UNITED
NATIONS

E

Economic and Social Council

Distr.
GENERAL

ECE/TRANS/SC.3/WP.3/2006/3
3 April 2006

Original: ENGLISH

ECONOMIC COMMISSION FOR EUROPE

INLAND TRANSPORT COMMITTEE

Working Party on Inland Water Transport

Working Party on the Standardization of Technical and Safety Requirements in Inland Navigation

Thirtieth session
Geneva, 6-8 June 2006
Agenda item 5(a)

INTERNATIONAL STANDARD FOR TRACKING AND TRACING ON INLAND WATERWAYS

Transmitted by the Central Commission for the Navigation of the Rhine (CCNR)

Note: Reproduced below is version 1.4 of the Vessel Tracking and Tracing Standard for Inland Navigation of 21 September 2005 received from the CCNR. The International Expert Group on Tracking and Tracing is currently finalizing the section of the standard relating to AIS. The Working Party will be informed of the state of this work and may wish to proceed with consideration of the International Standard and reporting to the Working Party on Inland Water Transport accordingly.

Annexes B (Example of EMMA Codes); C (Example of signal status); D (Proposed digital interface sentences for Inland AIS) and E (ERI ship type) are not included in this document but will be made available on the website of the Working Party.

VESSEL TRACKING AND TRACING STANDARD FOR INLAND NAVIGATION

Foreword

The concept of River Information Services (RIS) has emerged throughout several European research projects, aiming at increasing safety and efficiency of inland waterway transport. The European RIS Platform, the CCNR and the Danube Commission have recognized the need for means of automatic exchange of navigational data between ships and between ship and shore for automatic identification and tracking and tracing solutions in inland navigation.

In inland shipping several developments for Vessel Traffic Monitoring as well as for (Vessel) Tracking and Tracing take place in different European countries (Austria, Germany, The Netherlands, France and former EC projects). These developments make use of different technologies and functions. To ensure inter-operability between the developments in inland shipping, it will be necessary to define standards and set up harmonized procedures for tracking and tracing in European inland shipping. This has also been stressed by the European RIS platform and during the workshop on "Application of Inland-AIS and other systems for tracking and tracing of vessels in inland waterways" in June 2003 in Koblenz.

The Guidelines and Recommendations for River Information Services (RIS Guidelines 2002) of PIANC and CCNR define Inland-AIS as important technology.

In maritime navigation, IMO has introduced the Automatic Identification System (AIS). All seagoing ships on international voyage falling under SOLAS convention Chapter 5 were to be equipped with AIS by the end of 2004.

The European RIS Platform founded the expert group for tracking and tracing. The main task of this expert group is the development and maintenance of a vessel tracking and tracing standard for inland navigation. Because of mixed traffic areas it is important that the standards and procedures for inland shipping are compatible with already defined standards and procedures for seagoing navigation.

To serve the specific requirements of inland navigation, AIS has been further developed to the so-called Inland AIS Standard while preserving full compatibility with IMO´s maritime AIS and already existing standards in inland navigation.

A network-based solution, which has been called AI-IP, has been developed as an alternative to AIS.

Useful usage of both tracking and tracing systems, AIS and AI-IP depends on:

- All other vessels being equipped with AIS or AI-IP and the systems operating properly.
- A proper set-up, sufficient accuracy, reliability and undisturbed operation of the connected GNSS systems and other ship-borne instruments.
- Proper usage of the parameters, including the proper input of static and variable parameters, such as vessel dimensions, antenna positions, cargo information, status, etc.

In this document chapter 1 describes the functional specifications related to tracking and tracing in inland navigation. In chapter 2 the inland AIS standard is described, including the standard inland tracking and tracing messages. The last chapter describes the AI-IP standard. An overview of definitions of services and players is given in Annex A: Definitions.

REFERENCES

The content of this document is based on:

Document title	Organization	Publication date
Directive on harmonized River Information Services on inland waterways in the community	EU	
SWP 2.1: Reference Model and the Objective and Scope of River Information Services	COMPRIS	
SWP 4.1: Development of monitoring and VTM equipment. Functional Specifications	COMPRIS	
SWP 4.2: Calamity Abatement and the Use of VTM Databases. Specifications of a RIS tool and data needs for calamity abatement procedures	COMPRIS	
SWP 4.5: New technologies for tracking and tracing. Development of requirements for tracking and tracing and for traffic monitoring	COMPRIS	
SWP 5.1: Questionnaire to evaluate user needs for the development of logistic and transport applications around RIS-systems	COMPRIS	
SWP 6.1: Technical report, specification and recommendation on cross border traffic and transport information	COMPRIS	
WP 8: Glossary of terms and abbreviations	COMPRIS	
WP 9.1: AI-GPRS Pilot	COMPRIS	July/15/2003
Draft Inland AIS Standard v1.3	RIS Platform	Nov/25/2004
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VTS guidelines	IALA	
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IMO MSC.74(69) Annex3, "Recommendation on Performance Standards for a Ship-borne Automatic Identification System (AIS)"	IMO	1998
Recommendation ITU-R M.1371-1, "Technical characteristics for a universal shipborne automatic identification system using time division multiple access in the VHF maritime mobile band"	ITU	2001
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UN-ECE Location code	UN-ECE	
UN-ECE Ship type code	UN-ECE	
RCC 768, User Datagram Protocol	IETF	1980
RFC 791, Internet Protocol	IETF	Sept/1980
IANA Port Numbers	IANA	Dec/15/ 2004
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ABBREVIATIONS

AI	Application Identifier
AIS	Automatic Identification System
AI-IP	Automatic Identification via Internet Protocol
AND	European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways
ASCII	American Standard Code for Information Interchange
ATIS	Automatic Transmitter Identification System
A-to-N	Aids to Navigation
CCNR	Central Commission for Navigation of the river Rhine
COG	Course Over Ground
COMPRIS	Consortium Operational Management Platform River Information Services
CSTDMA	Carrier Sense Time Division Multiple Access
DAC	Designated Area Code
DC	Danube Commission
DGNSS	Differential GNSS
DSC	Digital Selective Calling
ECDIS	Electronic Chart Display and Information System
EMMA	European Multiservice Meteorological Awareness system
ERI	Electronic Reporting International
ETA	Estimated Time of Arrival
FI	Functional Identifier
GLONASS	(Russian) Global Navigation Satellite System
GlW	Gleichwertiger Wasserstand (reference water level in Germany)
GNSS	Global Navigation Satellite System
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile communication
GUI	Graphical User Interface
HDG	Heading
IAI	International Application Identifier
IANA	Internet Assigned Numbers Authority
IALA	International Association of Lighthouse Authorities
ID	Identifier
IEC	International Electro technical Committee
IEEE	Institute of Electrical and Electronics Engineers

IETF	Internet Engineering Task Force
IMO	International Maritime Organisation
IP	Internet Protocol
ITU	International Telecommunication Union
LOCODE	Location Code
MKD	Minimum Keyboard and Display
MID	Maritime Identification Digits
MHz	Megahertz (Megacycles per second)
MMSI	Maritime Mobile Service Identifier
RAI	Regional Application Identifier
RAIM	Receiver Autonomous Integrity Monitoring
RIS	River Information Services
RNW	Regulierungs Niederwasser (granted water level during 94% the year)
ROT	Rate Of Turn
RTA	Recommended Time of Arrival
SAR	Search And Rescue
SOG	Speed Over Ground
SOLAS	Safety Of Life At Sea
SOTDMA	Self Organizing Time Division Multiple Access
SQRT	Square Root
STI	Strategic Traffic Image
TDMA	Time Division Multiple Access
TTI	Tactical Traffic Image
UDP	User Datagram Protocol
UMTS	Universal Mobile Telecommunications System
UN	United Nations
UTC	Universal Time Coordinated
VDL	VHF Data Link
VHF	Very High Frequency
VTS	Vessel Traffic Services
WGS-84	World Geodatic System from 1984
WiFi	Wireless Fidelity (IEEE 802.11 wireless networking standard)

1. THE USE OF VESSEL TRACKING AND TRACING IN INLAND NAVIGATION

1.1 INTRODUCTION

The purpose of this chapter is to define all necessary functional requirements related to tracking and tracing in inland navigation.

This chapter describes the user needs, and particularly the information needs for each field of interest. Related to the information needs, three groups of information are distinguished:

- Dynamic information, information changing very often in seconds or minutes.
- Semi-dynamic information, information changing just a few times a voyage.
- Static information, information changing less then a few times a year.

The functional specifications are based on rules and regulations for navigation, based on discussions with experts and based on existing experiences.

Tracking and tracing systems will exchange particularly the dynamic information. Electronic reporting devices, like email, can exchange the semi-dynamic information, and static information can be retrieved from Internet or CD's will provide updates.

In the paragraphs below especially the dynamic information is described in detail.

1.2 SCOPE

For each field of interest within River Information Services the users and the information needs are described. The fields of interest consist of services and tasks, which can benefit from an automatic exchange of navigational data between ships and between ships and shore. The table below gives an overview of the fields of interest dealt with in this document. Each field of interest is split up in tasks and for each task the users are defined.

Table1.1: Overview of Fields of Interest, Tasks and Users

Field of interest	Task	User
Navigation	Medium term: Looking minutes hours ahead, outside on board radar scope	Conning skipper
	Short term: Looking minutes ahead, in on board radar range	Conning skipper
	Very short term: Looking from seconds – 1 minute ahead	Conning skipper
Vessel Traffic Management	VTS	VTS operator, conning skipper
	Traffic monitoring systems	RIS operator, Competent authority, VTS operator
	Lock operation	Lock operator, conning skipper
	Lock planning	Lock operator, conning skipper, shipmaster, fleet manager
	Bridge operation	Bridge operator, conning skipper
	Bridge planning	Bridge operator, conning skipper,

Field of interest	Task	User
		shipmaster, fleet manager
Calamity Abatement Service		Operator in calamity centre, VTS operator, lock operator, bridge operator, conning skipper, ship master, Competent Authority
Transport Management	Voyage planning	Shipmaster, freight broker, fleet manager, terminal operator, conning skipper, VTS operator, lock operator, bridge operator, RIS operator
	Transport logistics	Fleet manager, shipmaster, consignor, consignee, supply forwarder
	Port and terminal management	Terminal operator, shipmaster, supply forwarder, port authority, competent authority
	Cargo and fleet management	Fleet manager, consigner, consignee, supply forwarder, freight broker, shipmaster
Enforcement	Cross border	Customs, competent authority, shipmaster
	Traffic Safety	Competent authority, shipmaster (police authorities)
Waterway and port infrastructure charges		Competent authority, shipmaster, fleet manager, Waterway-authority
Fairway information services	Meteo information	Conning skipper
	Signal status	Competent authority, shipmaster, fleet manager

1.3 NAVIGATION

The process navigation can be split up in three phases, depending on the time ahead.

- Navigation, medium term ahead
- Navigation, short term ahead
- Navigation, very short term ahead

For each phase the user requirements are different.

a) 1.3.1 Navigation, Medium term ahead

Navigation a medium term ahead is the navigation phase in which the skipper observes and analyses the traffic situation looking some minutes up to an hour ahead and considers the possibilities of where to meet, pass or overhaul other vessels.

The traffic image needed is the typical ‘looking around the corner’ feature and is mainly outside the scope of the on board radar range.

Traffic information consists of information (most important in bold) of other vessels:

- **Identification (name)**
- **Position (actual) (accuracy: 15-100 m)**
- **Loaded/unloaded**
- **Direction**
- Intended track/route information
- Destination
- Speed over ground (accuracy: 1 - 5 km/h)

- Navigational status of the vessel (anchoring, mooring, sailing, …)
- Ship or combination type
- Dimensions (Length & Beam)
- Remarks (restricted by special conditions)

and the position and identification of the own vessel.

Any other information needed is environmental, geographic information and notices to skippers.

After a request of the skipper the actual information will be exchanged with an agreed update range (3 up to 20 sec) during an agreed period.

In case of implementing dead reckoning functionality, the update frequency of the information will be lowered.

b) <u>1.3.2 Navigation, Short term ahead</u>

Navigation a short term ahead is the decision phase in the navigation process. In this phase traffic information has relevance for the process of navigation in situ. Apart from relevance for local navigation purposes this information can be used as a direct aid for collision avoidance measures.

This function deals with the observation of other vessels in the close surroundings of the vessel. Relevant information comprises (most important in bold):

- **Position (actual)** (accuracy 15 m)
- **Identification (name)**
- Direction
- Speed over ground (accuracy 1 km/h)
- Course over ground (accuracy 5º)
- Heading (accuracy 5º)
- Intention (blue sign)
- Number of blue cones
- Loaded/unloaded
- Navigational status of the vessel (anchoring, mooring, sailing, …)
- Intended track
- Destination
- Dimensions (Length & Beam)
- Ship / combination type
- Remarks (restricted by special conditions)
- History of vessel positions
- In special (open) areas: (time and distance of closest point of approach)
- The position and identification of the own vessel.

Any other information needed is environmental, geographic information and notices to skippers. The actual information on position, identification (name), direction, speed over ground, course, heading and intention (blue sign) will be exchanged continuously every 3 seconds. For some routes the Authorities will set a predefined update rate.

All other information will be exchanged after request of the skipper or on event (in case the information changes)

<u>Remark</u>: The display of traffic information must be limited in terms of quantity and needs only to contain essential navigational information. It must enable skippers to act adequately and must improve the quality of their decision making process.

c) 1.3.3 Navigation, very Short term ahead

Navigation a very short term ahead is the operational navigation process and it is based on actual perception of the situation within 1 km. It consists of execution of the decisions that were made beforehand, on the spot, and monitoring its effects. The information needed from other vessels especially in this situation is related to its own vessel conditions, such as relative position, relative speed, etc.

In this phase following highly accurate information is needed (all important in bold):

- **Relative Position** (accuracy ± 5 m)
- **Relative Heading** (accuracy ± 3º)
- **Relative Speed** (accuracy 0.5 km/h)
- **Relative Drift** (accuracy ± 3º)
- **Relative Rate of turn**

Any other information needed is environmental, geographic information and notices to skippers. This information requires a very high update rate, almost real time, typically less then 3 sec.

1.4 VESSEL TRAFFIC MANAGEMENT

Vessel traffic management comprises at least one of the elements defined below:

- Vessel traffic services
- Lock planning and operation
- Bridge planning and operation

d) 1.4.1 Vessel Traffic Services

Within Vessel Traffic Services (VTS), different services can be distinguished:

- An information service
- A navigational assistance service
- A traffic organisation service

In the next paragraphs the user needs related to traffic information are described.

i) 1.4.1.1 Information Service

A VTS information service is a service to ensure that essential information becomes available in time for on board navigational decision-making.

The VTS operator will provide traffic information and environmental information to all vessels at fixed times or on request.

For the information services an overview of traffic in a network or on fairway stretch is needed. The traffic information will comprise vessel information like:

- **Identification (name)**
- **Position (actual) (accuracy 100 m till 1 km, depending of the scale of the area you are interested in)**

- **Direction**
- Additional info on special attention vessels
- Limitations on navigable space

This information will be exchanged on request of the VTS operator.

Additional information that may be relevant is:

- Navigational status
- Dimensions (Length & Beam)
- Ship / combination type
- Loaded/unloaded
- Number of cones
- Number of persons on board (in case of an incident)
- Destination

Sometimes this kind of information will be provided upon additional request.

The Competent Authority will set the predefined update rate.

ii) <u>1.4.1.2 Navigational Assistance Service</u>

A navigational assistance service is a service to assist on board navigational decision-making and to monitor its effects. Navigational assistance is especially of importance in reduced visibility or difficult meteorological circumstances (for example to help vessels without radar and overtaken by fog to find a safe mooring place or anchorage) or in case of defects or deficiencies affecting the radar, steering or propulsion. Navigational assistance is given in due form of position information at the request of the traffic participant or in special circumstances when deemed necessary by the VTS operator.

To provide individual information to a skipper, the VTS operator needs an actual detailed traffic image.

This traffic image will comprise information on (all important in bold) :

- **Identification (name)**
- **Position (actual) (accuracy 15 m)**
- **Direction**
- **Speed over ground (accuracy 1 km/h)**
- **Course over ground** (accuracy 5º)
- **Intention (blue sign)**
- **Navigational status (anchoring, mooring, sailing, …)**
- Intended track / route information
- Indication of priority vessels
- Dimensions (Length & Beam)
- Airdraught (in case of obstacles) (in dm)
- Draught (in dm)
- Ship / combination type
- Additional info on special attention vessels
- Loaded/unloaded
- Number of cones (>=2)

Any other information needed is environmental, geographic information and notices to skippers.

