



ITU 'Young ICT Leaders Forum 2015'

Maritime digital communication for e-Navigation

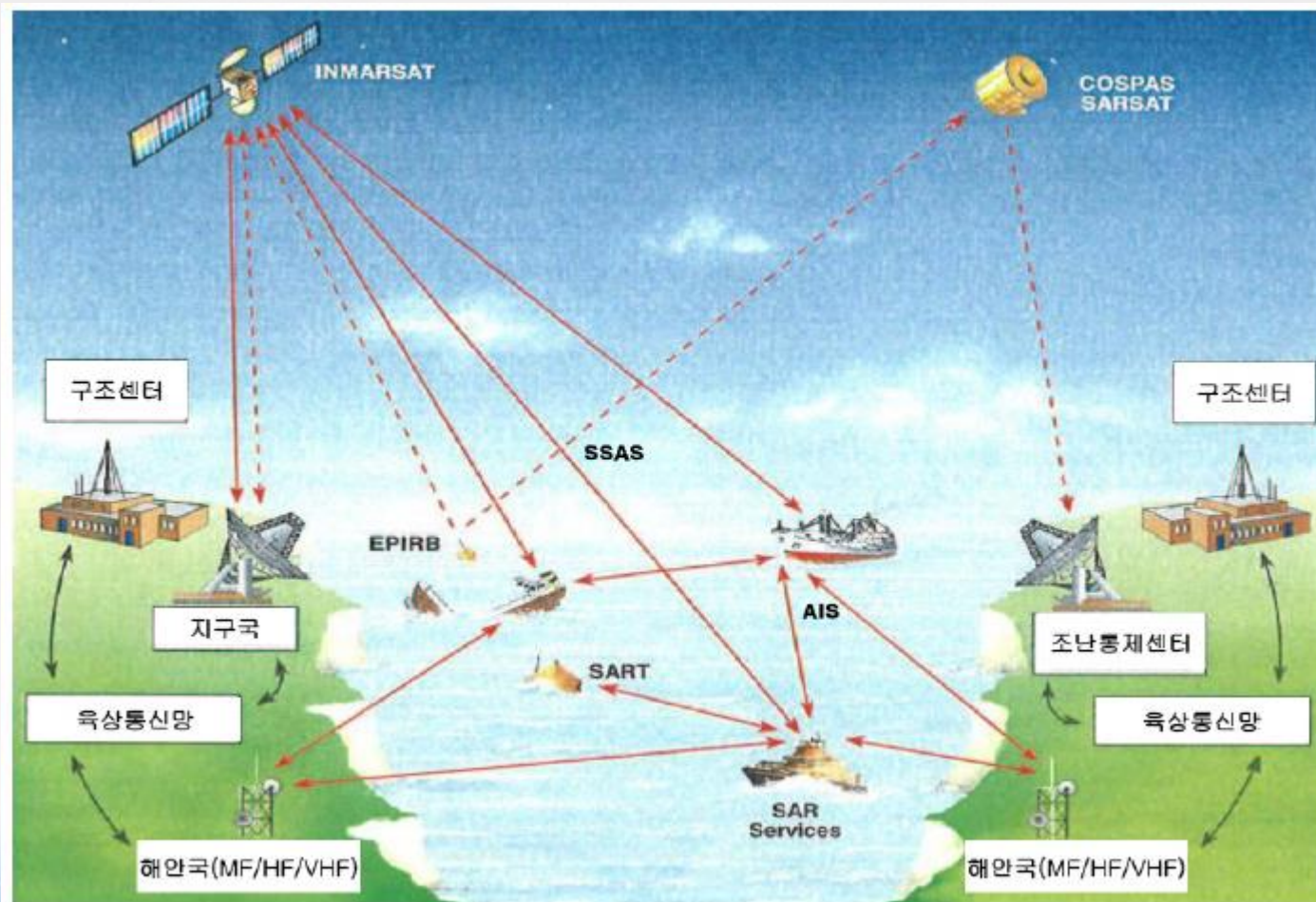
2015. 12. 9. (WED)

