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

**□** ARM **□** ENG **□** PAP **□** Input

**X** DTEC **□** VTS **■** Information

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Technical Domain / Task Number 2 …………………………………

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DIGITAL COMPLIANCE SOLUTIONS FOR NET ZERO SHIPPING

# Summary

The National IT Industry Promotion Agency (NIPA), under Korea’s Ministry of Science and ICT, is driving digital transformation in shipping in response to strengthened environmental regulations such as IMO’s EEXI/CII and the EU’s ETS/FuelEU Maritime. To support carbon neutrality and address the challenges faced by small and mid-sized shipping companies, the “Digital-Centric Global Environmental Regulation Response Solution Development and Dissemination Project (2025–2027)” was launched. Led by the Ulsan Information Industry Promotion Agency (UIPA) with AllforLand Co., Ltd. as the key partner, the project will develop and demonstrate three data-driven solutions: operational performance optimization, energy efficiency enhancement, and fleet management support using AI, big data, and IoT.

## Purpose of the document

Proposal for a discussion on establishing data standards and verification measures for ensuring the quality of near real-time data collection between ships and shore. Also the document introduces three main solutions to be developed through the “Digital-Centric Global Environmental Regulation Response Solution Development and Dissemination Project (2025–2027),” along with relevant international standards and key discussion points.

# Background

Since 2023, IMO, the EU, and other bodies have enforced stricter regulations such as EEXI, CII, EU ETS, and FuelEU Maritime, with IMO requiring tougher GHG criteria and carbon pricing from 2027. Korea faces high urgency, especially at ports like Ulsan, and its 2050 roadmap mandates a full transition to eco-friendly vessels. Small and mid-sized shipping companies, however, struggle with digital transformation, and current AIS/noon report-based solutions lack accuracy. To address this, the Ulsan Information Industry Promotion Agency and NIPA have developed equipment to directly collect engine and sensor data from 60 shipping companies, enabling accurate carbon emission calculations and supporting optimized, energy-efficient operations.

# Discussion

## Project Overview

Development and demonstration of data-driven environmental regulation response solutions in the shipping sector to support domestic large, medium, and small shipping companies in complying with global environmental regulations and to promote the reduction of ship-generated carbon emissions.

* (Part 1 Data Collection) Development of technologies for collecting operational data from existing ships, shipboard installation, and data acquisition
* (Part 2 Platform Development) Development of the SIDC platform capable of processing, analyzing, managing, and distributing real-world data
* (Part 3 Solution Development) Development and demonstration of solutions to achieve reduction of ship-generated carbon emissions

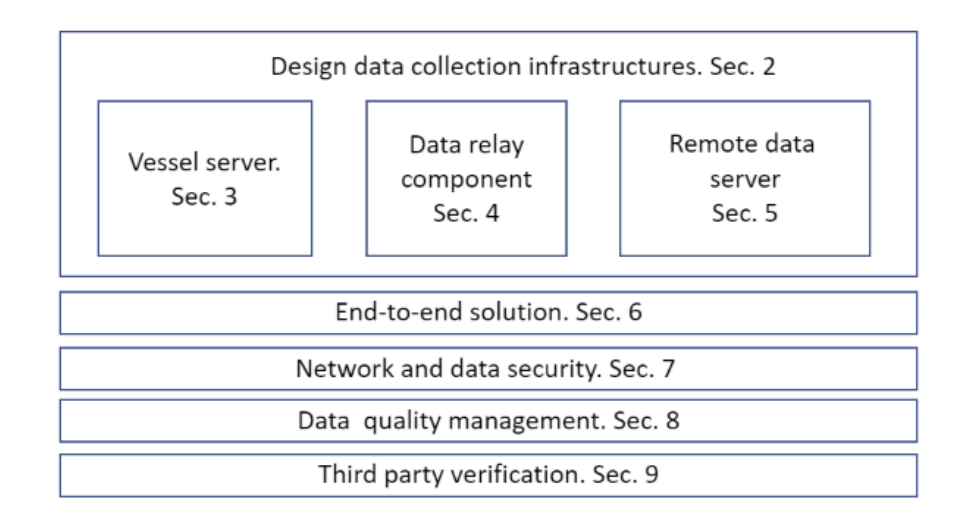
## Development of Digital-Centric Global Environmental Regulation Response Solutions and Platform

