

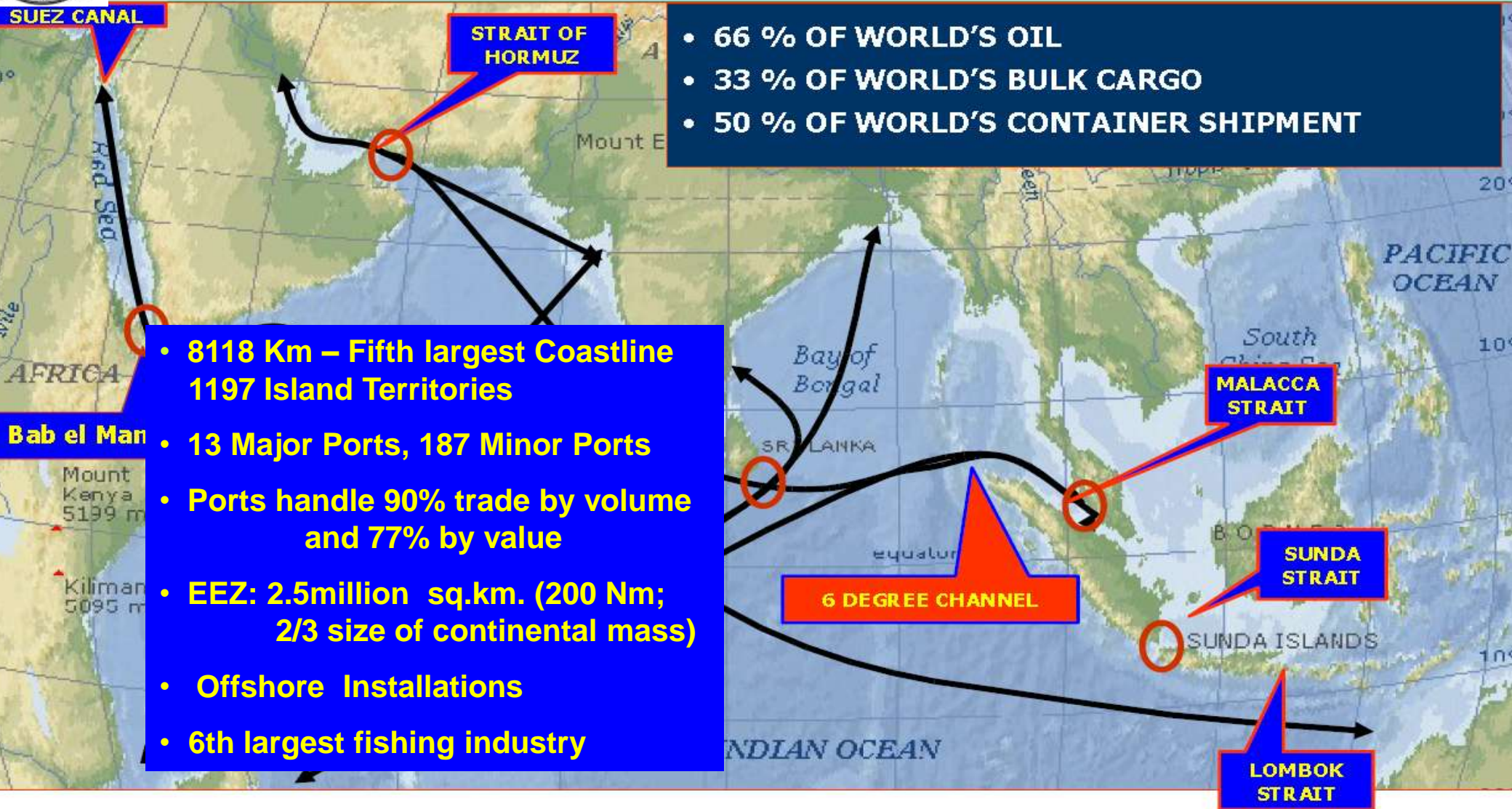


# INDIA'S MARITIME ENVIRONMENT





# India's Maritime Environment





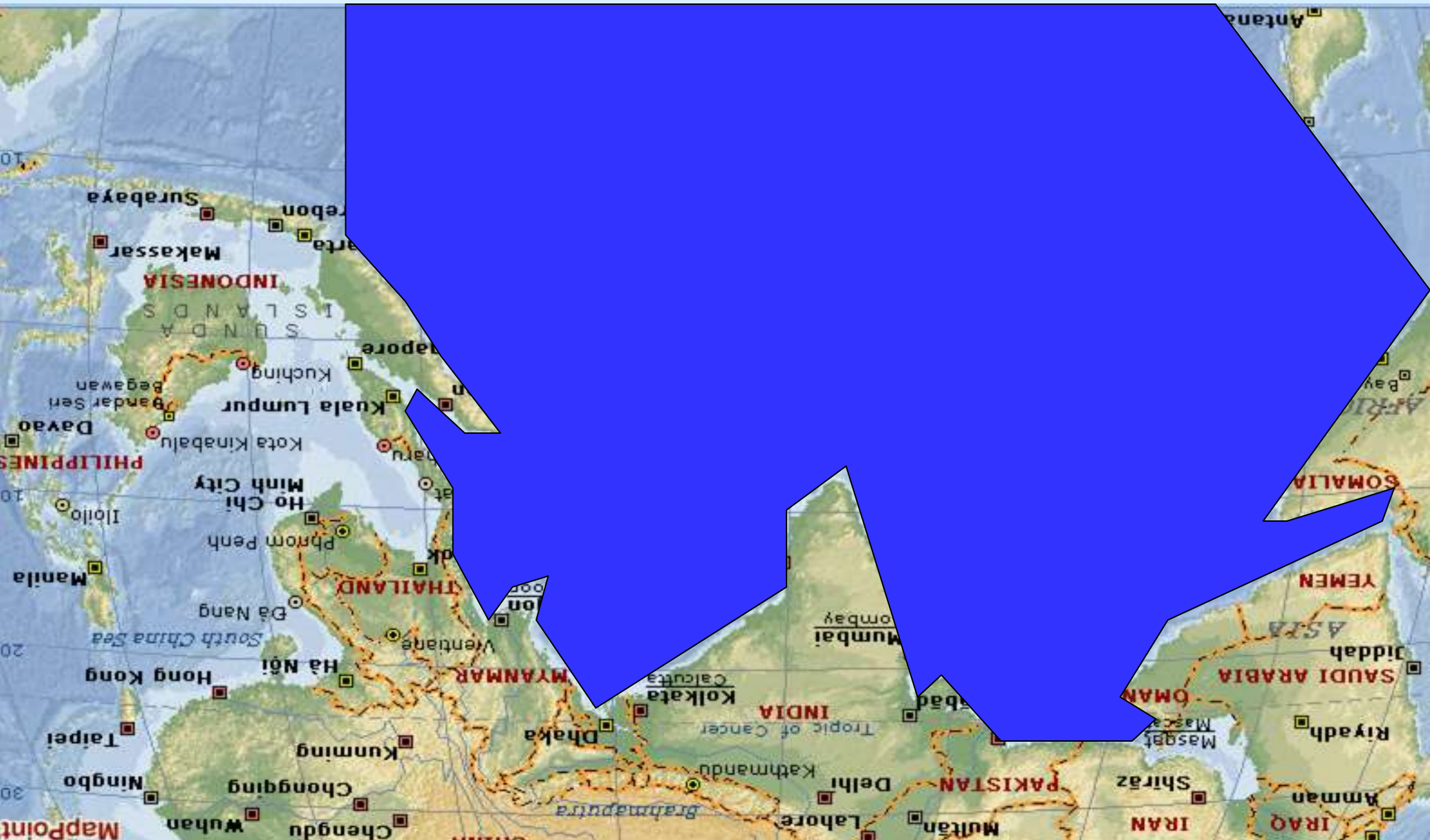
# High Traffic Density

• STRAIT OF MALACCA





# The "ULTA" Perspective





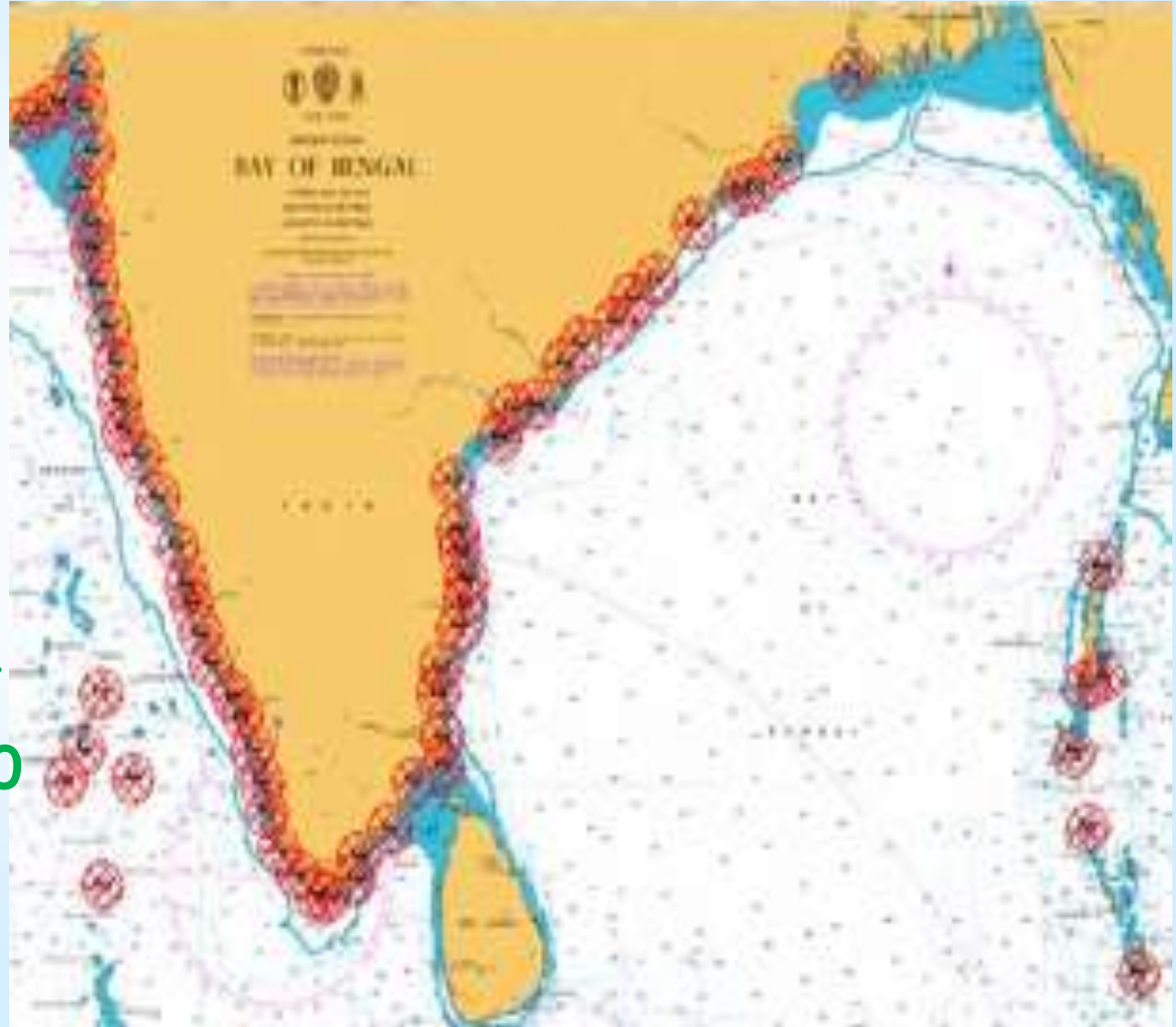
# India's Maritime Environment





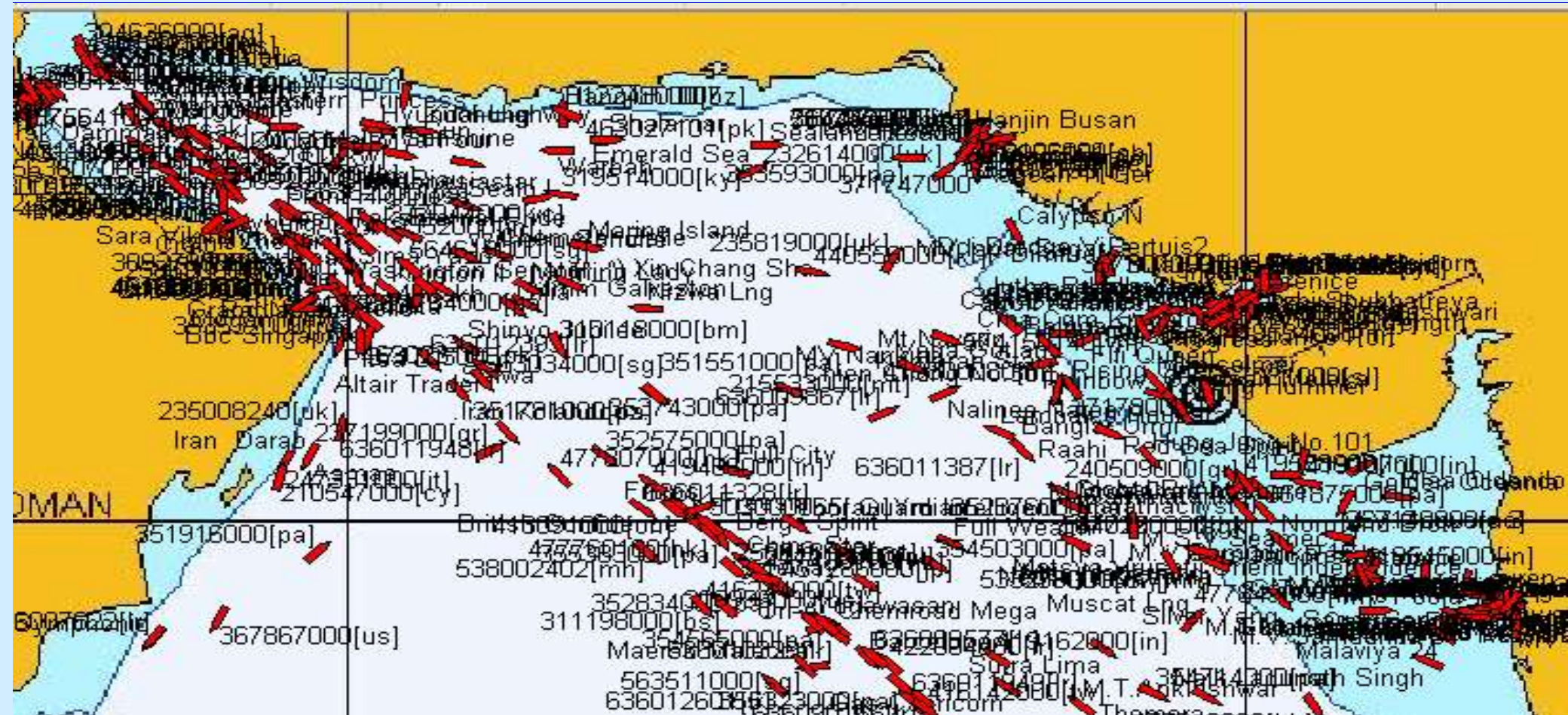
# National AIS Chain

- DG LIGHTSHIPS AND LIGHTHOUSES INITIATIVE
- INSTALLED ON LIGHTHOUSES
- PROVIDES INFO OF TRAFFIC WITHIN 20 NM OF COAST





# Snapshot - AIS Picture



IN V/UHF RANGE ONLY- WILL GET FURTHER COMPLICATED WITH LRIT  
PROBLEM OF IDENTIFICATION INCREASES MANIFOLD



# Information - The Key



- FOR EFFECTIVE MDA, MARITIME PICTURE MUST INCLUDE INPUTS FROM AS MANY GLOBAL SOURCES AS POSSIBLE
- ACCESS TO INFORMATION OF TRAFFIC OF PORTS AND COASTS OUTSIDE RANGE OF NATIONAL DETECTION CAPABILITIES
- WEAVED TOGETHER TO GENERATE A COMMON OPERATING PICTURE





# Information to Action

- ❖ “Network Centric Operations is not narrowly about technology, but broadly an emerging response of defence forces to the Information Age”
- ❖ NCO translates the info advantage to competitive war fighting advantage.

