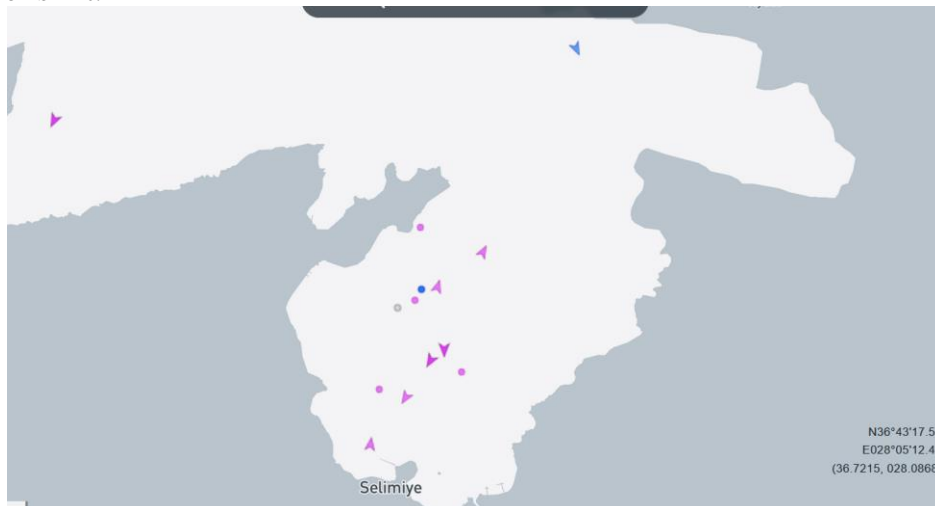


Software-Defined Satellite Automatic Identification System (AIS) Receiver

An Automatic Identification System (AIS) transmits a ship's identity, position, and speed along with other relevant information to other AIS-equipped ships and shore stations within range. The International Maritime Organization and other governing bodies require large vessels, including many commercial fishing vessels, to broadcast their AIS data to support the safety of navigation and enhance traffic management. Collecting, processing and tracking AIS signals are important in many applications including search and rescue, strategic planning, disaster response, and environmental protection.

The main purpose of this project is to develop an AIS receiver located on a low earth orbit (LEO) satellite using a software-defined radio. The AIS signal transmitted from a ship reveals the ship's unique identification, position, speed, heading etc. The proposed system will capture and decode AIS signals and report the following parameters:

- AIS message content,
- Received signal strength indicator (RSSI),
- Time of arrival of the signal,
- Doppler shift.



Features of the system are listed below.

- **AIS signal generation:** AIS signals will be generated based on ship data with valid AIS signal message contents. The model parameters of the transmit signal shall be adjustable for simulating different transmitters. The simulated transmit signal shall be compatible with the AIS frequency band.
- **Channel Modeling:** The radio propagation channel between AIS transmitters and LEO satellite will be modeled. The channel model shall include at least the following effects:
 - Free space path loss,
 - Doppler shift.

The output of this step is to construct a typical transmitted RF signal that contains the effects of the channel model.

- **AIS Receiver Development:** A LEO-satellite AIS receiver will be developed that captures and decodes AIS signals transmitted from different transmitters located at different locations.
- **Visualization:** The information provided by the AIS messages (such as unique identification, position, speed, etc.) and RSSI, time of arrival, and Doppler shift information of the received AIS signal will be displayed on a screen.

The suggested platform for signal processing and software-defined radio development is Python/GNU Radio. The software-defined radio platform will be provided by the sponsoring company.

Extra features:

- The following channel parameters are optional for modeling:
 - Multi-path fading (based on ray tracing and typical AIS transmit antenna patterns)
 - Atmospheric loss (ITU radio propagation models can be helpful.)
- Multiple-Access Channel Modeling: The multiple-access method for AIS shall be defined and a corresponding received signal shall be constructed. The multiple-access signal shall include different transmit signals coming from different locations, and corresponding channel model effects (defined in the Channel Modeling part) depending on the transmitter's location.