

**Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)**

**Submission Title :** Surface Wave Propagation for NG-SUN PHY in Ship Area Network

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**Re :** TG4ad Next Generation SUN PHYs

**Abstract :** This contribution proposes new PHY that utilizes surface wave propagation in Ship Area Network

**Purpose:** Discussion

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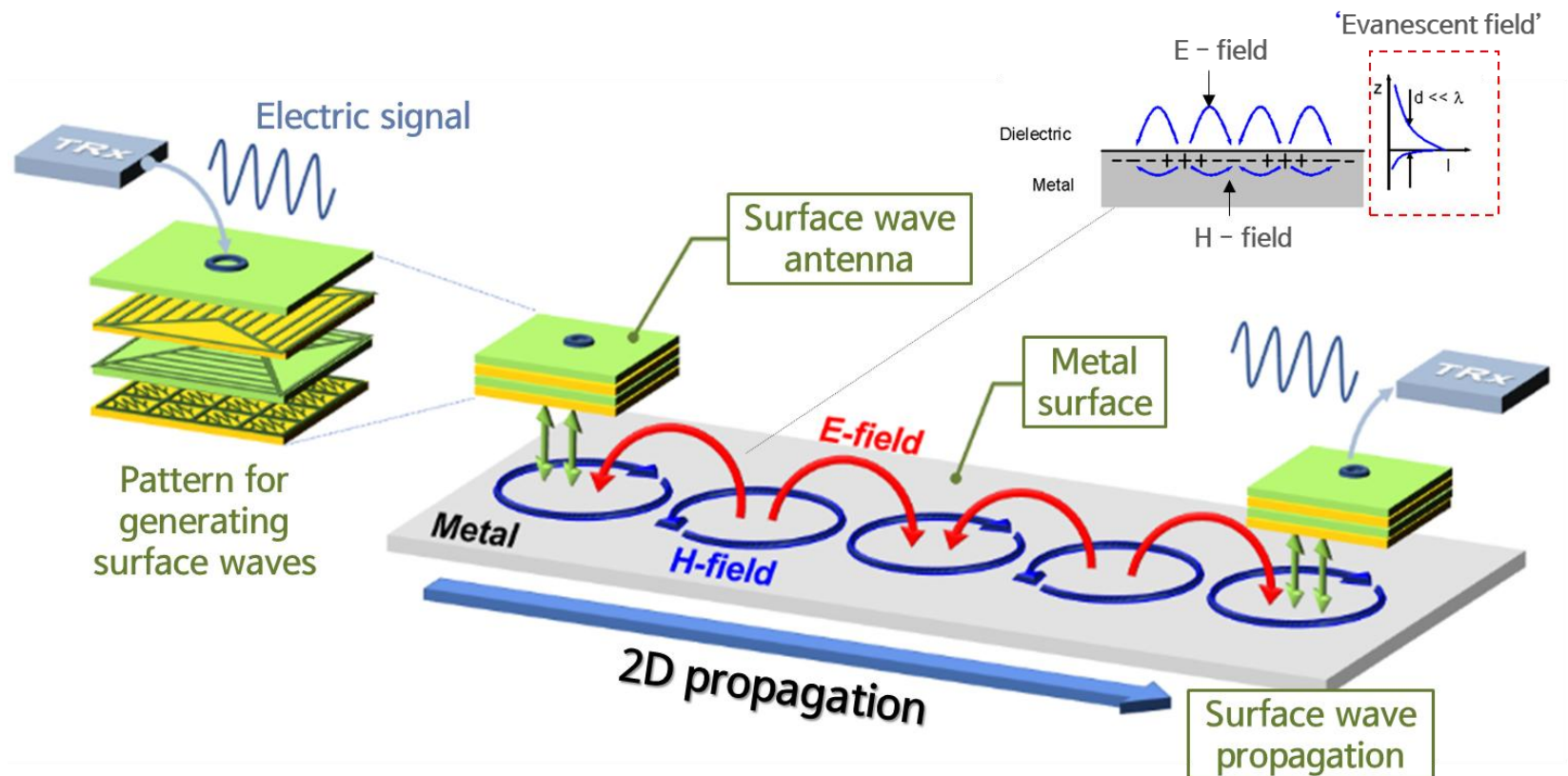
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# Background

- **Ship Area Network (SAN) has been proposed in 2024 as one of use cases of NG-SUN[1].**
  - NG-SUN is used for data transfer between various devices (e.g. sensing and communication ones) on ships.
  - The NG-SUN network is essential part for ship automation.
- **NG-SUN faces harsh conditions in SAN, leading to severe signal attenuation, especially over long distances.**
  - Metallic bulkhead structures of ships significantly attenuate propagating waves.
  - Therefore, a new PHY is required to overcome such propagation challenges in SAN.

