

An Experiment Result on Information Exchange using MASS communication Relay System

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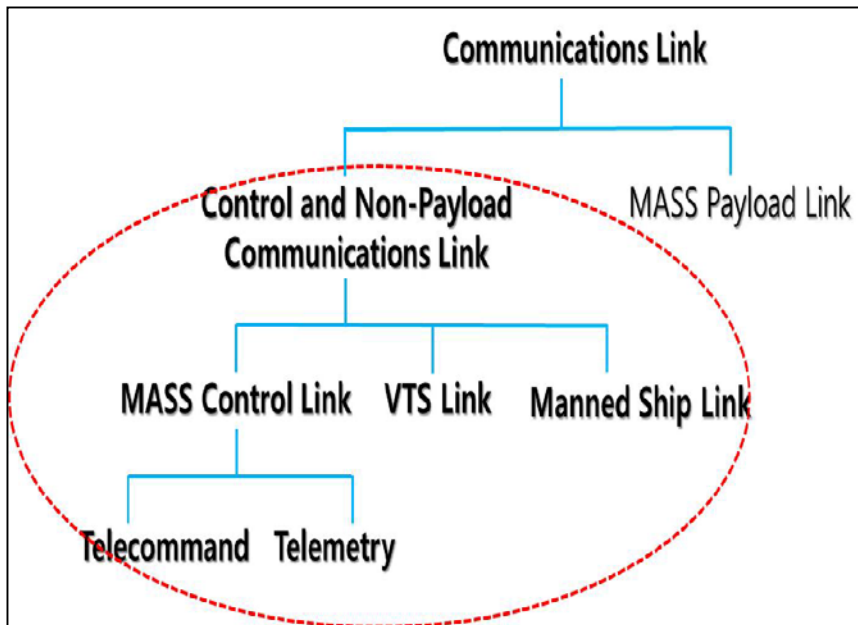
Conclusion

1. Background and Purpose

| Background

*The MASS has received much attentions in maritime society.
has been developed with active support at national level in the world.*

- **MUNIN** has been conducted by EU 7th Framework Programme from 2012 to 2015
- **SARUMS** has represented a legal review for operations, design, and regulation
- **ITU-R** has suggested an communication characteristics, its services, including CNPC
- **IMO** has recognized a regulatory framework for co-existence with MASS and manned ships
- **NK Class** has suggested the guidelines for concept design of autonomous operation of ships



Information acquisition

Acquisitioning information using LIDAR, RADAR, Camera, AIS, and communications system

Situation Awareness

Perceiving information related to the condition of the surrounding environment and ships

Taking an action

Planning and implementing movement that should be taken in the future based on the results of decision

Making a decision

Understanding the present condition, including prediction of the condition in the near future

1. Background and Purpose

| Review of MASS application in the COLREGs

Rule 5 : Look-out	Rule 7 : Risk of collision
<ul style="list-style-type: none">• Monitor a safety of MASS by collecting and analyzing all navigational information from all available navigational sensors and/or all the information collected from MCS(Maritime Control Station)/other related ships.	<ul style="list-style-type: none">• The risk of collision may be decided by analyzing all the information that has been sent from MASS to MCS.• It is important to obtain any other useful information to compensate scanty information for right decision.
Available means	
<ul style="list-style-type: none">• on board sensors• Radar, AIS, and other available data communications• Decision-making procedure	<ul style="list-style-type: none">• Image/picture including Radar, AIS, and any other communications

1. Background and Purpose

| Review of MASS application in the COLREGs

Rule 13~17 (overtaking, head-on, crossing, give-way vessel, stand-on vessel)	Rule 19 (Conduct of vessels in restricted visibility)
<ul style="list-style-type: none">• The MCS shall be able to use navigation rules as an MASS is meeting other vessel in overtaking/crossing/head-on situation in sight of one another.• The MASS and also the MSC are requested to obtain information related to<ul style="list-style-type: none">- the intended way of other vessel (WP, Speed ..)- the manoeuvring characteristics of other vessel.	<ul style="list-style-type: none">• All the information required By the rule 5 look-out , the rule 6 safety speed, the rule 7 risk of collision.• The MCS shall be able to use navigation rules applicable to restricted visibility as an USV is meeting other vessel in restricted visibility.
Available means	
<ul style="list-style-type: none">• Rule based on Command & Control• Radar, AIS, and other data communications	<ul style="list-style-type: none">• Rule based on Command & Control• Radar, and AIS, other data communication means

