

The Next Generation Electronic Warfare Systems And Its Impact on Submarine Operations And Navies

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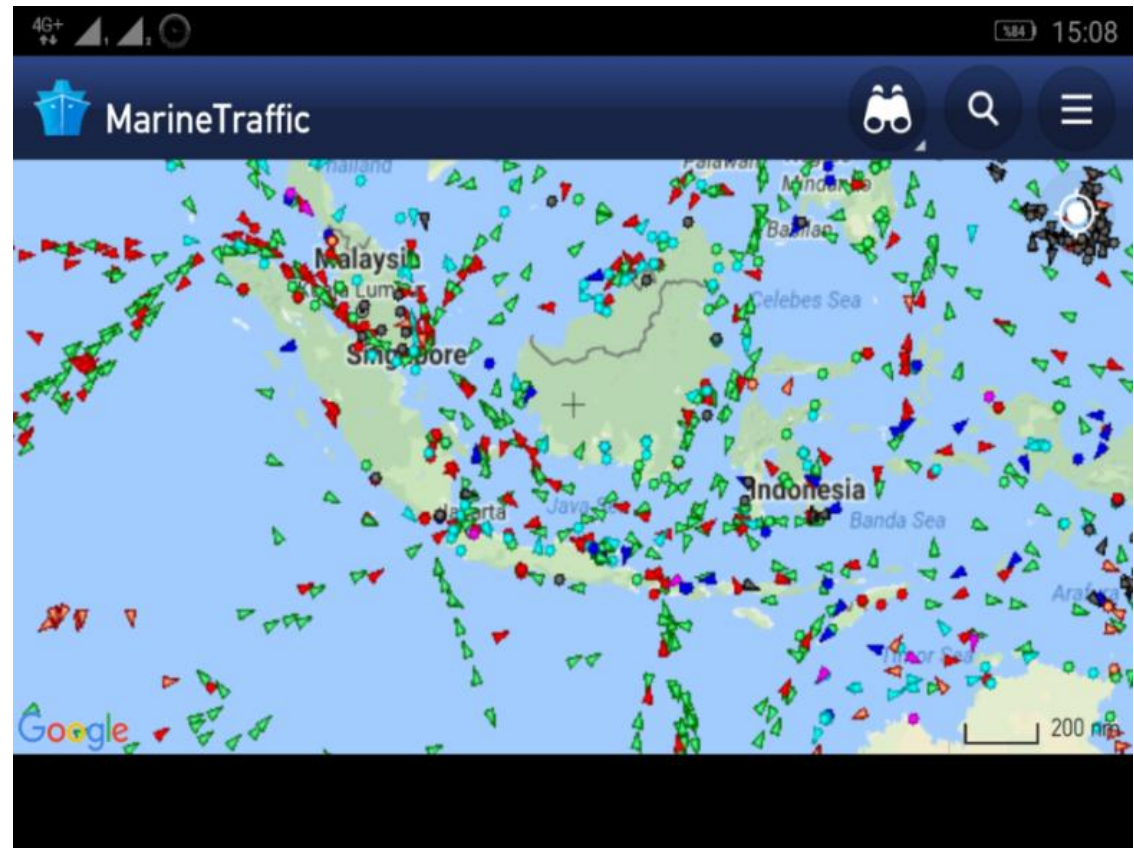
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- Extensive military and commercial vessel traffic (Asia Pacific Region)
- In 2016, %84 of 13.5Billion tons of cargo was delivered by Ships
- Naval platforms of navies are widely sail around commercial ships as if commercial ship
- To differentiate the platforms by using radar signals of the platforms will be a force multiplier in the field especially for the navies in Asia



Commercial Vessel Traffic in Asia Pacific Region (Marine Traffic)

- Sea Surface EW Systems are widely used to identify air, naval and land base platforms by using the radar signals on platforms
- EW Systems on submarine platforms are passive systems and antennas are integrated on top of mast
- Submarine platforms;
 - Stealth Capability
 - Harsh environment
- EW systems installed on submarine platforms will be a big advantage for the navies in the region to control the sea traffic and collect intelligence data with the stealth feature of submarine



Today's EW Systems should have the capability;

- High probability of intercept
 - Azimuth/Elevation angular coverage
 - Frequency
 - Polarization
 - Amplitude

Why?

- Today's complex threat environment includes different types of threats on different types of platforms. High speed platforms such as aircrafts may change angular position very fast
- Threats may change operating frequency band very fast for ECCM (Electronic Counter Counter Measure)
- Threats may emit very low output power for ECCM. For example, LPI (Low Probability Of Intercept) Radars.

Today's EW Systems should have the capability;

- Different type of sensors should be integrated in a single platform

Why?

