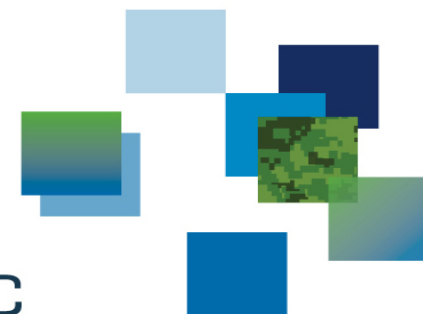# SigMa Lab – Concept and Development

Layton Gilroy
DRDC Atlantic Research Centre

2018 NATO MODELLING & SIMULATION GROUP (NMSG) SYMPOSIUM
October 11-12, 2018

DRDC | RDDC

Canada

Outline

- Background

- SigMa Lab concept

- Pieces of SigMa Lab

    - SCOR Sim

    - APRON

    - SASS

    - SEMS/SENS

- Conclusion, way ahead

Background – Why Signature Management?

- Both above water and underwater ship signatures are crucial information for own-ship operational decision making.

- All navies make considerable effort to regularly measure signatures but, for a variety of reasons, these measurements (rangings) are often not performed.

- Also, between rangings, signatures can change and ships may either not be aware of these changes or may not be able to revisit the range.

- In partnership with the Centre for Ship Signature Management and, in particular, Norway, Germany and the Netherlands, DRDC developed a prototype signature management system (SMS) for real-time monitoring and management of ship signatures under the COSIMAR (Continuous Operational Signature Monitoring, Awareness and Recommendation) project.

Background – The SigMa Lab

- As part of the COSIMAR signature management project, DRDC was to provide *CFAV Quest* for the final prototype testing.

- The original plan involved installing both the Signature Management System (SMS) and the Sensor Error Notification System (SENS) on *Quest* tied into a data acquisition system and the onboard network.

- In early 2015, the RCN decided to tie up *Quest* and it has now been scrapped.

- In response, DRDC proposed delivering a simulated environment in which to test the COSIMAR SMS and SENS.

- This capability is called the SigMa (Signature Management) Lab.

- DRDC also developed a free-play simulation of *Quest* (SCORSim) to assist with demonstrating the SMS and SENS.

DRDC | RDDC

SigMa Lab Concept

- Basic concept was to create a virtual *Quest* operating in a virtual environment.

- This virtual *Quest* would provide all necessary data (ship and sensor data) to the network for distribution to the SMS and SENS.

- The SigMa Lab must also provide the infrastructure in which the SMS will operate (not expected to reside on only one computer).

- The SMS will predict the signature and recommend changes to the ship configuration, state, or operation.

- The simulated ship should be able to respond to these changes and update all sensor data.

- Note that the system does not have to be *Quest*.