1. Background and Purpose

| *Problems*

- There is no any procedure for information exchange between MASS and VTS/manned ship



| *Purpose*

- **Establish an efficient procedure for information exchange** between MASS and VTS/manned ship
- **Validate a proposed procedure** by carrying out an experiment at sea

1. Background and Purpose

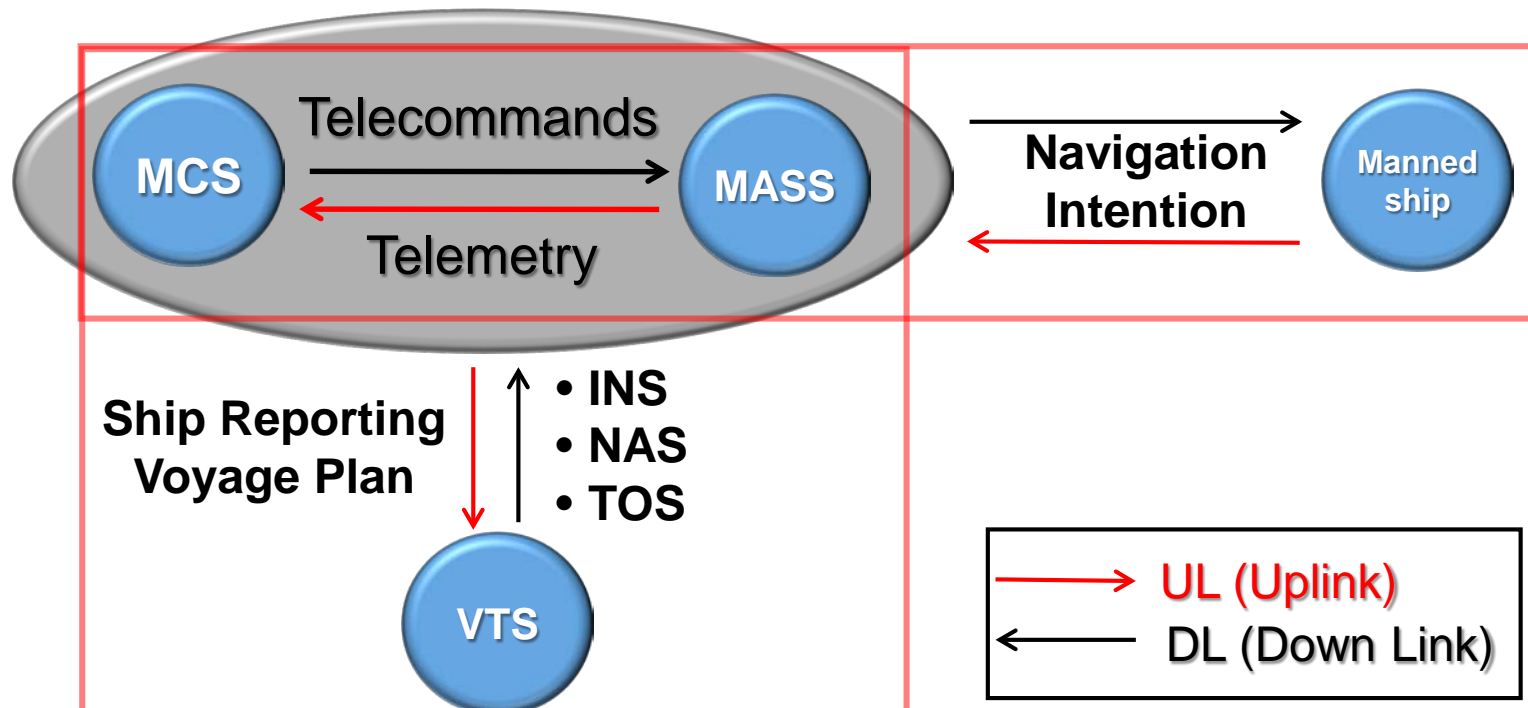
| Study Area



Controlling

- Situational Awareness (Video, Image etc.)
- Sense and Avoid

Planning Voyage



