Input paper: [[1]](#footnote-1) DTEC3-5.2.2.5

Input paper for the following Committee(s): check as appropriate Purpose of paper:

**□** ARM **□** ENG **□** PAP  Input

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**Agenda item** [[2]](#footnote-2) 5.2

**Technical domain/ Task number** 2 1.2.2

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Result of trial for the Metal Surface Wave Technology (MS@MS)

# Summary

The document ENAV30-5.1.2.3 has introduced Radio-free wireless communication, the Metal Surface Wave Technology (MS @ MS). This document is presented MS@MS is more efficient and capable of overcoming the limitation of metal surrounding structure for wireless communication and primarily applying to the wireless IoT network in the maritime sector.

DTEC WG1 has conducted a review of new technology through document EM1-5.1.2.1 and document DTEC1-12.3.2.1.2, and is considering additional reviews to finalize this review.

The “MS@MS TEST” was conducted to determine if the Metal Surface Wave Technology (MS@MS) could be used for communications within ship using a coastal passenger ship.

## Purpose of the document

This document presents the result of trial for Radio-free wireless communication based on the Metal Surface Wave(MS@MS) on a coastal passenger ship to confirm as communication performance applying to the wireless communication.

## Related documents

1. ENAV30-5.1.2.3 Radio-free wireless communication based on Metal Surface Wave in the maritime sector
2. EM1-5.1.2.1 Further Review of Radio-free wireless communication based on Metal Surface Wave in the maritime sector
3. DTEC1-12.3.2.1.2 Completed Review of Radio-free wireless comms MS@MS
4. DTEC1-12.3.3.2 LN ARM ENG on Technology review MS@MS

# Background

The Metal Surface Wave Technology (MS@MS) was initially presented to ENAV30, with further review using the G1153 template at ENAV-EM1 and the review was completed at DTEC1. And DTEC WG2, through DTEC1-12.3.3.2, requests IALA members to conduct tests for implementation of MS@MS technology and to present results of trial.

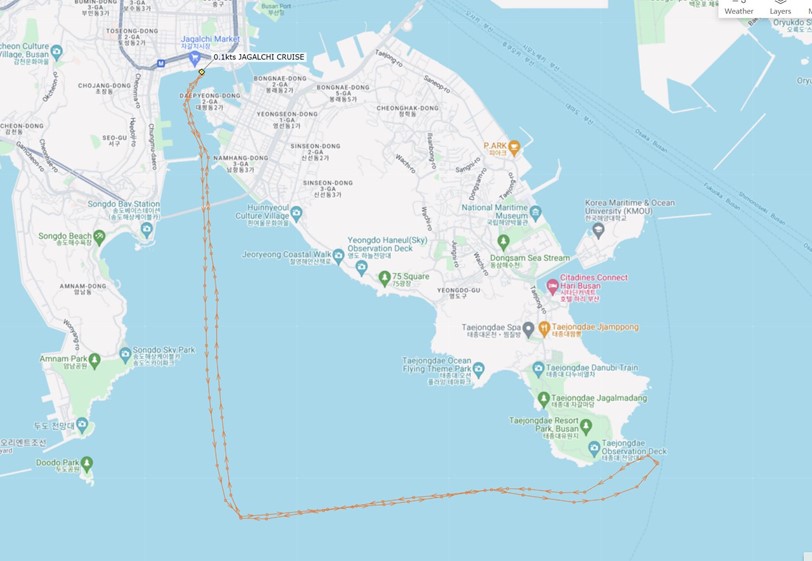
# Discussion

## GENERAL INFORMATION

The “MS@MS” test is being conducted from July 2024 to the present using a coastal passenger ship “JAGALCHI CRUISE”(passenger ship, iron ship, 397 tonnage and a total length of 37.61 meters). The ship usually sails around Busan Port of the Republic of Korea, more than four times a day.

