

Prototype development of ENC and Marine information services in the SMART Navigation project



25 January, 2018

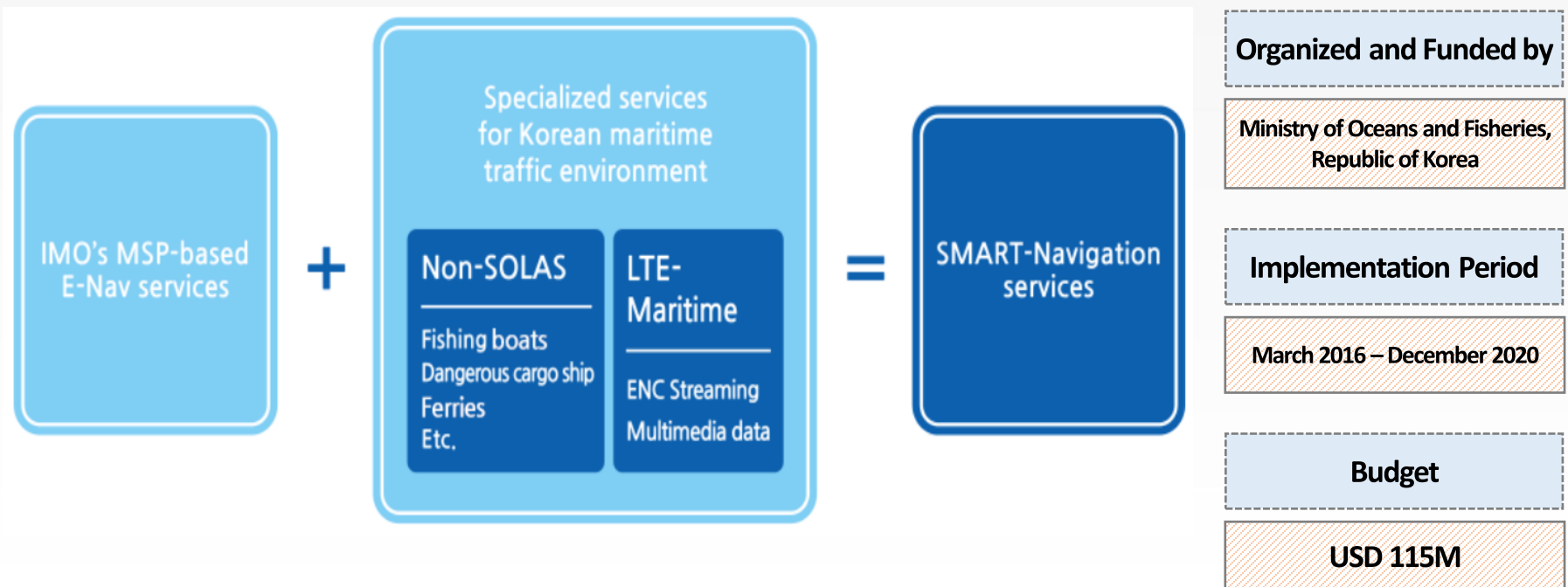
KRISO (Korea Research Institute of Ships & Ocean Engineering)
Sewoong OH

- 01 SMART Navigation Project
- 02 REDSS (ENC Distribution and Streaming Service for Non-SOLAS Vessel)
- 03 MESIS (Marine Environment and Safety Information Service)
- 04 Prototype development of REDSS and MESIS
- 05 Future plan

01 SMART Navigation Project

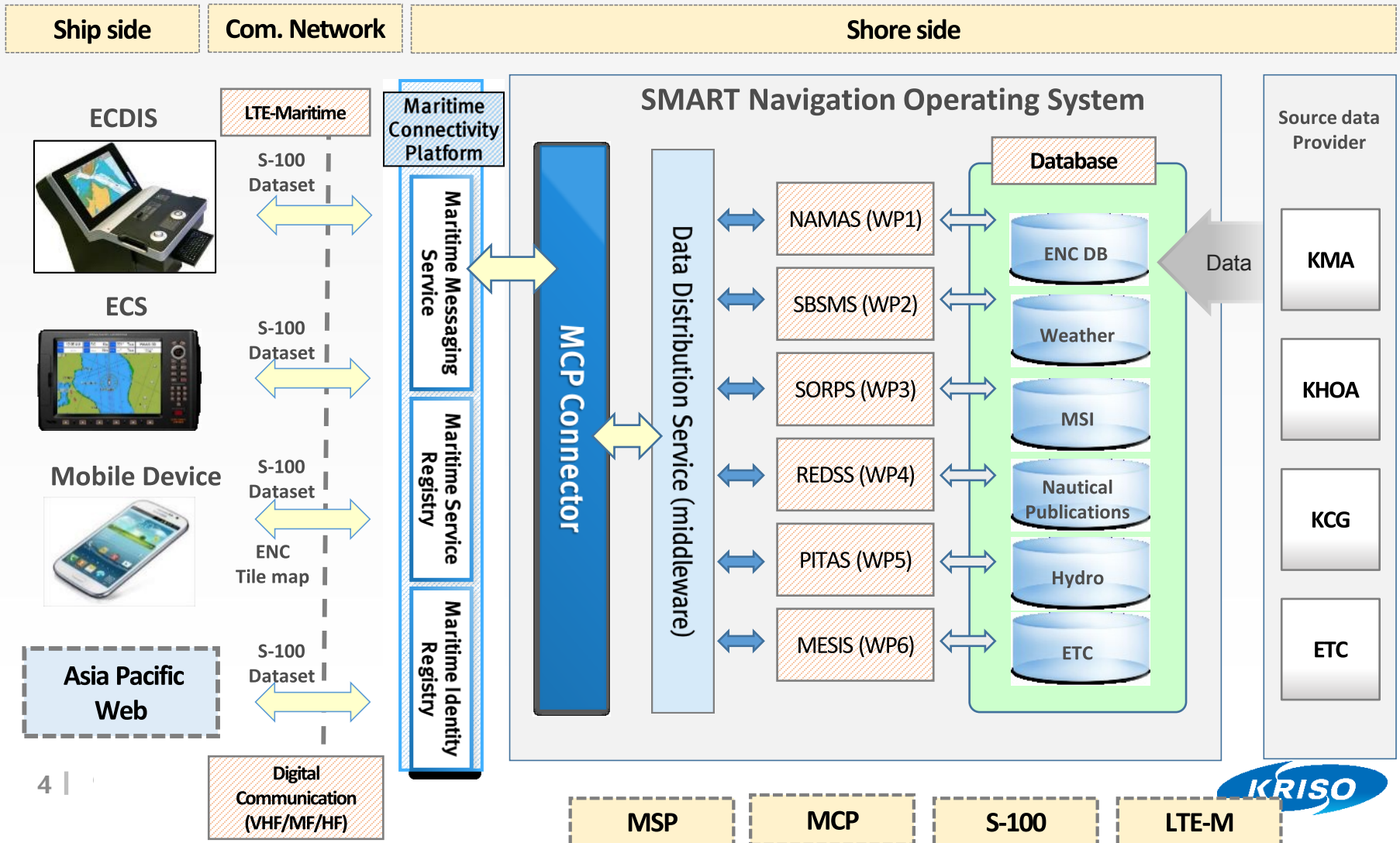
▪ The SMART-Navigation

- implements the concept of IMO's e-Navigation, providing additional services for Non-SOLAS ships such as Fishing boats, coastal vessels and ferries