Daeho Kim

ETRI

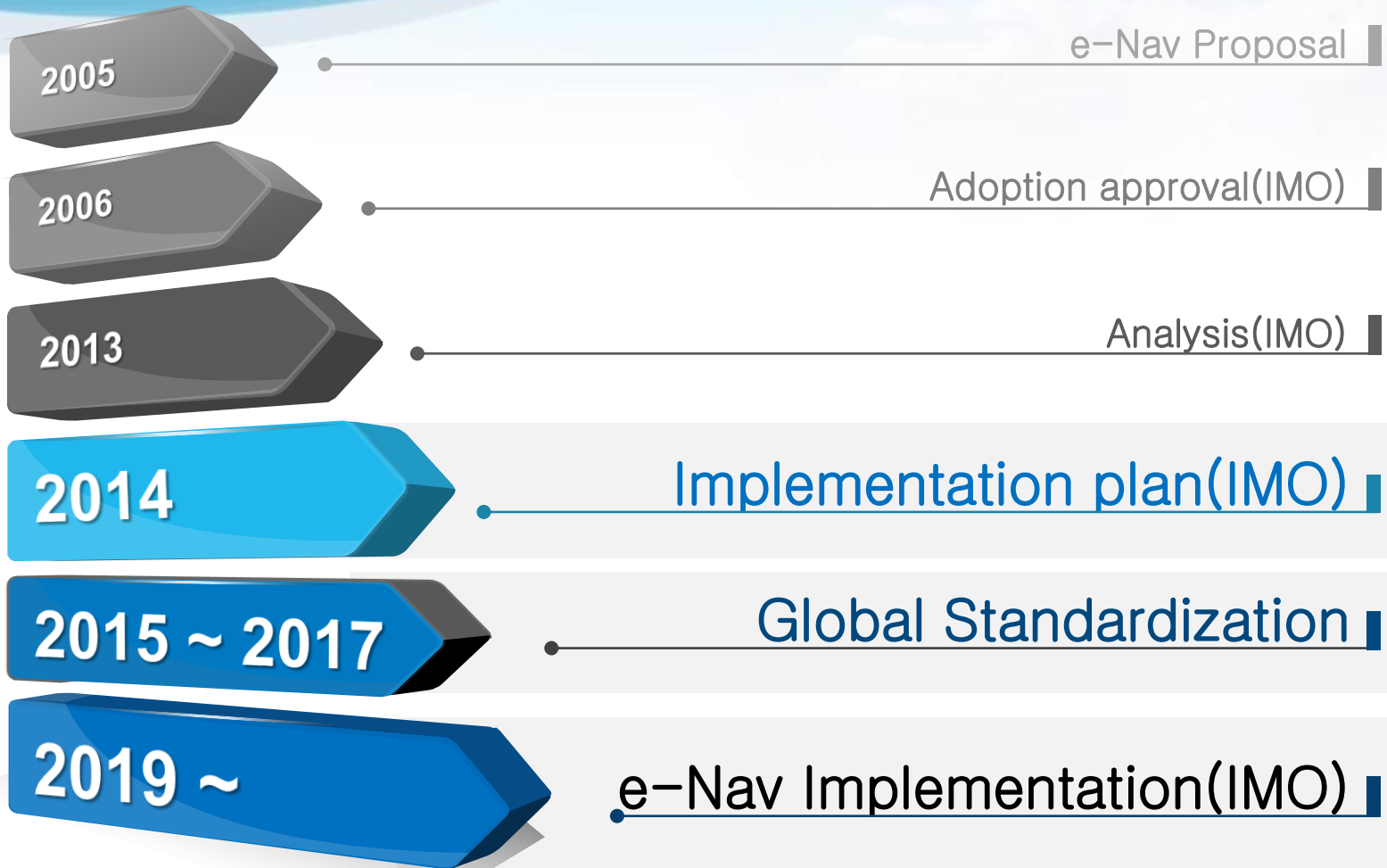


GMDSS Communication



<자료>: ITU-R Telecommunication Seminar(2000)

e-Navigation Roadmap

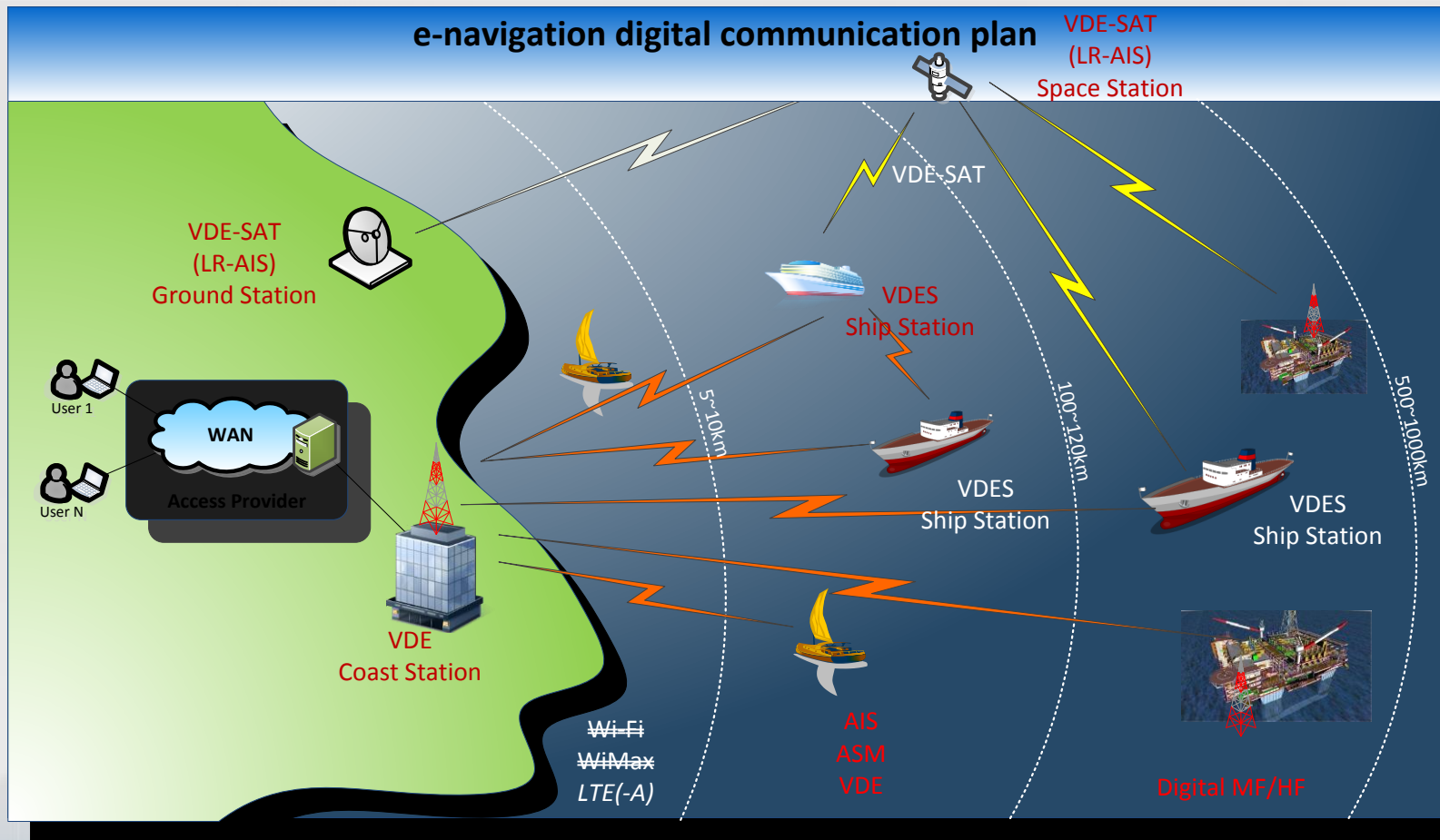




“e-Navigation is the harmonized collection, integration, exchange, presentation and analysis of maritime information onboard and ashore by electronic means to enhance berth to berth navigation and related services, for safety and security at sea and protection of the marine environment”



Digital comm. for e-Navigation (ITU-R)

