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

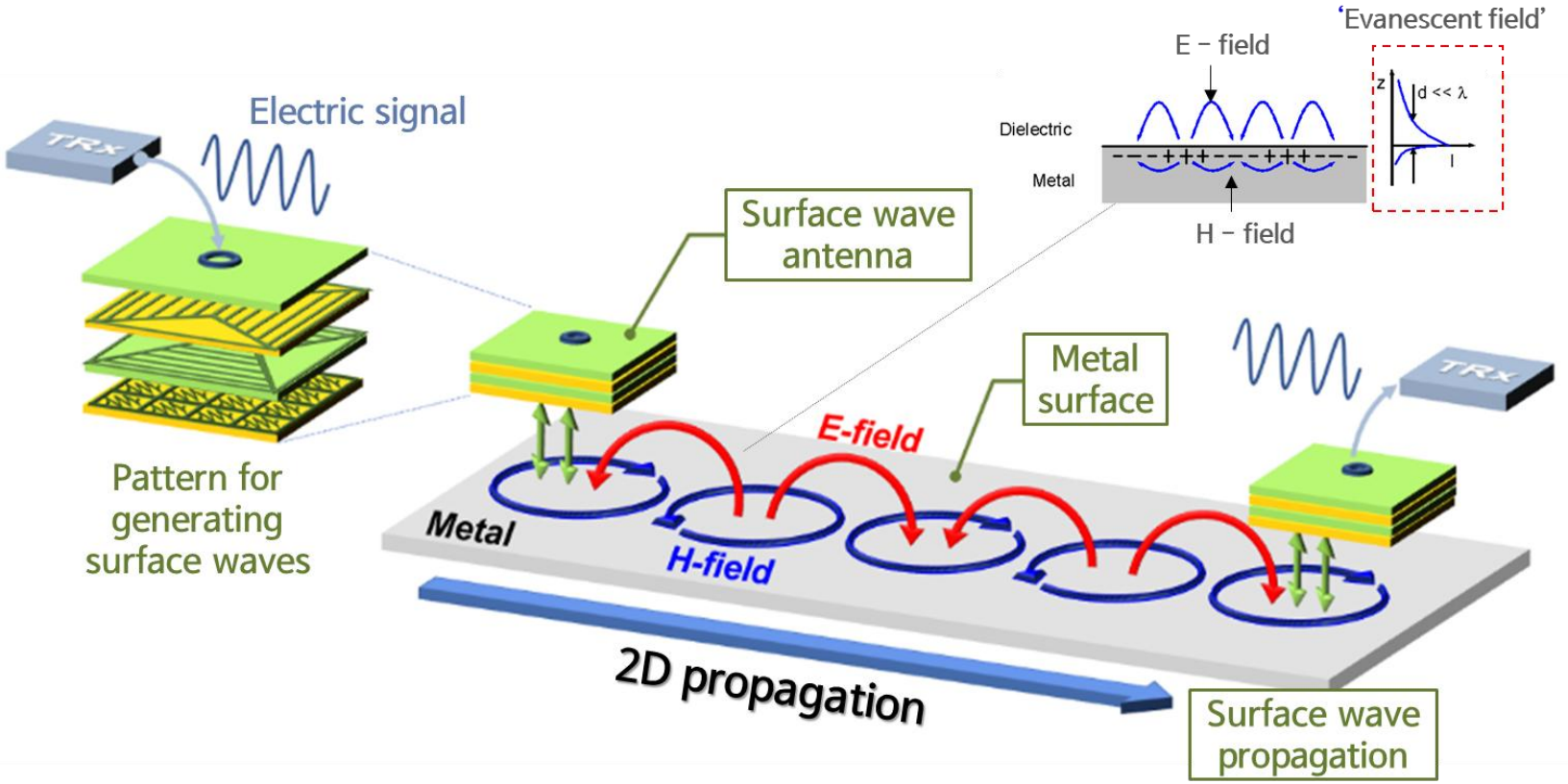
Purpose: Discussion

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.

