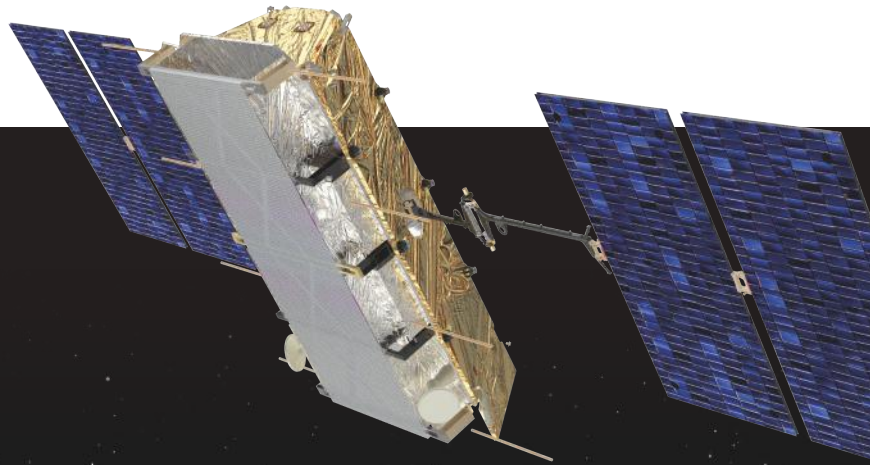


SPACE NOSTRUM

GLOBAL MARITIME
SURVEILLANCE FROM SPACE



**SATELLITE MARITIME
SURVEILLANCE**

**NEW SATELLITE
CONSTELLATION**

**LARGE RADAR COVERAGE
(1000 km) & REDUCED
HOURLY REVISIT TIME**

**INNOVATIVE MULTI-SHIP
REALTIME TRACKING**

**DATA FUSION BETWEEN
AIS & RADAR**

**MARITIME RISK MODELISATION
& BEHAVIOUR ANALYSIS**

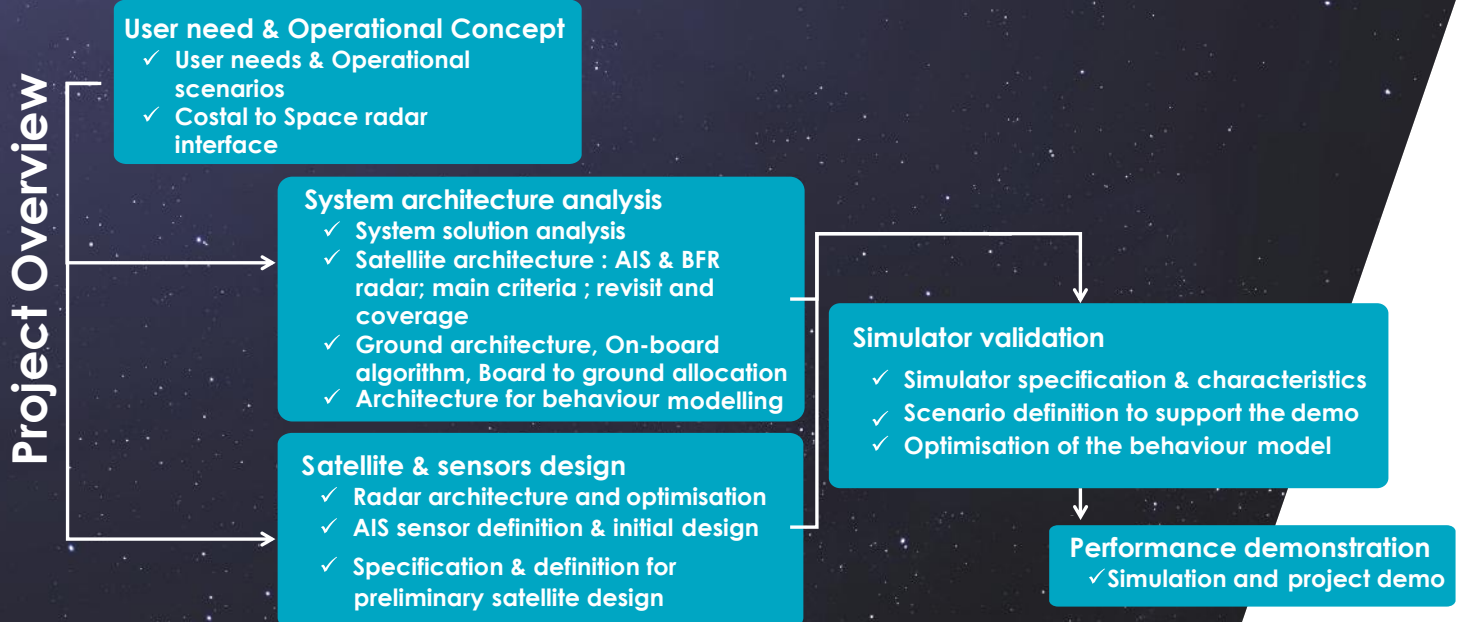
SPACE NOSTRUM GLOBAL MARITIME SURVEILLANCE FROM SPACE

An R&D project to demonstrate the technical feasibility of a dedicated maritime surveillance satellite constellation enabled by a new large swath radar sensor embedding fusion with high performing Sat.AIS; addressing at the same time cooperative vessels and non-cooperative vessels (either without positioning systems, or with false AIS spoofing position). A specific focus over the mediterranean sea.

The project encompasses:

- Aggregation and Consolidation of user needs for open seas and dense areas surveillance,
- Preliminary definition of a space surveillance system based on a constellation and ground processing including multi-ship tracking and automated behaviour analysis