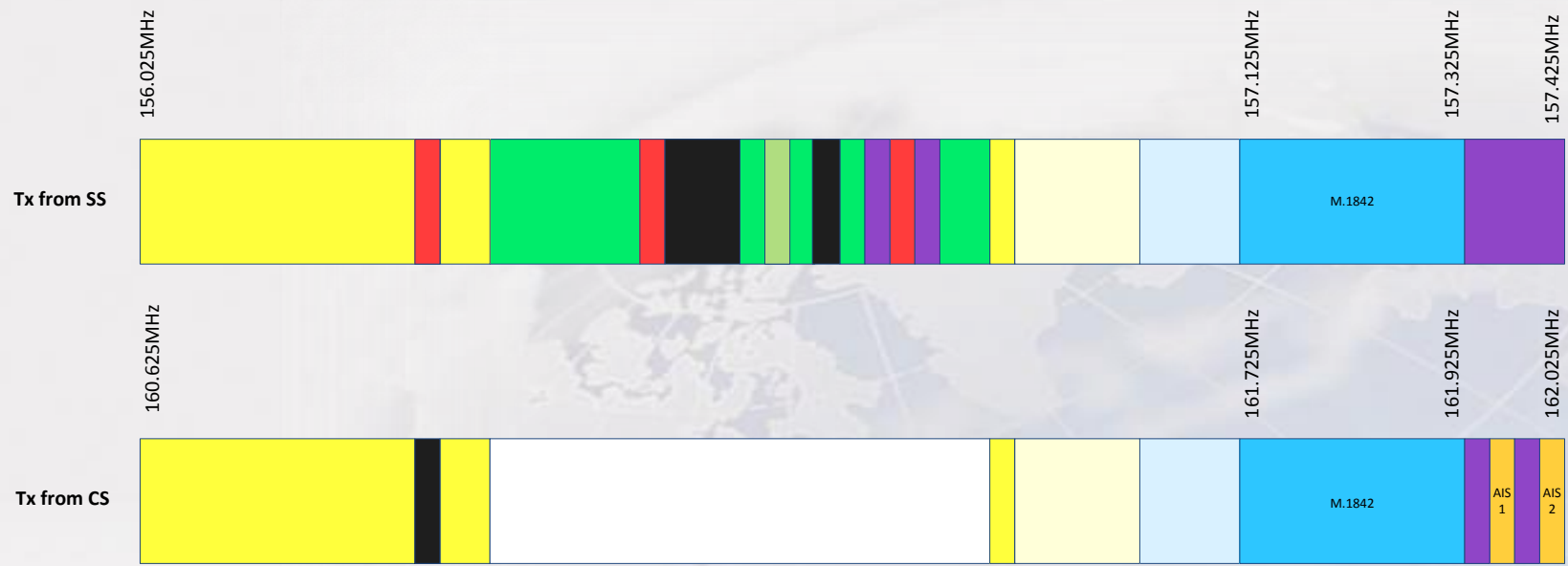


VDE: VHF Data Exchange
 VDE-SAT: VDE Satellite
 VDES: VHF Data Exchange System

AIS: Automatic Identification System
 LR-AIS: Long Range AIS
 ASM: Application Specific Message

Maritime VHF frequency band

❑ Maritime VHF Channel Allocation (WRC-12, RR 18), (2017.1.1. 시행)



VHF Voice(duplex)
VHF Voice(simplex)
Digital Selective Calling
Ship-Ship
Navigation in worldwide
Experimental use
M.1842 from 1 Jan. 2017
Digital VHF until 1 Jan. 2017
Existing AIS
Future AIS

Maritime VHF frequency band

Maritime VHF allocation for digital communication (WRC-12)

ITU-R RR Appendix 18 proposed Regulation

Proposed Maritime VHF Frequency Usage Table – Appendix 18

Channel designator	Notes	Transmitting frequencies (MHz)		Port operations and ship movement	
		From ship stations	From coast stations	Single frequency	Two frequency
15	g)	156.750	156.750	x	
75	n)	156.775	156.775	x	
16	f)	156.800	156.800	DISTRESS, SAFETY AND CALLING	
76	n)	156.825	156.825	x	
17	g)	156.850	156.850	x	
77		156.875			
18	m)	156.900	161.500	x	x
78	m)	156.925	161.525		x
19	m)	156.950	161.550		x
79	m)	156.975	161.575		x
20	m)	157.000	161.600		x
80	m)	157.025	161.625		x
21	m)	157.050	161.650		x
81	m)	157.075	161.675		x
22	m)	157.100	161.700	x	x
82	m), o)	157.125	161.725	x	x
23	m), o)	157.150	161.750	x	x
83	m), o)	157.175	161.775	x	x
24	m), o)	157.200	161.800	x	x
84	m), o)	157.225	161.825	x	x
25	m), o)	157.250	161.850	x	x
85	m), o)	157.275	161.875	x	x
26	m), o)	157.300	161.900	x	x
86	m), o)	157.325	161.925	x	x
27		157.350	ASM1		x
87		157.375	AIS1	x	
28		157.400	ASM2		x
88		157.425	AIS2	x	
AIS 1	f), l), p)	161.975	161.975		
AIS 2	f), l), p)	162.025	162.025		

Maritime VHF allocation(WRC-12)

- Digital VHF Data 주파수 (2017.1.1. ~)
 - CH 80,21,81,22,82,23,83 for M.1842 except in Region 2
 Freq. band 157.025~157.175 MHz
 161.625~161.775 MHz
 - CH 24,84,25,85,26,86 for M.1842 (worldwide)
 Freq. band 157.200~157.325 MHz
 161.800~161.925 MHz
- New AIS frequency (2013.1.1. ~)
 - CH 27,28,87,88 for future AIS
 - CH 75,76 for Long Range AIS

(Ref: 2012, ITU-R RR Appendix 18)