01 SMART Navigation Project

Major components of Project



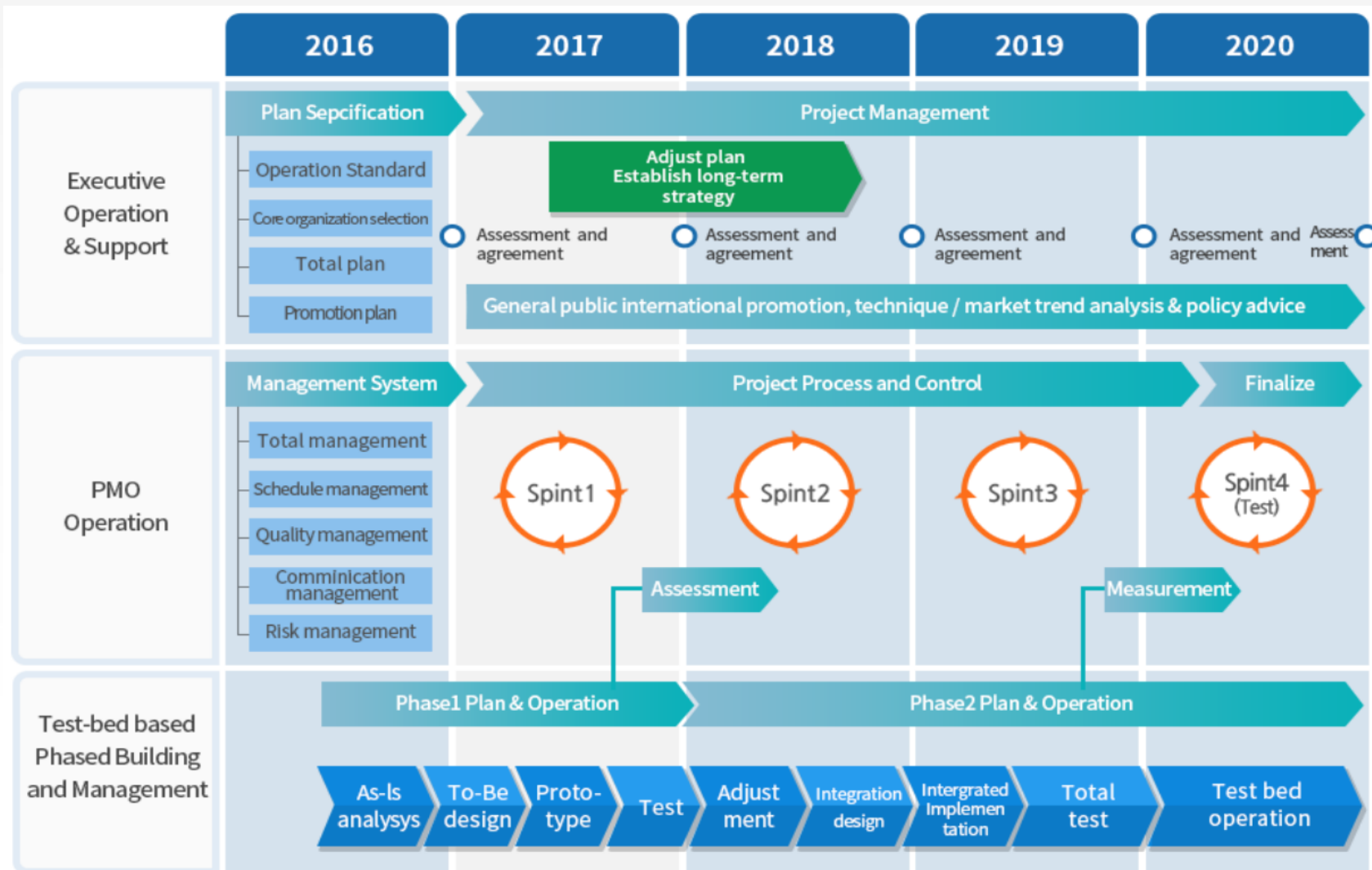
01 SMART Navigation Project

SMART-Navigation Service

ID	Service	Target Vessels	Communication Method
WP1 (NAMAS)	SV1-Navigation Monitoring & Assistance Service	Vulnerable vessels	LTE-Maritime VDES/D-HF
WP2 (SBSMS)	SV2-Ship-borne System Monitoring Service	Korean passenger ship (Domestic/International) Upon request	LTE-Maritime VDES/SAT
WP3 (SORPS)	SV3-Safe & Optimal Route Planning Service	Korean passenger ship (Domestic/International) Upon request	LTE-Maritime VDES/SAT
WP4 (REDSS)	SV4 – ENC Distribution & Streaming Service for Non-SOLAS Vessel	Domestic Coastal vessel	LTE-Maritime
WP5 (PITAS)	SV5-Pilot & Tugs Assistance Service	Pilots and Tugs	LTE-Maritime
WP6 (MESIS)	SV5-2 – Marine Environment and Safety Information Service	Upon request	LTE-Maritime VDES/D-HF/SAT

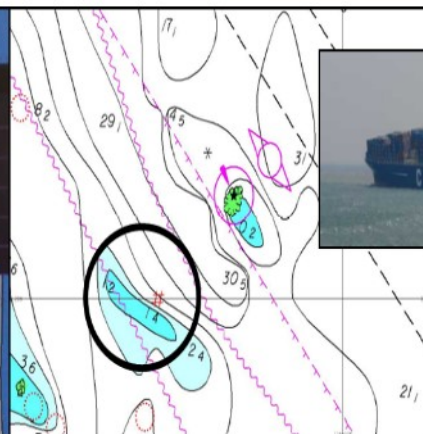
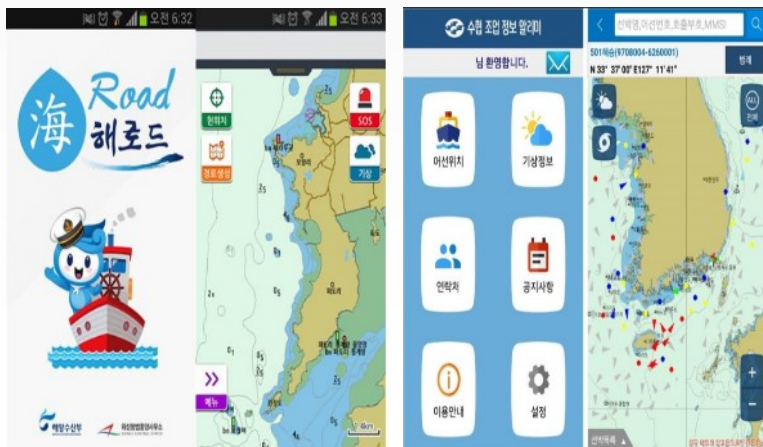
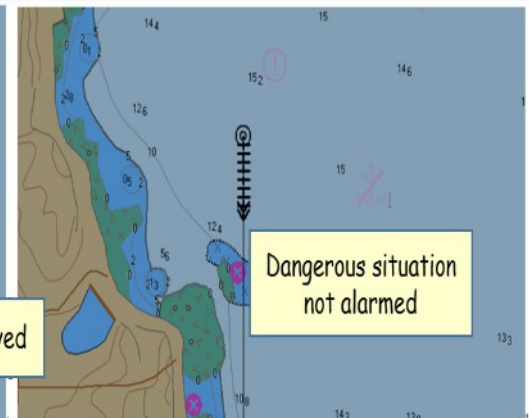
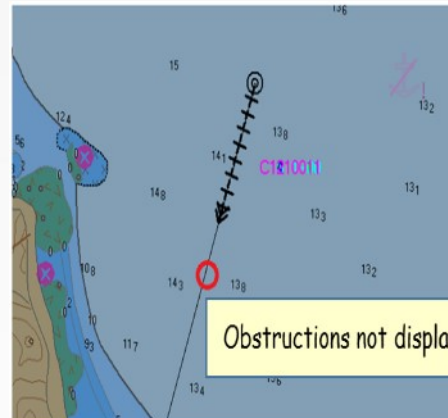
01 SMART Navigation Project

Process of Project Implementation



02 REDSS (ENC Service for Non-SOLAS Vessel)

- Today (Problem with using chart in Non-SOLAS Vessels)
 - Small vessels equipped with GPS Plotter (ECS)
 - Chart data display and performance is different due to lack of ECS Standard

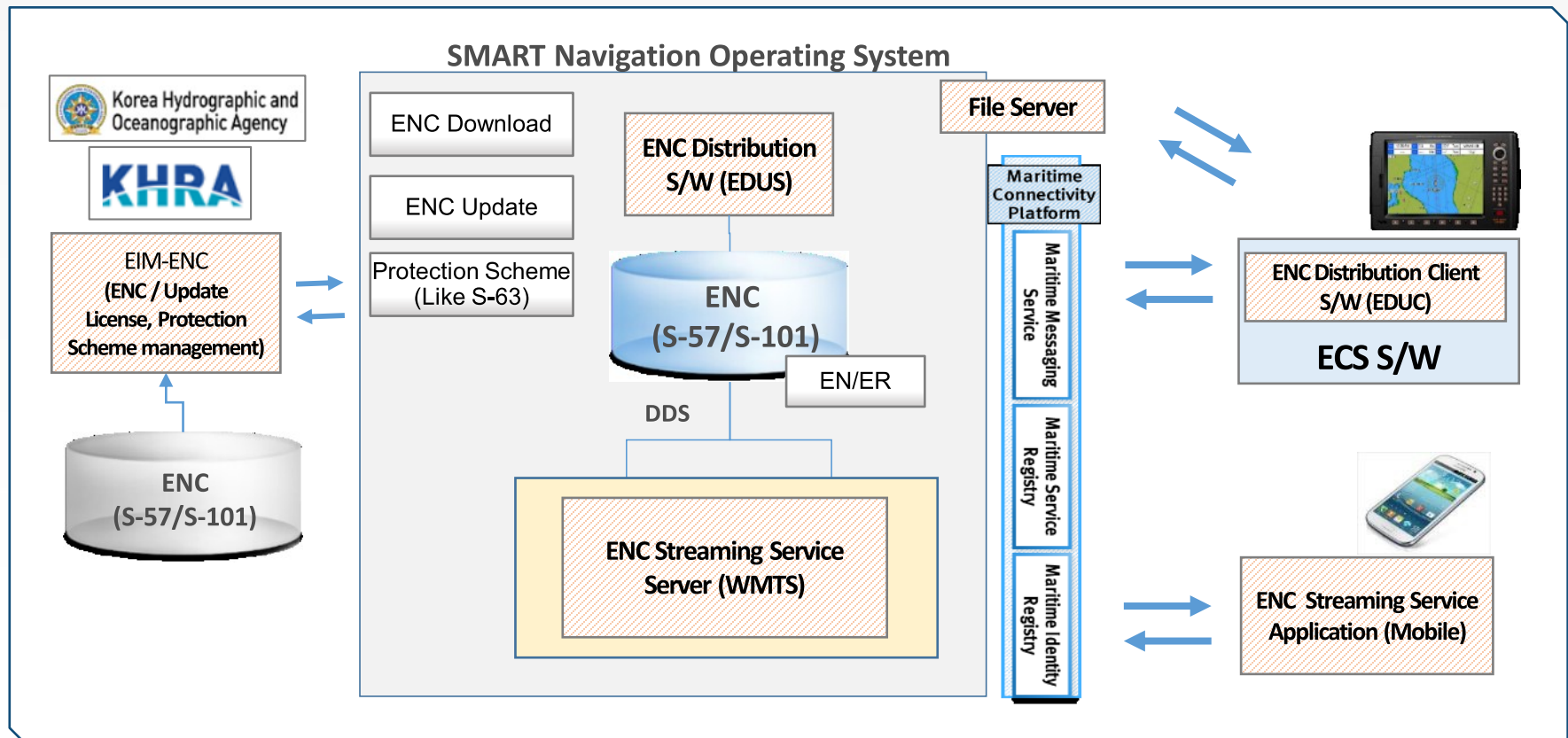


02 REDSS (ENC Service for Non-SOLAS Vessel)

- Future (Developing ENC Service in SMART Navigation Project)

Research Topics

Develop ENC download and update service for ECS
Develop ECS standard for SMART Navigation Project
Develop ECS Prototype considering S-101 according to the ECS Standard
Develop ENC Streaming Service (Web Map Tile Service)



