On the use of AIS binary messages for exchanging navigational intentions in encounter situation

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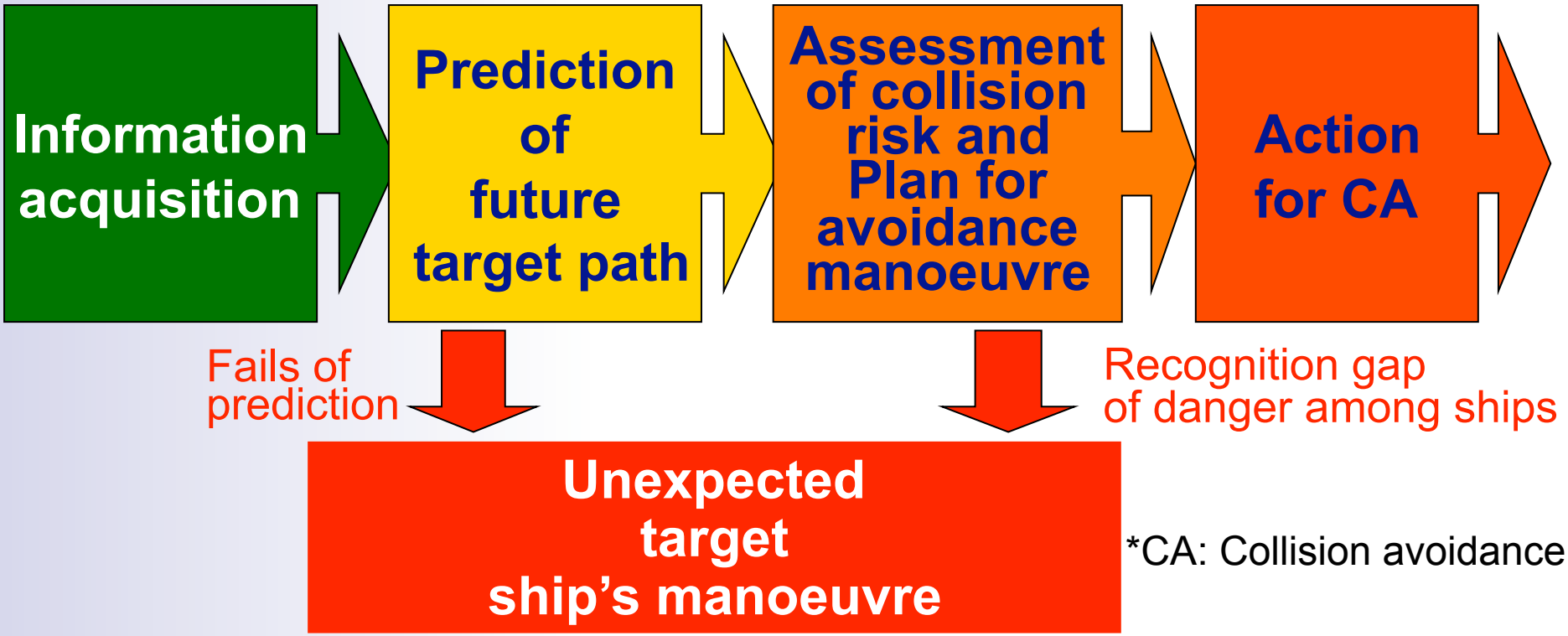
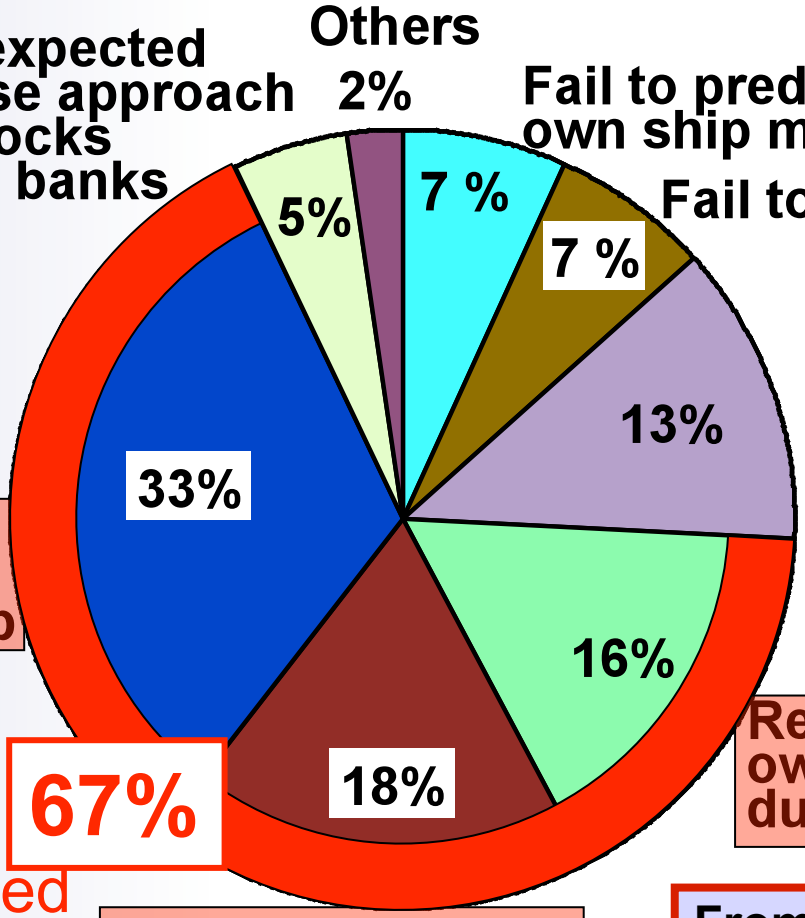
Steps of collision avoidance



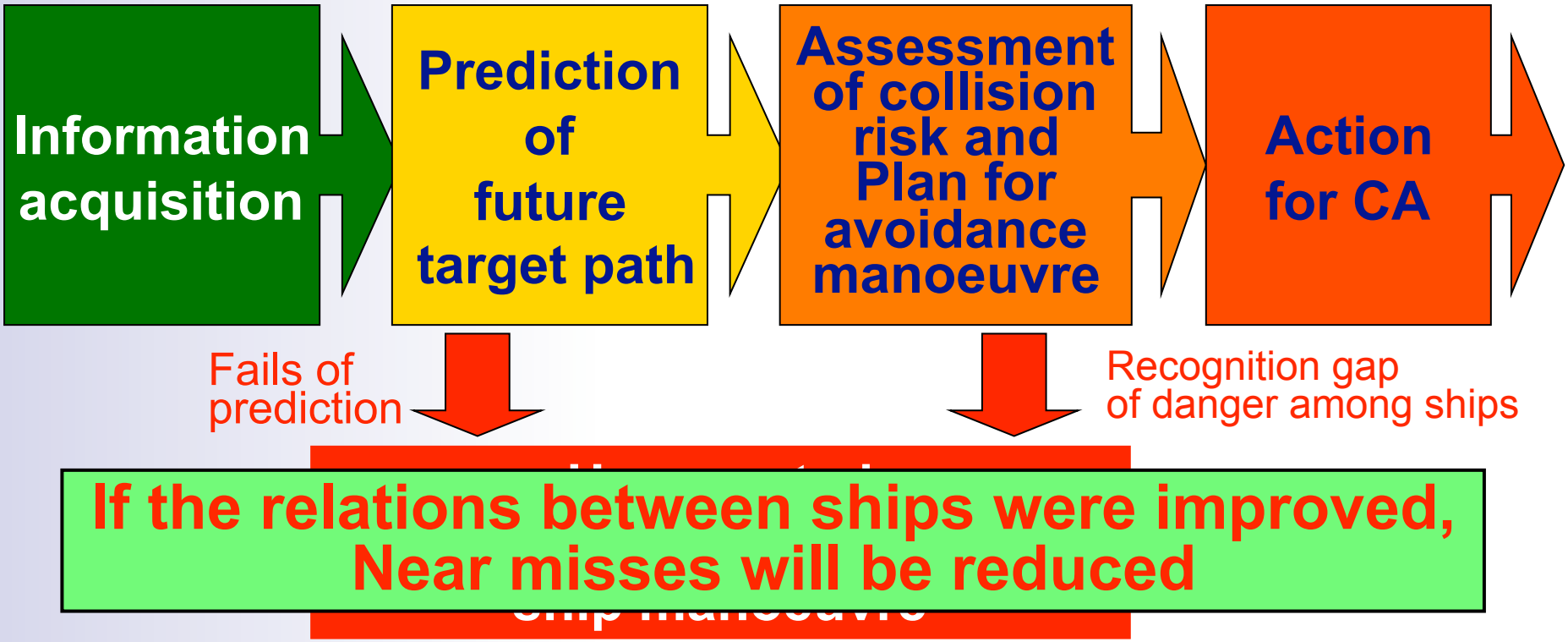
*CA: Collision avoidance

Reported near misses from active seafarers



From Study on Near Misses under Ship's Operation, 1997
Total 2484 reports

Steps of collision avoidance



Navigational intension exchange is a good solution to clear the ambiguity of the ship's behaviour

Information technology at sea and e-Navigation

- Advance in navigation systems
  - Widely introduction of AIS
  - New radars are required to show AIS information on its display from 2008
  - and more....
- e-Navigation strategy
  - It promotes to make new application with new and existing systems.
  - Use of AIS binary message is an effective approach for realising e-Navigation

NIESS (Navigational intention exchange support system)

Exchanging navigational intensions

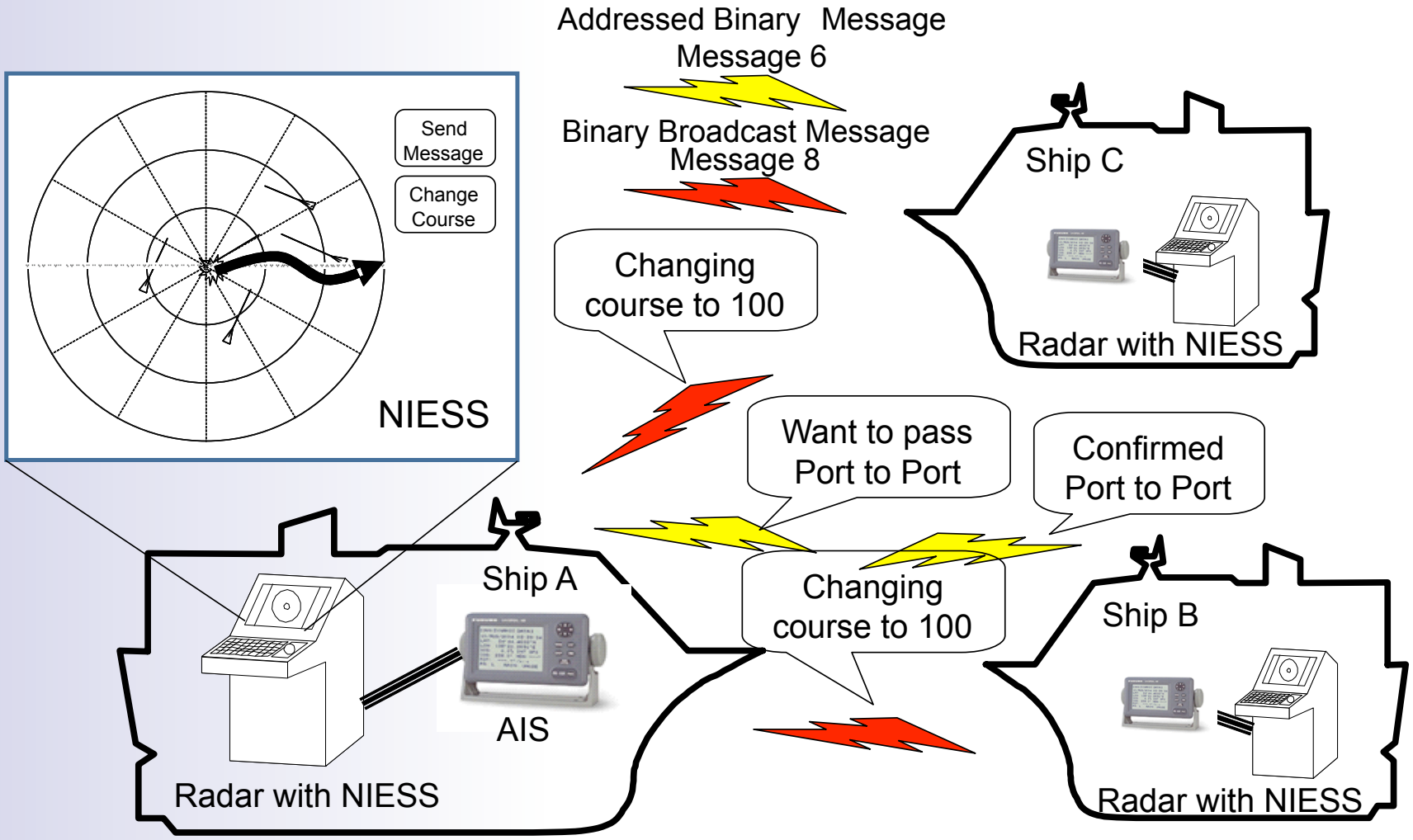
- VHF Voice communication
  - Linguistic barriers disturbs effective communication
  - False recognition may occur in noisy condition
- Whistles
  - Difficult to identify the ship that sent message
  - Effective distance is too short for collision avoidance

NIESS (Navigational intention exchange support system)

