

UK Marine Autonomous Systems Regulatory Working Group Conference 16th to 17th Nov., 2016  
Unmanned Surface Vessel Regulation – The Human Element

**Towards the establishment of  
USV regulation in Korea**

**- Part 3. Research activities for remotely controlled USV  
communication systems in Korea**

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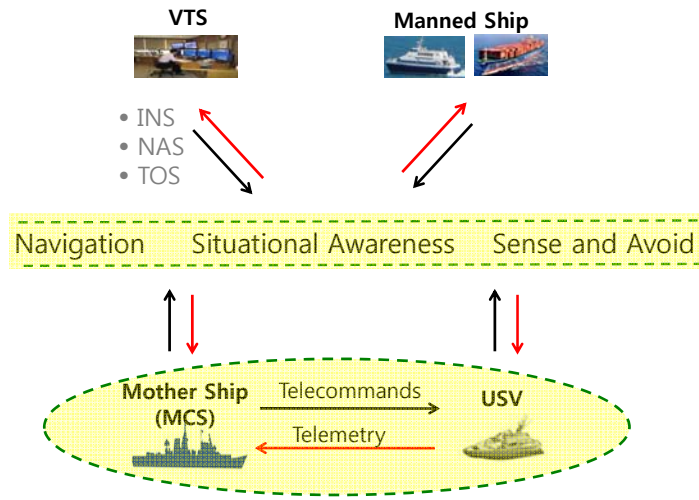
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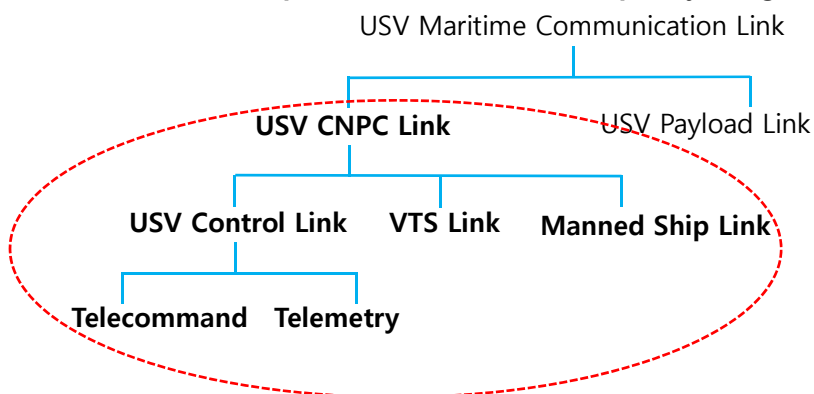
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### 1. Introduction – USV remotely controlled by MCS