2. Communication Relay System

Information flow on Communication Relay System

VHF telephone

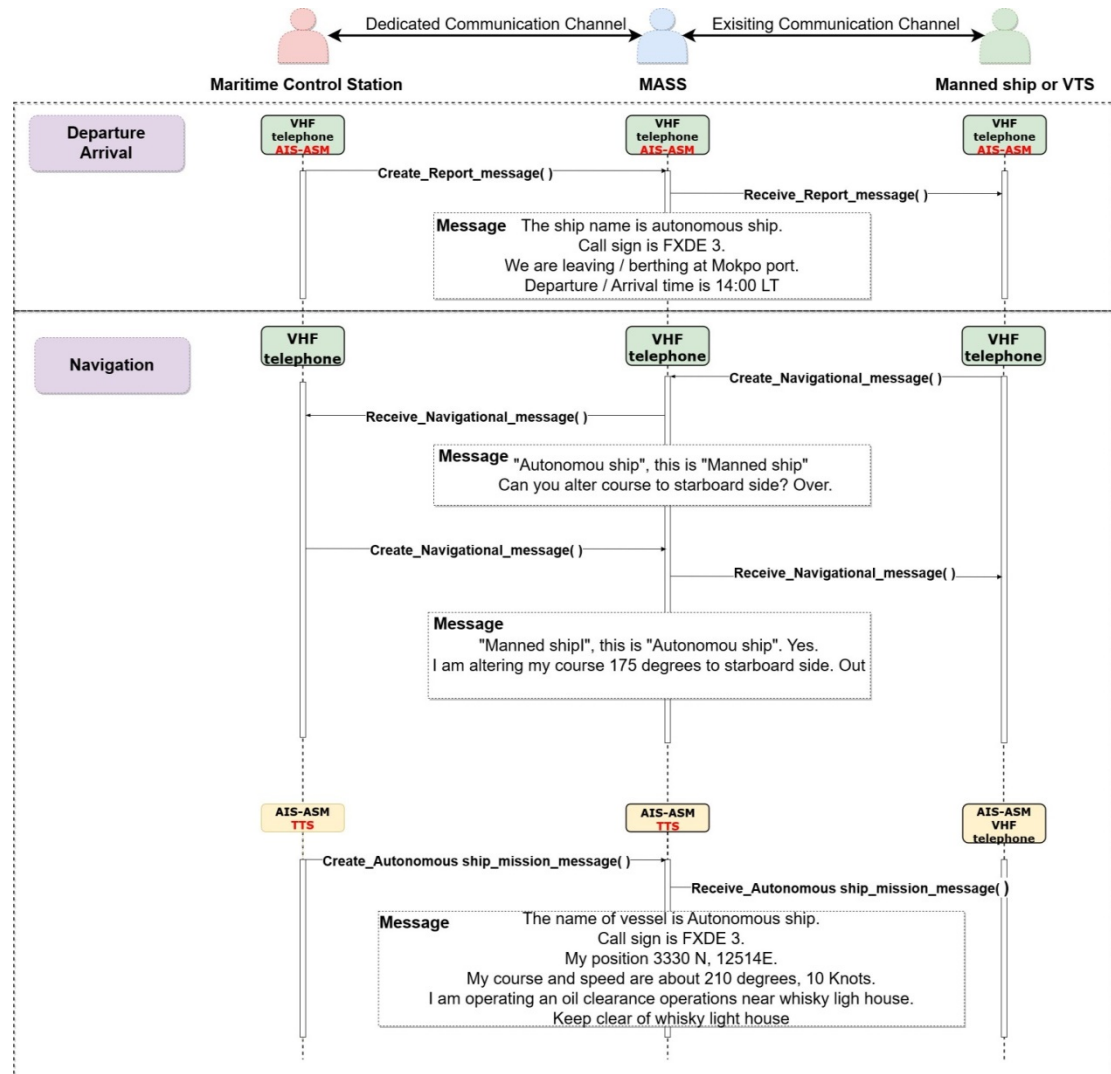
- Voice communication for navigation intention between MCS and VTS/MS via MASS

AIS-ASM

- Text communication for MASS navigation/mission information between MCS and VTS/MS via MASS

TTS (Text to Speech)

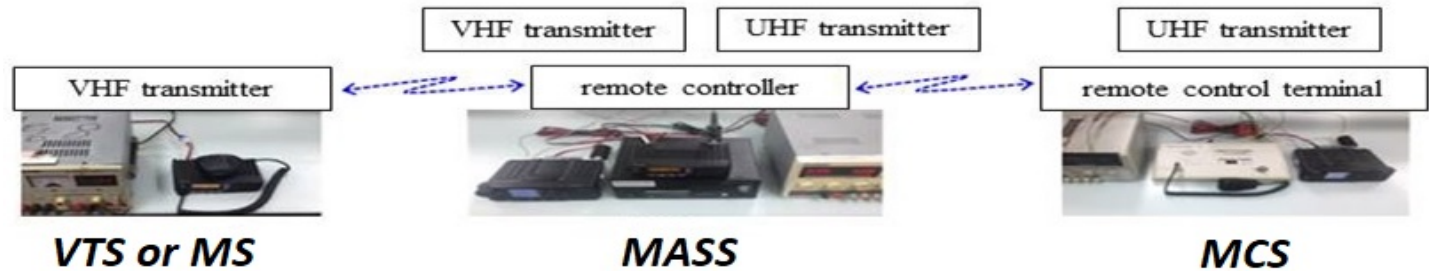
- Voice communication for MASS navigation/mission information between MCS and VTS/MS via MASS