- Today's platforms should be cost effective, different type of sensors should be installed on a platform to support different type of missions
- To identify today's complex threats, sensor correlation may be a solution. For example, the communication and radar signals on a single platform may be correlated to identify a single, unique platform.

Today's EW Systems should have the capability;

- Should work with the other EW systems of Allied forces

Why?

- To be able to calculate some parameters of threats such as Geolocation, a lot of time needed
- Cooperative work with allied systems may decrease time requirements of this parameter dramatically
- Especially for time sensitive targets, cooperative work is mandatory

Today's EW Systems should have the capability;

- Should be supported by Ground Support Segment (GSS) infrastructure

Why?

- Training requirements: Today's complex systems should be operated by well trained staff. Real and simulated data should be used for training.
- Manual Analysis: Today's systems have to record the threat data for post mission analysis.
- National Threat Database: Today's EW Systems should serve as intelligence devices to update Static Threat Information.
- Software Update: Very fast changing complex threat environment may require new algorithms and software updates.

Today's EW Systems should have the capability;

- Should be tested not only in factory, but also in field to comply the performance

Why?

- Installed performance of EW systems may be affected by the platform itself.
- The Systems should also be tested in the field by using complex threat senario.

Advantages of Digital Receiver:

- Superior parameter measurement accuracy (Pulse Width, Pulse Amplitude, Frequency),
- Robustness to CW signals (can measure parameters of a pulse signal in the vicinity of one or more CW signals),
- Retaining phase information of the received signals, enabling phase comparison based interferometry,
- Improved sensitivity,
- Enabling detection of very low power LPI signals by digital channelization,
- Real-time monitoring the RF spectrum with desired arbitrarily small “resolution bandwidth”,
- Specific Emitter Identification Analysis

- Today's EW missions should be cost effective.
- Platforms in the operation should get as much information as possible from different type of sensors installed on the platform such as Radars and Communication Devices.
- Not only cost effectiveness but also sensor correlation of the information gathered is another important reason to be able to use different type of sensors in a single platform

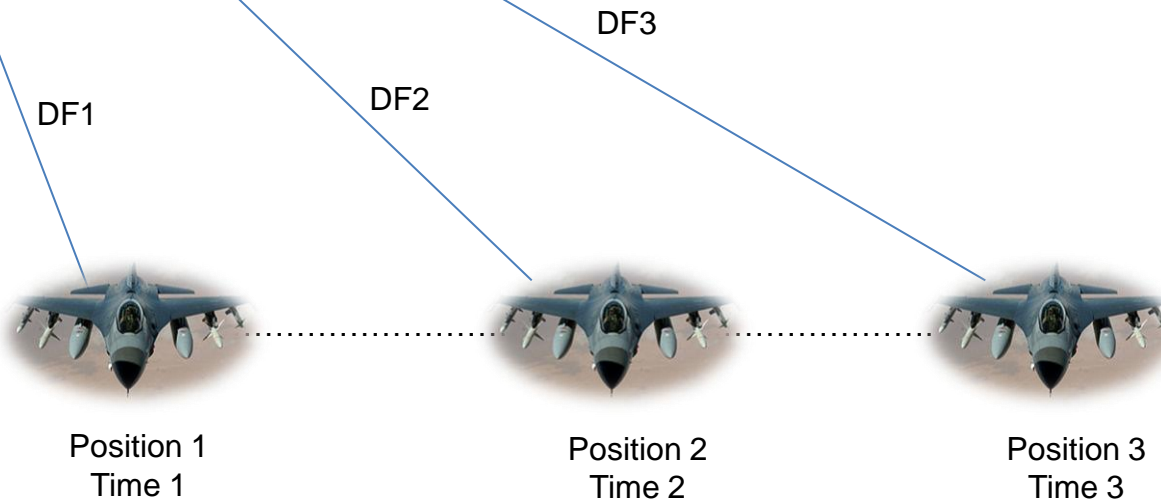
Because of the less space on submarine platforms, it is crucial to design combined antennas