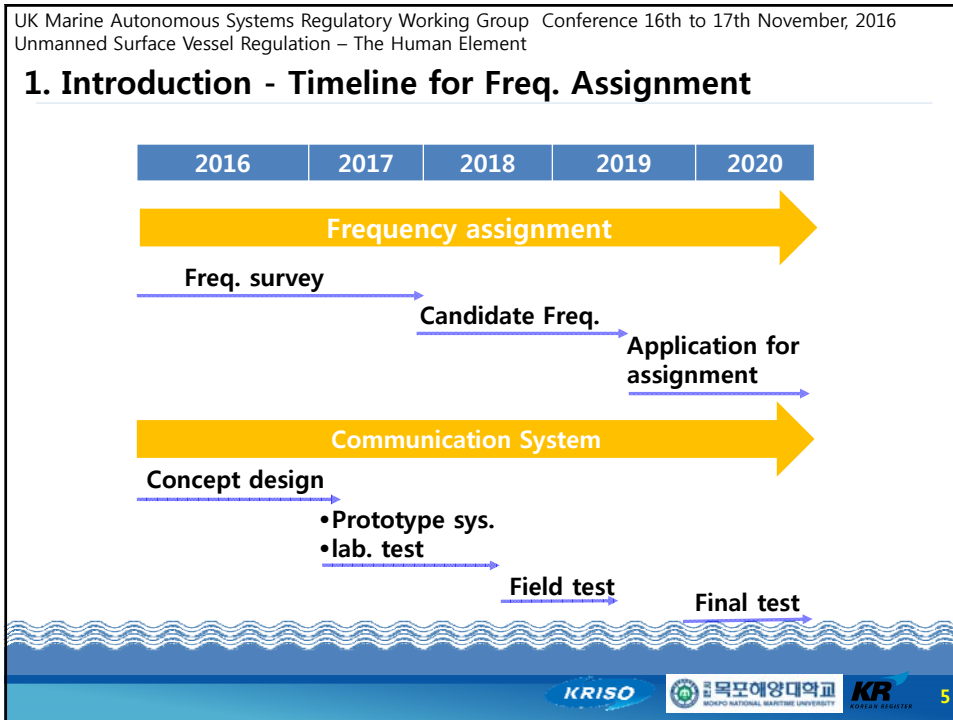


### 1. Introduction

#### (1) Minimum data requirements for CNPC : Frequency Assignment



#### (2) USV system combined with existing maritime communication systems



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### 2. Min. Data Req. for CNPC : S & A (1/4)

#### A. CORLEG '72 : Part B Steering and Sailing Rules

Section I Conduct of vessels in any condition of visibility	Section II Conduct of vessels in sight of one another	Section III Conduct of vessels in restricted visibility

#### B. IALA Guideline No. 1089 on Provision of Type of Services(INS, NAS, TOS), 2012




Information Service	Navigational Assistance Service	Traffic Organization Service
[Navigation Situations] [Navigational Warnings] [Meteorology & Warning] [Hydrography].	[Request and identification] [Advice] [Warning]	[Traffic clearance] [Enforcement] [Waterway management]

Logos: KRISO, 목포해양대학교 (Mokpo National Maritime University), KR (Korean Register)

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## 2. Min. Data Req. for CNPC : S & A (2/4)

C&C	Sense & Avoid	Situation Awareness
<ul style="list-style-type: none"> <li>▪ Type of ship, Position</li> <li>▪ Time stamp</li> <li>▪ Heading, ROT, Course, Speed, Way points</li> <li>▪ Lights</li> <li>▪ Special manoeuver</li> <li>▪ Trim, heeling, draught</li> <li>▪ Depth, wind direction, wind force, sea state (wave &amp; swell, height, direction),</li> <li>▪ Air pressure, temperature, salinity, engine status etc</li> </ul>	<ul style="list-style-type: none"> <li>▪ Ship name, type of cargo, LOA, ETA, draught, destination,</li> <li>▪ Navigation status,</li> <li>▪ Position, course, speed, ROT,</li> <li>▪ Intension, target track data etc</li> </ul>	<ul style="list-style-type: none"> <li>▪ Visibility etc</li> <li>- Image/Video</li> <li>▪ Radar Image</li> <li>▪ AIS Information</li> </ul>




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## 2. Min. Data Req. for CNPC : S & A (3/4)

Command & Control		VTS			Situation Awareness	Sense & Avoid	
Telecommand	Telemetry	Voice	Data		Video	Target Tracking	Radar
UL	DL	UL/DL	UL	DL	DL		
174	262	25kHz	60	4,530	600,000	296	100,055