03 MESIS (Marine and Safety Information Service)

- Today
 - Marine information service to support Safe Navigation

MSI (NAVTEX/SafetyNet) MSP 5

Q	R	S
Transmit Interval Character	Subject Indicator Character	Message Number Character
1: 1 min	A: Navigational Warnings	1: 001
2: 2 min	B: Meteorological Warnings	2: 001
3: 3 min	C: New Messages	3: 001
4: 4 min	M: Maritime Safety Information, Lists of Safety Warnings, Orders and other text of broadcast	4: 001
5: 5 min	E: Meteorological Forecasts	5: 001
6: 6 min	P: Pilot and VTS service messages	6: 001
7: 7 min	AG: AIS service messages (not yet defined)	7: 001
8: 8 min	L: LORAN messages	8: 001
9: 9 min	U: Unassigned	9: 001
0: 0 min	J: GMDSS messages	0: 001
X: X	X: Other electronic navigational aid system messages	X: 001
Y: Y	Y: Other electronic navigational aid system messages	Y: 001
Z: Z	Z: No messages on hand	Z: 001

Figure 5 - Example of NAVTEX receiver with LCD Screen

Table 1 - Technical "B" characters which make up the full NAVTEX message identity

Nautical Publication MSP 12

Marine Weather Service MSP 14

Marine Environ. & Hydro Service MSP 15

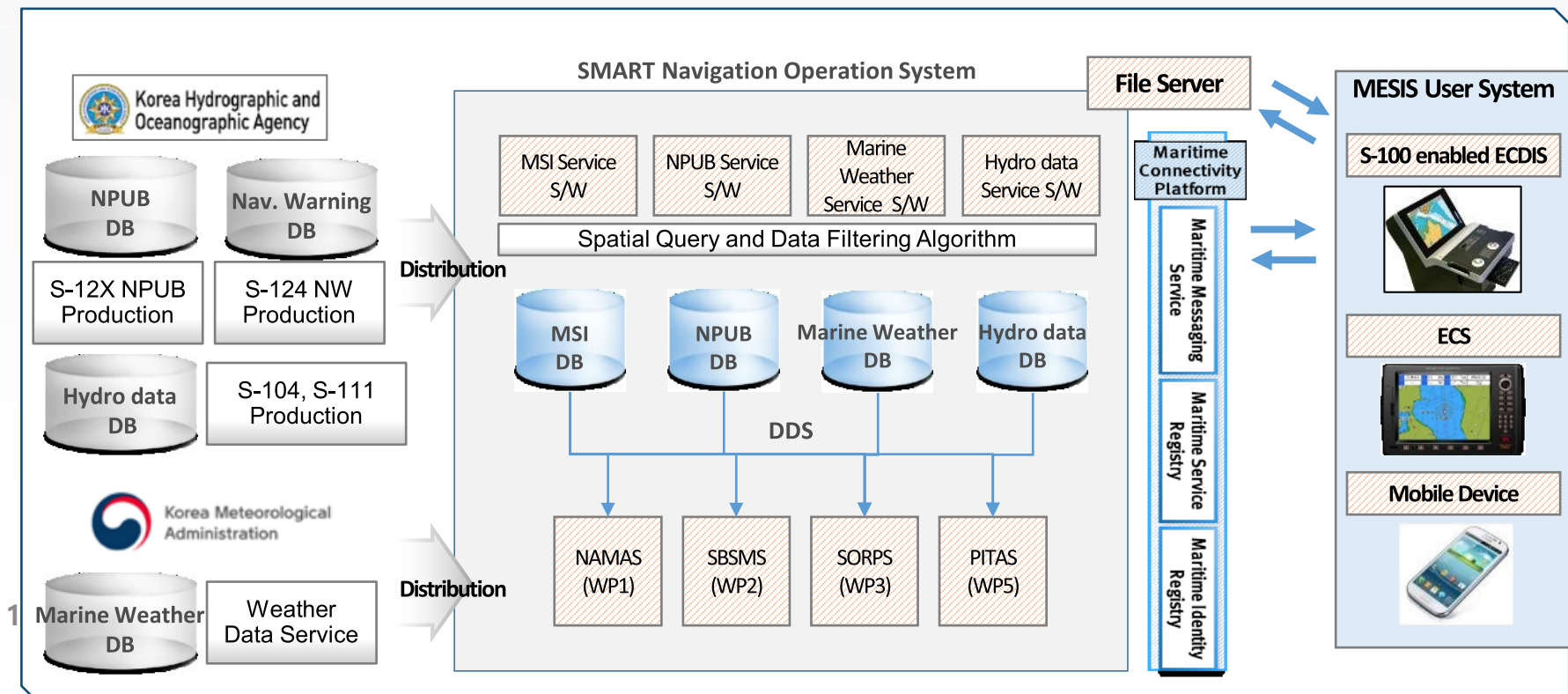
03 MESIS (Marine and Safety Information Service)

Future

- Developing Marine information service considering the MCP, S-100 for MSP 5, MSP 12, MSP 14 and MSP 15)

Research Topics

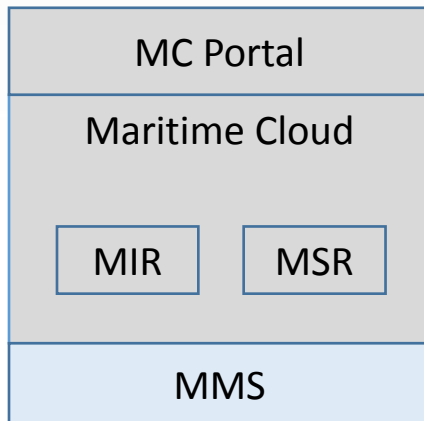
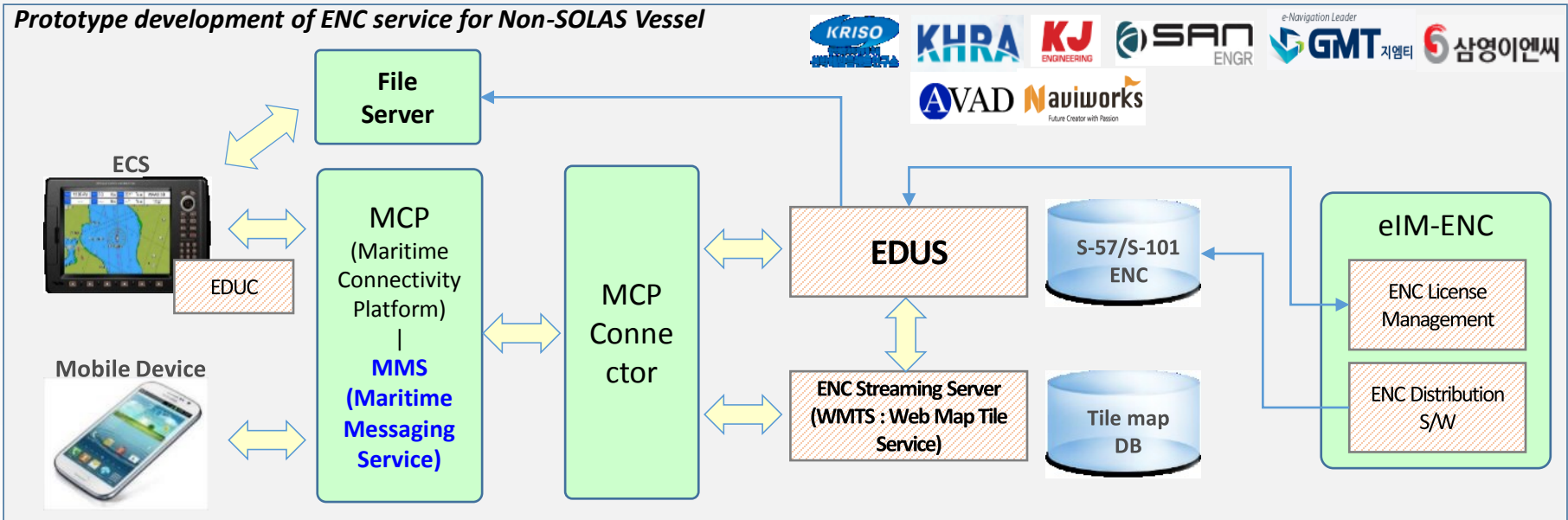
Develop MSI Service (NAVTEX, S-124 NW)
Develop Nautical Publication Service (S-122, S-123, S-125, S-126, S-127)
Develop Marine Weather Service (S-412)
Develop Marine environment and Hydrographic Service (S-104, S-111)



04 Prototype development of e-Nav Service

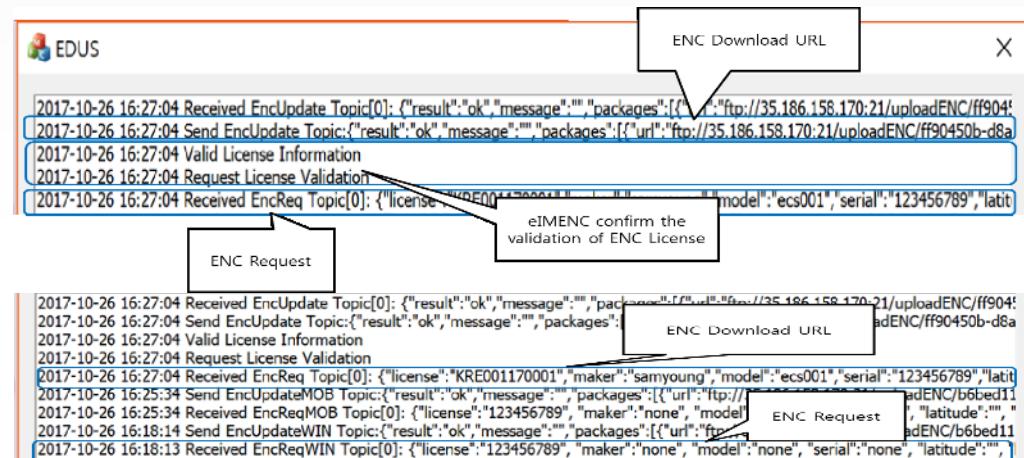
Prototype of ENC Service for Non-SOLAS Vessel