### Development of Ship Data Collection Devices

* Data Collection Equipment and Platform Connectivity Infrastructure : Expansion of maritime and shore-based network infrastructure to enable seamless communication between onboard sensors/edge devices and the onshore big data platform. From the outset, scalability will be considered, and infrastructure standards will be established to ensure interoperability with both domestic and international shipping industry ecosystems.
* Data Standardization in Line with International Regulations : Design and integration of data structures and exchange formats in compliance with global regulations and standards such as IMO and ISO, ensuring compatibility of diverse operational information. Data standardization will enable the accumulation of high-quality big data and facilitate obtaining global classification society certification.

### Development of a Ship Data-Specialized Platform

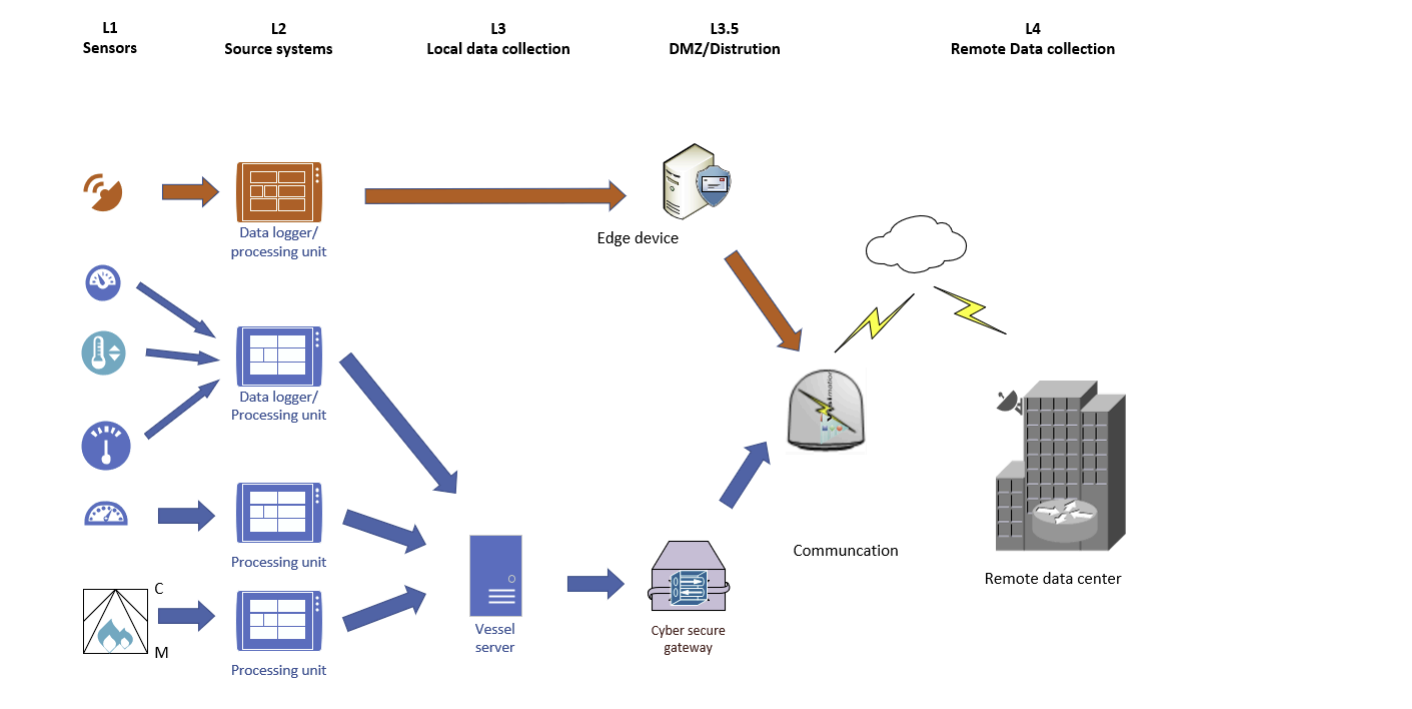
* Expansion of two additional servers for the data management system, data distribution portal, and allocation of virtualized resources for new solutions, along with one dedicated server for data backup. In the event of a failure in the virtualized servers, the dedicated backup server will ensure data preservation.
* The configuration of each platform is as follows:



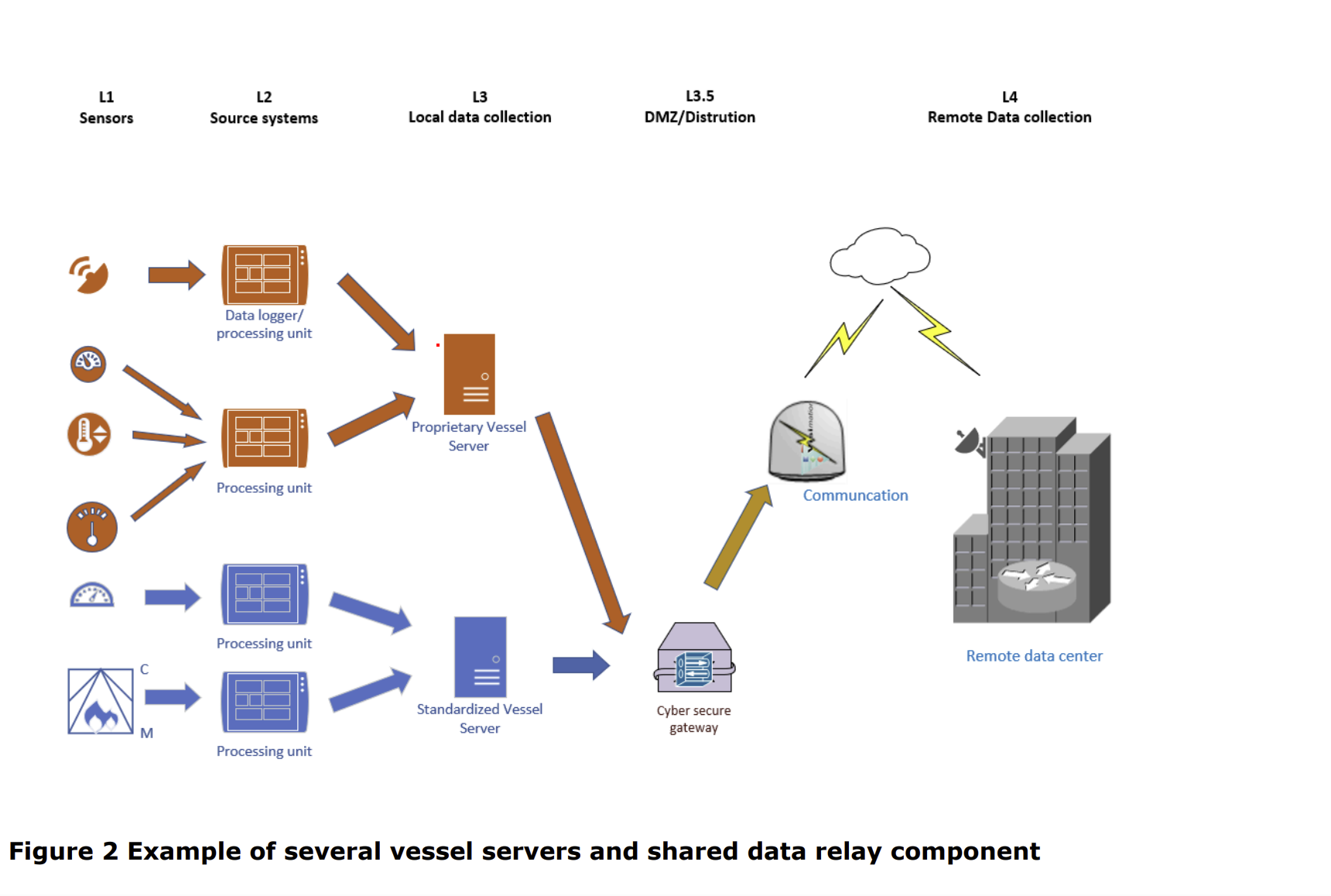
* Our primary focus has been on researching and developing a standardized method to collect machinery, engine, and various sensor data onboard ships and transmit them in a standardized format to shore-based centers. We have been discussing this with DNV, with the goal of obtaining future classification certification.
* The greatest challenges for this platform are how to continuously deliver large volumes of data in a standardized format at regular intervals under poor maritime communication conditions, and how to comply with security regulations that are drawing significant international attention.