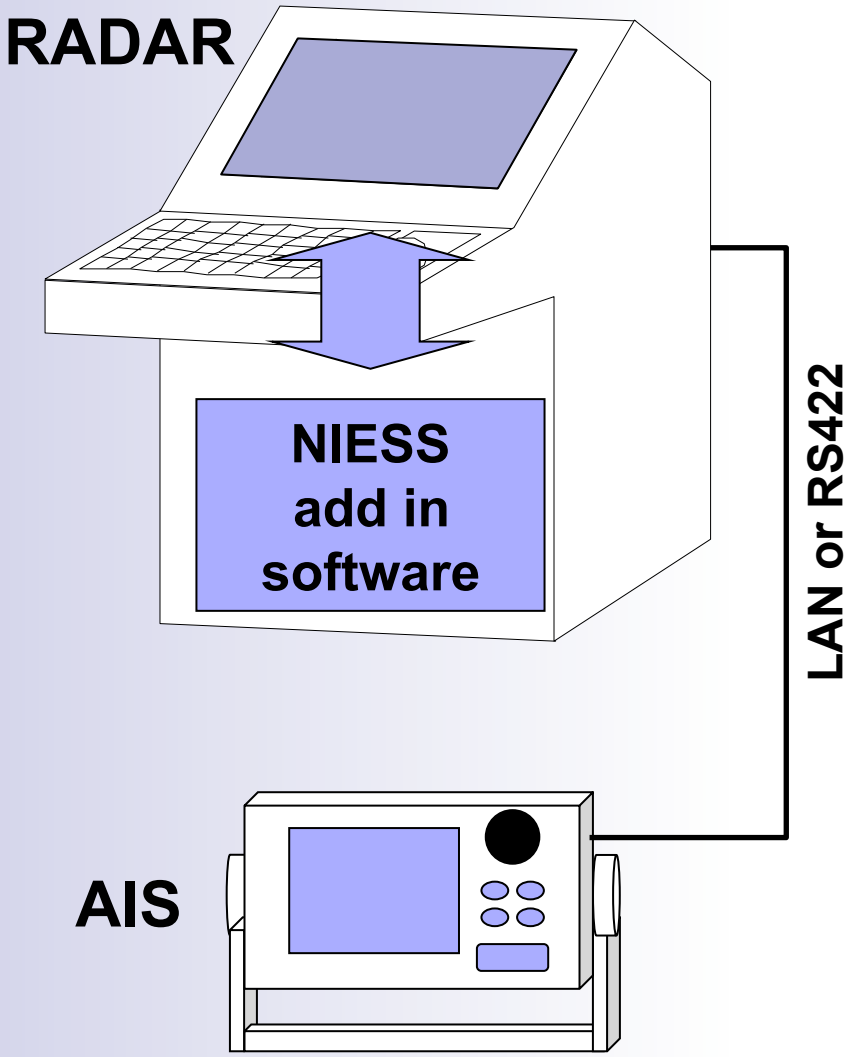
- Purpose
  - To support exchange of navigational intensions among encountered ships
  - We focus on support for collision avoidance.
    - About 90% of VHF call is for negotiating Collision Avoidance*
- Design
  - We decided that the NIESS is designed as an add-in software for RADAR.
  - It should not disturb all RADAR operation
  - It should be simple and easy operation

***From AIS: Implications for Collision Avoidance, Nick Bailey, ISIS 2006**

NIESS (Navigational intention exchange support system)



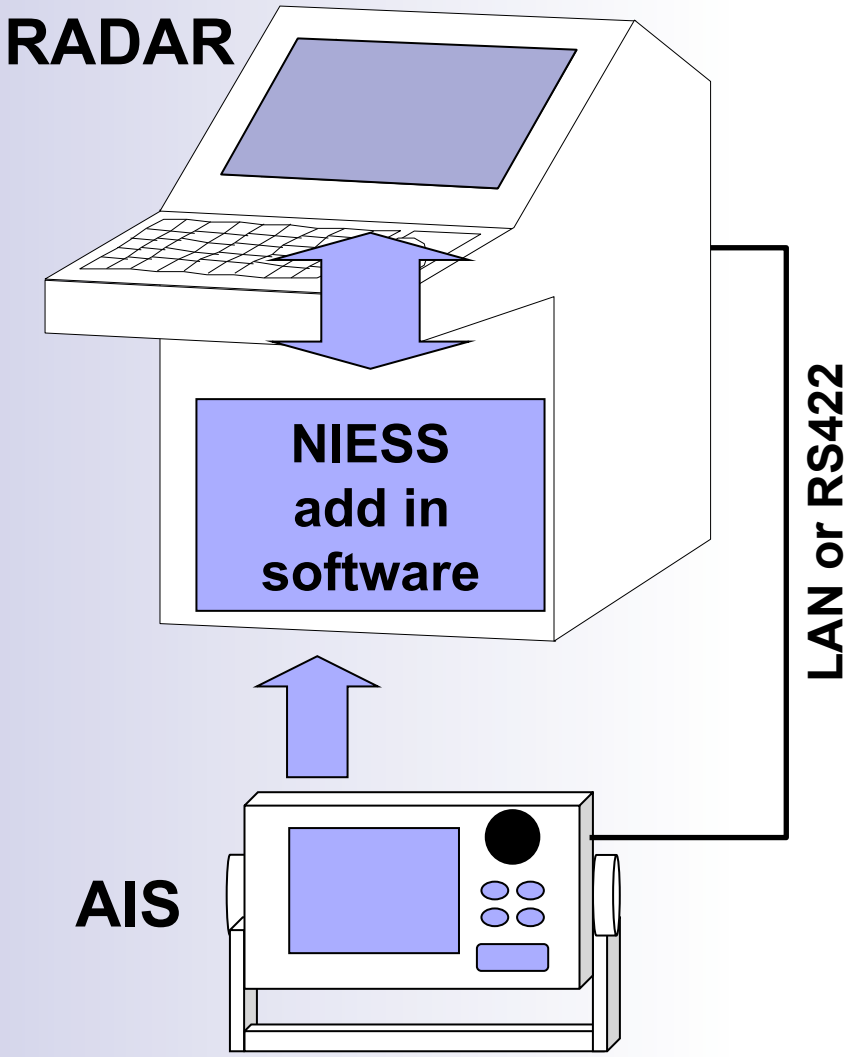
NIESS (Navigational intention exchange support system)



NIESS add in software has function for ;

1. Managing user interface for the NIESS on RADAR

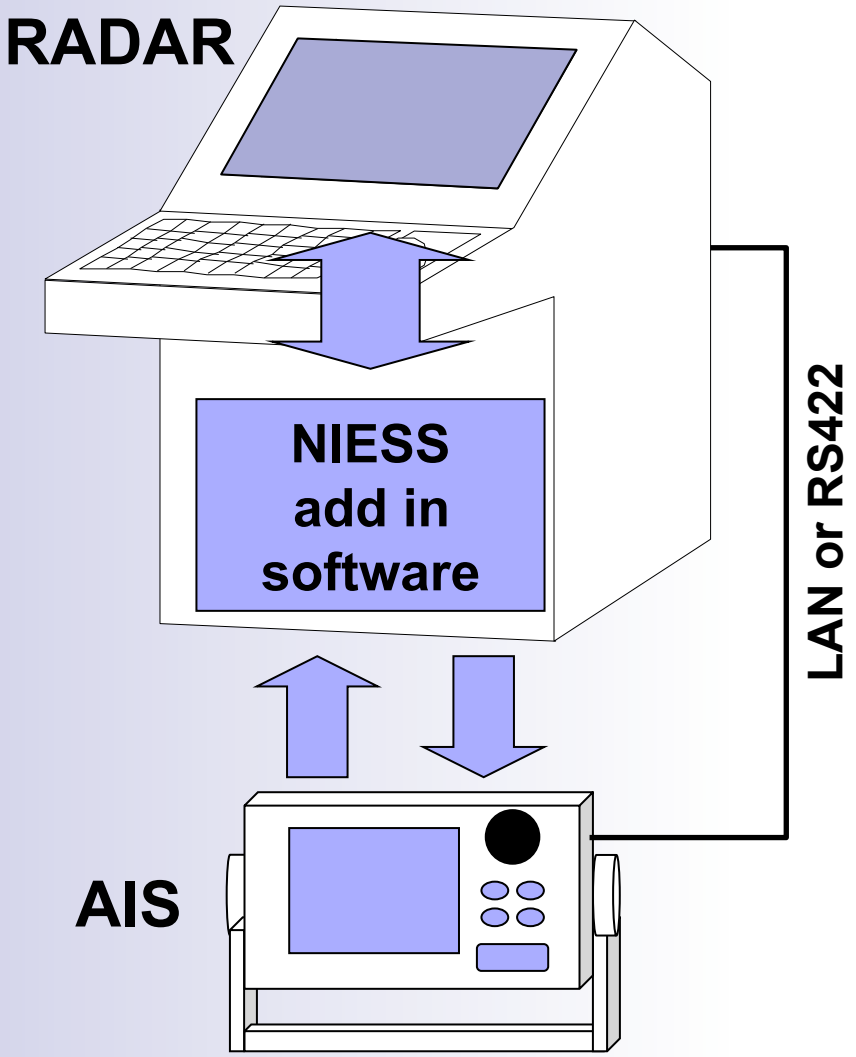
NIESS (Navigational intention exchange support system)



NIESS add in software has function for ;

1. Managing user interface for the NIESS on RADAR
2. Interpret AIS binary messages

NIESS (Navigational intention exchange support system)



NIESS add in software has function for ;

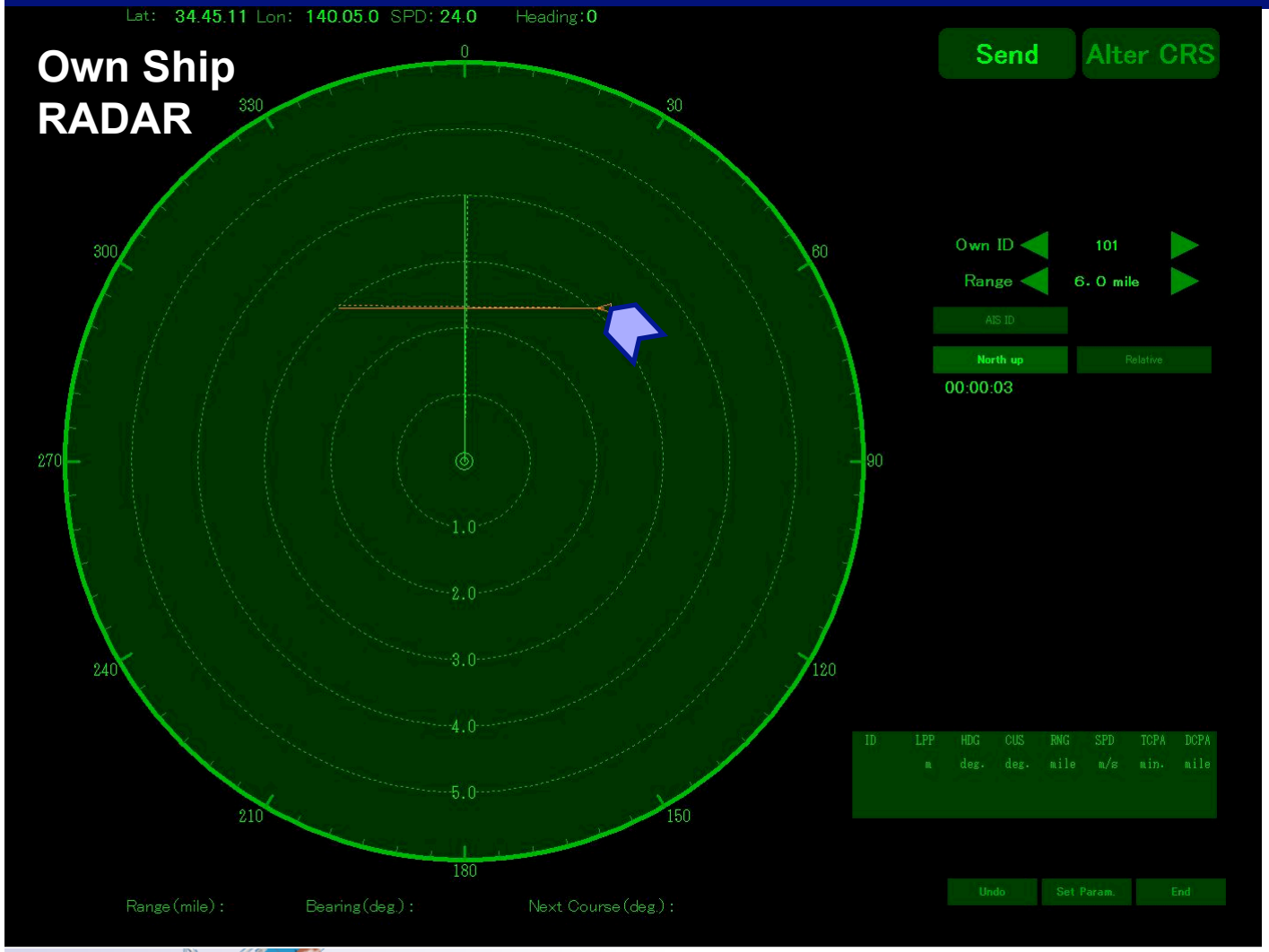
1. Managing user interface for the NIESS on RADAR
2. Interpret AIS Binary messages
3. Control the AIS to manage AIS binary message

Functions of a prototype of the NIESS

Functions for ;

1. Confirming topological relation of each ship at passing Mess. 6
2. Notifying intentional course change Mess.8
   - It broadcasts intentional course change to ships around to show that on the target RADAR display
3. Requesting VHF voice call Mess.6
   - It shows the demand on the target RADAR display as a highlighted symbol

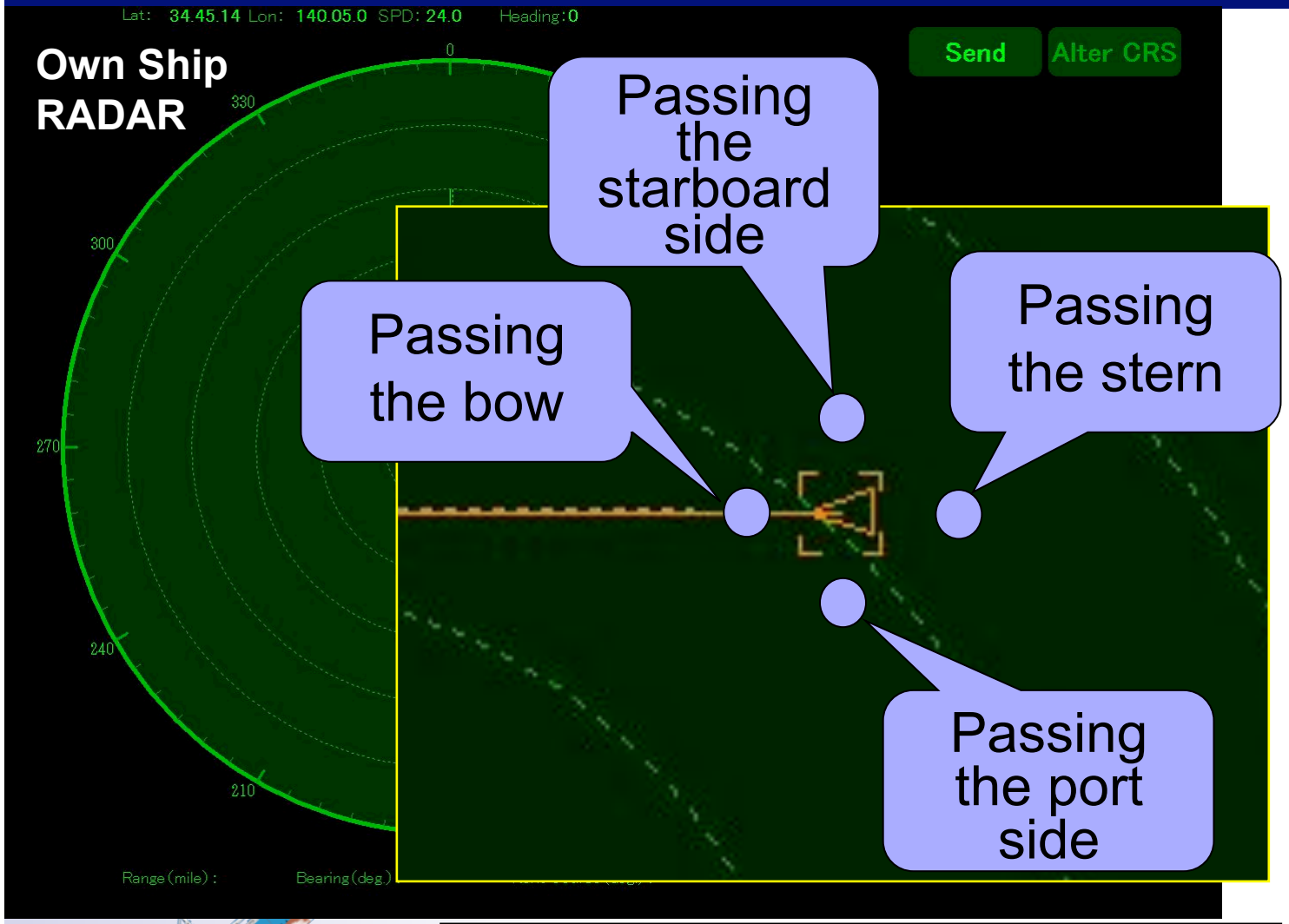
NIESS Function for confirming passing pattern