1. General Information of Trial

| Time and duration of testbed | July, 2024 ~ (24hr, excluded Every Tuesday) |
| --- | --- |
| Contact person(s) | Bu Young KIM / kby@kriso.re.kr |
| Organization(s) involved | 1. KRISO(**Korea Research Institute of Ships and Ocean Engineering)** : Government-funded research institute 2. Sunny Wave Tech : The Metal Surface wave communication technology specialized company 3. KOMSA (Korea Maritime Transportation Safety Authority) : Quasi-governmental organizations in the fields of marine safety and ship inspection |
| Test ID | MS@MS TEST |
| Funding program and budget | This research was supported by the Korea Institute of Marine Science & Technology Promotion(KIMST) funded by the Ministry of Oceans and Fisheries in Republic of Korea. |



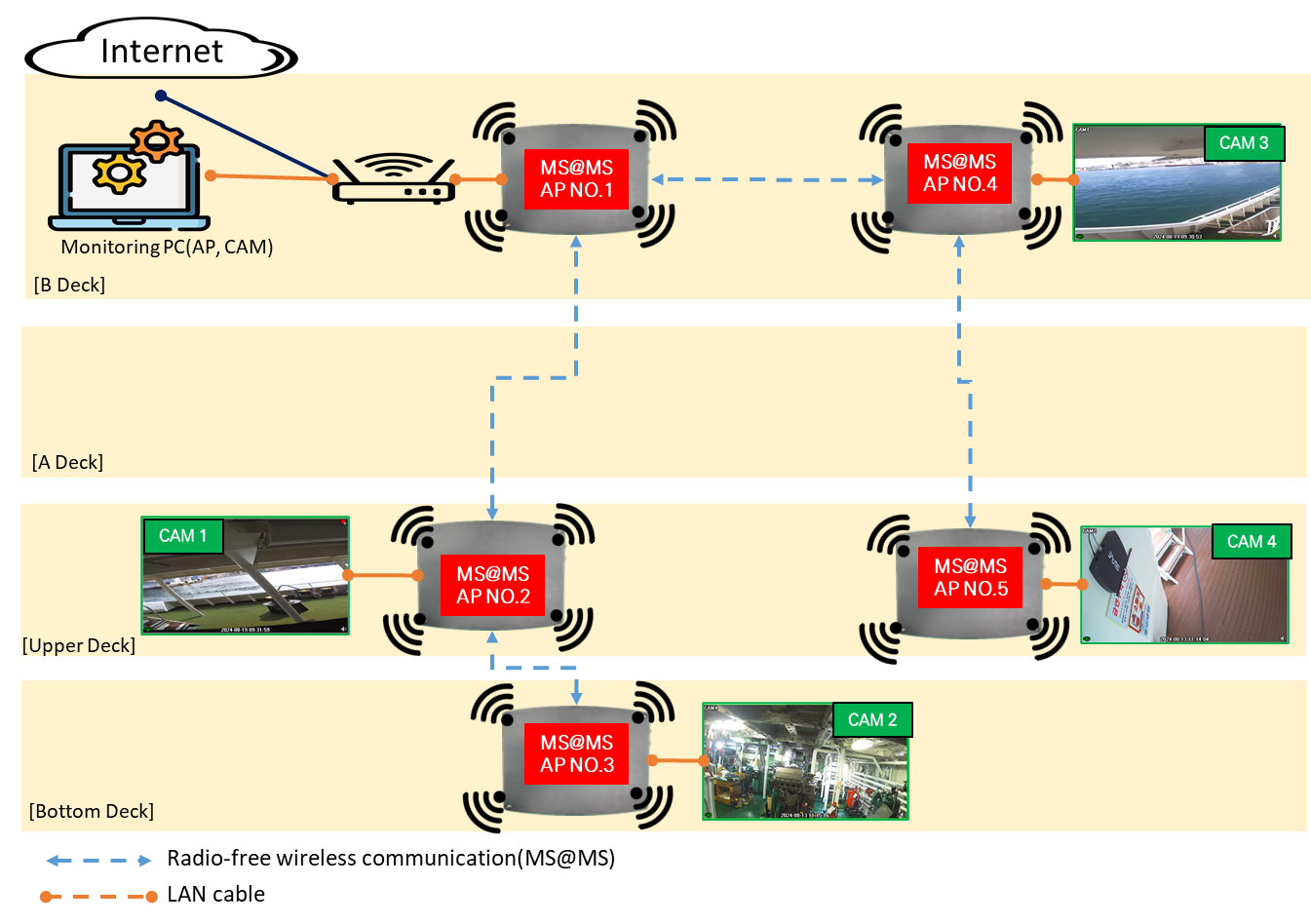
1. Test ship and sailing section

## EXECUTIVE SUMMARY

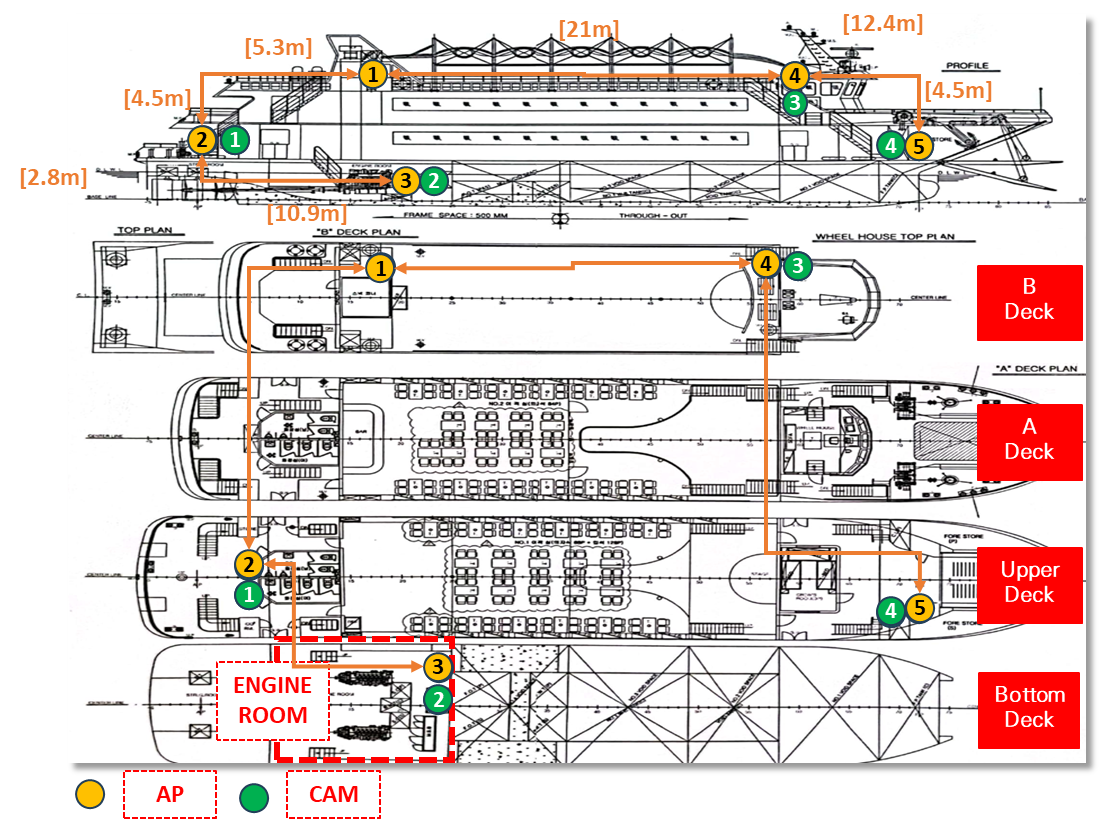
The test system was composed that took into account verification of the Metal Surface Wave Technology (MS@MS)’s performance and implementation of video information service on the based MS@MS in response to the needs of “JAGALCHI CRUISE”’s shipboard users. A total of five the Metal Surface Wave Technology devices (MS@MS AP) and a total of four the CAMs were installed on the coastal passenger ship “JAGALCHI CRUISE” as shown in Figure 2 and 3.