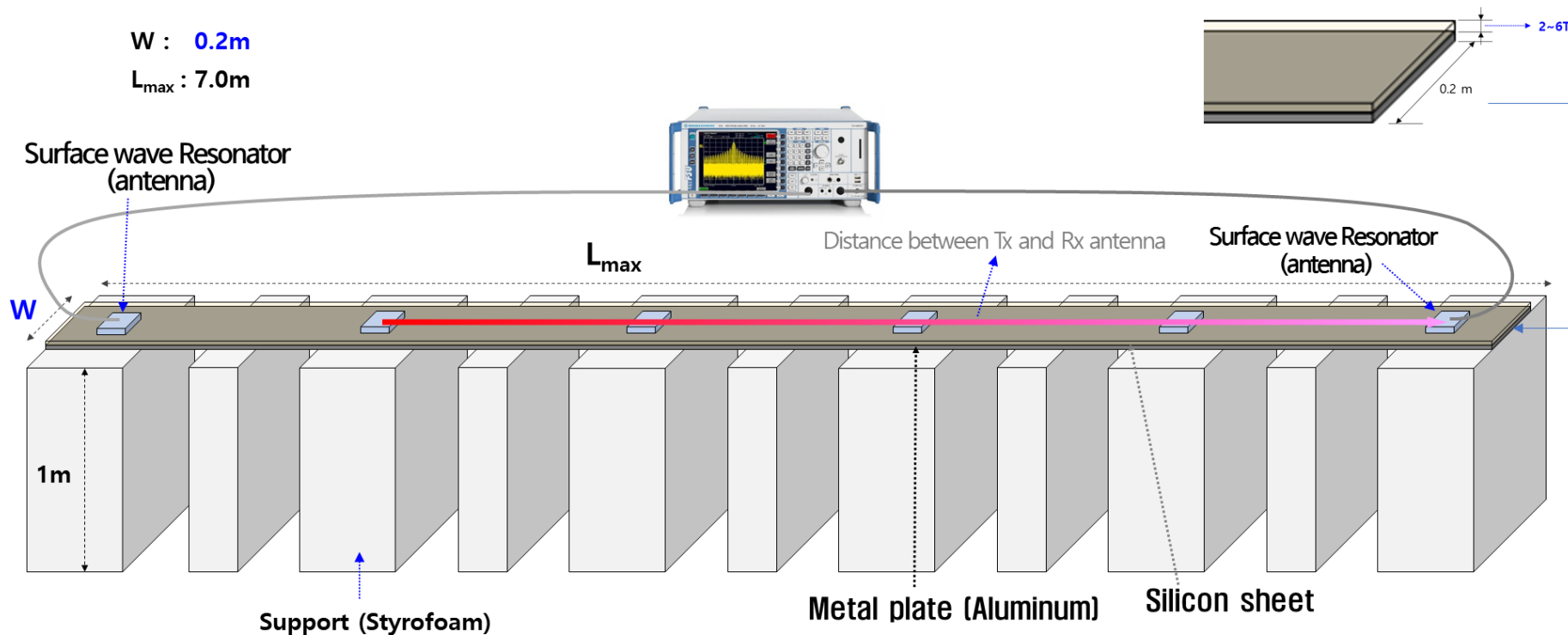
# Surface Wave Propagation

- **(Definition)** Wave mode propagating along boundary between air and metal layers or air and metal-dielectric layers