VDES Channel Plans

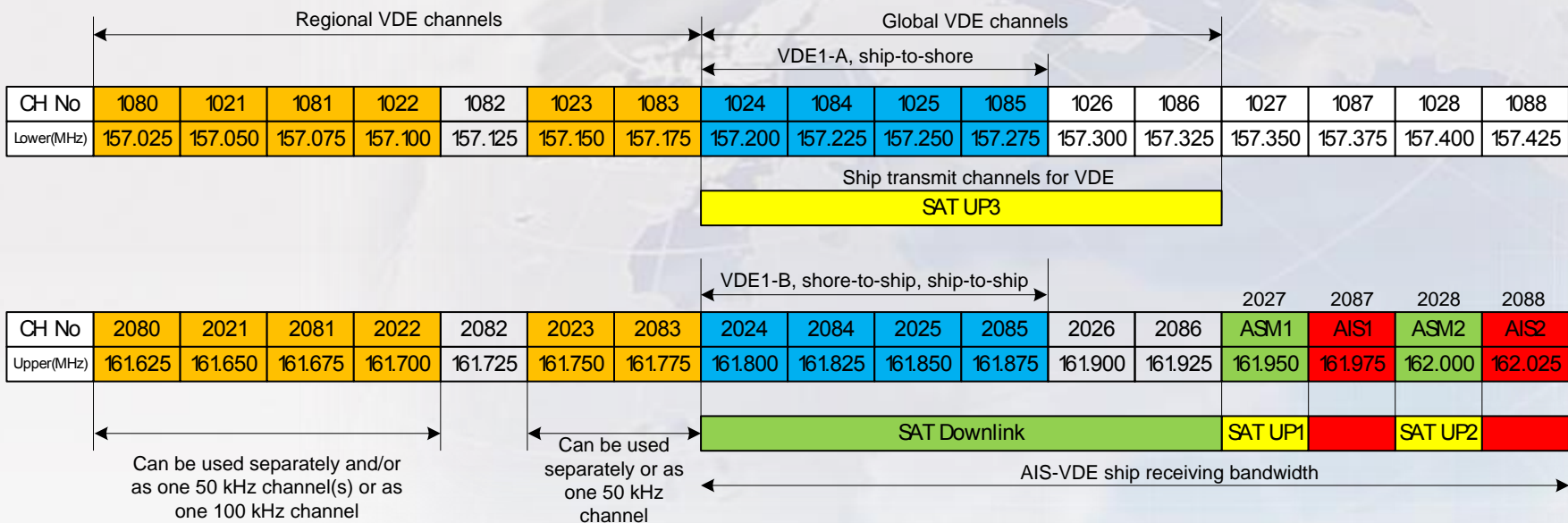
CH No	75		76
(MHz)	156.775		156.825

Long Range(Satellite) AIS

CH No	1078	1019	1079	1020
Lower(MHz)	156.925	156.950	156.975	157.000

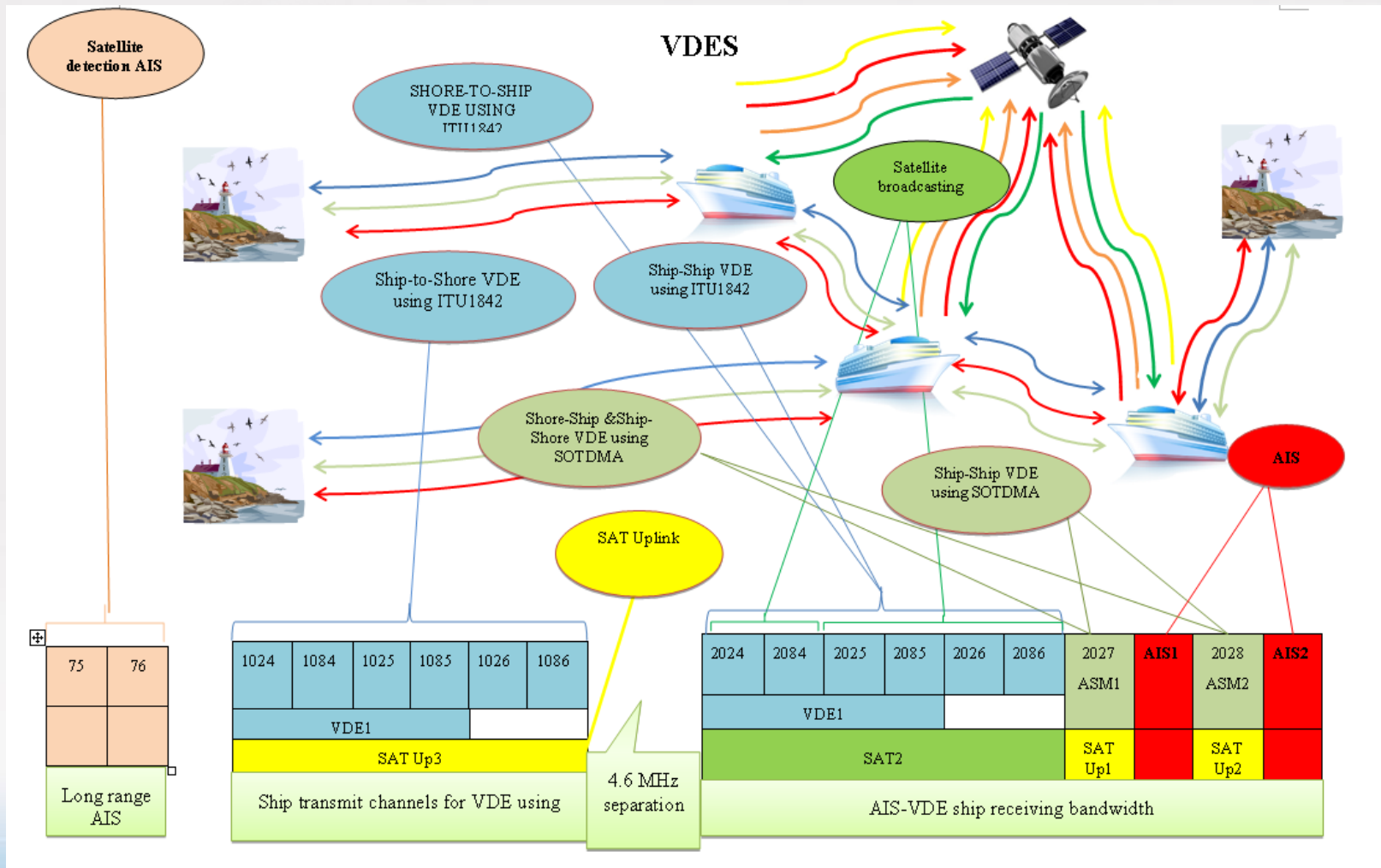
CH No	2078	2019	2079	2020
Upper(MHz)	161.525	161.550	161.575	161.600