Prototype development of ENC service for Non-SOLAS Vessel



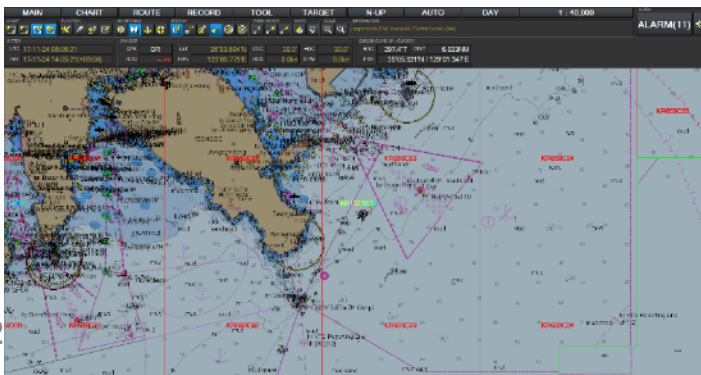
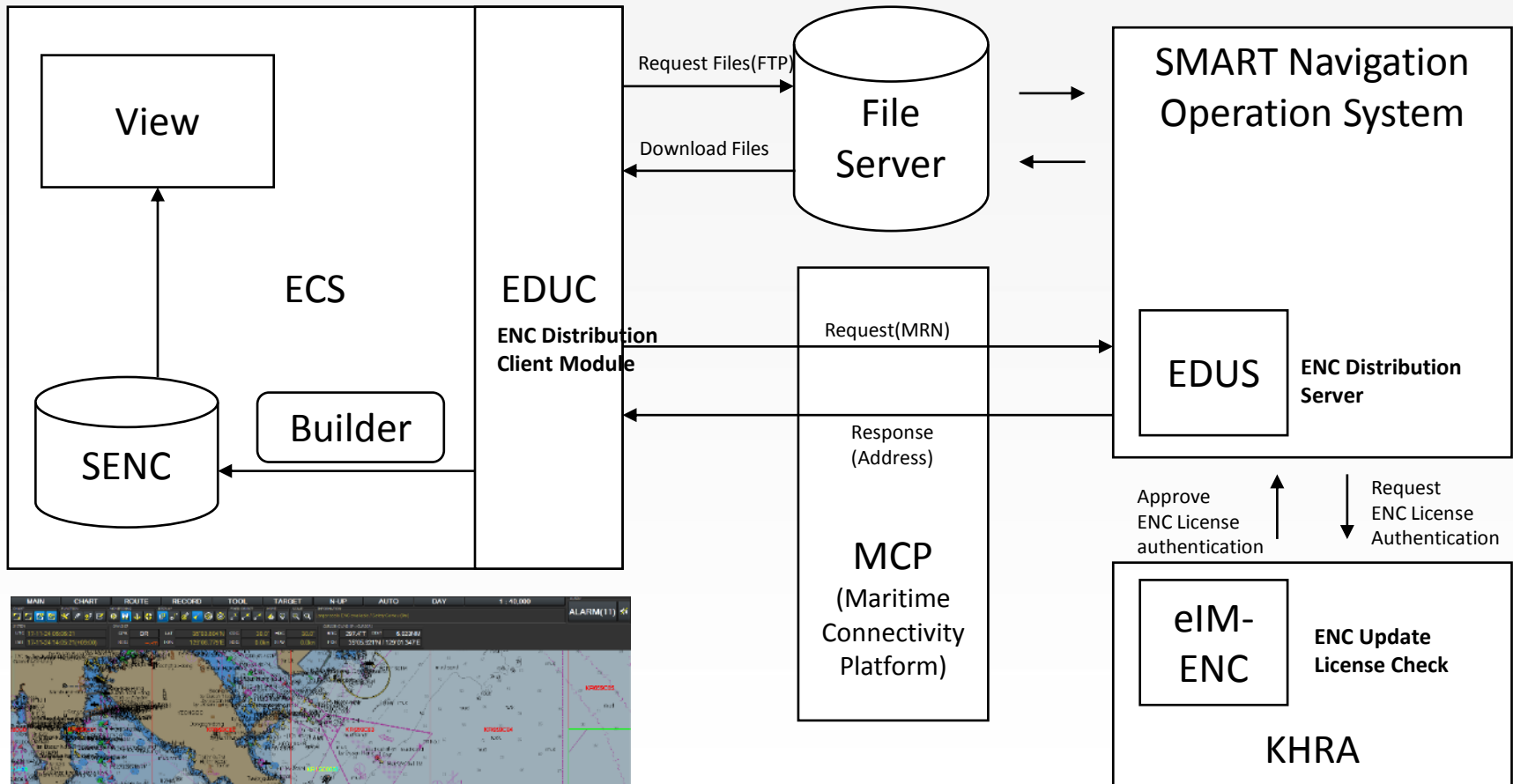
- 1) Message Relaying
- 2) Message Queueing
- 3) Message Casting
- 4) Seamless Roaming

- 1) Unicasting
- 2) Broadcasting
- 3) Geo-casting
- 4) Multicasting



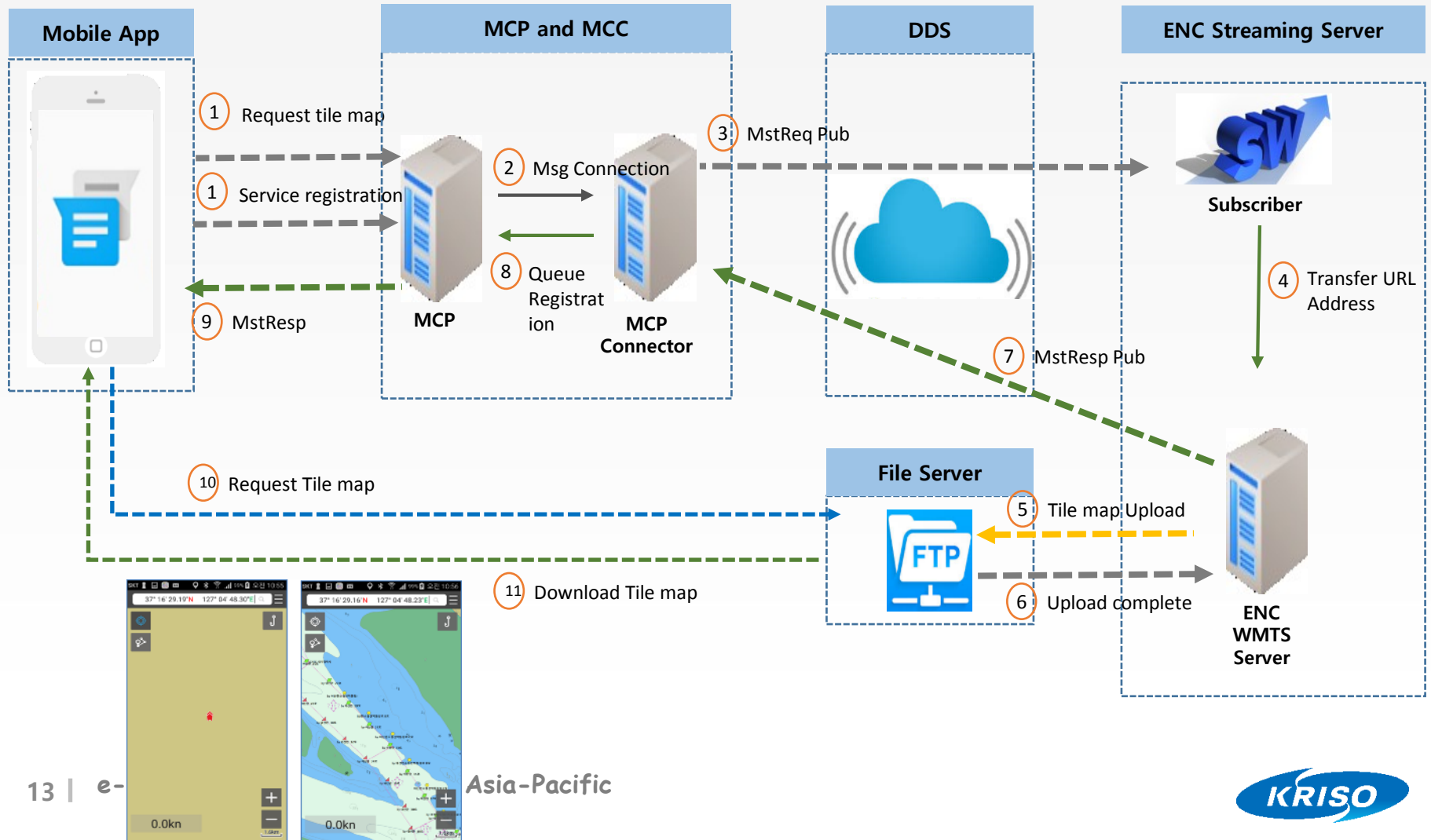
04 Prototype development of e-Nav Service

ENC Distribution Service to ECS



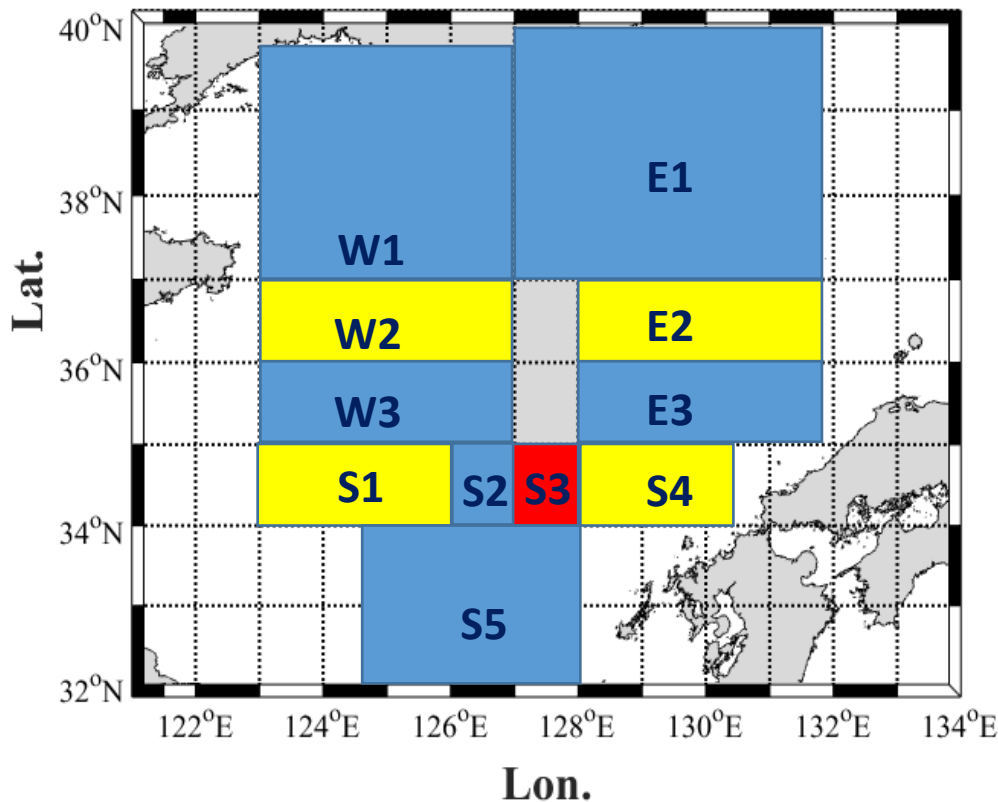
04 Prototype development of e-Nav Service

