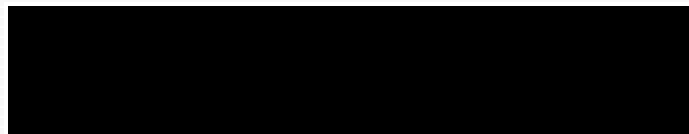


WORKSHOP ON EU FUNDED BORDER SECURITY RESEARCH PROJECTS

RANGER Project



EXUS

- RANGER at glance
- Objectives
- Evolution
- RANGER results
- Next Milestones

- RANGER is an EU funded project, within the H2020 Horizon programme.
- “RANGER: RAdars for loNG distance maritime surveillance and Search and Rescue operations”
- Grant agreement no: 700478
- Start date: 1 May 2016
- End date: 31 October 2019
- Duration: 42 months
- **We are running Month 26**
- Pilots will be held in 2 Phases
 - In France [M30] [M38] &
 - In Greece [M34] [M41]
- Total budget: 7,992,312.50 €
- Total funding: 7,992,312.50 €

Introducing Ourselves

- 10 partners
- 7 countries

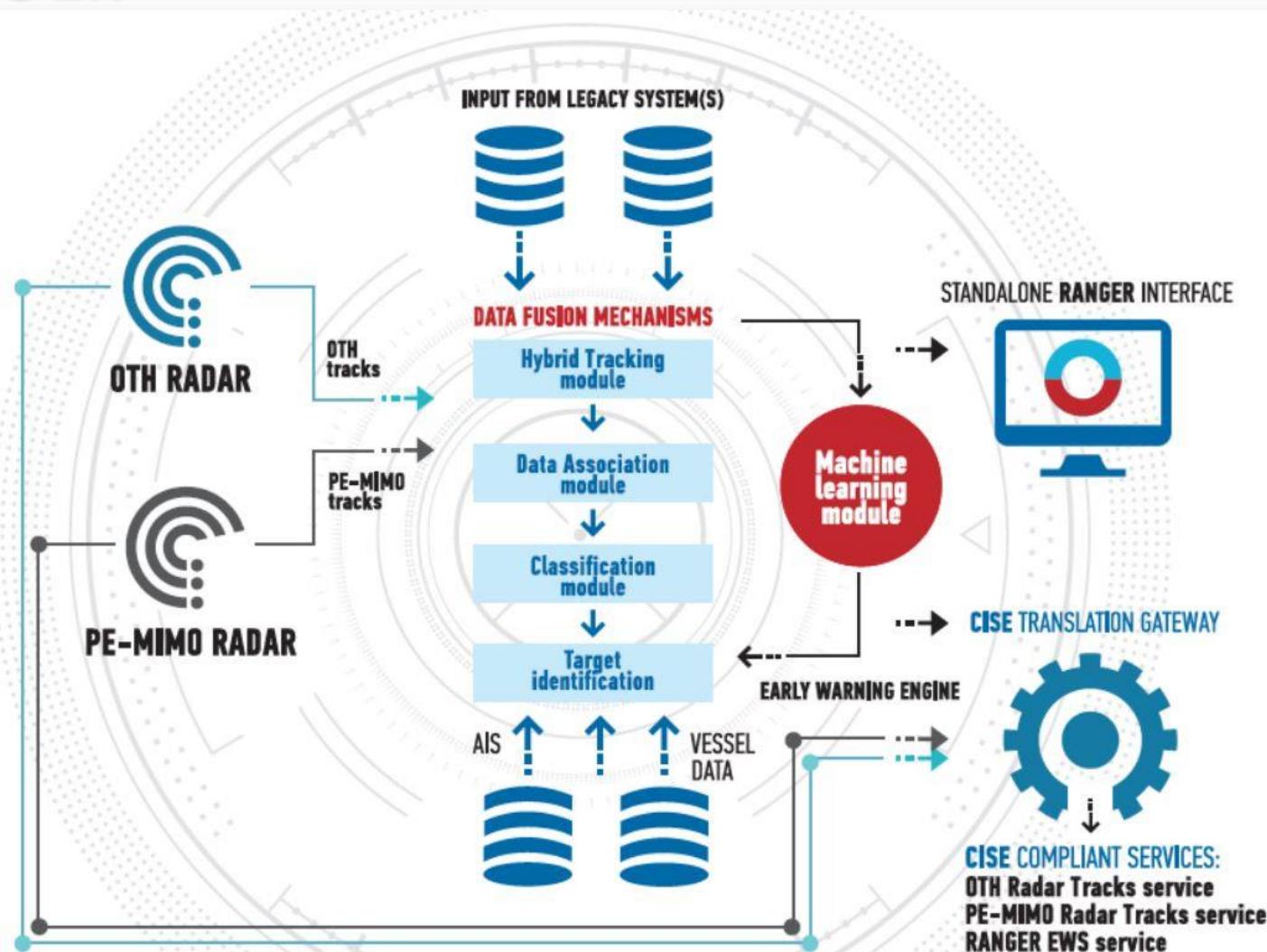


- RANGER innovates, by combining **novel and ground-breaking Radar technologies** with innovative supporting technological solutions for Early Warning, in view of delivering a **surveillance platform** that will offer tracking as well as detection, recognition, and identification of vessels **far beyond** existing legacy radar systems, seamlessly fitting and contributing to the **CISE framework** through the provision of on-demand CISE compliant services.

- The main goal of RANGER is to provide **innovative solutions** for early warning and distant border surveillance to **support SAR operations and tackle illegal conduct** in the marine environment.
- The solution will drastically **improve the performance of existing Radar systems**, by employing a blend of Over the Horizon Radar system and Photonics Enhanced MIMO radar system with other novel supporting technologies for data fusion and early warning and existing infrastructures, validated in the context of real pilot exercises.