Prohibit ship transmit



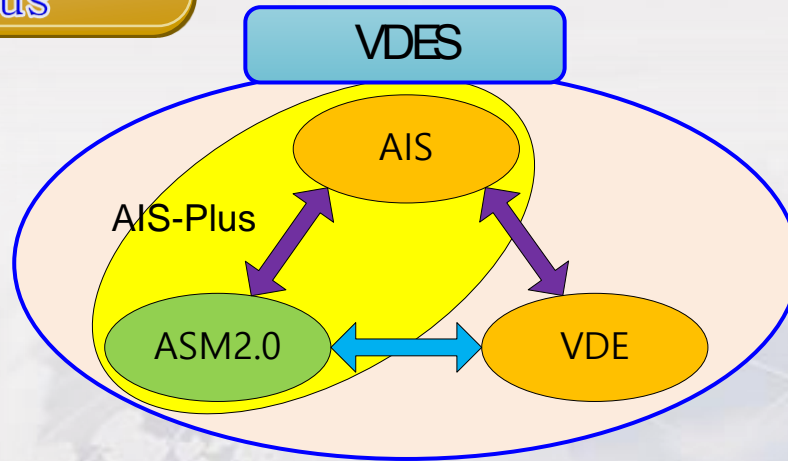


VDES functions and frequency usage





Concept of AIS-plus



AIS	<ul style="list-style-type: none"> • Position, route and speed of ship • MMSI • Non-GPS Sync • Coast station info.(MSG_ID 20) • CH 70: Region Information 	➔	<p>AIS-plus (AIS+ ASM)</p> <p>AIS overload Mitigation & Maritime safety</p>
ASM 2.0	<ul style="list-style-type: none"> • Optimum and safe route exchange • Collision possibility information • Meteorological information • Danger region alert and report • Arrival/departure report 		

MMSI: Maritime Mobile Service Identify

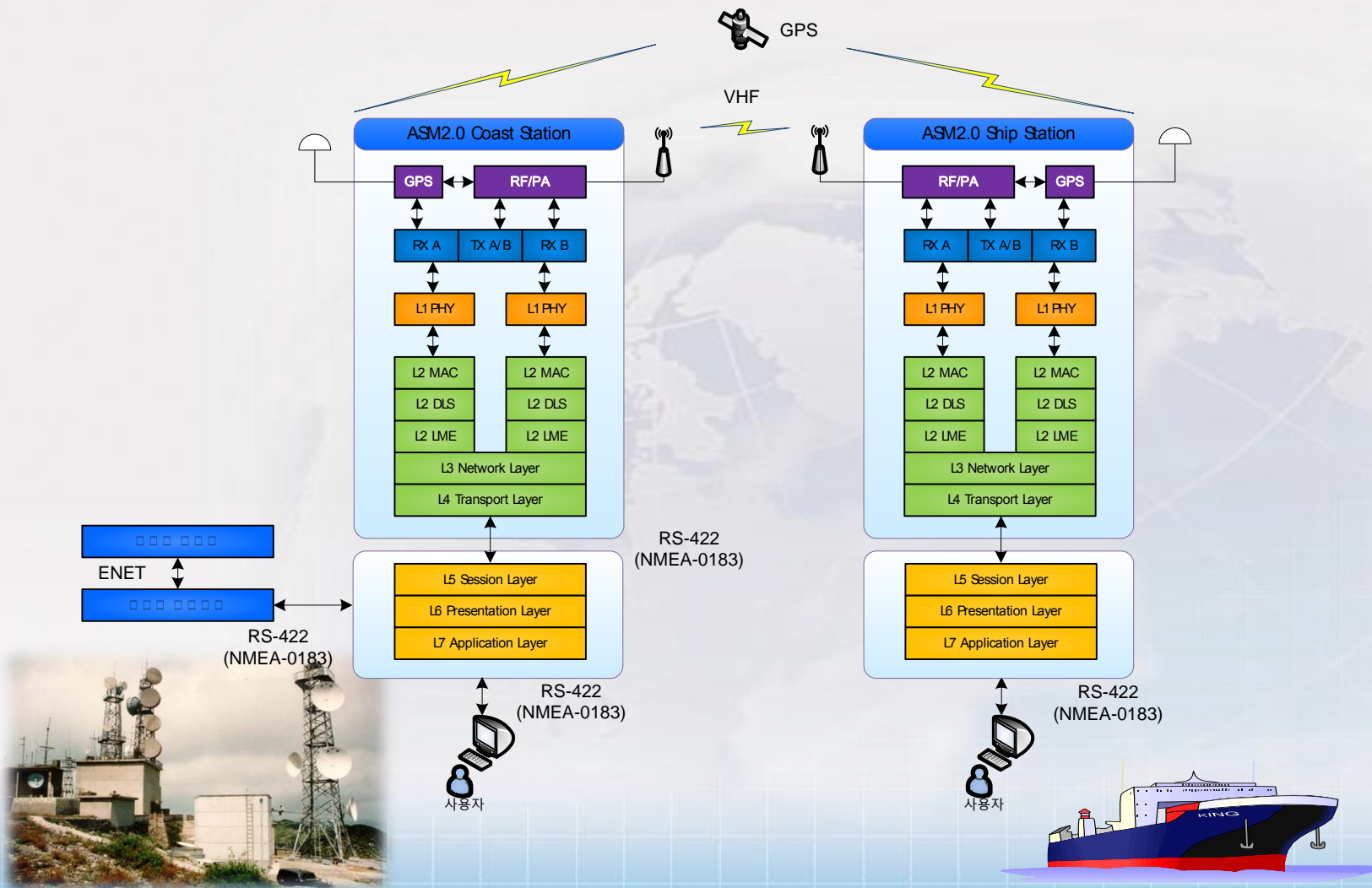
Comparison of AIS and ASM (IALA)

