EGCS IoT / Remote Monitoring System

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In recent years, ship-to-shore broadband communications using satellite communications have been spreading rapidly. As a result, ships navigating at sea can now enjoy fixed-price, high-speed communication services. This means that the information gap with land-based services is being resolved, resulting in a sharp increase in needs related to remote services. It is against this backdrop that Fuji Electric has developed an Internet of Things (IoT) system for ships that provides a better service for its exhaust gas cleaning system (EGCS).

1. Development Background

In principle, emissions regulations based on the "International Convention for the Prevention of Pollution from Ships" (MARPOL 73/78) require the use of Class-A heavy oil, which contains low sulfur and is expensive. However, low cost Class-C heavy oil can be used if equipment is installed to remove sulfur content from the emissions gas. Given the circumstances, Fuji Electric has developed and offered an exhaust gas cleaning system (EGCS) for ships since FY2018. The EGCS faces the following challenges for operation:

(a) The EGCS should be easy to operate by non-specialist operators (i.e., seafarers).
(b) The EGCS should facilitate quick recovery in the event of a fault.

To solve these challenges and improve its EGCS services, Fuji Electric has developed its IoT system for ships.

2. Overview

Figure 1 shows the system configuration diagram for our IoT system for ships. The system consists of onboard and onshore subsystems as shown below:

(a) An IoT relay panel (onboard) that collects EGCS

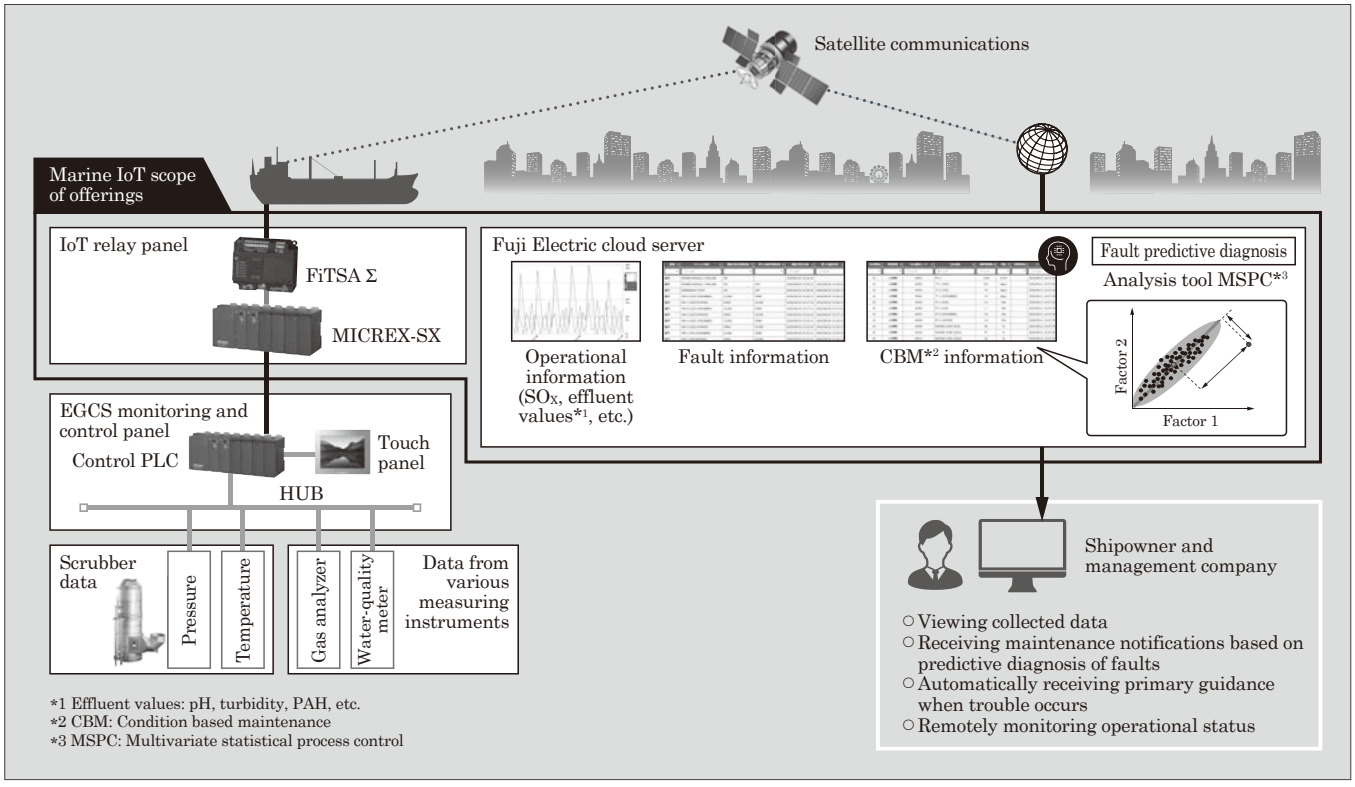

Fig.1 System configuration diagram

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log and history data and transmits it to the Fuji Electric cloud server via onboard communication devices

(b) A Fuji Electric cloud server (onshore) that automatically collects and stores data transmitted*1 from the ship in 30-minute intervals, except when the system is stopped for periodic inspections, etc.

