“IoS Open Platform” adaptive scheme to implement maritime data

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As shipping evolves into a “Big Data” industry, ClassNK and its subsidiary Ship Data Center Co., Ltd. (ShipDC) are supporting the maritime community by providing the platforms to reap the benefits in partner with the related parties in Japan.

KEY WORDS
big data; Japanese industry; Internet of Shipping

INTRODUCTION
ClassNK and its subsidiary Ship Data Center Co. Ltd.(ShipDC) have investigated how the industry can utilize so-called big data teaming up with shipping companies, shipbuilders, suppliers, ICT companies, and other related parties. For sharing the data in the industry, shipping companies as the data source have pointed out the necessity of a common rule for data property and distribution as well as a secure data center. Responding to these needs, ClassNK and ShipDC have designed a scheme in which shipping companies are able to provide the data with less concern, and data users in the industry can utilize for development and improvement of their products and services.
The paper describes the above-mentioned scheme of “IoS Open Platform(IoS-OP)” consist of the data center with various functions to encourage the data use and “the common rules” to store, exchange, utilize the data, as the model of data sharing and distribution in the industry.

THE ERA OF DATA
Big Data has been called “the oil of 21st century” to emphasize the wide spread of data flows brought about by the new era of digitization. ‘Internet of Things’ is expected to comprise between 20-40 billion devices by 2020 depending on who is doing the forecasting, but keeping pace with data flows is certainly likely to be challenging.
Once considered a very “low data” industry, the maritime industry is now vigorously waking up to the new digital age. Thanks to rapid advances in the development of information and communication technologies, it is now possible to collect large volumes of data on a diverse range of items related to ship operations. The information acquired from sensors of equipment, machinery and any other onboard devices can be recorded as digitalized data. The generated data connected to the internet as IoT can be accumulated as Big Data, which can be the basis of digitalization in the maritime industry. Remote access monitoring, condition-based maintenance, data analytics and forecasting are significantly improving and optimizing numerous functions in operations and ship management. As a result, the international shipping industry is beginning to embrace the tangible opportunities that the growth of big data presents.

In addition, regulatory requirements also pose the necessity of data collection. The implementation of fuel consumption data reporting regulations has been ongoing in an effort to reduce GHG emissions and the EU-MRV (European Union - Monitoring, Reporting, Verification) regulations for ships operating in the EU area began in 2018. The upcoming IMO DCS regulations require all globally operating ships over 5,000GT to collect fuel consumption data and create an annual fuel consumption data report to submit to their flag administration or recognized organization for verification.
While more shipping companies need and are willing to share information with a view to reaping the benefits of big data or complying with the international or local regulations, the approach to data capture remains very fragmented. Similar data is routinely sent to several vendors and analysis is still being carried out almost entirely on a ship-by-ship basis, in processes that are both time-consuming and inefficient.
To make larger gains, an effective platform capable of centralizing and managing such diverse data is essential. However, creating and maintaining this kind of platform is costly, time-consuming and unrealistic for some organizations. Furthermore, special care needs to be given to the handling of data to ensure confidentiality of information; hence it is also necessary to establish a secure yet effective platform from an impartial perspective.

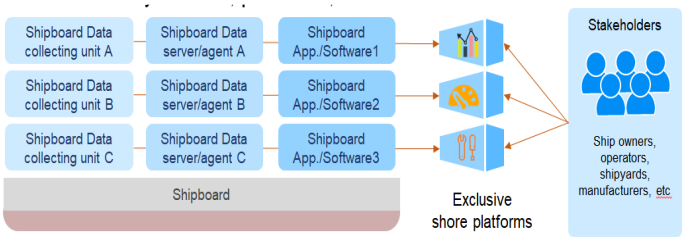

Fig.1 Fragmented data capture

TIMELINE AND THOUGHTS
ClassNK has long served the maritime industry thorough its technical and third-party service responding to industry needs. Its longstanding commitment to helping shipping realize the potential of big data is summarized as follows. In Dec. 2015 Ship Data Center Co., Ltd. (ShipDC) was established as a separate entity from ClassNK. It started to store shipping data in May 2016 as a trial, and simultaneously, ShipDC started to receive marine weather information from Japan Weather

Association. Through Japan Weather Association's free provision of real-time marine weather information such as offshore wind (direction, speed), waves (height, frequency, direction) and ocean currents (direction, speed), the comprehensive analysis of voyage data from vessels at sea and marine weather information was made possible.
In Aug. 2016, the trial for calling the data started. While ShipDC was preparing for the data center operation and technical trial to transmit the ship data to shore, it discussed with industry players how to best utilize the data related to ships. In 2017 the related conferences were held with more than 700 attendees in total, and the "Internet of Ships Open Platform Promotion Council" was established to deepen the discussion.

