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User Requirements for VTMIS

WP 3 Integrated transportation system for Artic oil and gas

WP 3.6 VTMIS

Author(s): Prof. Jens Froese, Karsten Bruns-Schüler
Maritime Logistics – ISSUS; Hamburg, Germany

Dr. R.N. Chernyaev
CNIIMF; St. Petersburg, Russia

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PARTNERS:

Kvaerner Masa-Yards	FIN
Royal Wagenborg	NL
Maritime Logistics – ISSUS of the Technical University Hamburg-Harburg (previously: Hamburg University of Applied Sciences)	D
Tecnomare SpA	I
Merenkulun turvallisuuskoulutuskeskus	FIN
Central Marine Research and Design Institute	RU
Arctic and Antarctic Research Institute	RU
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DELIVERABLE SUMMARY SHEET

Short Description
The report describes the user requirements for VTMIS under ARCOP conditions und consideration of the legal, administrational and organizational framework.

Author(s)	
Name	Company
Prof. Jens Froese	Maritime Logistics – ISSUS
Karsten Bruns-Schüler	Maritime Logistics – ISSUS
Dr. R.N. Chernyaev	CNIIMF

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Name	Company	Approval	Date
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REMARK

This document will be enhanced and supplemented over the project's lifetime. Revisions and further versions might follow.

ARCOP USER REQUIREMENTS

Table of Content

List of Figures

List of Abbreviations / Glossary

AARI	Arctic and Antarctic Research Institute of Russia
AIS	Automatic Identification System
AMTS	Arctic Marine Transportation System
ARCDEV project)	Arctic Demonstration and Exploration Voyage (EU founded 4th framework
ARP	Automatic Radiotechnic Posts
ATA	Actual Time of Arrival
AtoNs	Aids to Navigation
BMBS	Baltic Sea Monitoring System
CA	Concertated Action
COLREG	Collision Regulations
DGNSS	Differential Global Navigation Satellite System
DSC	Digital Selective Calling
ECDIS	Electronic Chart Display and Information System
EDI	Electronic Data Interchange
ETA	Expected Time of Arrival
ETD	Estimated Time of Departure
EUROREP	European Reporting Scheme
FS	Feasibility Study
FSA	Formal Safety Assessment
GIS	Geographic Information System
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
HAZMAT	Hazardous Material Directive
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ICC	International Co-Ordination Committee of the TEDIM Programme
ILS	Integrated Logistic Support
IMDG	International Maritime Dangerous Goods code
IMO	International Maritime Organization
INSROP	International Northern Sea Route Programme
MARPOL	Maritime Pollution
MIS	Management Information Service
MMSI	mobile maritime service identity
MPCU	Marine Pollution Control Unit
MSA	Marine Safety Agency

NAVTEX	Navigational Warnings by Telex
NMSI	National Mobile Station Identity
NOAA	National Oceanographic and Atmospheric Administration (US department)
NSR	Northern Sea Route
NSRA	Northern Sea Route Administration
POSEIDON	European **P**roject **o**n Integrated VTS, **S**ea **E**nvironment and **I**nteractive **D**ata **O**n-line **N**etwork (4th Framework project)
PSC	Port State Control
SAR	Search and Rescue
SBP	Management Information System
SMHI	Swedish Meterological and Hydrographic Institute
SMV	Standard Marine Vocabulary
SOLAS	International Safety of Live at Sea convention
SRS	Ship Reporting System
SSM/I	Special Sensor Microwave/Imager (Satellite System)
TEDIM	Telematics in Foreign Trade Logistics and Delivery Management
TSS	Traffic Separation Schemes
VHF	Very High Frequency
VHF/DF	Very High Frequency Direction Finding
VPL	Voyage Planning
VTMIS	Vessel Traffic Service and Information Service
VTMIS-NET	Vessel Traffic Management and Information Service – NETwork (EU founded 4th Framework project)
VTS	Vessel Traffic Service
VTT	Technical Research Centre of Finland

1 Executive Summary

The purpose of VTS (Vessel Traffic Service) is to improve the maritime safety and efficiency of navigation, safety of life at sea and the protection of the marine environment and/or the adjacent shore area, worksites and offshore installations from possible adverse effects of marine traffic in a given area. This definition according to IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities) has been implemented worldwide to several areas e.g. ports, waterways, coastal zones etc.