* AIS-ASM : Automatic Identification System – Application Specific Messages

2. Communication Relay System

| VHF controller

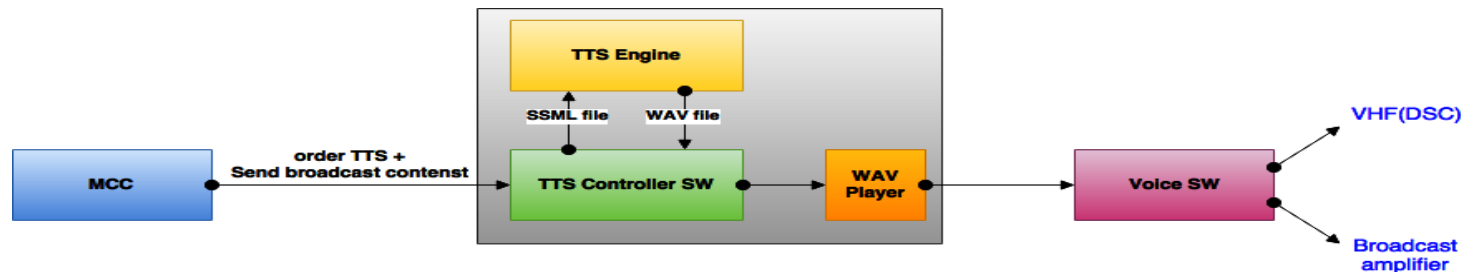


| AIS-ASM controller



AIS-ASM creation terminal → VDES transmitter & receiver → AIS-ASM expression terminal

| TTS controller



* VDES : VHF Data Exchange System, SSML : Speech Synthesis Markup Language, * WAV : Waveform Audio File Format

3. Experimental Result

I Experimental date and ship

- **Experimental date**
 - 19th Sep, 2019 : 1st experiment based on navigation scenario related on SAR
(search and rescue)
 - 20th Sep, 2019 : 2nd experiment based on navigation scenario related on collision avoidance
- **Experimental ship**
 - * [1st experiment] 'Ship A (MCS/VTs)', 'Ship B (MASS)'
[2nd experiment] 'Ship A (MCS/VTs/Manned ship)', 'Ship B (MASS)'



[1st experiment 'Ship A']



[1st experiment 'Ship B']



[2nd experiment 'Ship A, B']

3. Experimental Result

Process of VHF communication between MCS and VTS/MS via MASS

VHF communication

1. Ship A (MCS)	2. Ship B (MASS)	3. Ship A (VTS/MS)	4. Ship B (MASS)
<ul style="list-style-type: none">Sends a voice message to MASS via UHF telephone	<ul style="list-style-type: none">Receive a voice message via UHF telephone, and transfer a voice message to VTS/MS via VHF telephone	<ul style="list-style-type: none">Sends a response message to MASS via VHF telephone	<ul style="list-style-type: none">Receive a response message via VHF telephone, and transfer a message to MCS via UHF telephone



3. Experimental Result

I Process of AIS-ASM communication between MCS and VTS/MS via MASS

AIS-ASM

1. Ship A (MCS)

- Requests sending a text message to MASS

2. Ship B (MASS)

- Transfers a text message to VTS or MS

3. Ship A (VTS/MS)

- Receives a text message from MASS

ASM Area Notice 생성 서비스

Message Linkage ID : 302 (0 ~ 1023) default: 0(not available)

Notice description : 75 : Distress Area: SAR area

UTC Month : 9 월 (1 ~ 12) default: 0(not available)

UTC Day : 19 일 (1 ~ 31) default: 0(not available)

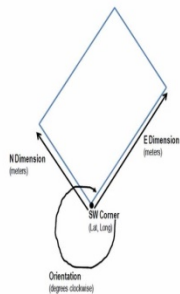
Start Date and Time : UTC Hour : 13 시 (0 ~ 23) default: 24(not available)

UTC Minute : 30 분 (0 ~ 59) default: 60(not available)

Duration : 60 분 (0 ~ 262,143) default: 262143(undefined)

Sub-areas : Rectangle

Figure 11-1
Description of the process required to define a "rectangle" area



Longitude : East 126 20 30 A= 7589000 181 : not available (default)