The actual information on identification, position, direction, speed, course and intention (blue sign) has to be exchanged continuously (every 3 sec, almost real time or another predefined update rate set by the Competent Authority).

All other information had to be available on request of the VTS operator or in special occasions (on event).

iii) <u>1.4.1.3 A Traffic Organization Service</u>

A traffic organization service is a service to prevent the development of dangerous vessel traffic situations by managing of traffic movements and to provide for the safe and efficient movement of vessel traffic within the VTS area.

To optimize the traffic flow and to improve the safety the VTS operator will provide information to all vessels in a restricted area. To do this, the VTS operator needs a detailed actual traffic image.

The requirements on the traffic image for the traffic organization service are the same as described in paragraph 1.4.1.2 Navigational assistance service

e) <u>1.4.2 Lock Planning and Operation</u>

In the next paragraphs the lock planning processes – long and medium term- and lock operation process are described.

iv) <u>1.4.2.1 Lock Planning, Long term</u>

Lock planning a long term ahead is dealing with the planning of a lock some hours up to a day ahead.

In this case the traffic information is used to improve the information on waiting and passing times at locks, which are originally based on statistical information.

Traffic information needed for long term lock planning is (most important in bold):

- **Identification**
- **ETA at lock (in minutes)**
- **Direction**
- **Number of cones**
- **Dimensions (Length & Beam) (in dm)**
- **Draught** (in cm)
- **Airdraught** (in cm)
- **Ship/combination type**
- Ships position (to check ETA) (accuracy 100 m – 1 km, depending on the time ahead)
- Restrictions by special conditions
- Quantity of cargo
- Cargo type
- Number of persons on board
- Additional info on special attention vessels

Any other information needed is environmental, geographic information, notices to skippers, service times and rules and regulations.

ETA and position should be available on demand or should be exchanged as the deviation from the original ETA, as predefined by the Competent Authority is exceeded.

v) <u>1.4.2.2 Lock planning, Medium term</u>

Lock planning a medium term ahead is dealing with the planning of a lock up to 2 or 4 lock cycles ahead.

In this case the traffic information is used to map the arriving vessels to the available lock cycles and based on the planning to inform the skippers about the RTA (Required Time of Arrival).

Traffic information needed for medium term lock planning is (most important in bold):

- **Identification**
- **ETA at lock (in minutes)**
- **Direction**
- **Number of cones**
- **Dimensions (Length & Beam) (in dm)**
- **Draught** (in cm)
- **Airdraught** (in cm)
- **Ship/combination type**
- Number of assisting tug boats
- Ships position (to check ETA) (accuracy 100 m)
- Speed over ground (to check ETA) (accuracy 0,5 km/h)
- Navigational status
- Identification of priority vessels
- Restrictions by special conditions
- Quantity of cargo
- Cargo type
- Number of persons on board
- Additional info on special attention vessels

Any other information needed is environmental, geographic information, notices to skippers, service times and rules and regulations.

ETA and position should be available on request or should be exchanged in case the deviation from the original ETA, as predefined by the Competent Authority is exceeded. All other information should be available at the first contact or on request.

vi) <u>1.4.2.3 Lock Operation</u>

In this phase, the actual locking process takes place.

To facilitate the lock operational process, the following information is required (most important in bold):

- **Identification**
- **Position (actual)**
- **Speed over ground (accuracy 0,5 km/h)**
- **Course over ground (accuracy 3º)**
- **Direction**
- **Navigational status**
- Number of cones
- Dimensions (Length & Beam) (in dm)
- Draught (in cm)
- Airdraught (in cm)
- Ship / combination type
- Number of assisting tug boats
- Identification of priority vessels
- Restrictions by special conditions
- Quantity of cargo
- Cargo type
- Number of persons on board
- Additional info on special attention vessels

Any other information needed is environmental, geographic information and rules and regulations.

The actual information on identification, position, direction, speed and course has to be exchanged continuously.

f) 1.4.3 Bridge Planning and Operation

In the next paragraphs the bridge planning processes – medium- and short term- and bridge operation process are described.

vii) 1.4.3.1. Bridge Planning Medium term

The bridge planning process on a medium term is dealing with the optimization of the traffic flow in such a way that the bridges are opened in time for passing of vessels (green wave). The time looking ahead ranges from 15 minutes to 2 hours ahead. The timeframe will depend on the local situation.

Traffic information needed for medium term bridge planning is (most important in bold):

- **Identification**
- **ETA (in minutes)**
- **Direction**
- **Airdraught (in cm)**
- **Bridge opening required**
- Ship/combination type
- Dimensions (Length & Beam) (in dm)
- Loaded/unloaded
- Speed over ground to check the ETA (accuracy 1 km/h)
- Position (actual) to check the ETA (accuracy 100 m – 1 km)
- Navigational status

Any other information needed is environmental, geographic information, notices to skippers, rules and regulations and service times.

Also the exchange of information on the rail/road traffic situation is necessary to optimize the traffic situation in general (rail/road/water)

ETA and position should be available on request or should be exchanged in case the deviation from the original ETA, as predefined by the Competent Authority is exceeded. All other information should be available at the first contact or on request.

viii) 1.4.3.2 Bridge Planning, Short term

In case of bridge planning process on a short term decisions are made on the strategy for opening of the bridge.

Traffic information needed for medium term bridge planning is (most important in bold):

- **Identification**
- **Position (actual) (accuracy 15 m)**
- **Direction**
- **Speed over ground (accuracy 0,5 km/h)**
- **Airdraught (in cm)**
- **Bridge opening required**
- Ship/combination type
- Dimensions (Length & Beam) (in dm)
- Loaded/unloaded
- Navigational status

Any other information needed is environmental, geographic information, notices to skippers, rules and regulations.

Also, the exchange of information on the rail/road traffic situation is necessary to optimize the traffic situation in general (rail/road/water)

Actual information on the position, speed and direction should be available at the update rate predefined by the competent authority, e.g. every 5 minutes. Information on the navigational status should be exchanged in case of changes. All other information should be available once at the first contact or on request.

ix) <u>1.4.3.3 Bridge Operation</u>

In this phase the actual opening and passing of the vessel through the bridge take place.

To facilitate this process, the following information is required:

- **Identification (name)**
- **Position (actual) (accuracy 5 m)**
- **Direction**
- **Speed over ground** (accuracy 0.5 km/h)
- **Course over ground** (accuracy 3º)
- **Airdraught** (in cm)
- Ship/combination type
- Dimensions (Length & Beam) (in dm)
- Loaded/unloaded

Any other information needed is environmental, geographic information and rules and regulations.

The actual information on identification, position, direction, speed and course has to be exchanged continuously or at the update rate predefined by the competent authority.

1.5 CALAMITY ABATEMENT

As a basis for the functional specification we made use of the calamity abatement safety chain.

This safety chain consists of five links:

- Pro-active – diminish the structural causes of risks (for instance, no recreation on the water near chemical, industrial activities);
- Prevention – try to anticipate the direct causes of incidents (for instance, prevent improper seamanship);
- Preparation – prepare calamity abatement (defining strategies for calamity abatement);
- Repression – actually abating incidents and eventual calamities caused by the incidents; and
- After care – taking all the actions needed to recover the ‘normal’ situation (care for the victims, repairing the damage and analyzing the incident and its consequences).

It was decided to restrict ourselves to the link ‘Repression’.

Repressive measures: dealing with real accidents and providing assistance during emergencies. This is traditionally a task of the police and fire-fighting services in close cooperation with waterway authorities. These services should also be geared to the other links in the safety chain.

Activities in general involve:

- Detection of incidents and accidents and their identification and classification;
- Determination of the characteristics and geographical scope of the calamity;
- Determination of the strategy for calamity abatement and for incident management as well as the responses;
- Actual abatement of the incident and calamity.

To facilitate this process, the following information is required:

- **Unique identifier / Ship number**
- **Vessel name**
- **Position (actual)**
- **Direction**
- **Type of combination, convoy type**
- **Ship type**
- **Number of persons on board**
- **Loaded / unloaded**
- **Cargo information**
- Quantity of cargo
- ETA at lock / bridge / next sector
- Maximum capacity
- Water levels
- Notices to skippers
- Status of signals

In case of accident, the information can be provided automatically, for example by way of an emergency button or the calamity fighter will ask for the information.

1.6 TRANSPORT MANAGEMENT

This service is divided in six activities:

- Voyage planning, long term, indicative planning
- Voyage planning, medium term, pre-trip
- Voyage planning on-trip
- Transport logistics
- Port and terminal management
- Cargo and fleet management

g) <u>1.6.1 Voyage Planning, Long term ahead</u>

With voyage planning, a long term ahead is meant the process of planning from several minutes up to several hours and maybe days ahead to enable skippers to anticipate on their actual plans and enables them to look for alternatives in an early stage.

Traffic information that is used consists of:

- Expected waiting times at locks, bridges
- Average effect speed on a certain stretch
- Expected traffic density

The information is mainly based on statistical information and, if available, updated with actual information derived from reported voyage plans.

The skipper or planner will ask for the information if needed.

h) <u>1.6.2 Voyage Planning, Medium term ahead</u>

Voyage planning a medium term ahead is the process of planning from several hours up to a day ahead. Observing the actual situation and anticipating the traffic situation enables skippers to optimize their planning.

Traffic information that is used consists of:

- Anticipated waiting times at locks, bridges
- Average effect speed on a certain stretch
- Forecast of traffic density

The information is mainly based on actual traffic information (position, speed) and on reported voyage plans.

The skipper will ask for the information if needed and will be informed on relevant changes in predicted waiting times at lock and bridges.

i) <u>1.6.3 Voyage Planning On-trip</u>

During the voyage the skipper will check his original planned voyage.

For this process he needs the following information:

- Position (actual, own vessel)), (100 m)
- Speed over ground (own vessel)
- Intended track/route information
- ETA at lock/bridge/next sector/terminal
- RTA at lock/bridge
- Airdraught
- Draught
- Loaded / unloaded (20 % step)
- Destination

Other required information on the cargo (type of cargo, amount, …), overnight harbor information, pre-planned lock cycles, derived traffic information (average effect speed, actual and expected waiting times at locks and bridges, …), geographic information, environmental information, notices to skippers and rules and regulations.

The information is needed on request or in case of a special event like a relevant change in RTA.

j) <u>1.6.4 Transport Logistics</u>

Transport logistics consists of the organization, planning, execution and control of transport.

For these processes, the following information is needed:

- Unique identification
- Vessel name
- Actual position (100 m up to 1 km)
- Direction (upstream/downstream)

Additional information on the cargo owner (address information, contact information) is needed.

All information is needed upon request of the ship owner or logistic players.

k) **<u>1.6.5 Intermodal Port and Terminal Management</u>**

Intermodal port and terminal management considers the planning of resources in ports and at terminals.

The information needed for this these processes is described below:

- Unique identification
- Vessel name (100m up to 1km)
- Position (actual)
- Navigational status (anchoring, mooring, sailing, …)
- Direction (Upstream/downstream)
- Length of combination/ship (1/10 m)
- Width of combination / ship (1/10 m)
- Combination or ship type
- Loaded / unloaded (20 % steps)
- ETA at lock / bridge / next sector/terminal
- RTA at lock/bridge

Additional information needed consists of detailed information on the cargo (ADNR, UN, HS code and the quantity in Tons, containers, pieces), intended track/route information, vessel owner, special attention vessels, actual waiting times at lock/bridge, expected waiting times at lock/bridge, environmental and hydro/meteo information and notices to skipper.

The terminal and port manager will request for information or will agree that, at specified times, the information will be sent automatically.

l) **<u>1.6.6 Cargo and Fleet Management</u>**

Cargo and fleet management are responsible for planning and optimizing the use of vessels, and for arranging cargo and transportation.

The information needed for this these processes is described below:

- Unique identification
- Vessel name
- Position (actual) (100m up to 1km)
- Navigational status (anchoring, mooring, sailing, …)
- Length of combination/ship (1/10 m)
- Width of combination / ship (1/10 m)
- Direction (Upstream/downstream)
- Intended Track/route information
- ETA at lock / bridge / next sector/terminal
- RTA at lock/bridge
- Loaded / unloaded (20 % steps)

On the other hand, detailed information on cargo (kind and quantity), voyage (terminal of departure and destination), actual status of the lock, and environmental and hydro/meteo information is needed.

The shipper or ship-owner will ask for the information or the information will be sent to them under certain circumstances specified in advance.

1.7 ENFORCEMENT

The scope of the enforcement task described below is limited to the services on dangerous goods, immigration control and customs.

To fulfill these tasks, the following information is needed:

- Unique identification
- Vessel name
- Direction
- Navigational status (anchoring, mooring, sailing, …)
- Type of combination/ship
- Draught
- Air draught
- Number of persons on board
- ETA at lock / bridge / next sector
- RTA at lock
- Intended Track/route information

Additional information needed on cargo (dangerous cargo class, number of cones, loaded / unloaded, quantity), number of accompanying vessels, voyage information (destination, terminal of departure), notices to skippers and rules and regulations.

The information will be communicated to customs, waterway authorities and water police. The information exchange will take place on request or at fixed, predefined points or at circumstances predetermined by the responsible authority.

1.8 WATERWAY AND PORT INFRASTRUCTURE CHARGES

At different locations in Europe one has to pay for the use of the waterway and ports.

- Unique identification
- Vessel name
- Type of combination / ship
- Length of combination/ship
- Width of combination/ship
- Draught
- Intended Track/route information

Additional information needed on the vessel (loading capacity, motor capacity), cargo (name, coded, quantity), voyage (land, terminal or port of departure), and owner of the vessel (name, address, nationality, VAT number, payment method).

The information will be exchanged on request or at fixed points predetermined by the responsible waterway or port authority.

1.9 FAIRWAY INFORMATION SERVICES

Related to fairway information services two services are described:

- Weather warnings in case of extreme weather conditions
- Signal status

In the next paragraphs, the provided information is described.

m) <u>1.9.1 Weather Warnings (EMMA)</u>

The European ongoing project "EMMA" (European Multiservice Meteorological Awareness system) is dealing with standardization of weather warnings. Standardized symbols for meteorological warnings have been developed within the EMMA project and can be used for the display of messages on the Inland ECDIS screen.

EMMA is not going to provide continuous weather information, but only warnings in case of special meteorological situations, like: wind, rain, snow and ice, thunderstorm, fog, extreme temperatures (low and high), flood, fire in the forest, avalanches.

The warnings are provided for regions.

There have been accidents in inland navigation, which have been caused by bad weather and might have been prevented by advance information.

Inland navigation might not be interested in all of them, but strong wind and fog, for example, are of importance.

As in all the other messages, the messenger should always use the same standardized units of measure. Only km/h (wind), °C (temperature), cm/h (snow), l/m²h (rain) and m (visibility distance in fog) may be used for weather warnings.

- Period of validity
- Start of validity period
- End of validity period (indefinite: 99999999)
- Start time of validity period
- End time of validity period
- Fairway
- Geo Information of fairway location
- Unique id of the fairway section (1x or 2x)
- (Local) Name of the fairway section
- Fairway section begin and end co-ordinates (2x)
- Weather Warning (see annex B)
- Type of weather warning (see annex B)
- Minimum value
- Maximum value
- Classification of warning
- Direction of wind (see Annex B)

This information is only exchanged in special events, in case of extreme weather conditions.

n) <u>1.9.2 Signal Status</u>

Dynamic Objects in Inland ECDIS, proposal for the extension of the presentation library for the display of signals.

One of the most important examples for dynamic objects is signals in inland navigation. At the moment there is a static object available, which provides the information, that there is a signal on a certain position. On one hand the skipper is not able to see the signal in dense fog. On the other hand it would be useful to have the information on the current status of the available signal before the skipper can see it even in good weather conditions. Therefore a technical solution is required to display the current status of signals on the ECDIS display on board of vessels.

However, the status of a specific signal is not of interest for all the vessels in Europe, only for the vessels in the vicinity of the signal. The distribution of the information must be restricted to a specific area.

Information to be exchanged consists of:

- The position of the signal;
- An identification of the kind of signal (single light, two lights, “Wahrschau”, etc.);
- The direction of impact (the heading field can be used for it); and
- The current status of the signal.

Examples of signals are given in Annex C.

1.10 CONCLUSION

The functional specifications described the user needs and the data needs for each field of interest. Tracking and tracing systems will exchange particularly the dynamic information.

In the next chapters different technical standards for tracking and tracing are described. The standardized messages are based on dynamic information needs and a selection of other relevant information needs.

2. INLAND AIS STANDARD

2.1 INTRODUCTION

In maritime navigation, IMO has introduced the Automatic Identification System (AIS). All seagoing ships on international voyage falling within the SOLAS convention Chapter 5 were to be equipped with AIS by the end of 2004.