### System Infrastructure

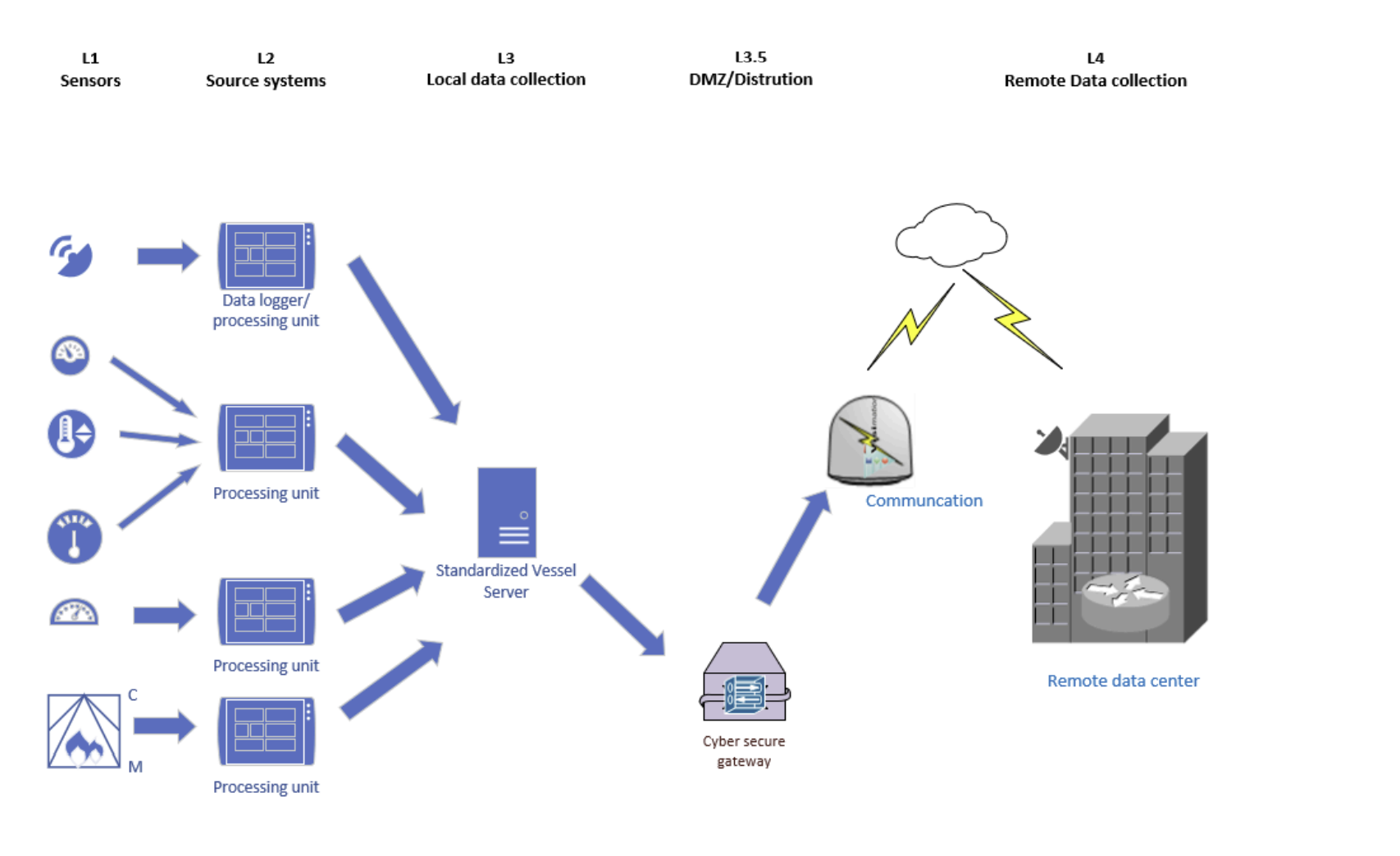
* In its DNV-CG-0564, DNV presents four possible cases for such data infrastructure structures.