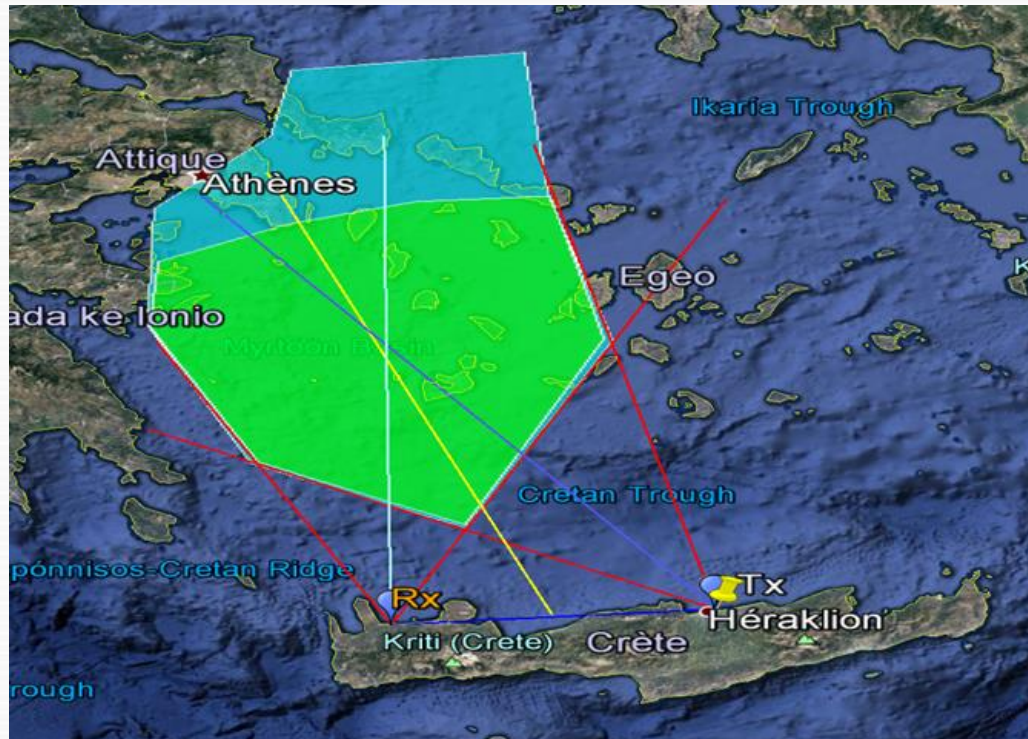
1. to provide **a complete solution** for maritime surveillance and SAR operations.
2. to **lower the total cost of ownership** compared to existing marine surveillance platforms and radar solutions.
3. to ensure **compatibility** of the RANGER platform **with** the Common Information Sharing Environment – **CISE**.
4. to **validate and demonstrate the effectiveness** of the integrated RANGER platform.
5. to **define** a multilevel **compliance framework** (ethical - legal - societal) that RANGER solution will be aligned with

The platform



- **OTH (Over-The-Horizon) Radar**
- **Photonics Enhanced MIMO (PE-MIMO) Radar**
- **Uniform Communication Gateway (UCG) – Interoperability Layer**
- **Early Warning System**
 - **Data fusion and Machine Learning**
 - **Early Warning Engine (EWE) (rule engine & Alerts)**
- **Advanced User Interface (AUI)**
- **CISE Translation gateway**

Both radar solutions (OTH and PE-MIMO) as part of the RANGER platform, are going to cover clear operational needs creating a **“24/7, effective in different weather conditions surveillance” system** that it can track different kind of vessels over a wide maritime zone of **up to 200 nautical miles**.



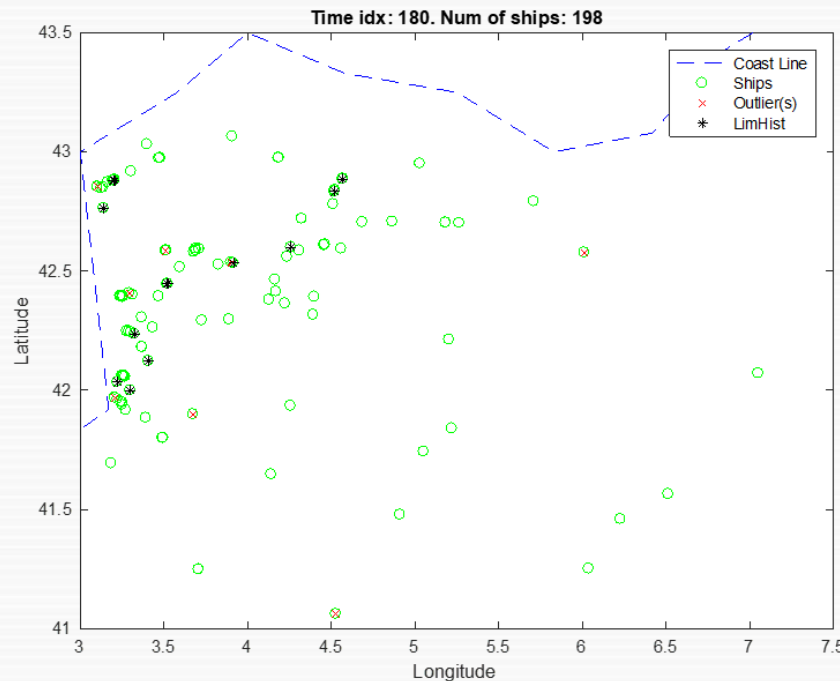
RANGER Early Warning System (EWS)

EWS will be built upon **advanced Data fusion** algorithms and architectures, as well as **novel deep machine learning** structures, to provide:

- A **threat classification** of all simultaneously detected targets based on AIS data, historical data in available databases, as well as maneuvering patterns of detected and tracked vessels.
- **Automatic Target Recognition (ATR)** through cross correlation of Radar and AIS data.

RANGER Early Warning System (EWS)

- **Target Continuous Tracking**, especially valuable for high-threat vessels.
- **Alarms** including collision warning, speed violations and proximity alerts.
- **Recommendations** on required interventions based on risk assessment and self-training of threat detection models.



Advanced user Interface (AUI)

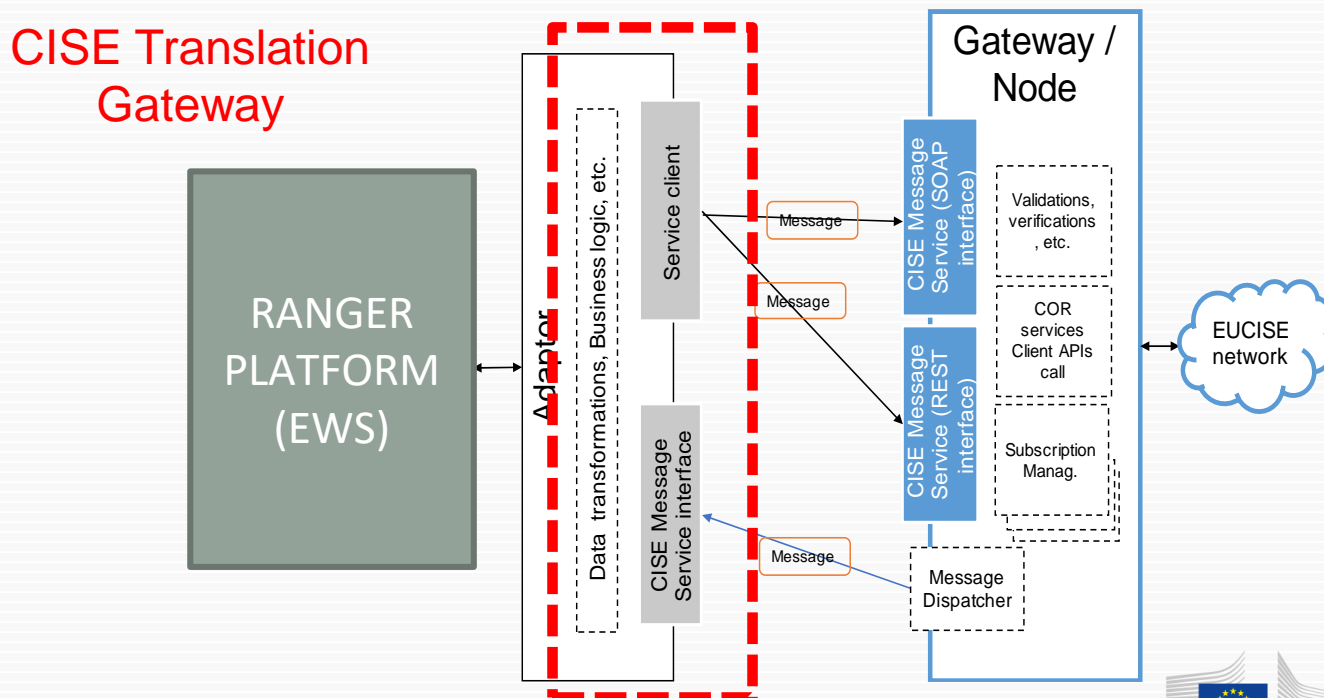
RANGER also will generate a **common situational picture**, improve **detection** and **on-time identification**, of non-collaborative and/or suspicious vessels