Latitude : North 34 47 27 A= 2091500 91 : not available (default)

```
kgu@palmtree:/home/test-ums/sbin
파일(F) 편집(E) 보기(V) 검색(S) 터미널(T) 도움말(H)

[kgu@palmtree sbin]$ ./rcv_pr_pisdsm_out 192.168.20.30 9009 2)/home/kgu/rcv_err.0
9261500
05d1@FieN00t: T9g6Q? SdB4lwhwl=t92HVPCr6v4Q; d<9u302@URT4vQ@@
05d1PFieN00t: T9g6Q? SdB4lwhwl=t92HVPCr6v4Q; d<9u302@URT4vQ@@
05d1HfieN00t: T9g6Q? SdB4lwhwl=t92HVPCr6v4Q; d<9u302@URT4vQ@@
05d1JfieN00t: T9g6Q? SdB4lwhwl=t92HVPCr6v4Q; d<9u302@URT4vQ@@
05d1@FieN00t: T9g6Q? SdB4lwhwl=t92HVPCr6v4Q; d<9u302@URT4vQ@@
05d1JPFieN00t: T9g6Q? SdB4lwhwl=t92HVPCr6v4Q; d<9u302@URT4vQ@@
05d1HfieN00t: T9g6Q? SdB4lwhwl=t92HVPCr6v4Q; d<9u302@URT4vQ@@
05d1JfieN00t: T9g6Q? SdB4lwhwl=t92HVPCr6v4Q; d<9u302@URT4vQ@@
05d1KPFieN00t: T9g6Q? SdB4lwhwl=t92HVPCr6v4Q; d<9u302@URT4vQ@@
05d1K@FieN00t: T9g6Q? SdB4lwhwl=t92HVPCr6v4Q; d<9u302@URT4vQ@@
05d1KPFieN00t: T9g6Q? SdB4lwhwl=t92HVPCr6v4Q; d<9u302@URT4vQ@@
05d1j@FieN00t: T9Ha1? D4B4cm@l= 92FipCqw; 4Q; Dh9u2PR@Jeq4vQ=988mv20@p1
```

```
파일(F) 편집(E) 보기(V) 검색(S) 터미널(T) 도움말(H)

MsgLncId: 108
Route Info
Sender Classification: ship
Route Type : ship route plan
Start(UTC) : 09/19 13:30 Duration: 60 min(s)
No of Waypoints: 5
Waypoints #1 : E 126° 21' 39.000 N 34° 47' 33.000
Waypoints #2 : E 126° 21' 21.000 N 34° 47' 30.000
Waypoints #3 : E 126° 21' 0.000 N 34° 47' 30.000
Waypoints #4 : E 126° 20' 45.000 N 34° 47' 30.000
Waypoints #5 : E 126° 20' 30.000 N 34° 47' 27.000

MsgLncId: 109
Route Info
Sender Classification: ship
Route Type : ship route plan
Start(UTC) : 09/19 13:30 Duration: 60 min(s)
No of Waypoints: 5
Waypoints #1 : E 126° 21' 39.000 N 34° 47' 33.000
Waypoints #2 : E 126° 21' 21.000 N 34° 47' 30.000
Waypoints #3 : E 126° 21' 0.000 N 34° 47' 30.000
Waypoints #4 : E 126° 20' 45.000 N 34° 47' 30.000
Waypoints #5 : E 126° 20' 30.000 N 34° 47' 27.000

MsgLncId: 110
Route Info
Sender Classification: ship
Route Type : ship route plan
Start(UTC) : 09/19 14:30 Duration: 60 min(s)
No of Waypoints: 6
Waypoints #1 : E 126° 20' 30.000 N 34° 47' 27.000
Waypoints #2 : E 126° 20' 27.000 N 34° 47' 29.400
Waypoints #3 : E 126° 20' 33.000 N 34° 47' 18.000
Waypoints #4 : E 126° 20' 36.000 N 34° 47' 27.000
Waypoints #5 : E 126° 20' 38.700 N 34° 47' 26.700
Waypoints #6 : E 126° 20' 37.200 N 34° 47' 21.000
```