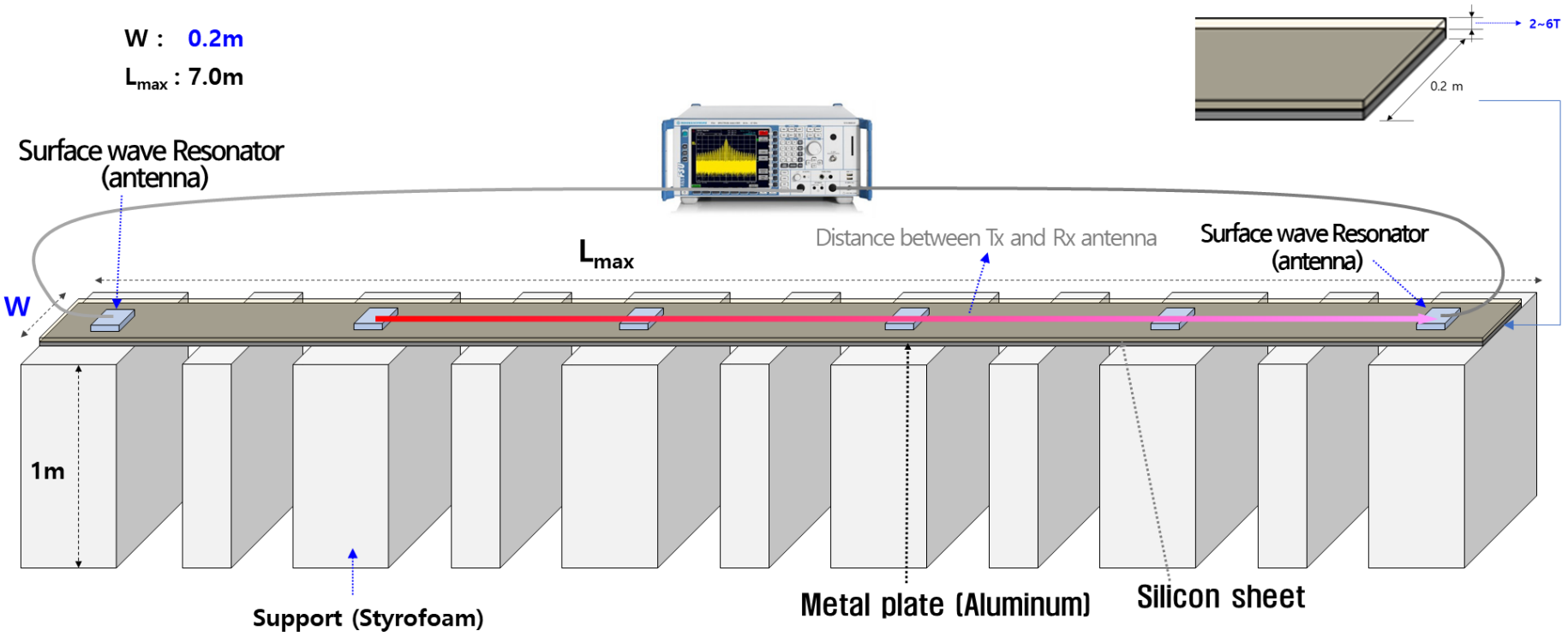
Surface Wave Propagation

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



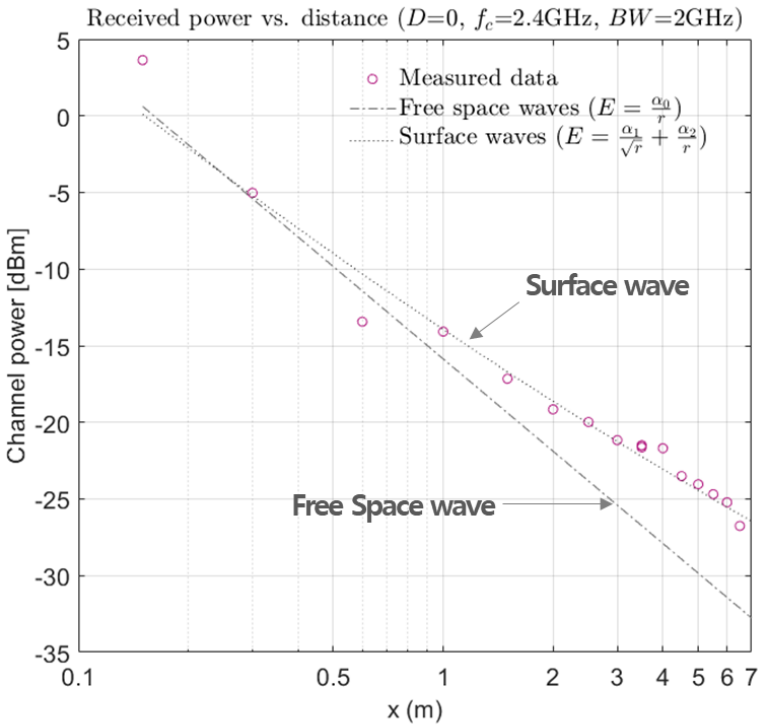
Key Features(1)