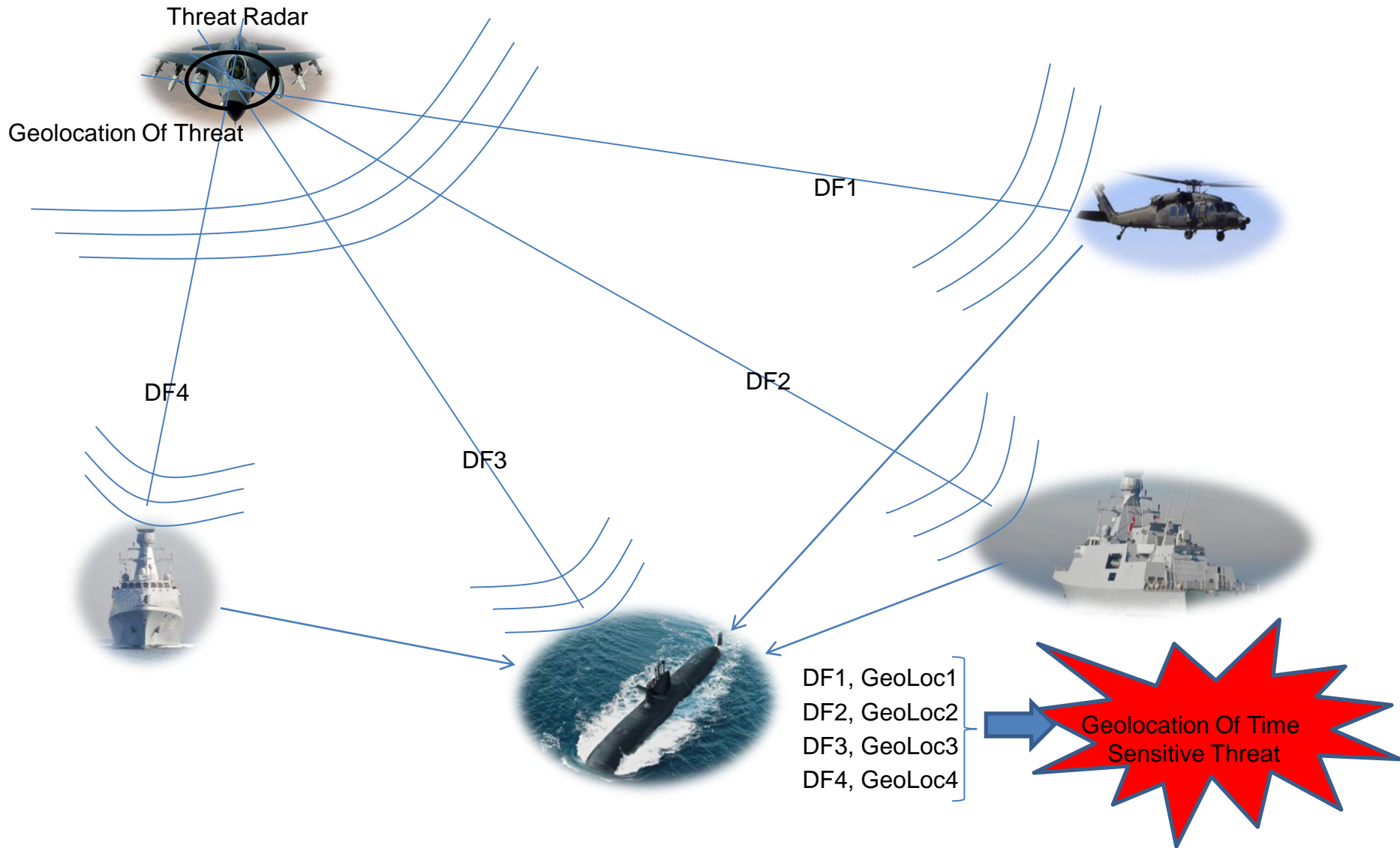
Different Type of Antennas may be integrated on top of ESM Mast of Submarine

Triangularization for Geolocation of Threats

Threat Radar



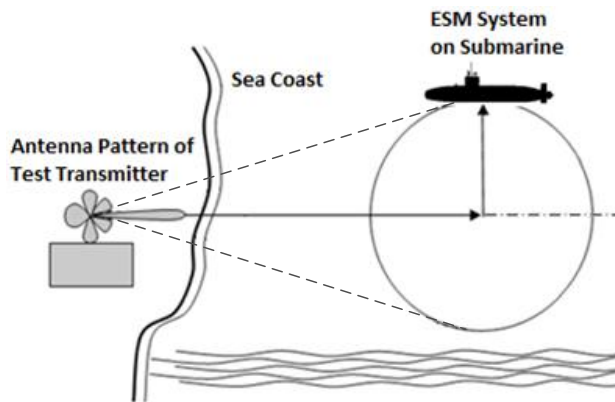
Cooperative ESM Operations



The DF performance of the antenna should be tested not only in anechoic chamber but also in the field and on the platform itself. The installed performance of the system should be tested over the;

- whole frequency band,
- whole azimuth angles,
- at different polarizations.

It is not possible to form complex threat environment in the field. In order to test EW System in intense threat environment, Mobile Test Simulator equipped with radar simulator should be used.