Overview
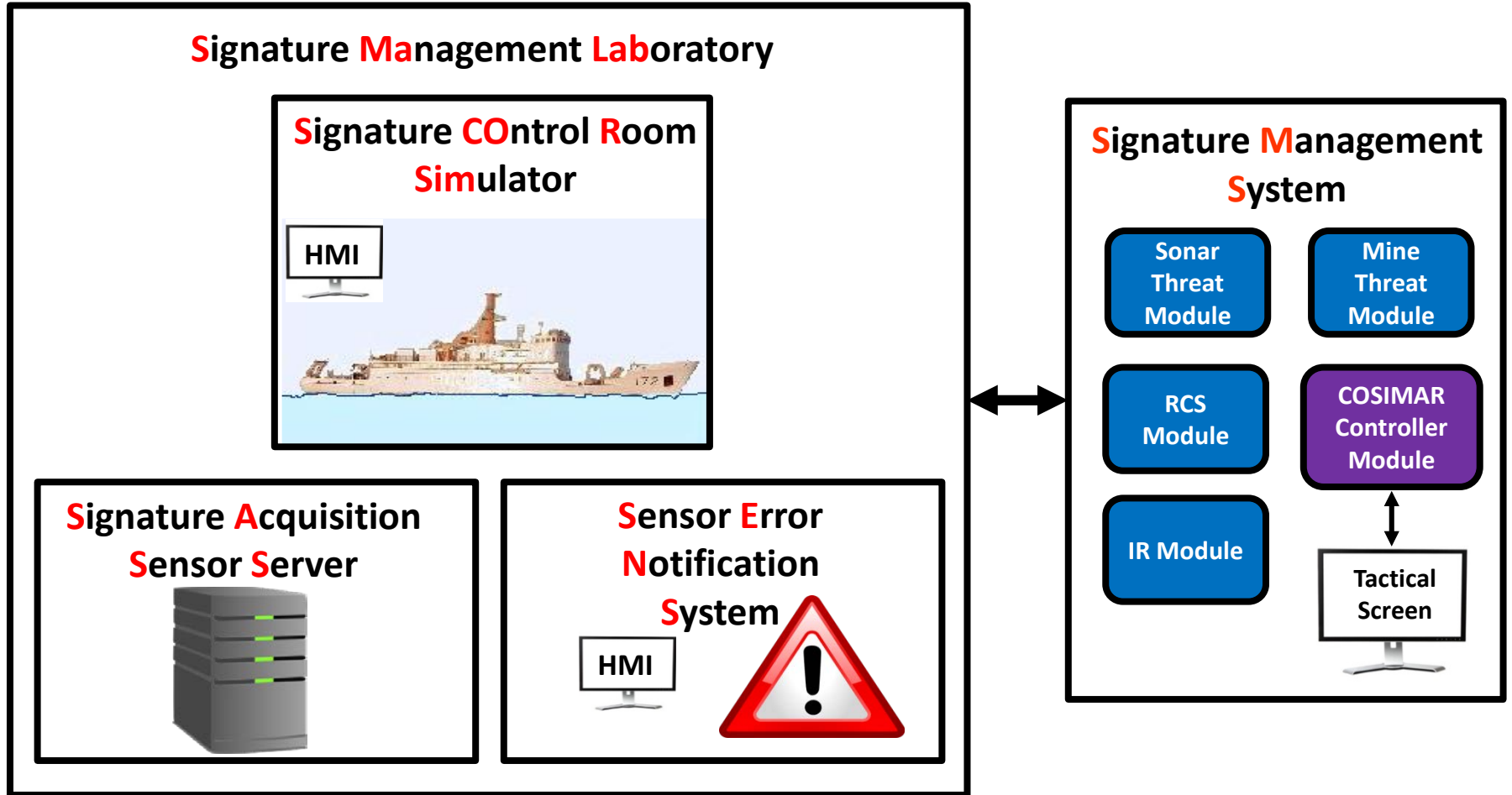
SCORSim (Signature COntrol Room Simulator)

- The SMS requires sensor information for the system to function.

- The simulator must be able to estimate the sensor information, ship state, and the environment and be able to follow a variety of realistic scenarios.

- Sensor data include ship data (course, speed, etc.), hull vibrations, IMCS info, shaft currents, hull potential, magnetic info, door sensors, hull temperatures, and stack temperatures.

- Environmental data include atmospheric and ocean environmental data, and ocean bathymetry.

- Simulator controls includes helm, machinery states, signature errors, environmental controls, locations, etc.