CISE

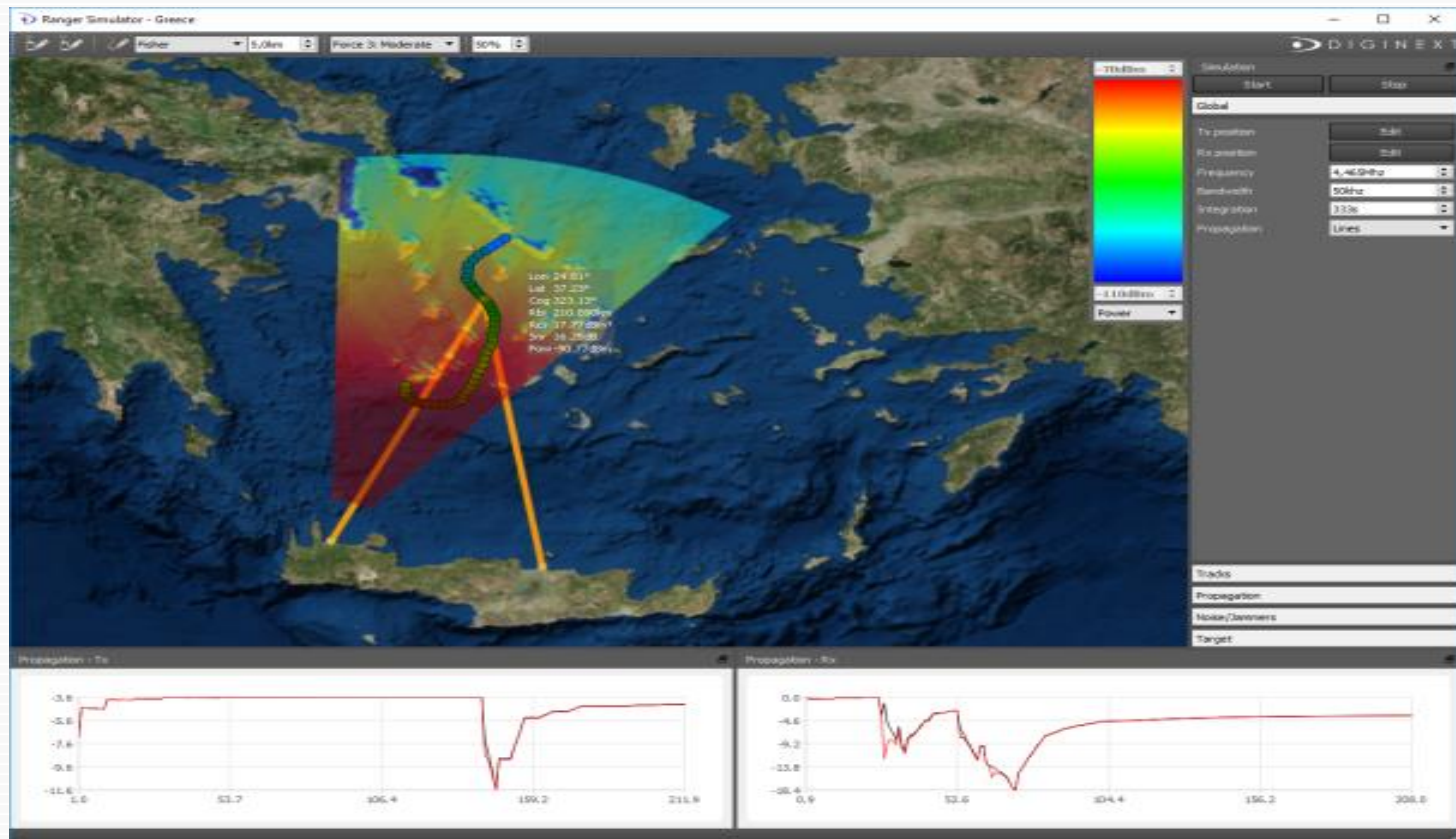
The **CISE translation gateway** will allow the integration of the RANGER platform with the **CISE network**. It is responsible to convert the data model and adapt the protocol from RANGER to CISE. It translates the acquired data from OTH, PE-MIMO and EWS to the appropriate format needed from the CISE Network.

“CISE translation gateway” will be an “**Adaptor**” between the CISE network (developed by EUCISE2020 Consortium) and RANGER platform.

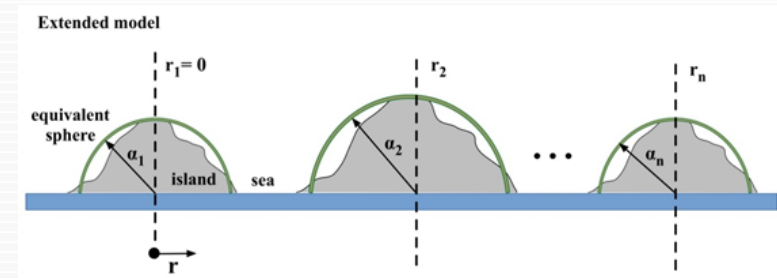
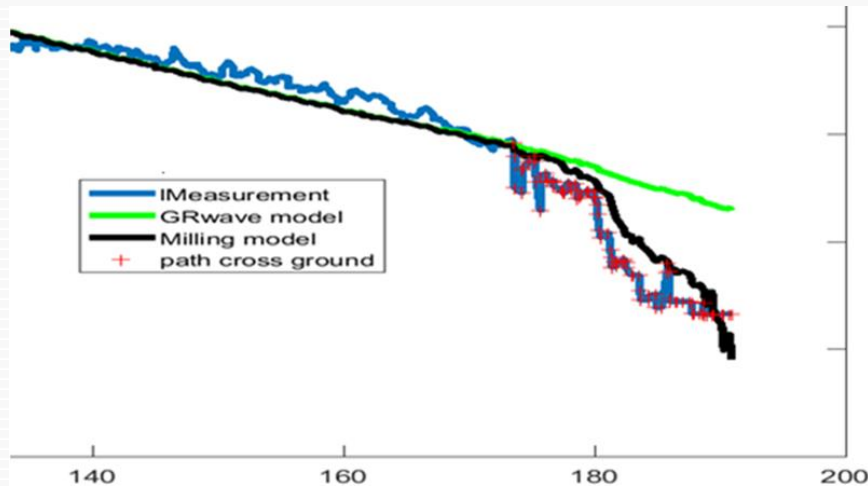