3. IoT Relay Panel (Onboard)

3.1 Features

The IoT relay panel (see Fig. 1) is composed of the following devices to temporarily store data acquired from the EGCS monitoring and control panel (log data and history data such as pH, turbidity, and PAH*2 concentrations) and transmit it to the onshore side at regular intervals.

(1) "MICREX-SX"

A controller that converts data from the control panel so that it can be used in serial communications to ensure security and to support future functionality expansion

(2) "FiTSA Σ"

A gateway that temporarily stores data collected from the control panel and transmits it to the onshore station at regular intervals

In consideration of the characteristics of satellite communications, the Message Queue Telemetry Transport (MQTT) protocol is adopted, because its data volume is small and it ensures the reachability of information by retransmitting data even if the network environment is unstable. The connection between the IoT relay panel and the link used by the customer is established by setting up a fixed IP address, default gateway, and other configurations similar to those of general Internet connection work.

3.2 Functionality

The IoT relay panel has the following two functions to ensure ship-to-shore communications.

(1) Data transmission retry function

If transmission fails due to satellite communication failure or other reasons, this function is used to retry transmission at the next opportunity.

(2) Communication log transmission function

Since ship-to-shore communications using satellite link are affected by weather conditions, this function can be used to determine whether the cause of a communication failure is due to ship-to-shore communications or to the equipment. Communication logs are sent to the onshore station at regular intervals, enabling quick identification of the cause of the fault and prompt response.

4. Fuji Electric Cloud Server (Onshore Side)

4.1 Features of the Fuji Electric cloud server

Data transmitted from a ship via satellite link is stored in the Fuji Electric cloud server. The accumulated data can be viewed using an Operation & Maintenance (O&M) service platform.

The following describes the features of the Fuji Electric cloud server:

(a) It has an authentication function to identify the ship-side gateway device (FiTSA Σ) and ensure the security of communications.

(b) Its operation involves reducing risks and protecting critical information in accordance with security policies established based on ISO/IEC27017:2015 and Fuji Electric's IoT security guidelines.

4.2 Functions provided by the Fuji Electric cloud server

(1) Monitoring function (see Fig. 2)

It automatically collects data in 30-minute intervals, except when the system is stopped for periodic inspections, thereby enabling constant monitoring. The monitorable two items are as follows:

○ Measured values (log data monitoring)

○ Local status (history data monitoring)

The monitoring function provides the following benefits:

(a) Reduces labor-hours for seafarers in regard to data acquisition and transmission

(b) Solves the problem of miscommunication between onshore users and seafarers that prevent timely acquisition of necessary data

(c) Makes it easy to observe progress after troubleshooting. Provides feedback for subsequent maintenance activities

(2) Automatic primary guidance delivery function (see Fig. 3)

When an EGCS alarm goes off onboard, seafarers often use email to inquire of onshore personnel, costing time and labor. We have developed a function that automatically delivers troubleshooting information 24 hours a day by linking a troubleshooting list on the cloud server with automatically received alarm information. The delivering function allows seafarers with little experience or knowledge of EGCS to quickly resolve and minimize the impact of problems by registering their email addresses on the cloud server.

5. Future Developments

We consider developing the following functionality to improve remote services using IoT systems.

(1) Predictive diagnosis of faults

To prevent faults before they occur, a diagnosis system using the Fuji Electric's analytics and AI tech-

*1 Transmission: Performed using the customer's satellite communication system link