ENC Streaming Service



04 Prototype development of e-Nav Service

- REDSS (ENC Service for Non-SOLAS Vessel)
 - Zone for ENC Distribution Service : Group the ENC Coverage into 12 Zones for efficient Distribution service via LTE-M



File Size of Zone

Unit : Kb

ZONE	Size	ZONE	Size	ZONE	Size
Small Scale (Band1,2)	7,004				
W1	14,953	S1	11,511	E1	6,692
W2	16,225	S2	31,709	E2	4,496
W3	7,447	S3	27,222	E3	9,095
		S4	20,464		
		S5	8,474		

04 Prototype development of e-Nav Service

REDSS (ENC Service for Non-SOLAS Vessel)

ECS Standard for SMART Navigation

This Standard specifies the minimum operational, performance and technical requirements and methods of testing for SMART Navigation compliant ECS

IEC 60945
(General requirements)

IEC 62288
(Presentation of navigation related info)

IEC 61174
(ECDIS requirements and testing methods)

Class B level of
ECS and
Additional
Requirements

IEC 61162-1, 61162-2
(Digital interfaces)

S-101 and S-10X datasets

- ▶ S-101 ENC
- ▶ S-104 Water level for Navigation
- ▶ S-111 Surface Current
- ▶ S-124 Navigational Warnings
- ▶ S-12X Nautical Publications

SMART Navigation Service Based on S-100

- ▶ Message service for collision and grounding accident
- ▶ Remote monitoring service
- ▶ Optimal route planning service

Interoperability Requirement

- ▶ Interoperability catalogue
- ▶ Files describing how an ECS must combine data products conforming to different product specifications for display purposes

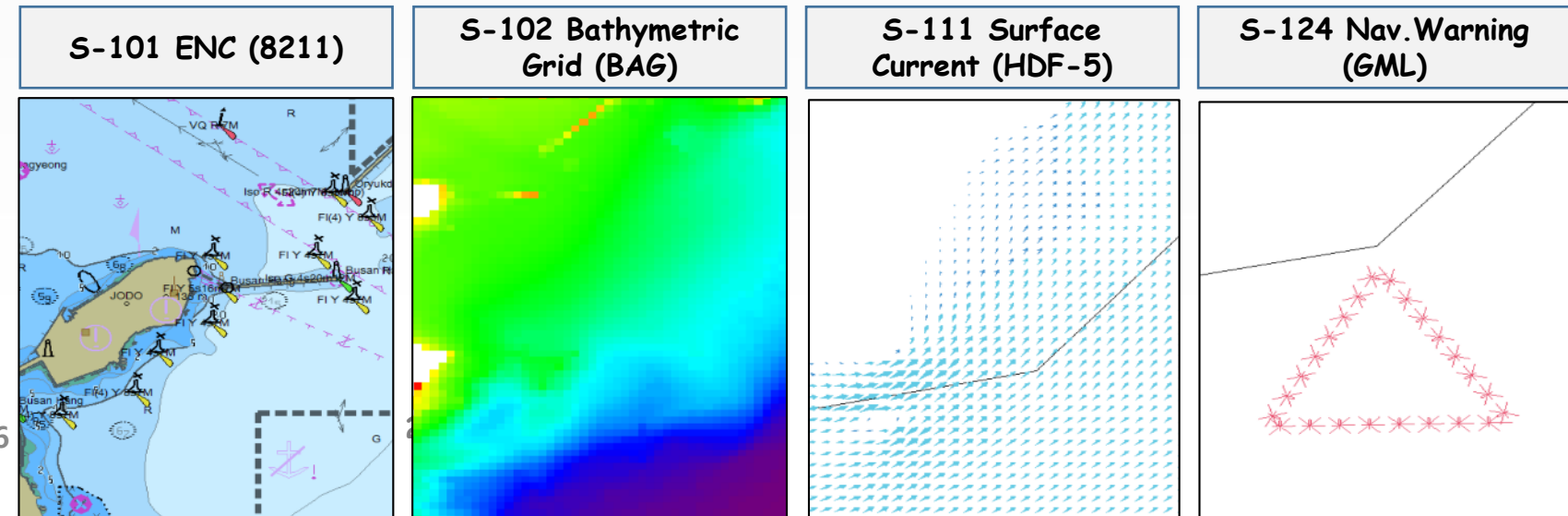
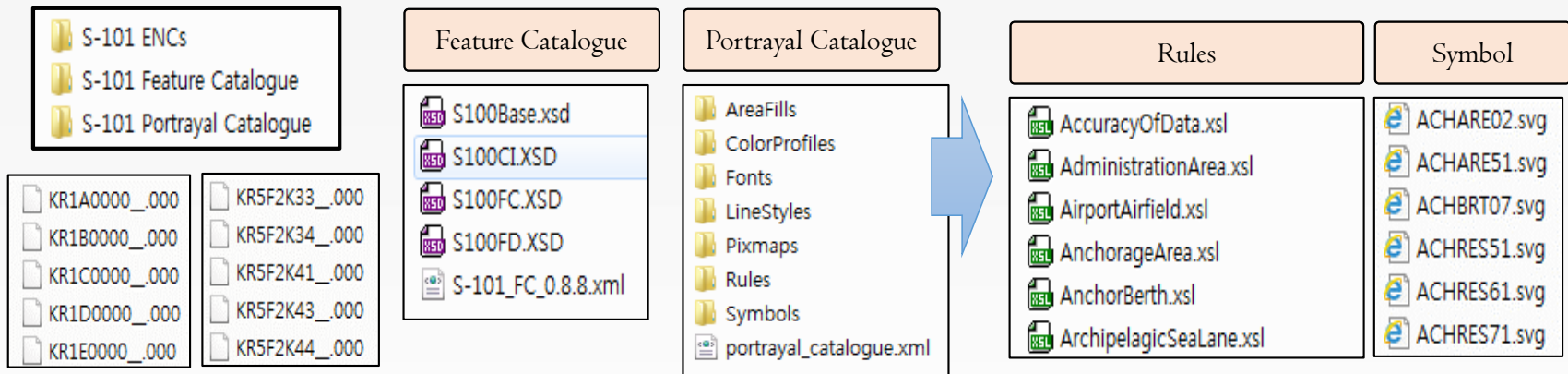
LTE-M Router Interface

- ▶ Define the digital interfaces to link to the LTE-M Router

04 Prototype development of e-Nav Service

REDSS (ENC Service for Non-SOLAS Vessel)

- The Research team improved the user S/W to process S-101 ENC according to the S-100 Portrayal Process



04 Prototype development of e-Nav Service

- REDSS (ENC Service for Non-SOLAS Vessel)
 - Process and Display of S-101 ENC

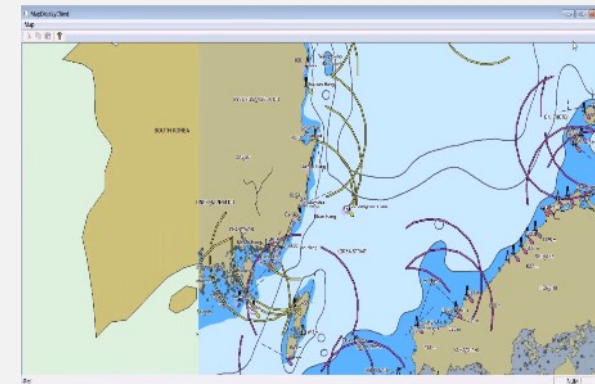
ECS (GMT)



ECS (Samyoung)



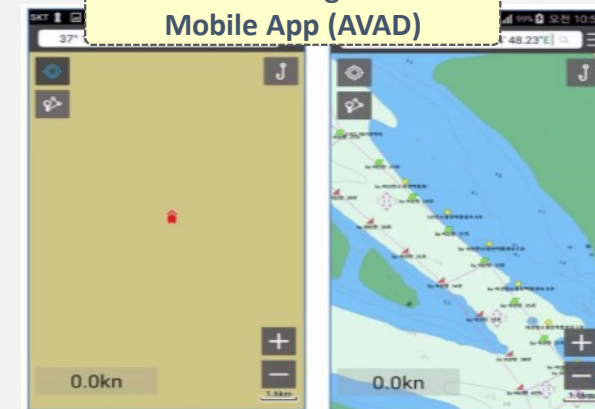
ENC Streaming Server (Naviworks)



ECS (SANE)