OWN SHIP

1. Select a ship to communicate by click AIS symbol

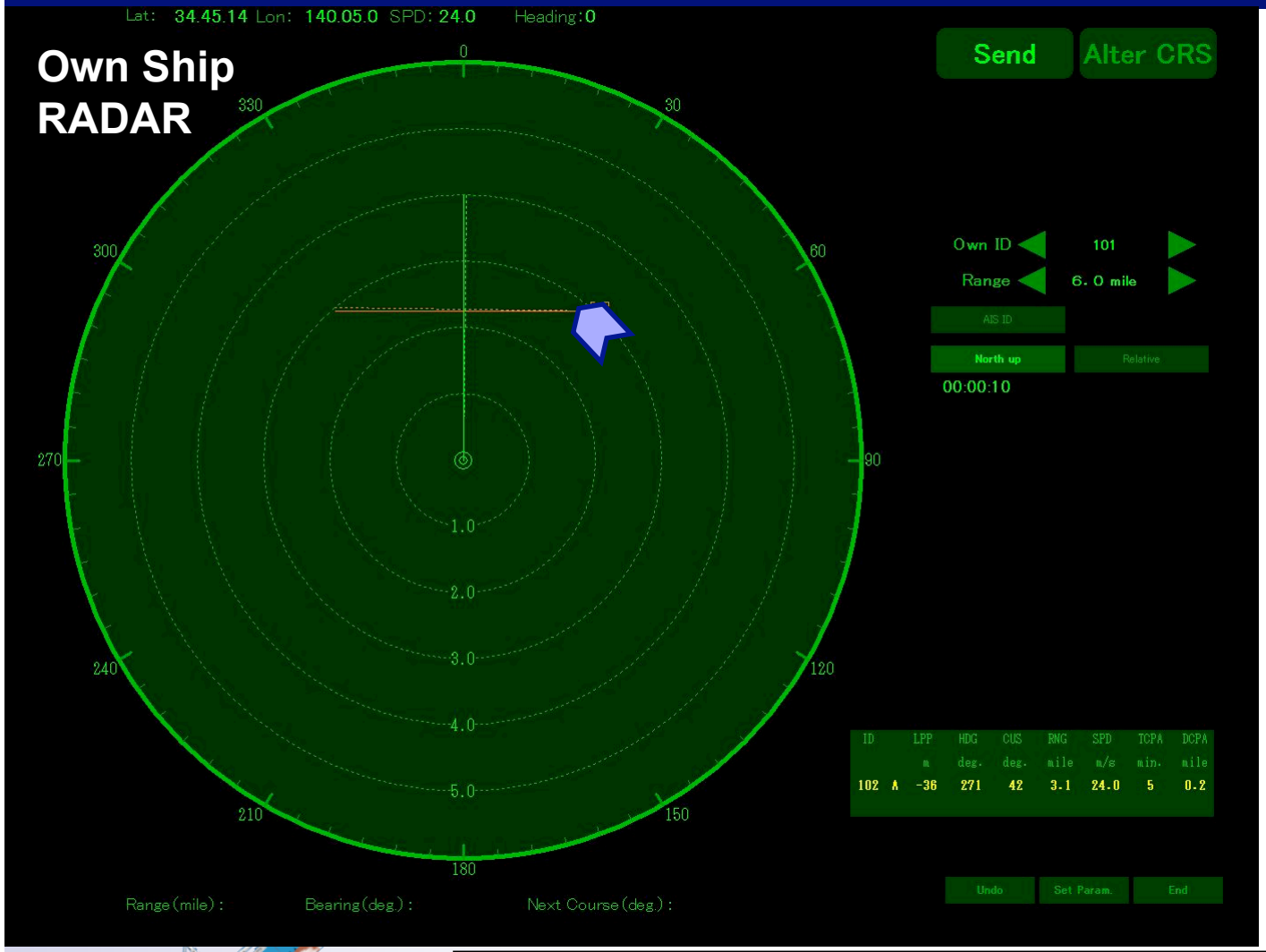
SHIP A



OWN SHIP

2. Select passing point by click AIS symbol

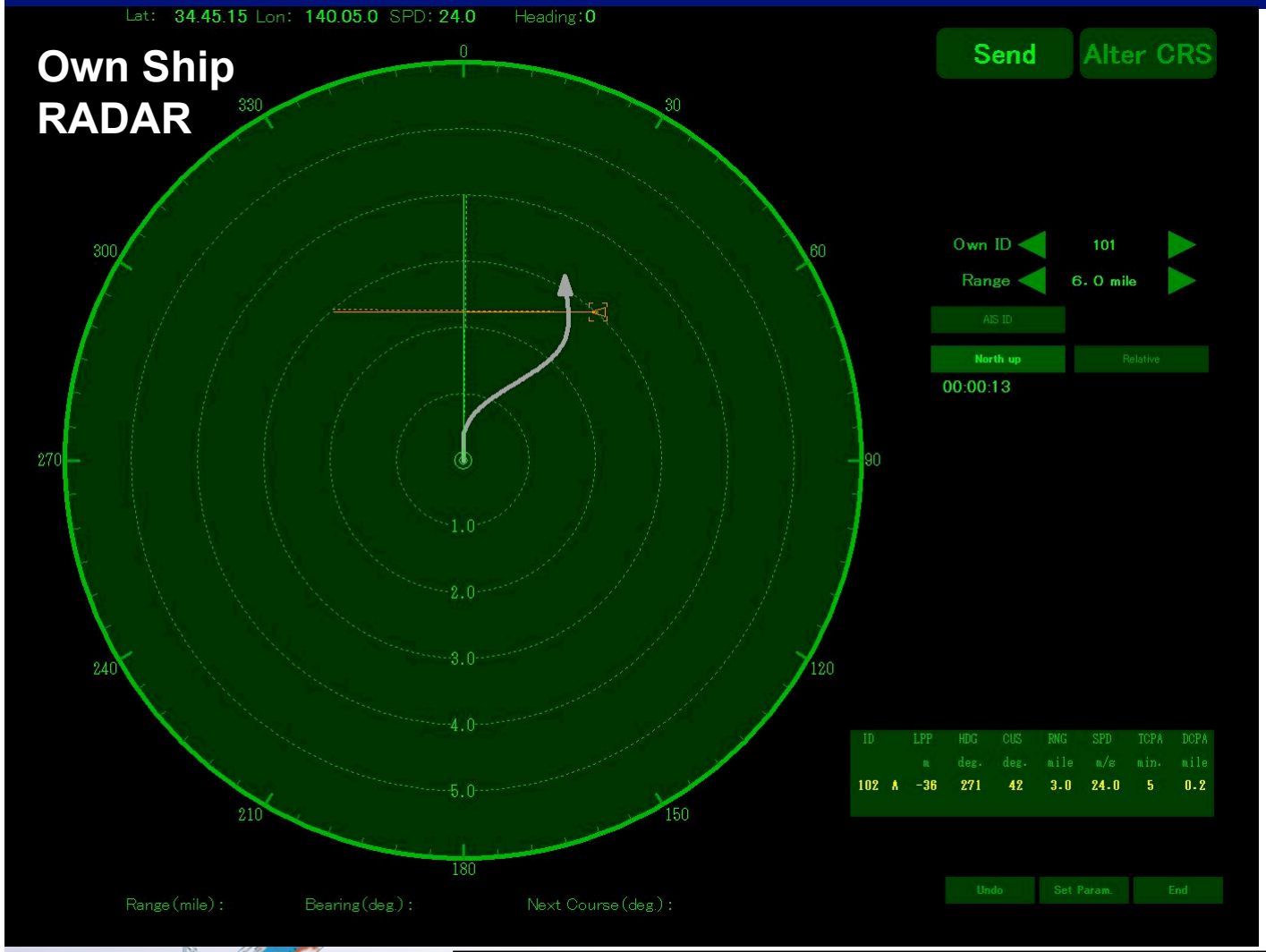
SHIP A



OWN SHIP

2. Select passing point by click AIS symbol

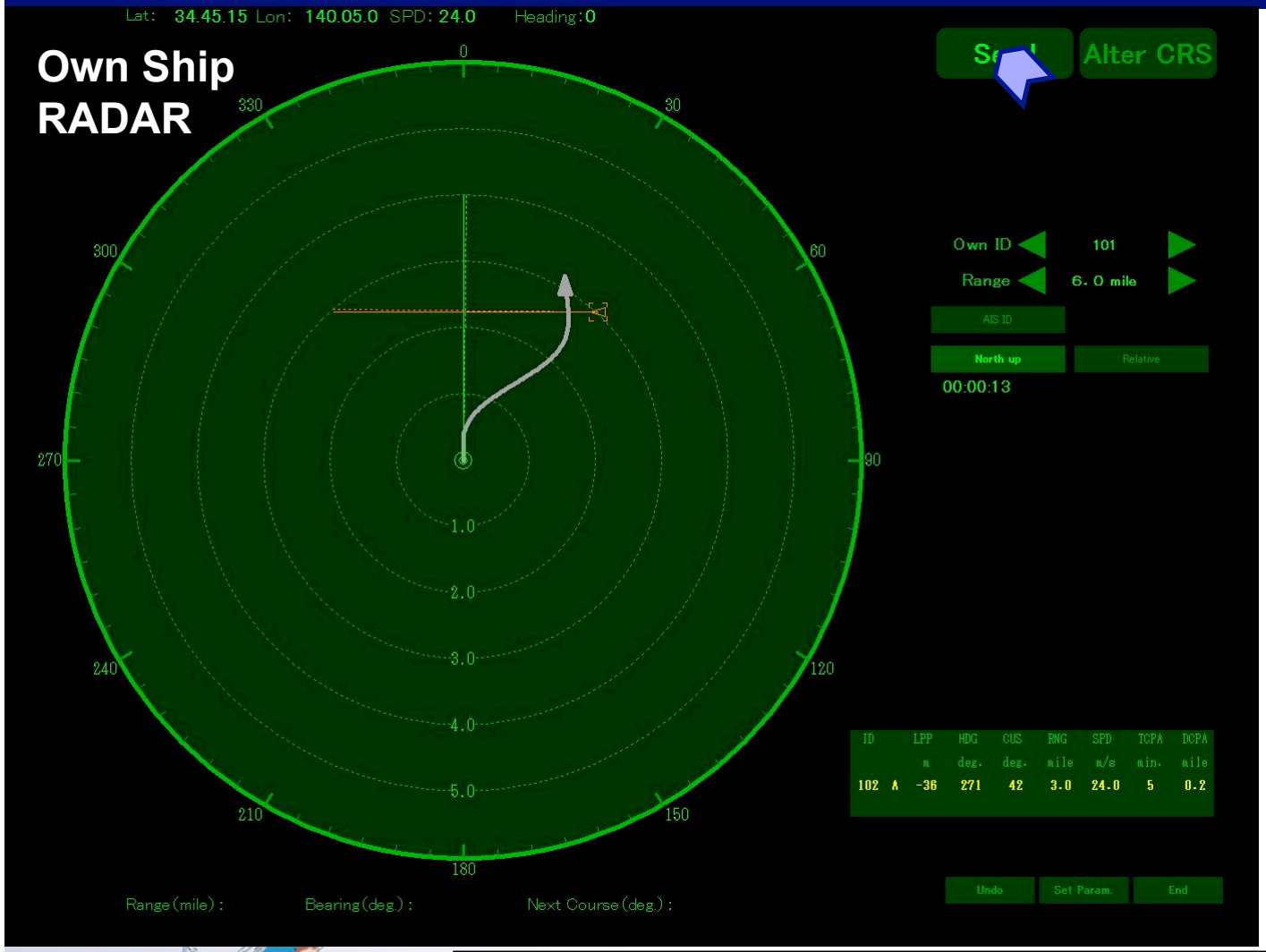
SHIP A



OWN SHIP

2. Passing pattern is displayed

SHIP A



OWN SHIP

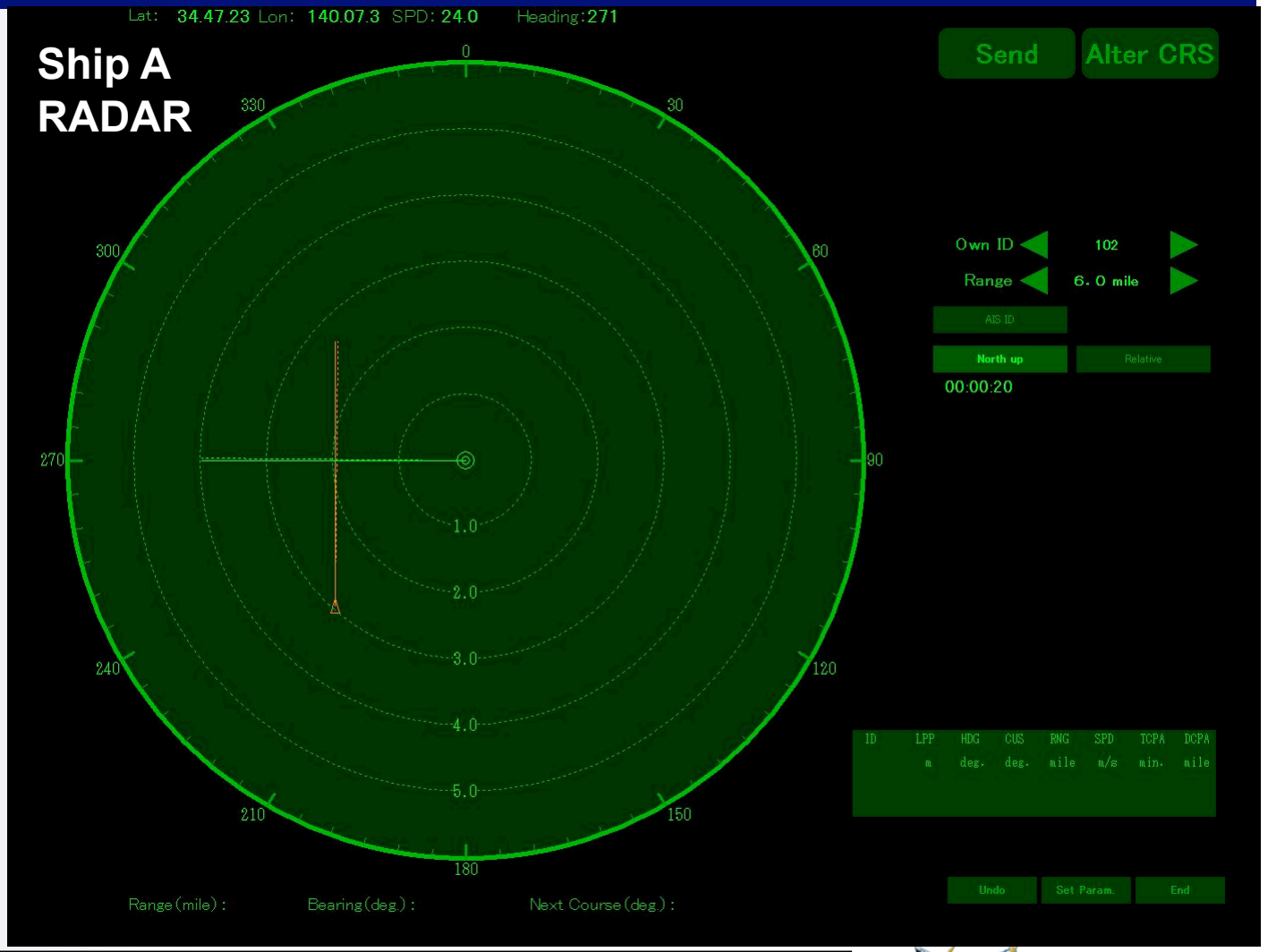
3. Send the message to the ship by click send button