- OTH Radar

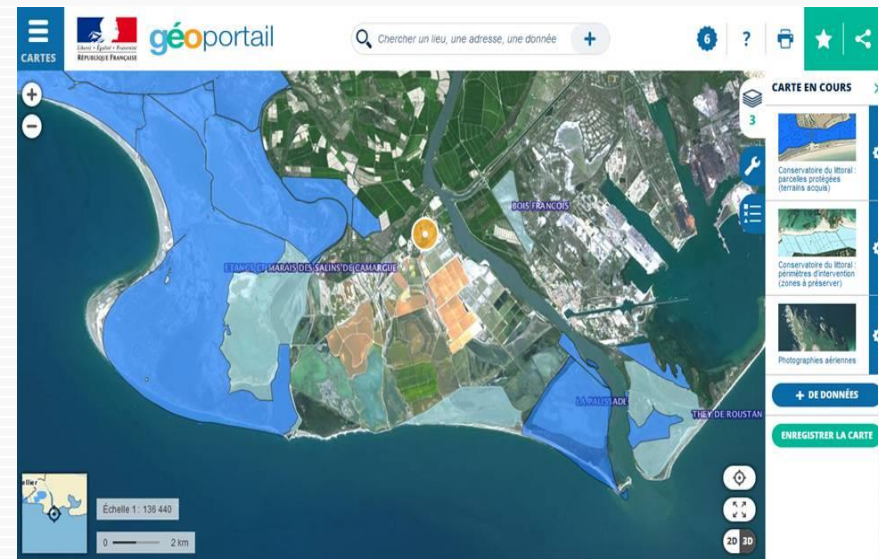
- Simulator tool software development of OTH radar has been finalized
- Analysis of results for French sea and Greek archipelago has been finalized



- 2 versions of an **extended propagation model** has been realized (especially for the Greek archipelago)
- **Validation of modeling: propagation losses** (Original Millington approach and extended method)
- **Validation of modeling/link budget:** Comparison with measurement

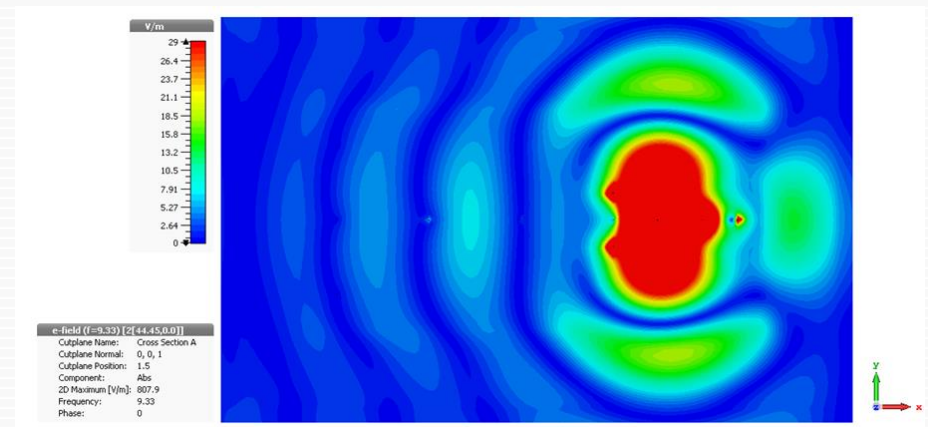
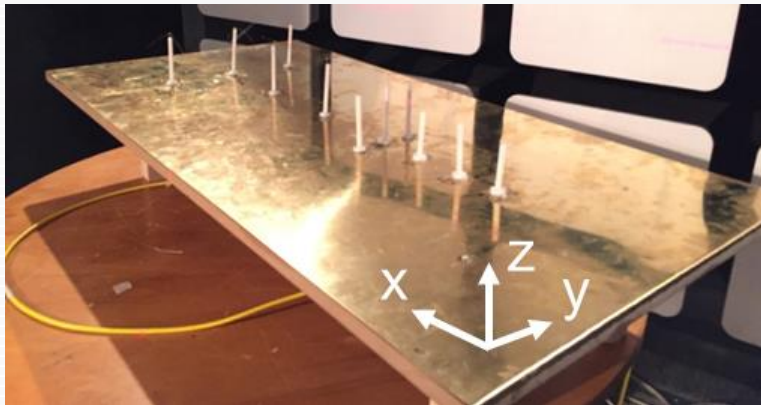


- **French Rx site has been upgraded**
 - To incorporate the 9MHz array in the existing array
 - A complementary sub antenna array installed
 - Modification has been made based on specific environmental constraints.
 - Site survey done



- **Greek OTH Tx antenna design has been finalized**
 - Maximum height of elements reduced to 10 m from 17 m
 - High gain of at least 10 dBi
 - High isolation between Tx and Rx sites
 - The occupied place for the Antenna installation will be 80m x 40m

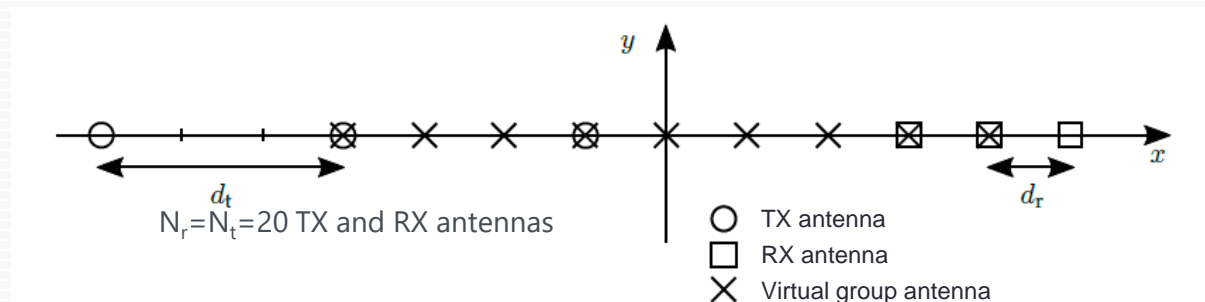
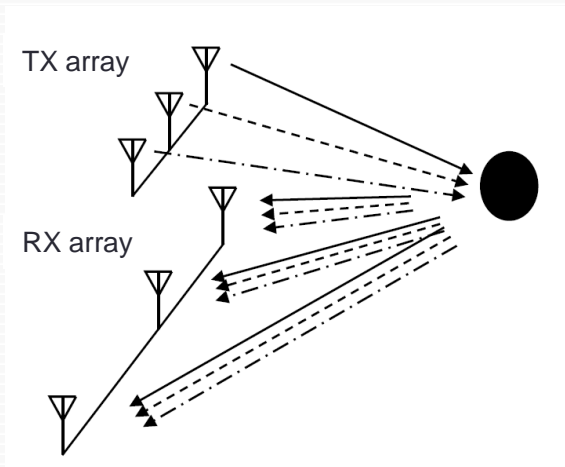
- **Greek OTH Tx antenna design has been finalized**
 - Scale model (1:100) construction and pattern measurement in the anechoic chamber
 - Estimation of the minimum safety distance has been done



- **PE-MIMO radar**
- Range 14km
- S band
- Resolution/Accuracy sufficient for rubber boat - human trafficking detection
- Bistatic radar FMCW
- IALA V128 Recommendation compliant
- TRL 6 Prototype in actual environment

