ISTS Demonstration Plan

ISTS Report R5.1
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MARITIME ITS

Intelligent Ship Transport System

Document information

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Rev.	Who	Date	Comment
0.1	ØJR	08.01.2024	First summary of existing plans
0.2	JMK	15.01.2024	Comments – most included in the text
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1.0	MH	19.11.2024	Final version

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Executive Summary

This document describes the demonstrations that will be done in the ISTS-project. It also provides some background information that are important for the understanding of the scenarios.

A total of six scenarios are described with varying degrees of detail. The document will be updated as progress are made on the different implementations.

Scenarios A4.1 (arrival negotiation) and D1 (PKI) are given priority 2 and will be put on hold until more work has been done on other scenarios.

Abbreviations

ETA	Estimated time of arrival
ETD	Estimated time of departure
GLN	Global Location Number (GS1 standard)
HTTP	Internet hypertext transfer protocol, in this document HTTPS will be used.
HTTPS	Secure version of HTTP
IDSPA	International Dataspaces Association
IMO	International Maritime Organization
IP	Internet Protocols (all protocols such as TCP/IP, HTTP, HTTPS etc.)
ISO	International Organization for Standardization
ISTS	Intelligent Ship Transport System (project), http://ists.mits-forum.org/
ITCPO	International Task Force on Port Call Optimization, https://portcalloptimization.org/
JSON	JavaScript Object Notation
MDS	Maritime Data Spaces
MPA	Maritime and Port Authority, Singapore, https://www.mpa.gov.sg/home
MQTT	Message Queuing Telemetry Transport
MSW	Maritime Single Window
NDP	Nautical data provider
PCS	Port Community System
PKI	Public Key Infrastructure
PTA	Planned Time of Arrival
PTD	Planned Time of Departure
RTA	Requested time of arrival
RTD	Requested time of departure
S-100	The new hydrographic system for description of electronic charts and overlays
S-131	Marine Harbour Infrastructure– part of S-100
S-421	Route plan based on S-100
SSN	SafeSeaNet Norway – Norwegian MSW
TLS	Transport Layer Security
VDES	VHF Data Exchange System
VSAT	Very Small Aperture Terminals (satellite system)
VTS	Vessel Traffic Service

XML	Extensible Markup Language
XSD	XML Schema Definition – defining syntax of XML messages

1 Introduction

1.1 Scope

This report describes the demonstration plans for the ISTS project. Time period for demonstrations is the year 2024, until 31. October 2024.

The demonstration is proposed as six scenarios described in Section 4. These will have to be elaborated with the following:

- A priority -highest priority will be done first.
- Participants and timing.
- More details on actual execution of the demonstration will be added when the participants have been selected.

The purpose of the ISTS tests is to demonstrate actual use of new digital standards related to port calls and to report on this to IMO. This will be a follow-up to a similar demonstration performed by Rotterdam and Singapore as part of their green and digital corridor (see section 2.3).

1.2 Structure of this report

The sections are organized as follows:

1. This is the introduction and general overview to this document.
2. This section provides an overview and summary of various background material.
3. This is an overview of the general demonstration concept.
4. This is the description of the concrete demonstration scenarios.

An annex gives a brief description of how ISO 28005 can be implemented to realize the demonstration scenarios that make use of that protocol.

The last unnumbered section contains references. References in the text is a number in square brackets, e.g. [1].

2 Background for the demonstration plan

This version of the document is based on the following previous documents:

1. The very brief project plan for ISTS. This is included in section 2.1. This is not directly relevant anymore and will be modified as needed [3].
2. The general port call optimization process as documented by ITPCO [2]. This is summarized in section 2.2
3. Demonstration plan for the Digital Corridor Rotterdam-Singapore. This is an early description that also in parts is outdated. Input documents have not been released to the public, so section 2.3 is a summary.
4. Outline port call processes as discussed and documented at project meeting in Bergen, 2. November 2023 [4]. This is also summarized in section 2.4.
5. Noon at sea reporting as described by the Smart Maritime Network [5]. This will also be integrated in the IMO Compendium and furthermore into the ISO 28005 standard.

Each of the following sub-sections will briefly describe the relevant documents as referenced in the numbered list.

2.1 WP5 description from project description

The following text is from the proposal. This is only a proposal, and the actual plans have changed over the years as described in this document. However, the changes should be within the overall intended scope of the project.

This is an industrial research (IF) work-package.

This WP is included to enable full scale tests to be made in the test areas of Trondheim (ITS) and Haugesund (KYV/NMA). This is used in validation of hypothesis described under sec. 1.2 and will also be used in the user requirements work. The tests will use existing or coming infrastructure in the areas. Tasks are:

1. Integrated ship-shore communication tests, including VHF Data Exchange and mobile data/Satellite. Communication to private and public parties (KYV, all).
2. New communication methods based on data pull rather than conventional data push, e.g. using MDS/IDSPA system (ITS, all). This will not be demonstrated as specifications are not yet available.
3. The digital port, including port community systems, ship movement registration and prediction (GC, KYV).

2.2 The ITCPO port call process

ITCPO has defined a standardized port call process that is described in various documents at their web site [2]. The flow diagram is shown in Figure 1. A more detailed image can be found at [1]. Note that this diagram only includes the authorities as one actor while this typically will be several, e.g. maritime single window, VTS, etc.

Seen from the proposed port call demonstration, the most relevant phases of the process are described below. Note that the two first phases (sales of goods and contract for hiring ships are not included).

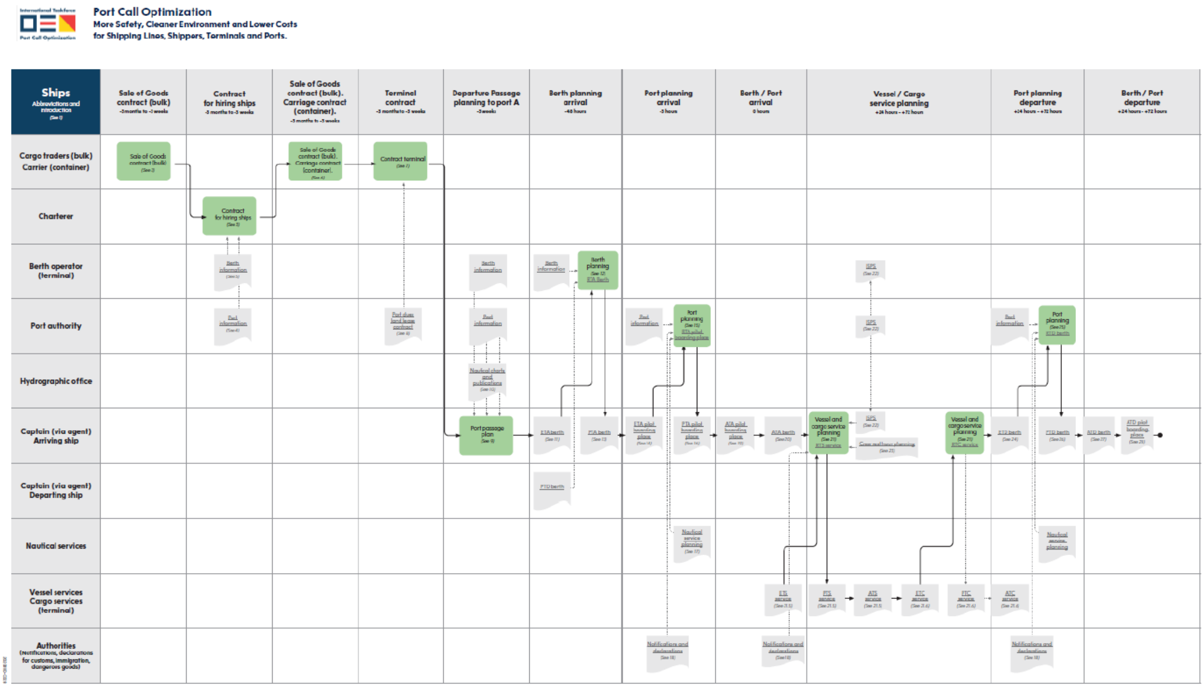


Figure 1 – ITPCO Port call phases

Thus, the below list starts with the third ITPCO phase. Times are included relative to arrival time and assuming a port call duration up to 72 hours:

1. **Sale of goods or carriage contract**: For our demonstration this will correspond to the planning of the next ship round-trip or rotation. This establishes the expected sailing plan with approximate arrival and departure times in relevant ports and terminals.
2. **Terminal contract**: Agreeing estimated time of arrival and ship and cargo general information. The terminal will generate a terminal call reference. For our demonstration this must be done for all ports and terminals. This is part of the planning of the next rotation.
3. **Departure passage planning (-3 weeks)**: Voyage planning from departure port to arrival port done by the ship master. In principle, this will have to be repeated before departure from each port on the route. Necessary input is nautical publications, reference routes and more specific port and terminal related information. This should also include establishing as accurate as possible arrival and departure time to allow speed optimization.
4. **Berth planning arrival (-48h)**: This is the phase when arrival is less than 24-48 hours in the future. This includes agreeing on (almost) exact time of arrival and departure in terminal. Based on the ETA, the terminal may request a new time (RTA), which eventually is accepted by the ship as PTA.
5. **Port planning arrival (-3 hours)**: This is the planning done immediately before arrival in port, e.g. less than three hours before. This consists of agreeing on ETA and location for

any pilot boarding, as well as ordering other services directly related to arrival, such as the use of tugs, VTS, linesmen etc.

6. **Port and berth arrival (0 hours)**: This is the actual process of taking the ship to the berth. This will normally require real-time information exchanges over VHF and will be demonstrated by the use of VDES.
7. **Vessel and cargo service planning (+24–72h)**: This is the planning of services to ship, cargo and crew that must be done during port call. It may also include optional services that, if necessary, can be delayed to the next port call. For larger ships with long port stays, this will normally be done during the port call. For shorter stays, parts of or all of this must be done before arrival.
8. **Port departure planning (+24–72h)**: When services are completed, the ship agrees an estimated time of departure with the terminal. This is used by port authority to determine the requested departure time. When agreed by the ship, this becomes the planned departure time. In conjunction with this, the ship also must order necessary departure related services (linesmen, tugs, VTS etc.) This phase will also include departure passage planning (stage 3 above).
9. **Berth and port departure (+24–72h)**: This is the actual departure, including real-time communication over VHF with the different relevant parties (like stage 6 above).

Although these phase names are developed for large ships in large ports, it is probably useful to refer to these phase names also in our demonstration project. This will help to identify any variations due to different ship, voyage, port or terminal organizations.

2.3 Early outline of digital corridor demonstrator

This section is based on various input from the digital corridor project. Annex A contains a brief description of how the ISO 28005 standard can be used to implement the demonstration's communication requirements.

2.3.1 Objectives

To showcase data connectivity for nautical, operational and administrative data by testing multiple API's against each other

To promote the adoption of the standards defined and to ensure consistent implementation by large numbers of diverse stakeholders

Unique Selling Point for press release in Lloyds List and demo during IMO FAL 48 (March 2024):

- From data owner to multiple stakeholders
- Data exchange versus information exchange
- Using robust IHO, IMO and ISO standards for port to port operations

2.3.2 End result

To improve and standardize wherever feasible the exchange of nautical, administrative and operational data between ship and shore, ensuring all relevant parties are able to facilitate an efficiently completed vessel port call, be it for containers, bulk, liquid bulk or general cargo, passengers or crew.

Ultimately, it will reduce ship emissions en route, in and around ports, terminals and port cities, whilst at the same time ensuring greater safety, compliance , a cleaner environment and lower costs for Shipping Lines, Shippers, Terminals and Ports. It will also improve crew rest hour planning and reduce fatigue and stress that comes with missed deadlines and unexpected events during a port call.

Specific per data set:

- Nautical data: optimizing deadweight and ship-berth compatibility, improving nautical charts and publications
- Operational data: optimizing speed and safety in approaches of ports
- Administrative data: improving rest hours and Turn Around Time

2.3.3 Scope

The project will demonstrate the transfer of key information between ship and port within the following main categories. It is a proof of concept and does not include any changes in work processes or intervention in existing port or ship systems.

Nautical data (S-131 preferred)

- Definition: data that are provided by hydrographic offices or similar service provider that is used in safe navigation
- Limited data set of one berth: GLN, coordinates, depth, UKC and water density
- Limited use case: from data owner to data user

Operational data (ISO 28005)

- Definition: data that are submitted to non-authority parties as part of planning or execution of certain operations
- Limited data set of one berth: GLN, coordinates, PTD Berth of one ad random port call
- Limited data set of one pilot boarding place: GLN, coordinates, PTA Pilot Boarding Place of one ad random port call
- Limited use case: from data owner to data user

Administrative data: (ISO 28005)

- Definition: data that are submitted by ships or other non-authority parties to authorities based on legislation or regulations
- Limited data set: top 10 data elements used in FAL Forms
- Limited use case: from data owner to data user

2.3.4 Representatives in digital corridor project

Ports: Port of Singapore and Port of Rotterdam

Shipping: DCSA

Standardization bodies:

- Nautical data: IHO (S-131 or S-57 as a plan B)
- Operational data: ISO TC 8/ISO 28005
- Administrative data: ISO TC 8/ISO 28005

2.3.5 Planning

- Q1/23: Technical specs ready, start coordinating building and testing API
- Q2/23: Meeting with API builders
- Q3/23: API testing and collecting data from other ports

- Q4/23: API evaluation and prepare demo and submission to IMO
- Q1/24: Demonstration IMO FAL and press release Lloyds List

2.3.6 Management

- A technical coordinator to keep track of developments and attempt to correct deviations. This must be done in a cooperative way
- Agree on the physical architecture we are using. This also includes a possibly asynchronous (and a bit more complex) interface between ship and shore. There may be more to this, e.g. including authorization, authentication and integrity checks that we may want to or not test. We may in any case need an agreement between partners how this can be done in the future. The latter will go into the ISO 28005-1 part of the standard
- Test with some simple workflows based on IMO MSW port call process. This will in principle involve three parties on the shore side: port and MSW. Have to define details in how cooperation between these are tested – if at all.

The way it is planned in ISO 28005 is that the APIs are the same for all parties. It is the information payload that differs between e.g. port and MSW. Thus, it is possible to simplify testing of different stakeholders quite a lot.

2.3.7 On boarding process of other ports

One port per region to cover east to west for IMO demo:

- Africa – TangerMed
- Americas – Panama
- Asia – Singapore
- Baltic – Gothenburg
- Baltic – Norwegian port TBD
- Europe – West – Rotterdam
- Europe – South – Algeciras
- Middle East – Sohar

Per port the aim is to first collect per data set the data elements by e-mail to showcase during IMO FAL.

2.4 Port call demonstration as outlined from Bergen meeting

2.4.1 Main phases and events

The following subsections describe each of the phases and/or events that were discussed at the meeting. A sequence diagram is usually included to show current message flow. Today, many of these exchanges take place in the form of telephone calls, VHF Radio or e-mail. Where operations can be automated, one should aim towards automatic machine-to-machine digital messages. A number of gaps in the flow of information were also pointed out. Therefore, the diagrams shown in the following must be seen as more idealized representations of the information flow. However, the diagrams are more representative of the current state than a planned future flow of information. Also note that on short voyages, typically two hours, there is a need for answers and clarifications quickly. Mail/telephone is then used. This cannot be solved with SSN and sending a request for a berth through SSN today.

2.4.1.1 Early planning of journeys

Planning well in advance: Rough plan 6 months ahead.

More precise plan typically 4 weeks ahead.

Publication on own websites: 8 weeks in advance. Ports keep themselves up to date by keeping an eye on these. For the coming 2 weeks, information should be quite correct and dates fairly settled.

Periods of bad weather are expected to generate more uncertainty. This is handled internally in the shipping company.

2.4.1.2 Planning two weeks ahead

Analysis of traffic to and from the continent etc.: Planning 2 weeks in advance (only ships and calls). This is done internally in the shipping company, but the schedule is published.

The ports can start planning based on the published schedule, but this is not seen as a formal order of berth or port call.

2.4.1.3 Planning the next rotation

The shipping company plans the next rotation 2-3 days before the next voyage starts (when calling on the continent). A plan is made for the sequence of terminal calls per port call. There is usually only one terminal call per port in Norway. Exceptions may, for example, be in the case of bunkering at a different terminal than the cargo terminal.