- ❖ **Detect, Identify and Engage**

- **IDENTIFICATION ??**

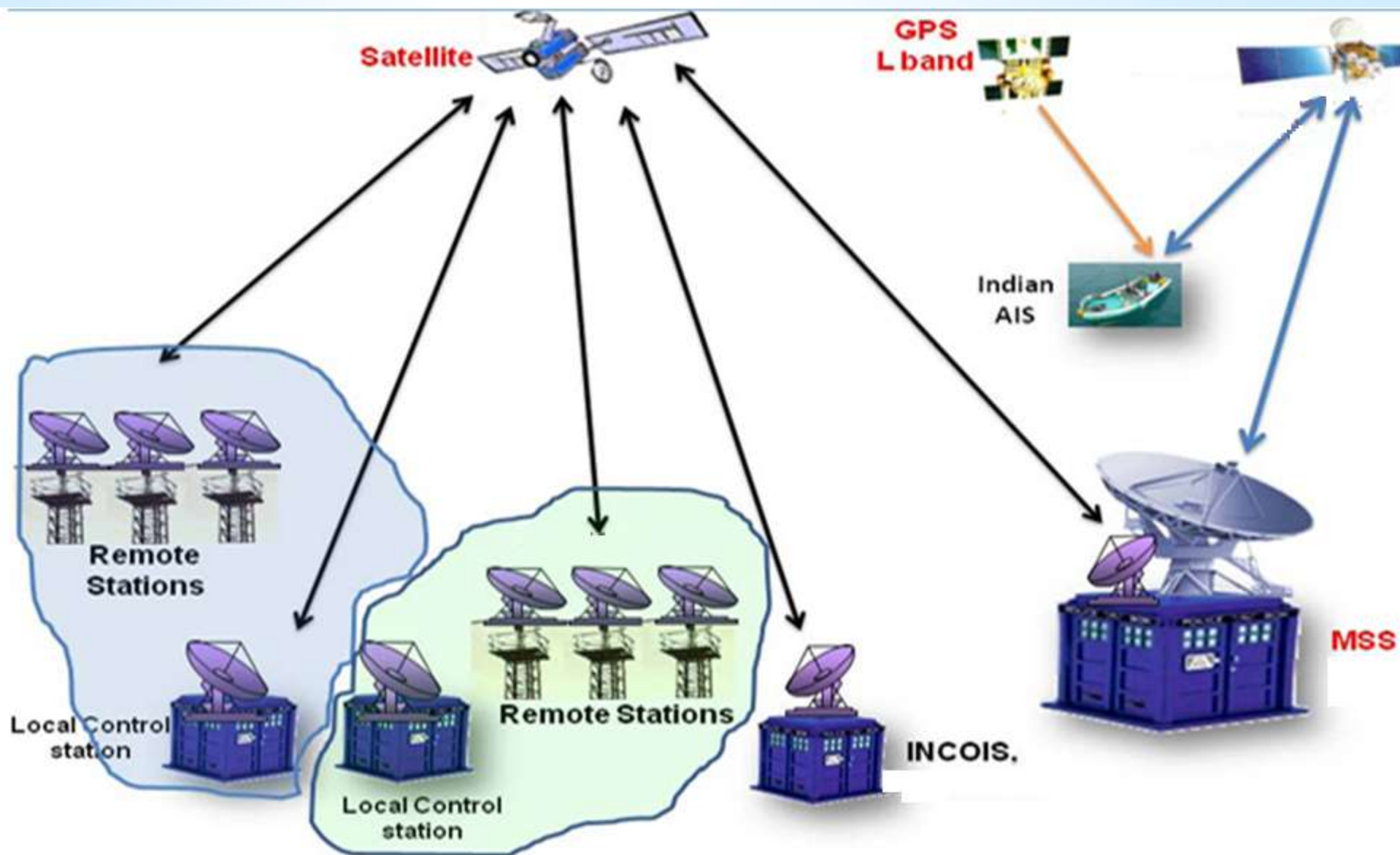
- ANALYSIS OF DATA
- INFORMATION MANAGEMENT
- FEEDBACK TO UNITS AT SEA

**Maritime Domain Awareness (MDA)  
&  