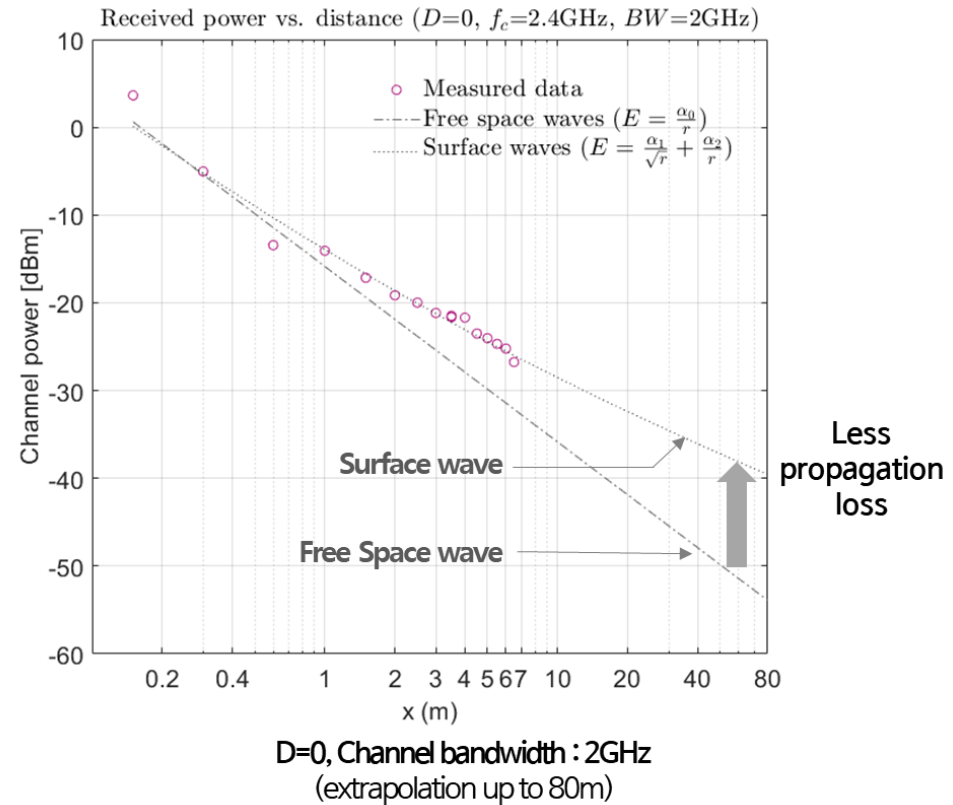
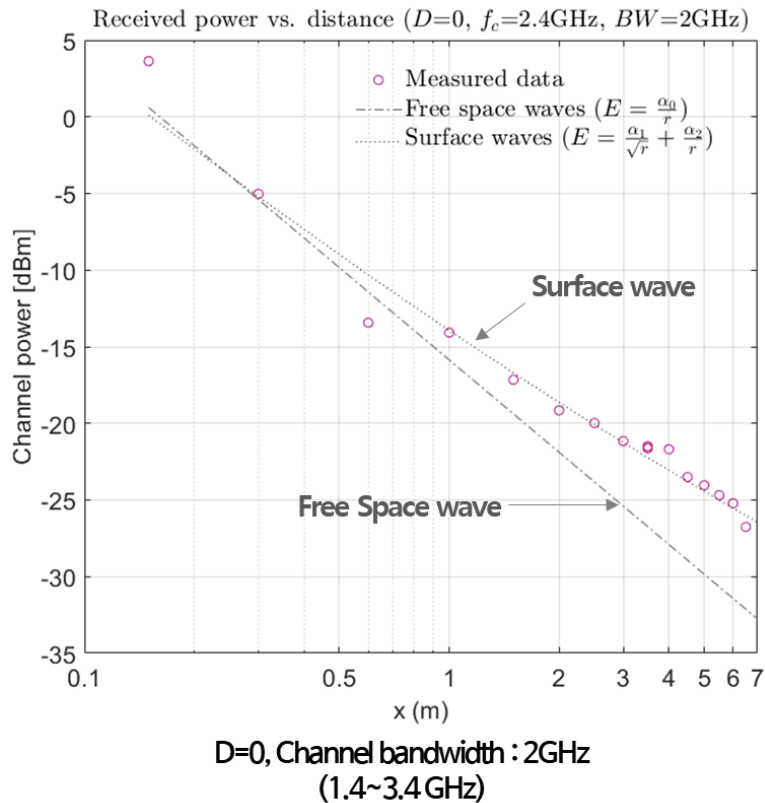
# Key Features(1)

- (Low loss) Long-distance propagation causes less signal attenuation compared to the space-wave propagation at the same distance