In the large ports, e.g. Rotterdam, Antwerpen-Brugges or Hamburg, the ships normally call on several terminals to deliver and pick up cargo for the next rotation.

2.4.1.4 The voyage starts on departure from the continent

The voyage starts when the departure time from RTM/HAM is ready, approximately 1-2 hours before departure.

The captain makes a passage plan (to the next port).

When enroute:

- Reporting to MSW
- Sends ETA to port and terminal

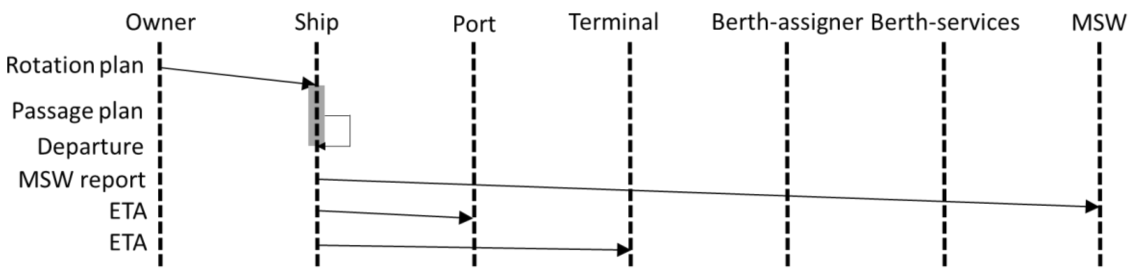


Figure 2 – Start of voyage

2.4.1.5 Before arrival at port – enroute (how long before?)

A message is sent about arrival at the terminal and port. There may be feedback about berth space from the terminal and/or port. There may be a bit of back and forth if there is a problem – slightly different between the ports.

Messages about:

- Updated arrival at port and terminal
- Various services:
    - Crew change
    - Waste, bunkers, water

In some ports, the port guard is the common point of contact.

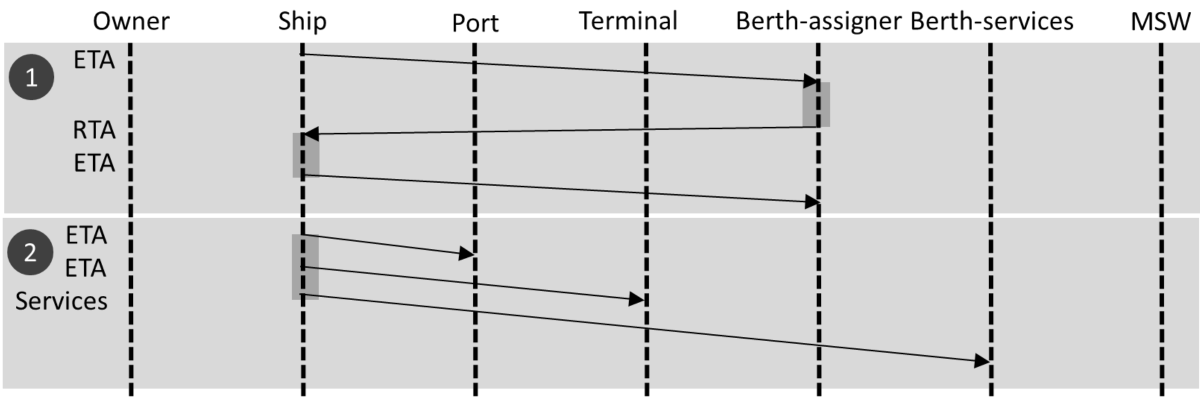


Figure 3 – Before arrival at port

In the figure it is described as the ship must clarify the estimated time of arrival (1 – sends estimate, receives requested time of arrival (RTA) back, and updates with new ETA) before this is sent to other parties together with requests for services (2).

Normally, part 1 will only consist of the first message.

RTA is one of the new terms used in just in time arrival:

- ETA: Sent by ship as estimated time of arrival
- RTA: Sent by the port/terminal as a request for a different arrival time
- PTA: Finally sent by ship as confirmation of requested time, now as planned arrival time
- ATA: Real time of arrival recorded at port of call.

2.4.1.6 Update of arrival time

There may be deviations along the way: Update to actors (which actors?). This will be as in part two of the sequence diagram in section 2.4.1.5.

2.4.1.7 Planning of port call

A mooring plan is required in the event of a call where the ship is unknown to the port - in principle it should be made by the ship based on information about infrastructure from the port. However, the plan is often made by the port, if no plan already exists. In this case, the port needs ship data either from ship or database.

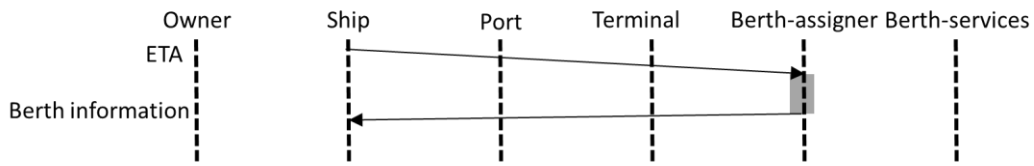


Figure 4 – Planning of port call

2.4.1.8 Immediately before arrival port (how long before?))

The ship sends information to the port and terminal:

- Stowage/cargo discharge plan
- Ordering mooring etc. (Cold ironing?).
- Update arrival time (slightly dependent on opening hours).

Harbor Guard can coordinate service delivery (except bunkers).

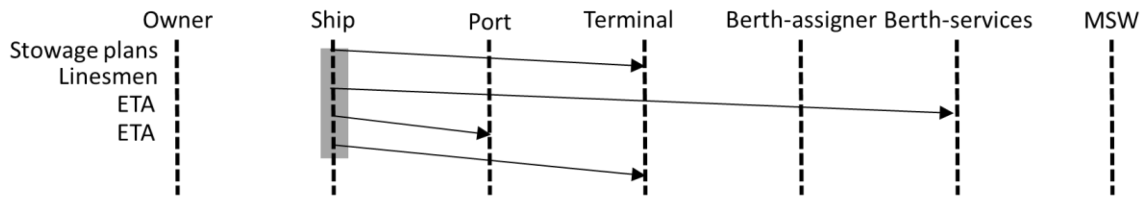


Figure 5 – Immediately before port arrival

2.4.1.9 Before departure

Send ETD and order lines men. Update MSW with next port.

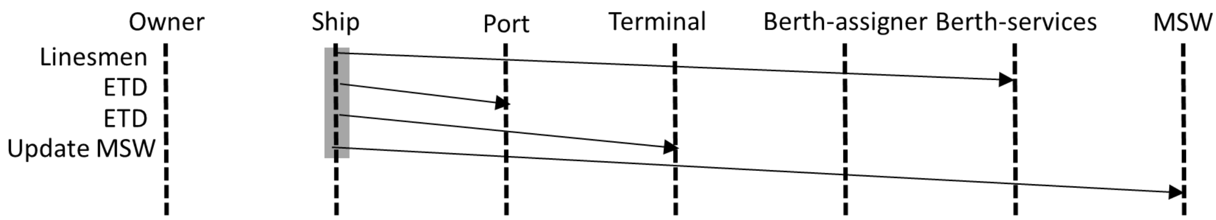


Figure 6 – Before departure

2.4.2 Mapping ISTS processes to ITPCO processes

The ISTS demonstration processes are somewhat different than the ITPCO processes, but Table 1 shows a possible mapping between them. Note that the two first steps in the ISTS processes are more related to the ITPCO processes that were not included in the description in section 2.2 and are not included in the table.

As one can see, there is not a direct one-to-one mapping, but the basic functions are present in both plans. Section 4 will map the cases to specific demonstration scenarios. This also includes scenarios from section 2.4.3.