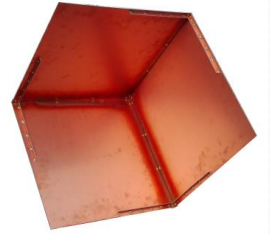
Antenna

- Multiple Input (20 transmitters) implement an angular diversity
- 20 receivers linear array

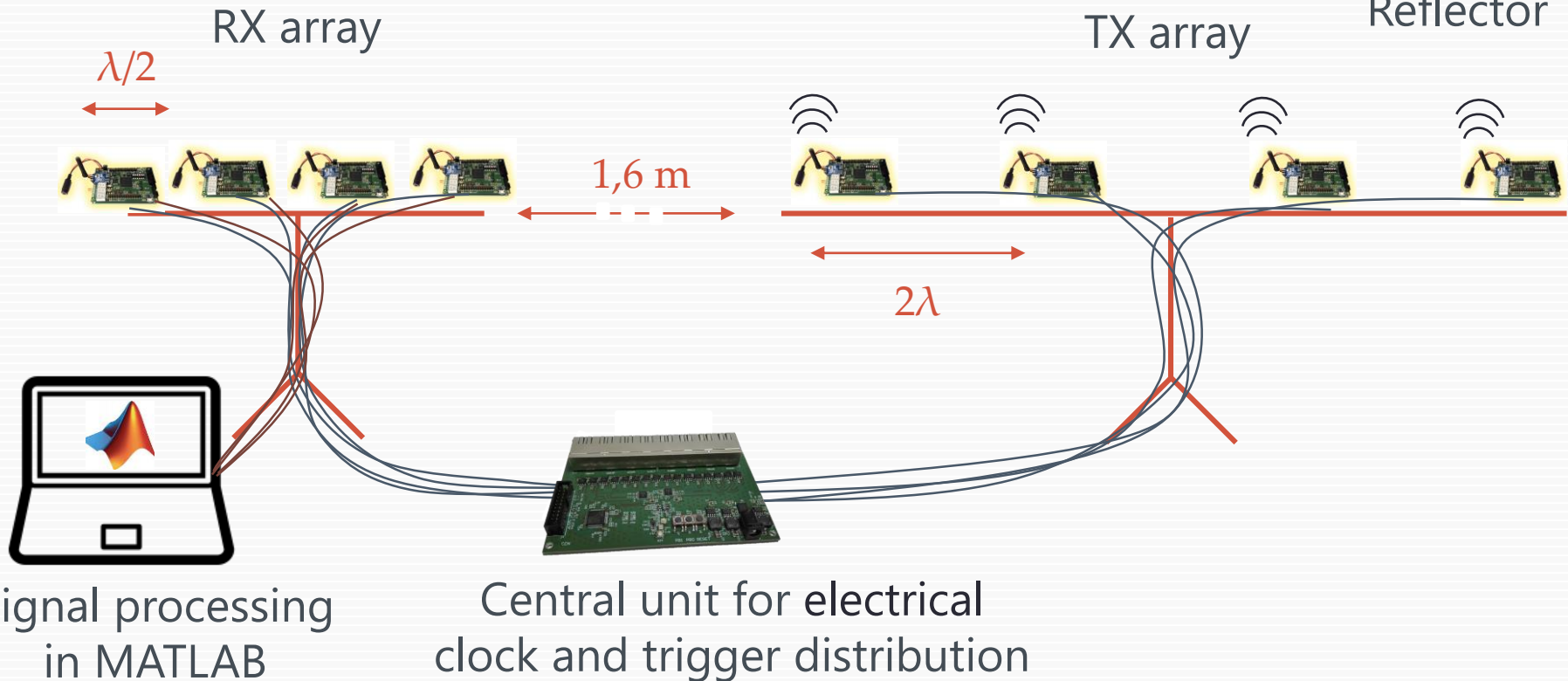


- **PE-MIMO radar**

- PE-MIMO Prototype arrangement with $N_r = N_t = 4$



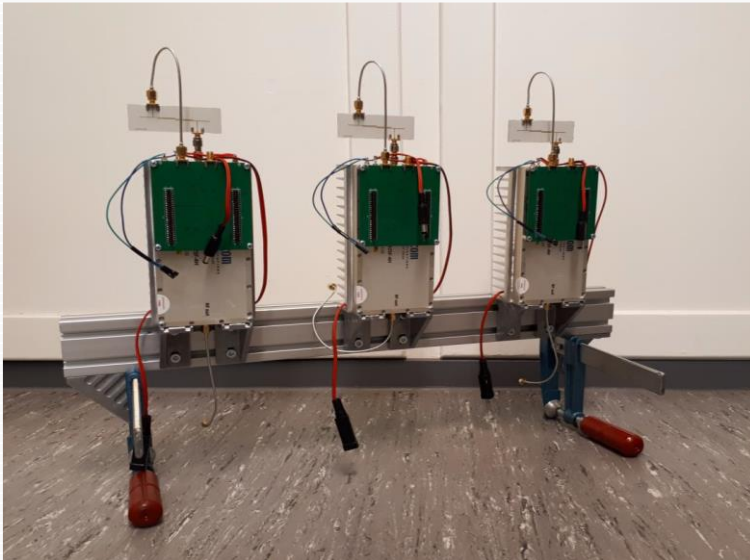
Reflector



- **PE-MIMO Antenna Tests and Simulations**
 - Design, realization and test of a PE-MIMO small-scale radar prototype with 4x4 antenna array (initial version prototype, PLL-based)

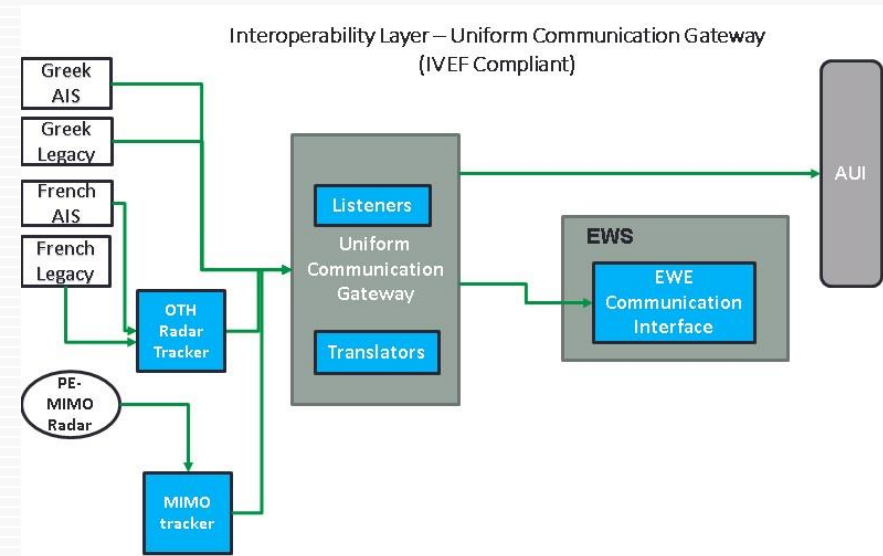


- **PE-MIMO Antenna Tests and Simulations**
 - Simulations and production test runs were done for various different shapes of rectangular patch antennas
 - Lab evaluation of production runs and comparison to simulation results