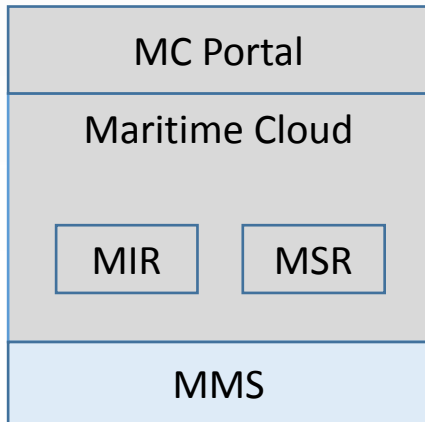
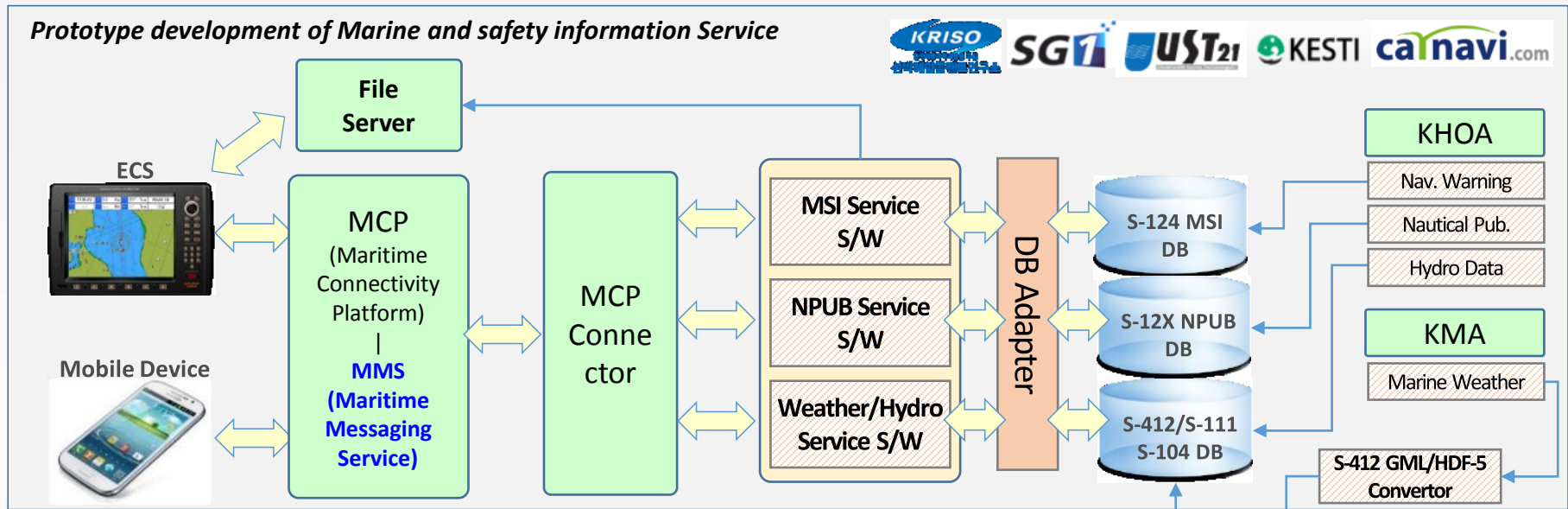
ENC Streaming Service Mobile App (AVAD)



3 ECS Teams
and 2 ENC Streaming
Service Teams

04 Prototype development of e-Nav Service

■ MEDSIS(Prototype of Marine and safety information service)



- 1) Message Relaying
- 2) Message Queueing
- 3) Message Casting
- 4) Seamless Roaming

- 1) Unicasting
- 2) Broadcasting
- 3) Geo-casting
- 4) Multicasting

```

2017-10-25 15:03:54,465 INFO [controller.FileUploadController] Called fileDistribute. targetMrn : urn:mrn:smart:vessel:imo-no:mof:tmp520fors52, fileName : urn:mrn:smart:vessel:imo-no:mof:tmp520fors52_20171025150354_s122_point.gml
2017-10-25 15:03:54,465 INFO [service.FileDistributeService] fileName : 1508911434465.gml
2017-10-25 15:03:54,469 INFO [service.FileDistributeService] requestParam : /e952e604-b702-4303-92c5-14982cc4a154
2017-10-25 15:03:54,469 INFO [service.FileDistributeService] fullUri : http://192.168.0.14:8080/file/download/e952e604-b702-4303-92c5-14982cc4a154
2017-10-25 15:03:54,469 INFO [controller.FileUploadController] {"protocol":"http","port":"8080","ipAddress":"192.168.0.14","context":"/file","resourceUri":"/download","fullUri":"http://192.168.0.14:8080/file/download/e952e604-b702-4303-92c5-14982cc4a154","requestParam":"/e952e604-b702-4303-92c5-14982cc4a154"}
    
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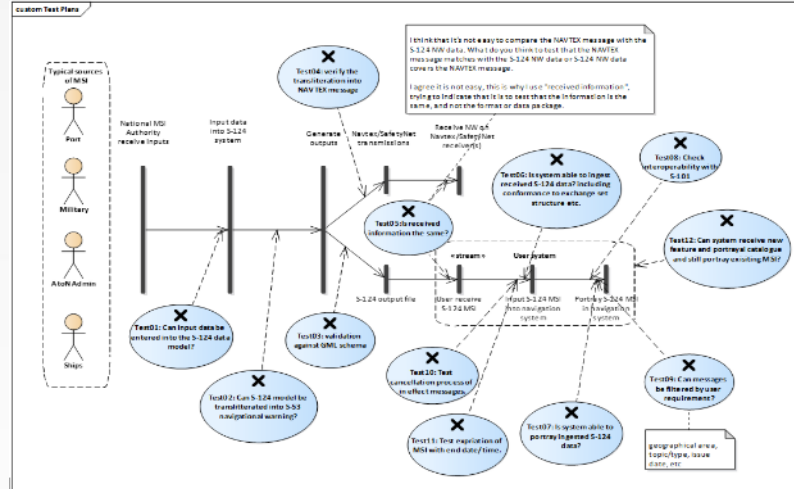
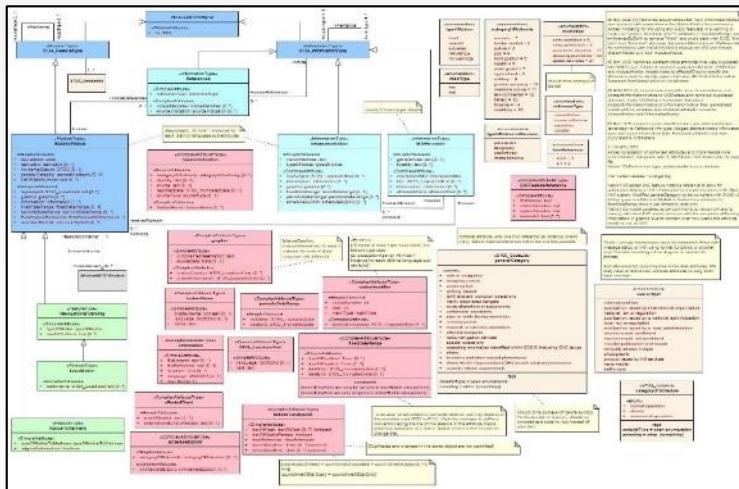
```

10-25 15:03:53.969 [http-bio-8080-exec-7] INFO c.ust21.enavi.api.core.dao.SearchDao.getMbr:128 - getMbr startTime : 20171025150353969000000
10-25 15:03:54.156 [http-bio-8080-exec-7] INFO c.ust21.enavi.api.core.dao.SearchDao.getMbr:130 - getMbr endTime : 20171025150354156000000
    