SHIP A

Wants to pass by at your bow side

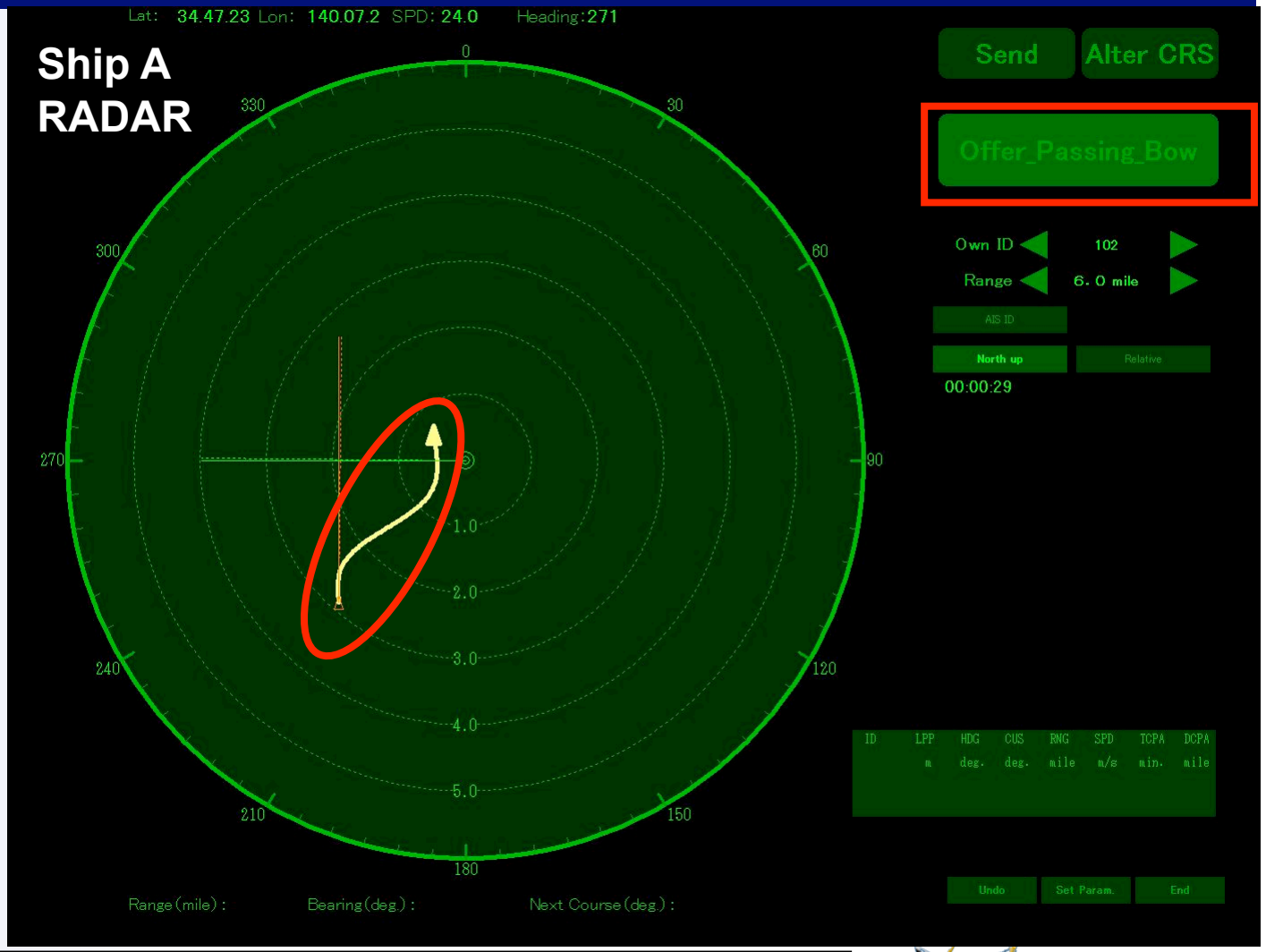
OWN SHIP

SHIP A



OWN SHIP

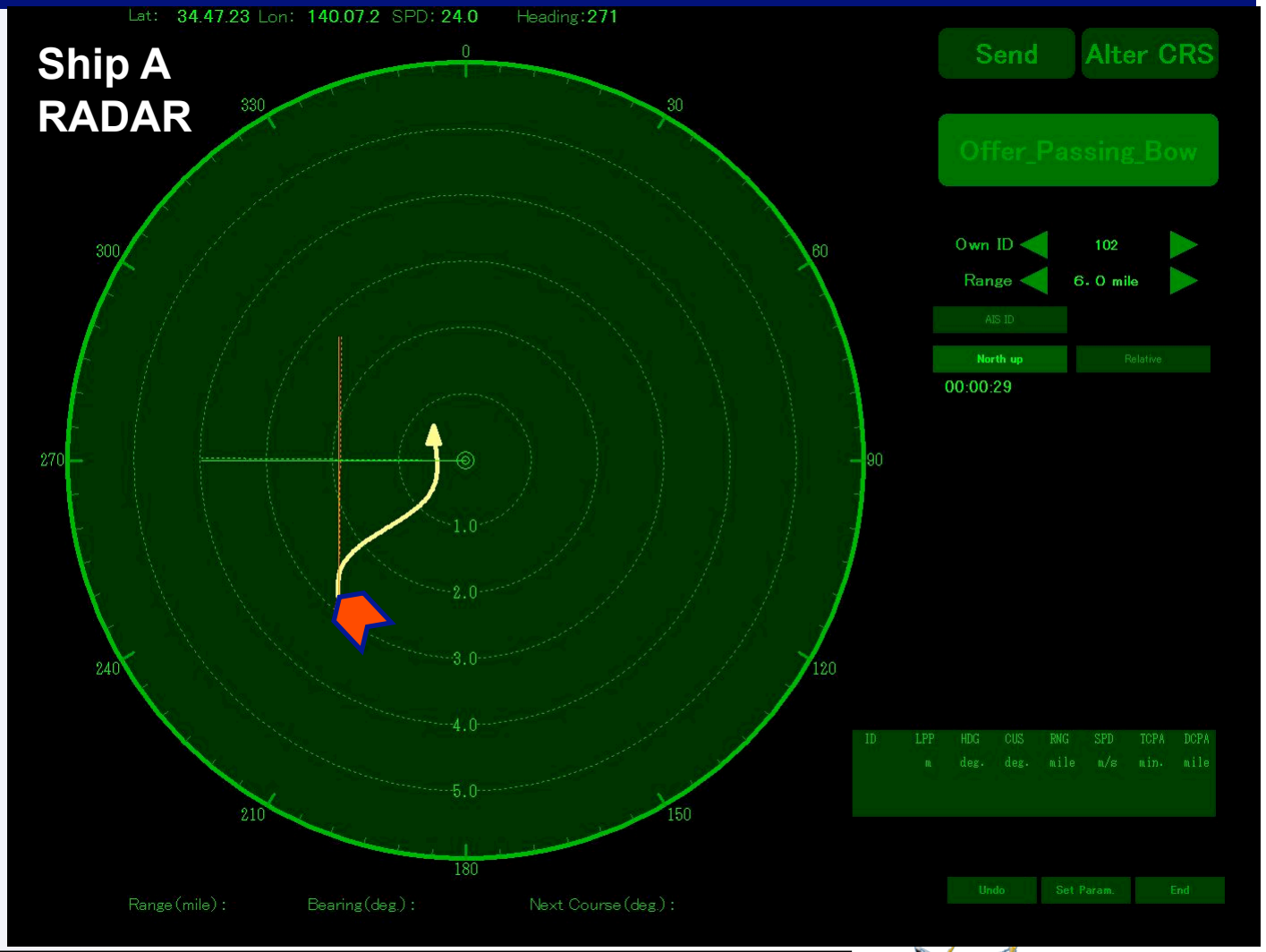
SHIP A



OWN SHIP

4. The offer of the passing pattern is displayed on the receiver's RADAR

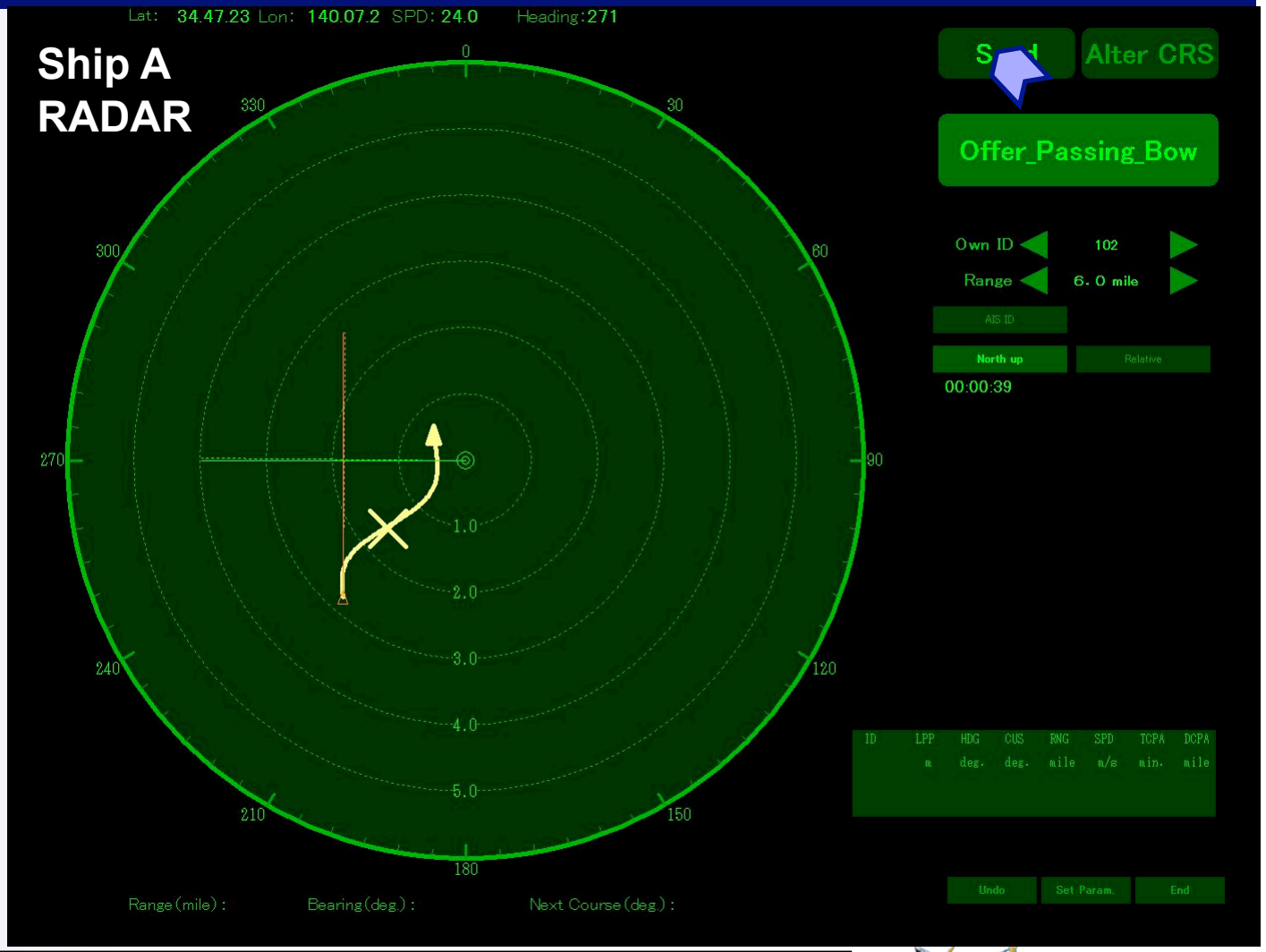
SHIP A



OWN SHIP

5. When the offer is not acceptable, right click the ship to NO.

SHIP A



OWN SHIP

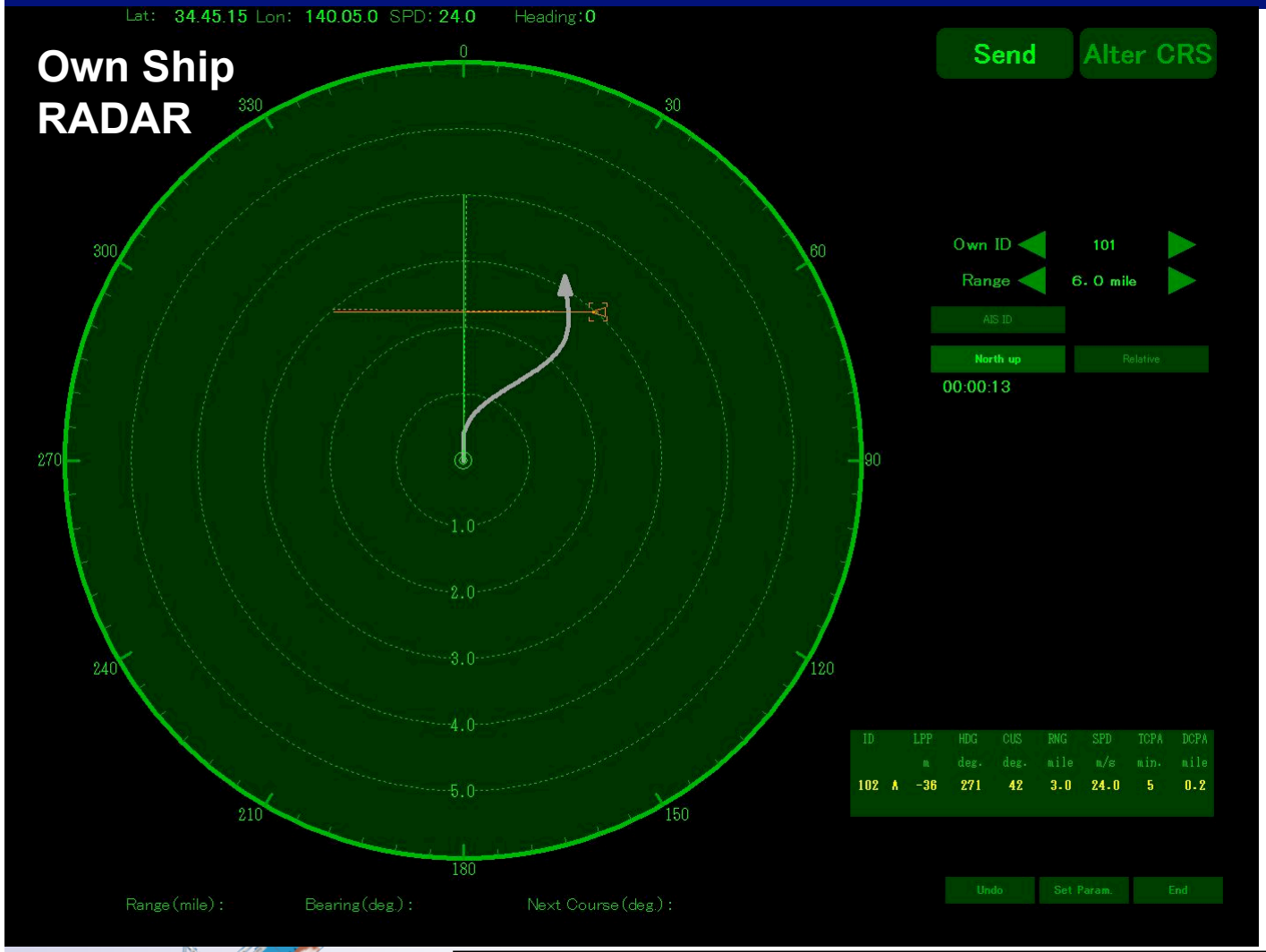
6. Send the message to the ship by click send button