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

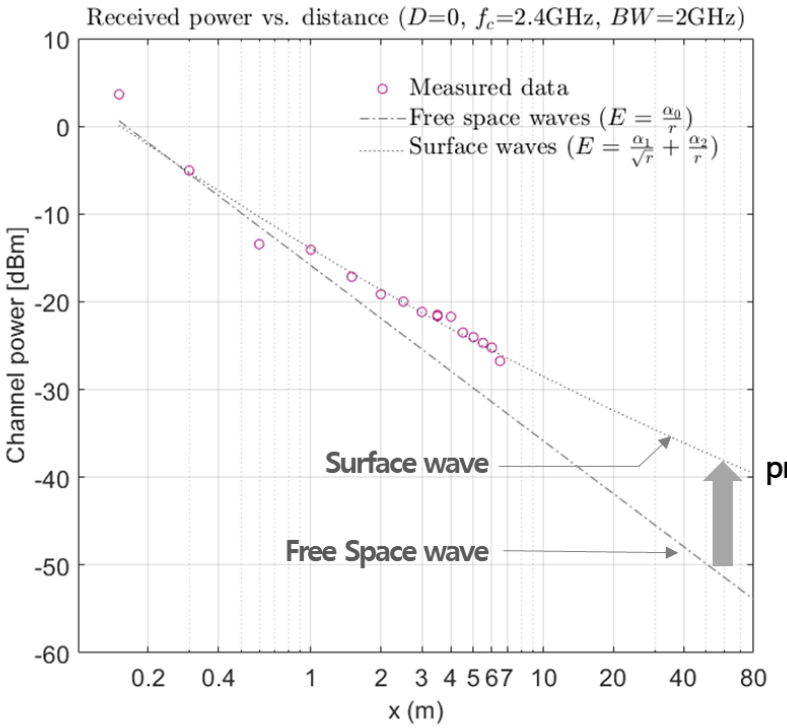


< Experimental Setup inside an EM chamber>

< Experiment Results – Path Loss Vs. Distance>



D=0, Channel bandwidth : 2GHz
(1.4~3.4 GHz)

