

EDF-2021-DIS-RDIS: Research for disruptive technologies for defence applications

Proposals are invited against the following topic:

EDF-2021-DIS-RDIS-OTHR: Over-the-horizon radars applications

Budget

The Union is considering a contribution of up to EUR 60 000 000 to support proposals addressing the abovementioned topics and their associated specific challenge, scope, targeted activities and main functional requirements.

A lump sum approach will be used. For selected projects, the maximum EU contribution will be based on the eligible costs in the requested funding, but actual payments will be conditioned to the completion of work packages. Proposals should include clear descriptions of the proposed criteria to assess work package completion.

Several actions, addressing different topics, may be funded under this call.

The EU requirements for surveillance, as depicted in the 2018 capability development plan, describe the necessity for increased situational awareness through means such as long-range radar systems. In that sense HF (High Frequency) Over the Horizon radars can be a viable solution that offers target detection over very long-range by exploiting propagation characteristics of HF waves. This can be distances in the order of thousands of kilometres by using the sky waves, which are reflected down from the ionosphere, or some hundreds of kilometres by using surface waves, which follow the earth curvature. However, sky wave radars have an extensive blind area (the skip distance) because the sky waves reflect down to earth at distances beyond 1,000km and thus leave areas at shorter ranges without illumination.

For the reasons stated above, such installations are well suited to countries occupying a large area, particularly because of the zone of about 1,000km radius extending the radar transmitter which is not covered by sky-wave propagation. USA, Russia, and Australia among others have already developed OTH radars and have the ability to monitor such large areas. For geographically confined countries though, collaborative air and maritime picture over large areas can be acquired only through a cooperation among them that will utilize OTH radar units operating in a networked environment. Thus, this technology scale naturally fits the extent of the European continent and requires collaboration between Member States to improve collective defence and situational awareness.

Specific challenge

The specific challenge of this topic is to address new technologies to be developed by integrating different HF infrastructures (transmitters and receivers) in a collaborative and passive mode to increase air and sea detection range. That includes:

- Collaborative and passive OTH Radar networking,
- Ionospheric sounding network to monitor the status of the ionosphere interacting with OTH radar,
- Non-cooperative broadcasting HF emitters as illuminators of opportunity.
- Cognitive spectrum management and algorithms to detect challenging targets.

Scope

To enhance situational awareness and operation superiority, there is an EU requirement to improve detection, tracking and identification capabilities over wide areas and with minimum latency. High frequency over-the-horizon systems need therefore to be improved whilst an EU concept for cognitive and scalable network, both active and passive, of HF OTH sensors could be investigated.

This topic addresses the technologies for EU OTH radar concept offering deep collaborative strategic surveillance and data sharing. In this regard, both HF Surface- and Sky- Wave radar technologies should be explored regarding their respective advantages in terms of covered area in long ranges and as a gap filler.

Targeted activities

The proposals must cover the following activities as referred in article 10.3 of the EDF Regulation, not excluding upstream activities eligible for research actions if deemed useful to reach the objectives:

- Activities that aim to increase interoperability and resilience, including secured production and exchange of data, to master critical defence technologies, to strengthen the security of supply or to enable the effective exploitation of results for defence products and technologies;
- Studies, such as feasibility studies to explore the feasibility of new or upgraded products, technologies, processes, services and solutions;
- The design of a defence product, tangible or intangible component or technology as well as the definition of the technical specifications on which such a design has been developed, including any partial tests for risk reduction in an industrial or representative environment.

The proposals must conclude to the creation of a proof of concept for the intended solution. This will exhibit the intended functionality and act as a testbed for the development of prototype-scale projects in the future.

The targeted activities should in particular include:

(1) Integrating knowledge

- Review of defence requirements and accordingly define the preliminary CONOPS for the OTH radars.
- Definition of OTH Radar specifications based on preliminary CONOPS coming from the end users (armed forces of involved EU members). These should cover collaborative air space and maritime surveillance.

(2) Studies

- New signal processing techniques, among others, for:
 - Clutter mitigation,
 - Improving target localization and tracking,
 - Multiple Input Multiple Output (MIMO) configuration,

- Reduction/use of multipath and Doppler fading.
- Study of the very long baseline related issues:
 - Synchronization of installations,
 - Direct signal disturbance mitigation.
 - Usage of passive mode by exploiting (non-)cooperative illuminators in HF band.

Furthermore, activities specifically targeted on HF Sky-wave radars should include:

- Support for multiple radar configurations for better footprint management (e.g. one remote illuminator/multiple reception sites or multiple remote illuminator/multiple reception sites).
- Focus on receiver architectures, mainly oriented to SDR technology.
- Focus on transmitter technologies, particularly on power amplifier architectures.
- Signal waveforms and coding.
- Novel antenna element designs, array architectures and/or scanning techniques.

(3) Design

- Real time atmospheric propagation models based on processing of data collected by a network of sensors, such as advanced ionosphere stratification models.
- New techniques for optimized use of electromagnetic spectrum management (frequencies and bandwidth).
- New signal processing techniques, among others, for:
 - Clutter mitigation,
 - Improving tracking capabilities and target localization,
 - Multistatic system combinations and Multiple Input Multiple Output (MIMO) configuration,

The abovementioned technologies should be demonstrated (partially or in whole) through small scale or reduced functionality (e.g. shorter antennas, reduced power etc.) technology demonstrators. Modularity in terms of future expansion towards a prototype and use of existing equipment / infrastructures must have positive consideration. Additionally, EU technology should be incorporated to the greatest possible extent.

Functional requirements

The proposals must fulfil the following requirements:

- Operate at long over-the-horizon ranges, far beyond current existing systems, to detect and track air and sea targets such as large aircrafts and ships moving at speed of more than 25kts,
- Fill the gaps and extend current air and sea EU radar surveillance coverage, using a collaborative network of sensors and the necessary synchronization,
- Implement advanced ionospheric sounding networks and validated models in order to operate cognitive radar management schemes for radar network operation,
- Implement advanced signal processing to improve OTH detection and tracking performances and target localization.

Expected impact

- Development of the necessary infrastructure to the participant Member States for making them capable to pursue research and development in the OTH Radar field,
- Incorporation of ionospheric propagation models for supporting the radar in real-time,
- Collaborative operational exploitation of the networked OTH radars (active and passive),
- Instigation of future research projects in the topics of detecting extra-atmospheric and/or hypersonic objects,
- Strengthening the European industrial and technology base by identifying critical components and units,
- Strengthening the collaboration among industries and research institutes.