```


04 Prototype development of e-Nav Service

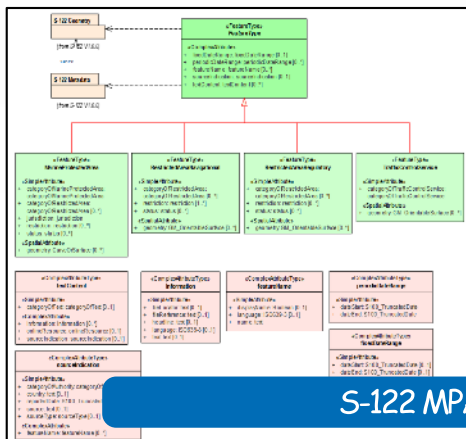
■ S-100 Data model

MSI – S-124 NW data model

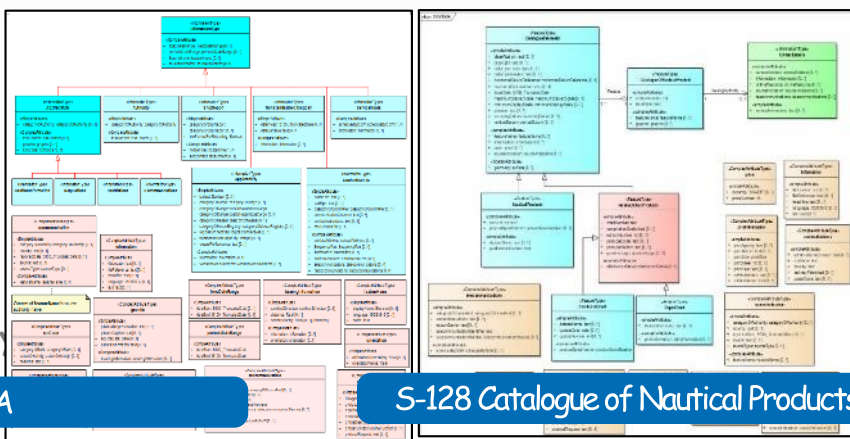


- Thomas Christensen
- Eivind Mong (CCG)
- STM Validation
- DMA NIORD
- SMART Nav. Project

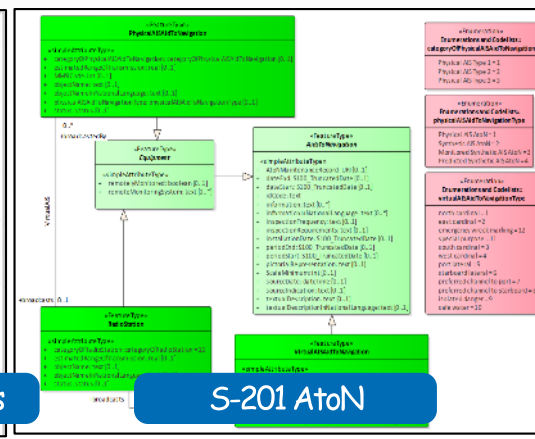
NPUB – S-122 MPA, S-128 Catalogue of Nautical Products, S-201 AtoN



S-122 MPA



S-128 Catalogue of Nautical Products



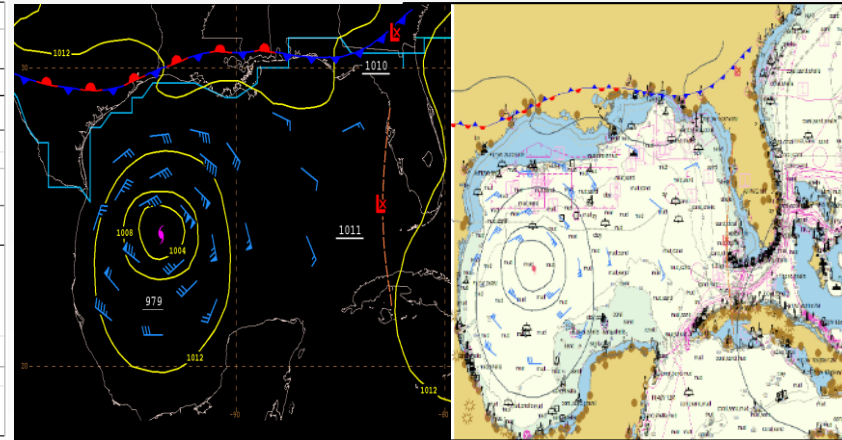
S-201 AtoN

04 Prototype development of e-Nav Service

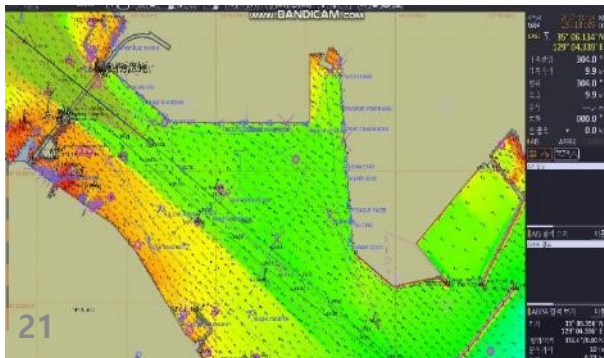
■ S-100 Data model

Marine Weather – S-412

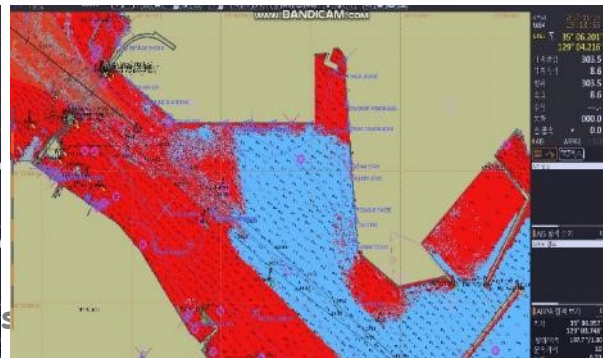
Feature Number	Feature Name	Acronym	Feature Type	Feature	Acronym	Abbrev.	Gateway	SVG Symbols Used	Complete Symbol Legend: no. 1000 according to display mode
1.01	Air Temperature	AIRTEMP	Geo	Atmospheric Pressure	AIRPR	Atmospheric	China		
1.02	Air Pressure	AIRPR	Geo	Centre Of High	CENHP	Geo			
1.03	Centre Of High	CENHP	Geo	Centre Of Low	CENLOW	Geo			
1.04	Centre Of Low	CENLOW	Geo	Cloud	CLOUDS	Geo			
1.05	Cloud	CLOUDS	Geo	Complex Sea	COMSEA	Geo			
1.06	Complex Sea	COMSEA	Geo	Convergent Boundary	CONVBO	Geo			
1.07	Convergent Boundary	CONVBO	Geo	Down-Front Temperature	DFTEMP	Geo			
1.08	Down-Front Temperature	DFTEMP	Geo	Frontal Spray	FRSPRY	Geo			
1.09	Frontal Spray	FRSPRY	Geo	Front	FRONTS	Geo			
1.10	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.11	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.12	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.13	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.14	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.15	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.16	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.17	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.18	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.19	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.20	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.21	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.22	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.23	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.24	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.25	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.26	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.27	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.28	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.29	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.30	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.31	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.32	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.33	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.34	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.35	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.36	Front	FRONTS	Geo	Front	FRONTS	Geo			
1.37	Front	FRONTS	Geo	Front	FRONTS	Geo			



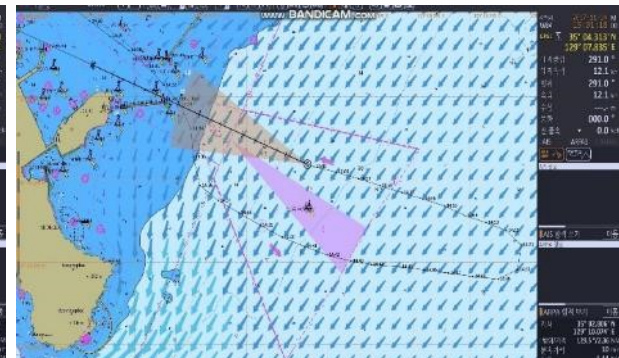
Marine environment and Hydro – S-102 Bathy, S-104 Tidal Height, S-111 Surface current



S-102 Bathymetric surface grid



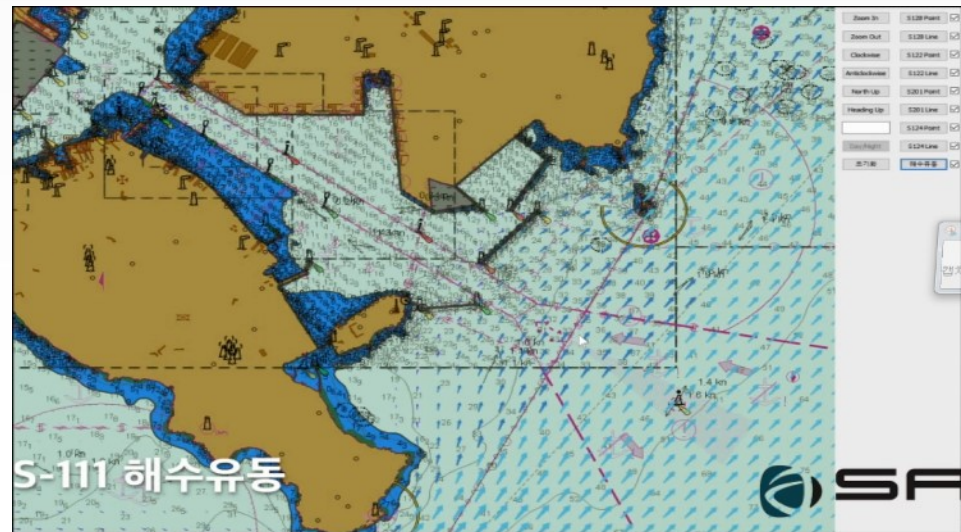
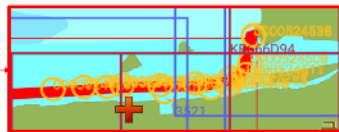
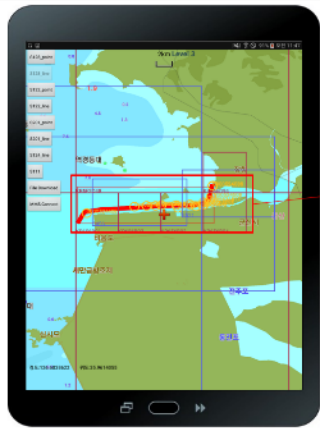
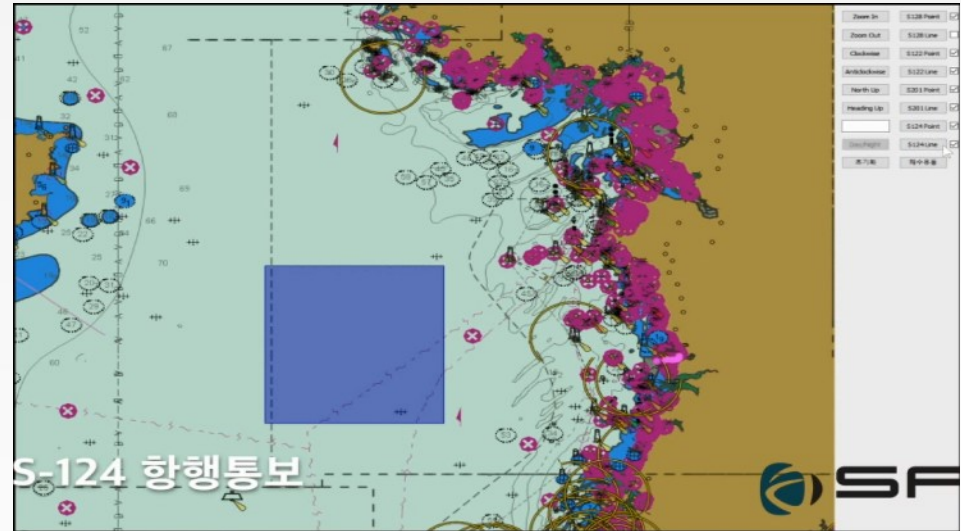
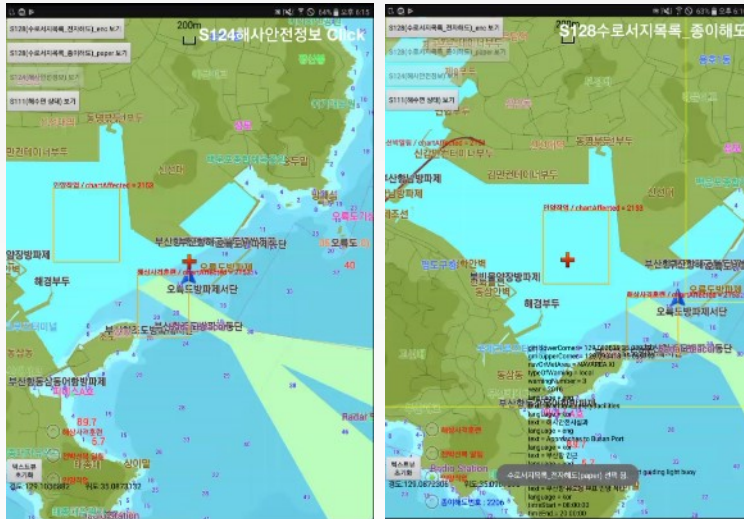
S-104 Tidal Height



S-111 Surface Current

04 Prototype development of e-Nav Service

Test results



fic

04 Prototype development of e-Nav Service

■ User satisfaction survey for the service prototype

- ✓ Title : User Satisfaction Survey for the SMART Service Prototype
- ✓ Date : 18 Dec, 2017
- ✓ Venue : Daejeon Railway Station Meeting Room
- ✓ Participants : Mariners, Fishermen (25 Persons)
- ✓ Survey Results : 56.4 (WP4), 57.53 (WP6)

한국형 e-Navigation 서비스 사용자 만족도 조사 설문지 (공공문형)

1. 최대 어떤 문항에 동의하고 계신가요?

2. 귀하의 연령은?

3. 선박 안전 장비는 얼마나 되시나요?

4. 공항이나 보행자 안전 사고는 어떤 것이 많나요?

5. 해양사고의 주 원인은 어디에 있다고 보시나요?

6. 한국형 e-Navigation 시스템은 어떻게 개선되나요?

7. 한국형 e-Navigation 서비스를 개발에 대해 얼마나 쉬운 사용자에 식별할 수 있는가?