Table 1 – Mapping between ISTS and ITPCO processes

Bergen process	**ITPCO process**
3. Planning rotation	1. Carriage contract, 2. Terminal contract
4. Voyage start	3. Departure passage planning
5. Before arrival	4. Berth planning, 7. Vessel and service plan
6. Update of arrival time	5. Port planning arrival (note 1)
7. Planning port call	4. Berth planning
8. Immediately before arrival	n/a
9. Before departure	8. Port departure planning

2.4.3 Route exchange together with call information

The ISTS project also wants to do a demonstration of route exchange together with call information. Five use cases are defined:

1. Ship plan passage by access to a reference route in S-421 with some additional minor information, e.g. MSW or MRS reporting points.
2. As case 1, but with additional information about port facility (ISPS) and other action points such as reporting to port and terminal.
3. Same as case 2, but also with port nautical information included (probably as S-131 file).
4. Send route and port call message together from vessel. May use S-421 but also JIT information in ISO 28005 may be needed.
5. A ship delivers S-421 to port/VTS based on RTZ exported from ECDIS.

Cases 1, 3 and 4 are prioritized at the moment. Further prioritization may be necessary.

2.5 Noon at sea reporting

Noon at sea reports is a status report, normally sent at the start and end of a voyage leg as well as with approximately 24 hours intervals during the sailing of the leg. It is sent by the ship to charterer and/or owner/manager to report on progress and fuel consumption. This can be used to calculate charter party performance or other types of, e.g. mandatory reporting of operational efficiency and CO_2 emissions.

A data set was developed by the Smart maritime Network [5] and the plan is to include this into the IMO Compendium through an input paper to IMO from BIMCO. When that has been done, it will also go into the ISO 28005 data set.

We plan a relatively simple demonstration of this as described in section 4.6.

2.6 Demonstration of PKI

The demonstration of PKI has already been done in the CySiMS project [6] and the plan here is to repeat it so that it can be better documented and reported to IMO. The concept is also illustrated in Figure 7 and will be further described in section 4.7.

3 Demonstration context

3.1 The high-level demonstration concept

The general demonstration concept is illustrated in Figure 7. The numbers in circles represent demonstration cases as discussed below. There are four general cases indicated with the fill colour of the circle:

A. **Blue**: Port call demonstration over IP protocols.

B. **Orange**: VDES in port call demonstration.

C. **Green**: Noon at sea reporting.

D. **Yellow brown**: Demonstration of digital signatures.

Not all demonstrations may be completed in all its variants. Arrow colours are explained in the middle text block at the right side of the in figure.

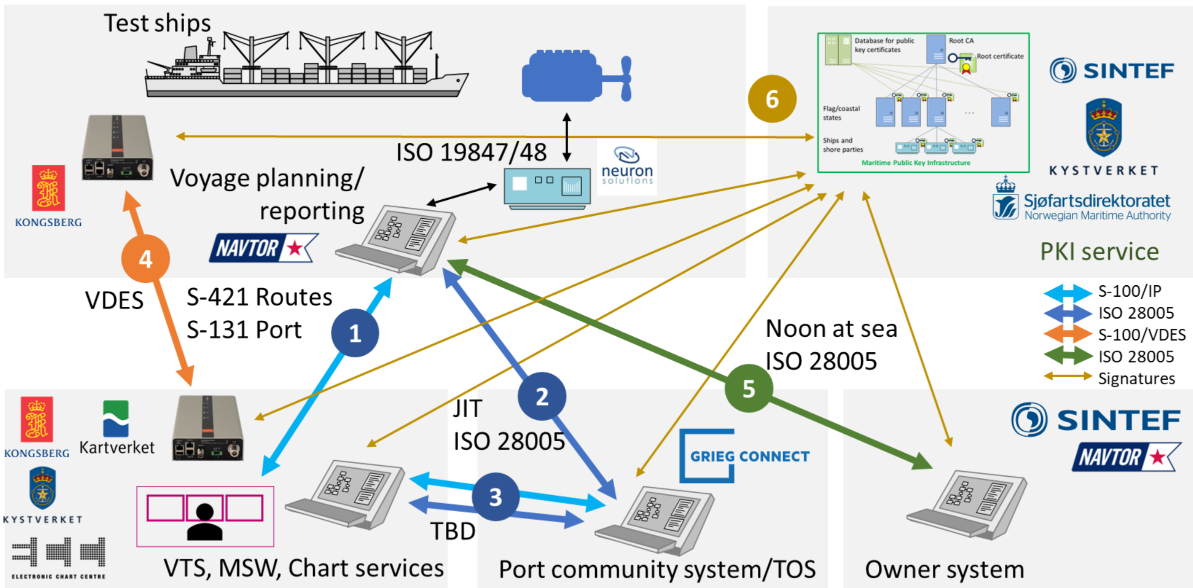


Figure 7 – Baseline demonstration concept

This includes six main use cases as briefly described below and marked with the corresponding number in the coloured circles in the figure.

1. Sending nautical information about the port from, e.g. the VTS, PCS or from other source to the planning station, containing e.g. routes and port data. Relevant formats are S-421 (Reference routes/Initial routes) and S-131 (Port infrastructure information).

2. Agreeing on arrival time through the ISO 28005 JIT protocol. Estimated, requested, planned times + required ship data. This is identical to the first phase of the digital corridor demonstration (see section 2.2). In the demonstration this would be a simple notification of arrival time and confirmation from port.

3. Transfer between PCS/MSW and VTS to exchange information about planned and actual arrival. This may also cover nautical information to ships. This step is not very much

detailed and must be developed further. The idea here is that the MSW can assist in certain business to business data exchanges between ship and port.

4. Real-time route suggestions or nautical data from VTS or update of arrival time over VDES during port approach. This also needs to be elaborated further.
5. Noon-at-sea reporting via Neuron data collection (fuel consumption, RPMs etc). A new data model for noon reports has been proposed by BIMCO and this will also be supported by ISO 28005. Data collection on ship can use ISO 19847 or other protocols as appropriate.
6. It is also desirable to include a PKI infrastructure to save and distribute public signature certificates. This is mostly relevant for the ISO 28005 messages related to port call arrangement, but this may also be used by S-100 type data exchanges.

The company logos indicate what partners should be involved in each part of the demonstration.

3.2 Necessary actors

The following actors are defined as parties to information exchanges in the demonstration scenarios.

1. **NDP - Nautical data provider:** The party that provides ship with nautical data used in voyage planning. This can include general reference routes as well as detailed port approach routes, including route/port-information.
2. **Owner:** The ship owner or manager providing voyage plans to the ship.
3. **Ship:** The ship itself and its master. This is the main actor for messages related to the demonstration scenarios.
4. **Port:** This is the party that has the overall responsibility for safety and security in the port and its terminals.
5. **Terminal:** This is the party that is responsible for handling cargo on or off the ship, including berth assignment.
6. **Owner:** Owner and/or operator of the ship. Responsible for planning the voyages and cargo loading and discharge.
7. **MSW:** Maritime Single Window, SafeSeaNet Norway.
8. **VTS:** Vessel Traffic Services.
9. **PKI:** Public Key Infrastructure for management of public signature certificates.

3.3 Some important data objects

This section defines some data objects that serve as minimum identifiers for the different activities that are undertaken during a port or terminal call. The most relevant data items are shown in

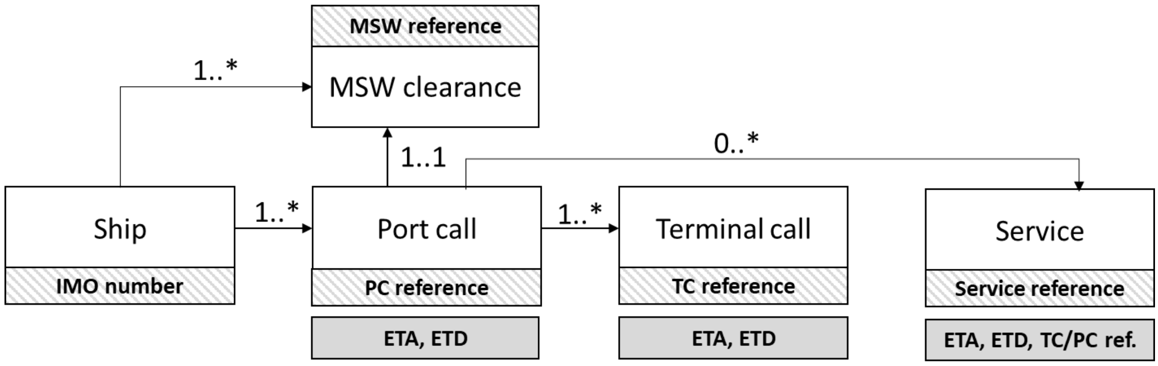


Figure 8 – Important reference data elements

In the context of these demonstrations, the **ship** is identified most easily by its IMO number. This follows the hull through its lifetime. In some cases, the MMSI may be more appropriate as it changes when the ship changes registration country.