	AIS	ASM2.0		
ITU Standard and Digital Modulation	ITU-R M.1371 GMSK	ITU-R M.1842 Annex 1 $\pi/4$ DQPSK	ITU-R M.1842 Annex 1 $\pi/8$ D8PSK	En 300392-2 v3.2.1 8-OFDM +16-QAM
Data Rate	9.6 kbps (1X)	28.8 kbps (3X)	43.2 kbps (4X)	76.8 kbps (8X)
Bandwidth	25 kHz	25 kHz	25 kHz	25 kHz
Sensitivity	-107dBm	-107dBm	-107dBm	-107dBm
Co-channel rejection (CCR)	10dB	19dB	25dB	19dB
Adjacent channel rejection (ACR)	70dB	70dB	70dB	70dB
AIS Message types	1, 2, 3, 5, 18, 19 ...	6, 7, 8,12,13,14 ...	6, 7, 8,12,13,14 ...	6, 7, 8,12,13,14 ...
Rationale	Optimum choice for recurring position reports in a ship-ship navigation safety environment.	Provides high (3X) data transmission. Inferior CCR (+9dB) and range discrimination.	Provides high (4X) data transmission. Inferior CCR (+15dB) and range discrimination.	Highest (8X) data rate for a 25kHz channel (compress multi-slot messages to a single slot)

Development of ASM system



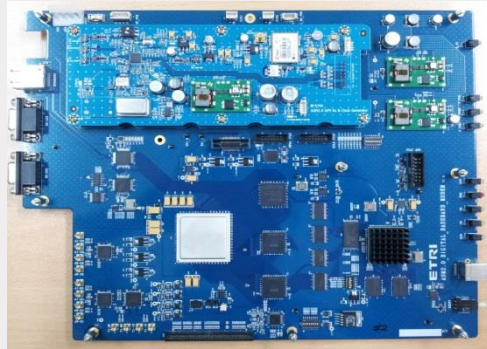
ASM System structure



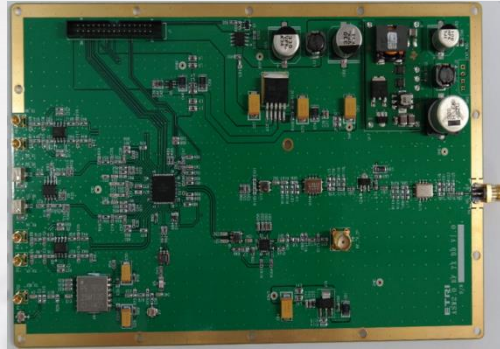
Development of ASM system



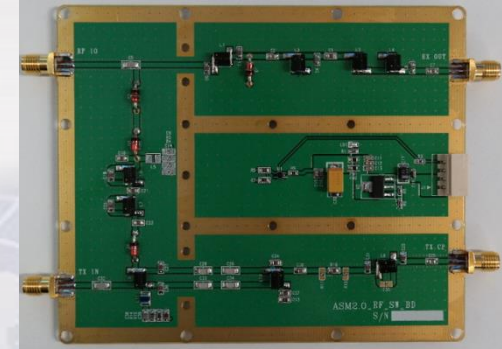
Main component



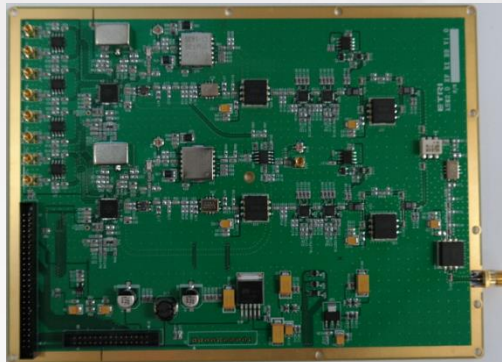
Baseband HW platform for ASM Coast/Ship station



RF Transmitter Module for ASM Coast/Ship station



RF Switch module for ASM Coast/Ship station



RF Receiver module for ASM Coast/Ship station



ASM system for Coast/Ship station



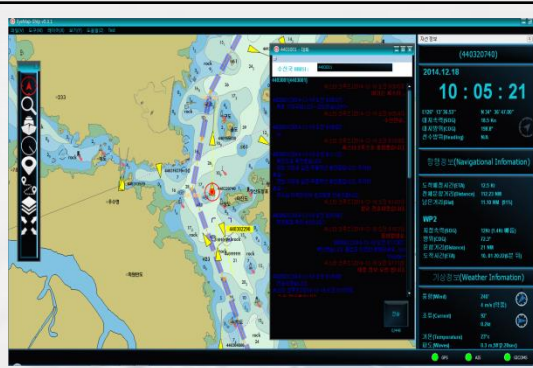
ASM Demonstration

Development of ASM system

Onboard ASM Service Test



Onboard ASM test system



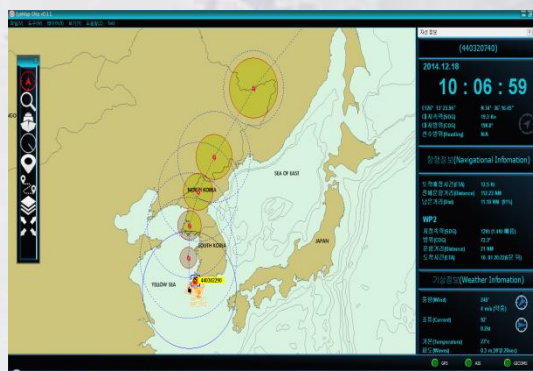
Korean/English based Short Message Service



Recommended sailing routine service



Maritime digital safety service based on ASM system



Maritime meteorological information providing service



Danger region alert and report service

Trial of ASM maritime service



Parameter of ASM maritime service trial

- Date: 2015.3.18
- Cooperation: MOF, NIA KRISO
- CS system: MMU Main hall
Tx Power: 37 dBm
- SS system: Sea Star Cruise Deck
Tx Power: 37 dBm
- CS ↔ SS Max coverage: 45 km
- Frequency: VHF CH 2028 162.000 MHz

Contents of ASM digital maritime service trial

- SS Rx SNR: 15~25 dB
- CS Rx SNR: 14~23 dB
- Korean/English based short messaging
- Recommended route exchange
- Maritime meteorological information
- Danger region alerting and report