The European Parliament has introduced a “Community vessel traffic monitoring and information system” for seagoing vessels carrying dangerous or polluting goods using AIS for Ship Reporting and Monitoring (Directive 2002/59/EC).

AIS technology is considered as a suitable way that can also be used for automatic identification and vessel tracking and tracing in inland navigation. Especially the real time performance of AIS and the availability of world-wide standards and guidelines are beneficial for safety related applications.

To serve the specific requirements of inland navigation, AIS has to be further developed to the so called Inland AIS Standard while preserving full compatibility with IMO´s maritime AIS and already existing standards in inland navigation.

Inland AIS being compatible with the IMO SOLAS AIS, enables direct data exchange between seagoing and inland vessels navigating in a mixed traffic area.

The use of AIS for automatic identification and vessel tracking and tracing in inland navigation offers following features.

AIS is:

- a maritime navigation system complying with IMO mandatory carriage requirements for all SOLAS vessels;
- a system operating in direct ship-to-ship mode, as well as in a ship-to-shore, shore-to-ship mode;
- a safety system with high requirements regarding availability, continuity and reliability;
- a real time system due to the direct ship-to-ship data exchange;
- an autonomous operating system in a self-organized manner without a master station, thus not requiring central control intelligence;
- a system based on international standards and procedures according IMO SOLAS Chapter V regulations;
- a type approved system enhancing the safety of navigation following a certification procedure;
- a system inter-operational with maritime AIS.

The purpose of this document is to define all necessary functional requirements, amendments and extensions to the existing maritime AIS in order to create an Inland AIS for use in inland navigation.

2.2 SCOPE

The Automatic Identification System (AIS) is a ship borne radio data system, exchanging static, dynamic and voyage related vessel data between equipped vessels and between equipped vessels and shore stations. Ship borne AIS stations broadcast the vessel's identity, position and other data in regular intervals. When receiving these transmissions, ship borne or shore based AIS stations within the radio range can automatically locate, identify and track AIS equipped vessels on an appropriate display like radar or Inland ECDIS. AIS systems are intended to enhance safety of navigation in ship-to-ship use, surveillance (VTS), vessel tracking and tracing, and calamity abatement support

Several types of AIS stations can be distinguished:

a) Class A mobile stations to be used by all sea going vessels falling under the IMO SOLAS chapter V carriage requirements;

b) Class B mobile stations with limited functionality to be used by e.g. pleasure crafts;

c) Class A derivatives, having full class A functionality on VDL level, may deviate in supplementary functions and can be used by all vessels not falling under IMO carriage requirements (e.g. tugs, pilot vessels, inland vessels (to be called Inland AIS in this document);

d) Base stations, including shore based simplex and duplex repeater stations.

The following modes of operation can be distinguished:

a) Ship – ship operation: All AIS equipped vessels are able to receive static and dynamic information from all other AIS equipped vessels within the radio range;

b) Ship – shore operation: Data from AIS equipped vessels can also be received by AIS base stations connected to the RIS centre where a traffic image (TTI and/or STI) can be constructed;

c) Shore – ship operation: safety related data from shore to vessel could be transmitted.

A characteristic of AIS is the autonomous mode, using SOTDMA without any need for an organizing master station. The radio protocol is designed in a way that vessel stations operate autonomously in a self-organized manner by exchanging link access parameters. Time is divided into 1 minute frames with 2.250 time slots per radio channel which are synchronized by GNSS UTC time. Each participant organizes its access to the radio channel by choosing free time slots considering the future use of time slots by other stations. There is no need for a central intelligence controlling the slot assignment.

An Inland AIS station consists in general of the following components:

a) VHF transceiver (1 transmitter/2 receivers);

b) GNSS receiver;

c) Data processor.

Universal ship borne AIS, as defined by IMO, ITU and IEC, and recommended for the use in inland navigation uses self-organized time division multiple access (SOTDMA) in the VHF maritime mobile band. AIS operates on the internationally designated VHF frequencies AIS 1 (161,975 MHz) and AIS 2 (162,025 MHz).

To serve the specific requirements of inland navigation, AIS has to be further developed to the so-called Inland AIS while preserving compatibility with IMO´s maritime AIS.

Vessel tracking and tracing systems in inland navigation shall be compatible with maritime AIS, as defined by IMO. Therefore, AIS messages should contain:

a) Static information, such as official ship number, call sign of vessel, name of vessel, type of vessel;
b) Dynamic information, such as vessels position with accuracy indication and integrity status;
c) Voyage related information, such as length and beam of vessel combination, hazardous cargo on board;
d) (Blue cones/lights according to ADN/ADNR) estimated time of arrival (ETA).

For moving vessels, an update rate for the position information on tactical level should be similar to the update rate of the radar. For vessels at anchor, it is recommended to have an update rate of several minutes, or if information is amended.

AIS is an additional source for navigational information. AIS does not replace, but supports navigational services such as radar target tracking and VTS. AIS's strength is as a means of surveillance and tracking of vessels equipped with it. Due to their different characteristics, AIS and radar complement each other.

2.3 FUNCTIONAL REQUIREMENTS

o) <u>2.3.1 General Requirements for Inland AIS</u>

Inland AIS is based on the maritime AIS according IMO SOLAS regulation.

Inland AIS should cover the main functionality of IMO SOLAS AIS while considering the specific requirements for inland navigation.

Inland AIS should be compatible with the IMO SOLAS AIS and should enable a direct data exchange between seagoing and inland vessels navigating in a mixed traffic area.

The following requirements are complementary or additional requirements for Inland AIS, which differs from the IMO SOLAS AIS.

p) <u>2.3.2 Information Content</u>

Generally only tracking and tracing and safety related information shall be transmitted via Inland AIS. Taking into consideration this requirement the messages listed at the end of this document (EMMA warning, water levels, dynamic Inland ECDIS objects) need further discussion.

Inland AIS messages should contain following information:

Items marked with '*' have to be handled differently as for seagoing ships.

x) <u>2.3.2.1 Static Ship Information</u>

The static ship information for inland vessels should have the same parameters and the same structure as that of IMO AIS, as far as it is applicable. Parameter fields that are not in use should be set to not available.

Inland specific static ship information should be added.

Static ship information is broadcast autonomously from ship or on request.

• User Identifier (MMSI)	(Standard IMO AIS)
• Name of Ship	(Standard IMO AIS)
• Call Sign	(Standard IMO AIS)
• IMO number *	(Standard IMO AIS/not available for Inland ships)
• Type of Ship and Cargo *	(Standard IMO AIS/amended for Inland AIS)
• Overall Length (decimetre Accuracy)*	(Standard IMO AIS/amended for Inland AIS)
• Overall Beam (decimetre Accuracy) *	(Standard IMO AIS/amended for Inland AIS)
• Official ship number (ERI)	(Inland AIS extension)
• Type of combination (ERI)	(Inland AIS extension)
• Maritime/Inland Vessel	(Inland AIS extension)

xi) <u>2.3.2.2 Dynamic Ship Information</u>

The dynamic ship information for inland vessels should have the same parameters and the same structure as that of IMO AIS, as far as it is applicable. Parameter fields that are not used should be set to not available.

Inland specific dynamic ship information should be added.

Dynamic ship information is broadcast autonomously from ship or on request.

• Position (WGS 84)	(Standard IMO AIS)
• Speed SOG*	(Standard IMO AIS)
• Course COG (quality information)*	(Standard IMO AIS)
• Heading HDG (quality information)*	(Standard IMO AIS)
• Rate of turn ROT	(Standard IMO AIS)
• Position accuracy (GNSS/DGNSS)	(Standard IMO AIS)
• Time of el. position fixing device	(Standard IMO AIS)
• Navigational status	(Standard IMO AIS)
• Blue sign set	(Inland AIS extension/ regional bits in Standard IMO AIS)
• Quality of speed information	(Inland AIS extension/derived from ship sensor or GNSS)
• Quality of course information	(Inland AIS extension/derived from ship sensor or GNSS)
• Quality of heading information	(Inland AIS extension/derived from certified sensor (e.g. gyro) or uncertified sensor)

xii) 2.3.2.3 Voyage Related Ship Information

The voyage related ship information for inland vessels should have the same parameters and the same structure as that of IMO AIS as far as it is applicable. Parameter fields that are not in use should be set to not available.

Inland specific voyage related ship information should be added.

Voyage related ship information is broadcast autonomously from ship or on request.

- Destination (ERI location codes) (Standard IMO AIS)
- Category of dangerous cargo (Standard IMO AIS)
- Maximum present static Draught * (Standard IMO AIS)
- ETA (Standard IMO AIS)
- Maximum present static Draught * (cm accuracy) (Standard IMO AIS/amended for Inland AIS)
- Hazardous cargo classification (Inland AIS extension)

xiii) 2.3.2.4 Traffic Management Information regarding Lock, Bridge and Terminal Operation

Traffic management information regarding lock, bridge and terminal operation is for specific use in inland navigation. This information is transmitted when required or upon request to/from inland vessels only. It should not be broadcast, but sent as an addressed message.

(a) 2.3.2.4.1 ETA at Lock/Bridge/Terminal

ETA at lock/bridge/terminal information is transmitted as addressed message from ship to shore.

- Lock/bridge/terminal ID (UN/LOCODE) (Inland AIS extension)
- ETA at lock/bridge/terminal (Inland AIS extension)
- Number of assisting tugboats (Inland AIS extension)
- Airdraught (Inland AIS extension)

(b) 2.3.2.4.2 RTA at Lock/Bridge/Terminal

RTA at lock/bridge/terminal information is transmitted as addressed message from shore to ship.

- Lock/bridge/terminal ID (UN/LOCODE) (Inland AIS extension)
- RTA at lock/bridge/terminal (Inland AIS extension)

(c) 2.3.2.4.3 Number of Persons On board

The number of persons on board is transmitted, preferably as an addressed message from ship to shore on request or on event.

- Total number of persons on board (Standard IMO AIS)
- Number of crew member on board (Inland AIS extension)
- Number of passengers on board (Inland AIS extension)
- Number of supporting personnel on board (Inland AIS extension)

(d) 2.3.2.4.4 Safety Related Messages

Safety related messages are transmitted when required as broadcast or as addressed messages.

q) <u>2.3.3 Reporting interval of Information Transmission</u>

The different information types of Inland AIS should be transmitted with different reporting rates.

For moving vessels in inland waterway areas the reporting rate for the dynamic information on tactical level should be similar to the update rate of the radar. In mixed traffic areas like seaports it should be possible to decrease the reporting rate for dynamic information from by the competent authority to ensure a balance in reporting behavior between inland vessels and SOLAS vessels. The reporting behavior should be switchable by TDMA commands from a base station (automatic switching by TDMA telecommand via message 23) and by commands from ship borne systems, e.g. MKD, ECDIS or board computer, via interface, e.g. IEC 61162 (automatic switching by ship borne system command) [AIS message 23 is defined during the Class B standardization process, it has to be approved by ITU (Revision Rec. ITU M. 1371-1); This message has to be further developed for inland navigation.].

For static and voyage related information it is recommended to have a reporting rate of several minutes, on request, or if information is amended.

Following reporting rates are applicable:

Static Ship Information	every 6 minutes or when data has been amended or on request
Dynamic Ship Information	depends on navigational status and ship operating mode, either inland waterway mode or SOLAS mode (default), see Table 2.1
Voyage related Ship Information	every 6 minutes or when data has been amended or on request
Traffic management information	as required
Safety related messages	as required

Table 2.1 Update Rate of Dynamic Ship Information

Ship dynamic conditions	Nominal reporting interval
Ship status “at anchor” and not moving faster than 3 knots	3 minutes [1]
Ship status “at anchor” and moving faster than 3 knots	10 seconds [1]
Ship operating in SOLAS mode, moving 0 – 14 knots	10 seconds [1]
Ship operating in SOLAS mode, moving 0 – 14 knots and changing course	3 1/3 seconds [1]
Ship operating in SOLAS mode, moving 14 – 23 knots	6 seconds [1]
Ship operating in SOLAS mode, moving 14 – 23 knots and changing course	2 seconds
Ship operating in SOLAS mode, moving faster 23 knots	2 seconds
Ship operating in SOLAS mode, moving faster 23 knots and changing course	2 seconds
Ship operating in inland waterway mode [2]	assigned between 2 seconds and 10 minutes

1 When a mobile station determines that it is the semaphore (refer to ITU-R M.1371-1, Annex 2, § 3.1.1.4), the reporting rate should increase to once per 2 seconds (refer to ITU-R M.1371-1, Annex 2, § 3.1.3.3.2)

2 shall be switched by competent authority using message 23 when ship enters inland waterway area.

r) 2.3.4 Technology Platform

The technical platform of Inland AIS is based on the same technical standards as that of IMO SOLAS AIS [Rec. ITU-R M.1371-1].

The use of Class A mobile station derivates or Class B professional mobile station derivates are recommended as platform for Inland AIS. The use of the Class B using CSTDMA technology is not possible, because it does not guarantee the same performance as the Class A standard. Neither can the successful transmission to radio link be granted nor does it provide the capability to send binary messages.

As long as no professional Class B devices are available, Inland AIS Mobile equipment is a derivative of the maritime AIS Class A Mobile equipment according to IMO SOLAS regulation.

s) 2.3.5 Compatibility to IMO Class A Transponders

Inland AIS transponders must be compliant with IMO Class A transponders and must therefore be capable of receiving and processing all IMO messages (according to ITU-R M.1317-1and IALA technical clarifications on ITU-R M.1371-1) and transmitting the messages defined in chapter 2.4 of these Guidelines.

The DSC tx capability and the provision of an MKD are not prescribed for Inland AIS transponders. It is open to the manufacturers to remove the according hard- and software from the Class A transponders.

t) 2.3.6 Unique Identifier

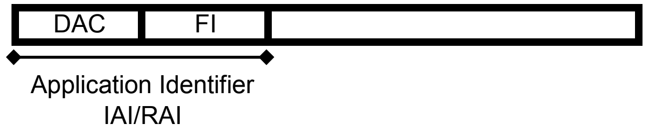
In order to guarantee the compatibility with maritime vessels, the Maritime Mobile Service Identifier (MMSI) number must be used as a unique station identifier (radio equipment identifier) for the Inland AIS transponders.

u) 2.3.7 Application Identifier

According to ITU-R M.1371-1, each binary message needs to have an Application Identifier (AI) heading the binary data field to identify the regional application for which the data is provided. The application identifier consists of two values: the Designated Area Code (DAC) and the Function Identifier (FI).

The DAC can either consist of an International Application Identifier (IAI) which is always of the value “001”, or of the regional application identifier (RAI) which is identical to the Maritime Identification Digits (MID) for that region. The RAI consists of the leading 3 digits of the MMSI number scheme. A full list is available on the website of the ITU (www.itu.int).

Figure. 2.1: Numbering scheme of binary messages



The numbering scheme of the IAI branch is being worldwide maintained by IMO. A list of the actual IAI and FI is published by IMO.

For Inland AIS messages, it is proposed to introduce a new European DAC code [“200”] in the MID scheme. In order to assure harmonized standardization of the FI, it is further proposed to have the list of FI maintained by the CCNR.

Remark: That must be done by ITU and leads to a revision of the ITU MID code.

v) 2.3.8 Application Requirements

It is necessary to input and display Inland AIS Messages (binary coded). This should be handled by an Application (preferably with a GUI capable of interfacing the AIS transponder) at the Presentation Interface (PI). Possible data conversions (e.g. knots into km/h) or information concerning all ERI codes (location, ship type) should be handled there.

Furthermore the transponder or the relevant application should be capable of storing also the inland specific static data in the internal memory, in order to keep the information when the unit is without power supply.

In order to program the inland navigation specific data into the transponder, the input sentences listed in Annex D are proposed.