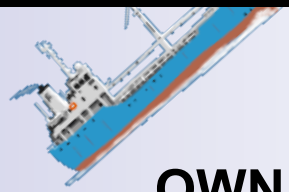
SHIP A

I don’t accept your offer

OWN SHIP

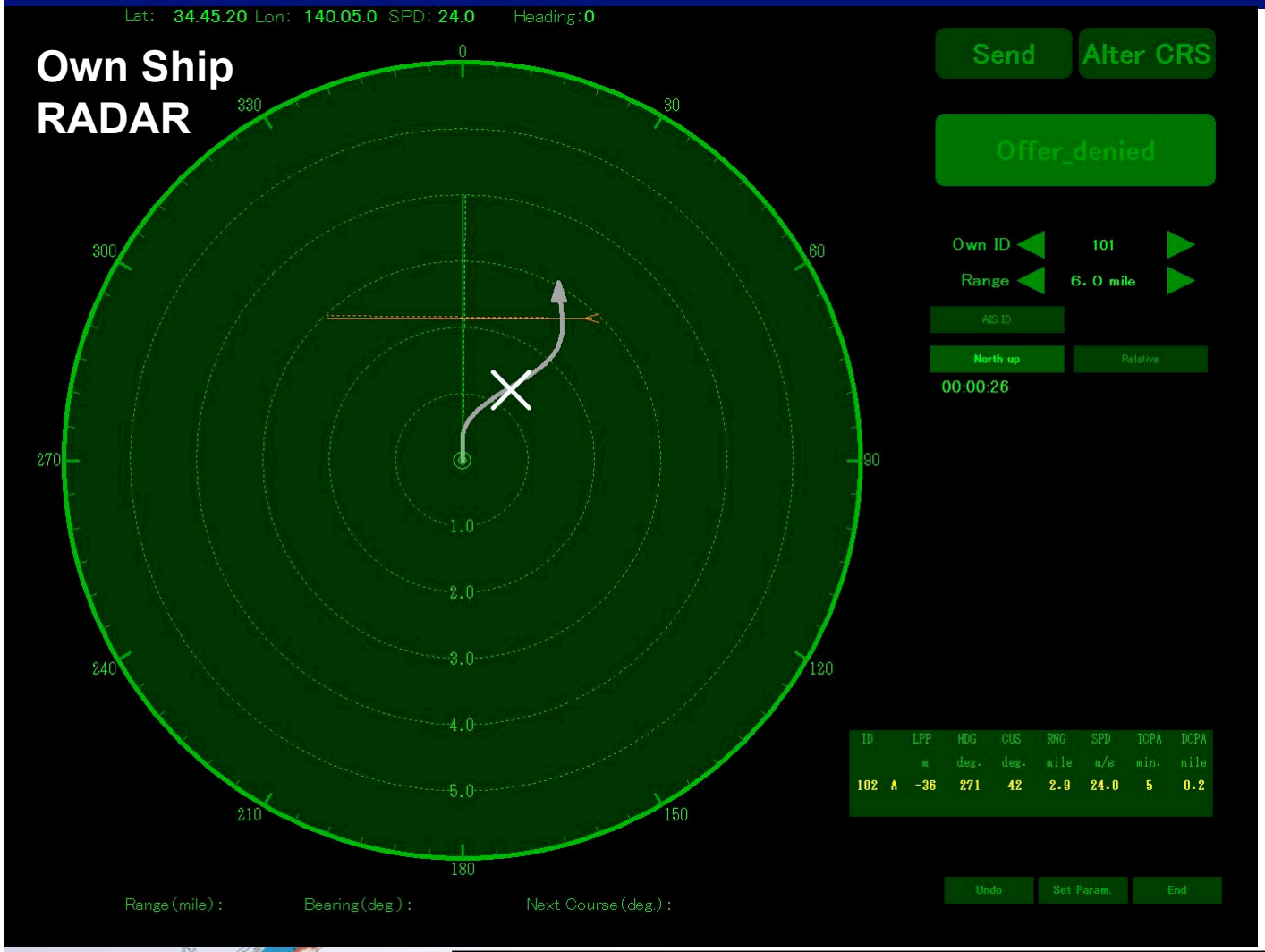
SHIP A





OWN SHIP

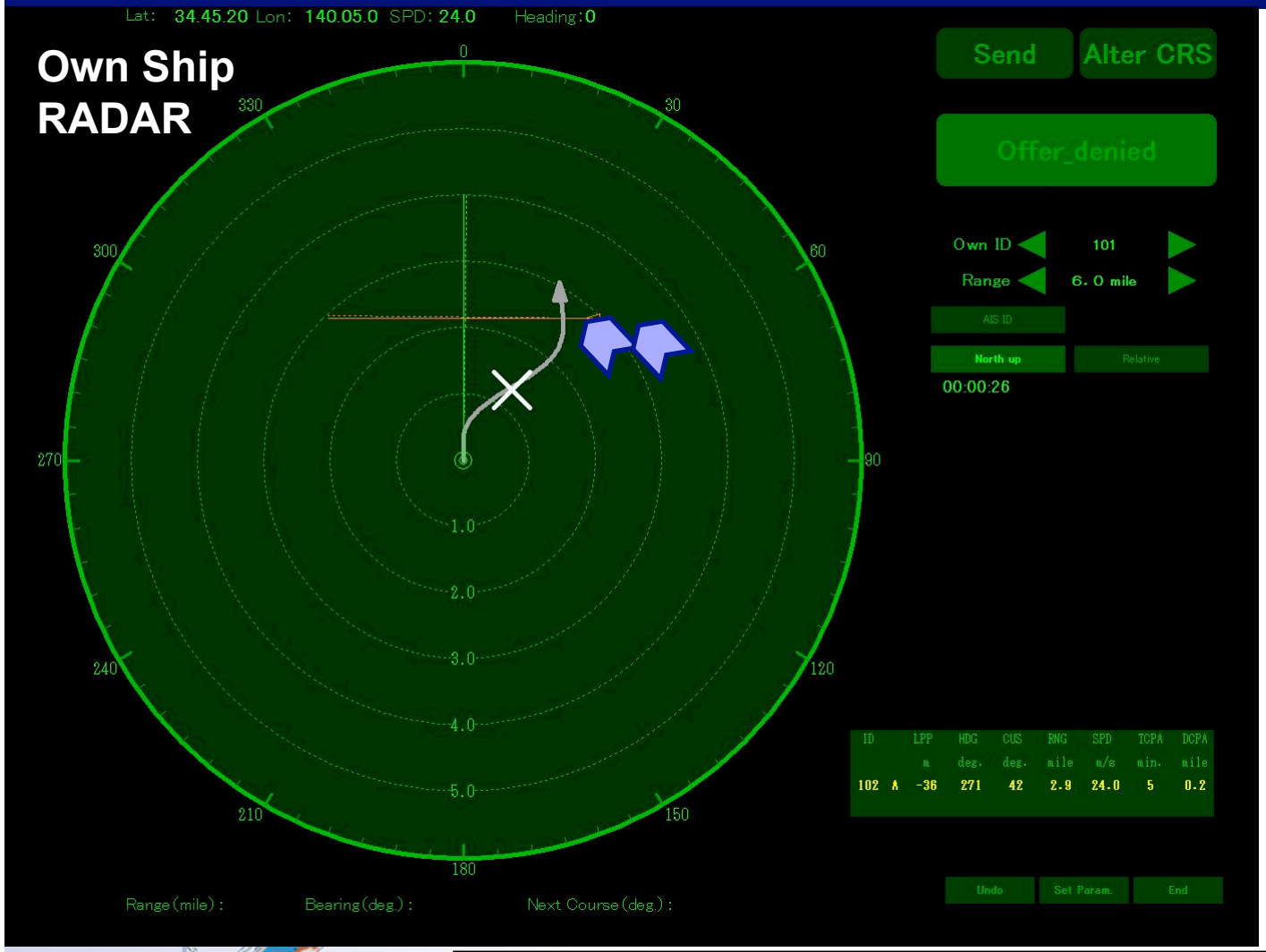
SHIP A

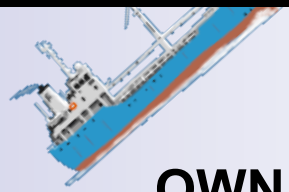


OWN SHIP

7. The response of offer is displayed on the RADAR

SHIP A

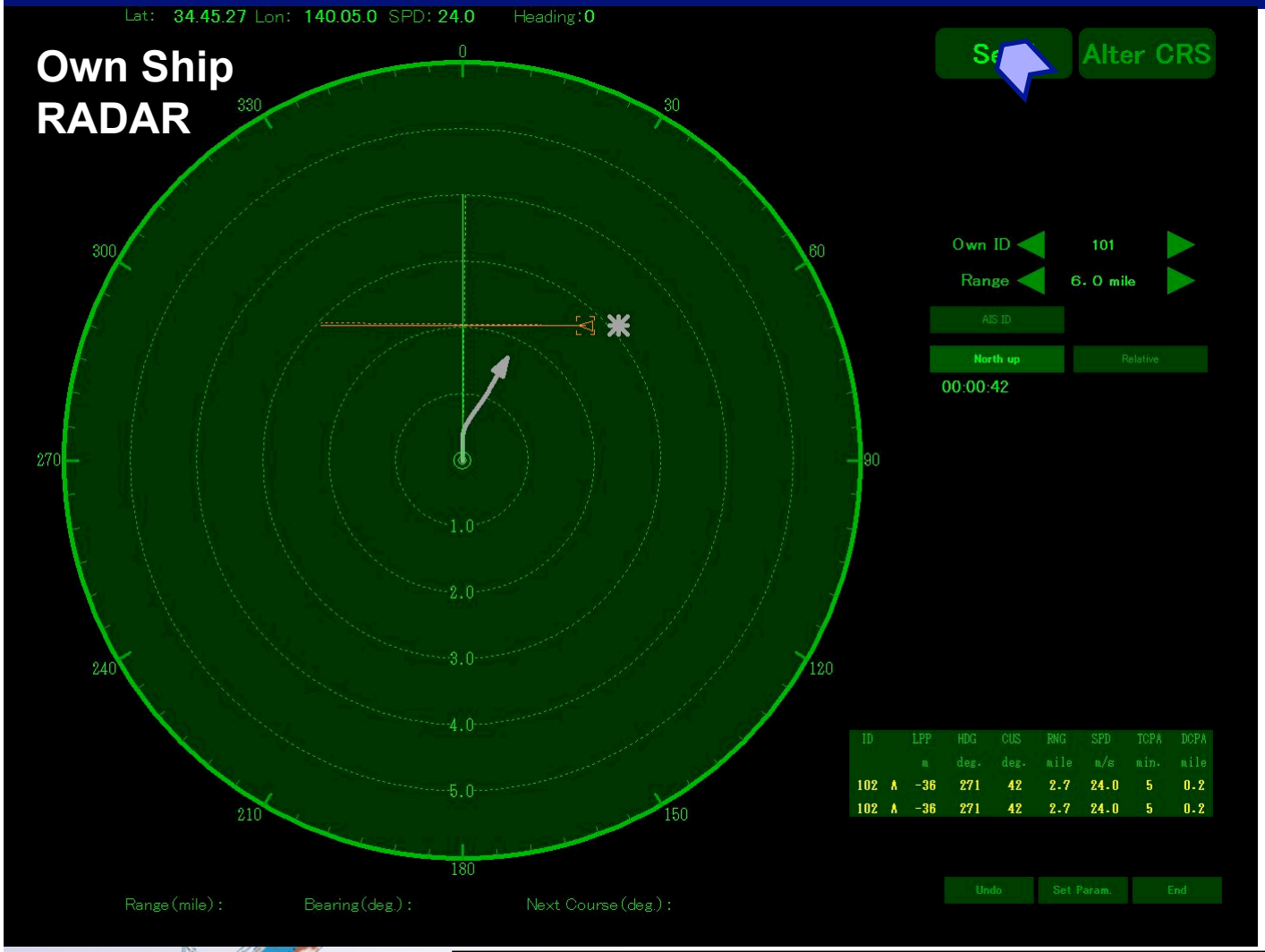




OWN SHIP

8. Select the ship and passing point again

SHIP A



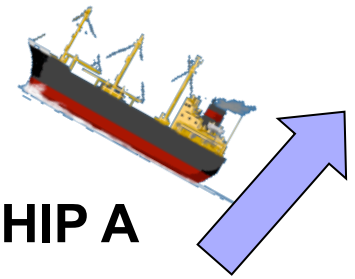
OWN SHIP

9. Send the message to the ship by click send button

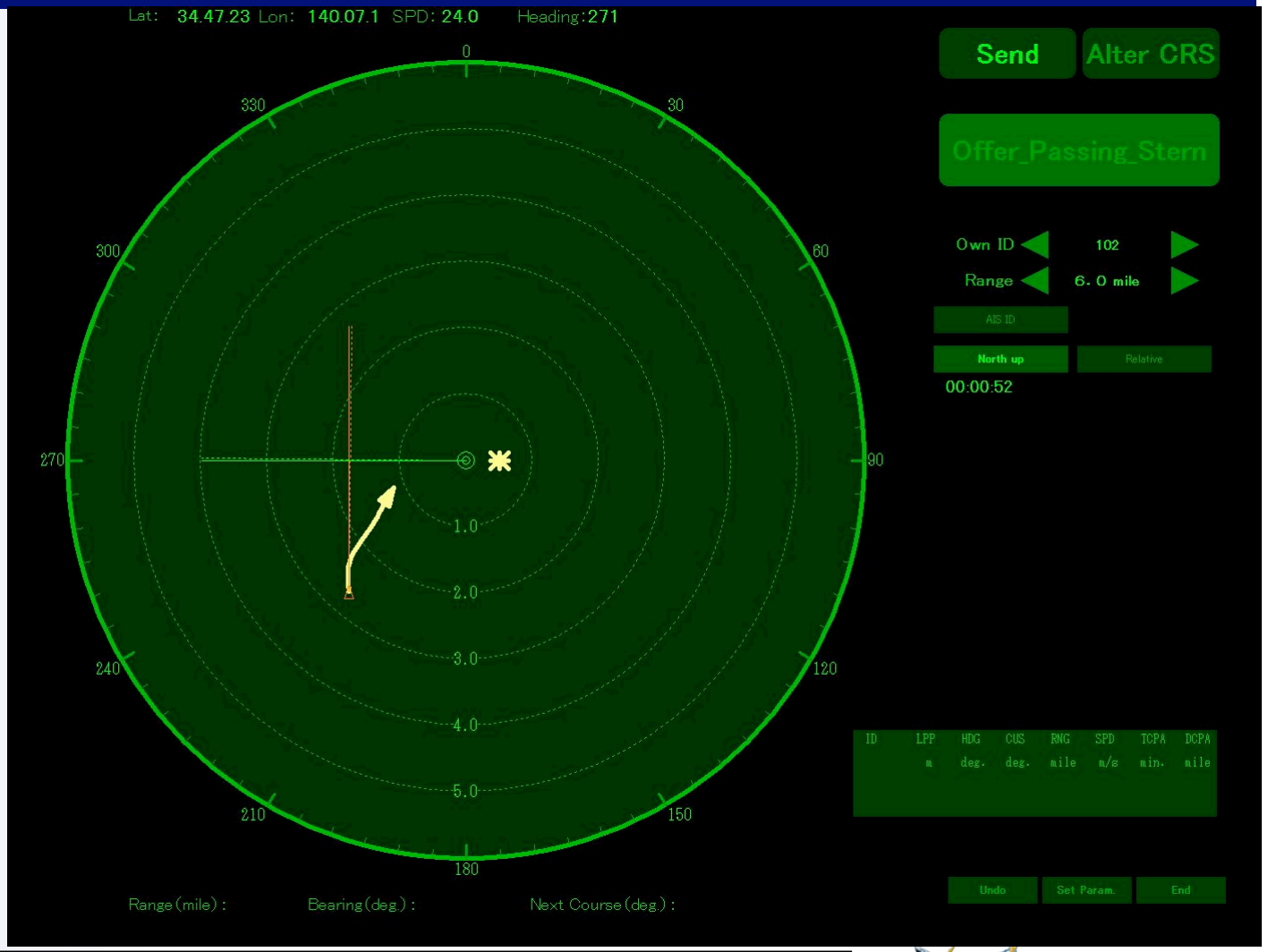