Comparison of Data Transfer Methods for VDE

	VDE Data Transfer Methods For 25 kHz Channels	VDE Data Transfer Methods For 50 kHz and 100 kHz Channels	
ITU Standard and Digital Modulation	ITU-R M.1842 Annex 1 $\pi/4$ DQPSK or $\pi/8$ D8PSK or En 300392-2 v3.2.1 Section 5.11* (8-OFDM +16-QAM)	ITU-R M.1842 Annex 3 16-OFDM + 16-QAM	ITU-R M.1842 Annex 4 32-OFDM + 16-QAM
Data Rate	28.8 or 43.2 kbps (3X or 4X) or 76.8 kbps (8X)	153.6 kbps (16X)	307.2 kbps (32X)
Sensitivity	-107dBm (ship & shore)	-103dBm (ship stations)	-98dBm (ship stations)
Co-channel rejection (CCR)	19dB or 25dB	19dB	19dB
Adjacent channel rejection (ACR)	70dB	70dB	70dB
Message types	AIS 6, 7, 8,12,13,14 and ASM	VDE messages TBD	VDE messages TBD
Rationale	Provides higher (3X or 4X) data transmission than AIS. Inferior CCR (+9dB or +15dB) and range discrimination compared to AIS.	Provides much higher (16X) data transmission than AIS. Inferior CCR (+9dB) and range discrimination compared to AIS.	Provides much higher (32X) data transmission than AIS. Inferior CCR (+9dB) and range discrimination compared to AIS.

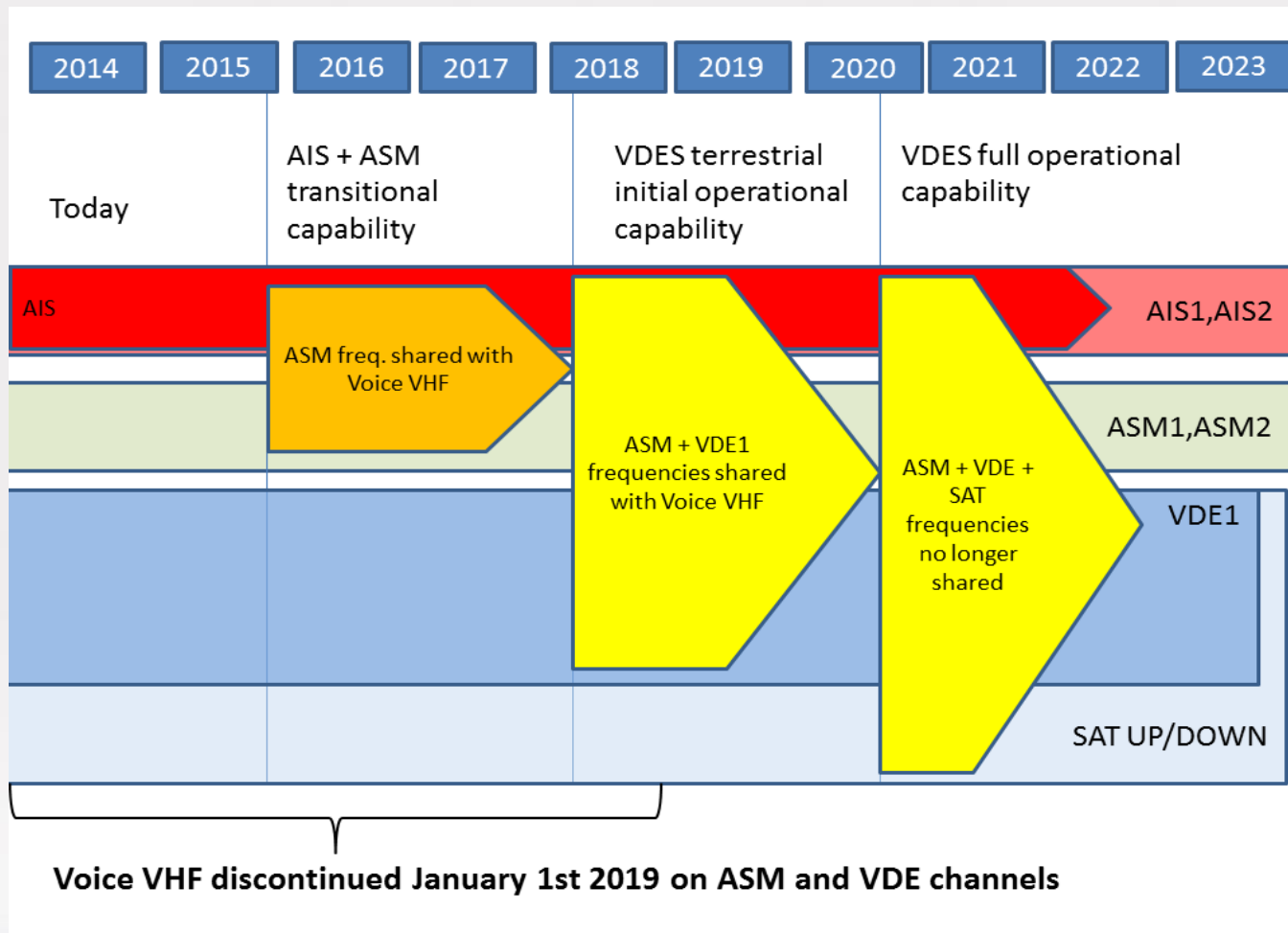
RR Appendix 18 channels used for VDES applications: AIS, ASM, VDE and SAT

Channel Number (RR Appendix 18)	Transmission Frequency(MHz) for Ship and Coast Station		Notes
	Ship stations : UL (ship-to-shore) (long range AIS) (ship-to-satellite)	Coast stations : DL Ship stations (ship-to-ship) Satellite-to-ship	
AIS 1	161.975	161.975	ITU-R M.1371-5
AIS 2	162.025	162.025	
LR-AIS (75)	156.775 (ships are Tx only)	N/A	ITU-R M.1371 (?) SAT Rx Only Permitted from 2013.1.1
LR-AIS (76)	156.825 (ships are Tx only)	N/A	
ASM 1 (2027)	161.950 (2027)	161.950 (2027)	ITU-R M.[VDES] ASM: Application Specific Messages Permitted from 2013.1.1.
ASM 2 (2028)	162.000 (2028)	162.000 (2028)	
VDE1 (24/84/25/85)	100kHz CH BW Ship to Shore Ship to Satellite (<i>Condition</i>)	100kHz CH BW Shore to Ship, Ship to Ship Satellite to Ship(<i>Condition</i>)	ITU-R M.[VDES] Permitted from 2017.1.1.
	157.200(1024), 157.225(1084) 157.250(1025), 157.275(1085)	161.800(2024), 161.825(2084) 161.850(2025), 161.875(2085)	
VDE-SAT (24/84/25/85/26/86)	150kHz CH BW Ship to Satellite	150kHz CH BW Satellite to Ship	ITU-R M.[VDES] SAT2, SAT UP1/2/3
	1024 ~ 1086	2024 ~ 2086	