2.4 PROTOCOL AMENDMENTS FOR INLAND AIS

w) 2.4.1 Message 1, 2, 3: Position Reports (ITU-R 1371-1, §3.3.8.2.1)

Table 2.2 : Position Report

Parameter	Number of bits	Description
Message ID	6	Identifier for this message 1, 2 or 3
Repeat Indicator	2	Used by the repeater to indicate how many times a message has been repeated. Default = 0; 3 = do not repeat any more
User ID (MMSI)	30	MMSI number
Navigational Status	4	0 = under way using engine; 1 = at anchor; 2 = not under command; 3 = restricted manoeuvrability; 4 = constrained by her draught; 5 = moored; 6 = aground; 7 = engaged in fishing; 8 = under way using engine; 9 = reserved for future amendment of Navigational Status for HSC; 10 = reserved for future amendment of Navigational Status for WIG; 11 - 14 = reserved for future use; 15 = not defined = default

Parameter	Number of bits	Description
Rate of Turn ROTAIS	8	±127 (–128 (80 hex) indicates not available, which should be the default). Coded by ROTAIS=4.733 SQRT (ROTINDICATED) degrees/min ROTINDICATED is the Rate of Turn (720 degrees per minute), as indicated by an external sensor. +127 = turning right at 720 degrees per minute or higher; –127 = turning left at 720 degrees per minute or higher.
Speed over Ground	10	Speed over ground in 1/10 knot steps (0-102.2 knots) 1023 = not available; 1022 = 102.2 knots or higher *1
Position Accuracy	1	1 = high (< 10 m; Differential Mode of e.g. DGNSS receiver) 0 = low (> 10 m; Autonomous Mode of e.g. GNSS receiver or of other Electronic Position Fixing Device) ; default = 0
Longitude	28	Longitude in 1/10 000 min (±180 degrees, East = positive, West = negative. 181 degrees (6791AC0 hex) = not available = default)
Latitude	27	Latitude in 1/10 000 min (±90 degrees, North = positive, South = negative, 91 degrees (3412140 hex) = not available = default)
Course over Ground	12	Course over ground in 1/10° (0-3599). 3600 (E10 hex) = not available = default; 3 601 – 4 095 should not be used.
True Heading	9	Degrees (0-359) (511 indicates not available = default).
Time Stamp	6	UTC second when the report was generated (0-59, or 60 if time stamp is not available, which should also be the default value, or 62 if Electronic Position Fixing System operates in estimated (dead reckoning) mode, or 61 if positioning system is in manual input mode or 63 if the positioning system is inoperative).
Blue sign	2	Indication if blue sign is set 0 = not available = default no, 1 = no 2 = yes, 3 = not used *2
Regional Bits	2	Reserved for definition by a competent regional authority. Should be set to zero, if not used for any regional application. Regional applications should not use zero.
Spare	1	Not used. Should be set to zero.
RAIM Flag	1	RAIM (Receiver Autonomous Integrity Monitoring) flag of Electronic Position Fixing Device; 0 = RAIM not in use = default; 1 = RAIM in use)
Communication State	19	See ITU-R M. 1371-1 table 15B
	168	occupies 1 slot

*1 knots should be calculated in km/h by external onboard equipment

*2 should only be evaluated if the report is coming from an Inland AIS vessel and if the information is derived by automatic means (direct connection to switch),

x) 2.4.2 Message 5: Ship Static and Voyage Related Data (ITU-R 1371-1, §3.3.8.2.3)

Table 2.3 : Ship Static and Dynamic Data Report

Parameter	Number of bits	Description
Message ID	6	Identifier for this message 5
Repeat Indicator	2	Used by the repeater to indicate how many times a message has been repeated. Default = 0; 3 = do not repeat any more
User ID (MMSI)	30	MMSI number
AIS Version Indicator	2	0 = Station compliant with AIS Edition 0; 1 - 3 = Station compliant with future AIS Editions 1, 2, and 3.
IMO Number	30	1 – 999999999 ; 0 = not available = default *1
Call Sign	42	7 × 6 bit ASCII characters, "@@@@@@@" = not available = default. *2
Name	120	Maximum 20 characters 6 bit ASCII, @@@@@@@@@@@@@@@@@@@@ = not available = default.
Type of Ship and Cargo	8	0 = not available or no ship = default; 1 - 99 = as defined in § 3.3.8.2.3.2; 100 - 199 = preserved, for regional use; 200 - 255 = preserved, for future use. *3
Dimensions of ship/convoy	30	Reference point for reported position; Also indicates the dimension of ship in metres (see Fig. 18 and § 3.3.8.2.3.3) *4,5,6
Type of Electronic Positioning Fixing device	4	0 = Undefined (default); 1 = GPS, 2 = GLONASS, 3 = Combined GPS/GLONASS, 4 = Loran-C, 5 = Chayka, 6 = Integrated Navigation System, 7 = surveyed, 8 - 15 = not used.
ETA	20	Estimated Time of Arrival; MMDDHHMM UTC Bits 19 - 16: month; 1 - 12; 0 = not available = default; Bits 15 - 11: day; 1 - 31; 0 = not available = default; Bits 10 - 6: hour; 0 - 23; 24 = not available = default; Bits 5 - 0: minute; 0 - 59; 60 = not available = default
Maximum Present Static Draught	8	in 1/10 m, 255 = draught 25.5 m or greater, 0 = not available = default; *5
Destination	120	Maximum 20 characters using 6-bit ASCII; @@@@@@@@@@@@@@@@@@@@ = not available. *7
DTE	1	Data terminal ready (0 = available, 1 = not available = default)
Spare	1	Spare. Not used. Should be set to zero.
	424	occupies 2 slots

*1 should be set to 0 for inland vessels
*2 ATIS code should be used for inland vessels
*3 best applicable ship type should be used for inland navigation
*4 the dimensions should be set to the maximum rectangle size of the convoy
*5 the decimetre accuracy of the inland information should be rounded upwards
*6 The reference point information has to be taken out of the SSD NMEA-record by distinguishing the field “source identifier”. Position reference point information with source identifier AI, has to be stored as internal one. Other source identifiers will lead to reference point information for the external reference point.
*7 the UN location codes and ERI terminal codes should be used

y) <u>2.4.3 Message 23, Group Assignment Command (IEC 62287 / Class-B [Draft])</u>

Table 2.4 : Group Assignment Command

Parameter	Number of bits	Description
Message ID	6	Identifier for message 23; always 23
Repeat Indicator	2	Used by the repeater to indicate how many times a message has been repeated. 0 - 3; default = 0; 3 = do not repeat any more.
Source ID	30	MMSI of assigning station.
Spare	2	Spare. Shall be set to zero.
Longitude 1	18	Longitude of area to which the group assignment applies; upper right corner (north-east) ; in 1/10 min (±180°, East=positive, West=negative).
Latitude 1	17	Latitude of area to which the group assignment applies; upper right corner (north-east); in 1/10 min (±90°, North=positive, South=negative).
Longitude 2	18	Longitude of area to which the group assignment applies; lower left corner (south-west) ; in 1/10 min (±180°, East=positive, West=negative).
Latitude 2	17	Latitude of area to which the group assignment applies; lower left corner (south-west); in 1/10 min (±90°, North=positive, South=negative).
Station type	4	0 = all types of mobiles (default) ; 1 = reserved for future use; 2 = all types of Class B mobile stations ; 3 = SAR airborne mobile station; 4 = A to N station; 5= Class B"CS" shipborne mobile station (IEC62287 only); 7 to 9*1= regional use and 6=*1 inland waterways ; 10 to 15 = for future use
Type of ship and cargo type	8	0= all types (default) 1...99 see Table 18 of ITU-R M.1371-1 100...199 reserved for regional use 200...255 reserved for future use
spare	22	Reserved for future use. Not used. Shall be set to zero.
Tx/Rx mode	2	This parameter commands the respective stations to one of the following modes : 0 = TxA/TxB, RxA/RxB (default); 1 = TxA, RxA/RxB , 2 = TxB, RxA/RxB, 3 = reserved for future use
Reporting Interval	4	This parameter commands the respective stations to the reporting interval given in Table 2.5 below.
Quiet Time	4	0 = default = no quiet time commanded ; 1 – 15 = quiet time of 1 to 15 min.
Spare	6	Spare. Not used. Shall be set to zero.
Total	160	Occupies one time period

Reporting Interval Settings for use with msg23

Table 2.5: Reporting Rate Settings

Reporting Interval field setting	Reporting interval for msg18
0	As given by the autonomous mode
1	10 minutes
2	6 minutes
3	3 minutes
4	1 minute
5	30 seconds
6	15 seconds
7	10 seconds
8	5 seconds
9	2 seconds
10	Next shorter reporting interval
11	Next longer reporting interval
12 - 15[*1]	Reserved for future use

Note: When the dual channel operation is suspended by Tx/Rx mode command 1 or 2, the resulting reporting interval is twice the interval given in above table.

[*1] Proposal by EU T&T Expert Group

z) 2.4.4 Application of Specific Messages (ITU-R 1371-1, §3.3.8.2.4/§3.3.8.2.6)

For the necessary data exchange in inland navigation some new application of specific messages are proposed. These should use the Regional Application Identifiers (RAI) in order to avoid amendments in the International Application Identifier (IAI) branch.

Instead of using the regional Maritime Identification Digits (MID) of the different countries, it is proposed to generate an European MID for the use in inland navigation. The proposal is to use the MID 200 for that purpose.

xiv) 2.4.4.1Allocation of Function Identifiers (FI) within the Inland branch (MID 200)

The FIs within the Inland branch should be allocated and used as described in ITU-R M.1371-1 table 37B. Every FI within the Inland branch should be allocated to one of the following groups of application fields:

- General Usage (Gen)
- Vessel Traffic Services (VTS)
- Aids-to-Navigation (A-to-N)
- Search and Rescue (SAR).

Table 2.6: FI within the Inland branch

FI	FIG	Name of International Function Message	Sent by	Broadcast	Addressed	Description
10	Gen	Inland ship static and voyage related data	ship	X		See 2.4.4.2.1 Inland Specific Message FI 10: Inland Ship Static and Voyage Related Data
21	VTS	ETA at lock/bridge/terminal	ship		X	See 2.4.4.2.2 Inland Specific Message FI 21: ETA at Lock/Bridge/Terminal
22	VTS	RTA at lock/bridge/terminal	shore		X	See 2.4.4.2.3 Inland Specific Message FI 22: RTA at Lock/Bridge/Terminal
23	VTS	EMMA warning	shore	X		See 2.4.4.2.5 Inland Specific Message FI23: EMMA Warning
24	VTS	Water level	shore	X		See 2.4.4.2.6 Inland Specific Message 24: Waterlevels
40	A-to-N	Signal status	shore	X		See 2.4.4.2.7 Inland Specific Message 40: Signal Status
55	SAR	Inland number of persons on board	ship	X	X (preferably)	See 2.4.4.2.4 Inland Specific Message FI 55: Number of Persons On board

Some FI within the Inland branch should be reserved for future use.

xv) <u>2.4.4.2 Definition of Inland Specific Messages</u>

(e) 2.4.4.2.1 Inland Specific Message FI 10: Inland Ship Static and Voyage Related Data

This message should be used by inland vessels only, to broadcast ship static and voyage related data in addition to message 5. The message should be sent with binary message 8 as soon as possible (from the AIS point of view) after message 5.

Table 2.7: Inland Vessel Data Report

	Parameter	Bits	Description
	Message ID	6	Identifier for Message 8; always 8
	Repeat Indicator	2	Used by the repeater to indicate how many times a message has been repeated. Default = 0; 3 = do not repeat any more
	Source ID	30	MMSI number
	Spare	2	not used, should be set to zero
Binary data	Application Identifier	16	as described in Table 2.6
	European ship number	48	8*6 Bit ASCII characters
	Length of ship	13	1 - 8000 (rest not to be used) length of ship in 1/10m 0 = default
	Beam of ship	10	1 - 1000 (rest not to be used) beam of ship in 1/10m; 0 = default
	Ship/combination type	14	numeric ERI Classification (CODES): 1 Vessel and Convoy Type as described in Annex E
	Hazardous cargo	3	number of blue cones/lights 0 - 3; 4 = B-Flag, 5 = default = unknown
	Draught	11	1 - 2000 (rest not used) draught in 1/100m, 0 = default = unknown
	Loaded/unloaded	2	1 = loaded, 2 = unloaded, 0 = not available/default, 3 should not be used

	Parameter	Bits	Description
	Quality of speed information	1	1 = high, 0 = low/GNSS = default *
	Quality of course information	1	1 = high, 0 = low/GNSS = default *
	Quality of heading information	1	1 = high, 0 = low = default *
	Spare	8	not used, should be set to zero
		168	occupies 1 slot

*** shall be set to 0 if no professional sensor (e.g. gyro) is connected to the transponder.**

The details regarding the ERI ship type coding can be found in Annex E.

(f) 2.4.4.2.2 Inland Specific Message FI 21: ETA at Lock/Bridge/Terminal

This message should be used by inland vessels only, to send an ETA report to a lock, bridge or terminal in order to apply for a time slot in resource planning. The message should be sent with binary message 6.

An acknowledgement by Inland branch function message 22 should be received within 15 minutes. Otherwise the Inland branch function message 21 should be repeated once.

Table 2.8: ETA Report

	Parameter	Bits	Description
	Message ID	6	Identifier for Message 6; always 6
	Repeat Indicator	2	Used by the repeater to indicate how many times a message has been repeated. Default = 0; 3 = do not repeat any more
	Source ID	30	MMSI number of source station
	Sequence Number	2	0 – 3
	Destination ID	30	MMSI number of destination station[1]
	Retransmit Flag	1	Retransmit Flag should be set upon retransmission: 0 = no retransmission = default; 1 = retransmitted.
	Spare	1	not used. Should be set to zero
Binary data	Application Identifier	16	as described in Table 2.6
Binary data	UN country code	12	2*6 Bit characters
Binary data	UN location code	18	3*6 Bit characters
Binary data	Fairway section number	30	5*6 Bit characters
Binary data	Terminal code	30	5*6 Bit characters
Binary data	Fairway hectometre	30	5*6 Bit characters
Binary data	ETA at lock/bridge/terminal	20	Estimated Time of Arrival; MMDDHHMM UTC Bits 19 - 16: month; 1 - 12; 0 = not available = default; Bits 15 - 11: day; 1 - 31; 0 = not available = default; Bits 10 - 6: hour; 0 - 23; 24 = not available = default; Bits 5 - 0: minute; 0 - 59; 60 = not available = default
Binary data	Number of assisting tugboats	3	0 - 6, 7 = unknown = default
Binary data	Airdraught	12	0 - 4000 (rest not used), in 1/100m, 0 = default = not used
	Spare	5	not used, should be set to zero
		248	occupies 2 slots

[1] a virtual MMSI number should be used for each country, each national AIS network should route messages addressed to other countries using this virtual MMSI number

(g) 2.4.4.2.3 Inland Specific Message FI 22: RTA at Lock/Bridge/Terminal

This message should be sent by base stations only, to assign a RTA at a lock, bridge or terminal to a certain vessel. The message should be sent with binary message 6 as reply on Inland branch Function Message 21.

Table 2.9: RTA Report

	Parameter	Bits	Description
	Message ID	6	Identifier for Message 6; always 6
	Repeat Indicator	2	Used by the repeater to indicate how many times a message has been repeated. Default = 0; 3 = do not repeat any more
	Source ID	30	MMSI number of source station
	Sequence Number	2	0 - 3
	Destination ID	30	MMSI number of destination station
	Retransmit Flag	1	Retransmit Flag should be set upon retransmission: 0 = no retransmission = default; 1 = retransmitted.
	Spare	1	not used, should be set to zero
Binary data	Application Identifier	16	as described in Table 2.6
Binary data	UN country code	12	2*6 Bit characters
Binary data	UN location code	18	3*6 Bit characters
Binary data	Fairway section number	30	5*6 Bit characters
Binary data	Terminal code	30	5*6 Bit characters
Binary data	Fairway hectometre	30	5*6 Bit characters
Binary data	RTA at lock/bridge/terminal	20	Recommended Time of Arrival; MMDDHHMM UTC Bits 19 - 16: month; 1 - 12; 0 = not available = default; Bits 15 - 11: day; 1 - 31; 0 = not available = default; Bits 10 - 6: hour; 0 - 23; 24 = not available = default; Bits 5 - 0: minute; 0 - 59; 60 = not available = default
Binary data	Lock/bridge/terminal status	1	0 = operational 1 = out of order
Binary data	Spare	3	not used, should be set to zero
		232	occupies 2 slots

(h) 2.4.4.2.4 Inland Specific Message FI 55: Number of Persons On board

This message should be sent by inland vessels only, to inform about the number of persons (passengers, crew, supporting personnel) on board. The message should be sent with binary message 6 preferably on event or on request using IAI binary functional message 2.

Alternatively the Standard IMO binary message "number of persons on board" (IAI number 16) could be used.

Table 2.10: Persons On board Report

	Parameter	Bits	Description
	Message ID	6	Identifier for Message 6; always 6
	Repeat Indicator	2	Used by the repeater to indicate how many times a message has been repeated. Default = 0; 3 = do not repeat any more
	Source ID	30	MMSI number of source station
	Sequence Number	2	0 – 3
	Destination ID	30	MMSI number of destination station
	Retransmit Flag	1	Retransmit Flag should be set upon retransmission: 0 = no retransmission = default; 1 = retransmitted.
	Spare	1	not used, should be set to zero
Binary data	Application Identifier	16	as described in Table 2.6
Binary data	Number of crew members on board	8	0 - 254 crew members, 255 = unknown = default
Binary data	Number of passengers on board	13	0 - 8190 passengers, 8191 = unknown = default
Binary data	Number of supporting personnel on board	8	0 - 254 supporting personnel, 255 = unknown = default
Binary data	Spare	50	not used, should be set to zero
		168	occupies 1 slot

The following messages need further discussion:

(i) 2.4.4.2.5 Inland Specific Message FI23: EMMA Warning

The EMMA warning shall be used to warn shippers using graphical symbols on the ECDIS screen of heavy weather conditions. The following message is capable of transmitting the EMMA data using the AIS channel. It will not replace the Notices to Skippers warnings.