Integrated Coastal Surveillance System (ICSS)**



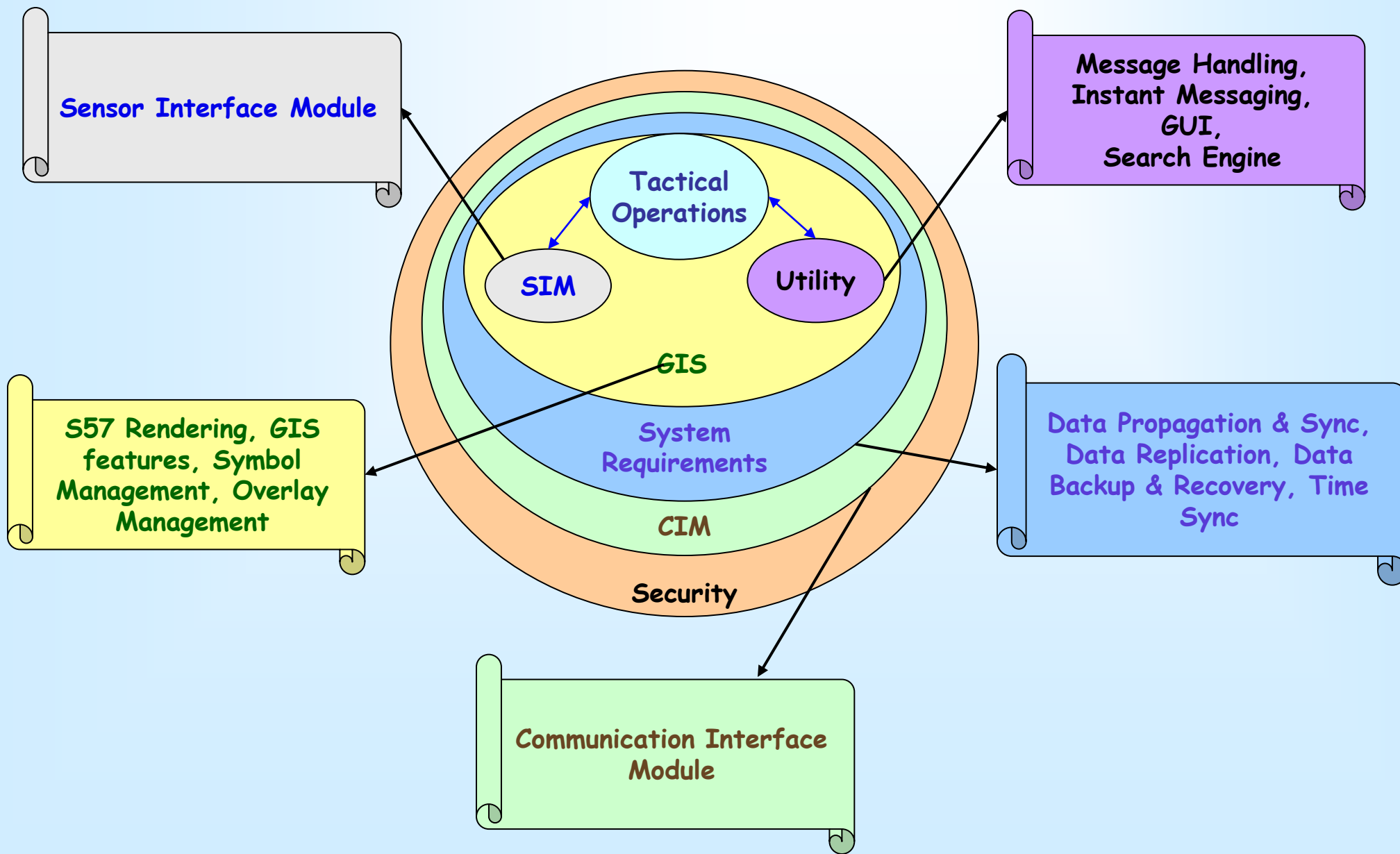


# ICSS Deployment



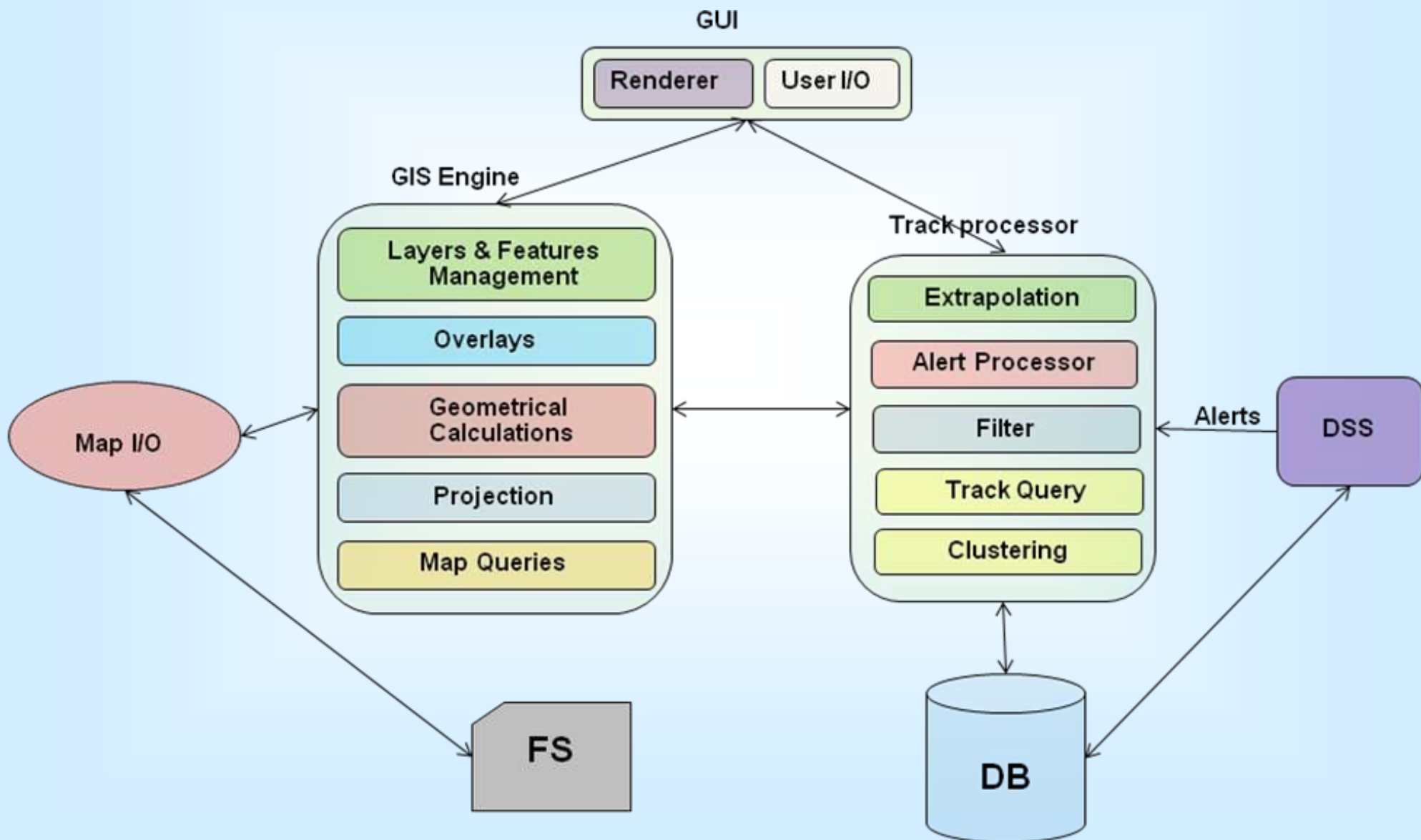


# Functional View



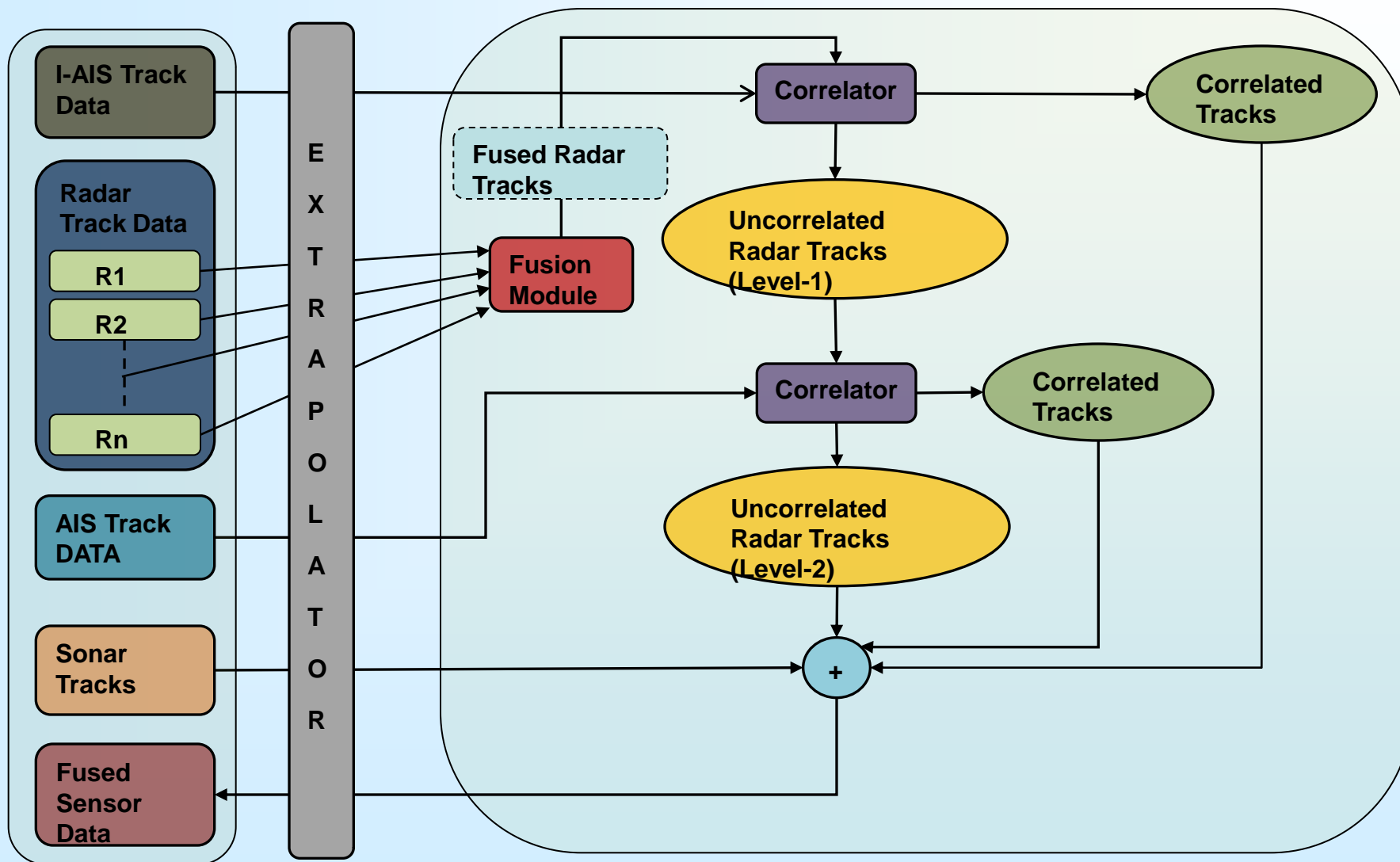