Communication Schemes and Components for Maritime Digital Communication

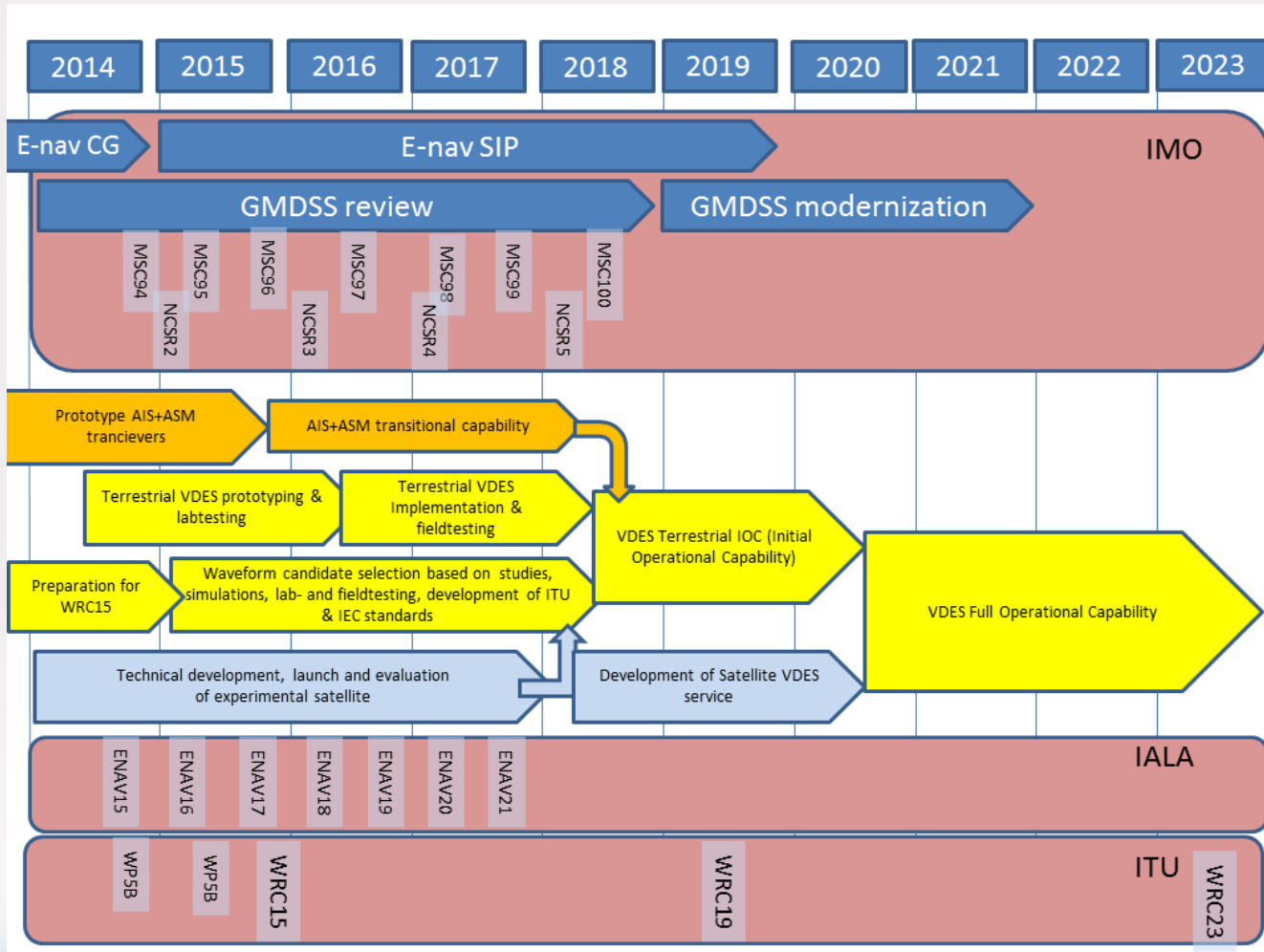
Freq.	Communications Scheme	Ship stations	Coast stations	Notes
VHF	AIS 1/2	AIS Ship Station	AIS Coast Station	ITU-R M.1371-5
	ASM 1/2	ASM Ship Station	ASM Coast Station	8-OFDM +16-QAM (76.8kbps (8X))
	VDE (24/84/25/85)	VDE Ship Station Annex 1,3,4	VDE Coast Station Annex 1,3,4	ITU-R M.[VDES]
	LR AIS (75/76)	Satellite LR-AIS Transmitter	Satellite LR-AIS Receiver	ITU-R M.[LR-AIS]
	VDE-SAT (26/86)	SS for VDE-SAT (SAT1 + SAT2 Rx) (SAT3 Tx)	위성탑재 송신기 (SAT1/2) 위성탑재 수신기(SAT3) 위성 지상국	ITU-R M.[VDES]
	VDES (AIS, ASM, VDE)	VDES Ship Station	VDES Coast Station VDE-SAT Satellite Station VDE-SAT Earth Station	ITU-R M.[VDES]
	HF	Digital HF	Digital HF Ship Station	Digital HF Coast Station
MF	Digital MF	Digital MF Ship Station	Digital MF Coast Station	디지털 MF: M.2010(NAVDAT) 495~505 kHz, 250/350 NM 15/25 kbps(flow rate)

Roadmap for VDES



Possible roadmap for operational availability (IALA)

Roadmap for VDES development



Possible roadmap for the development of VDES (IALA)

Thank you !!