For a given port call, the ship also may need **MSW clearance** for call at the foreign port. A MSW reference code should be issued by the national authority to identify each clearance granted. It varies between nations if one clearance is valid for all port calls in that country or not. In any case, each port call will be associated with one MSW clearance. There may also be a need for managing VTS clearance at this or a lower level.

Each **port call** should be associated with one unique PC Reference issued by the port authorities. There may be several calls to the same port during one voyage, but these can be differentiated by their respective ETA and ETD.

During one port call, the ship may call at one or more **terminals** or berths. Each of these calls should be associated with a unique TC reference. It is possible that a ship calls at the same terminal more than once during a port call but also these can be differentiated by the ETA and ETD.

Several **services** may be requested during a port call and a service reference should be issued by the service provider. This reference code should be unique during the port call and this can be achieved by adding a service provider reference. As several services may be ordered, even at the same terminal, one may need to differentiate between them by looking at ordered start and end times as well as what terminal it shall be delivered at.

4 Detailed demonstration scenarios

This section describes concrete demonstration scenarios. The intention is to make relatively small and isolated scenarios that can be added together to generate the larger use cases described in sections 2.2 and 2.4.12.4.

Each scenario is given a code consisting of a letter and two digits. The letter corresponds to the general use cases specified at the start of section 3.1.

For the port call demonstrations (A and B), the first digit refers to the numbered ITPCO process listed in section 2.2. The final digit is a serial number without specific meaning.

For other demonstrations, only a serial number is added to the letter (C or D).

4.1 A3.1 Route planning from reference routes and actions and harbour data

This scenario will demonstrate planning of voyage through access to a reference route in S-421 files and port information in S-131 files.

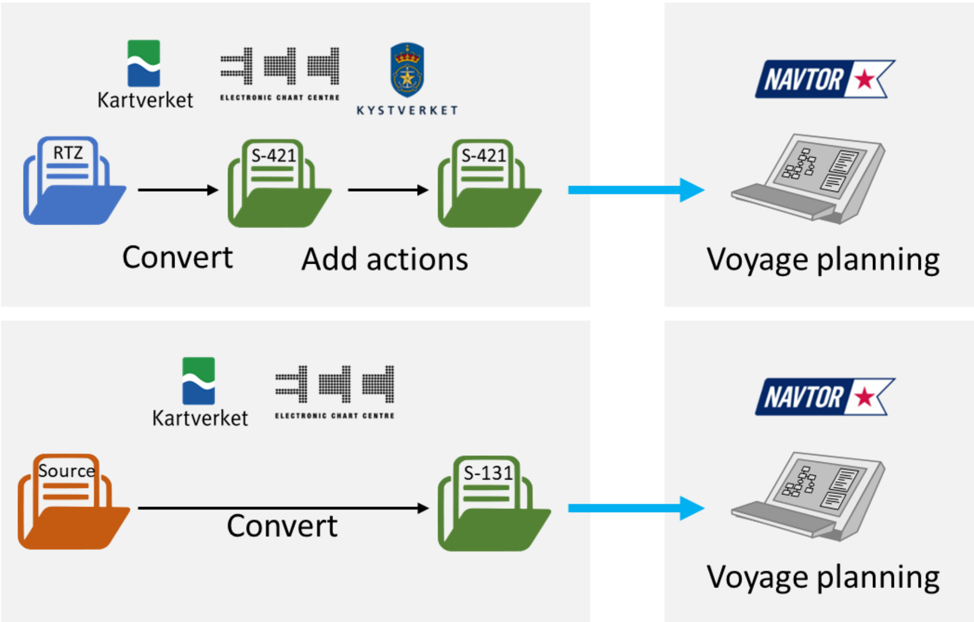


Figure 9 – Schematic concept of route planning from S-421 and S-131

The scenario contains the following components:

1. Convert existing RTZ to S-421.
2. Add actions, e.g. MSW reporting or notification to port.
3. Planning station retrieves S-421 from HTTPS server based on departure and destination port.
4. Plan voyage.
5. Convert harbour data from source (official harbour data) to S-131.
6. Planning station retrieves S-131.

7. Plan voyage.

Figure 9 shows a conceptual workflow based on the steps above. Figure 10 shows the sequence diagram. For the first scenario, only two parties need to be involved, and the S-421 and S-131 related transaction may be implemented as a simple HTTPS service request.

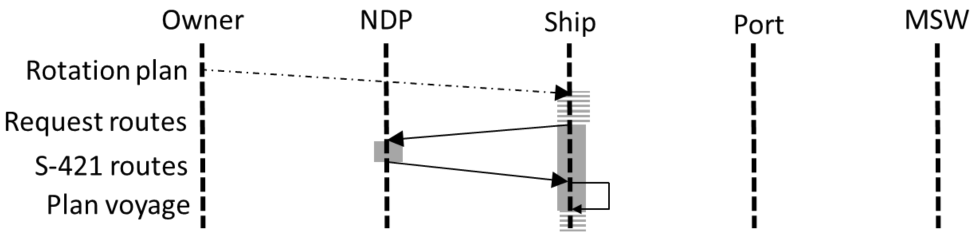


Figure 10 – Sequence diagram case A3.1

Table 2 – Possible data elements in port and MSW message

Data element	**ISO 28005 name**	**In/Out**
Ship identity	IMO number	In
ETA	ETA	In
ETD	ETD	In
Port	LOCODE or other	In
Port call reference	Service reference	Out

Table 2 will eventually list the data elements that go into the ISO 28005 messages.

4.2 A3.2 Transmission of planned route

This scenario adds one step to the previous scenario by reporting the planned route to MSW, VTS and/or port. Reporting points will be specified in the S-421 file.

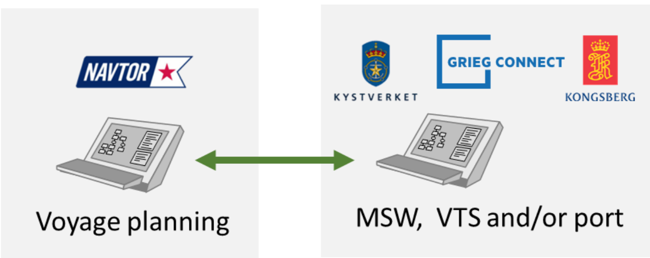


Figure 11 – Reporting planned route in S-421

The scenario contains the following components where step 1 belongs to the previous scenario:

1. Plan voyage.
2. If relevant, report to other parties as described in the route plan action points and get a port call (PC) reference returned.

Figure 11 shows a conceptual workflow based on the steps above. Figure 12 shows the sequence diagram. For the first scenario, only two parties need to be involved, and the S-421 related transaction may be implemented as a simple HTTPS service request.

This diagram may also need the addition of VTS reporting. This will be looked into during further detailing of the description.

For the second scenario, one will also need to add either a PMIS or TOS or adapt the MSW to accept ISO 28005 messages. These are indicated with dashed arrows.

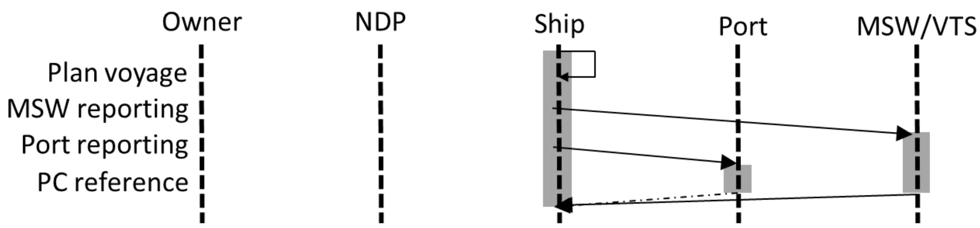


Figure 12 – Sequence diagram case A3.2

Table 2 can be used for this case as well.

4.3 A4.1 Arrival time agreement with terminal (Priority 2)

This scenario corresponds to the arrival time agreement process in ITPCO process 4. The scenario is a simplified version where no negotiation takes place. It is assumed that a port pre-arrival message has been sent through MSW or directly to the port so that a PC reference has been got. This demonstration is on hold until further notice.