And we measured the Latency(ms), the network bandwidth(Mbits/sec), the packet loss rate(%) from monitoring PC to designated AP and monitored whether the video information service was operating normally from shore to remote control.

* Latency: The time it takes for one data packet to travel from monitoring PC to designated AP
* Network Band Width : Maximum amount of data that can be transferred within a specific time period from monitoring PC to designated AP
* Packet Loss Rate : Failure rate of ping test results from monitoring PC to designated AP



1. Architecture of “MS@MS” test



1. Configuration of “MS@MS” test

## RESULTS OF TRIAL

Result of trial is as follow about verification of communication network performance and implementation of video information service one based MS@MS.

### Measurement results of verification of communication network performance

In the first phase, the communication performance of the Metal Surface Wave Technology(MS@MS) communication in sailing and while berthed was observed using three APs and two CAMs from July 19th to 31st.

* As it is increased the distance between the monitoring computer and the APs, each indicator tended to decrease. In particular, the Latency, Network Band Width, and Packet Loss Rate of AP1 were initially worse than AP2, but gradually stabilized and improvement
* It was confirmed that there is no significant difference in the values ​​of Latency, Network Band Width, and Packet Loss Rate in sailing and while berthed

1. Average measurement results(Phase 1)

| Section | | Latency(ms) | Network Band Width (Mbits/sec) | Packet Loss Rate(%) |
| --- | --- | --- | --- | --- |
| PC-(A3-AP2)-AP1  [MS@MS distance  : 23.5m] | Total | 104.67 | 5.78 | 33.96 |
| In sailing | 99.44 | 7.11 | 26.48 |
| while berthed | 106.21 | 6.54 | 35.20 |
| PC-(A3)-AP2  [MS@MS distance  : 9.8m] | Total | 108.57 | 50.55 | 7.27 |
| In sailing | 81.41 | 47.78 | 5.49 |
| while berthed | 113.07 | 51.48 | 7.26 |
| PC-AP3  [by Lan cable] | Total | 93.58 | 87.58 | 0.00 |
| In sailing | 82.86 | 94.87 | 0.00 |
| while berthed | 96.05 | 87.58 | 0.00 |

In the Second phase, the communication performance of the Metal Surface Wave Technology(MS@MS) communication in sailing and while berthed was observed using five APs and four CAMs from Aug 5th to 25th.

* AP1 was measured to have improved performance compared to PHASE 1 as the system configuration was stabilized and Performance changes due to AP expansion were minimal, but overall latency tended to increase due to data processing speed issues
* As phase 1, It was confirmed that there is no significant difference in the values ​​of Latency, Network Band Width, and Packet Loss Rate in sailing and while berthed