UL	DL
316bps	141.943 kbps + optional 810kbps
Remark : Overhead 35% was included	

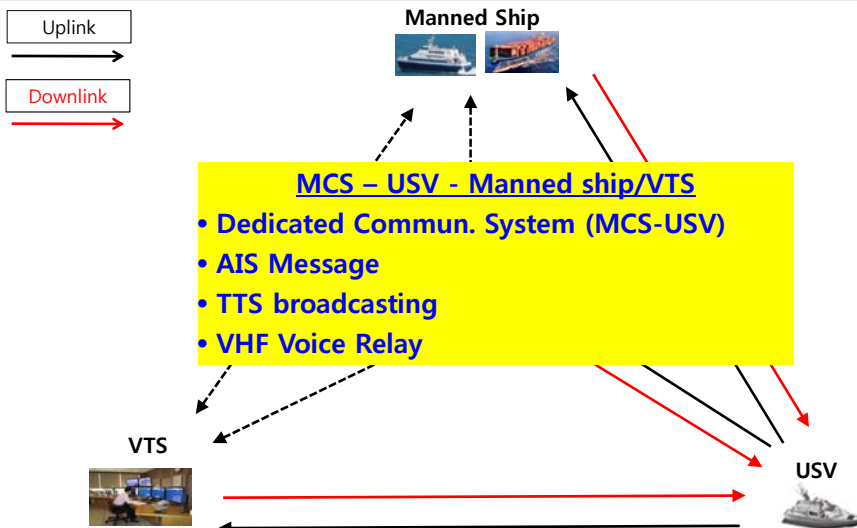



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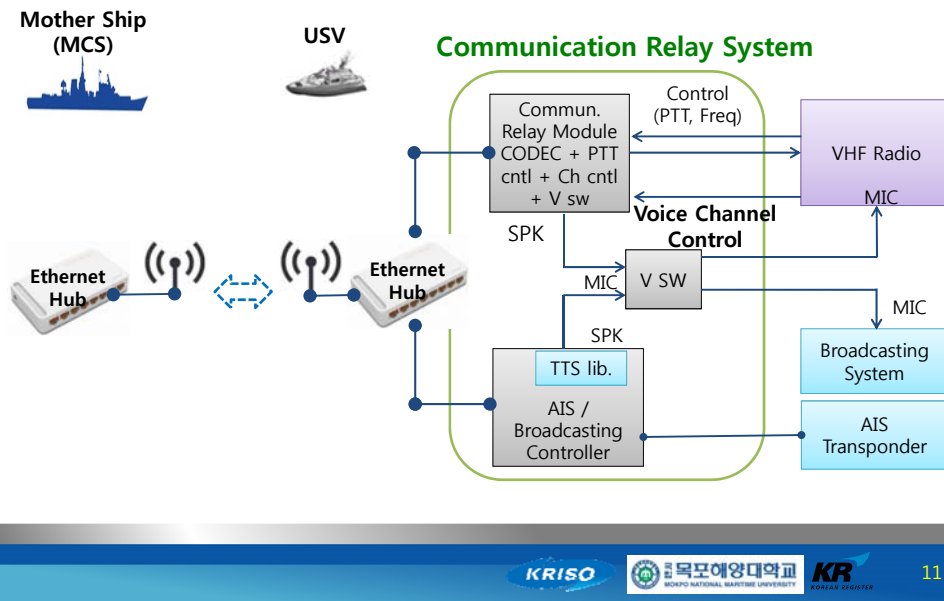
## 2. Min. Data Req. for CNPC : S & A (4/4)

Phase 1	Phase 2	Phase 3
<ul style="list-style-type: none"> <li>• USV Info.</li> <li>• Target Info.</li> <li>• Control &amp; Command</li> <li>• Image</li> </ul>	<ul style="list-style-type: none"> <li>• USV Info.</li> <li>• Target Info.</li> <li>• Control &amp; Command</li> <li>• Video Image,</li> <li>• Radar Image</li> <li>• AIS/LiDar</li> </ul>	<ul style="list-style-type: none"> <li>• USV Info.</li> <li>• Target Info.</li> <li>• Control &amp; Command</li> <li>• Image</li> <li>• Radar/AIS/LiDar</li> </ul>
146.8kbps	264.7kbps	515.7kbps