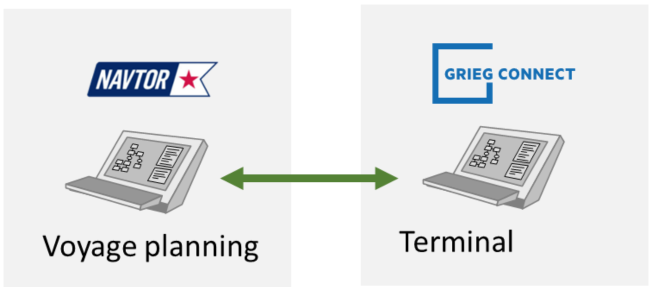


Figure 13 – Arrival time agreement with terminal

The sequence is:

1. A PC reference must have been defined through MSW or directly from port. That could be a reply from step 5 in scenario A3.2.
2. The ETA is sent to the terminal. This may include a preferred time window.
3. The terminal replies with an RTA.
4. The planning system finalizes the transaction by acknowledging with a PTA.

Step 2 will in principle also contain information about the ship that the terminal needs to schedule the call, unless this information is available from the terminal or the port already.

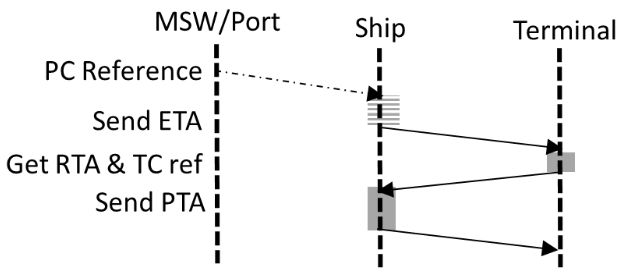


Figure 14 – Sequence diagram for scenario A4.1

Figure 14 shows the sequence diagram for the transaction.

Table 3 – Possible data elements in arrival time agreement messages

Data element	ISO 28005 name	In/Out
Ship identity	IMO number	In
Port call reference	Service reference	In
ETA	ETA	In
Berth identification	Berth	Out
RTA	RTA	Out
PTA	PTA	In
Terminal call reference	Service reference	Out

Table 3 will eventually list the data elements that go into the ISO 28005 messages. “In” refers to message to terminal while “out” refers to message from terminal.

4.4 A5.1 Port planning and service arrangements

This scenario demonstrates the preparation for a port call, including ordering of services. Each service has to be ordered in a separate message sequence, so the scenario only includes one service request, e.g. instructions for cargo handling in the form of discharge and loading plans.

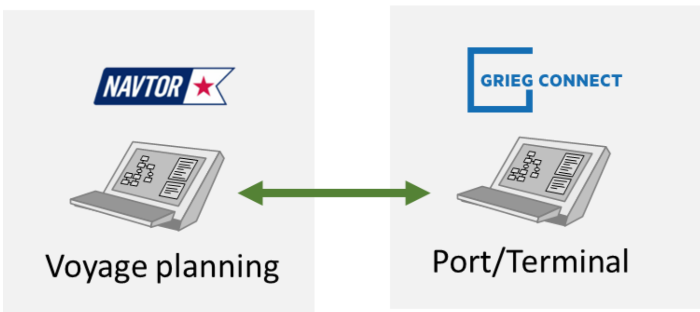


Figure 15 – Service ordering scenario

It is assumed that this can be done via the planning station, possibly as a pre-programmed action from the passage plan.

Figure 16 shows the sequence diagram. This is a simple exchange of a request and acknowledgment with the inclusion of an estimated, requested and planned service start time.

Table 4 shows the preliminary list of data elements.

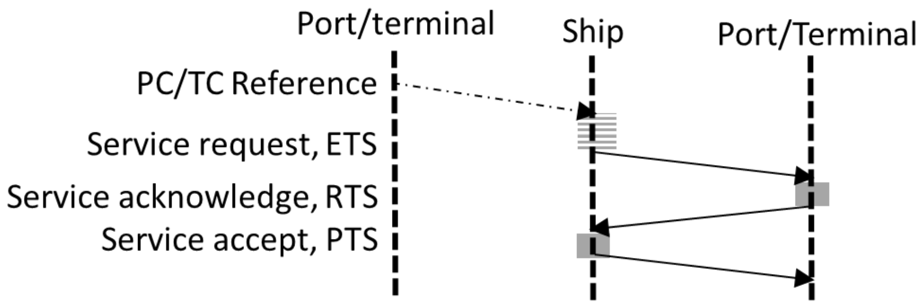


Figure 16 – Service ordering sequence diagram

Table 4 – Possible data elements in service request

Data element	**ISO 28005 name**	**In/Out**
Ship identity	IMO number	In
Port call reference	Service reference	In
Terminal call reference	Service reference	In
Service type	Service identificatory	In
Additional data	As needed for service	In
ETS	Estimated start time of service	In
RTS	Requested start	Out
PTS	Planned start	In

4.5 A6.1 Arrival time update via VDES

It is desirable to demonstrate arrival time updates via VDES. This could replace voice over VHF communication with port guard. The demonstration scenario is shown in Figure 17.

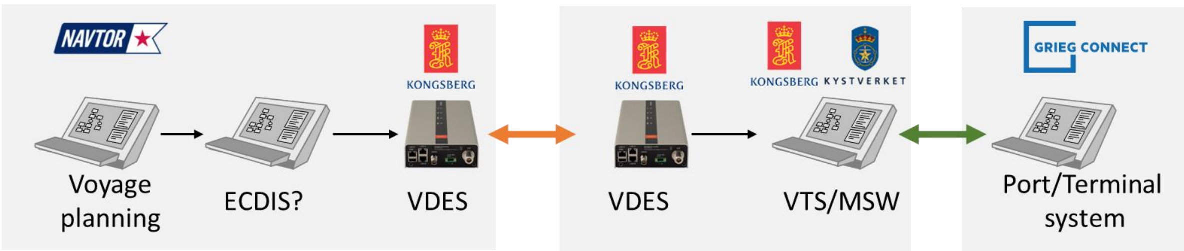


Figure 17 – A6.1 demonstration scenario

Figure 18 shows the sequence diagram, only covering VDES and ISO 28005 type messages. The scenario consists of the following steps:

1. The planning station transfer the route information to the ECDIS and/or track pilot for execution. This plan should contain a VDES reporting point close to port arrival.
2. The ECID/Track pilot instructs the VDES unit to send this message, including the port and terminal call references together with other relevant information, e.g. service references for linesmen or tugs.
3. This message is picked up by base stations associated with MSW or VTS.
4. The information is forwarded in ISO 28005 format to the relevant parties in the port and terminal.

5. Acknowledgements are sent in the opposite direction to inform about acceptance of the message.

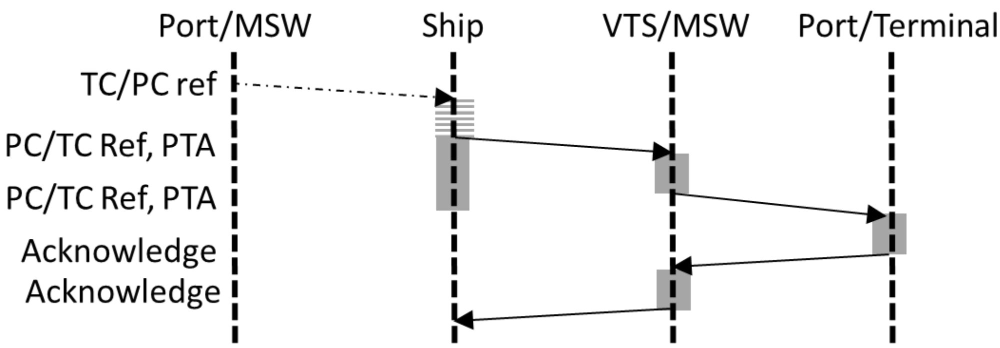


Figure 18 – A6.1 sequence diagram

Table 5 – Possible data elements in VDES arrival message

Data element	ISO 28005 name	In/Out
Ship identity	IMO number	In
Port call reference	Service reference	In
Terminal call reference	Service reference	In
PTA	PTA	In
Acknowledgement	Service status	Out

Table 5 will eventually list the data elements that go into the ISO 28005 messages. "In" refers to message to shore while "out" refers to message to ship.