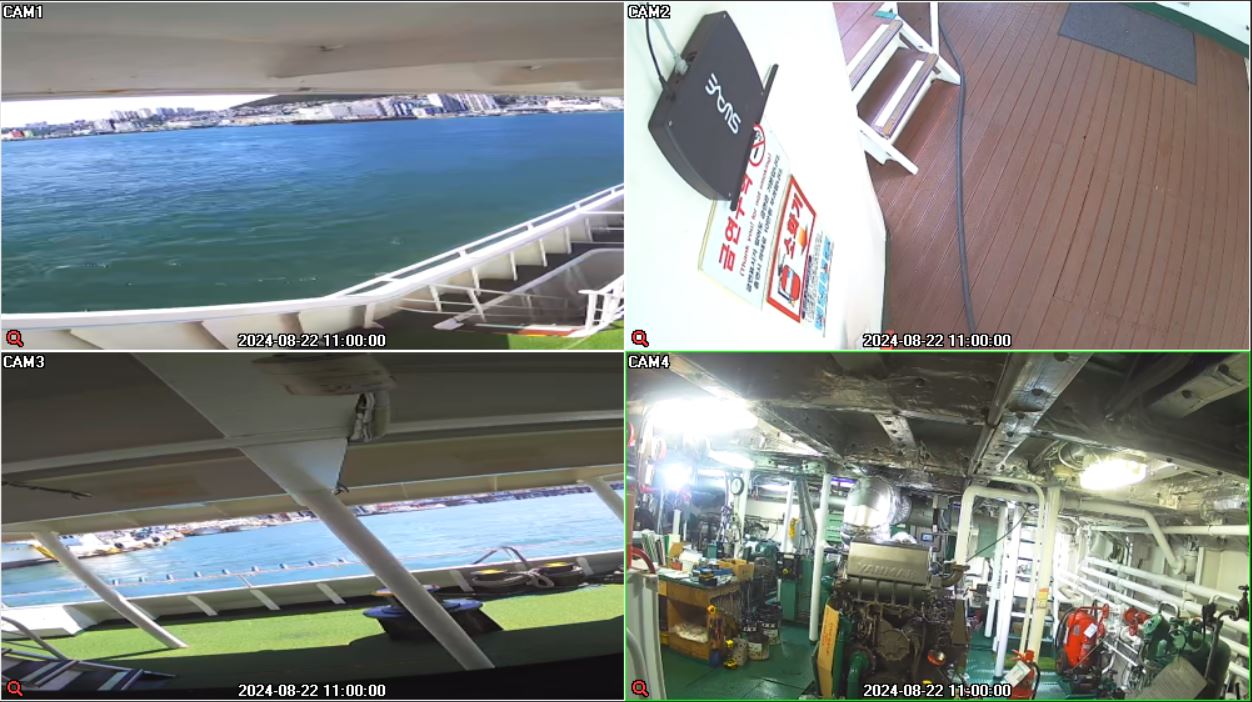
1. Average measurement results(Second phase)

| Section | | Average Latency(ms) | Average Band Width(Mbits/sec) | Packet Loss Rate(%) |
| --- | --- | --- | --- | --- |
| PC-(A3-AP2)-AP1  [MS@MS distance  : 23.5m] | Total | 230.24 | 12.98 | 2.72 |
| In sailing | 242.73 | 16.18 | 4.86 |
| while berthed | 228.32 | 13.49 | 2.11 |
| PC-(A3)-AP2  [MS@MS distance  : 9.8m] | Total | 289.23 | 50.47 | 0.60 |
| In sailing | 252.60 | 50.27 | 1.91 |
| while berthed | 248.67 | 51.57 | 0.20 |
| PC-AP3  [by Lan cable] | Total | 222.95 | 91.91 | 0.00 |
| In sailing | 224.25 | 94.64 | 0.00 |
| while berthed | 221.84 | 91.43 | 0.00 |
| PC-(A3)-AP4  [MS@MS distance  : 21m] | Total | 181.57 | 44.04 | 0.44 |
| In sailing | 175.75 | 58.68 | 1.80 |
| while berthed | 184.14 | 38.84 | 0.26 |
| PC-(A3-AP4)-AP5  [MS@MS distance  : 16.9m] | Total | 178.68 | 28.34 | 1.06 |
| In sailing | 193.85 | 36.14 | 1.07 |
| while berthed | 177.34 | 26.61 | 0.44 |

### Video information service

The possibility of large-capacity data communication and service operation using MS@MS was confirmed through IP-based CAM operation.

1. Video information service operation based on MS@MS

## CONCLUSIONS AND RECOMMENDATIONS

It was confirmed that there was almost no difference in measurement results such as delay rate, band width, and loss rate when in sailing and while berthed. And the performance of the MS@MS communication tended to decrease depending on the distance between the monitoring PC and the APs.

In addition, in order to secure stable communication performance of MS@MS, it is necessary to configure system that satisfies communication performance according to the required service level and to operate the equipment for a long time to stabilize the network.

MS@MS TEST is scheduled to be conducted until next year to utilize it as a communication network within the ship, and to operate various sensors to implement an IoT communication system based on MS@MS.

# references

N/A

# action requested of the committee

The committee is kindly invited to note the above information, and take actions as appropriate.

1. Input document number, to be assigned by the Committee Secretary [↑](#footnote-ref-1)
2. Leave open if uncertain [↑](#footnote-ref-2)