# Towards the establishment of USV regulation in Korea

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

**17th November 2016**

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

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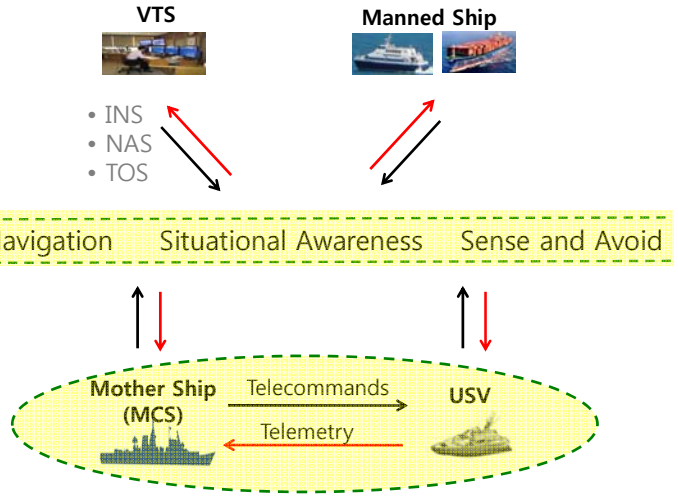
## 1. Introduction – USV remotely controlled by MCS

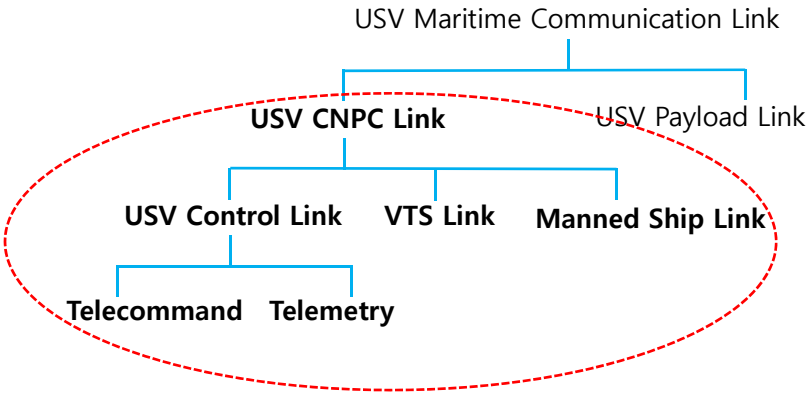






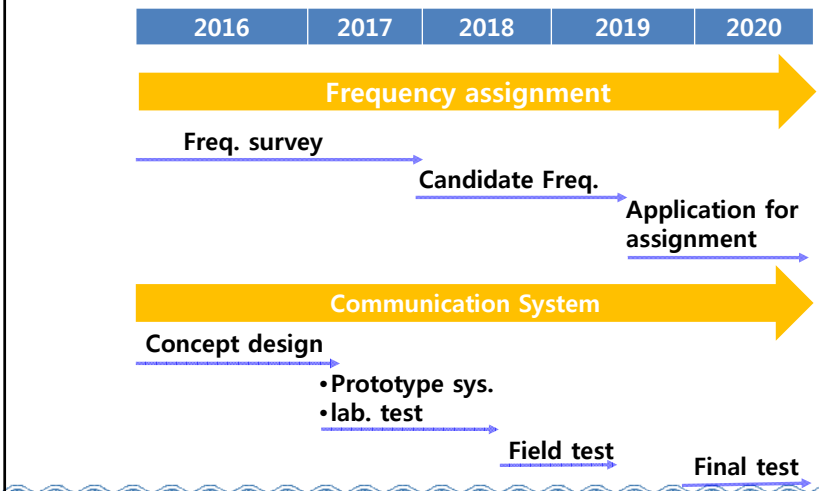

## 1. Introduction

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




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

## 1. Introduction - Timeline for Freq. Assignment








## 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] |

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

| C&C | Sense & Avoid | Situation Awareness |
|---|---|---|
| ▪ Type of ship, Position<br>▪ Time stamp<br>▪ Heading, ROT, Course, Speed, Way points<br>▪ Lights<br>▪ Special manoeuver<br>▪ Trim, heeling, draught<br>▪ Depth, wind direction, wind force, sea state (wave & swell, height, direction),<br>▪ Air pressure, temperature, salinity, engine status etc | ▪ Ship name, type of cargo, LOA, ETA, draught, destination,<br>▪ Navigation status,<br>▪ Position, course, speed, ROT,<br>▪ Intension, target track data etc | ▪ Visibility etc<br>- Image/Video<br>▪ Radar Image<br>▪ AIS Information |



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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 | |

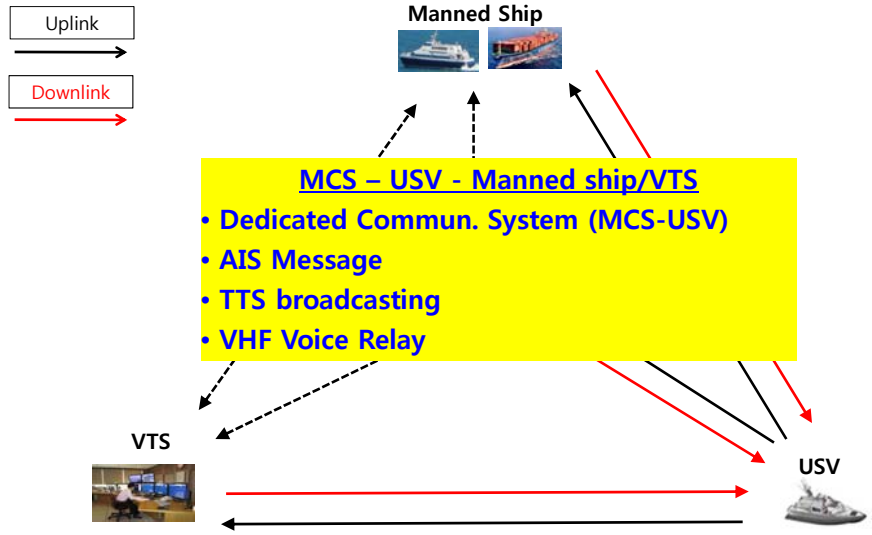
## 2. Min. Data Req. for CNPC : S & A (4/4)

| Phase 1 | Phase 2 | Phase 3 |
|---|---|---|
| • USV Info.<br>• Target Info.<br>• Control & Command<br>• Image | • USV Info.<br>• Target Info.<br>• Control & Command<br>• Video Image,<br>• Radar Image<br>• AIS/LiDar | • USV Info.<br>• Target Info.<br>• Control & Command<br>• Image<br>• Radar/AIS/LiDar |
| 146.8kbps | 264.7kbps | 515.7kbps |