SHIP A

Wants to pass by at your stern side

OWN SHIP

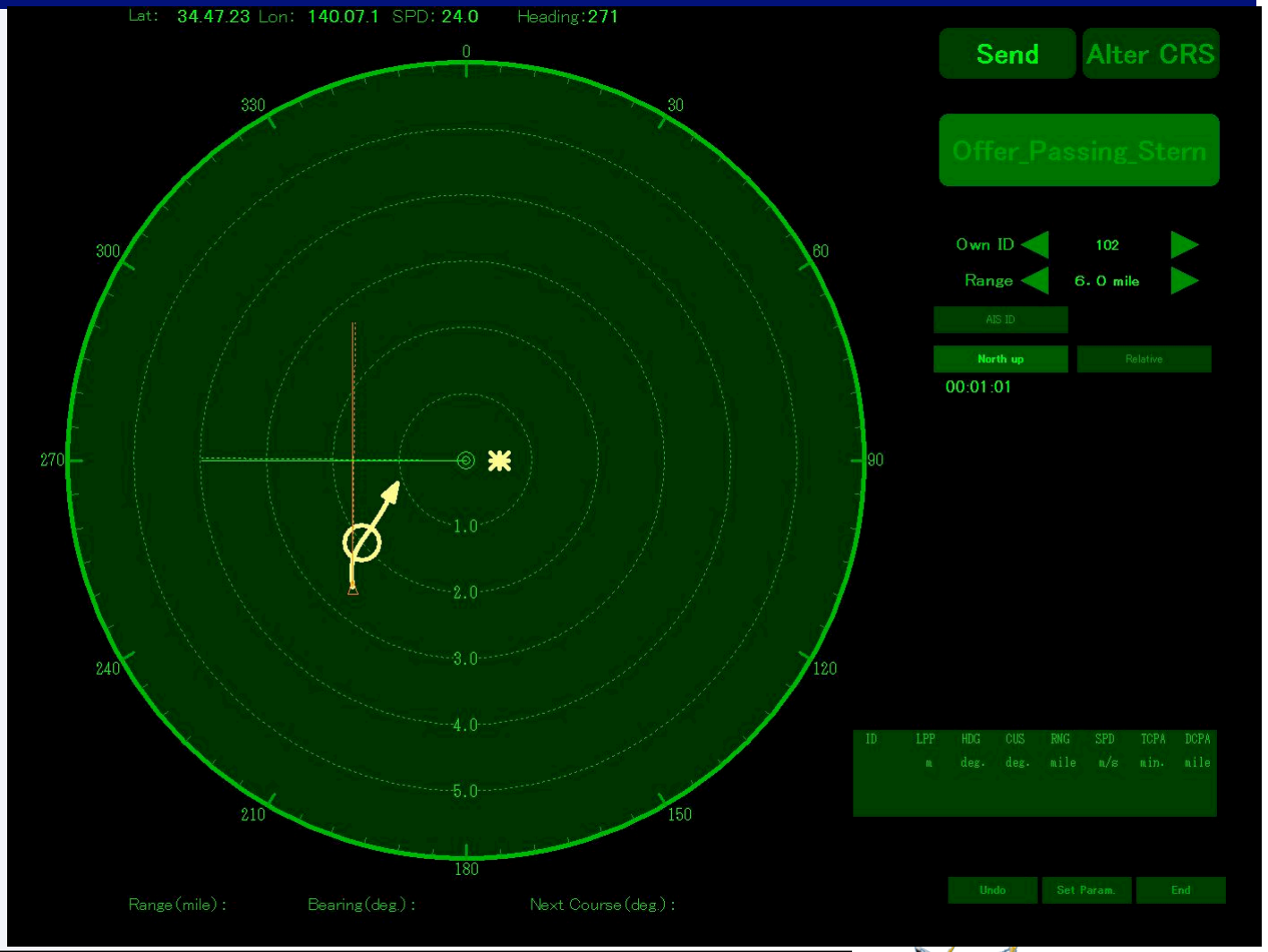


SHIP A



OWN SHIP

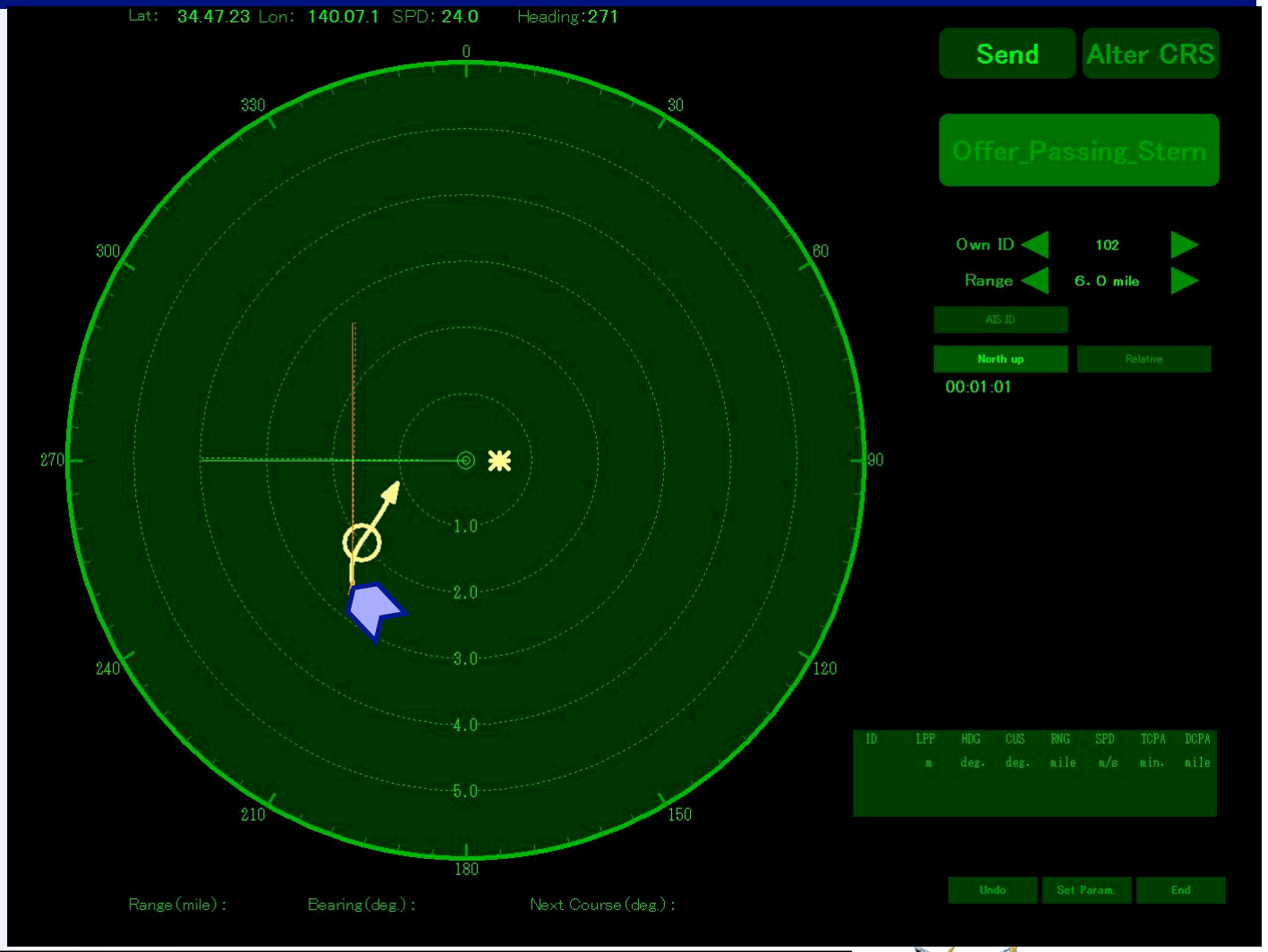
SHIP A



OWN SHIP

10. The offer of the passing pattern is displayed again on the receiver's RADAR

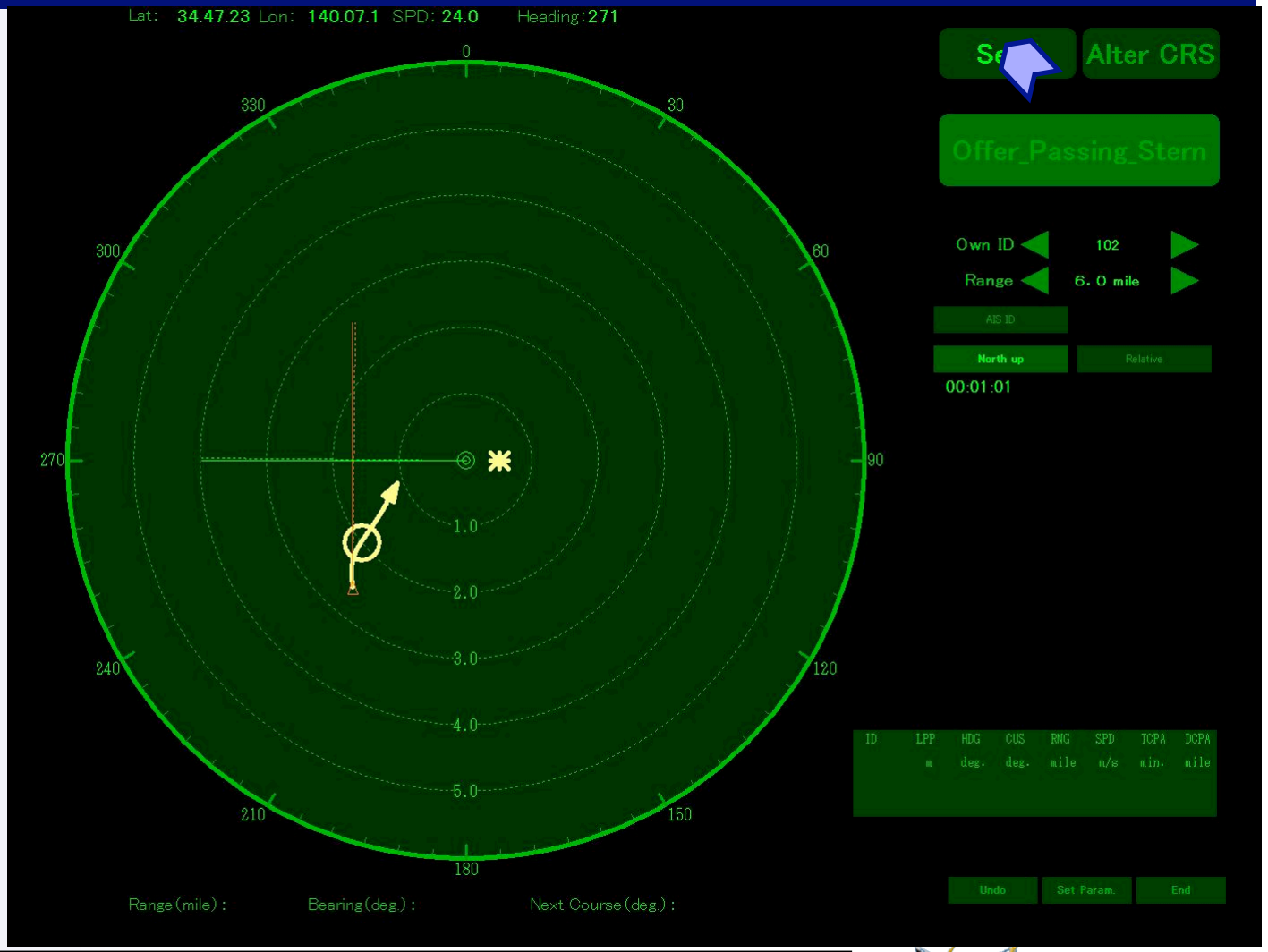
SHIP A



OWN SHIP

11. When the offer is acceptable, click the sender ship to YES.

SHIP A



OWN SHIP

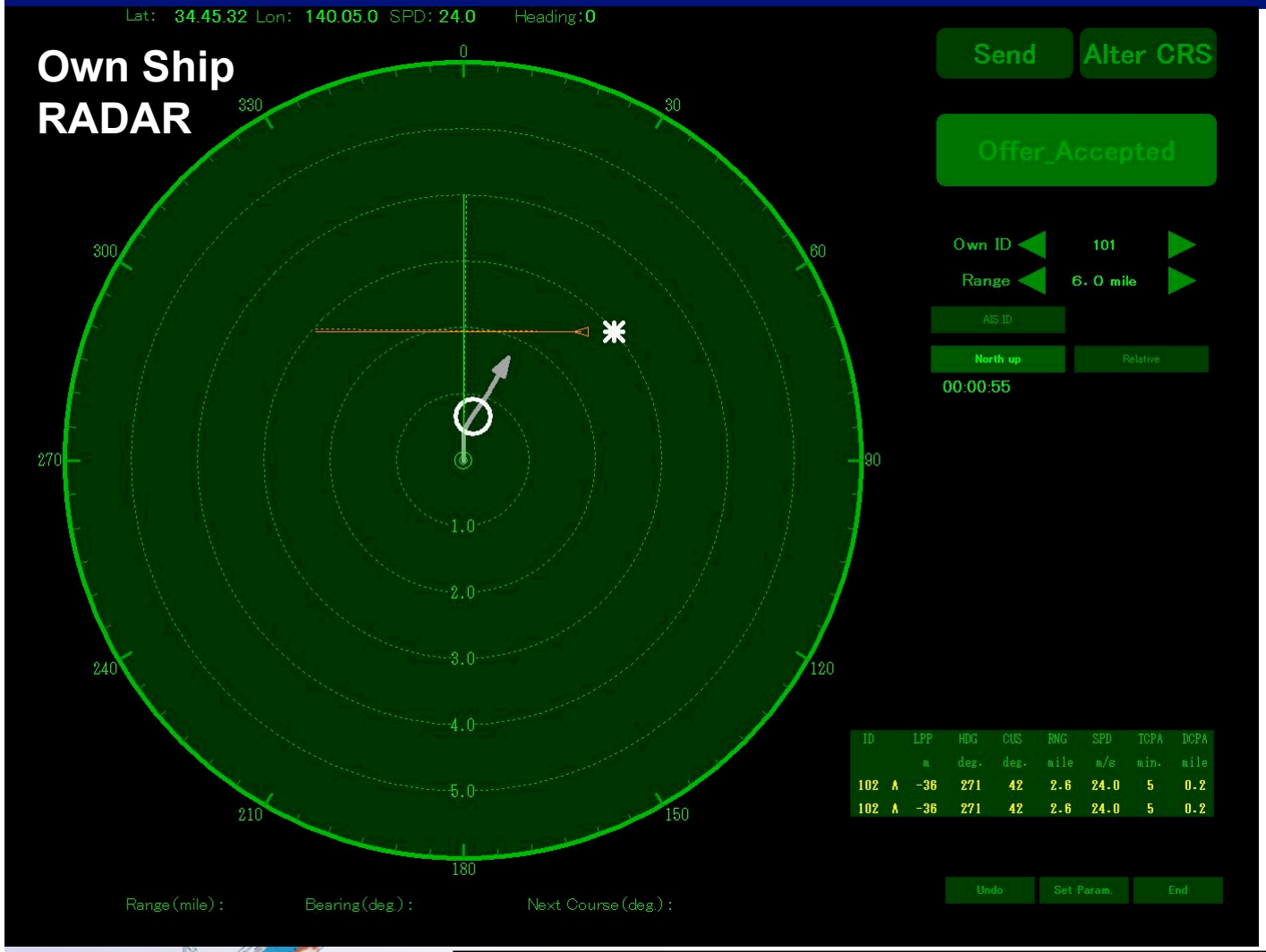
12. Send the message to the ship by click send button

SHIP A

I accept
your offer

OWN SHIP