4.6 C1 Noon at sea reporting

The noon at sea reporting scenario is illustrated in Figure 19. Data is collected on the ship by software from Neuron systems. This can be sent directly via ISO 28005 to a corresponding system on shore, e.g. at ship owner's premises or it can go via, e.g. planning station where noon reporting functionality is being developed.

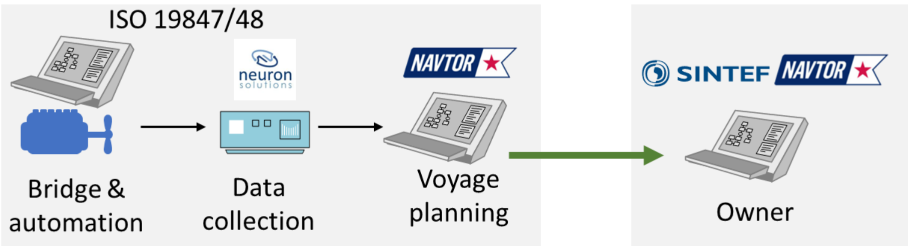


Figure 19 – Noon at sea reporting scenario

Figure 20 shows the simple sequence diagram as a simple report transfer.

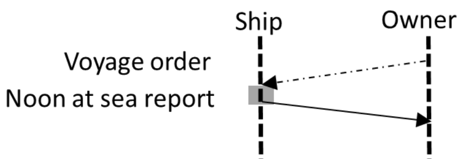


Figure 20 – Sequence diagram for C1

The data set will have to be defined relatively to what is easy to get from the ship used as example. Some elements are listed in Table 6. All elements are input to owner. No return other than accepted or not accepted will be sent.

Table 6 – Possible data elements in noon reporting

Data element	ISO 28005 name	In/Out
Ship identity	IMO number	In
Voyage number	Voyage number	In
Leg number	Leg number	In
Time of report	Reporting time	In
Fuel used	Volume	In
Distance sailed	Distance	In

4.7 D1 Demonstration of PKI (Priority 2)

The purpose of this demonstration scenario is to demonstrate the use of a possible PKI for maritime use in the different functionalities it provides. This should be documented and reported to IMO. This demonstration is on hold until further notice.

The scenario (Figure 21) consists of three distinct clusters:

1. The PKI system (centre). This can be implemented by the same software as was used for the CySiMS demonstrations.
2. A VDES test case, e.g. from scenario A6.1.
3. An ISO 28005 test case, e.g. from scenario A6.1.

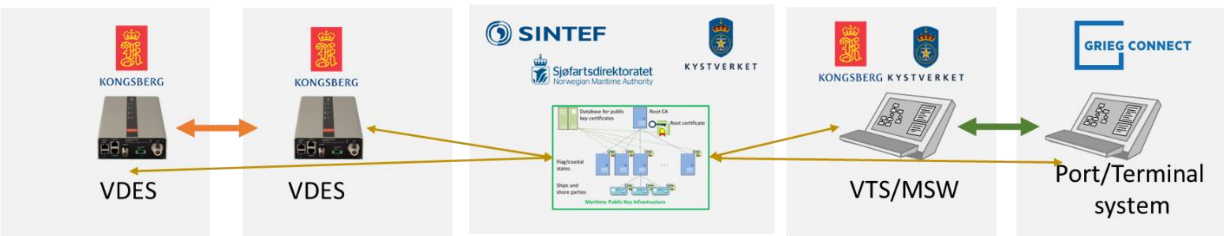


Figure 21 – PKI Scenario

The sequence diagram is illustrated in Figure 22. It consists of three different operations:

1. A device requests a public key certificate based on its public key code. This requires verification of identity of requestor and addition of the certificate to the PKI data base.
2. A device requests a list of all changed public key certificates since a specific date and time. This should include revoked as well as new certificates. By setting time to zero, it will get the whole valid database.
3. A device requests a revocation of a public key certificate. This requires the same verification as in step 1 and removal of the certificate from the data base.

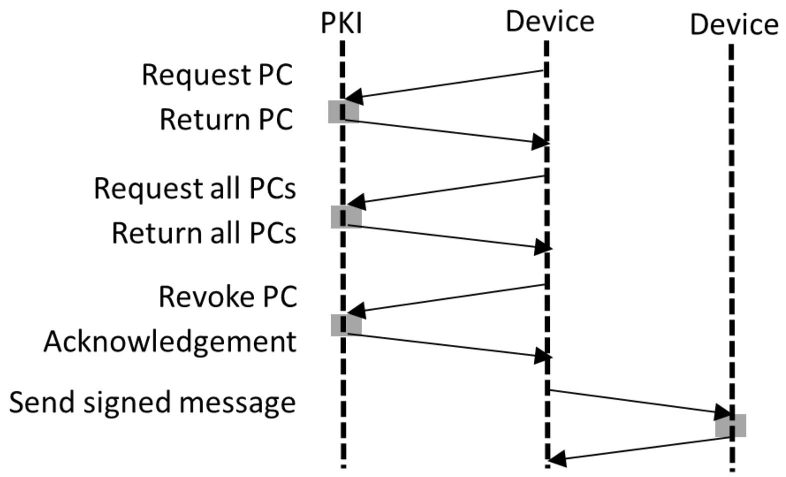


Figure 22 – PKI Sequence diagrams

The **Device** actor represents the software system or physical device that is used to sign outgoing messages or verify the signature of incoming messages. This may be the MSW or the planning station on the ship, or a dedicated signature device as was used in the CySiMS demonstrations.

The final demonstration is to test the use of signed messages between two devices, both over VDES and ISO 28005.

4. Test the use of digital signatures.

This scenario must be developed further as the demonstration activities for other scenarios develop.

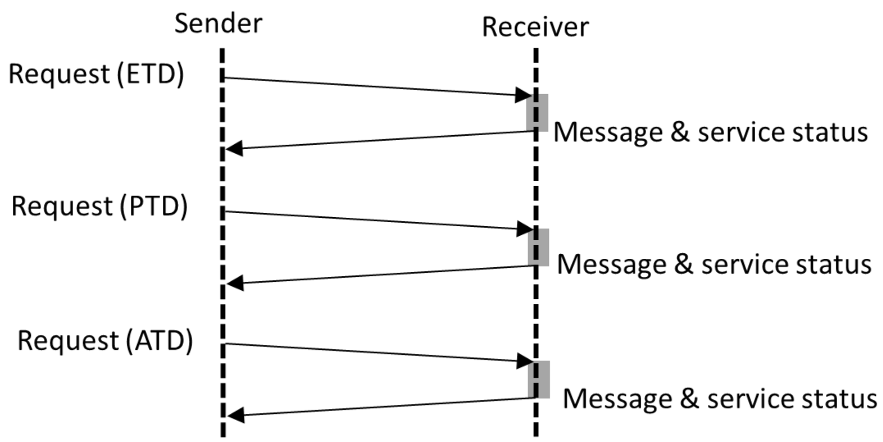
Annex A – Use of ISO 28005 in the digital corridor

This annex gives a short overview of how to use the ISO 28005 series of standards in a just-in-time port call context. This is based on a very simple data exchange as described in section 2.

ISO 28005 is a standard for communication between ship and shore based on HTTPS and XML. It also has provisions for including EDIFACT, JSON or other message blocks, e.g. for cargo load and discharge instructions. We expect part 1 (communication protocol and general API construction) to be published in Q3 of 2024. The main data model (part 2) was published in 2021 and the specific model for just in time will also be published in Q3 2024.

A.1 Scope of example

The example is to exchange three messages with respectively estimated, planned and actual time of departure from a specified berth location. For consistency it is assumed that a port call number has been assigned to the port call. The messages should also identify the sender, but do not require any additional signatures or other similar annotations. The example will be executed as three independent message exchanges as illustrated below. ETD is the estimated time of departure sent by the ship. When the estimate has been updated and confirmed, the ship sends a planned time of departure (PTD) and when departing, sending the actual time of departure (ATD).

