Activities of Smart Ship Application Platform 2 Project (SSAP2)

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Chair of SSAP2
(Senior General Manager, MTI)
Outline

1. IoT and Big data
2. SSAP (Smart Ship Application Platform) Project
3. Standardization - ISO DIS 19847/19848
4. Ship data center
5. Roadmap and summary
Outline

1. IoT and Big data
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“Operation Technology (OT)” and “Information Technology (IT)” are to be bridged. The era of “transparency” where user can access field data.

* PLC: Programmable Logic Controller
Big data in shipping
For operational efficiency, safety operation and business decision support

Examples of Big data in shipping

Voyage data
- Automatically collected data (IoT)
- Noon report

Machinery data
- Automatically collected data (IoT)
- Manual report data
- Maintenance data / trouble data

AIS data
- Satellite AIS / shore AIS (IoT)

Weather data
- Forecast / past records
- Anemometer / wave measurement (IoT)

Business data
- Commercial data
- Market data
Coming IoT applications in marine industry

**Target**
- Prevent unpredicted downtime
- Reduce maintenance cost
- Energy efficiency in operation

**Measure**
- Condition monitoring
- Big data analysis
- Support service engineer
- Intelligent machinery
  - Self diagnostics

*Working style will be changed*
Digital Twin

Digital representations of artifacts in computer simulations. Real and virtual are linked closely by IoT data.

Reference:
Before IoT:
Engineering knowledge, simulations and tools have been used for design and production

- Designers and engineers consider life cycle values of products only at design stage
  - Manufacturability, usability, maintainability, disposability ...

CAD, CAE  CAM  Engineering knowledge  Engineering knowledge
Design  Build  Operation  Dispose
Era of IoT: Engineering knowledge, simulations and tools are now demanded through life cycle of products

- Designers and engineers can access actual products via IoT data
  - New services in operation
  - Feedback to new design
- Engineering knowledge become more available in operation
### IoT and Big data applications

<table>
<thead>
<tr>
<th>Role</th>
<th>Function</th>
<th>Example of IoT and Big data application</th>
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</table>
| Ship owner         | Technical management | • Safety operation  
                     |                                                          | • Condition monitoring & maintenance  
                     |                                                          | • Environmental regulation compliance  
                     |                                                          | • Hull & propeller cleaning  
                     |                                                          | • Retrofit & modification  
|                    | New building    | • Design optimization                                                                                   |
| Ship operator      | Operation       | • Energy saving operation                                                                               |
|                    | Fleet planning  | • Fleet allocation  
                     |                                                          | • Service planning  
                     |                                                          | • Chartering                                                                 |
| Shipyard           | In-service ship | • Ship performance analysis                                                                             |
|                    | New building    | • Design optimization                                                                                   |
| Manufacturer       | Maintenance     | • Remote monitoring & diagnosis                                                                          |

Other partners in value chains, such as cargo owners, class societies and insurance companies, have also interests in ship Big data. With appropriate data governance and business rules, IoT data will be widely used.
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Smart Ship Application Platform (SSAP) project

- The concept of smart ship is to utilize automation and IoT application services to achieve optimum ship operation in terms of safety and energy efficiency.

- The target of Smart Ship Application Platform Project (SSAP1 & SSAP2) is to provide better and controlled accessibility to ship machinery and equipment data for IoT application services onboard and ashore by providing a standardized platform.
IoT application services (without common platform)

IoT application services (onboard and shore)

Optimum Trim  Performance Monitoring  Weather Routing  Engine Monitoring  Remote Maintenance

Similar data are sent to shore without good control

Cabling and interfacing one by one

Onboard machineries & equipment

ECDIS  VDR  Engine Data Logger  Ballast Control System

Energy Efficient Autopilot

IoT application services (onboard and shore)
IoT application services (target of SSAP1&2)

IoT application (onboard)

- Optimum Trim
- Performance Monitoring
- Weather Routing
- Engine Monitoring
- Remote Maintenance
- Energy Efficient Autopilot

Ship IT LAN for IoT applications

Shipboard data server (IoT gateway)

Onboard machineries & equipment

- ECDIS
- VDR
- Engine Data Logger
- Ballast Control System

To Shore ShipDC

Ship IT LAN for machineries and equipment
Open platform of maritime industry for sharing data

IoT Open platform
(Industry standard)

Application / services
(Competition)

Ship

Onboard data server

Software agent

LAN

M/E
D/G
Boiler
T/G...
VDR
Radar
ECDIS
BMS
Cargo crane

....