사용자 만족도 조사 설문지

Q1. 소형선박용 전자해도 서비스 사용과 만족도를 규정하는 표준의 필요성을 평가해 주시겠습니까?

Q2. 전자해도 서비스 사용 속도 관련 정보 제공 관련 정보 제공 정도를 평가해 주시겠습니까?

Q3. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?

Q4. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?

Q5. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?

Q6. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?

서비스 도입에 비해 중요도는 저평가되나요?

Q7. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?

Q8. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?

Q9. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?

Q10. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?

Q11. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?

Q12. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?

Q13. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?

Q14. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?

Q15. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?

Q16. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?

Q17. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?

Q18. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?

Q19. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?

Q20. 전자해도 서비스 사용 속도 관련 정보 제공 정도를 평가해 주시겠습니까?



한국형 e-Navigation 서비스 사용자 만족도 계산

Type	SR	Result	Value
SV10	22	22	59.1
SV30	22	22	64.83
SV40	21	21	56.4
SV51	13	13	67.57
SV52	21	21	57.53

Title	[Add]											Calculation	Save	Exit	
만족도 요인별 쌍대 비교															
Question 1															
	Absolutely more important	Very strongly more important	strongly more important	Weakly more important	Equally important	Just equal	Equally important	Weakly more important	strongly more important	Very strongly more important	Absolutely more important				
Q1-1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Q1-2	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Q1-3	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Q1-4	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Q1-5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

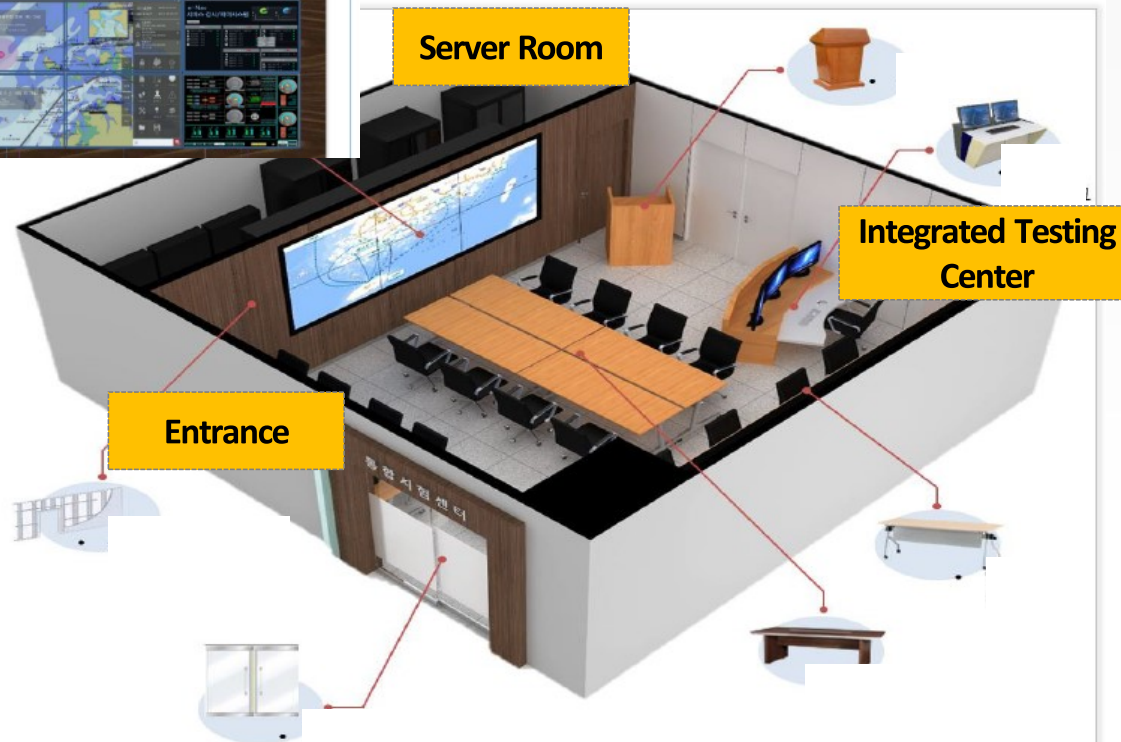
- **Summary of Prototype development**
 - Prototype development of REDSS and MESIS which is ENC service for Non-SOLAS Vessel and Marine information Service based on S-100
 - Concentration of system integration with other research teams considering MSP, MCP and S-100
 - MMS among MCP components (MMS, MIR, MSR) was used in the basic level
 - REDSS consists of two ENC Services for Non-SOLAS Vessels (S-57 ENC and S-101 ENC Download and Update service for ENC, ENC Web Map Tile Service for Mobile App)
 - MESIS consists of four marine information services (MSI, Nautical publication, Marine weather, Marine environ and hydro service) according to international standard based on S-100
 - User satisfaction survey was conducted by the Questionnaire method

05 Future Plan

- **Testing SMART Navigation Services in the Simulation Environ.**
 - SMART Navigation Integrated Test Center was established in KRISO
 - Consists of Integration Operation System and 4 Simulators
 - REDSS and MESIS will be tested completely before installing in real service system

Shore side

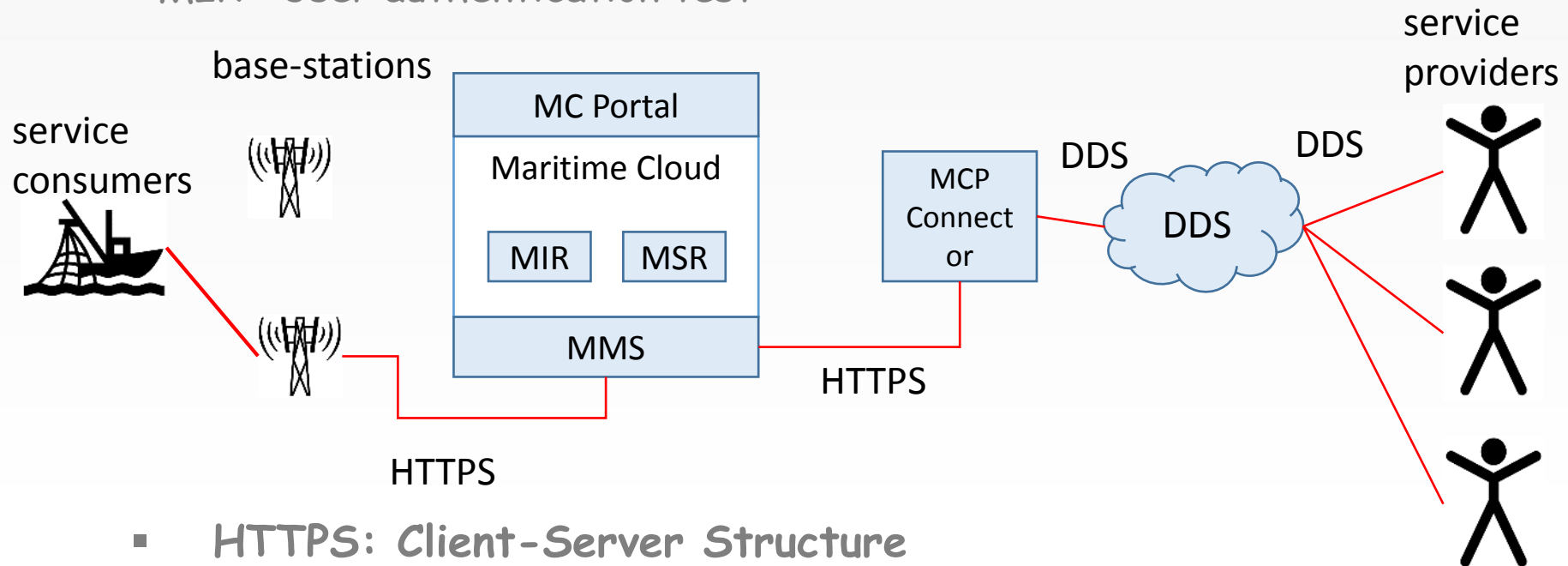
Ship side



05 Future Plan

▪ MCP - MMS, MSR, MIR

- MMS : Relating, Queueing, Roaming and Casting will be tested (Uni, Multi, Geo, Multi-Casting)
- MSR : Revision of Service spec, technical design and service instance and search SMART Navigation Service List and apply those
- MIR : User authentication test



- **HTTPS: Client-Server Structure**
- **DDS: Publisher-Subscriber Structure**

- **Cooperation with KHOA, KCG and KMA**
 - S-101 ENC will be produced and tested by REDSS (S-57/S-101 Download and Update Service for ECS, ENC Streaming Service for Mobile Device Application)
 - S-124 Navigation warning, NAVTEX Message by KCG
 - Nautical Publication (S-122, S-123, S-127, S-128) by KHOA
 - Marine environment and Hydrographic data (S-102 Bathymetric grid, S-104 Tidal height for surface navigation, S-111 Surface Current) by KHOA
 - S-201 Aids to navigation by MOF