# GIS Modules



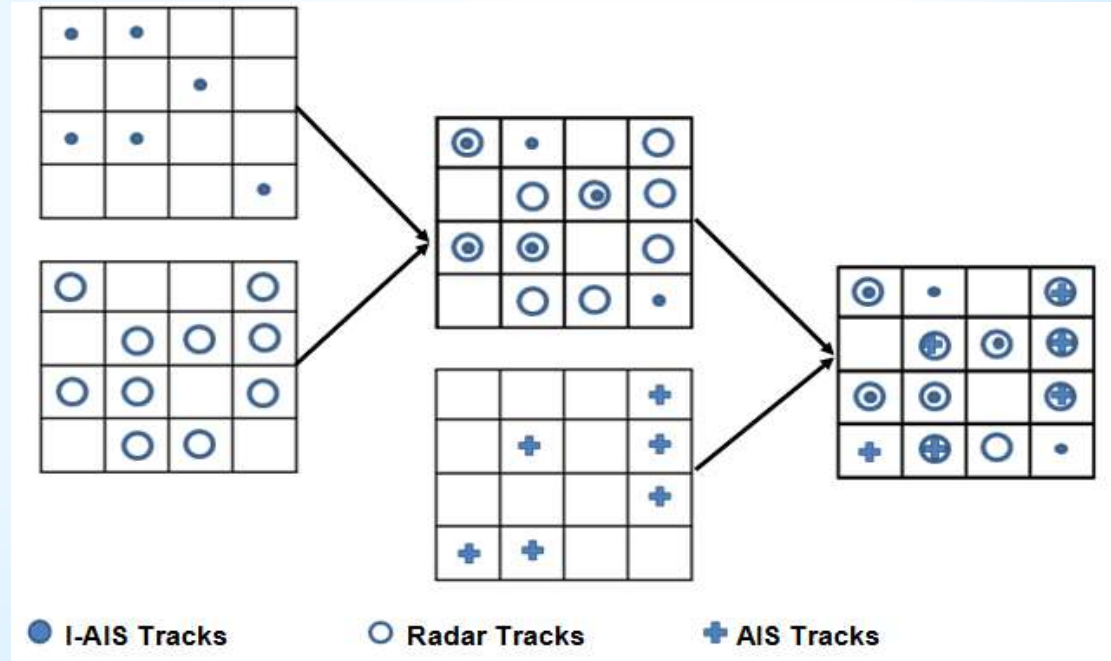
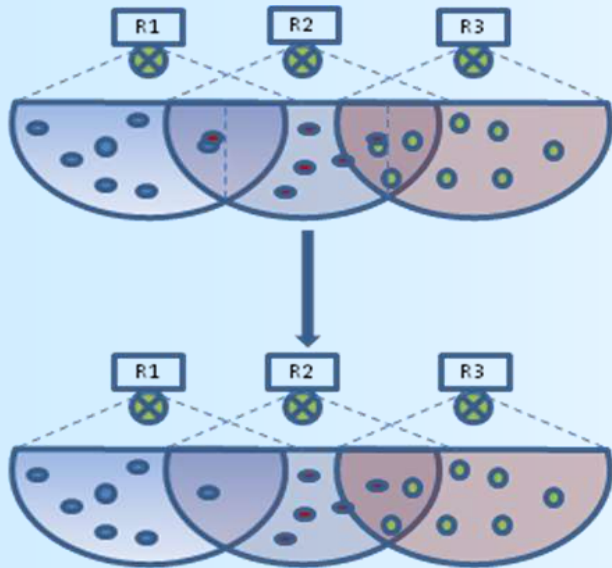


# Fusion Process: Logical Flow





# Fusion Process

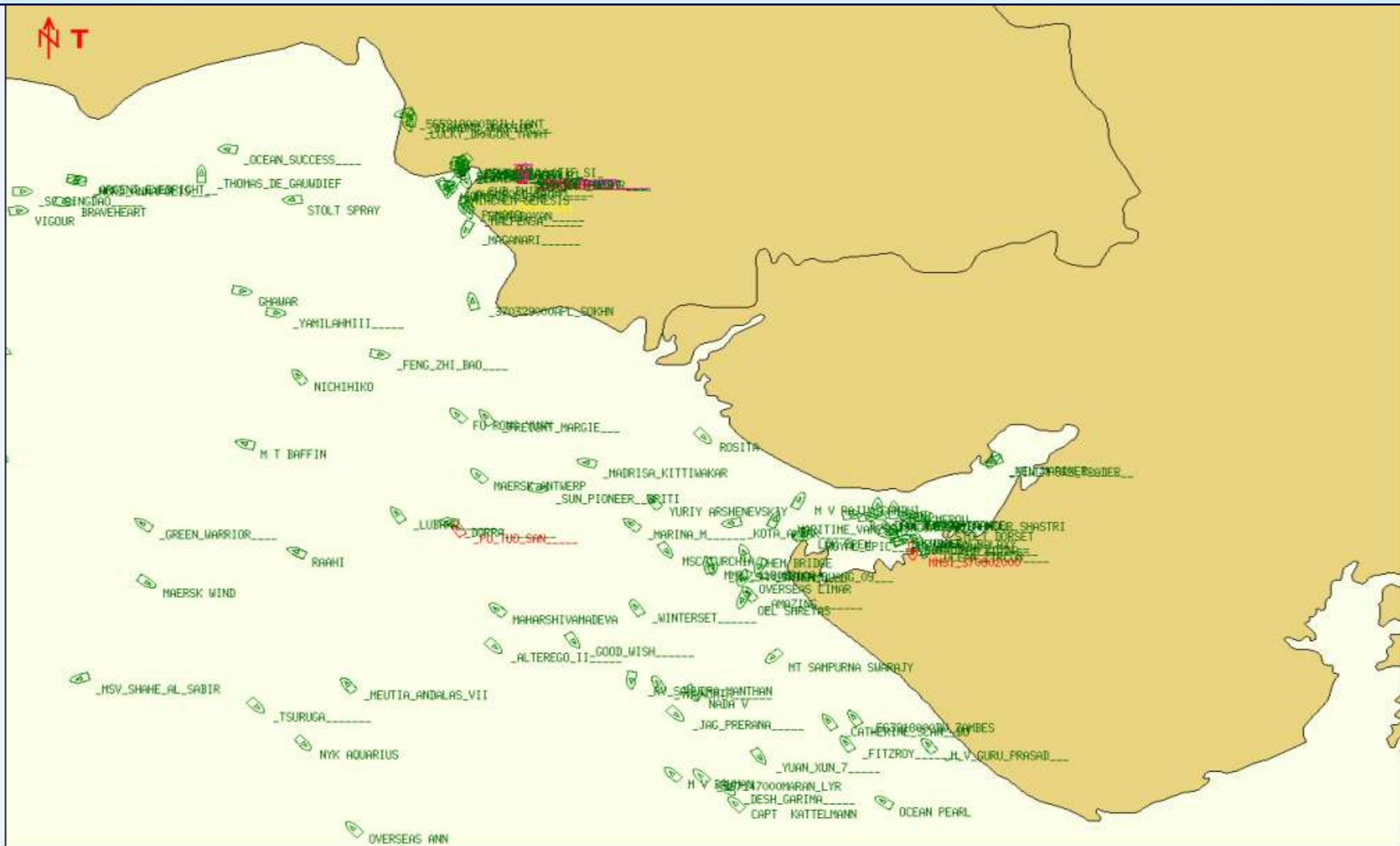


- ✓ **Step-1: Radar data will be fused first using Kalman filter**

- ✓ **Step-2: I-AIS track data will be correlated to fused Radar tracks**
- ✓ **Step-3: AIS track data will be correlated to uncorrelated Radar tracks from step-1**