SCORSim HLA
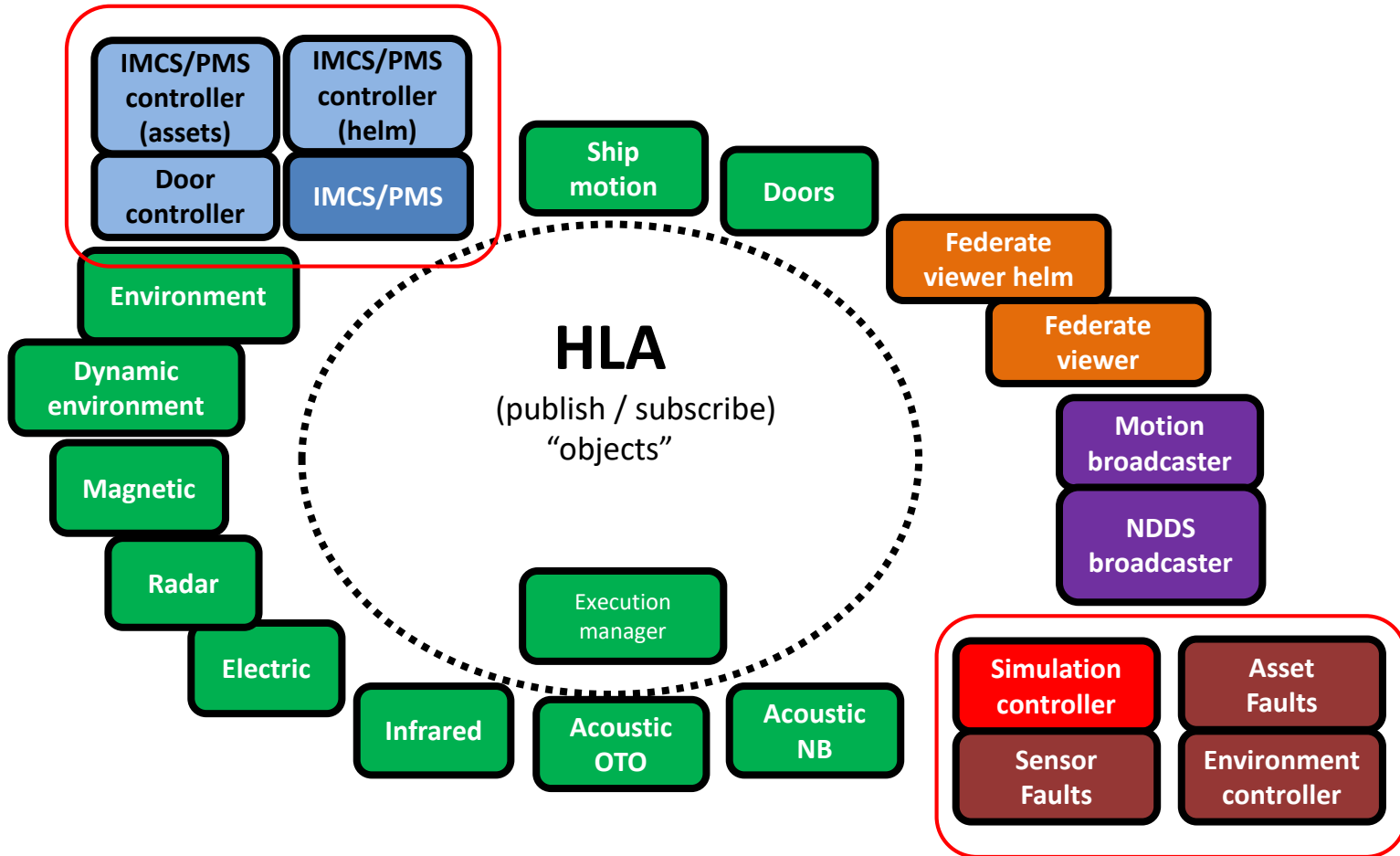
SCORSim – Controller/Viewer

IMCS	Doors	Environment	Faults
■ Helm control ■ Sets asset states	■ Opens/closes doors ■ Adds/removes RAM covers on cranes	■ Controls environment and ship-state	■ Adjusts assets and sensors ■ Introduces errors

Federate viewer

- ■ Visualizes ship motion
- ■ Different camera settings available

Helm viewer
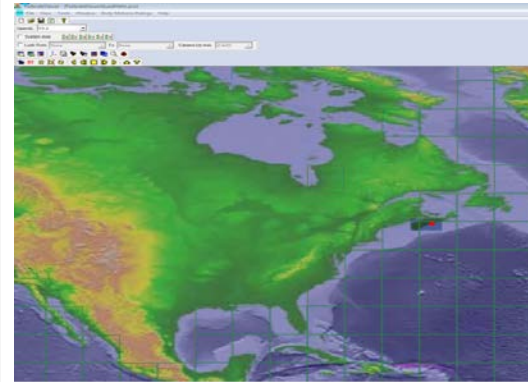
- ■ Shows ship location, heading and course
- ■ Database boundaries of salinity and temperature

DRDC | RDDC

IMCS Controller (Helm)

IMCS Controller (Assets)

IMCS Controller (Environment)

IMCS Controller (Asset Faults)

IMCS Controller (Sensor Faults)