This message should be sent by base stations only, to give weather warnings to all vessels in a certain area. The message should be sent with binary message 8 on demand.

Table 2.11: EMMA Warning Report

	Parameter	Bits	Description
	Message ID	6	Identifier for Message 8; always 8
	Repeat Indicator	2	Used by the repeater to indicate how many times a message has been repeated. Default = 0; 3 = do not repeat any more
	Source ID	30	MMSI number
	Spare	2	not used, should be set to zero
Binary data	Application Identifier	16	as described in Table 2.6
Binary data	Start date	17	Start of validity period (YYYYMMDD), Bits 18-10: year since 2000 1-255; 0 = default) Bits 9-6: month (1-12; 0 = default) Bits 5-1: day (1-31; 0 = default)
Binary data	End date	17	End of validity period (YYYYMMDD), Bits 18-10: year since 2000 1-255; 0 = default) Bits 9-6: month (1-12; 0 = default) Bits 5-1: day (1-31; 0 = default)
Binary data	Start time	11	Start time of validity period (HHMM) UTC Bits 11-7: hour (0-23; 24 = default) Bits 6-1: minute (0-59; 60 = default)

Parameter	Bits	Description
End time	11	End time of validity period (HHMM) UTC Bits 11-7: hour (0-23; 24 = default) Bits 6-1: minute (0-59; 60 = default)
Start longitude	28	Begin of the fairway section
Start latitude	27	Begin of the fairway section
End longitude	28	End of the fairway section
End latitude	27	End of the fairway section
Type	4	Type of weather warning: 0 = default/unknown, others see Table B.1
Min value	9	Bit 0: 0 = positive, 1 = negative value = default Bits 1 - 8 = value (0 - 253; 254 = 254 or greater, 255 = unknown = default)
Max value	9	Bit 0: 0 = positive, 1 = negative value = default Bits 1 - 8 = value (0 - 253; 254 = 254 or greater, 255 = unknown = default)
Classification	2	classification of warning (0 = unknown/default, 1 = slight, 2 = medium, 3 = strong/heavy) according to Table B.2
Wind direction	4	direction of wind: 0 = default/unknown, others see Annex B, Table B.3
Spare	6	not used, should be set to zero
	256	occupies 2 slots

Table 2.12: Weather type code

Code	Description (EN)	AIS
WI	Wind	1
RA	Rain	2
SN	Snow and ice	3
TH	Thunderstorm	4
FO	Fog	5
LT	Low temperature	6
HT	High temperature	7
FL	Flood	8
FI	Fire in the forests	9

Table 2.13: Weather category type code

Code	Description (EN)	AIS
1	Slight	1
2	Medium	2
3	Strong, heavy	3

Table 2.14: Wind direction code

Code	Description (EN)	AIS
N	North	1
NE	North east	2
E	East	3
SE	South east	4
S	South	5
SW	South west	6
W	West	7
NW	North west	8

(j) 2.4.4.2.6 Inland Specific Message 24: Waterlevels

This message should be used to inform skippers about actual water levels in their area. It is additional information to the water levels distributed via Notices to Skippers. The update rate shall be defined by the competent authority. It is possible to transmit the water levels of more than 4 gauges using multiple messages.

This message should be sent by base stations only, to give water level information to all vessels in a certain area. The message should be sent with binary message 8 at regular intervals.

Table 2.15: Water Level Report

	Parameter	Bits	Description
	Message ID	6	Identifier for Message 8; always 8
	Repeat Indicator	2	Used by the repeater to indicate how many times a message has been repeated. Default = 0; 3 = do not repeat any more
	Source ID	30	MMSI number
	Spare	2	not used, should be set to zero
Binary data	Application Identifier	16	as described in Table 2.6
	UN country code	12	UN country code using 2*6-Bit ASCII characters according to ERI specification
	Gauge ID	11	National unique ID of gauge *1 1-2047, 0 = default = unknown
	Waterlevel	14	Bit 0: 0 = negative value, 1 = positive value Bits 1-11: 1-8191, in 1/100m, 0 = unknown = default *2
	Gauge ID	11	National unique ID of gauge *1 1-2047, 0 = default = unknown
	Waterlevel	14	Bit 0: 0 = negative value, 1 = positive value Bits 1-11: 1-8191, in 1/100m, 0 = unknown = default *2
	Gauge ID	11	National unique ID of gauge *1 1-2047, 0 = default = unknown
	Waterlevel	14	Bit 0: 0 = negative value, 1 = positive value Bits 1-11: 1-8191, in 1/100m, 0 = unknown = default *2
	Gauge ID	11	National unique ID of gauge *1 1-2047, 0 = default = unknown
	Waterlevel	14	Bit 0: 0 = negative value, 1 = positive value Bits 1-11: 1-8191, in 1/100m, 0 = unknown = default *2
	Spare	0	not used, should be set to zero
		168	occupies 1 slot

*1 should be defined by ERI for each country

*2 difference value referring to reference waterlevel (GlW in Germany, RNW on the Danube)

(k) 2.4.4.2.7 Inland Specific Message 40: Signal Status

This message should be sent by base stations only, to inform about the status of different light signals to all vessels in a certain area. The information should be displayed on an external Inland ECDIS display as dynamic symbols. The message should be sent with binary message 8 at regular intervals.

Table 2.16: Signal Status Report

	Parameter	Bits	Description
	Message ID	6	Identifier for Message 8; always 8
	Repeat Indicator	2	Used by the repeater to indicate how many times a message has been repeated. Default = 0; 3 = do not repeat any more
	Source ID	30	MMSI number
	Spare	2	not used, should be set to zero
Binary data	Application Identifier	16	as described in Table 2.6
	Signal position longitude	28	Longitude in 1/10 000 min (±180 degrees, East = positive, West = negative. 181 degrees (6791AC0 hex) = not available = default)
	Signal position latitude	27	Latitude in 1/10 000 min (±90 degrees, North = positive, South = negative, 91 degrees (3412140 hex) = not available = default)
	Signal form	4	0,15 = unknown = default, 1-14 signal form according to Annex C
	Orientation of signal	9	Degrees (0-359) (511 indicates not available = default).
	Direction of impact	3	1 = upstream, 2 = downstream, 3 = to the left bank, 4 = to the right bank, 0 = unknown = default, rest not used
	Light status	30	Status (1 to 7) of up to 9 lights (light 1 to light 9 from left to right, 100000000 means colour 1 at light 1) per signal according to Annex C: example of signal status. 000000000 = default, 777777777 maximum, rest not used
	Spare	11	not used, should be set to zero
		168	occupies 1 slot

An example of signal status is given in Annex C- Example of Signal Status

3. AI-IP STANDARD

3.1 INTRODUCTION

Many of the River Information Services require vessels to be equipped with broadband mobile communication. The development of network-based mobile communication like GPRS, UMTS and broadband two-way satellite communication led to the reflection if it would be feasible to extend tracking and tracing systems towards monitoring of vessels/traffic in inland navigation.

In maritime navigation, IMO has introduced the Automatic Identification System (AIS). All seagoing ships on international voyage falling within the SOLAS Convention Chapter 5 were to be equipped with AIS by the end of 2004.

The difference between tracking and tracing and monitoring for traffic management and navigation purposes (such as AIS) seems to be mostly limited to the update rate. Therefore, a network-based solution, which has been called AI-IP, has been developed as an alternative to AIS. AI-IP mimics AIS functionality except that it does not use its own infrastructure, but is based on already existing public communication infrastructures and standard technology equipment (also known as Customer Premises Equipment) using standard IP-protocols. AI-IP is based on client-server technology, which means a vessel will have a client installed on board that will communicate with one or more servers to relay their messages to other clients (comparable with email, but then on a continuous realtime basis). This server (or group of servers) can also be used to interconnect AI-IP with shore-based systems.

The features of AI-IP are:

- A high level of protection of privacy, commercial and security interests;
- A scalable solution which allows support for both a small number of users as well as large number of users;
- Very high commercial stakes implies the operational status of the communication infrastructure that is used by AI-IP;
- Compatibility with the maritime and inland AIS on the data level.

This chapter defines all necessary functional requirements of AI-IP for use in inland navigation as well as a description of the AI-IP system in general and the AI-IP communication protocol.

3.2 SCOPE

The following paragraphs contain the description of the AI-IP system in general and the AI-IP communication protocol.

The AI-IP system is a system that uses standard equipment available at many different stores, such as an Internet connection, cell phone systems and a standard computer. Communication standards such as GSM, GPRS, UMTS and the IP standard will not be described in this document. These standards are already proven technology and comply with, for example, European requirements (e.g. CE). Internet knows a wide acceptance and is used for secure online money transactions, internal government data communication (even in critical areas), industrial chemical plant operations and many more appliances. Mobile data communication is widely used, not only in inland shipping or the logistics, but also in safety related areas, such as the GPRS based safety tracking & tracing system for the Dutch and German railways (the German railways uses a private guaranteed network over public communication infrastructures).

This chapter describes how these standards are used to exchange AIS messages between vessels and also between vessels and vessel traffic management centers. This exchange is the core functionality of AI-IP.

AI-IP is based upon both the functional requirements for Tracking and Tracing in inland shipping and the existing maritime AIS system. AI-IP uses the Internet infrastructure to transport AIS-messages to an AI-IP server, which will relay those messages to other AI-IP clients (or other destinations). It is compatible with the maritime AIS system on a data message level. Within the European research project COMPRIS, a tight integration of both systems will be tested and demonstrated.

AIS is an acronym for Automatic Identification System. It provides, by using radio technology, a means for the exchange of static, semi-static and dynamic information about vessels. Each vessel equipped with an AIS transponder (endpoint device of the AIS system) broadcasts its information on a regular, predetermined interval and other transponders can read this information. This is ship-ship communication. It is also possible to have ship-shore communication, in which a vessel traffic management center receives the information via a shore infrastructure of dedicated data lines and base stations and presents them via sensor fusion to the VTS operator.

The AI-IP system is developed by the inland shipping branch to provide a similar system on the functional level while using standard customer equipment, which is mostly already aboard a vessel. This equipment includes an Internet connection and a computer.

The AI-IP system consists of a client installed on the computer aboard a vessel and one or more servers that provide the AI-IP service to clients.

Based on the functional requirements with regards to the process of navigation and its tinging, described earlier in this document, the AI-IP client can operate in three modes:

- Tactical: The client will only send AIS messages to the AI-IP server, so that a VTS operator can have a full tactical traffic image of both vessels equipped with AI-IP and vessels equipped with AIS;
- Tactical on board: In this mode, the AI-IP client will not only send AIS messages to the AI-IP server, but it also requests the AI-IP server to return a list of vessels that are in the area of the requesting client; and
- Strategic: This mode will allow the client to "see" other vessels on a more strategic level. This allows the skipper to make decisions on the longer term (for example to stop early because of heavy traffic upstream or downstream the river). Because of privacy considerations, no detailed information (static and voyage data0 is provided to the end-user in the strategic mode.

The strategic client is used mostly on a minute interval, while both tactical modes will use the timing intervals defined as in the maritime AIS standard and the proposed inland AIS standard.

Independent of the mode, the AI-IP client will relay the information (when it is received) to other systems (radar systems or inland ECDIS applications) via a serial communication port and uses the same message structure as an AIS transponder.

The AI-IP server acts in two different functions:

- It provides an information store of messages reported by AI-IP clients or AIS transponders (via for example an AIS shore infrastructure);
- It will also act as an information relay station between two clients, whether these are AI-IP, AIS or VTS clients.

The client and server combined provide the same functional level compared to AIS. The AI-IP system will comply with both the maritime AIS standard as well as the proposed inland AIS standard with regards to the data being exchanged (via AIS messages), the timing and the accuracy required.

3.3 FUNCTIONAL DESIGN

aa) <u>3.3.1 Introduction</u>

The AI-IP system can be divided into three different elements: the client that is installed aboard a vessel, the server that provides different services to the clients and the communication protocol between the client and the server. This chapter describes these elements on a functional level. At first, a global overview of the working of the system is described. Following the global overview, the AI-IP client and the AI-IP server are described on a functional level containing all the elements and functions that comprise the AI-IP system.

bb) <u>3.3.2 System Overview</u>

AI-IP makes use of the Internet as communication layer. This has certain advantages, such as wide availability and usage, but it also has disadvantages. The option to see other AI-IP vessels dynamically can be done but is rather difficult. Therefore, one or more entities must be created with which the AI-IP vessels can communicate. These entities are called a server that provides a specific service, such as the AI-IP standard. The vessels all have a client aboard, which uses the AI-IP service. This mechanism of communication is called the client-server technology and the AI-IP server provides Automatic Identification services to the AI-IP clients.

The figure below displays the workings for the client-server technology.

Figure 3.1 AI-IP Client Server Technology

The client sends a request for information to the server. The server processes the request and after authentication and authorization (identification of information seeker and verification of whether the requestor is allowed access to the information) sends a response to the server. One very good example of the client-server technology is the World Wide Web. The client software is for example Internet Explorer. When a client wants to view a certain webpage (for example www.euro-compris.org), the web-browser requests that specific page from the web-server that provides the www.euro-compris.org website.

AI-IP uses not only the client-server technology, but also the push technology. Each AI-IP client will not only request information about vessels in a specific area, but it also sends its own position with that request. The server will process the position information and if a request has been made as well (the request for information about vessels in the area is optional), it will receive the information about other vessels in the area from the AI-IP server.

When the AI-IP client receives the position information about other vessels from the AI-IP server, the client will alter the received information in such a way that it can send the received information out via a serial communication port using the same format as AIS transponders use. This allows the skipper to see the AI-IP vessels as if they were vessels received via an AIS network.

So, the principle of the AI-IP system is that each client retrieves its own position (using either a GNSS device or the messages received from a connected (inland) AIS transponder), sends this information to the server and optionally requests information about other vessels in the area. The server will process the information and can possibly return the requested information. The requested information will be translated and sent out via a serial communication port to other systems using the same format as AIS transponders do.

Because AI-IP is a software-based solution, the timing, range and other settings can be set dynamically while the skipper is sailing. This means that the AI-IP system can be used in different ways and in different scenarios. In general, the AI-IP client can be set into three different modes:

- Tactical mode: The client will only send AIS messages to the AI-IP server, so that a VTS operator can have a full tactical traffic image of both vessels equipped with AI-IP and vessels equipped with AIS.
- Tactical on board mode: In this mode, the AI-IP client will not only send AIS messages to the AI-IP server, but it also requests the AI-IP server to return a list of vessels that are in the area of the requesting client.
- Strategic mode: In the strategic mode, it is not necessary for the skipper to make decisions for navigation on the short term, but rather on the longer term. The update frequency is set more towards a number of minutes instead of a number of seconds. The range will also be set to a higher value so that the skipper can make a strategic decision, for example to stop early because of heavy traffic upstream or downstream the river. In this mode, no static information about the vessel (containing the identity) is retrieved from the AI-IP server because of privacy considerations.

These modes are based on the timing requirements described in the functional requirements for Tracking and Tracing in inland shipping. These requirements do not mention the words tactical and strategic but mention functions for short-term navigation and long-term navigation. The functions for short-term navigation fall under the two tactical modes, while the latter functions fall under the strategic mode.

To summarize how the AI-IP system works, each AI-IP client retrieves its position information from either a GNSS device or a connected AIS transponder at a defined interval (based on the mode of the AI-IP client). It will then send this information to the AI-IP server. The AI-IP server receives the information and stores it in an information store (only the latest information received will be stored). If the client has also requested information about vessels in a given area, the server will provide that information to the AI-IP client. The client will then process the received information and relay the information to another system via a serial communication port.

xvi) <u>3.3.2.1 Smart AI-IP</u>

Within AI-IP the standard AIS massages can be extended with extra messages to reduce the amount of unnecessary traffic on the network infrastructure. For example, it is not really useful in a busy harbor that moored vessels send a position report every 180 seconds. It could be possible that a device on the network would remember which vessels are moored and will send the proper messages on behalf of that vessel, so that the vessel can turn off their navigation equipment when the skipper is away.