3. Experimental Result

Process of TTS communication via MASS

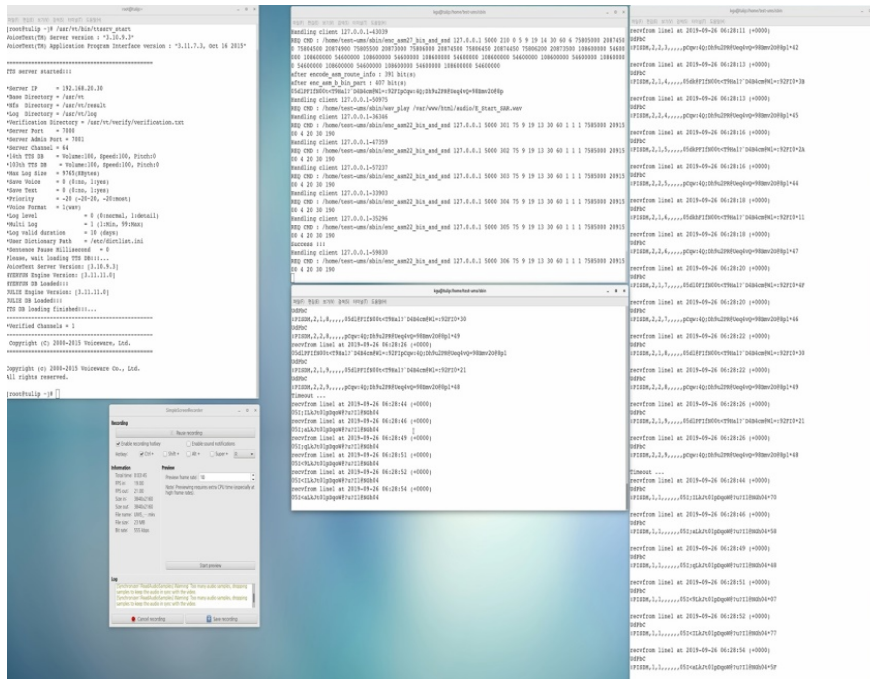
TTS

Ship A (MCS)

- Creates a TTS file for sending from MCS to MASS

Ship B (MASS)

- Converts a TTS file to voice, and provide mission information from MASS to VTS/MS via VHF telephone



UMS 방송 요청

TEST for ASM Route Informa

TEST for ASM Route In

192.168.20.30/inst_play_file_req.html

즉시 방송 요청 서비스

File Name: E-RPT1 .wav

질의 보내기

실행 결과 --- Played File : /var/www/html/audio/E-RPT1.wav

처음으로

UMS 방송 요청

TEST for ASM Route Informa

TEST for

192.168.20.30/inst_play_file_req.ht

즉시 방송 요청 서비스

File Name: E_Start_SAR .wav

질의 보내기

실행 결과 --- Played File : /var/www/html/audio/E_Start_SAR.wav

처음으로

3. Experimental Result

I Methods of Performance Validation

- Voice communication : **SINPO code** described in document REC.ITU-R SM. 1135

* SINPO code is a signal reporting code used to describe the quality of radiotelegraph transmission

→ Voice communication was evaluated on basis of the measured voice signals by using SINPO code according to the navigation scenario