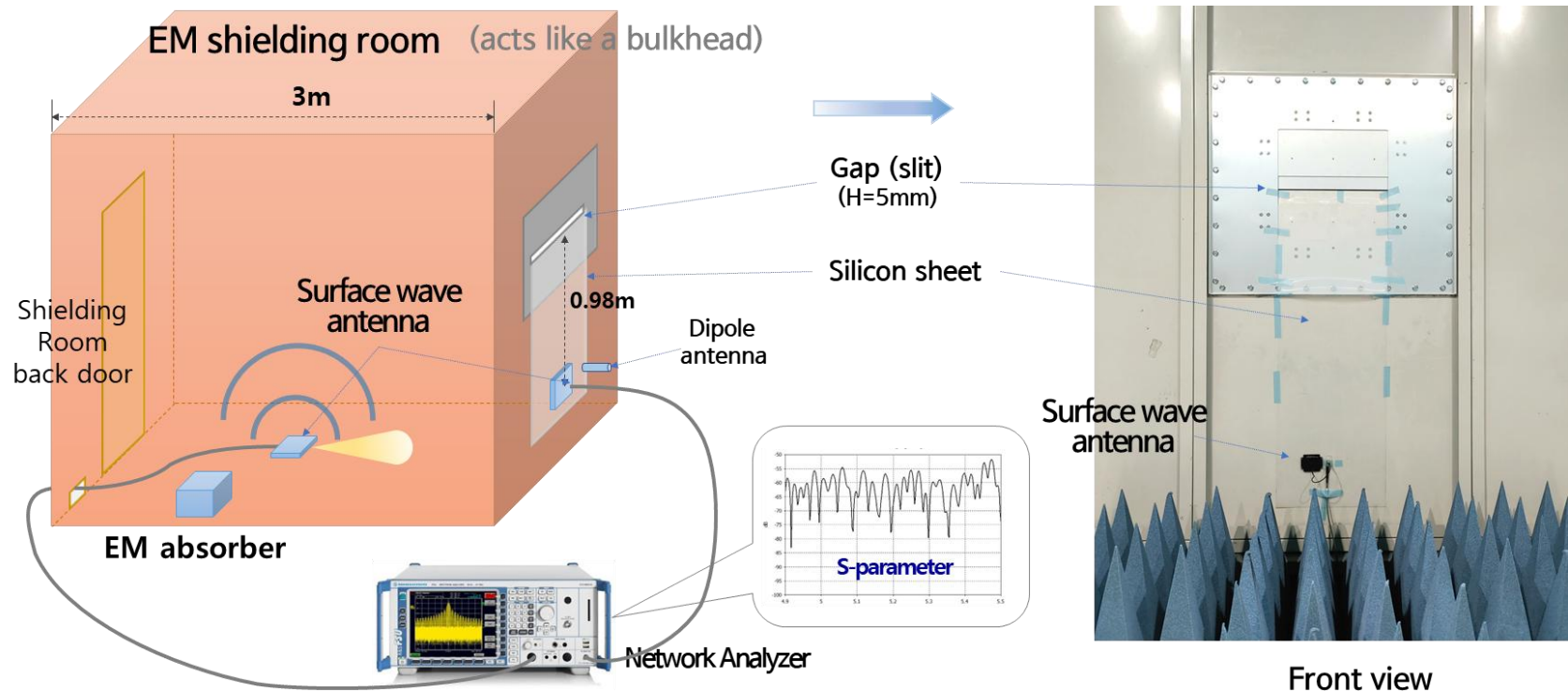
< Experimental Setup inside an EM chamber >

## < Experiment Results – Path Loss Vs. Distance >



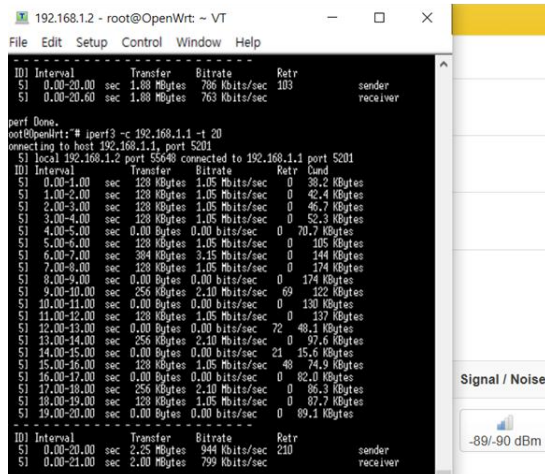
## Key Features(2)