It is also possible to use an extra message in the communication protocol that requests only the moored vessels or only the dynamic vessels within an area. These two improvements would reduce the number of messages sent between the client and server quite dramatically. These two improvements are part of the "smart AI-IP" feature. It is extra functionality onto the AIS functionality to improve the functionality in certain situations.

Another part of smart AI-IP is also the semi-automatic change of the status. Currently, the status of a vessel must be changed manually according to the maritime AIS standard. However, it would also be possible to detect changes in the position and speed over ground. If there have been no changes in the position and speed, one can conclude that the vessel is not moving at all and the status can be changed to moored. Of course the other way around is also possible, the status is moored, but the vessel is moving for a specific period of time can result in a status change to sailing.

The "smart AI-IP" feature is part of AI-IP, but its messages and functions are currently optional.

cc) 3.3.3. AI-IP Client

The AI-IP client is the piece of software that is installed aboard a vessel. The application can run on different types of computers and systems. An AI-IP client must fulfil the following requirements and implement the functions described in this section.

The requirements for the AI-IP client are described below.

- The client must implement the AI-IP communication protocol;
- The AI-IP client must have the option to use a GNSS device (such as a GPS receiver) via minimally a serial communication device. It is recommended to have different connection options for the GNSS device, for example via an USB port or via a network;
- The client can either generate the different AIS messages (both the maritime AIS messages as well as the inland AIS specific messages) itself. It can optionally use the AIS messages generated by an inland AIS transponder that is connected to serial port of the AI-IP client;
- The client can be configured either via the user interface of the computer on which the client runs and via the serial NMEA sentences, part of the maritime AIS and the inland AIS standard;
- The AI-IP client can optionally send vessels that are received from the server to a serial port as NMEA sentences, so that radar overlay systems and inland ECDIS systems can present the received vessels.

The AI-IP client consists of different functions. These functions are described in the following paragraphs. With each function, a short description is given of what the function provides and whether the function is mandatory or optional.

xvii) 3.3.3.1 Start AI-IP

This function is used to start the AI-IP process. It is requested by the client (or at system startup). When smart AI-IP is enabled, it will initially call the sign-on function before it proceeds. Based on the chosen mode of the client, the client will set the timer task at the appropriate value (based on the appropriate standard or interval set in the preferences). After the timer has been set, the function "detect status change" will also be started, as well as the function "obtain position information". If, of course, an error occurs, this will be notified to the end-user. A display will be updated with the actual status in which the AI-IP client is working.

xviii) 3.3.3.2 Stop AI-IP

This function is used to stop the AI-IP process. It is requested either by the user interface or when the application quits. If the smart AI-IP feature is enabled, the sign-off function is called before the application will physically disconnect.

xix) 3.3.3.3 Edit Preferences

This function allows the user to edit all the necessary information of the AI-IP client. This information is not only related to the static information of the vessel, but also network related information and the information related to the AI-IP standard. The user can change the following information. The def column defines which values have a default value.

Table 3.1 Edit Preferences Field List

Field	Def	Description
Vessel name		Name of vessel
MMSI Number		MMSI Number
IMO Number		IMO Number of vessel (if applicable)
Vessel Id		The Unique Hull Identifier
Length		The length of the vessel
Width		The width of the vessel
Vessel type		The type of vessel
ERI Vessel Type		ERI vessel type
ATIS Code		ATIS Code of the vessel
GNSS bow distance		The distance from the GNSS device to bow
GNSS stern distance		The distance from the GNSS device to the stern
GNSS port distance		The distance from the GNSS device to port
GNSS starboard distance		The distance from the GNSS device to starboard
Default operating mode		The default operating mode in which the client will run
GNSS device port	√	Serial port to which the GNSS device is connected
GNSS device speed	√	Communication speed of the GNSS device
AIS output port	√	Serial port to which AIS messages must be sent
AIS output speed	√	Communication speed of the AIS port (varies from 300 to 57600)
Use AIS input	√	Determines whether the input of an AIS transponder must be used
AIS input port	√	The serial port to which the AIS transponder is connected
AIS input speed	√	The communication speed of the AIS input port.
Hostname	√	Name of the AI-IP Server
Tactical range	√	The default range to be used in tactical on board mode
Strategic range	√	The default range to be used in strategic mode
Interval	√	The interval (in seconds) that can will be used in strategic mode

When this function is started, the current preferences are loaded into a window and shown to the user. When there are no current preferences, the defaults (marked in the column "Def") are loaded and displayed to the client. The client can click on a cancel button to cancel the changes being made. When the user clicks on save, the information will be saved to file.

xx) 3.3.3.4 Edit Semi-static and Dynamic Data

This function allows the user to easily change the dynamic data, such as the destination, temporary dimensions and range, while the AI-IP client is running. This means that the user does not have to stop the client while changing these dynamic values. When the user clicks on apply, the information is saved and will be in effect immediately. The figure below shows how this screen could look.

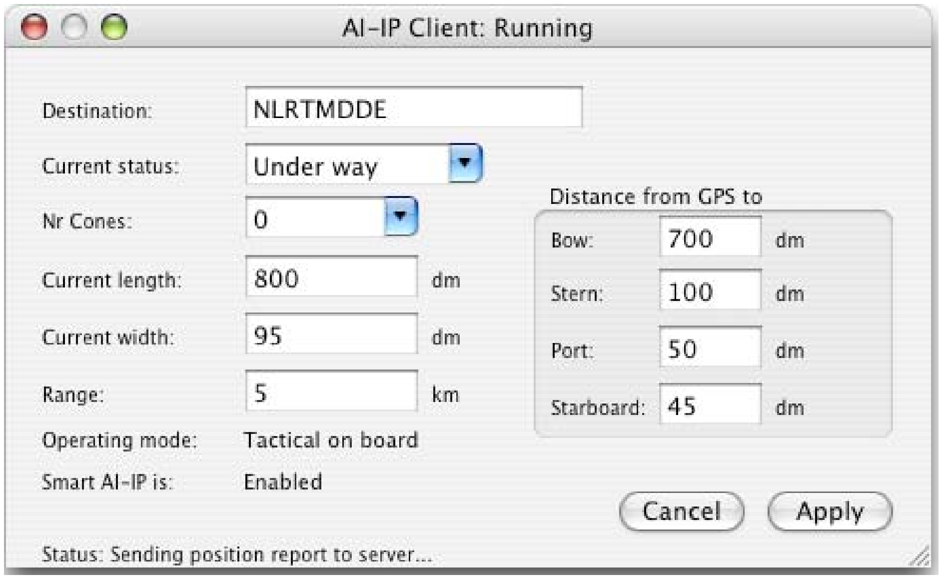


Figure 3.2 Example screen of function edit dynamic information

xxi) 3.3.3.5 Push/Request Information to Server

This function is part of the core of the AI-IP client. It is called at a regular interval and sends the latest obtained position to the server. Based on the mode in which the client is running, it can also request information on other vessels in the area.

When the function is called, it will obtain the latest available position information and other navigation information from the GNSS device and other necessary input devices. If this has been successful, the client will format the obtained information to an AIS position report message. This message will be sent by the client to the server using the appropriate protocol message and values, based on the current operating mode and whether smart AI-IP is enabled or not.

If the AI-IP client is operating in tactical on board or in strategic mode, the AI-IP client will wait for an answer from the server (and if there is no response within four seconds, the AI-IP client will resend the position report for up to four times) and relay the received information via the function "relay received information".

If the AI-IP client is operating in tactical mode, it will also wait for a response from the AI-IP server. It could be possible that there is information available for that client from the AI-IP server.

The AI-IP client will check all received data to see whether extra information (such as directed messages, EMMA warnings, water level information or interval change notification) is available. If any of this information is available, a separate function will be called that will receive this information (function obtain local information from server).

While this function is active, it will continually update the status of the client, reflecting the actual status. For example, the status could be "reporting position to server" or "waiting for answer".

xxii) 3.3.3.6 Send Static and Voyage Information

This function is the second heart of the AI-IP client. It will be called at the regular intervals defined by the maritime AIS and inland AIS standard when the AI-IP client is operating in tactical or tactical on board mode. If the client is running in strategic mode, this function is immediately called after the push/request information to the server function.

This function fetches the semi-static and voyage related information from the different preferences and format the information into the proper AIS message (both the maritime message 5 as well as the inland AIS static message). After the message is defined, it will be sent to the AI-IP server. If the client is running in tactical on board mode, the client will also start the function "3.3.3.13 Request Vessel Static Data" for all the vessels that have been received between this request and the previous request. If information has been received, the function "relay received information" will be called with the information.

xxiii) 3.3.3.7 Relay Received Information

This function is used to relay the information that is received from the AI-IP server (or the possibly connected AIS transponder) to an inland ECDIS system or another system that understands AIS messages. This function is called with the information that needs to be relayed. This information is already formatted into proper AIS messages. The function will send the information out via the configured serial port. Except for buffer checking, there is no validation whether an application has successfully received and processed the information.

xxiv) 3.3.3.8 Relay Directed Message

This function is used to relay information received from the AIS output port to the AI-IP server. This information could, for example, be an ETA message sent from an inland ECDIS application. The client will not wait for an answer from the server, because the AI-IP server will notify the AI-IP client via the flags in a regular response that a message is waiting for a specific AI-IP client.

xxv) 3.3.3.9 Obtain Dynamic Information

This function is actually a process that is running all the time while the AI-IP client is running. This process "listens" to the NMEA [IEC 61162-1] sentences that the GNSS device is sending via the serial port. This function will decode the information from the GNSS device and allows other functions to request this information.

xxvi) 3.3.3.10 Set Operating Mode

This function is used to change the operating mode of the AI-IP client. The user can change the mode of the AI-IP client while it is running. The function " Change interval" will be used to let the system change automatically from the different modes. The newly chosen mode will also be stored in the preferences so that when the client is restarted, it will start in the same mode. This function is also used when the AI-IP client receives local location information from the AI-IP server that notifies the AI-IP client that the interval must be changed (based on the maritime AIS message number 23).

xxvii) <u>3.3.3.11 Change Interval</u>

This function is used by both the user action to change the mode of the AI-IP client as well as the function "3.3.3.12 Get Local Location Information" to change the interval of the AI-IP client.

When this function is called, it will change the appropriate values inside the AI-IP client in such a way that the different timer functions will be called at the proper time.

This function also monitors the speed obtained from the GNSS device (via the function "3.3.3.9 Obtain Dynamic Information") and will update the interval on which position information is reported to the AI-IP Server if the AI-IP client is operating in tactical or tactical on board mode.

If authorities decide to set an interval for a specific region, the AI-IP client will automatically (via the "Get local information function) change the interval independent of the current mode of the client.

xxviii) <u>3.3.3.12 Get Local Location Information</u>

This function is called when the client "sees" that local information, such as EMMA warnings; RTA information or a change of interval is available from the AI-IP server. When this function is called, it will request all the information that is available from the AI-IP server using the proper AI-IP message and waits for a response from the AI-IP server. As soon as the response is received from the server, the received information will be relayed via the function "3.3.3.7 Relay Received Information".

xxix) <u>3.3.3.13 Request Vessel Static Data</u>

This function is used to request static information about one or more vessels from the AI-IP Server. This function is called with a list of vessels that need information. The client will then request this information from the AI-IP Server and process the information via the function "3.3.3.7 Relay Received Information".

xxx) <u>3.3.3.14 Detect Status Change</u>

This function is part of the smart AI-IP feature. This function is a continuous process that determines whether the status of the AI-IP client has been changed or not. This change can be determined from the position information and the speed information obtained from the GNSS device.

xxxi) <u>3.3.3.15 Enable/Disable Smart AI-IP</u>

This function is used to enable or disable the "smart AI-IP" feature of the AI-IP client.

xxxii) <u>3.3.3.16 Smart Request Vessels</u>

This function is the smart AI-IP alternative to the push/request information function. It is part of the function "3.3.3.5 Push/Request Information to Server", but it can also be called from other functions. It allows the AI-IP client to request information about other vessels in the area using specific selectors, such as a selector for moored vessels or a selector for moving vessels.

xxxiii) <u>3.3.3.17 Sign-on</u>

This function is called when the AI-IP client is started and smart AI-IP is enabled. The client will initially send the sign-on message of the AI-IP protocol. If no response has been received from the AI-IP server after a certain amount of time, a separate position and static data will be sent to the AI-IP server to make sure that it has the latest information.

After the sending of position information, the "3.3.3.16 Smart Request Vessels" function is used to obtain all vessels with the status moored. The received information is then relayed via the function "3.3.3.7 Relay Received Information". If no information is received from the server (after retrying for the preferred amount), the smart AI-IP function will automatically be disabled because the AI-IP server might not support "smart AI-IP". The status of smart AI-IP will be updated in the status display of the AI-IP client.

xxxiv) <u>3.3.3.18 Sign-off</u>

This function is called when the AI-IP client is being stopped (independent of the mode). It sends a message to the server asking to store the position data and the static data on the server and update this information on a regular interval. This function is part of the smart AI-IP feature.

xxxv)<u>3.3.3.19 Function Matrix</u>

The different functions described above are not all used in the three different operating modes of the AI-IP client. Some functions are mandatory for a specific operating mode of the client, while others are recommended. The table below shows which function is mandatory for the AI-IP client in each of the operating mode.

Table 3.2 Function Matrix AI-IP Client

Function	Tactical	Tactical on board	Strategic
3.3.3.1 Start AI-IP	M	M	M
3.3.3.2 Stop AI-IP	M	M	M
3.3.3.3 Edit Preferences	M	M	M
3.3.3.4 Edit Semi-static and Dynamic Data	M	M	M
3.3.3.5 Push/Request Information to Server	M1)	M	M
3.3.3.6 Send Static and Voyage Information	M	M	M
3.3.3.7 Relay Received Information	R	M	M
3.3.3.8 Relay Directed Message	R	R	R
3.3.3.9 Obtain Dynamic Information	M	M	M
3.3.3.10 Set Operating Mode	M	M	M
3.3.3.11 Change Interval	M	M	M
3.3.3.12 Get Local Location Information	R	R	R
3.3.3.13 Request Vessel Static Data	O	M	M
3.3.3.14 Detect Status Change	O	O	O
3.3.3.15 Enable/Disable Smart AI-IP	O	O	O
3.3.3.16 Smart Request Vessels	O	O	O
3.3.3.17 Sign-on	O	O	O
3.3.3.18 Sign-off	O	O	O

1) The function "3.3.3.5 Push/Request Information to Server" is only used to send information, without any request for extra information.

dd) <u>3.3.4. AI-IP Server</u>

The AI-IP server is a central piece of software that provides the different AI-IP services to the AI-IP clients. This software is scalable from a single computer providing the services to a limited number of AI-IP clients up to a cluster of computers acting as a single AI-IP server, providing services for many AI-IP clients. The AI-IP server system (whether it is physically installed on one or more computers) must be made available on either the Internet or another IP based network. It must be accessible via the communication method defined in the AI-IP communication protocol and implement the AI-IP protocol messages and the corresponding functions.

The features (services) of the AI-IP server can be divided into four different feature sets. Each feature set contains different functions. Only the minimal feature set is mandatory, the other feature sets are optional for the AI-IP Server to implement.

- Minimal feature set:
  - With this feature set, the AI-IP server functions only as a relay station between the AI-IP clients and one or more VTS centers. All AIS messages received from the AI-IP clients are relayed to the appropriate VTS center. No intelligence is provided to the connecting AI-IP clients.
  - The communication between the AI-IP server and a VTS center is specific to the vendor of the VTS center system.
- Base station feature set:
  - This feature set contains all the functions that allow the AI-IP Server to act similarly as a maritime AIS base station. The AI-IP Server does not only relay information received from the AI-IP clients, but it also provides local information (such as EMMA warnings, water level information, interval changes and directed information) to the connecting AI-IP clients.
- Traffic on board feature set:
  - This feature set allows the AI-IP server to provide traffic information to the connecting AI-IP clients. The core feature of this set is that AI-IP clients can make requests about vessels in the area of that specific client.
- Smart AI-IP feature set:
  - This feature set embeds all the functions that are part of the smart AI-IP feature. It allows AI-IP clients to sign-on and sign-off from the AI-IP server and it also allows the AI-IP clients to request information about specific vessels or vessels with a specific status (for example, the request for only vessels in the area that are moored).

Each of the different feature sets described above contains both requirements and different functions that the AI-IP server must implement. The following paragraphs describe these requirements and functions. The last section describes a matrix that displays which function is mandatory or optional for each of the different feature sets.

xxxvi) <u>3.3.4.1 AI-IP Server Requirements</u>

The following table describes which requirements must be met in each of the different feature sets in order for the AI-IP Server to provide the proper services that come with the respective feature set.