- Development and Deployment of a demonstration platform to exhibit the system future capacities

MULTISOURCE SENSORS DATA FUSION & TRACKING



SPACE NOSTRUM



FINANCING:

Project co-financed by the EU (Feder funded)
Duration 22 month (July 2017 – April 2019)

Consortium and Responsibilities in the study:

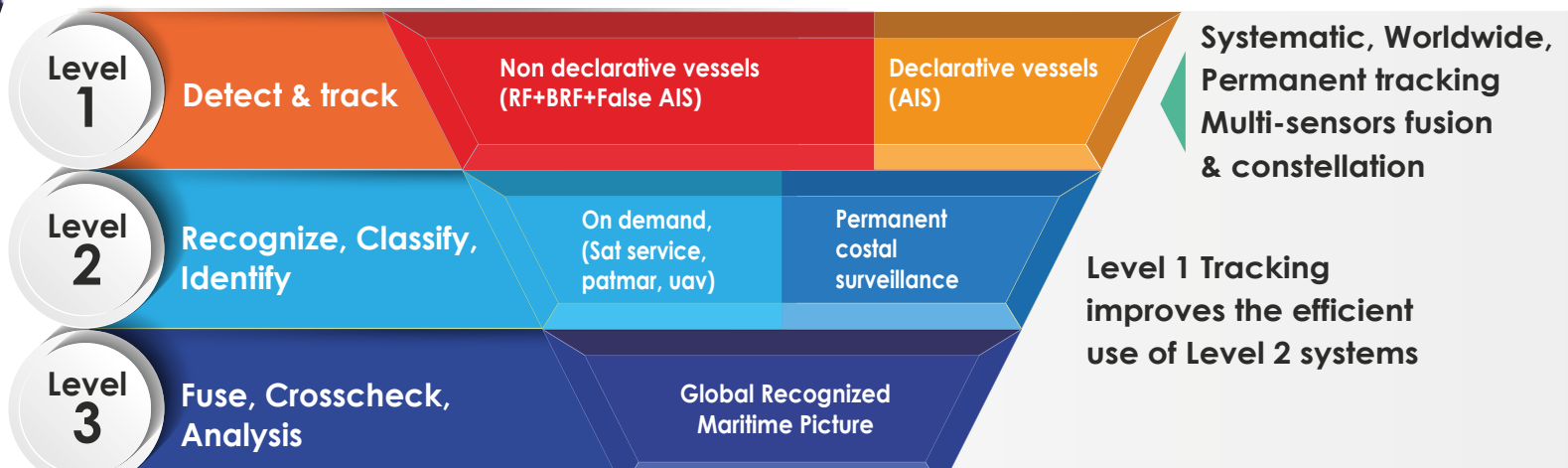
- **Thales Alenia Space:** Project head and coordination, Space Constellation sizing, Satellite and sensors definition; maritime tracking algorithm definition & simulation
- **Armires:** Data fusion and algorithm definition for maritime risk & behaviour analysis
- **Blue Solutions Consulting:** Maritime organization approach and end user need comprehension, Maritime scenario description
- **Cesigma:** Costal radar simulation; Interface between costal & radar data
- **Prolexia:** Demonstration platform software design and simulated physical model integration



PERMANENT WORLDWIDE MARITIME TRAFFIC MONITORING

SPACE SYSTEMS ARE OFTEN THE ONLY SYSTEMS ABLE TO MONITOR OPEN SEAS

Today, Sat.AIS is not sufficient to detect and track non cooperative vessels.
There is no comprehensive worldwide maritime traffic knowledge system.