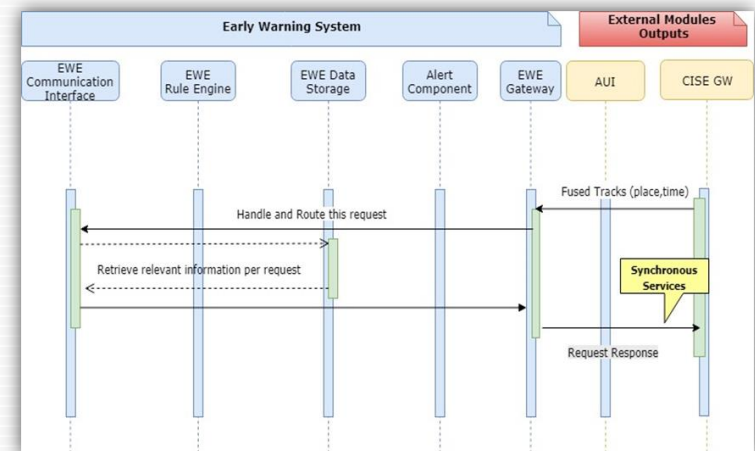
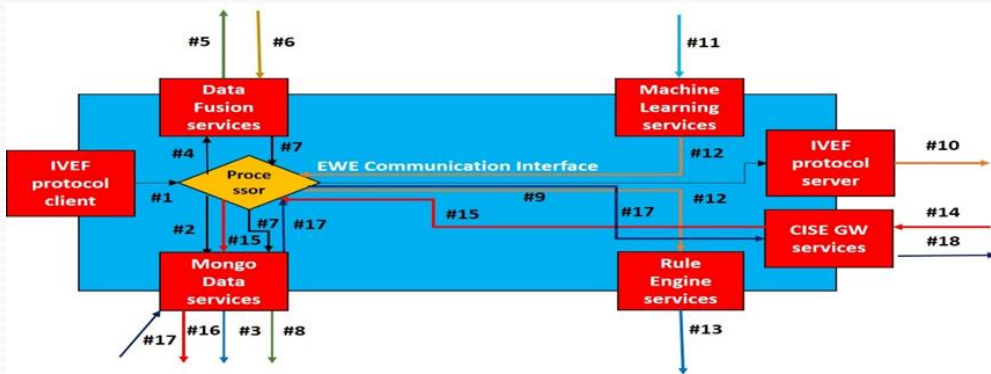
• Uniform Communication Gateway – Interoperability Layer

- Communication architecture of UCG Interoperability Layer has been defined (based on IALA Inter-VTS Exchange Format (IVEF))
- Communication protocol and data model has been defined
- Design of UCG IVEF services for interoperable communications of RANGER radar data, AIS and Legacy Radar data with RANGER Platform has been defined
- Security services has been defined (for authentication & authorization, data integrity, secure data exchange)
- First version of IVEF services (including listeners and translators) for AIS and radar data have been implemented



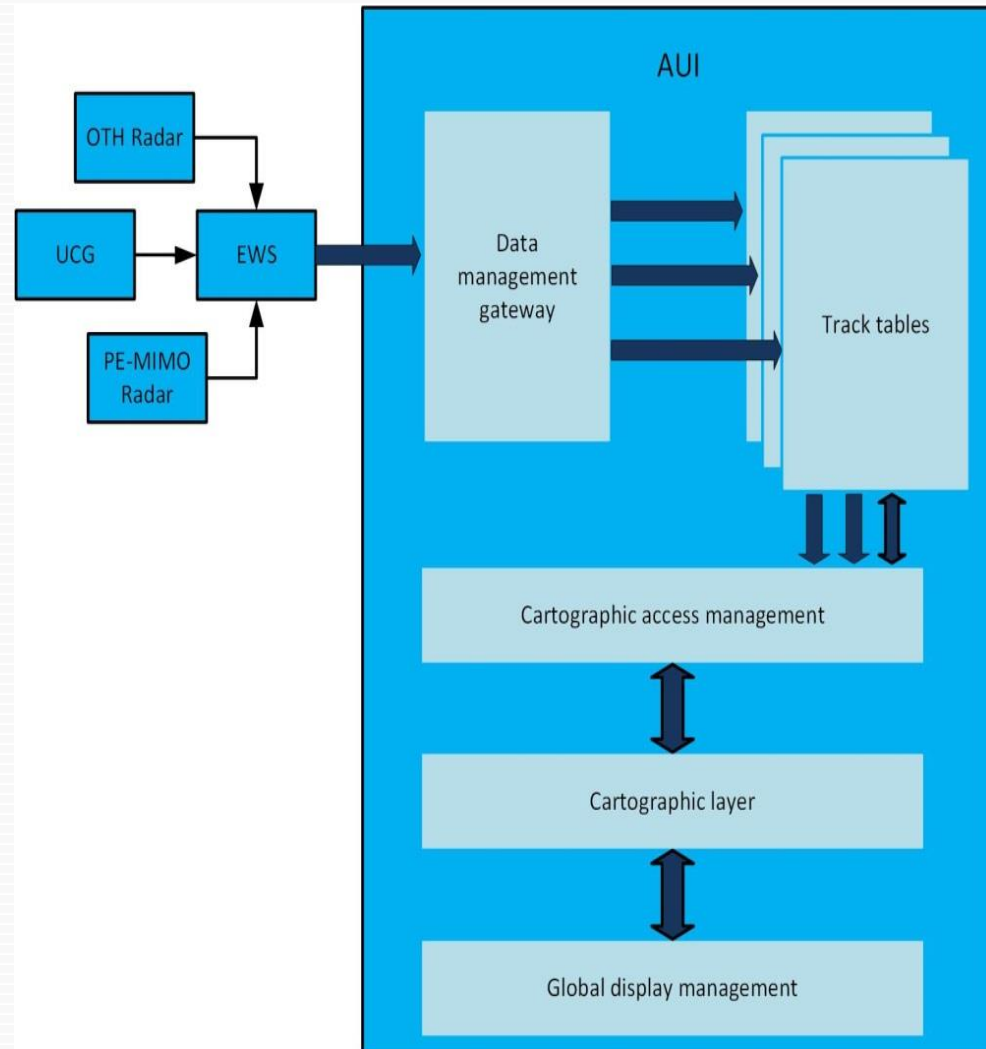
• EWS

- Communication protocols among the different components has been specified
- Communication flow among the different components has been specified
- Rule engine has been designed
- Alerts has been identified with the assistance of HMOD and DMA
 - Speed violation – navigation on restricted area – collision alert – merging of 2 vessels
- First results have been produced by Data fusion & ML module