Sensor Data

- SCORSim is also required to produce all sensor data. Modules were needed for:
  - Accelerometers – acoustic federates (1/3-octave and narrow band).
  - Magnetometers – simulation completed but not activated.
  - Temperature sensors – limited simulation developed but not activated.
  - ICCP and ASG currents – simulation developed.
  - Doors and RAM
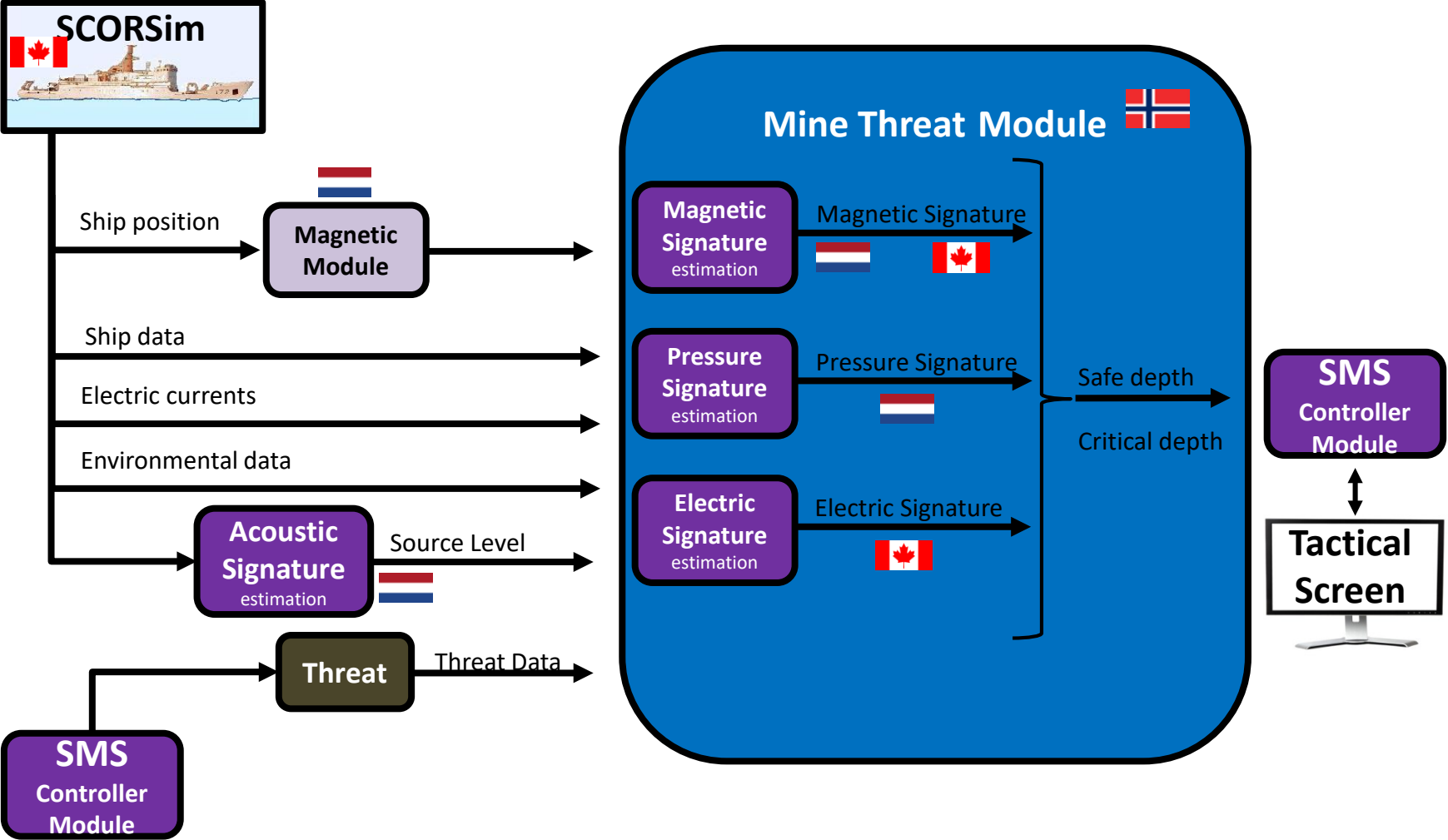- Magnetic and IR signature modules cannot currently utilize real-time sensor data.