Table 3.3 AI-IP Server Requirements

Requirement	Minimal	Base station	Traffic on board	Smart Ai-Ip
The AI-IP Server must provide the proper AI-IP protocol messages based on the feature set it implements, as required in the communication protocol	√	√	√	√
The AI-IP server must be capable of receiving AI-IP protocol messages from both different clients as well as a single client simultaneously	√			
The AI-IP server must be capable to process the received AIS messages and report them to one or more systems1)	√			
The server will store information local to a specific area in a database		√	√	√
The AI-IP server will relay directed messages and store received directed messages until the client sends information to the server		√	√	√
The AI-IP Server will provide a requesting client with the stored local information based on the latest position available		√	√	√
The AI-IP server will store the latest position information and static and voyage information in a database			√	√
The AI-IP server will provide requesting AI-IP vessels with information about other vessels			√	√
The AI-IP server has the option to receive information from AIS based vessels (via an AIS network)			R	R
The AI-IP server provides AI-IP clients information about vessels with a specific status				√
The AI-IP server will renew the information from a specific AI-IP client automatically until the client signs on again				√

√ This requirement must be met by the AI-IP server to comply with the given feature set
R This requirement is recommended to implement
1) Because the AI-IP server is not bound to a specific location, the AI-IP server can cover the area of different VTS centers. It must be possible for the AI-IP server to redirect the information to the appropriate VTS center.

The requirements described above also mention different functions that the AI-IP server must implement to comply.

xxxvii) <u>3.3.4.2 Listen for New AI-IP Messages</u>

This function is the actual heart of the AI-IP Server. This function runs continually as a process, waiting for an AI-IP message from an AI-IP client. When a request is received, the request will be examined and processed according to the feature set that the AI-IP server has implemented. For example, if a position report has been received, the information will be stored in a database. After successful processing and if the received information contains an AIS message, the received message will be relayed to a VTS center via the function "3.3.4.3 Relay to External System".

xxxviii) **3.3.4.3 Relay to External System**

This function is used to relay the received information to another system, which could be a VTS center, but also another AI-IP system or an AIS network. Because a single AI-IP server can cover the area of different VTS centers, it could be possible that a single message is sent to different VTS centers. How the information is sent to the other system is based on the communication protocol that the other system supports. Therefore, it is possible that this function is implemented more than once.

xxxix) **3.3.4.4 Receive Information from External System**

This function allows AIS messages from other systems, such as an AIS network or a VTS center, to be received and processed by the AI-IP server. There is currently no open standard on how an AIS network communicates with a VTS center. Therefore, the AI-IP sever can implement multiple versions of this function, each providing a service to a different VTS center or AIS network.

xl) **3.3.4.5 Store Latest Information**

This function is used to store the latest information dynamic and static information received from an AI-IP client. Only the maritime AIS messages 1,2,3 and 5 and the inland AIS message static and voyage data will be stored in the database. If an AIS message is received from an AI-IP client that is currently not in the database, a new record is inserted into the database. If a record already exists for this AI-IP client, the information in that record is updated with the newly received information.

xli) **3.3.4.6 Store Local Information**

This function is used to store information that is specific for a given area, such as a VTS center or a harbor. This information could be EMMA warnings, water level updates, aids-to-navigation information or an interval change area. This function is an essential part of the AIS base station feature set as it allows the AI-IP Server to perform the same functions (also for multiple areas) as a maritime AIS base station. The local information will be stored in such a way that this information can be set for a specific time period or permanent and that it is set for a specific area as the AI-IP Server is not limited to a single geographical area.

xlii) **3.3.4.7 Search for Vessels in a Given Area**

This function is the heart of the "tactical on board" feature set. The function is called with a given location and a range in kilometers. The system will calculate two coordinates based on these two parameters: a minimum and maximum coordinate. These two coordinates form a square (see Figure 3.3) with the given range as maximum distance from the original location going north-, south-, west- and eastbound.

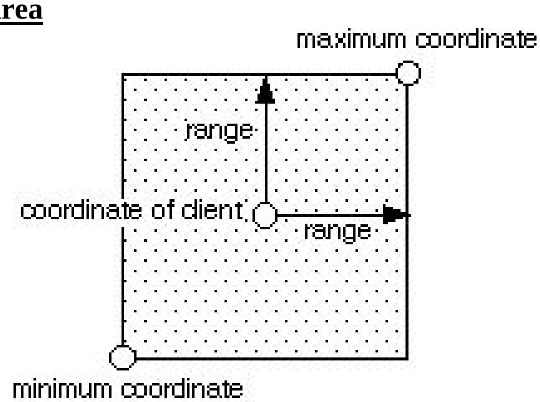


Figure 3.3 : AI-IP Server Range Calculation

The calculations used for calculating the minimum and maximum coordinate is based on the fact that, for small distances, the earth can be considered as a flat area (this does not provide true distance, but is on short distances quite accurate). Using a square for the range instead of a circle also improves the search in a relational database (indexes can be used to filter the proper vessels from the database).

The calculations used for the minimum and maximum coordinate are as follows.

distance_North = R1* (lat2-lat1)
distance_East=R2 * cos(lat1)* (lon2-lon1)
R1 = a * (1- e2) / (1-e2 * (sin(lat1))2)(3/2)
R2 = a / sqrt (1- e2 * sin(lat1))2)

where :
a = 6378,137000 km (the equatorial radius of the earth)
e2 = 2 * f * (1-f)
f = 1/298,257223563
cos = cosinus
sqrt = square root
sin = sinus

xliii) <u>3.3.4.8 Search for Vessels in a Given Area with Specific Status</u>

This function is part of "smart AI-IP". It is similar to the function "3.3.4.7 Search for Vessels in a Given Area", except that an extra filter is applied to the search. The client requests what type of filter has to be applied via the appropriate AI-IP protocol message. The client can apply the following filters.

Table 3.4 : Filter Types for Smart Request Vessel Positions

Filter	Description
Moored	Select only the vessels that are moored
Moving	Select only the vessels that are moving
Inland	Select only the Inland vessels
Maritime	Select only the Maritime vessels
Pleasure craft	Select only the pleasure crafts
AI-IP only	Select only vessels reported via AI-IP
AIS only	Select only vessels received via an external AIS network

The filters are not mutually exclusive and can be combined. For example, a request can be made for only the moving inland vessels.

xliv) <u>3.3.4.9 Search for Information meant for a Specific AI-IP Client</u>

This function is used to implement functionality similar to the base station functions of an AIS network. This function searches in the database whether directed information for a specific client is waiting to be delivered to the AI-IP client. Such information can for example be an RTA message sent in answer of an earlier sent ETA message.

xlv) <u>3.3.4.10 Search for Information Specific for a Location</u>

This function is also used to implement the functionality of an AIS base station. Base stations are allowed to transmit information that applies to a specific location. This information could be an aids-to-navigation message, EMMA warnings, water level updates or a change of interval message. This function searches (via a parameter) whether local information is available for the location of the requesting AI-IP client. If information is found, these messages will be sent to the AI-IP client as response to the appropriate AI-IP protocol message.

xlvi) <u>3.3.4.11 Change Interval for Location</u>

This function is used to change temporarily (for example in case of an emergency) or permanently the interval on which the connecting AI-IP clients report the position to the AI-IP server. The interval change is valid for a specific location (defined by two coordinates, forming a "square"). The interval can be set to a specific value in seconds, variable from 2 seconds to any lower rate. The change interval can also be used to "push" a reporting client into a specific mode. For example, when a vessel is entering a busy area in which higher security rules are valid, this function can be used to cover the area, make the interval change mandatory for all AI-IP clients and ensure that all clients change to at least tactical mode. This function makes use of the maritime AIS message 23, which is received from the AI-IP Server if a rate change is valid.

xlvii) <u>3.3.4.12 Renew Signed Off Vessels</u>

This function is used to renew the timestamp of the vessels that have been signed off via the "smart AI-IP" feature set.

xlviii) <u>3.3.4.13 Relay Messages for Signed Off Vessels</u>

This function is used to relay the position report and the static information of vessels that are "signed off" the AI-IP system to the appropriate external system. This function is an essential part of the smart AI-IP feature.

xlix) <u>3.3.4.14 Delete Obsolete Position Information</u>

The AI-IP system is a system with dynamic behavior. It is possible that a client is not transmitting its information to the AI-IP Server for a number of potential reasons. This function will regularly check the database for old position information and deletes this information from the database. Because an AI-IP client can operate in both tactical and strategic mode, the server will have a timer method for both tactical information as well as strategic information. This results in a more up-to-date traffic image aboard an AI-IP client for both the tactical on board mode as well as the strategic mode.

l) <u>3.3.4.15 Function Matrix</u>

The earlier described functions can be used in the different feature sets, either as mandatory functions or as optional functions. The table below describes which function is contained in which feature set and whether it is mandatory.

Table 3.5 AI-IP Server Function Matrix

Function	Minimal	Base station	Traffic on board	Smart AI-IP
3.3.4.2 Listen for New AI-IP Messages3.3.4.15 Function Matrix	M			
3.3.4.3 Relay to External System	M			
3.3.4.4 Receive Information from External System	O	O	O	O
3.3.4.5 Store Latest Information			M	M
3.3.4.6 Store Local Information		M	R	R
3.3.4.7 Search for Vessels in a Given Area			M	M
3.3.4.8 Search for Vessels in a Given Area with Specific Status				M
3.3.4.9 Search for Information meant for a Specific AI-IP Client		M	R	R
3.3.4.10 Search for Information Specific for a Location		M	R	R
3.3.4.11 Change Interval for Location		M	R	R
3.3.4.12 Renew Signed Off Vessels				M
3.3.4.13 Relay Messages for Signed Off Vessels				M
3.3.4.14 Delete Obsolete Position Information			M	M

3.4 PROTOCOL DEFINITION

ee) 3.4.1 Introduction

The AI-IP communication protocol is based on the current protocol used on the Internet. This protocol suite has become the de Facto standard for communication via a computer network. Its use is very diverse and includes applications such as video on demand, IP Telephony, Virtual Private Networking and also in mission-critical environments such as electronic banking, Electronic Data Exchange (X400 message system uses IP more and more as communication infrastructure), and even systems used by the national alarm systems communicate based on the Internet Protocol suite. Every major operating system for a computer supports both the current Internet Protocol suite (IPv4) as well as the next generation Internet Protocol suite (IPv6).

This chapter is an excerpt from the AI-IP communication standard that is used by AI-IP clients to communicate with the AI-IP server. This chapter assumes that the system on which the AI-IP client or the AI-IP server is running has a valid connection to an IP-network, whether this is the Internet or an Intranet. It also uses the following definitions:

ff) 3.4.2 General Overview

As described in the functional design of the AI-IP system, the AI-IP client can operate in three different modes (tactical mode, tactical on board mode and strategic mode). These three modes result in two different methods for communication with the AI-IP server.

- Push method: With the push-communication, an AI-IP client pushes information to the AI-IP server but it does not need information from the server. This communication method is used in the tactical mode.
- Request-response method: As the name of this method indicates, the AI-IP client requests information from the AI-IP server and can receive a response from the AI-IP

server. The push of information is embedded with the request for information. This mode is used in both the tactical on board mode as well as the strategic mode.

The communication between the AI-IP client and the AI-IP sever is based upon so-called protocol messages. A protocol message is the transmission of information from one network endpoint to another network endpoint. In the case of AI-IP, this means that a protocol message could be either a push from the client, a request from the client or a response from the AI-IP server.

These three messages can be used in different ways. However, the request and the push message can be integrated in a single protocol message. This allows the AI-IP protocol to use the following messages:

Table 3.6 AI-IP Protocol Message Definitions

ID	Message	From	To	Description
1	Push/Request	Client	Server	This message is used to send AIS sentences to the AI-IP server and optionally request information from the AI-IP server
2	Request detail information	Client	Server	This message is used to request detail information about, for example, other vessels.
3	Request location information	Client	Server	This message is used to request extra information about the location based on the current reported location of the client. It is similar to the base station feature within AIS.
4	Response	Server	Client	This message is used to send a response back from the client who requested information
20	Sign-on	Client	Server	This message is used by the client to sign on at the server
21	Sign-off	Client	Server	This message is used by the client to sign-off from the server
22	Smart request	Client	Server	This message is used to request information about either moving or moored vessels

1) Do not mix the id described in the table with the AIS Message Identifier. The message ID used in this table is the AI-IP message ID.

All the request messages within the AI-IP protocol contain a timestamp in UTC time. This timestamp is obtained from the connected GNSS device. The contents of the field are defined below (bit zero is the least significant bit).

Table 3.7 Timestamp Field Format

Field	Bits	Description
Year	31 to 26	Number of years since 2000 (allowing from 2000 until 2063)
Month	25 to 22	The month (value 1 to 12)
Day	21 to 17	Day of month (value of 1 to 31)
Hour	16 to 12	Hour (value of 0 to 23)
Minute	11 to 6	Minute (value of 0 to 59)
Second	5 to 0	Seconds (value of 0 to 59)

As can be seen, there are currently four basic messages and three extra messages within the AI-IP protocol. These messages are described in more detail in the following sections.

gg) <u>3.4.3 AI-IP Message 1 Push/Request Information</u>

The Push/Request information message allows the client to send information (such as position information, static data and ETA information) to the AI-IP server. It can also be used to simultaneously request information about vessels in a given area around the reporting position.

The last option for this message is used by both the tactical on board mode as well as the strategic mode. When the last option is used, the AI-IP server is required to send a response message back (message id 10). If the message is used to push information that does not require a response from the server (such as pushing position and static information), it is not necessary for the server to reply with a response message. The fields within this message are described below.

Table 3.8 AI-IP Message 1 Layout

Field	Length	Type	M/O	Description
ID	1	byte	M	The AI-IP message ID (1)
Timestamp	4	timestamp	M	The timestamp
Content	variable	string	M	The content of the message
Separator	1	byte	O	field separator, value is 0
Range	1	Integer	O	Range for request information

The content field contains the message that is sent to the server. It is formatted according to the NMEA-0183 standard. If the message is a list of NMEA-0183 sentences, the CR character separates the sentences. When the client also includes a range (for a request of vessels within the area), the separator field has a value of 0 to distinguish between the range field and the content field. The range is limited on the client side, based on the mode that the client is operating. The tactical on board mode has a maximum of 15 kilometers and the strategic mode has a limit of 50 kilometers.

hh) <u>3.4.4 AI-IP Message 2 Request Detail Information</u>

When the client is operating in the tactical on board mode or in the strategic mode, he could need the static and semi-static information about vessels. This information can be requested via the request detail information message. After the request has been made, the server will reply with a response message. The fields within this message are defined below.

Table 3.9 AI-IP Message 2 Layout

Field	Length	Type	M/O	Description
ID	1	byte	M	The AI-IP message ID (2)
Count	1	byte	M	The number of vessels requested
Group 1	variable		M	Repeating group of fields
type	1	byte	M	Type of identifier
id	4	byte	M	Identifier

As can be seen, this message contains a repeating group. This repeating group contains the list of identifiers for the vessels for which detail information is requested. The type field defines what value is stored in the id field. The default value is zero and is used for MMSI numbers. Below is a table that shows the current identifiers that can be used.

Table 3.10 AI-IP Message 2 Identifier Types

Type	Identifier
0	MMSI
1	Unique Hull Identification Number

This table can be extended with, for example, the IMO number or another numbering schema that might be implemented in the future. The Unique Hull Identification Number is part of the ERI group (Electronic Reporting International) and allows for a unified identification number across Europe.

ii) 3.4.5 AI-IP Message 3 Request Location Information

This message is used to request all information valid for the local area in which the client is situated. This information could be EMMA warnings, water levels, RTA messages, aids-to-navigation messages and a message informing the client for an alternative frequency update. The server will respond to this request with the messages that are currently valid for that client. The message definition is described below.

Table 3.11 AI-IP Message 3 Field Layout

Field	Length	Type	M/O	Description
ID	1	byte	M	The AI-IP message ID (3)
Timestamp	4	timestamp	M	The timestamp of the request
Flags	2	byte	M	Flags to inform the server what information is requested

A full timestamp is included in this message so that the server can also send messages that are valid for a specific period. The flags field defines what kind of information is requested. The flags field is formatted in the same way as the flag field in the response message. It has a length of two bytes, allowing for 16 different flags. The current flags are described in the table below. The index is within the two bytes where index 0 is the least significant bit and index 15 is the most significant bit.