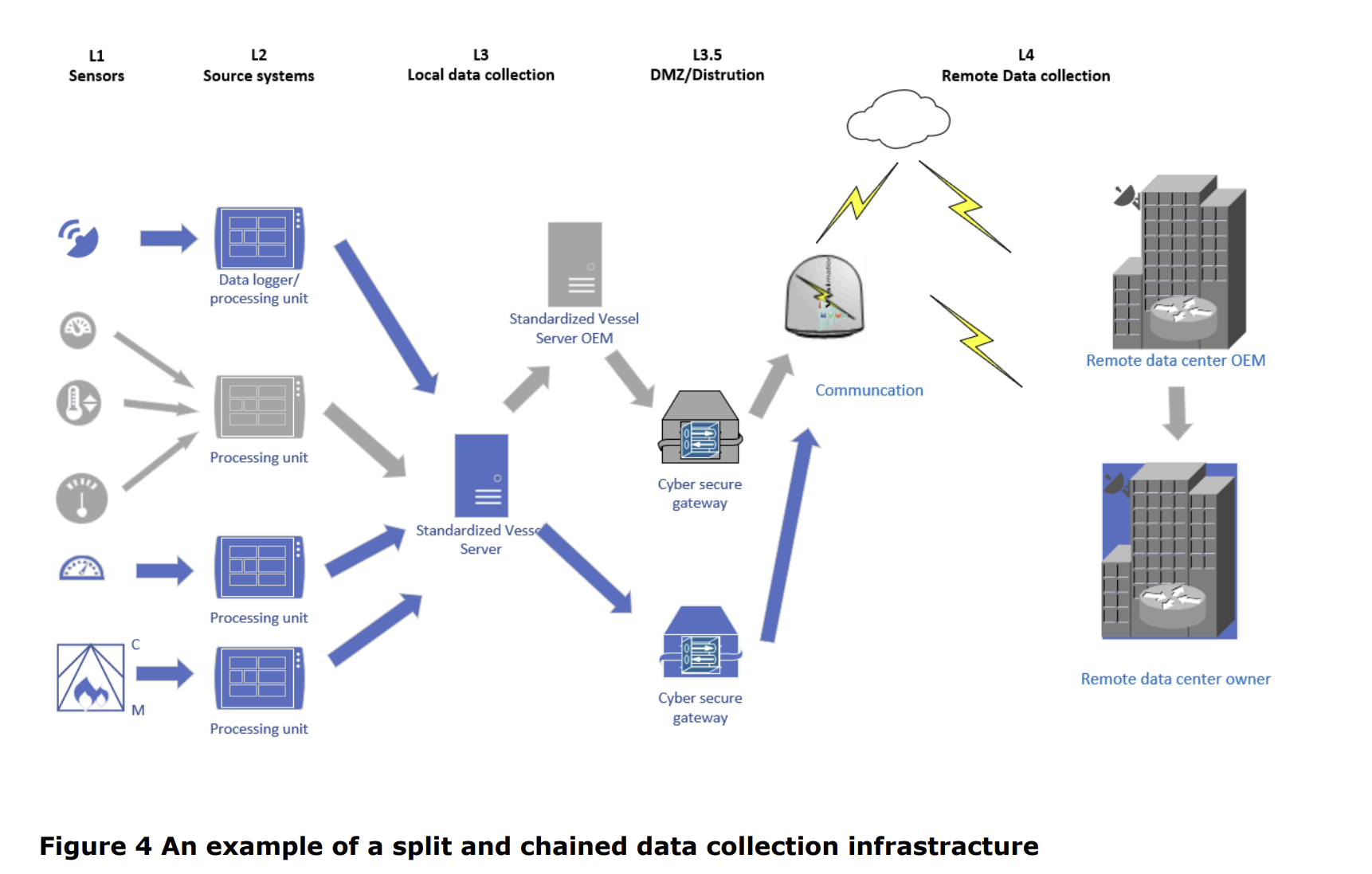
* The figure above shows an example of a split infrastructure where the upper red part may qualify as a proprietary infrastructure variant 1 while the lower blue part may be either a proprietary infrastructure variant 1 or a standardized variant 2 or 3 infrastructure.