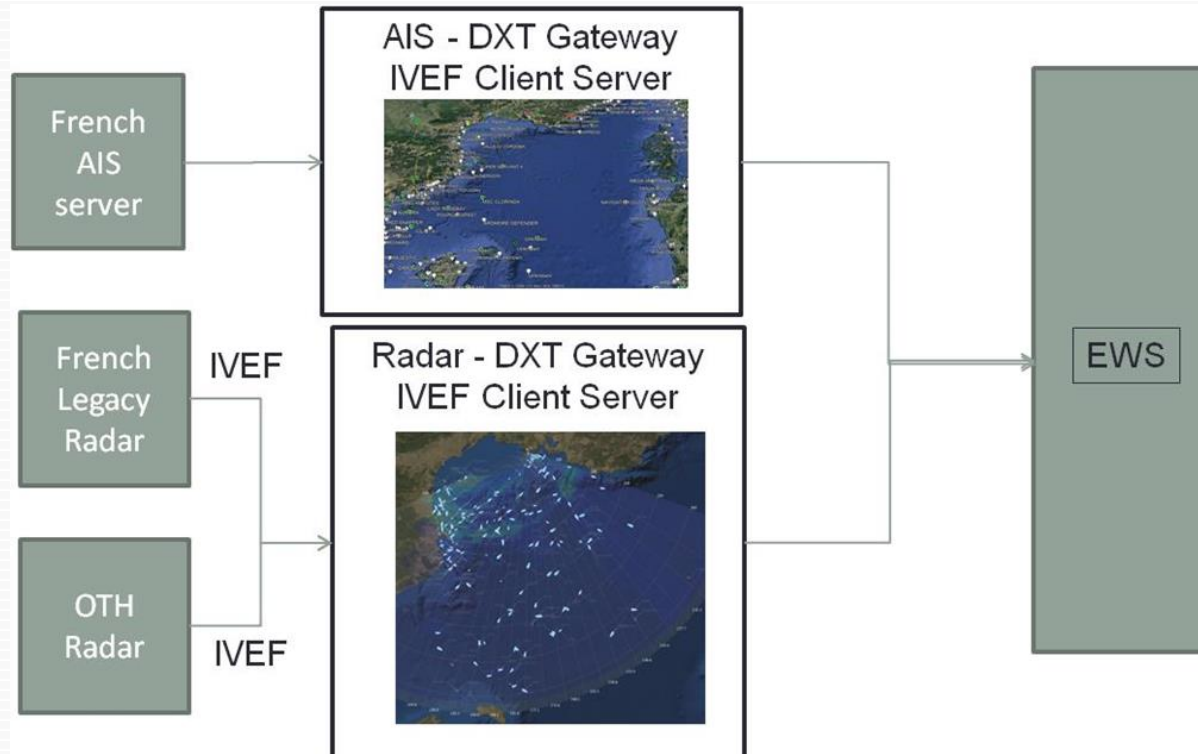
RANGER standalone **Advanced User Interface (AUI):**

- Functional architecture of AUI defined
- AUI will display :
 - Tracks from each sensor (OTH, PE-MIMO, Fused, AIS and Legacy)
 - Health message from sensors
 - Alarms over vessel from EWS



- **Legacy systems**

- Data from French legacy systems will be provided through OTH
- Data from Greek legacy systems will be provided through VPN
- AIS data will be provided by French and Greek authorities



- **Greek Pilot**

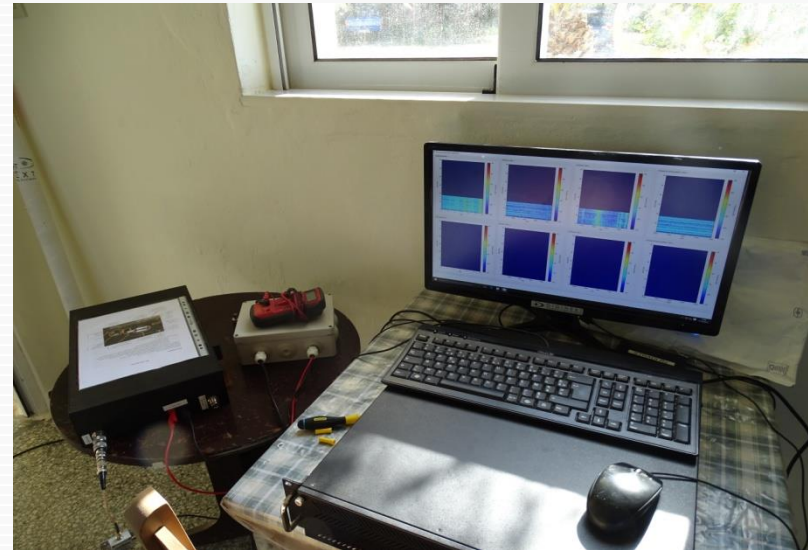
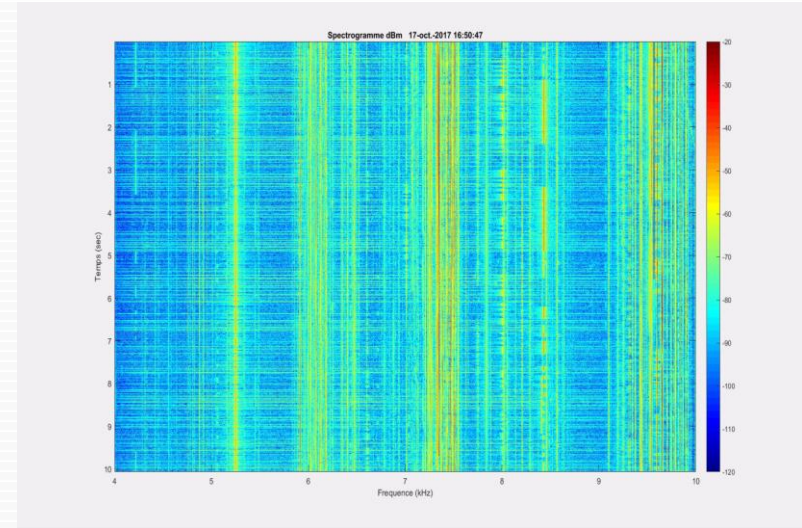
- Final locations have been selected after detailed study, specific prerequisites and 2 site surveys
- Locations: Heraklion Hellenic air force base (OTH Tx Antenna) – Maleme (Chania) OTH Rx Antenna and PE-MIMO radar
- OTH Tx & Rx Antenna installation design has been finalized
- PE-MIMO radar installation design has been finalized
- Extended documentation for the installations has been provided to HMOD for both sites, Heraklion and Maleme
- Installation approval for both sites has been provided by HMOD



Maleme site

An electromagnetic survey took place in Maleme

- Local environmental noise
- Propagation losses Tx-Rx
- Maleme is Suitable for RANGER

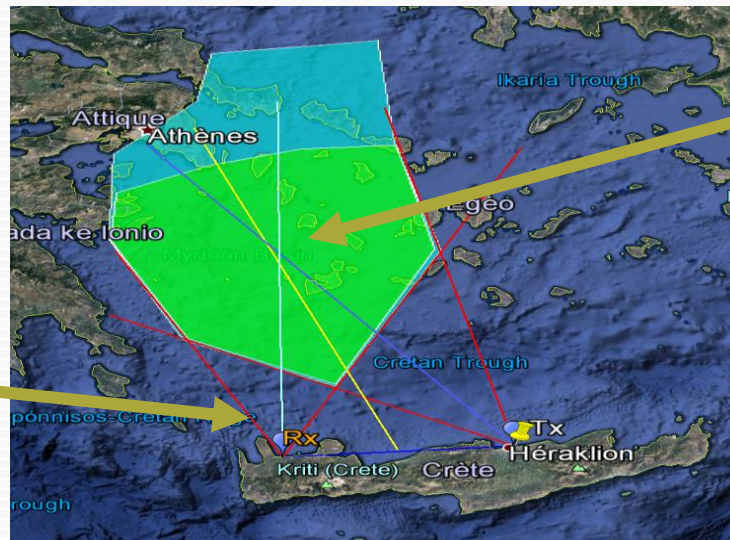


- **For Greek Pilot has been identified**

- Scenarios
- Available legacy systems
- Number and type of vessels
- Validation plan