Table 3.12 AI-IP Message 3 Field Layout

Flag	Index	Description
Update rate	0	Flag to inform that a special update rate is valid for this area
A-to-N	1	Flag to inform that Aid-to-Navigation messages are available
Emma warning	2	Flag to inform that EMMA warnings are available
Water level	3	Flag to inform that Water level information is available
RTA	4	Flag to inform that an RTA message is available

jj) 3.4.6 AI-IP Message 4 Response

This message is used in two ways. It is used as a general container to send information back from the AI-IP server to the AI-IP client. This response could be a list of vessels in the area or any other AIS or inland AIS related message. It is also used as an informative message (in response to a push message) to inform the client that extra information is available for that client. This extra information could be an RTA message for that client, an EMMA warning or that the update rate must be changed for the area in which the client is situated or other aids-to-navigation messages.

This message is optional for the AI-IP server to implement. However, it is recommended to implement this message so that AIS base station functionality can be reached. The format of the message is described below.

Table 3.13 AI-IP Message 4 Layout

Field	Length	Type	M/O	Description
ID	1	byte	M	The AI-IP message ID (4)
Flags	2	byte	M	Flags to inform the client that extra information is available
Content	variable	string	M	The response to be sent back to the client

All the fields in this message are mandatory. The flags field is a mandatory field. If no information is available, its content will be of a value zero. The flag field has a length of two bytes, allowing for 16 different flags. The current flags are described in the table below. The index is within the two bytes where index 0 is the least significant bit and index 15 is the most significant bit.

Table 3.14 Flag Fields for AI-IP Message 4

Flag	Index	Description
Update rate	0	Flag to inform that a special update rate is valid for this area
A-to-N	1	Flag to inform that Aid-to-Navigation messages are available
Emma warning	2	Flag to inform that EMMA warnings are available
Water level	3	Flag to inform that Water level information is available
RTA	4	Flag to inform that an RTA message is available
Final	15	Flag to inform that this message is the final message in the response

The content field contains the information that is sent to the client. The information is formatted as an NMEA-183 sentence, comparable with the push message. If the content contains multiple sentences, the CR character divides these messages within the content field. This could, for example, occur when the server sends a list of vessels back to the client or when the server sends local information to the client.

kk) <u>3.4.7 AI-IP Message 20 Sign-on Message</u>

This message is part of the "smart AI-IP" feature. It is used by a client to register itself to the server and tell the server that the client will send its own position report and status information again. The message is used when the client is started. If the AI-IP Server supports the smart AI-IP feature, it will send an acknowledgement (message 23) back to the client. The client will retry to send a sign-on message for three consecutive times. If no acknowledgement is received from the server, the client will send a position report and static voyage data message to the server to make sure that the AI-IP server has the latest information. This is independent of the mode the AI-IP client is operating in. The layout of the message is defined below.

Table 3.15 AI-IP Message 20 Field Layout

Field	Length	Type	M/O	Description
ID	1	byte	M	The AI-IP message ID (20)
Timestamp	4	timestamp	M	The timestamp
Type	1	byte	M	The type of identifier
Id	4	byte	M	The vessel identifier

The Type field defines what value is stored in the Id field. The Id field contains the Identifier of the specific AI-IP client that has sent the sign-on message. The following table describes the current identifiers that can be used.

Table 3.16 AI-IP Message 20 Identifier Types

Type	Identifier
0	MMSI
1	Unique Hull Identification Number

ll) 3.4.8 AI-IP Message 21 Sign-off Message

This message is part of the "smart AI-IP" functionality. It is used to tell the AI-IP server that the client is logging off from the AI-IP Server and that its status will remain moored until the clients register again (using the sign-on message). When the AI-IP server receives this message, it will automatically update the position report and static vessel data at the proper interval (according to the standard) on behalf of the client. This action is acknowledged to the AI-IP client via message 23. The layout of the sign-off message is defined below.

Table 3.17 AI-IP Message 20 Field Layout

Field	Length	Type	M/O	Description
ID	1	byte	M	The AI-IP message ID (21)
Timestamp	4	timestamp	M	The timestamp
Type	1	byte	M	The type of identifier
Id	4	byte	M	The vessel identifier

The Type and Id field are used in the same way as in AI-IP message 20 with the same values.

mm) 3.4.9 AI-IP Message 22 Smart Request Message

This message is part of the "smart AI-IP" functionality. It allows the client to request vessels for an area with a specific status, for example only the moored vessels or only the moving vessels. The message layout is defined below.

Table 3.18 AI-IP Message 22 Field Layout

Field	Length	Type	M/O	Description
ID	1	byte	M	The AI-IP message ID (22)
Timestamp	4	timestamp	M	The timestamp
Content	variable	string	M	The content of the message
Separator	1	byte	O	Field separator, value is 0
Range	1	integer	O	Range for request information
Selector	2	byte	O	Selector for vessels of interest

The smart request message is quite similar to the push/request message (message ID 1). However, it contains an extra selector field that is used to identify which vessels are requested. This field has a length of two bytes and uses the bits (16 in total) as selectors for the different types of vessels. If a bit has been set, the client requests that the answer contains vessels matching with that category. The bit with index 0 is the least significant bit and index 15 the most significant bit. The index used in the selector field is described below.

Table 3.19 AI-IP Message 22 Selector Field Layout

Selector field	Index	Description
Moored	0	Selector to identify that moored vessels are requested
Moving	1	Selector for moving vessels
Inland	8	Selector for Inland vessels
Maritime	9	Selector for Maritime vessels
Pleasure craft	10	Selector for pleasure craft vessels
AI-IP only	11	Selector for vessels equipped with AI-IP clients
AIS only	12	Selector for vessels equipped with AIS transponders

nn) 3.4.10 AI-IP Message 23 Acknowledgment

This message is sent from the AI-IP Server to the AI-IP client as acknowledgment to either the sign-on message or sign-off message. The message layout is defined below.

Table 3.20 AI-IP Message 23 Field Layout

Field	Length	Type	M/O	Description
ID	1	byte	M	The AI-IP message ID (23)
Timestamp	4	timestamp	M	The timestamp of the requesting AI-IP client

The timestamp field contains the same timestamp as the client has used as if it were a request identifier. This allows the client to know for sure that the message was received and processed successfully by the AI-IP server.

oo) 3.4.11 Message Matrix

It is quite clear that the AI-IP client can operate in different modes and that the AI-IP Server can provide different feature sets. Depending on the mode, certain messages are either mandatory or optional. In the table below an overview is given which message is mandatory, optional, recommended or not applicable in which mode.

Table 3.21 AI-IP Message Matrix

AI-IP Message	Client sends in			Server responds with			
	Tactical	Tactical on board	Strategic	Minimal	Base station	Traffic on board	Smart AI-IP
Push/Request information							
1,2,3 & 5 message + inland static	M	M	M	R	M	M	M
Addressed messages	O	R	R	R	M	M	M
Request detail information	O	M	M	O	O	M	M
Request location information	R	M	M	R	M	M	M
Sign-on message	O	O	O	O	O	O	M
Sign-off message	O	O	O	O	O	O	M
Smart push/request information	O	O	O	O	O	O	M

In the table above, the Push/Request information message is divided into two categories of messages. The first category contains the maritime AIS messages 1,2,3 and 5 and the inland AIS static and voyage data message. These messages can optionally have a response from the server in the normal mode (which is recommended).

The second category contains the so-called addressed messages. These are the messages that require a response from the server, such as the ETA/RTA interchange. In tactical mode, this category is optional for the client to send but it is recommended for the server to send a response so that the server can act as an maritime AIS base station on the functional level.

When the server is operating on Traffic on Board mode, all messages received from a client require a response from the server, no matter what message is sent.

pp) <u>3.4.12 Technical Details</u>

The previous sections have described the different messages that the AI-IP protocol currently consists of. This section describes certain technical implementations that are part of the AI-IP protocol.

Part of the AI-IP protocol must be the timely delivery of information, specifically in tactical or tactical on board mode. The Internet Protocol suite provides a specific protocol for this, the User Datagram Protocol (UDP). It is a connection-less communication protocol (it does not require the setup and negotiation of a communication channel) and does not provide services such as segmentation (dividing data into smaller packets) and reassembly (reassembling the smaller packets into one data unit). The result is a faster communication protocol, but potentially unreliable. This was indeed the case in the early days of the Internet. Nowadays, video streaming and certain security technologies, such as Virtual Private Networking, also use UDP. Although current communication technologies (such as GPRS, Wi-Fi or UMTS) provide reliable communication, the AI-IP protocol must consider the possibility of packet loss.

The AI-IP client can handle this potential packet loss in the tactical on board and strategic modes (there should always be a response from the server, this serves as an acknowledgement). There is no possibility to have a guaranteed delivery of information in the tactical mode, but this is the case for maritime AIS transponders in all cases (there is no knowledge on whether an AIS message was successfully received by another AIS transponder).

The Internet Protocol uses specific numbers (IP addresses) to uniquely identify computers that are connected to the Internet (or any other IP based network). However, this IP address only identifies the computer, but not one of the potential many communication channels that a single computer can have (for example a user that is downloading a file, sending an email and surfing the web at the same time). To resolve this, the Internet Protocol also uses port numbers. A port number is used to define either a specific service that is running on a computer (for example 80 is used for http (which is used for the world wide web) and 25 for the delivery of email) or to identify an endpoint of a communication channel (the client side of the communication). This means that the AI-IP communication protocol also needs to use a port number to identify the AI-IP service on the AI-IP server (the AI-IP server "listens" on this port for the earlier described AI-IP protocol messages). There is a list of port numbers that are already allocated for specific services. The port number 4155 currently has an unassigned status. AI-IP will use this port number and has requested a registry of this port number for AI-IP.

The AI-IP protocol is defined as an open standard. The default communication between the AI-IP client and AI-IP server is currently not encrypted. However, it is recommended to encrypt the information between the AI-IP client and AI-IP server using the techniques and methods agreed within the ERI workgroup. A request has been made with the proper authorities to use port number 4156 for the secure AI-IP communication protocol.

To summarize, AI-IP uses UDP for the communication between the client and the server. The server uses port number 4155 to listen for AI-IP messages sent by clients. A registry request has been sent to the proper authority for the registration of AI-IP on port 4155.

Annex A: Definitions

A.1 Services

River Information Services (RIS)

An European concept for harmonised information services to support traffic-management and transport-management in inland navigation, including the interfaces to other transport modes.

Vessel Traffic Management

Vessel traffic monitoring is providing information orally as well as electronically as well as giving directions in interaction with and response to vessels in a traffic flow to optimise the smooth (efficient) and safe transport.

Vessel traffic management should comprise at least one of the below defined elements:

- Vessel traffic services
- Information services
- Navigational assistance services
- Traffic organisation service
- Lock planning (long and medium term)
- Lock operation
- Bridge planning (medium and short term)
- Bridge operation
- Navigational information

Vessel Traffic Services (VTS)

A service implemented by a competent authority, designed to improve the safety and efficiency of vessel traffic and to protect the environment.

The service should have the capability to interact with the traffic and to respond to traffic situations developing in the area.

VTS services – VTS should comprise at least an information service and may also include others, such as a navigational assistance service, or a traffic organisation service, or both, defined as below:

- An information service is a service to ensure that essential information becomes available in time for on board navigational decision-making.
- A navigational assistance service is a service to assist on board navigational decision-making and to monitor its effects. Navigational assistance is especially of importance in reduced visibility or difficult meteorological circumstances or in case of defects or deficiencies affecting the radar, steering or propulsion. Navigational assistance is given in due form of position information at the request of the traffic participant or in special circumstances when deemed necessary by the VTS operator.
- A traffic organisation service is a service to prevent the development of dangerous vessel traffic situations by managing of traffic movements and to provide for the safe and efficient movement of vessel traffic within the VTS area.

(Source: IALA VTS guidelines)

VTS area is the delineated, formally declared service area of the VTS. A VTS area may be subdivided in sub-areas or sectors. (Source: IALA VTS guidelines)

Navigational information is information provided to the skipper on board to support in on board decision-making. (Source: IALA VTS guidelines)

Tactical Traffic Information (TTI) is the information affecting the skipper's or the VTS operator's immediate decisions with respect to the actual traffic situation and the close geographic surroundings. A tactical traffic image contains position information and specific vessel information of all targets detected by a radar presented on an Electronic Navigational Chart and – if available – enhanced by external Traffic Information, such as the information delivered by an AIS. TTI may be provided on board of a vessel or on shore, e.g. in a VTS Centre. (Source: PIANC RIS guidelines 2004)

Strategic Traffic Information (STI) is the information affecting the medium and long-term decisions of RIS users. A strategic traffic image contributes to the planning decision capabilities regarding a safe and efficient voyage. A strategic traffic image is produced in a RIS centre and delivered to the users on demand. A strategic traffic image contains all relevant vessels in the RIS area with their characteristics, cargoes and positions, reported by VHF voice reporting or electronic ship reporting, stored in a database and presented in a table or on an electronic map. Strategic Traffic Information may be provided by a RIS/VTS centre or by an office. (Source: PIANC RIS guidelines 2004)

(Vessel) Tracking and tracing

- **(Vessel) Tracking** means the function of maintaining status information of the vessel, such as the current position and characteristics, and – if needed – combined with information on cargo and consignments.
- **(Vessel) Tracing** means the retrieving of information concerning the whereabouts of the vessel and – if needed - information on cargo, consignments and equipment. (Source: PIANC RIS guidelines 2004)

Vessel traffic monitoring is providing important information relating to the movements of relevant ships in a RIS area. This includes information about ships identity, position, (type of cargo) and port of destination. (new)

Logistics

The planning, execution and control of the movement and placement of people and/or goods and the supporting activities related to such movement and placement within a system organized to achieve specific objectives. (Source: COMPRIS WP8 Standardization)

A.2 Players

Shipmaster

The person responsible for the overall safety of the vessel, cargo, passengers and crew and thereby for the voyage plan of the vessel and the condition of the vessel, the cargo, respectively passengers and the quality and quantity of the crew.

Conning skipper

The person who navigates the vessel on voyage plan instructions of the shipmaster. (Source: COMPRIS WP2, Architecture)

VTS operator

A person, appropriately qualified by the competent authority, performing one or more tasks contributing to the services of the VTS (Source: IALA VTS guidelines for Inland Waters).

The person who monitors and controls the fluent and safe progress of traffic within the area around the VTS Centre. (Source: COMPRIS WP2, Architecture)

Competent Authority

The competent authority is the authority made responsible for safety, in whole or in part, by the government, including environmental friendliness and efficiency of vessel traffic. The competent authority usually has the tasks of planning, arranging funding and of commissioning of RIS. (Source: PIANC RIS guidelines 2004)

RIS authority

The RIS authority is the authority with the responsibility for the management, operation and co-ordination of the RIS, the interaction with participating vessels and safe and effective provision of the service. (Source: RIS guidelines, PIANC 2004)

RIS operator

A person performing one or more tasks contributing to the services of RIS (new)

Waterway Authority

Lock operator

The person who monitors and controls the fluent and safe progress of traffic around and through a lock and who is responsible for the locking process in itself. (Source: COMPRIS WP2, Architecture)

Bridge operator

The person who monitors and controls the fluent and safe progress of traffic around a moveable bridge and who is responsible for the operation of a movable bridge. (Source: COMPRIS WP2, Architecture)

Terminal operator (Synonym: stevedore)

A party responsible for the execution of loading, stowing and discharging (unloading) of vessels. (Source: COMPRIS WP8 Standardization)

Fleet manager

A person planning and observing the actual (navigational) status of a number of vessels moving or working under one command or ownership. (new)

Operator in calamity centres of emergency services

The person who monitors, controls and organizes the safe and smooth fighting of accidents, incidents and calamities. (new)

Consignor (Synonym: cargo shipper or sender)

The merchant (person) by whom, in whose name or on whose behalf a contract of carriage of goods has been concluded with a carrier or any party by whom, in whose name or on whose behalf the goods are actually delivered to the carrier in relation to the contract of carriage. (Source: COMPRIS WP8 Standardisation)

Consignee

The party, such as mentioned in the transport document, from whom goods, cargo or containers are to be received. (Source: Transport and Logistics Glossary (P&O Nedlloyd) and COMPRIS WP8 Standardization)

Freight broker (Synonym: freight forwarder)

The person who is responsible on behalf of the transport supplier, for the physical transport of the goods to be executed. The freight broker offers transport capacity to shippers on behalf of the transport supplier and is this way mediator between supply forwarder and shipmaster. (Source: COMPRIS WP2, Architecture)

Supply forwarder

The person who is responsible on behalf of the shipper, for the organization of the physical transport of the goods that should be exchanged. The supply forwarder offers cargo to transporters on behalf of the shipper. (Source: COMPRIS WP2, Architecture)

Customs

The department of the Civil Service that deals with the levying of duties and taxes on imported goods from foreign countries and the control over the export and import of goods, e.g. allowed quota prohibited goods. (Source: Transport and Logistics Glossary (P&O Nedlloyd)

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