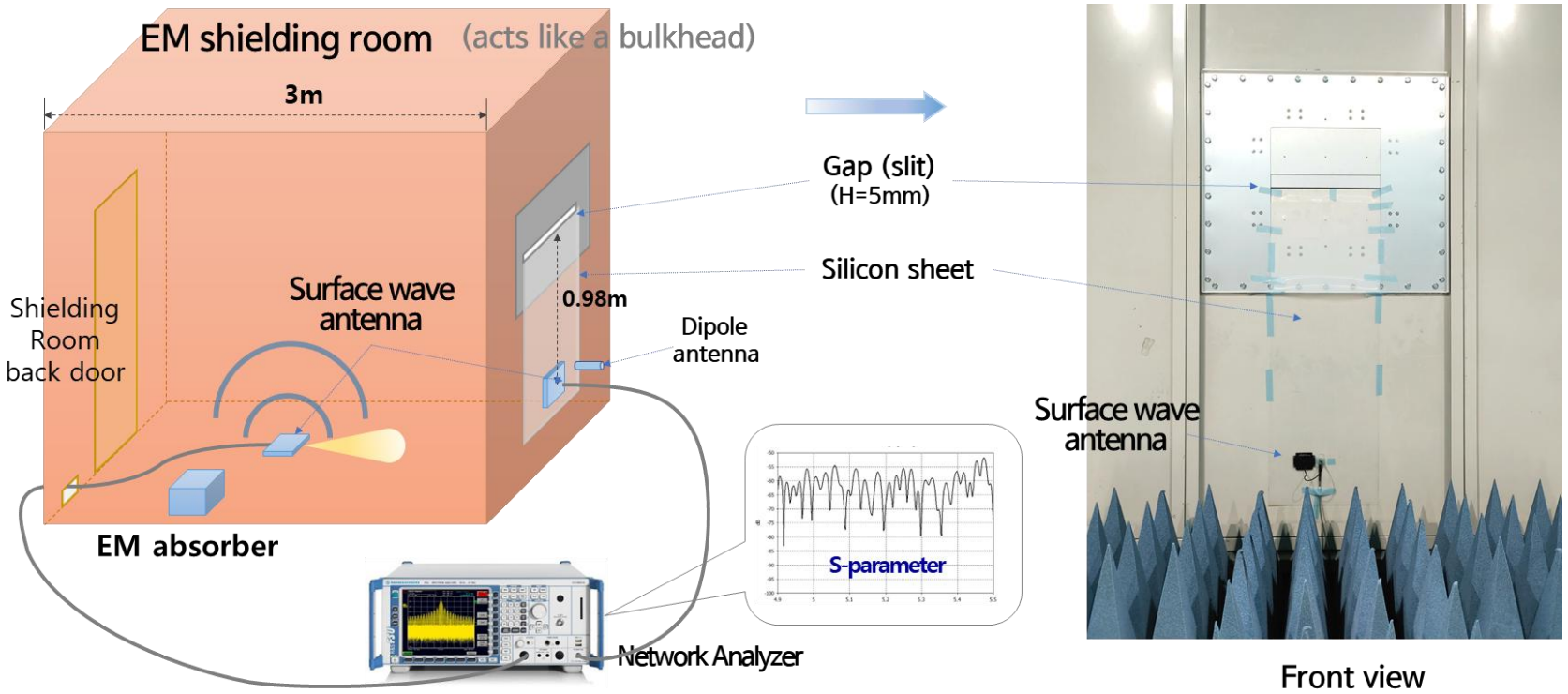


Less propagation loss

D=0, Channel bandwidth : 2GHz
(extrapolation up to 80m)

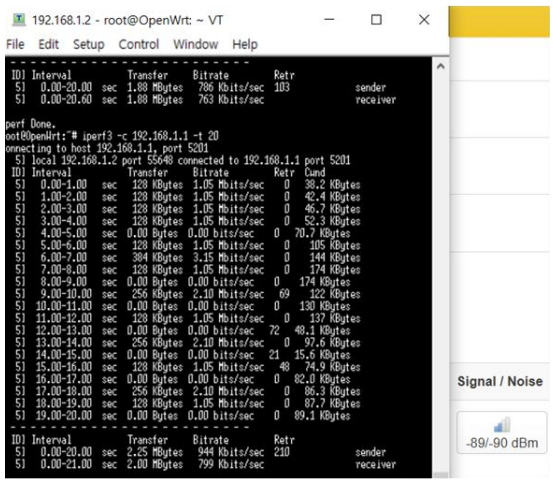
Key Features(2)