Onboard application
- Weather routing
- Performance monitoring
- Engine maintenance
- Plant operation optimization

Data Center

Data center (operated by neutral body)

Asia

Europe

Security / access control

Data center (operated by neutral body)

Performance monitoring

Engine monitoring

Energy management

Remote maintenance

Marketing and Big data analytics

User

Ship operator

Ship owner

Ship Management company

Class Society

Shipyard

Engine maker

Ship equipment maker

Remote maintenance

Security / access control

JSMEA
Japan Ship Machinery and Equipment Association
What are the benefits of such platform?

- Application providers can easily provide data analysis services to ship owners, who accumulate vast amount of ship operation data.

- Ship owners investment cost (CAPEX and OPEX) for onboard applications and shore services will be reduced by sharing data collecting platform.

- Shipyards and equipment manufactures can access their product operation data through life-cycle and can provide new services.

- Ship owners can manage/control data transmission between ship and shore.

- Standardized format and protocol will enhance more IoT application services development.
SSAP1 Project (Dec 2012 – Mar 2015)

• Participants
  – Members: 27 organizations
  – Observers: 9 organizations

• Joint Industry Project (JIP) supported by JSMEA + Class NK

• Achievements
  – Design specification of shipboard data server
  – Implementation of shipboard data server and trials on 2 domestic vessels
  – Ship – shore open platform design for ship IoT
  – Proposed 2 ISO NPs (ISO NP19847 / ISO NP19848)
Onboard trials in SSAP1 (2014)

RORO Ferry
SUNFLOWER SHIRETOKO

Crude-Oil Tanker
SHINKYOKUTO MARU
SSAP2 Project
(Smart Ship Application Platform 2 Project)

• Participants
  – 38 members + 10 observers (as of Sep. 2017)

• Schedule

• Action items
  1. Promotion of SSAP2 concept
  2. System design and prototyping of SSAP2
  3. Standardization – ISO DIS19847/DIS19848
  4. Public relations
Organization of SSAP2 Project

SSAP2 all members
Members: 38 organizations
Observers: 10 organizations
Chair:
- Dr. Ando (MTI)
Chief secretary:
- Mr. Morono (Terasaki Electric)

Steering Committee
- Chair
- Chief secretary
- All leaders and sub-leaders

ISO Correspondence Team
(Working with JSTRA correspondence group)
Correspondence members:
- Mr. Morono (Terasaki Electric)
- Mr. Yamada (Uzushio Electric)
- Dr. Ando (MTI)

Promotion Team
Leader:
- Dr. Ando (MTI)
Sub-Leader:
- Mr. Fujii (Diesel United)
- Dr. Hiekata (U. of Tokyo)

System Design & Prototyping Team
Leader:
- Mr. Moritani (ClassNK)
Sub-Leader:
- Mr. Nakano (JRCS)
- Mr. Ikeda (ClassNK)

Standardization Team
Leader:
- Mr. Morono (Terasaki Electric)
Sub-Leader:
- Mr. Yamada (Uzushio Electric)
- Mr. Hara (Furuno Electric)

Data Catalogue Team
Leader:
- Mr. Fujii (Diesel United)

Ship DC
Outline

1. IoT and Big data
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5. Roadmap and summary
Open platform of maritime industry for sharing data