Besides IALA “VTS guidelines” it is necessary, that further rules and laws have to be considered:

- National and local laws, by-laws, rules and recommendations,
- International Ship and Port Security Code (ISPS),
- the SOLAS Convention (International Convention for Safety of Life at Sea),
- the IMO Res. A.857 (20) [International Maritime Organisation: guidelines on VTS]

and any other applicable international rules, regulations and recommendations.

The conditions for the transport of oil and gas through the NSR differ a lot from those under “normal” conditions. It is necessary to define a specific organisation responsible for sailing means and regulating the traffic in the ARCOP context. Most significant are the extreme environmental conditions and the huge area, the long sailing routes accompanied by low traffic density. These might lead to divergences from the definitions and guidelines applied on other specified VTS.

The first step is to focus on the definition of VTMIS (Vessel Traffic Management and Information Service). It can be seen as a supplementation of VTS with its basic functions of evaluating and distributing traffic information, giving navigational assistance and doing the traffic organisation. Additionally waterborne transport related information is included, to allow for co-operative resource management. The terms VTS and VTMIS are used in parallel, since it might be necessary for ARCOP, to widen the existing definitions and regulations anyway.

The two primary partners are the VTMIS as the land based authority and the vessel’s command with its responsibility to navigate safely. VTS/VTMIS instructions to a vessel should be “result orientated” only, leaving the details of execution to the master, officer of the watch or pilot on board the vessel.

To point out the main requirements on a VTMIS at ARCOP, the Service and Operation Options defined by IALA have been investigated. These basic services have to be widened and adjusted in the ARCOP context.

1. The Information Service has the primary function to provide essential information to the general traffic such as the traffic image, the VTS area and the variables influencing the navigation of the vessel. At ARCOP it is most important to consider specific information reflecting the environmental arctic conditions such as hydrographical and hydro-meteorological support and the results of ice services and ice reconnaissance. Additionally legal information (e.g. about military areas) must be considered.
2. The Service of Navigational Assistance is very important in the ARCOP context since differences to sailing in open waters are significant. The primary service is to monitor and to assist the vessel’s command decisions relying on data like course and position. Supplementary shore based pilotage and ice pilotage should give advice on basis of recent information and experience of the area and its conditions. Furthermore icebreaker support has to be coordinated and instructed when requested and/or when the need is deemed to exist.

3. Even if traffic density is low, the Traffic Organisation is important since tankers or nuclear powered icebreakers could cause serious environmental incidents. The task of ensuring efficient traffic movement must include the organisation of convoy and escorting.
4. Operating Rules and Regulation comprises the organisational matters of a VTS/VTMIS. This includes the definition of the coverage area, sub-areas, regulations as communication frequencies, reporting points, compulsory pilotage and pilot boarding areas, etc. Especially the delineation of the ARCOP VTS/VTMIS areas is very important due to the big distances between ports and the specific geographic conditions. It is proposed to widen the VTMIS areas to allow seamless handing over along the whole NSR passage, taking into account national and local regulations.
5. The Cooperation with Allied Services is solely supplementing the traffic regulation. The VTS/VTMIS fulfils the task of establishing action agreements between services and vessels to ensure efficient cooperation of the involved parties. In case of incidents emergency services have to be organised and orchestrated (e.g. Search and Rescue (SAR)). Furthermore the collaboration between adjacent VTS/VTMIS must be ensured to exchange information about traffic, cargo flows, etc. In the ARCOP context the most obvious services in this regard are ice clearance, harbour breakout, port related services and support actions.

To fulfil these tasks it has to be considered that the vessels, as well as the vessel's command, have the ability to navigate safely in ice and the willingness to cooperate and comply with advice from ashore.

When regarding "physical" support the availability of service might depend on the location of the vessel requiring assistance, conditions of ice and weather but also the capability of a resource, e.g. in case of icebreaker support.

It is not possible to adapt only the general VTS/VTMIS concept to comply with the surveyed ARCOP requirements. Services have to be supplemented and organisational, as well as administrational changes, have to be applied.

For ARCOP it is proposed to define a VTS/VTMIS covering the total voyage on the NSR through arctic waters by combining

- a wide area VTS based on vessel tracking and
- additional local or thematic services according to the vessels' actual needs.

All regular VTS services should be offered tailor-made for the trade's special requirements based on a network of local/regional VTS/VTMIS and related services. The VTS/VTMIS feature means to enhance a classical VTS by transport-related information services.

To achieve this it is not considered reasonable to just extend existing services. It is proposed to establish an overall concept to build an appropriate VTMIS for arctic conditions taking into account the above listed requirements.