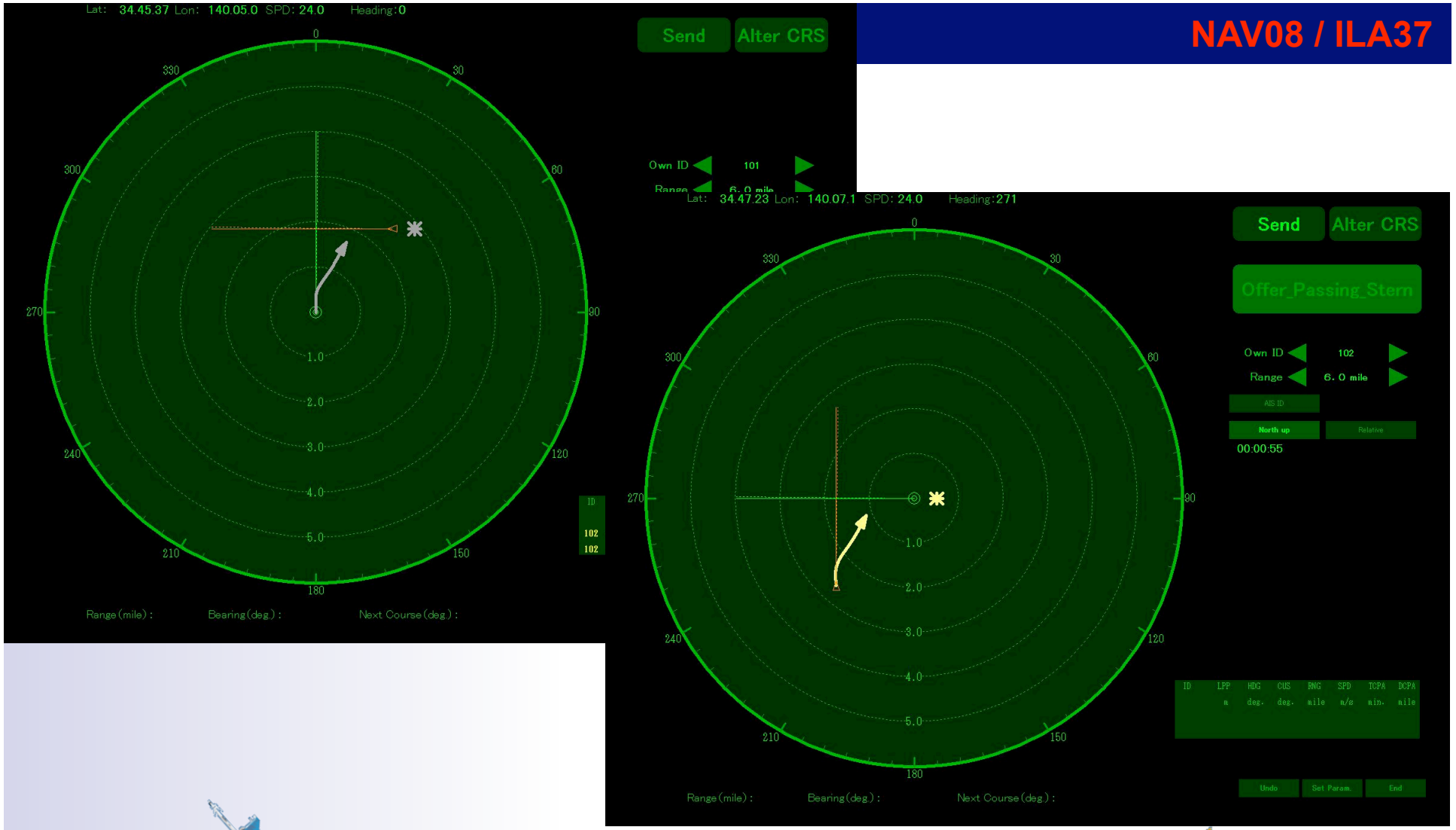
SHIP A



OWN SHIP

13. The response of offer is displayed on the RADAR says YES

SHIP A



OWN SHIP

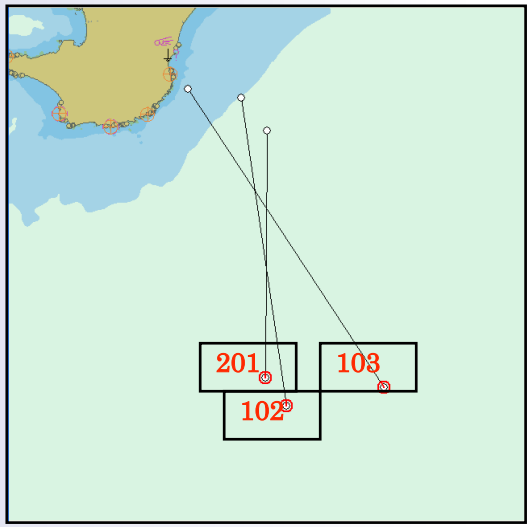
The confirmed passing pattern is displayed only when the cursor is on the target.

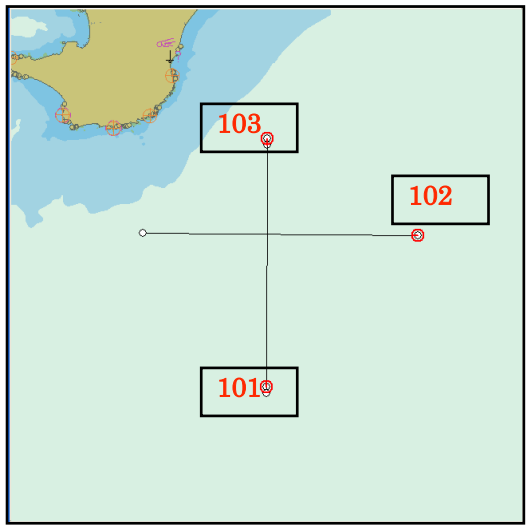
SHIP A

Simulator Experiment on the NIESS

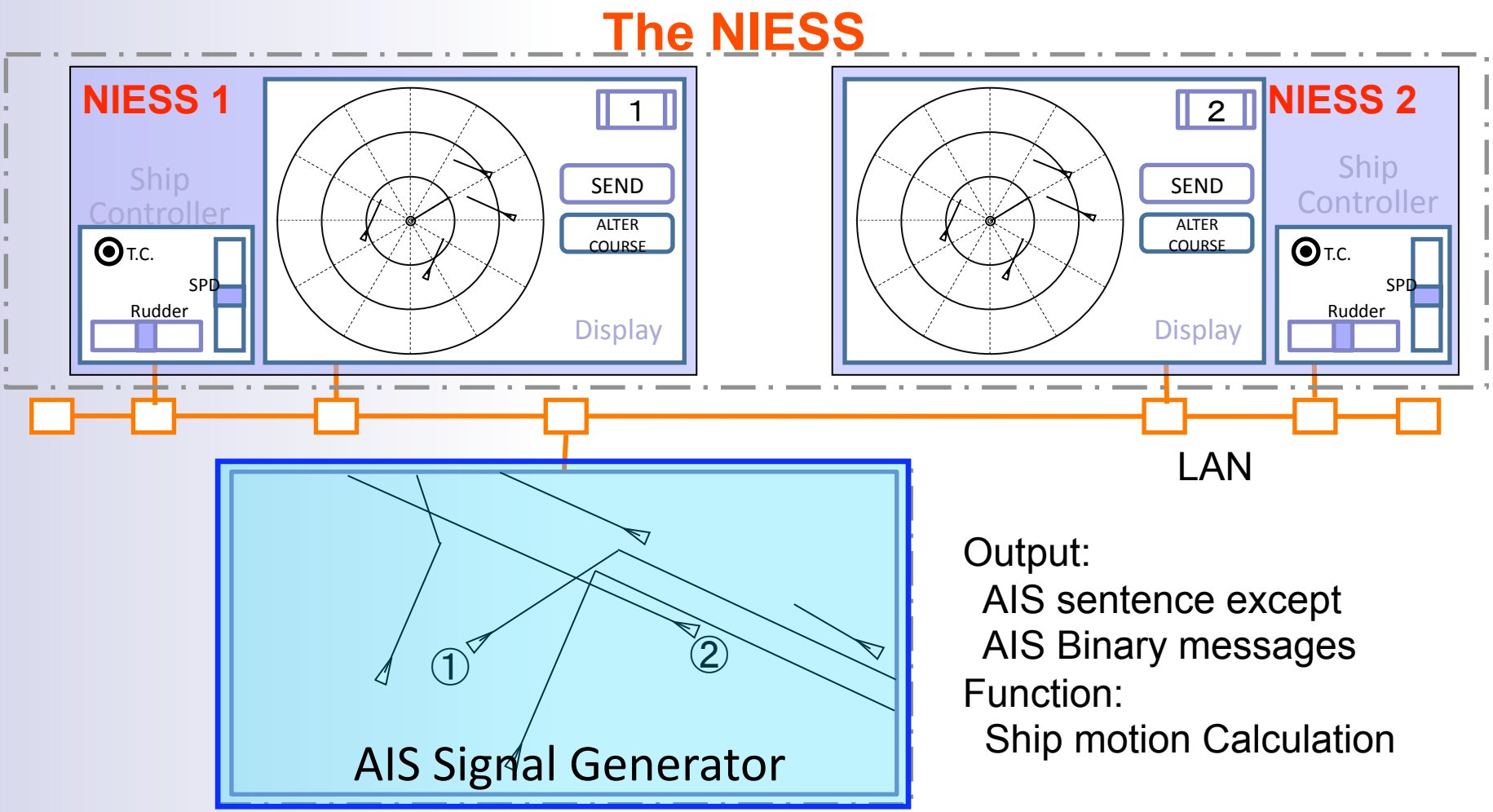
Outline of the experiment

- Scenario
  - 14 scenarios which includes three ship. These are relatively difficult for collision avoidance
- Subject
  - 2 licensed persons