Data flow within SCORSim (door example)
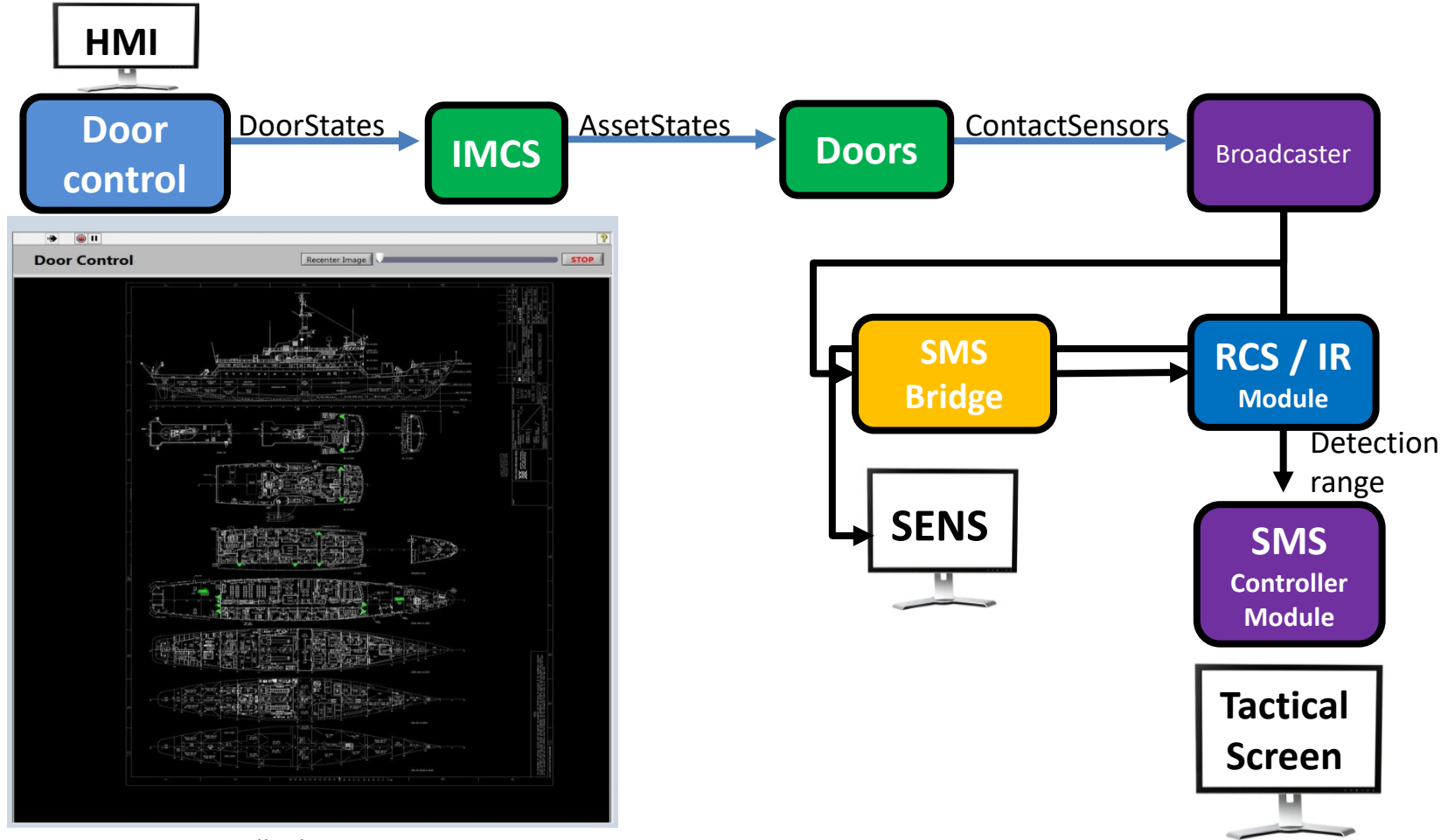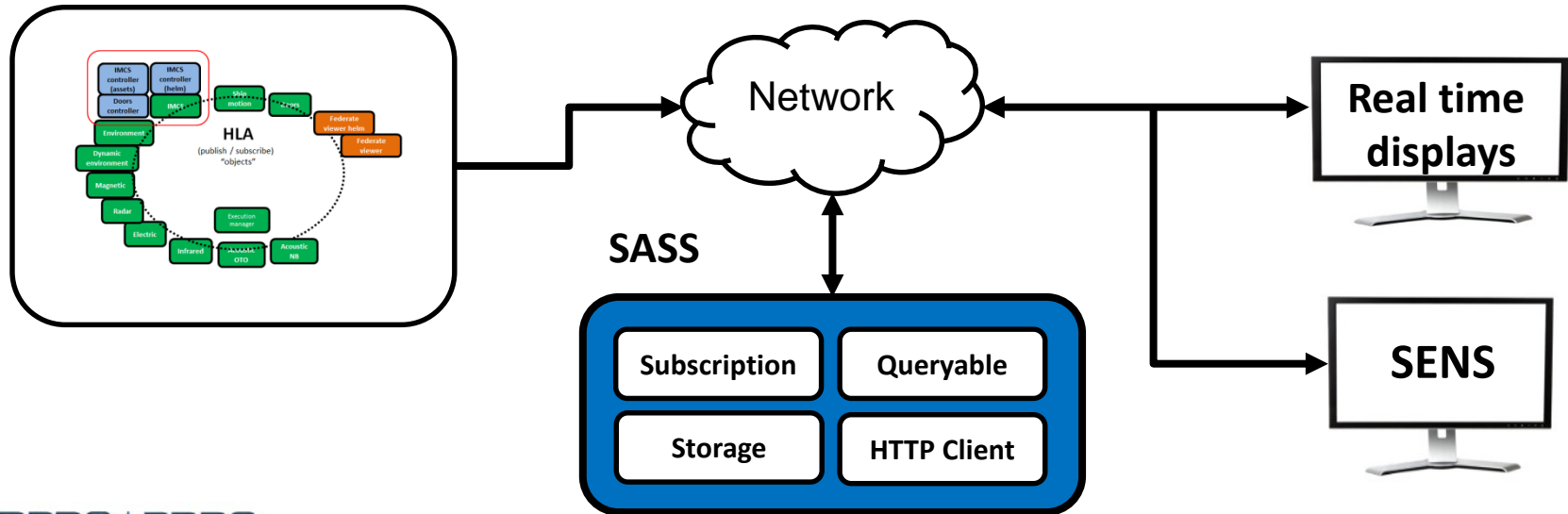