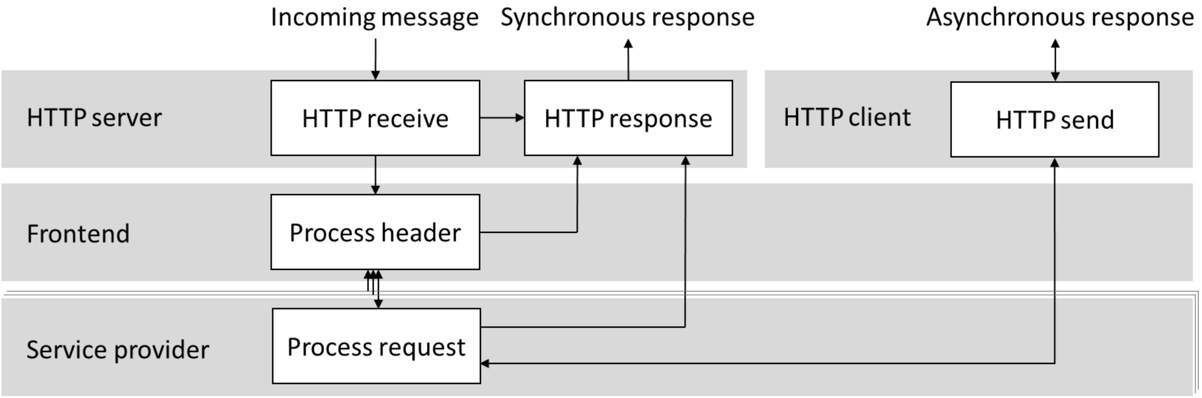


The ”Request” is the standard name for a message sent to a receiver for the receiver to take some action. The receiver will reply with a message status to confirm that the message was receiver. This may include an error code if something was wrong with the message. If the transaction is complete with the reception of the message (as in this case) the return message will also include a service status telling the sender that the transaction is complete and that no further messages are expected for this particular request.

It is assumed that the sender and receiver both are ports, and we do not include other than the name of the port in the sender identification.

A.2 System architecture

The system consists of a "sender", e.g. the ship or the ship agent, and a "receiver", e.g. the port community system (PCS) or a terminal operating system (TOS). The software on the receiver side is illustrated in the figure.



The protocol is constructed so that one can use a standard HTTP server and a generic message processing frontend for all APIs. The frontend reads a standardized message header and will invoke a service provider to process the application specific parts of the message.

The protocol also allows for asynchronous delivery of messages from receiver to sender. This requires a corresponding software architecture on the sender side. Alternatively, the sender can poll the receiver for later updates to a service request.

A.3 Transmission protocol

Clause 15.2 in ISO 28005-1 specifies the general transport protocol. The transmission protocol is HTTP/1.1 as defined in RFC 7231. All communication shall be encrypted, using Transport Layer Security (RFC 5246) as described in RFC 2818.

The preferred method for sending data is POST, but the receiver should be prepared to accept all relevant methods (PUT or GET).

There are no requirements to the URL used and the receiver can define this freely.

The HTTP return code may be an error code if the HTTP server is not able to process the message, e.g. if the URL was wrong or the HTTP protocol was otherwise used badly, e.g. in how the multipart message is formatted. Otherwise, a plain OK is expected on the HTTP level.

The frontend layer should check syntax and structure of the XML message header and data body and will return a message status giving the status of this processing. If the message is accepted, the service provider will return a service status giving the results of the processing.

A.4 General HTTP payload format

The HTTP payload is a HTTP multi-part message as defined by clause 9 in ISO 28005-1. For the exercise, the format for the sender is outlined below.

```
Content-Type: multipart/form-data; boundary="r4nd0m"

--r4nd0m
Content-Type: application/xml; charset=utf-8
Content-Disposition: form-data; name=header; filename=header.xml;

[XML header goes here]
--r4nd0m
Content-Type: application/xml; charset=utf-8
Content-Disposition: form-data; name=body; filename=body.xml;

[XML body goes here – one of this block]
--r4nd0m--
```

Th return message from the receiver do not need a body in this exercise, so that part can be omitted (blue text).

A.5 Header format for sender

The message header is defined in clause 10 of ISO 28005-1. An example of how it can look for the example is shown below.

```
<EPCMessageHeader>
  <ArrivalDeparture>Departure</ArrivalDeparture>
  <Final>True</Final>
  <MessageBodyFormat>1</MessageBodyFormat>
  <MessageFunctionCode>13</MessageFunctionCode>
  <MessageManifest>
    <HasBody>1</HasBody>
    <HasAttachments>0</HasAttachments>
    <HasCertificates>0</HasCertificates>
    <HasSignature>0</HasSignature>
  </MessageManifest>
  <MessageReference>1001</MessageReference>
  <SenderId>
    <Company>Ship Agent Inc.</Company>
    <ContactType>AG</ContactType>
  </SenderId>
  <ShipID>
    <IMONumber>IMO1234567</IMONumber>
    <ShipName>M/S Ship</ShipName>
  </ShipID>
  <SentTime>2023-11-01T14:00:00+02:00</SentTime>
  <ServiceCode>3021</ServiceCode>
  <ServiceTypeCode>5</ServiceTypeCode>
  <ShipStayReference>XYZ</ShipStayReference>
  <Version>2.1</Version>
</EPCMessageHeader>
```

This header has the ship agent as the physical sender (contact type is "AG"), but the message is related to a specific ship.

The message reference (1001) is a code assigned to this particular message and should be changed for subsequent messages. It is used by the receiver to send message status messages.

The Ship Stay Reference (XYZ) is a code for this particular port call that may be used to link the three message exchanges together. The service codes refer to JIT and estimated departure time. The respective codes to be used are:

- JIT Estimated departure time: 3021

- JIT Planned departure time: 3023
- JIT Actual departure time: 3024

The Final flag says that this is the last message related to this service request.

All dates and times in this memo are in standard XSD format where numeric date comes first in YYYY-MM-DD format, followed by 'T' and time stamp, including seconds. The time is in local time and the last part is the offset from UTC (here standard European time, UTC + 2 hours). It is legal to add fractions of seconds after the two-digit seconds and a full stop, but that is not relevant here. Alternatively, one can represent times in UTC directly by replacing the UTC offset by 'Z', e.g. 2023-11-01T12:00:00Z.

A.6 Body format for sender

An example of how it can look for the exercise is shown below.

```
<EPCMessageBody>
  <DataPackage>
    <BerthDeparture>
      <Departure>
        <DateTime>2023-11-01T23:00:00+02:00</DateTime>
        <TimeType>Estimated</TimeType>
      </Departure
      <Location>
        <GLN>70800001213916</GLN>
      </Location>
    </BerthDeparture>
  </DataPackage>
</EPCMessageBody>
```

Please refer to ISO 28005-3 for details.

For the different time stamps, the code in time type needs to be changed:

- Estimated
- Planned
- Actual

The actual GLN number should be updated as well as the date and time.

A.7 Header format for receiver

An example of how it can look for the example is shown below.

This is sent by the port authority as identified by the contact information type.

The message status refers back to the reference code in the sender's message. Status code 1 is accepted.

The service status assigns a reference code to this service reference (155). Again, 1 means accepted.

The Final flag says that this is the last message related to this service request.

```xml
<EPCMessageHeader>
  <Final>True</Final>
  <MessageFunctionCode>6</MessageFunctionCode>
  <MessageManifest>
    <HasBody>0</HasBody>
    <HasAttachments>0</HasAttachments>
    <HasCertificates>0</HasCertificates>
    <HasSignature>0</HasSignature>
  </MessageManifest>
  <MessageStatus>
    <Reference>1001</Reference>
    <StatusCode>1</StatusCode>
  </MessageStatus>
  <SenderId>
    <Company>Port of Ports Inc.</Company>
    <ContactType>POA</ContactType>
  </SenderId>
  <SentTime>2023-11-01T14:00:20+02:00</SentTime>
  <MessageStatus>
    <Reference>1001</Reference>
    <StatusCode>1</StatusCode>
  </MessageStatus>
  <ServiceStatus>
    <Reference>155</Reference>
    <StatusCode>1</StatusCode>
  </ServiceStatus>
  <Version>2.1</Version>
</EPCMessageHeader>
```

References

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[6] CySiMS deliverables, https://ists.mits-forum.org/resources.html#H6