Data source
Availability

- PE-MIMO
- Coastal radar
- AIS

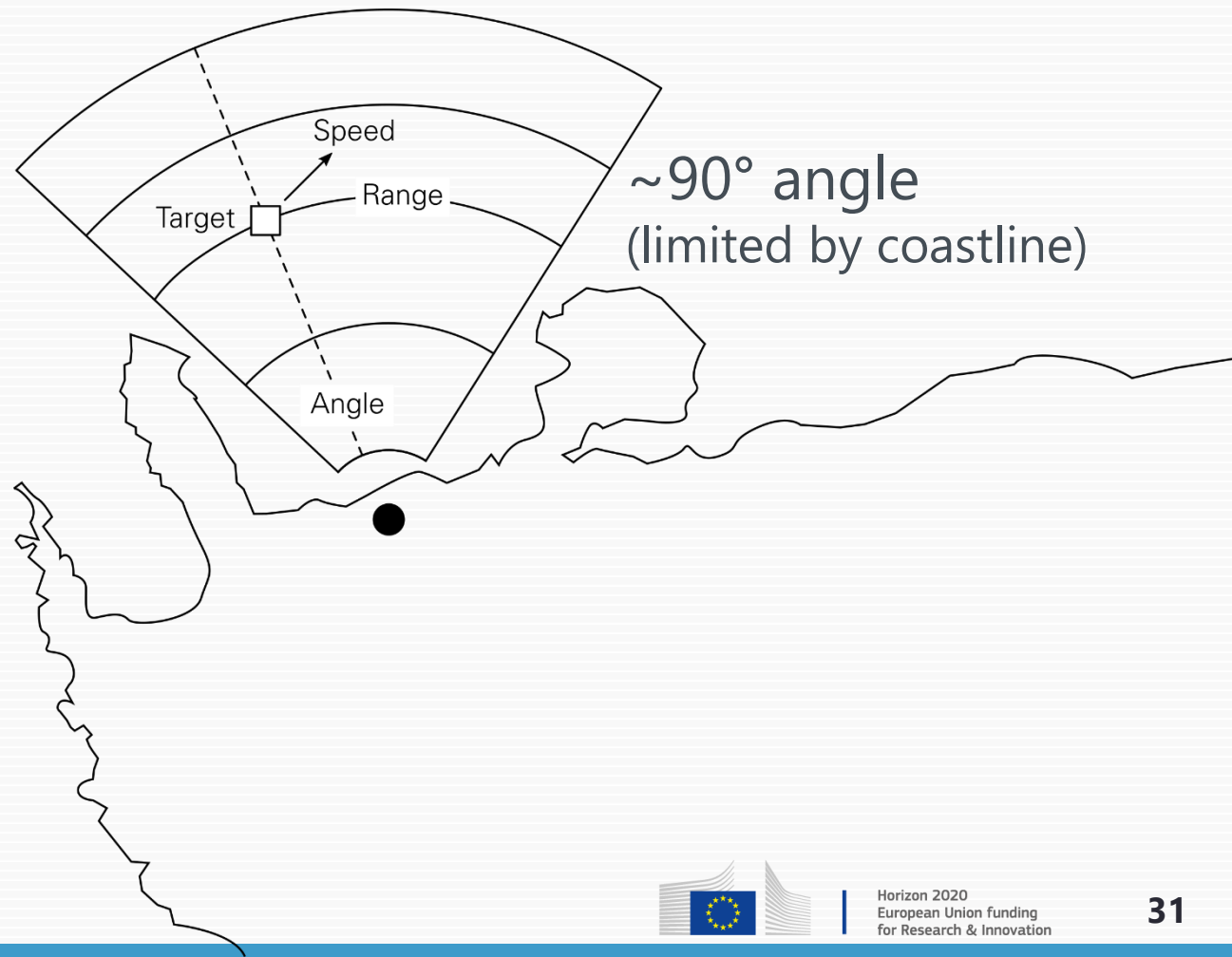


Data source
availability

- OTH radar
- Coastal radar
- On Board radar
- AIS

Installation and Coverage of PE-MIMO Radar

~15 km



- **French Pilot**

- Locations: Narbonne (OTH Tx Antenna) – Salins-de-Giraud (OTH Rx Antenna) and PE-MIMO radar (Cap Bear)
- PE-MIMO radar installation design has been finalized



OTH site



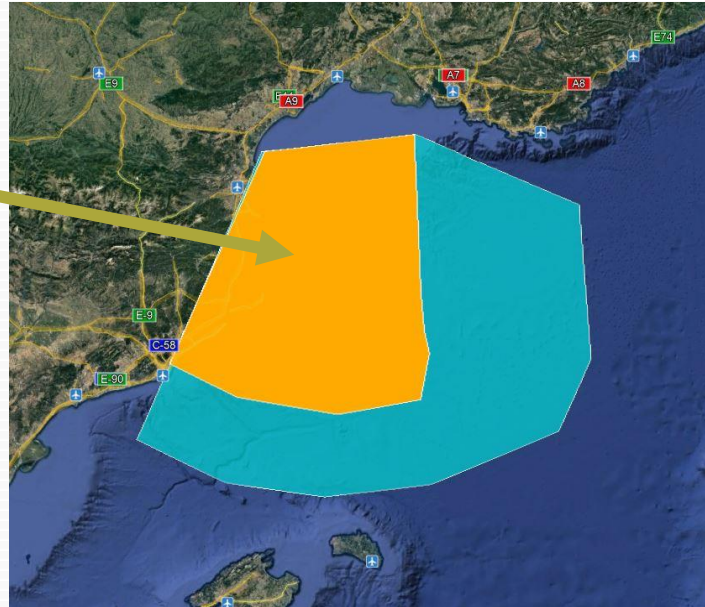
PE-MIMO site

- **For French Pilot has been identified**

- Scenarios
- Available legacy systems
- Number and type of vessels
- Validation plan

Data source availability

- PE-MIMO radar
- Coastal radar
- AIS
- OTH radar



- **1st Integration test will be held in Finland, during the technical meeting (3-5/7/2018)**
- **Installation of OTH Tx Antenna in Heraklion (September – October)**
- **Installation of OTH Rx Antenna in Maleme (July – October)**
- **Installation of PE-MIMO radar in Cap Bear (August - September)**
- **1st Pilot in France has been scheduled for October 2018 [M30]**
- **1st Greek Pilot has been scheduled for February 2019 [M34]**

Thank You!

<https://ranger-project.eu/>