- (Gap through) Propagating through a small gap, such as a metal slit, with less attenuation

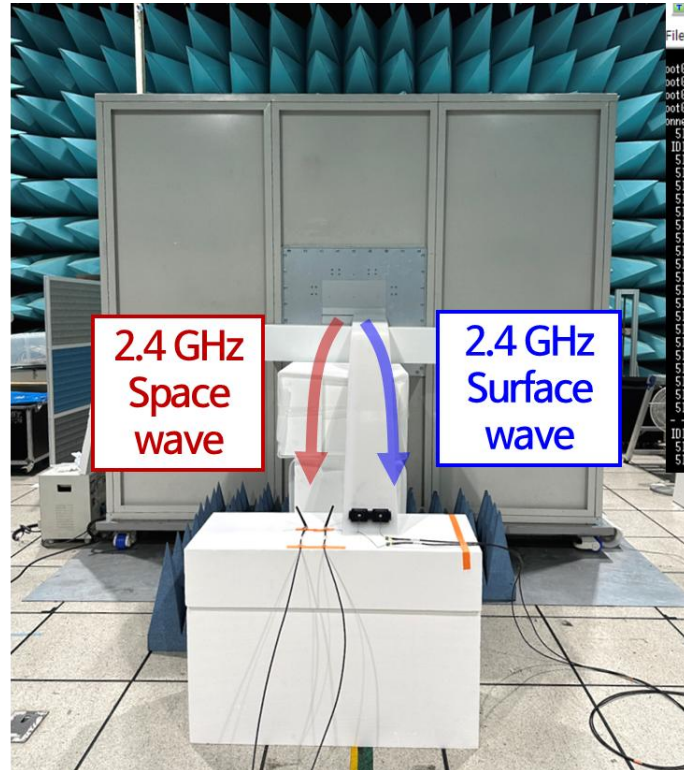


### < Experimental Setup >

## < Experiment Results – Comparison with space-wave mode >

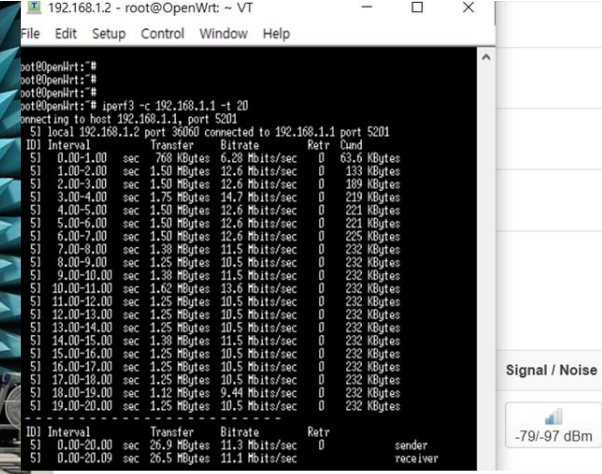


**Avg. throughput  
= 0.94 Mbps**



**2.4 GHz  
Space  
wave**

**2.4 GHz  
Surface  
wave**



**Avg. throughput  
= 11.3Mbps**

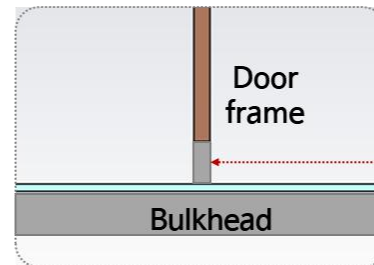


# Surface Wave Propagation for SAN

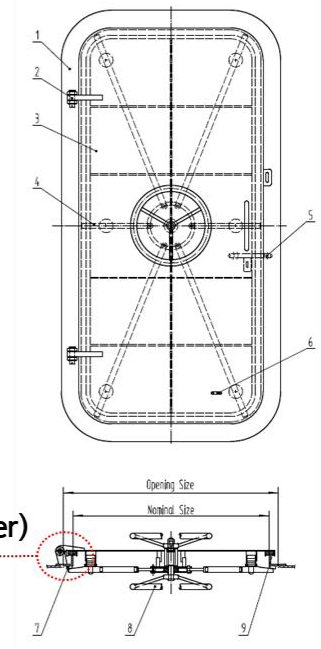
- **Realizing SAN with large communication coverage**
  - Silicon sealing on the watertight door acts as a gap or slit through which surface waves propagate.
  - Long metallic structure with protective coating on its surface is advantageous for surface wave propagation.