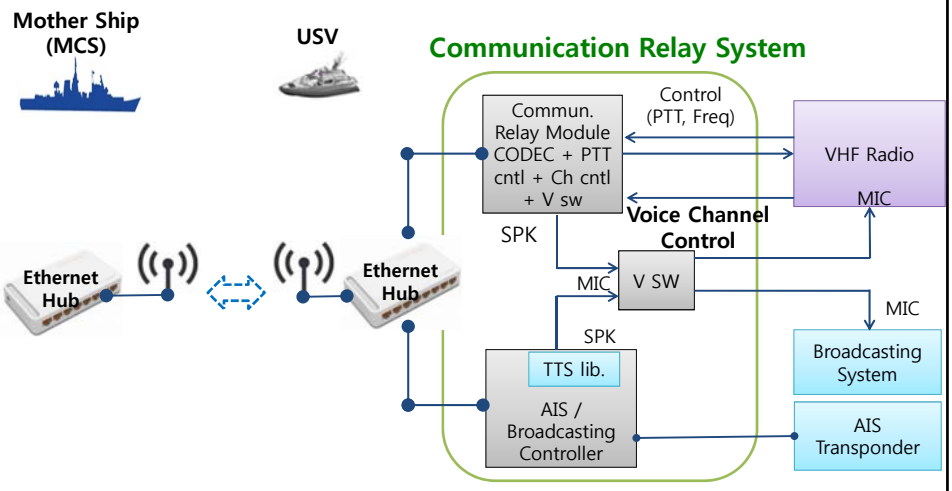




## 3. USV Communication Systems



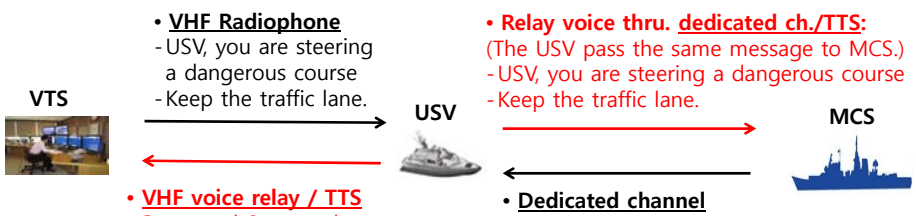
## 3. USV Communication Systems








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



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

**VSL1 (Manned Ship)**

• **VHF Radiophone**
- USV, I will pass on your starboard side.
- Keep your course.

→

**USV**

• **VHF Voice Relay, TTS**
(USV passes the same message to MCS.)

→

**MCS**

←

• **Dedicated channel**
- Command & control for cooperative navigation

←

• **VHF Voice Relay, TTS**
- VSL1, roger, I will alter course to 110 and to pass on your port side.

• **AIS message**
- Acknowledge the message by AIS
- Send the intened course of USV thru. AIS channel



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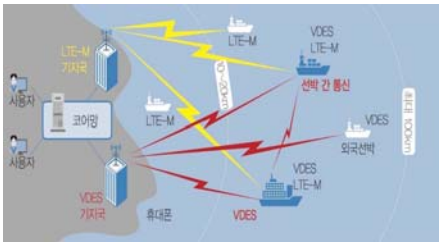
## 5. Candidate freq. bands

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

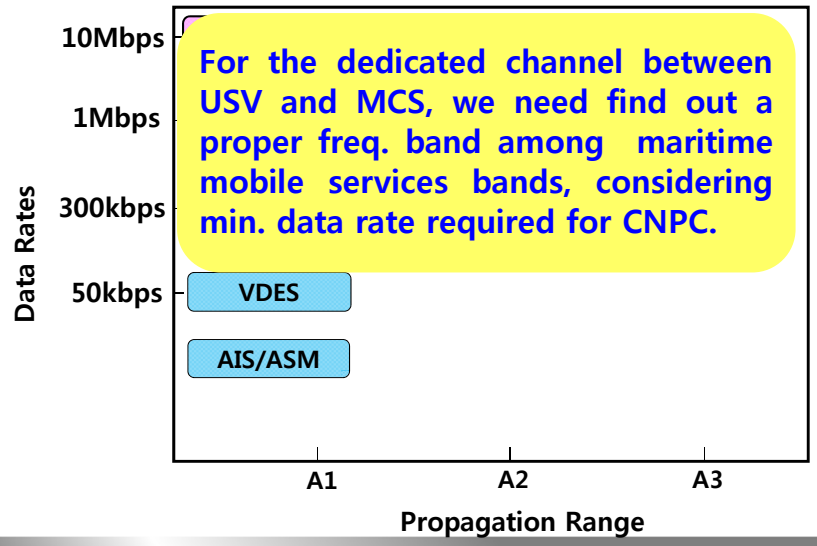




**LTE-M (20MHz)**

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

## 5. Candidate freq. bands




**For the dedicated channel between USV and MCS, we need find out a proper freq. band among maritime mobile services bands, considering min. data rate required for CNPC.**





## 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**