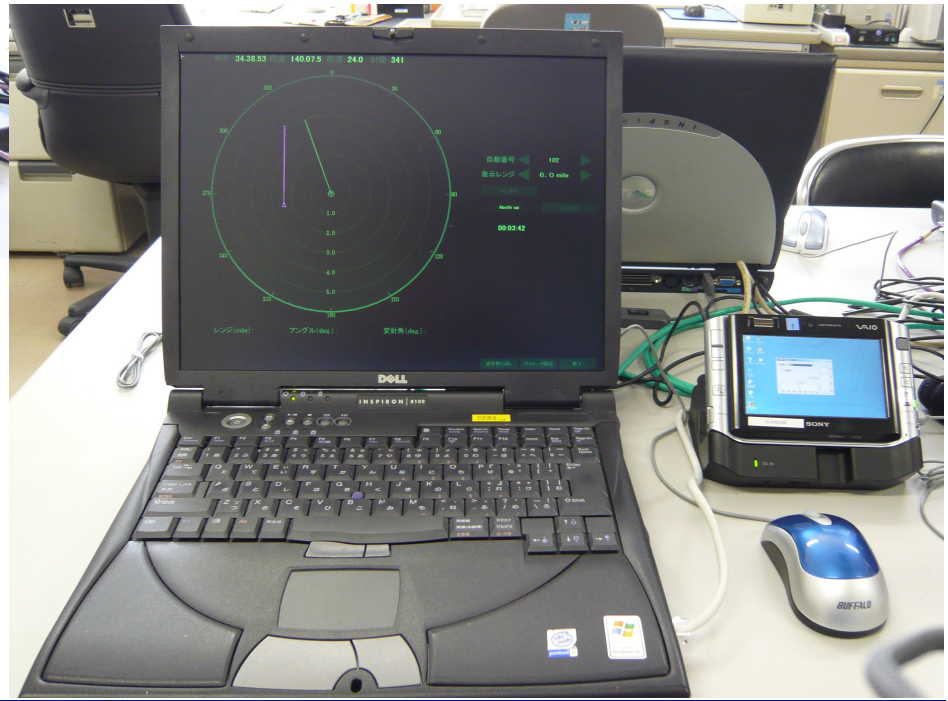
Simulator Experiment on the NIESS



Output:
AIS sentence except
AIS Binary messages
Function:
Ship motion Calculation

Simulator Experiment on the NIESS

Simulator for the NIESS



Simulator Experiment on the NIESS

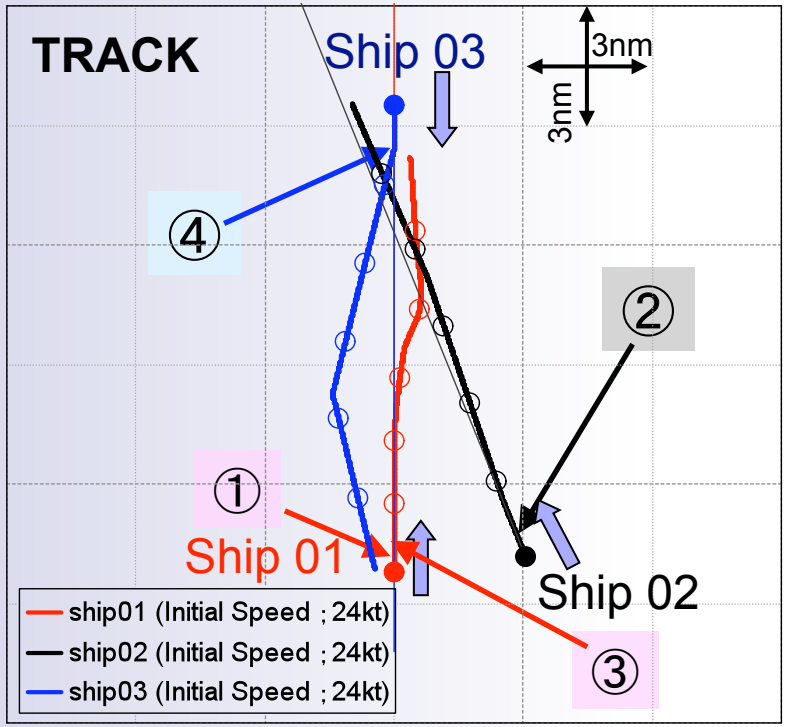
Steps of the experiments

1. Each subject is assigned a ship to operate.
2. Start the simulation.
    1. Subjects operate their ships with one's ship controller.
    2. If necessary, the subject communicates with demanded ships using the NIESS.
3. When all collision situations are cleared, end the simulation
4. Then get comments to the NIESS and results

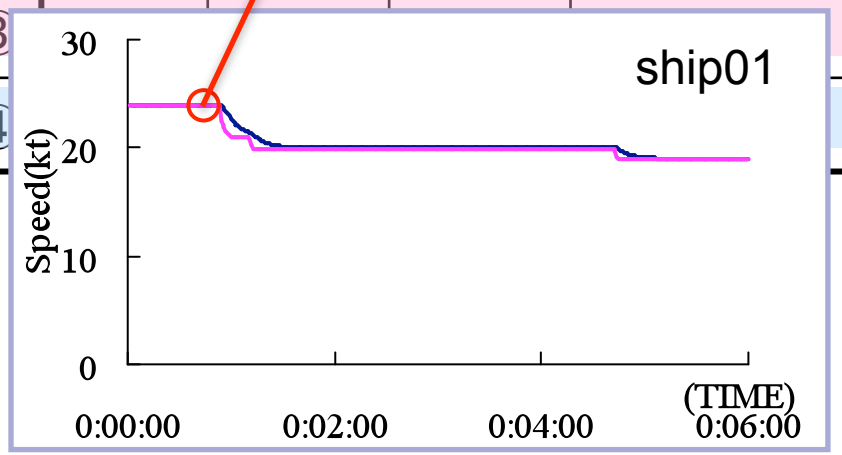
The time required to one experiment is about 40 minutes.

Simulator Experiment on the NIESS

Sample Result



	Time	Source	Target	Content
①	00:31	ship01	ship02	Pass astern
②	00:45	ship02	ship01	Confirmed
③				
④				



Result

- No serious problem for the use of the NIESS
- Merits found from the feasibility study
  - Linguistic barriers is reduced.
  - False recognition due to the use of voice is expected to be reduced by using coded data and graphical display.
  - Display of the confirmed navigational intension helps decision making for collision avoidance.

Result

- Points to improve
  - Function for cancelling or modifying exchanged information should be added.
  - Display method for expressing passing side, should be improved.
  - Trackball operations should be matched to PC manner to make it easy to use and understand.

Conclusions

- The Navigational Intention Exchange Support System (NIESS) is proposed.
- A feasibility study on the NIESS was carried out based on a series of simulator experiments.
  - There is no serious problem for the use of the NIESS
  - Effectiveness of the expected merits of the NIESS are confirmed
  - Some points to improve and additional functions are found.

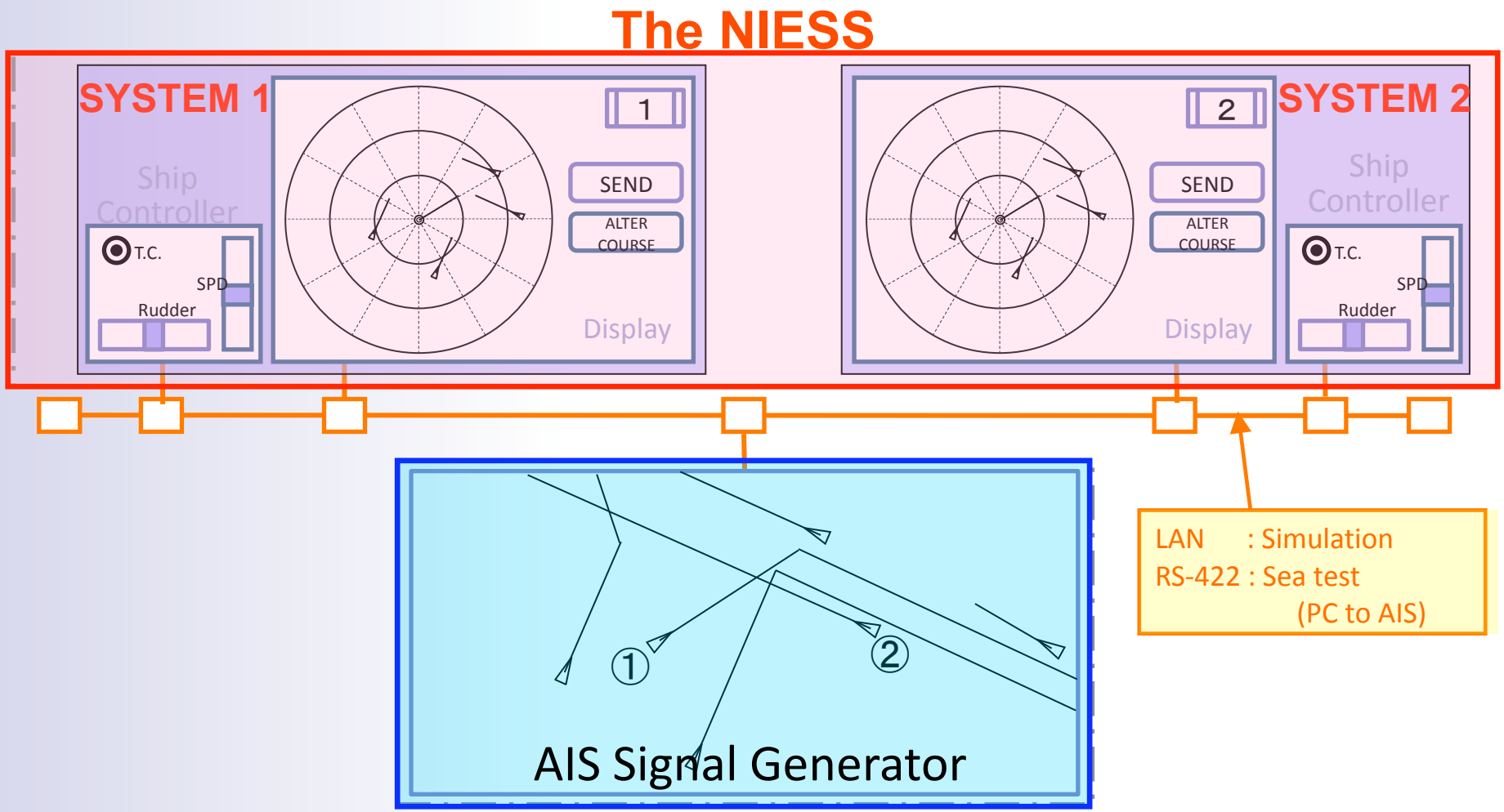
Future Plan

- A series of field tests, a series of usability tests will be carried out in 2009
- Development of the NIESS will be continue and required additional functions will be introduce to the NIESS in 2009.
- We will work international maritime organizations, such as IMO, to get international agreement to use AIS binary message for the NIESS.

Thank you

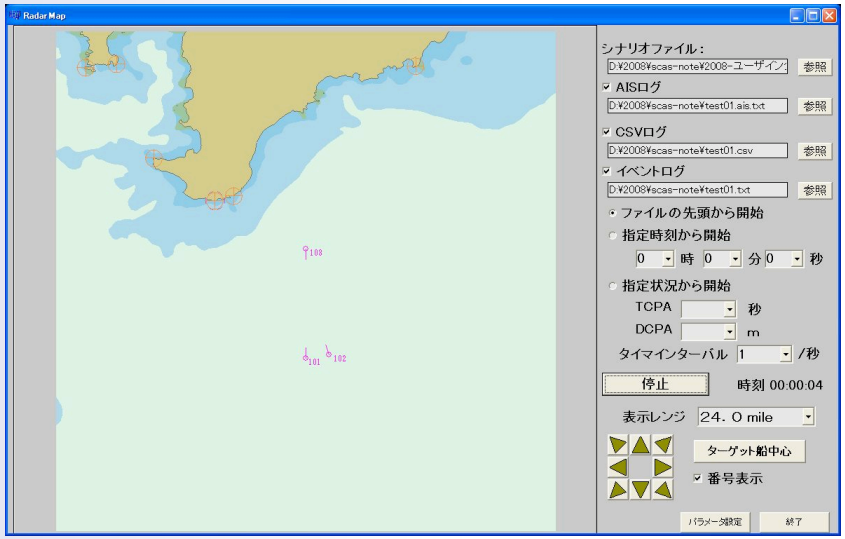
This research is sponsored by Maritime Bureau of Ministry of Land, Infrastructure, Transport and Tourism JAPAN

Simulator Experiment on the NIESS



Simulator Experiment on the NIESS

AIS Signal Generator



Output

AIS static and dynamic Information

Input

Rudder, Speed (Ship controller)

Recording Data

AIS Static and Dynamic Information

AIS Binary Message

Ship Position

Ship Speed

Ordered Speed

Course

State of Autopilot etc.