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

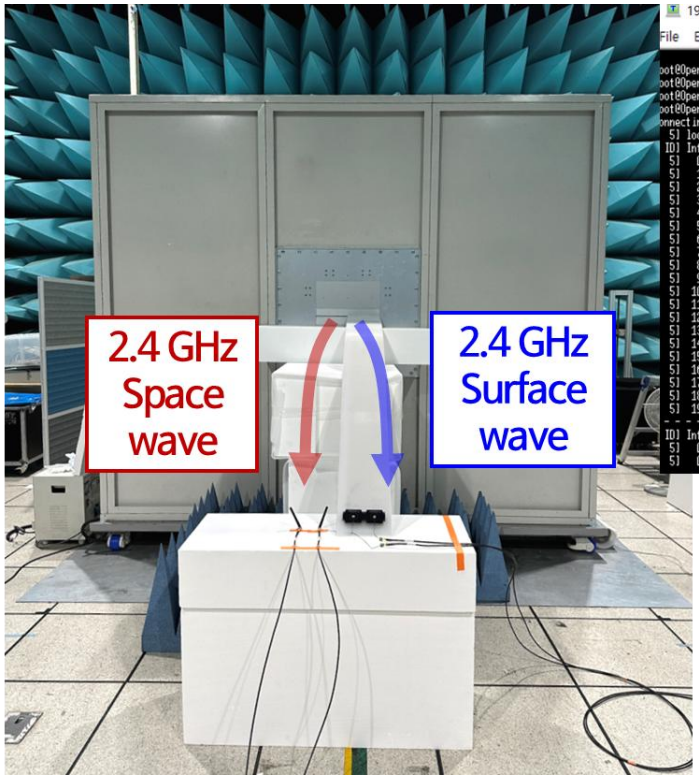


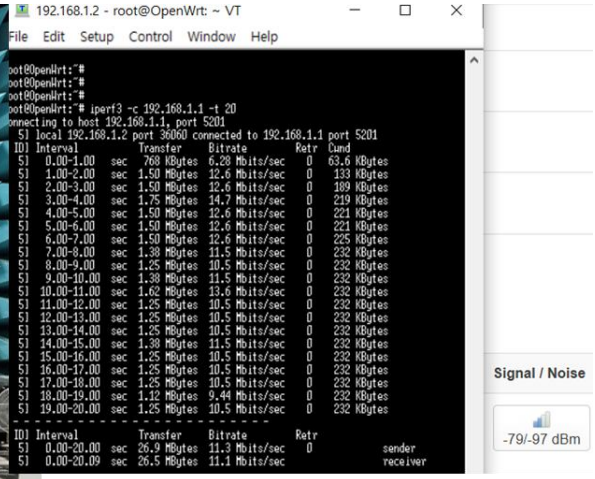
< Experimental Setup>

< Experiment Results – Comparison with space-wave mode>



Avg. throughput = 0.94 Mbps



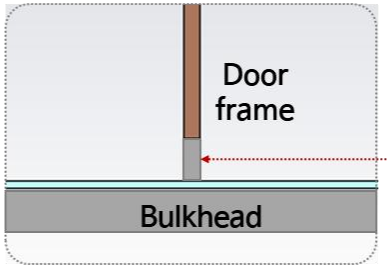


Avg. throughput = 11.3Mbps

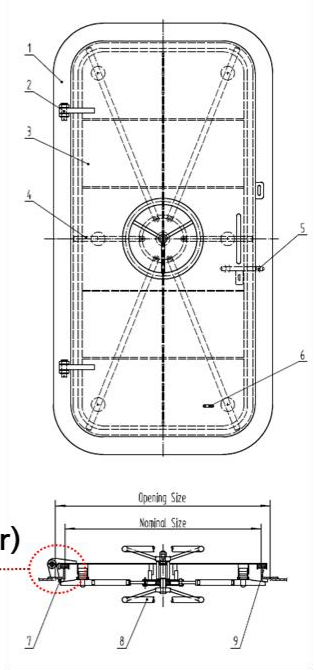
Surface Wave Propagation for SAN