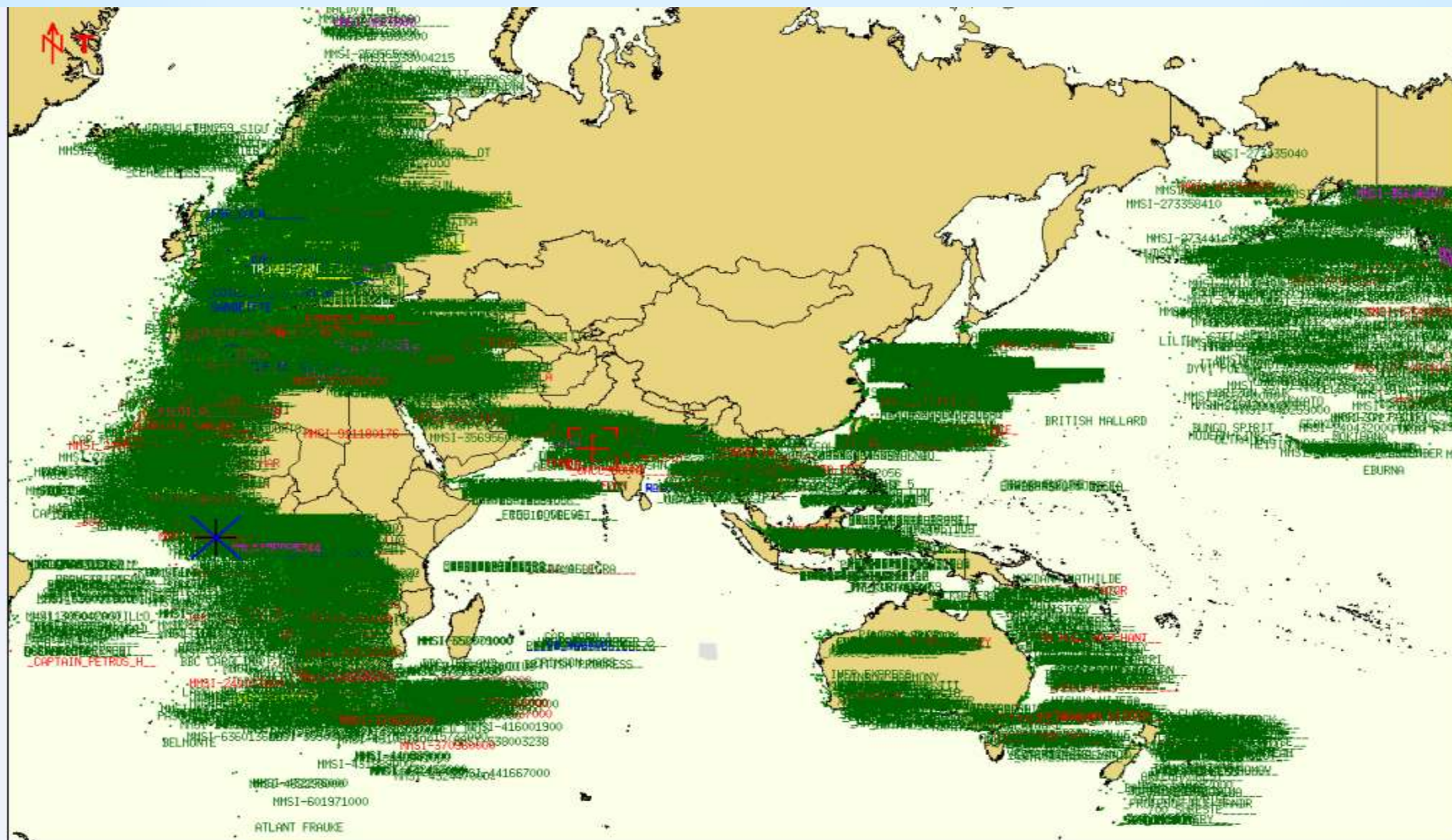
# Snapshot - COP Picture







# Snapshot - COP Picture





# Customized Solution

## ❖ Performance Enhancements

### ❖ Extrapolation - Use of Two algorithms

1. Fast but less accurate –only for drawing tracks on GIS.
2. Highly accurate but comparatively slow – for calculations,  
storage, text outputs etc

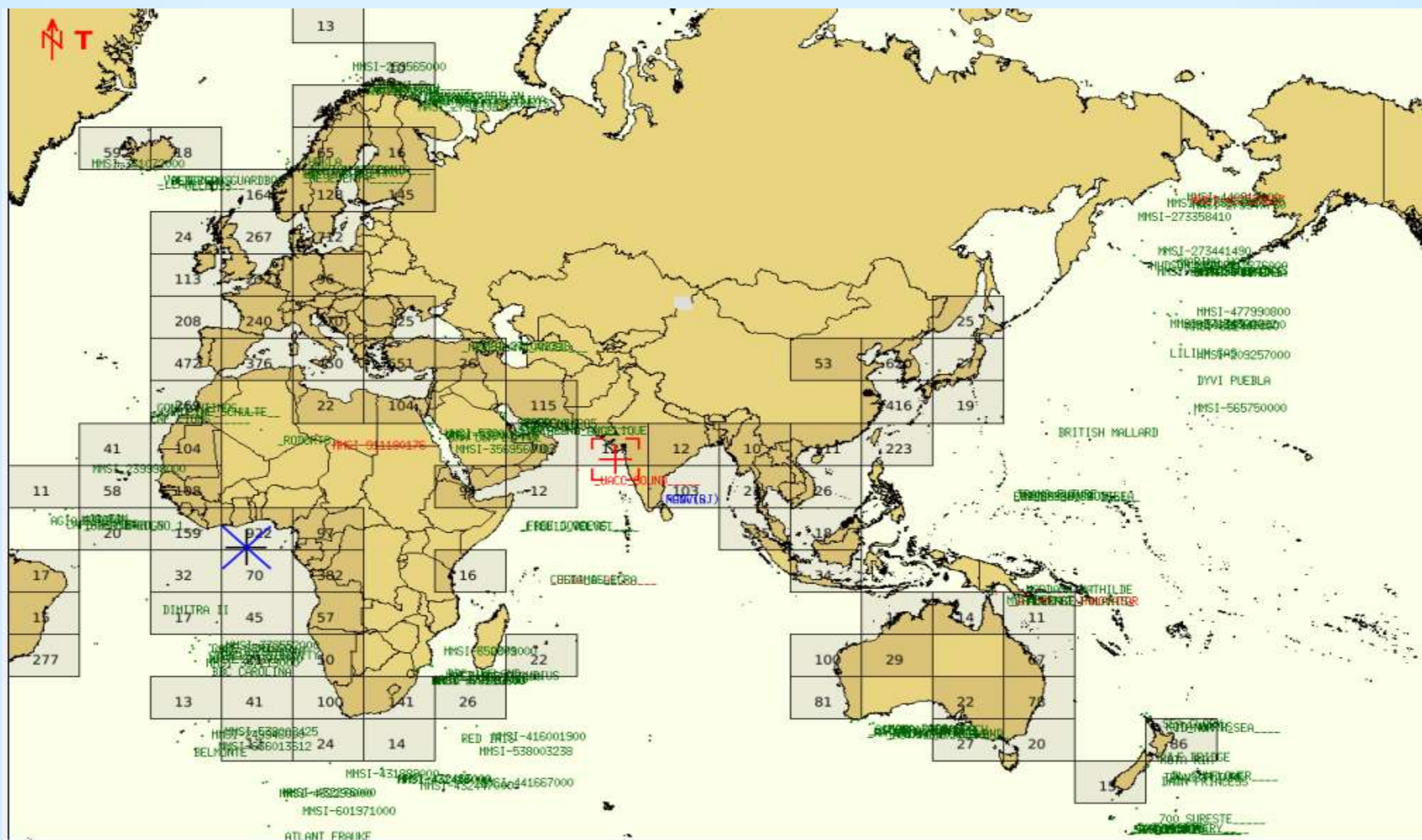
### ❖ World Map in predefined different resolutions