Beyond 30 or 40 nautical miles from the coast, apart from the information obtained via Vessels Monitoring Systems (VMS) for fishing boats, the recent Long Range and Identification (LRIT) systems for cooperative vessels and the information gathered from time to time by airborne maritime patrols, there are no resources enabling quasi-permanent operational knowledge of sea-based activity.

From this point of view, the added value provided by Space at sea, due to observation, navigation or telecommunications solutions, is unique. Space is complementary to other maritime surveillance systems (coastal, airborne, maritime).

Space systems are mostly used in the fundamental upper layer of the operational chain, in the preventive, surveillance, detection or alert phases. This new concept provides a revisit time that can also support the operation cycle for real-time intervention.

Space Based AIS:

Due to 20 years of experience in data collection systems like Argos, Thales Alenia Space has developed with CNES and ESA new efficient systems and technologies to capture AIS signals transmitted by ships with a low earth orbit constellation.

As those AIS signals transmit declarative useful information such as ships positions along their routes, port departure and arrival ..., it is of high interest for maritime traffic control system to get this information.

High performance, reliability, autonomy are key enablers for a European institutional system focusing on applications as critical as security and safety.

Unfortunately AIS is not enough to create the fundamental and global base layer.



MODELLING OF SUSPICIOUS SCENARIOS & SHIP TRAJECTORY VISUALISATION

More effective radar sensors:

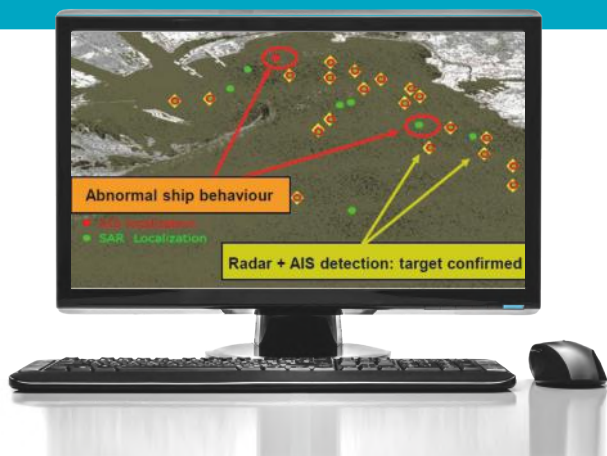
Optimal compromise between larger swaths while maintaining sufficient resolution.

Maritime surveillance from space is a question of time and spatial coverage that can be done only with space sensors which brings global coverage, all weather, day & night and short revisit time. Conventional SAR satellites like Radarsat, Sentinel 1 or Cosmo SkyMed have already demonstrated their huge benefit for maritime surveillance. To reach a global coverage and a short revisit time with a limited number of satellites, Thales Alenia Space proposes the use of an innovative radar sensor concept optimized for detection of vessel at sea over a very wide swath. This new radar exhibits high detection

performances of small ships even in adverse sea states conditions. The principle is based on Low Pulse Repetition Frequency radar, which allows wide swath coverage (as high as 1000 km), at low grazing incidence to reduce the sea clutter contribution as much as possible. The radar operates in convenient polarization to enhance the contrast between the target and the clutter. The radar output data is detection maps, where ships have been detected, localized and tracked. Then more accurate means (HR Optical or SAR satellite, Maritime Patrol Aircraft, Airborne Surveillance Drone,...) it can be tasked to identify the vessel thanks to more local observations.

This instrument is optimized for low power consumption. Its operation concept is specifically designed for detection.

ABNORMAL BEHAVIOUR ANALYSIS AND WARNING INDICATOR FOR DECISION MAKING



SPECIFIC FOCUS OVER MEDITERRANEAN SEA DEDICATED FOR MARITIME SITUATION AWARENESS

A 20 CONSTELLATION SATELLITES LAUNCHED IN TWO TIMES TO PERFORM AN EFFICIENT WORLDWIDE VESSEL TRACKING