**Ship**
- M/E
- D/G
- Boiler
- T/G...
- VDR
- Radar
- ECDIS
- BMS
- Cargo crane
- ....

**LAN**

**Shipboard data server**

**Software agent**

**Data Center**
- Data center (operated by neutral body)
- Asia

**Shore Service Provider**
- Performance monitoring
- Weather routing
- Engine monitoring

**User**
- Ship operator
- Ship owner
- Ship Management company

**New ISO regarding Ship IoT**

- **ISO/DIS19847** - Shipboard data servers to share field data on the sea
  - Specifications of ship onboard data server
- **ISO/DIS19848** - Standard data for machinery and equipment part of ship
  - Specifications of dictionary and format
ISO DIS 19847
Shipboard data servers to share field data on the sea

- Requirements for shipboard data servers to collect and share field data

**Input Data**
- IEC61162-1/2 Sentence data
- ISO/CD 19848 Format data
- File based on ISO/CD 19848

**Input Function**
- Data Streaming
- Data Stored

**Data Streaming**

**Output Function**
- Streaming Transport service
- Request-Response Transport service
- File Transport service

**Output Data**
- IEC61162-450
- ISO/CD 19848 Format data
- File based on ISO/CD 19848
ISO DIS 19848

- **Standardized ID of sensors, common data model & format**

- **ID of sensors**
  - *URL* compliant naming scheme
  - Dictionaries (*informative*)
    - JSMEA
    - DNV-GL

- **Data model**
  - Data channel list (meta data)
  - Time series data (data)

- **Data format**
  - *XML* with schema definition
  - *JSON* (*informative*)
  - *CSV* (*informative*)

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**Naming rule & data standard**

- **URL** compliant naming scheme
  - 
    - [http://data.shipdatacenter.jp/imo1234567/MainEngine/Cylinder2FO/In/Temp](http://data.shipdatacenter.jp/imo1234567/MainEngine/Cylinder2FO/In/Temp)
    - Unit: ℃
    - Range: 0-700
    - ... 
  - [http://data.shipdatacenter.jp/imo1234567/MainEngine/Cylinder1/ExhaustGas/Temp](http://data.shipdatacenter.jp/imo1234567/MainEngine/Cylinder1/ExhaustGas/Temp)
    - Unit: ℃
    - Range: 0-150
    - ... 

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**DataChannel List**

**XML/JSON**

**CSV**

**TimeSeries Data**

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JSMEA Japan Ship Machinery and Equipment Association
Examples of sensor naming in ISO DIS 19848

Universal ID

http://data.shipdatacenter.jp/imo1234567/MainEngineAirCooler3//CFW/Out/Temp

Naming Entity  ShipID  LoallID

Universal ID

http://data.dnvgl.com/imo1234567/dnvgl-vis/411.1/C101.31+1/ExhGas+t(C)

Naming Entity  ShipID  LoallID
Policy of standardization

❖ Corroborate and harmonize with
  – Existing standards
    • IEC61162-450/460 (Digital Interface – Part 450 Multiple taker and multiple listeners – Ethernet interconnection)
    • ISO16425 (Guidelines for the installation of ship communication networks for shipboard equipment and systems)
  – New proposed standards
    • IHO S-100series
    • IEC BAM (Bridge alert management – Operational and performance requirements, methods of testing and required test results)
  – Associated projects / Organization
    • e-Navigation(IALA)
    • SMART-Navigation(Korea)
    • IEC etc.,
  – Cyber security discussions
Process for ISO (ISO 19847, ISO 19848) *

- ISO PWI 19847/19848 were accepted as NP by ISO/TC8/SC6 in Jan. 2016.
- 2 CDs were accepted as CD in Nov. 2016 and moved into DIS phase.
- 2 DISs are now in voting (until 20th Sep. 2017)

*NP: New work item Proposal, WD: Working Draft
*CD: Committee Draft, DIS: Draft International Standard
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IoT Open platform (Industry standard)

Application / services (Competition)

ShipDC

Onboard application
- Weather routing
- Performance monitoring
- Engine maintenance
- Plant operation optimization

Data center (operated by neutral body)

Europe

Security / access control

Shore Service Provider

User

- Ship operator
- Ship owner
- Ship Management company
- Class Society
- Shipyard
- Engine maker
- Ship equipment maker

Data center

Performance monitoring

Weather routing

Engine monitoring

Energy management

Remote maintenance

Marketing and Big data analytics

Onboard data server

Software agent

broadband

LAN

Ship

M/E

D/G

Boiler T/G...