### ❖ Look Up Table for Symbol Drawing

### ❖ Track Clustering on GIS



# Snapshot - COP Picture





# Clustering

## Grouping of tracks based on Area and Speed

### Area - Use of Binary Spatial Partitioned tree (BSP Tree).

Fast position based query required in extrapolation and fusion, object selection, tool tip etc.

Not suitable for moving objects, Requires more memory.

Several refinement has been applied to make it suitable for moving objects as

- 1) The depth of the tree shall be less for tracks( around 5 or 6, tested with depth 5)
- 2) Excluding air tracks from clustering ( Fast moving and less in number)
- 3) The depth of the tree shall be around 8 or 9 for static objects such as GIS layers and feature
- 4) Linear search in the node at the lowest level of tree.



# Clustering continued...

## Speed based grouping of tracks

### Benefits

Reduce the extrapolation overhead without perceptible loss of accuracy

### Challenges

The tracks shall be extrapolated based on speed.

The fast moving tracks shall be extrapolated at quick interval

The slow moving tracks shall be extrapolated at delayed interval

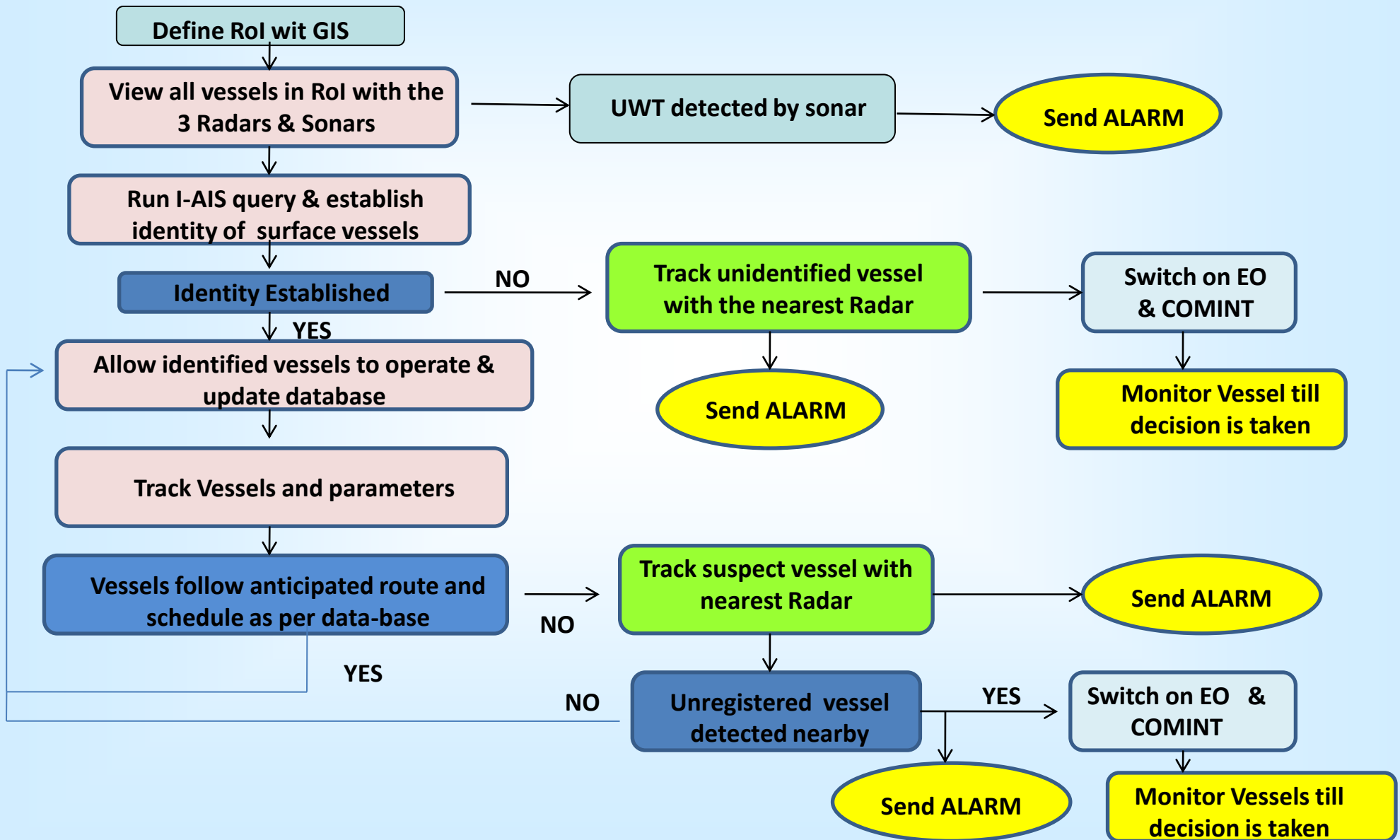
Tracks need to be in sorted order

(can be avoided if number of groups are less such as 8 or 16)

Multiple copy of tracks are needed for multiple windows



# Information to Action





# Information to Action



•VESSEL APPROACHING MUMBAI TRANSMITS NAME AND IMO NUMBER ON AIS

•INFORMATION ON COP INDICATES THAT VESSEL WITH SAME NAME/IMO NO OFF SINGAPORE



# Information to Action

Considering the complexity and scale of the problem, it is proposed to use the following technologies:

- ❖ Ontology based knowledge representation and inference.
- ❖ Rule engine for capturing static events and domain specific policies.
- ❖ Adaptive Spatio-temporal data mining techniques for model learning.
- ❖ Simulation engine for data generation, model building and analysis.
- ❖ Scalable and distributed software architecture using Hadoop, Mahout and distributed databases (like Cassandra, HBase etc).
- ❖ Work flow management system for what if analysis and decision support.





Thank You..