*2 PAH: Polycyclic aromatic hydrocarbon

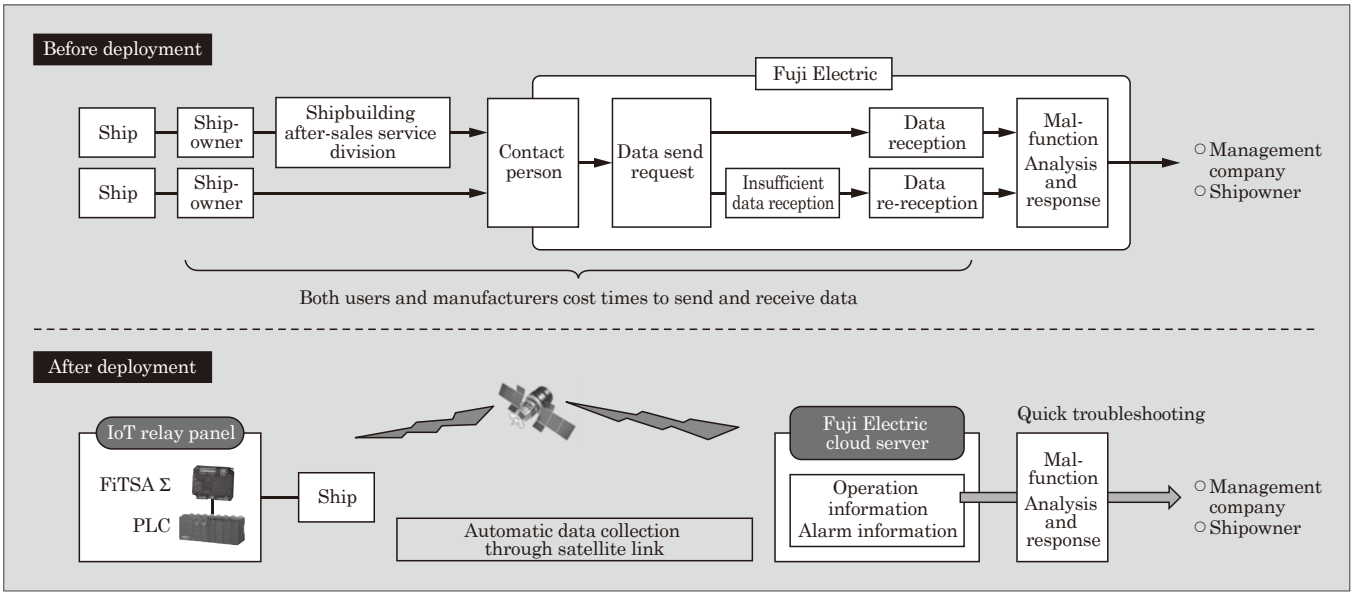

Fig.2 Overview of monitoring function

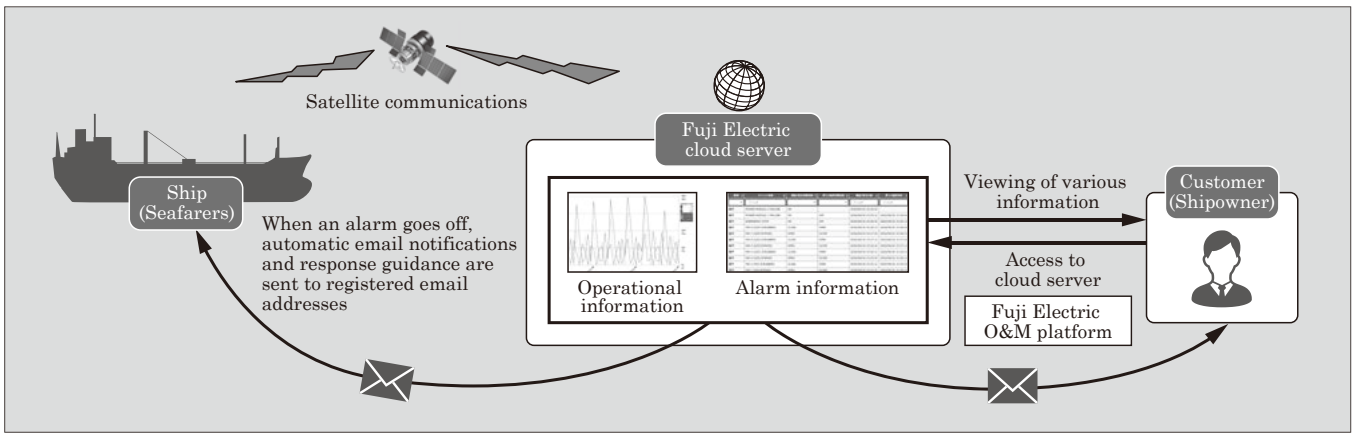

Fig.3 Automatic primary guidance delivery function

nology detects signs of failures before they occur and notify relevant personnel through an automatic delivery function.

(2) Interfacing with shipboard equipment of other companies

To enable integrated monitoring of auxiliary equipment including EGCS, the gateway FiTSA Σ installed in the IoT relay panel connects to other companies' shipboard equipment, such as boilers, ballast water treatment systems, and air conditioning equipment, and works together.

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