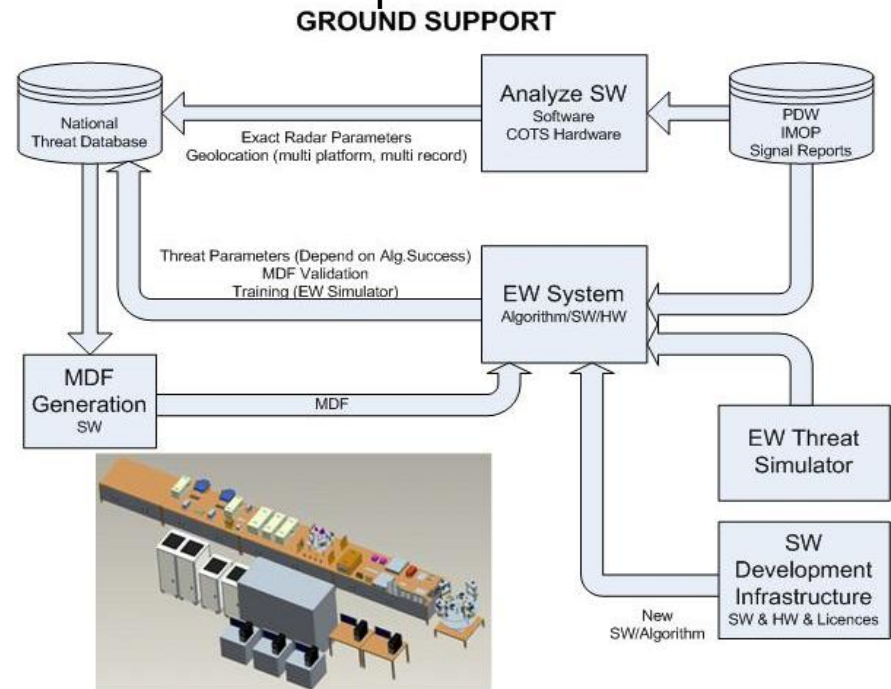


Representative Test Scenario



ASESLAN Mobile Test Simulator

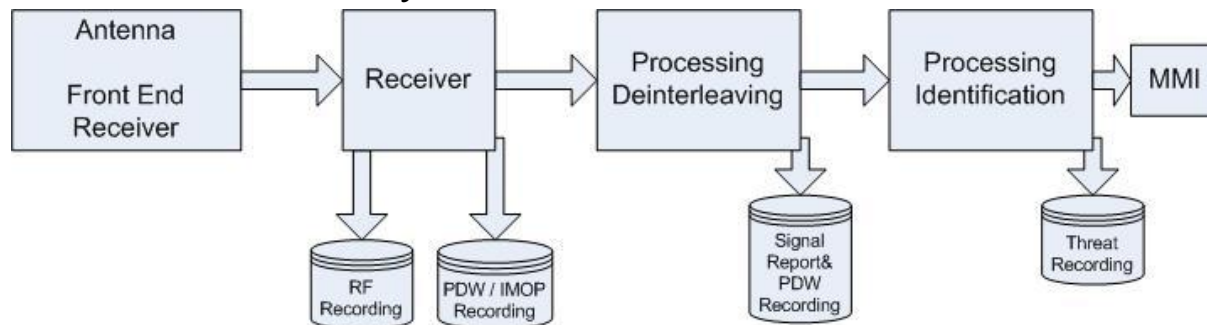
- Analyze Raw Data such as Pulse Descriptive Words (PDW), Intentional Modulation On Pulse (IMOP) to identify the parameters of the Threat and update National Threat Database with exact parameters and modulations **without depending on the algorithm success of the EW system**,
- Playback mission by using Signal Reports recorded during mission and train the EW operators and criticize the mission,
- Generate MDF for the mission with the information in updated National Threat Database,
- Test MDF on EW system Hot mockup with the Raw Data recorded during mission or with the data generated in EW Threat Simulator,
- Generate new EW software/algorithm in the SW Development Infrastructure and test new software versions in the EW System hot mockup,



Pulse Descriptive Word (PDW)/ IF Samples produced at the receivers of the system, is the smallest meaningful information of the Threats detected by the system and recording this information will give much information not only about the threats but also the success and upgrade necessity of the system.

With PDW/IF Sample recording;

- De-interleaving capability and success of the EW system may be revealed,
- Manually analyze the environment and investigate the threat parameters including parameter hopping new design radars,
- Update/Insert National Threat Database with the real parameters of the threats **without depending on success of the algorithms in system**,
- Up-to date modern threats, designed and deployed after EW system design phase, will be detected easily.



Typical Flow diagram and the data recording points/types of Radar EW System

Thanks...