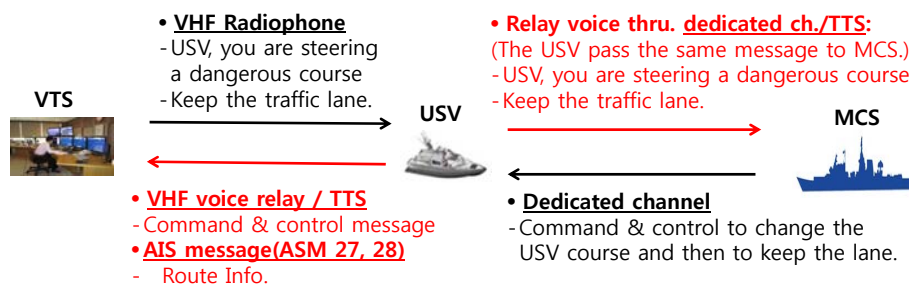
## 3. USV Communication Systems



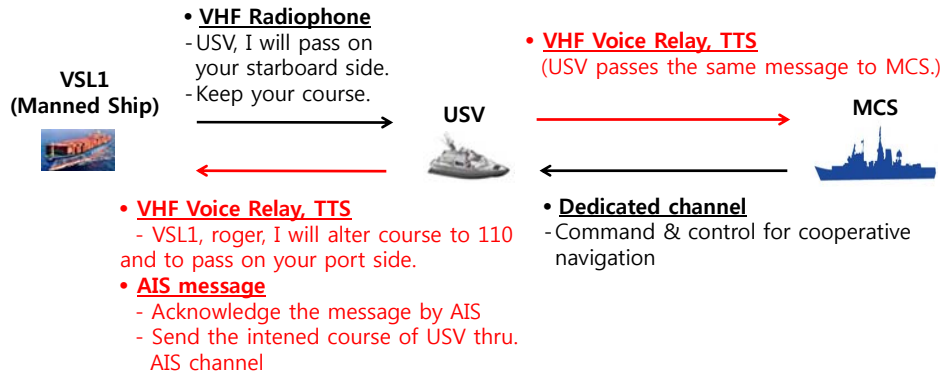
### 3. USV Communication Systems



### 4. Information exchange : (e.g 1) VTS – USV - MCS

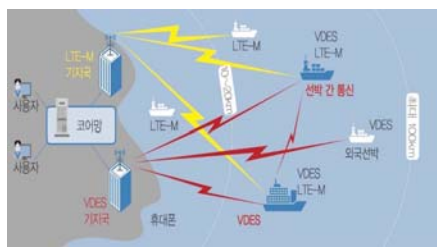


### 4. Information exchange : (e.g 2) VSL1 – USV - MCS



### 5. Candidate freq. bands

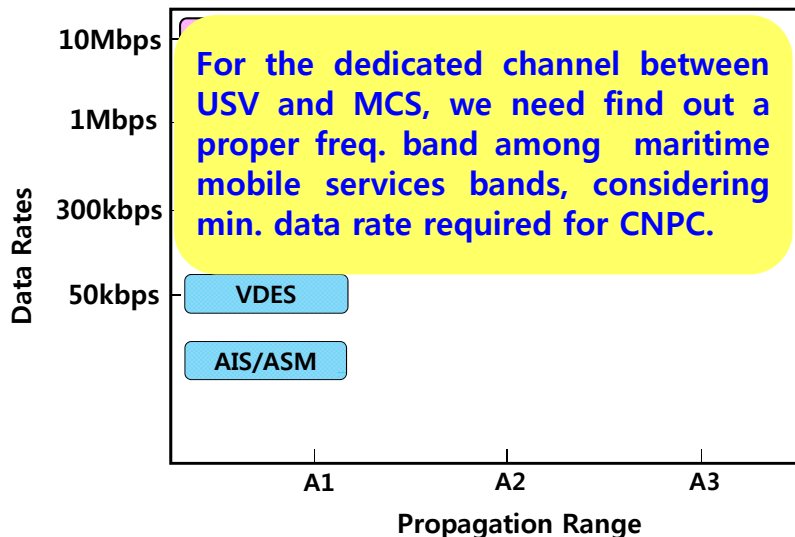
– Future plan for implementation of e-Navigation in Korean waters (2016~2020)



**LTE-M (20MHz)**

DL: 773-783MHz - 20Mbps  
UL: 718-728MHz - 10Mbps

## 5. Candidate freq. bands



## 6. Conclusion

- The implementation of USV communication system has been considered to be phased in, using the existing communication system
  - 4S Communication should be also considered: USV - Manned ship, USV – VTS/CG Monitoring Station
- To be phased in implemenration, we need to establish standard communication procedures based on CORLEG, and secondly, cooperative navigation
- ◆ For feasibility study, message standardization should be considered to operate USV, considering autonomous level