* The figure above shows example of a vessel with two infrastructures, one proprietary and one standardized that share use of a data relay component. Each infrastructure may be assessed and certified independently but the certification will address the shared components in terms of e.g. bandwidth, priority and cyber security.



* The above shows a variant 2 or 3 infrastructure where all data communication passes through a single vessel server and data relay component. Digital Compliance Solutions



* The above shows an example of an infrastructure that includes both data flow from a standardized vessel server to a remote data center but also a flow of data transported through an OEM infrastructure before it is sent to the remote data center.

## Development of Digital Compliance Solutions for Net Zero Shipping

The three core solutions of this project consist of operational performance optimization, energy efficiency enhancement, and fleet management support, each serving to maximize regulatory compliance and operational efficiency at the ship, port, and fleet levels. These solutions will undergo phased demonstration and standardization processes prior to commercialization, and are ultimately expected to contribute to the digital transformation of Korea’s shipping industry and the strengthening of its global competitiveness.

### Voyage Optimization

* The solution is an AI-based decision support system that uses high-resolution weather, ocean current data, and ship operation logs to optimize routes and speed. It analyzes factors such as speed, load, trim, and draft to train machine learning models, while improved A\* and D\* algorithms evaluate candidate routes to derive the most efficient path. The system predicts ship-specific fuel consumption, optimizes engine RPM, and accounts for weather-related resistance to enable real-time decision-making. It will be demonstrated on Korea–China and Korea–Southeast Asia routes to validate fuel savings and emission reductions.

텍스트, 전자제품, 스크린샷, 소프트웨어이(가) 표시된 사진

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### Energy Saving Solution

* The energy saving solution aims to reduce waiting times and fuel consumption by integrating ship–port data. It analyzes port congestion, berth occupancy, and real-time AIS/satellite data, using AI to optimize ETA and approach speed. By applying Transformer models instead of traditional LSTM, it achieves higher accuracy in long-term, multivariate route-based carbon emission forecasts. It also predicts berth delays to minimize unnecessary anchoring and demonstrates fuel savings through real-time simulation during operations.

텍스트, 소프트웨어, 스크린샷, 컴퓨터 아이콘이(가) 표시된 사진

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### Fleet Service Solution

* The fleet management support solution is an integrated system that optimizes operations and evaluates cost-effectiveness across entire fleets. It analyzes operational data, maintenance records, fuel use, and route characteristics to propose strategies considering both CAPEX and OPEX. Using AI-based simulations, it verifies the impact of Energy Saving Devices (ESDs), assesses ROI, and offers lightweight economic analysis tools accessible to small and mid-sized shipping companies. By comparing simulations with real operational data, it supports fleet deployment optimization, fuel savings, and carbon reduction, ultimately contributing to fleet-level carbon management.

텍스트, 소프트웨어, 스크린샷, 컴퓨터 아이콘이(가) 표시된 사진

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Key considerations in development include ensuring the reliability, refinement, and quality of ship-collected data, as well as establishing standards for data transmitted from shore centers, which currently do not exist. We are working with DNV to align these requirements with guidelines, and the platform will serve as a foundation for future autonomous ship data collection and remote control, accompanied by the development of necessary standards.

# Action requested of the Committee

The Committee is requested to:

1. Consider establishing a messaging standard for ship control from shore centers
2. Consider developing guidelines for ensuring the integrity and quality management of ship-collected data

1. Input document number, to be assigned by the Committee Secretary [↑](#footnote-ref-2)
2. Leave open if uncertain [↑](#footnote-ref-3)