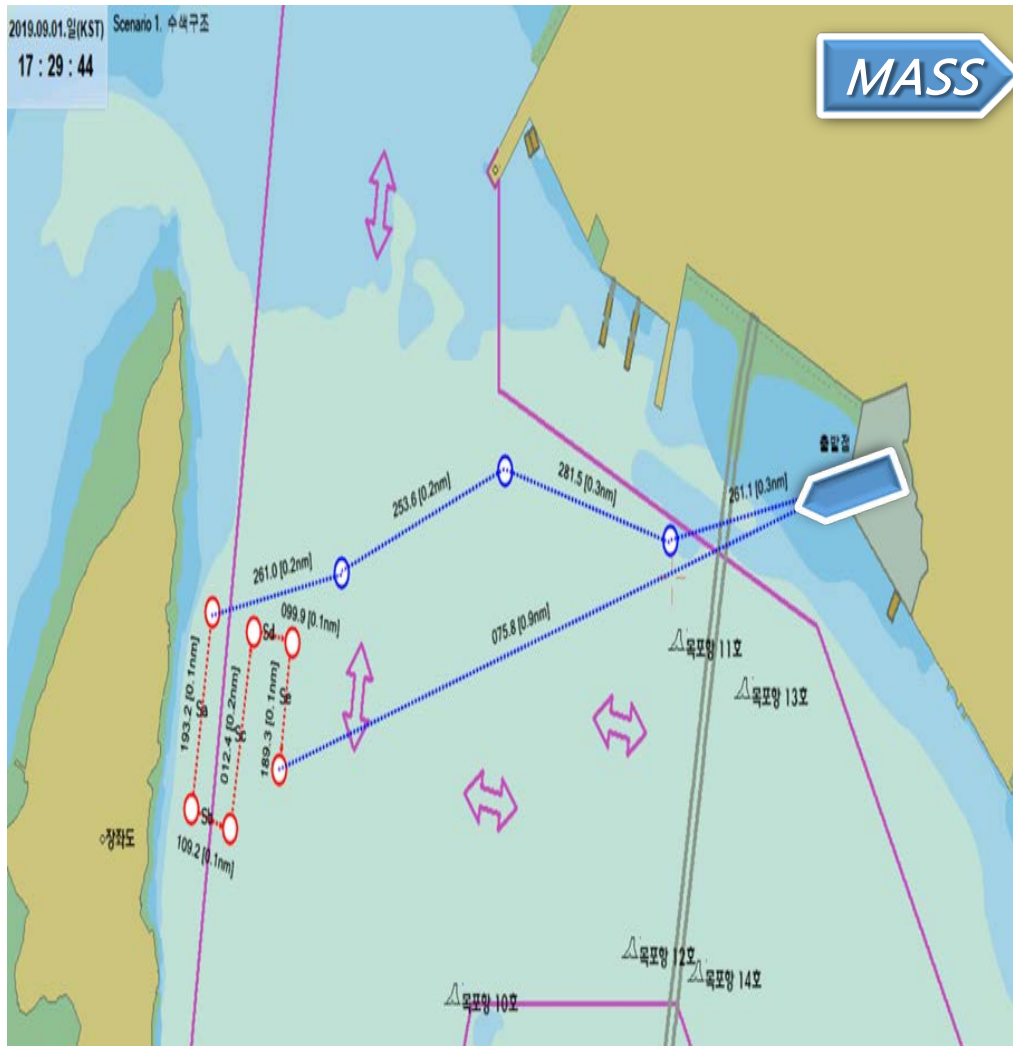
Rating scale	S	I	N	P	O
	Signal Strength	Degrading effect of			Overall rating
		Interference	Noise	Propagation disturbance	
5	Excellent	NIL	NIL	NIL	Excellent
4	Good	Slight	Slight	Slight	Good
3	Fair	Moderate	Moderate	Moderate	Fair
2	Poor	Severe	Severe	Severe	Poor
1	Barely audible	Extreme	Extreme	Extreme	Unusable

- Text communication

→ Comparison the number of messages sent by MCS and the number of messages received by VTS or MS