- **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



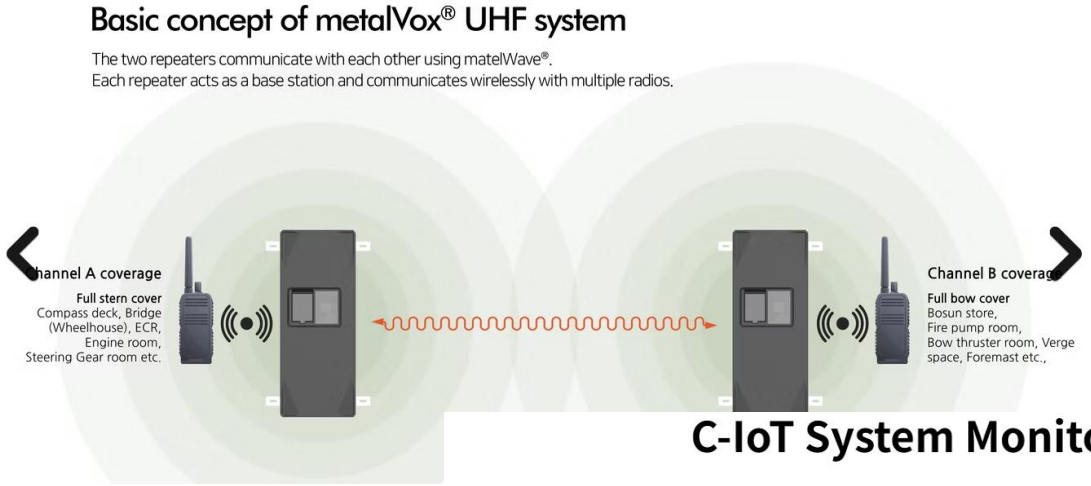
Experimental model of the watertight door



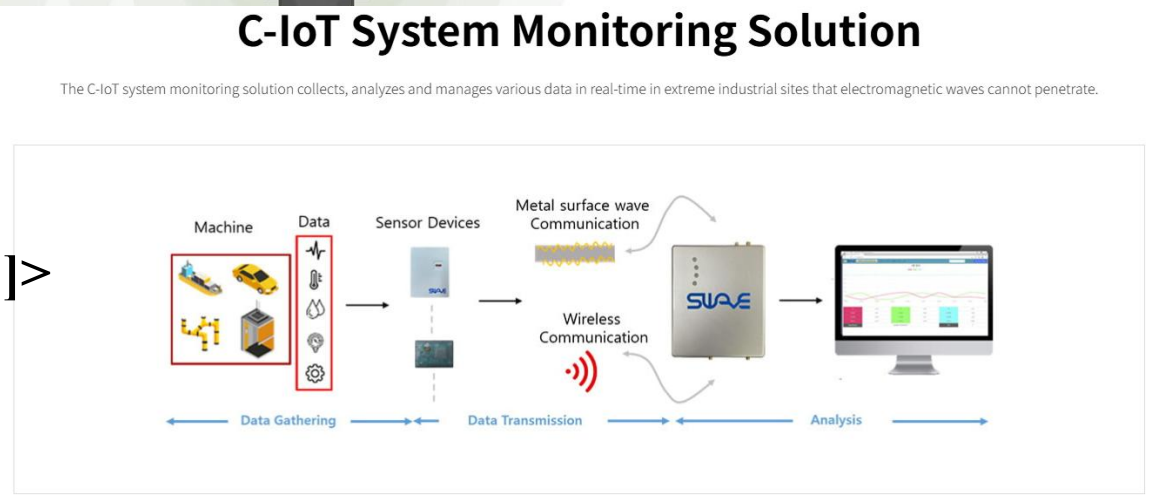
Marine watertight door

Initial Commercialization

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



< ZN Technologies[2]>



<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

Thanks for Listening !
Q&A