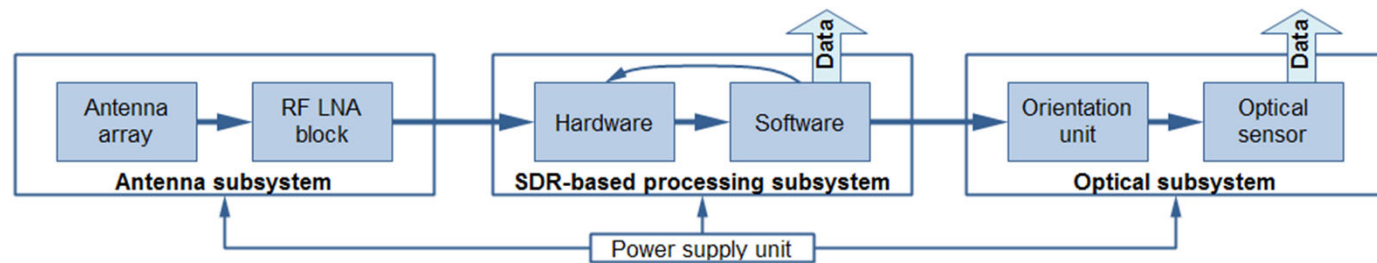
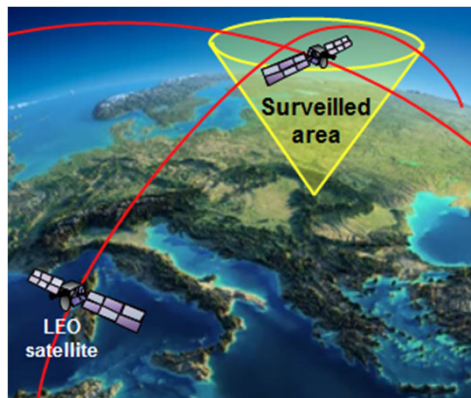
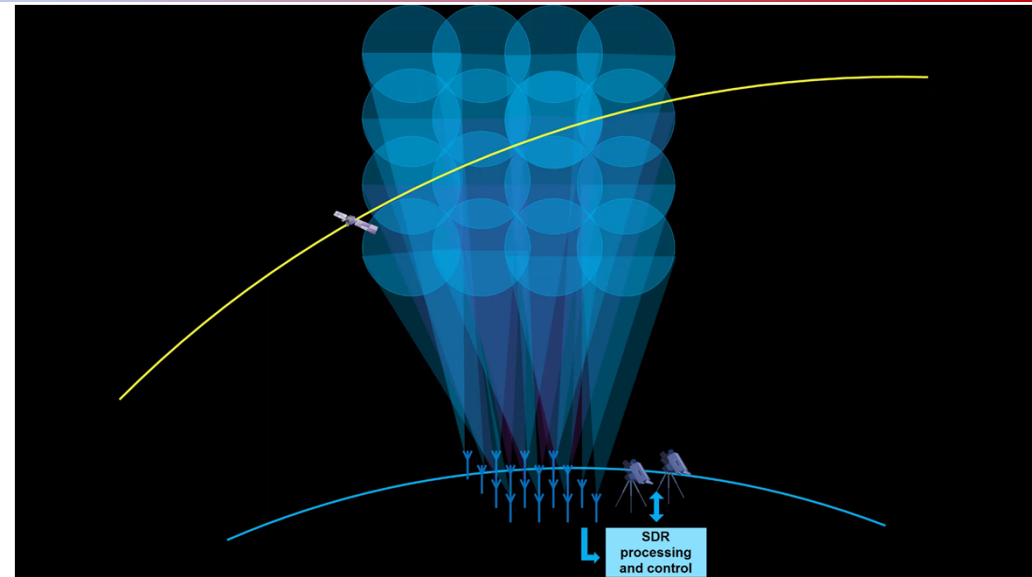
SDR-based System for Radio Surveillance of Low Earth Orbits (SDR4LEO)

Under evaluation: The Executive Agency for Higher Education, Research, Development, and Innovation Funding (UEFISCDI)

Implementation team: TUC-N and INCDTIM

Scope: SDR-based system for the passive surveillance of LEO satellites that employs two types of sensors:

- **radio** for spectrum sensing and fast target detection
- **optical** for target image acquisition that allows the accurate target trajectory determination



Thank you for your attention!



Contact: Tudor.Palade@com.utcluj.ro

15 Constantin Daicoviciu street, office 433

400020 Cluj-Napoca, Romania

tel: +40 264 401 285

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