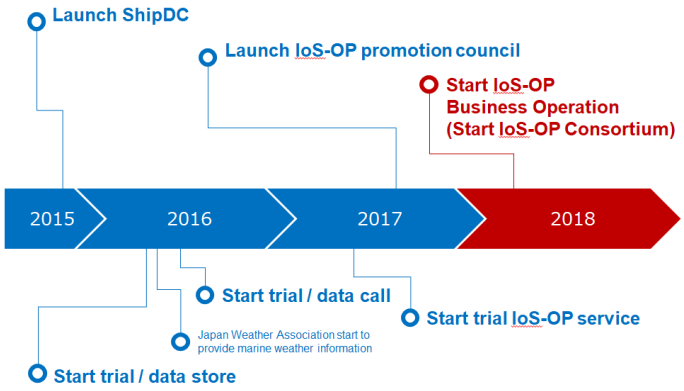

Fig.2 Summary of ShipDC activities

Without data collection beyond the border of companies, the data cannot become real Big Data. However, a giant platformer's monopoly on data and data use for their own business, which is often seen today in other industries, is not appropriate for industry platforms containing highly confidential information. There must be clear rules for fair data use between data owners and data users, and confidentiality of the data has to be strictly guarded. With this kind of framework, players especially who own the data can be willing to pass and share it. The conclusion from the discussion confirmed the necessity of common rules for data property and distribution, and a fair, reliable, and independent scheme.

IOS-OP AND IOS-OP CONSORTIUM

In May 2018, for satisfying the above-mentioned requirements, the "Internet of Ships Open Platform (IoS-OP)" was launched as the common platform to share and distribute the operation data of ships to enable shipbuilders, manufactures and other stakeholders to access the data without infringing on data providers' interest. IoS-OP consists of the data center service and the common rules for data distribution agreed among the industry. The initiative is aiming to co-create data-driven new values, new solutions, and foster innovation.
In order to operate IoS-OP as the neutral platform, and avoid any monopoly of the data, an association was formed by the member of ShipDC users which is called as "IoS-OP Consortium". ClassNK is also a member of IoS-OP Consortium and any important decisions to operate IoS-OP shall be made by the prescribed procedures of IoS-OP Consortium; This ensures sound and permanent management of the IoS-OP. Initial members of the IoS-OP Consortium consist of 46 shipping companies, shipbuilders, marine manufacturers, ICT and other organizations based in Japan.
On IoS-OP, data will be collected from multiple vessels, regardless of class or company, through data collection devices onboard. Companies will be free to choose what they want to share and to specify whether they want it shared with engine makers, equipment manufacturers, shipyards or other stakeholders who might benefit.
The IoS-OP is currently available to the IoS-OP Consortium members located mainly in Japan. However the IoS-OP Consortium and ShipDC are preparing for the global launch of the related service described in this paper.

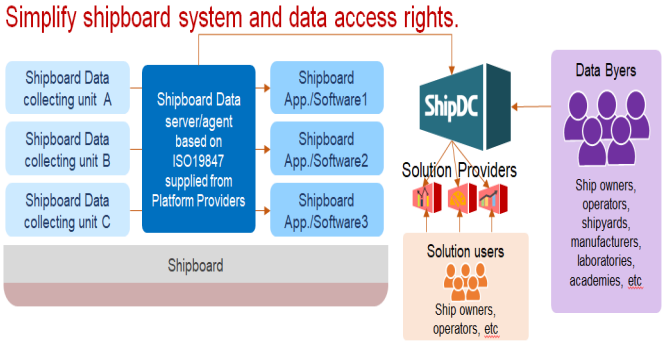

Fig.3 Simplified and integrated data capture

OUTLINE & ROLES ON IOS-OP

The players on IoS-OP are described as follows:

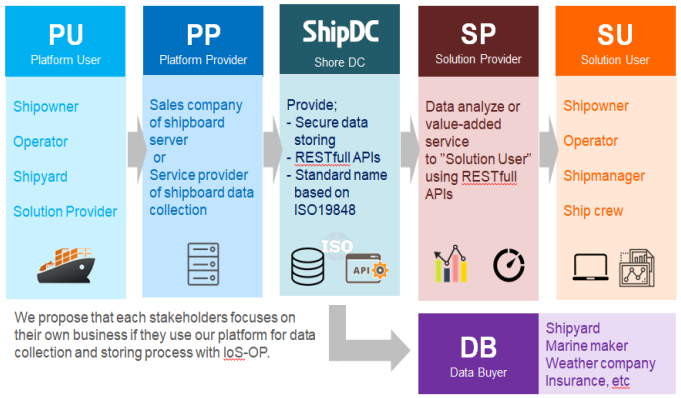

Fig.4 Outline of IoS-OP

Platform User (PU):
The PU should mainly be a shipowner or operator. A shipyard and Solution Provider (explained later) may also take this role. The PU bears the cost of data collection (data ownership). Costs means shipboard server cost, data communication cost and data storage cost, etc. The PU manages data access rights and data collection of the data they provide and authorize solution user and data set range.