Field test vessel in Incheon port



Experimental model of the watertight door



Marine watertight door

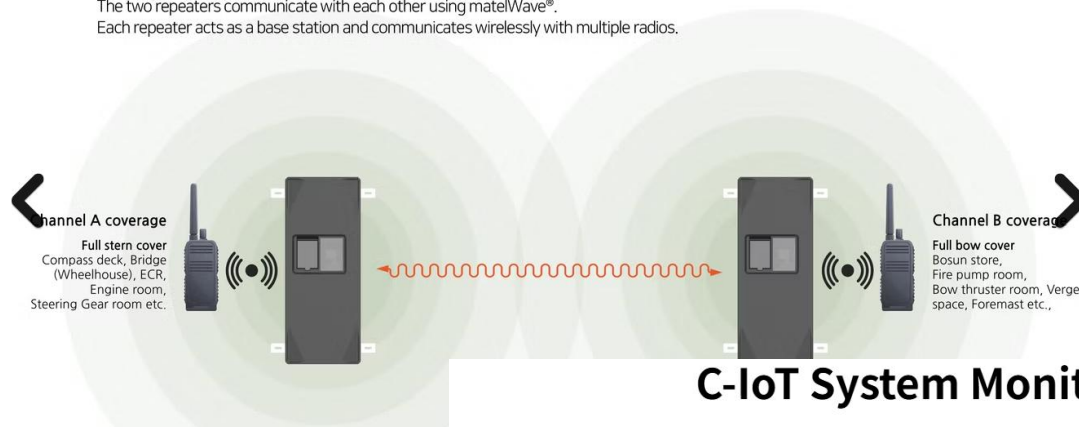


# Initial Commercialization

- **Successful commercialization, but no international standard exists for surface-wave communication.**

## Basic concept of metalVox® UHF system

The two repeaters communicate with each other using metalWave®.  
Each repeater acts as a base station and communicates wirelessly with multiple radios.

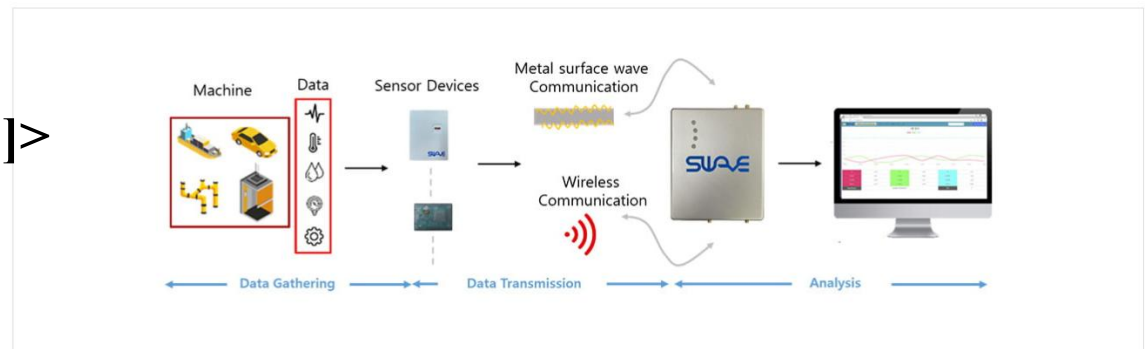


< ZN Technologies[2]>

## C-IoT System Monitoring Solution

The C-IoT system monitoring solution collects, analyzes and manages various data in real-time in extreme industrial sites that electromagnetic waves cannot penetrate.

<SunnyWave Tech[3]>



# Considerations

- (Contribution to TG4ad) Proposing PHY specialized for the surface wave communication
  - Using a wireless channel different from previous space-wave propagation, so proposing new PHY for the surface wave communication
  - Simultaneously, proposing a channel model for the surface wave communication

# References

- [1] 15-24-0376-00-04ad. The use-case for NG-SUN PHYs in ship area network
- [2] <https://www.zn-technologies.com/en-metalvox>
- [3] [https://sunnywt.com/page.php?p\\_id=product1](https://sunnywt.com/page.php?p_id=product1)

**Thanks for Listening !**  
**Q&A**