Door controller home screen

Mine Threat – Estimation

SigMa Acquisition Sensor Server (SASS)

- Stores topics for later HTTP querying and retrieval.
- Predetermined time resolution of storage and queries, typically a minute.
- Future capability for preloading static information, e.g. bathymetry.

SEMS/SENS

- Original SENS was intended as trials tool which would be re-imagined for naval implementation.

- We have since migrated SENS to SEMS (SEnsor Monitoring System) for trials work.

- Created new SENS more in line with operational purposes.

- SEMS monitors ship state and provides continuous display of sensors. Useful for monitoring sensors during trials and troubleshooting sensor fit.

- SENS provides capabilities for detecting errors in sensors and assets and investigating signature issues.
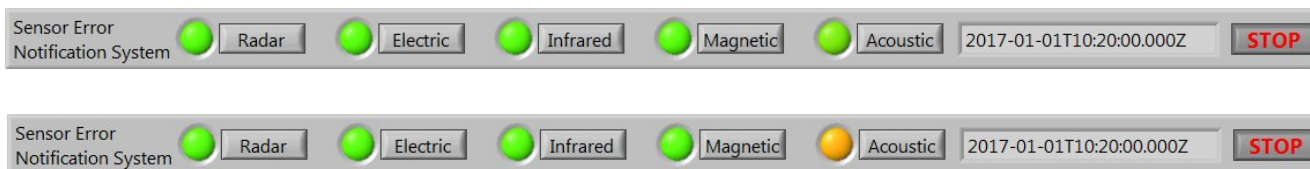
SEMS – Home Screen
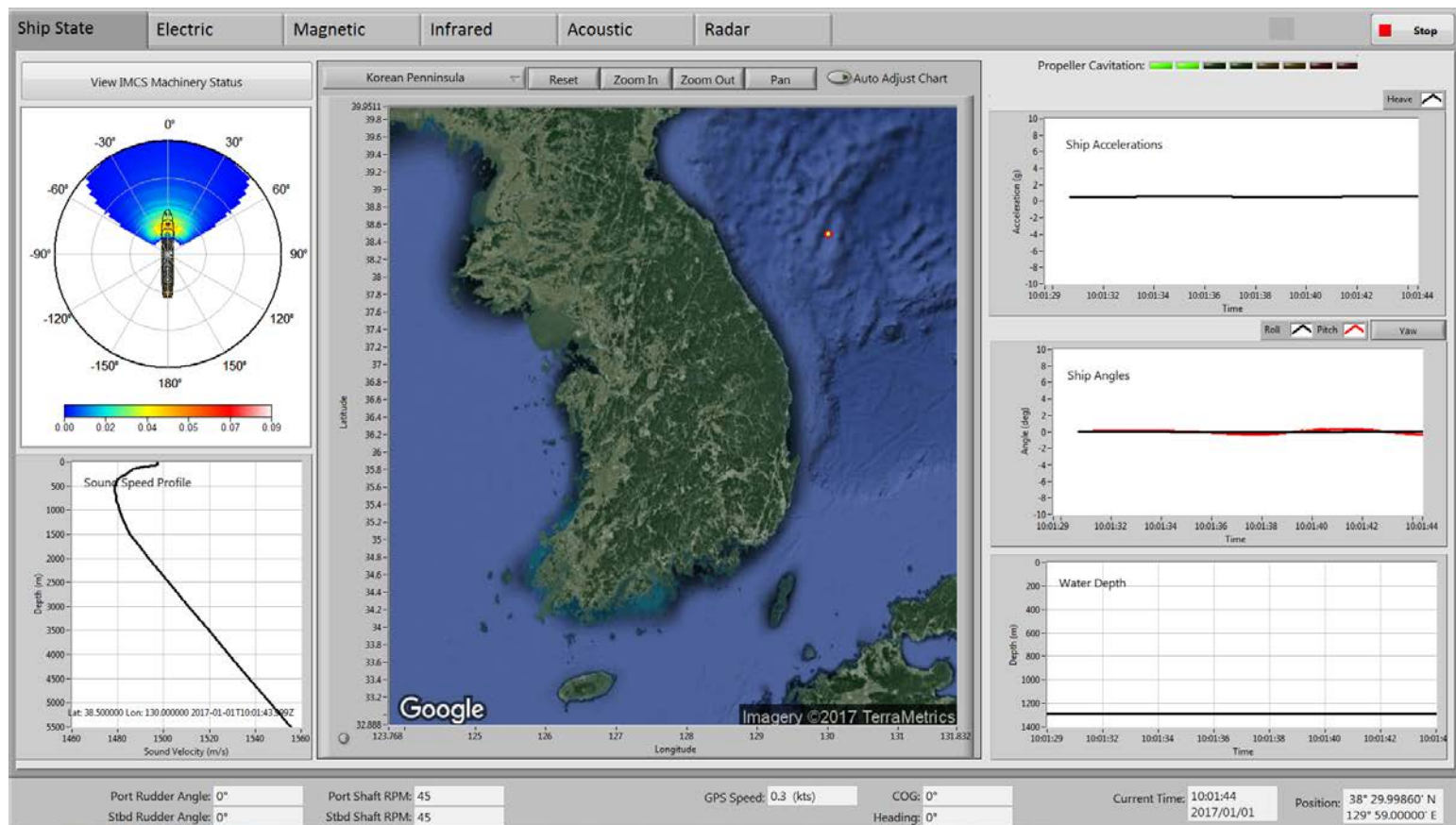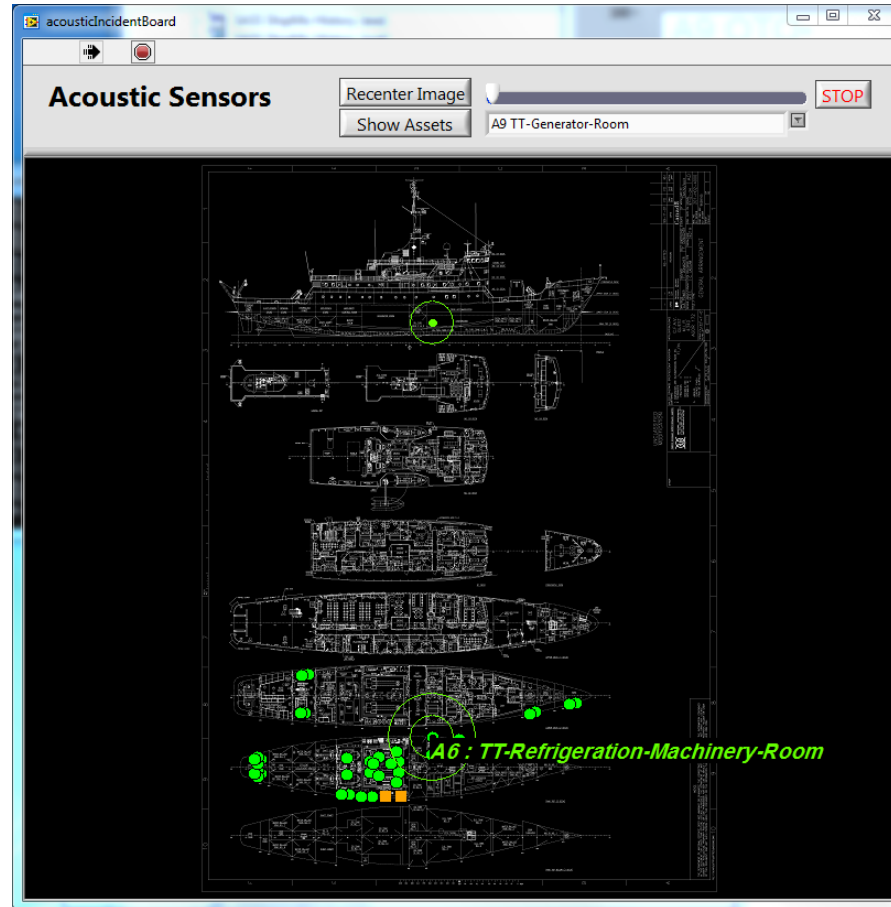
SEMS – Sample Sensor Monitoring
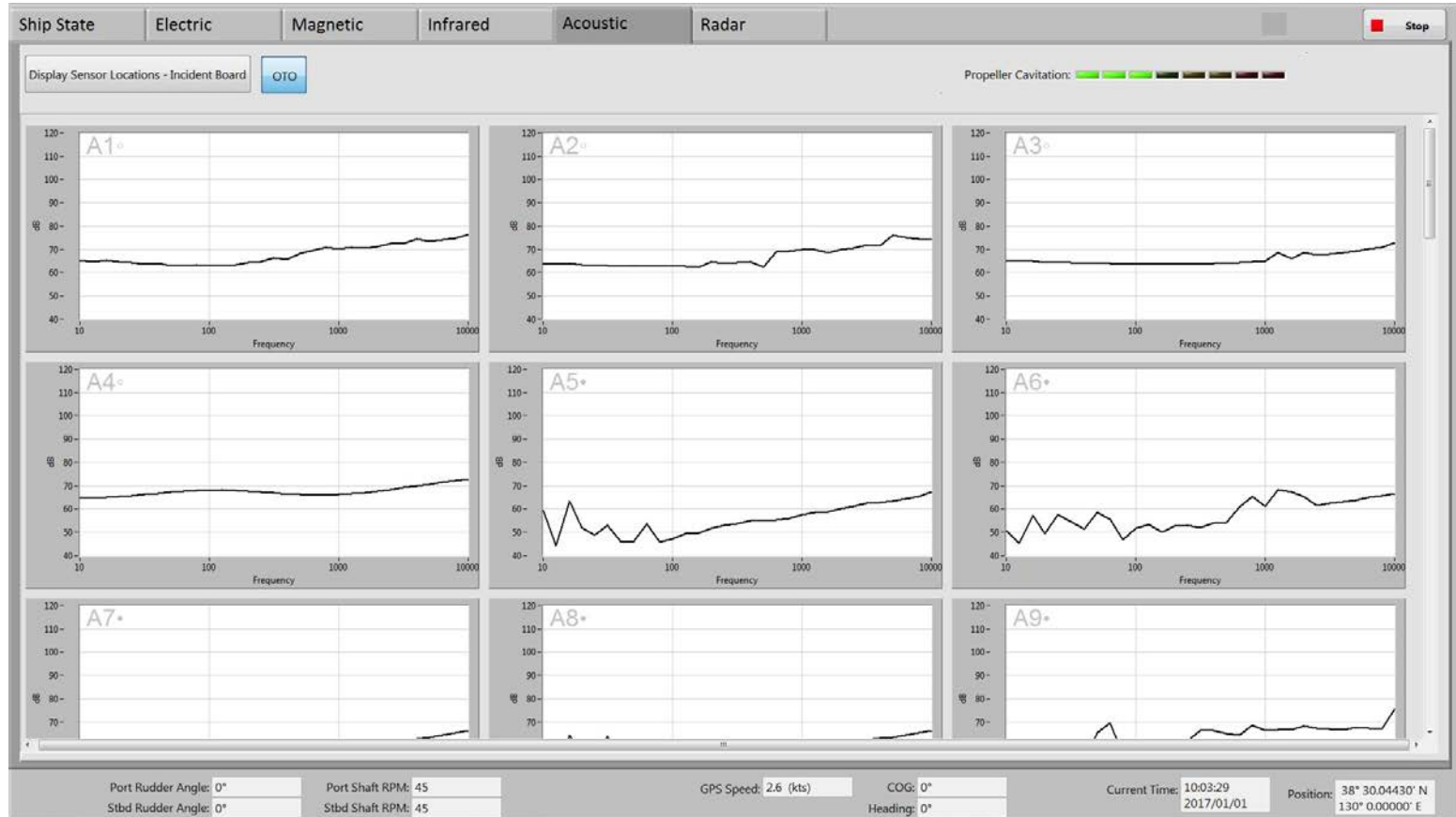
SENS – Basic Interface

- The interface is designed to be simple and occupy minimal screen space, enabling the user to determine sensor status at a glance. Each sensor suite has a light associated with it; green indicates that the suite of sensors is error free.

- SENS notifies the user when a sensor error has been detected (e.g., a limit has been exceeded) by changing the appropriate suite's colour to amber.

- Clicking on the appropriate signature's button brings up an incident board for the ship.

SENS – Error Investigation

SENS – Error Investigation

Conclusion

- The SigMa Lab environment provides a unique capability for examining the performance of signature management systems without taking them to sea.

- It also provides a capability for simulating a variety of vessels and environments which may be useful in evaluating either existing or planned platforms.

- While *Quest* was modelled here, future work could including modelling of the current RCN frigate or the future naval combatant.

- The system may also be useful for other simulation work requiring more complete platform information than exists in current platform simulations.

DRDC | RDDC

DRDC | RDDC

SCIENCE, TECHNOLOGY AND KNOWLEDGE
FOR CANADA'S DEFENCE AND SECURITY

SCIENCE, TECHNOLOGIE ET SAVOIR
POUR LA DÉFENSE ET LA SÉCURITÉ DU CANADA