3. Experimental Result

Scenario on search and rescue

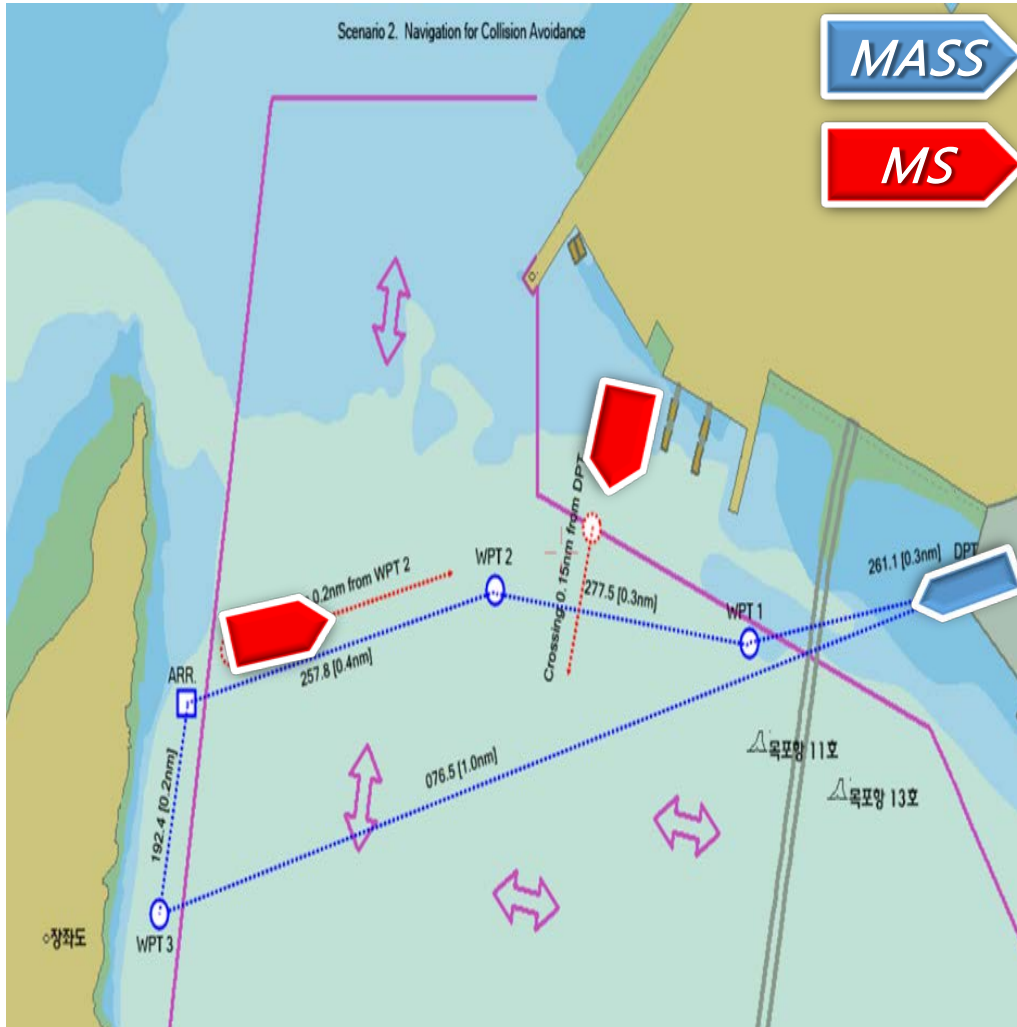


Position		Equipment
S1	Before departure	AIS-ASM, VHF
S2	Departure	VHF
S3	Way point 1	VHF
S4	Way point 2	VHF
S5	Arrival at search and rescue area	VHF
S6	Search and rescue operation	AIS-ASM, VHF, TTS
S7	Way point 3	VHF
S8	Arrival at pier	AIS-ASM, VHF

- Scenario 'S'

3. Experimental Result

Scenario on Collision Avoidance



Position		Equipment
S1	Before departure	AIS-ASM, VHF
S2	Departure	VHF
S3	Way point 1	VHF
S4	Head-on situation	VHF, TTS
S5	Way point 2	VHF
S6	Crossing situation	VHF, TTS
S7	Way point 3	VHF
S8	Arrival at pier	AIS-ASM, VHF

- Scenario 'S'

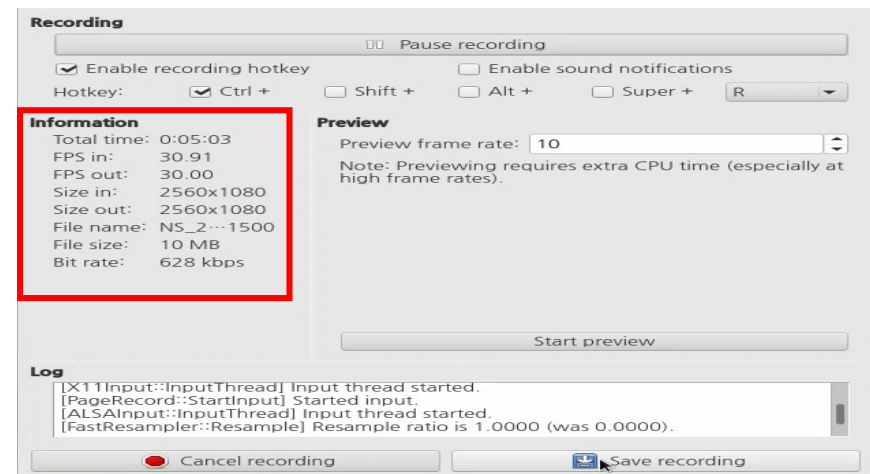
3. Experimental Result

| Overall rating: average score '4.15' (good)

Navigation Phrase	S	I	N	P	O
	Signal strength	Degrading effect of			Overall rating
		Interference	Noise	Propagation Disturbance	
S1	5	5	4	5	4.75
S2	5	5	4	5	4.75
S3	4	5	3	3	3.75
S4	4	5	4	5	4.50
S5	4	5	4	4	4.25
S6	4	5	3	3	3.75
S7	4	5	3	3	3.75
S8	4	5	3	3	3.75

| The number of messages was matched

→ the number of messages sent by MCS and the number of messages received by VTS/MS was matched.



4. Conclusion

- *To evaluate performances of communication relay system, the experiments were conducted at Mokpo sea area.*
- *Experimental scenario was composed of navigation stage including missions.*
- *In order to evaluate voice communication operation used by VHF telephone and TTS, SINPO code was utilized, and average overall rating was good(4.15/5).*
- *Aspects of evaluation on text communication operation used by AIS-ASM, the number of messages sent by MCS and the number of messages received by VTS/MS was matched.*
- *Therefore, it would be expected for MASS to make navigation cooperation via information exchange.*

Thank you for your attention!

Q & A