VDR

Radar

ECDIS

BMS

Cargo crane

....
ShipDC – ship data center at shore

Ship data center provides a platform to access ship IoT data safely, easily and reasonably. With the platform, utilizations of ship IoT data at shore will become much easier and it will enhance development and operation of ship IoT application services.

Each software or system has its specific data format. SDC convert them to the standardized ISO format.

API with access control provides ship IoT data to application services.
Use Case Scenarios of ShipDC

**Shipping**
- Safety operation
- Vessel performance analysis
- Fleet operation optimization
- Weather routing

**Shipyard**
- In-service performance analysis of delivered ships
- Feedback to new ship design

**Manufacturer**
- Remote condition monitoring
- Remote diagnostics
- After service support

**Class Society**
- Utilization in class inspection

**Software vendor**
- Application services

**Insurance/Bank**
- New services

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*ShipDC*

*JSMEA*  
Japan Ship Machinery and Equipment Association
Internet of Ship (IoS) open platform

Roles are defined and each player provides their expertise on the Internet of Ship (IoS) platform. Data governance and business rules are under discussion in the IoS promotion council.
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## Roadmap of ship Big data & IoT toward 2020

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<tr>
<td>R&amp;D projects (e.g. i-Shipping in Japan and autonomous ships in Europe)</td>
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<td>CBM<em>¹ &amp; PHM</em>² services &amp; class inspections</td>
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<td>Condition based maintenance and PHM for main engines, machineries and equipment.</td>
<td>Condition-based class inspection services ?</td>
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<tr>
<td>Big data and IoT utilization in fleet operation</td>
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<td>Integration of ship with shore operation system. Optimization, automation and simulation technologies.</td>
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<td><strong>Platform</strong></td>
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<td>ISO CD/DIS 19847/19848</td>
<td>(FDIS)</td>
<td>SSAP 3 ?</td>
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<td>SSAP2 and standardization (ISO DIS 19847/19848)</td>
<td>SSAP 2</td>
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<td>Ship data center and IoS (Internet of Ship)</td>
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<td>Preparation for IoS program</td>
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<td>Ship Data Center in operation</td>
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<td><strong>Regulatory</strong></td>
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<td>Cyber safety and cyber resilient ship</td>
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<td>Cyber safety (BIMCO guideline, IMO MSC guideline, Class guidelines)</td>
<td>Cyber resilient ship (IACS, class system integration regulations)</td>
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<td>EU MRV *³ and IMO DCS *⁴</td>
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<td>IMO DCS</td>
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<tr>
<td>e-Navigation and autonomous ship projects</td>
<td>Model development</td>
<td>Standardization</td>
<td>Implementation</td>
<td>Operation</td>
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<td>ithubolocal/autonomous ship projects in Norway, Finland and other nations</td>
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*1 CBM: Condition-Based Maintenance, *2 PHM: Prognostics and Health Monitoring
*3 MRV: Monitoring Reporting and Verification, *4 DCS: Data Collection System
Summary

• JSMEA, Class NK, 38 member organizations and 10 observers are working together for SSAP2 (Smart Ship Application Platform 2) Project

• The aim of SSAP2 Project is to design and to implement an open platform for supporting Ship IoT service development and operation

• SSAP2 follows up ISO DIS 19847/19848 standardization process

• SSAP2 works closely with Ship DC and contribute to discussions of data governance and business rules
Thank you very much for your attention

For further information, please contact

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JSMEA, Japan Ship Machinery and Equipment Association