Platform Provider (PP):
The PP is a service provider of data collection to the PU, which should be a sales company of shipboard servers or service provider of shipboard data collection.

ShipDC (DC):
Through devices and services of the PP, the data shall be transmitted to the datacenter operated by DC. DC is ShipDC itself storing the collected data securely and providing RESTfull API for the data distribution. Furthermore, it harmonizes the data captured from ships by converting the specific data format of a software service provider or system into a standardized ISO format: "ISO19848:2018 Ships and marine technology — Standard data for shipboard machinery and equipment", which was originally developed by Smart Ship Application Platform (SSAP). SSAP is the project of Japan Ship Machinery and Equipment Association.

Solution Provider (SP):
The SP provides the data analysis or any value added service utilizing the transmitted data such as remote maintenance, performance report, condition monitoring, and so on. SP will use ShipDC's RESTfull API as the data access interface.

Solution User (SU):
The beneficiary from SP and their service is categorized as SU, who should be a shipowner, operator, shipmanger, or crew.

Data Buyer (DB)
The DB uses the data for improvement of its own product/building ship, big data analysis, performance analysis, and so on under the authorization of PU. DB should be a shipyard, marine manufacturer, weather company, or insurance company.

For ensuring fair and transparent data use, membership in IoS-OP Consortium and company registration are required for the PP, SP and DB.
On IoS-OP, each stakeholder can focus on their own business by using the common platform for data collection and storing process.

RULES FOR IOS-OP

IoS-OP provides common and individual rules for corresponding to the role and relationship of each stakeholder in order to distribute IoS-OP data among stakeholders fairly. For the time being, 9 sets of rules are stipulated.

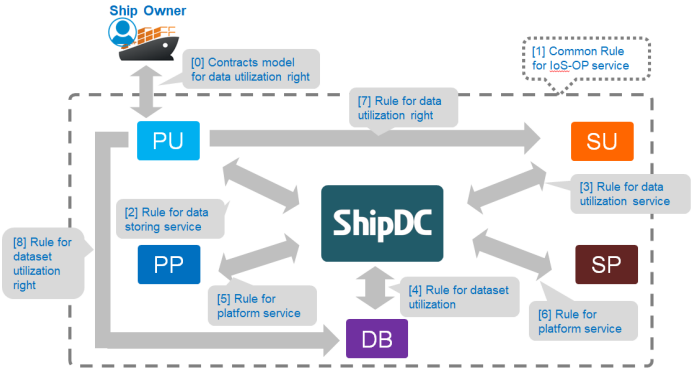

Fig.5 Rules for IoS-OP

[0] Contracts model for data utilization right
The contract model is for Ship Owner and PU to reduce the related negotiation of data ownership and data utilization rights.

[1] Common Rule for IoS-OP service
The rule is a basic one to be applied to all IoS-OP users. It shall be applied between ShipDC and each stakeholder.

[2] Rule for data storing service (for PU)
[3] Rule for data utilization service (for SU)
[4] Rule for dataset utilization service (for DB)
[5] Rule for platform service (for PP)
[6] Rule for platform service (for SP)
These rules contain requirements for participation qualification, registration condition, use condition, observance matters and prohibited items by each role.

[7] Rule for data utilization right between PU and SU
[8] Rule for dataset utilization right between PU and DB
These rules are for relative transaction between PU and SU/DB for data/dataset utilization right.

SHIPDC'S SERVICE ON IOS-OP

The primary role of ShipDC is datacenter operation of IoS-OP, centralizing the data from ships to shore. However it provides additional service for smooth distribution including data standardization.
On IoS-OP ShipDC provides the following functions to receive data from various equipment, facilities, and systems onboard:

- Automatic data registration from attached data files based on the file naming rule
- Support multiple onboard devices
- Support data other than text-format data files
- Support confidential data for maker

In order to accept and process various data, ShipDC has introduced the following data structure:

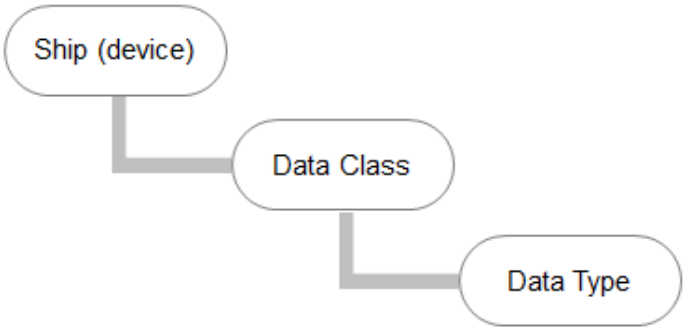

Fig.6 Data structure concept

"Data Class" defines the attribute of the data as follows:

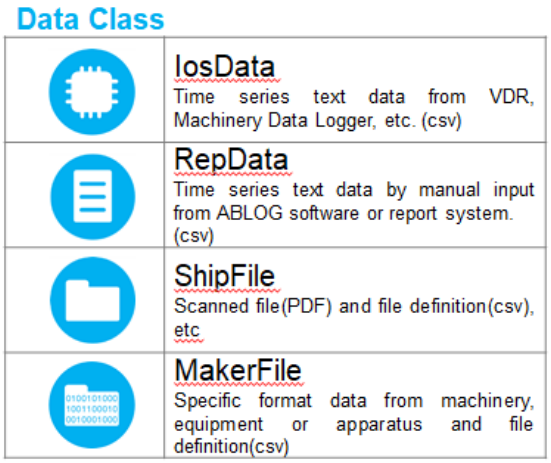

Fig.7 Data Class

'Data Type' is for specifying the data definition in "IoSData" and "RepData".
As the information hub for the maritime industry, security measures are taken for safe and secure distribution of data such as protection from unauthorized writing by specifying senders of data transmission mail, data key distribution by encrypted file, communication protection in data call, enhanced authentication for data access interface.
For data access control ShipDC provides sub-user setting function to grant access authority based on data ownership and schemes to detect/correct error data. ShipDC issues and distributes data keys with an access range set by ShipDC based on the request of data ownership holder. Users access data using the data key via software/application authorized by ShipDC. For data quality improvement, it also provides an error data detection/notification scheme to mechanically detect/notify errors including email non-delivery, data file damage, numerical data blanks and notification.

REQUIREMENT OF SHIPBOARD DEVICES (PP)

From onboard to shore, the data is stored in the database automatically by the email from a shipboard device to ShipDC with an attached data file. The following process is necessary with the shipboard device.

Data output: output text and file data in designated format
ZIP: compress data files in a ZIP file
Authentication key code: generate authentication key code by each sending action to prevent manipulation and unauthorized update,
Send mail: send mails to ShipDC with ZIP file and authentication key code file for data storage

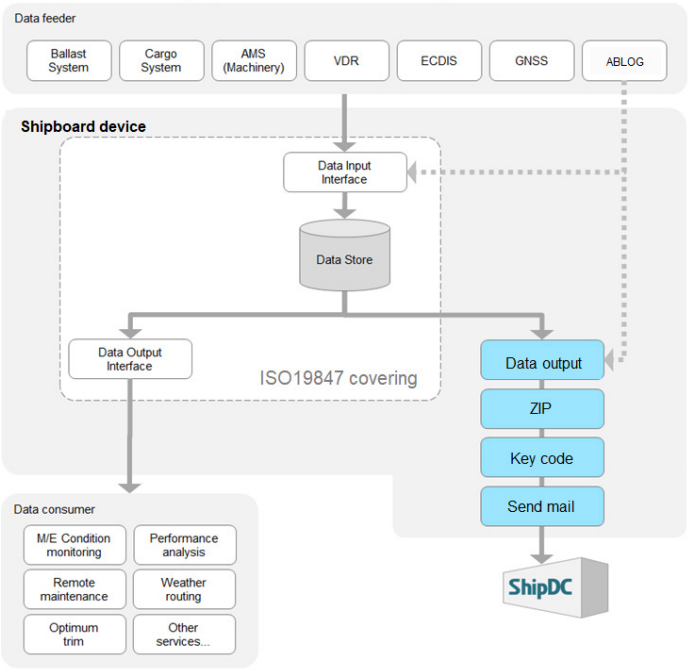

Fig.8 Requirement of Shipboard Devices (PP)

RESTFUL API SERVICE

For SP utilizing the data for their service or solution, RESTful API is provided as the data access interface:

DataSet API: GET available ships and data type list
DataClass API: GET accessible data with data key
Weather API: GET free marine weather information mapping to ship position/ date & time in time series data provided by Japan Weather Association
Maker API: GET specific data sending/storing available for maker confidential data
Other API: GET supplementary data such as data type definition (meta information)

CONCLUSIONS

IoS-OP is the adaptive scheme to best utilize the big data in the maritime industry and consists of the data center with various functions to encourage the data use and "the common rules" to store, exchange, and utilize the data. Following its establishment in 2018, ShipDC datacenter and other operation for IoS-OP and partners are now working on the global launch of the service.