2 Introduction

2.1 The ARCOP objectives in means of VTS/VTMIS: User Requirements

The objective of the VTS/VTMIS task within the ARCOP project is to assess the role of traffic management services for waterborne operations under the extreme conditions in northern Europe, taking into account the results and experiences made in other projects. The basis for recommendations for enhancements for waterborne transport and traffic management operations will be given, from the VT(MI)S point of view.

Within this report the requirements for the arctic VTMIS system were developed. Potential technical solutions and services are described and recommendations for investments, respectively for measures to reach an enhanced traffic management and waterborne transport system are given.

The report is structured into two main parts:

Chapter 2 gives an overview of user requirements for VTS/VTMIS under “normal” conditions. VTS/VTMIS is operated in different ports and areas. So general guidelines and recommendations already exist. This is described taken into account the results of various research projects, especially VTMIS-NET, Poseidon and Waterman. Furthermore the IALA VTS manual was considered.

Chapter 3 describes the specific ARCOP user requirements for operating VTS/VTMIS under ice conditions. These requirements were gained from different sources such as interviews, investigation of pre-existing projects and various services in this context.

To apply VTS/VTMIS regulations the very specific ARCOP conditions had to be kept in mind. Among others these are:

- Low traffic density in the investigated area
- The project gives a preliminary limitation to specific vessels (tankers). Furthermore only those vessels have to be taken into account which are classified to operate in arctic ice conditions. The ice conditions in the polar regions lead to extreme sailing conditions which determine the technical conditions and ability of vessels and crews which intend to use the Northern Sea Route.
- Very big area of interest with a determined number of ports and terminals.
- Services which are regularly offered in other VTS/VTMIS areas are not naturally useful under ARCOP conditions, others have to be considered.
- Existing rules and regulations for the NSR.

Thus not all listed requirements correspond to the more or less strict definition of VTS/VTMIS but should be considered due to the very special conditions of the regarded area.

The second main part is the contribution of the Central Marine Research and Design Institute (CNIIMF) by Dr. Chernyaev which was amended in Annex II. It gives a very valuable input by describing the VTMIS in the Gulf of Finland. Furthermore the perspective cargo’s flow in the western Arctic and main goals for ARCOP and the western Arctic are defined.

2.2 Introduction to VTS/VTMIS

Vessel Traffic Management Systems (VTMS) have been used in ice covered areas already for a long period of time. Both St. Petersburg and Murmansk have had these systems for tens of years. In the Gulf of Finland a system has been in operation since 1995 where the AIS is compulsory after July 2004.

Generally a vessel traffic management and information service (VTMIS) gathers, evaluates and distributes vessel traffic and waterborne transport data to improve the safety and efficiency of transport and to better protect the environment. A VTMIS basically consist of a vessel traffic service (VTS) according to IMO/IALA covering the services:

- Information,
- navigational assistance including shorebased pilotage,
- traffic organisation (traffic management),
- co-operation with allied services, port operations, emergency services and adjacent VTS,
- additionally transport related information services to allow for co-operative resource management of transport resources.

The responsibility of a VTS is to manage the traffic on the basis of specialized local knowledge and information sensors resulting in a complete traffic picture (traffic image). In relation to this the vessel's responsibility is to safely navigate on the basis of its behaviour and the professional skills of the crew. VTS instructions to a vessel should be "result oriented" only, leaving the details of execution to the master, officer of the watch or pilot on board the vessel.

Involved actors are mainly

- the vessel command,
- pilot (aboard or ashore),
- VTS operator.

There can be other relevant parties providing or requiring information in context to individual navigation and general traffic.

After proper planning the vessel command is executing the voyage by means of propulsion, steering, manoeuvring aids and, when required, by tugs and icebreakers whilst monitoring it by dedicated information and communication technologies. The vessel needs to be prepared to react on internal disturbances such as failure of individual systems or a blackout and on external disturbances such as hydrodynamic effects, wind, current, ice, traffic and navigational obstacles.

The functions of VTS are to

- monitor the area, traffic and related conditions,
- assist onboard navigational decision making,
- monitor effects.

The information required to fulfil these tasks is

- course and speed made good by individual vessels,
- position relative to navigable area, way-points and aids to navigation (e.g. buoys),
- positions, identities and intentions of surrounding traffic,
- alerts and warnings to traffic and individual vessels,
- other on request from individual vessels.

A VTS can participate in the decision making process by giving navigational advice but it is important to consider the distinction between navigational information and navigational advice because of its potential legal implication which depends on the fact to which extent a master can himself assess the situation and override advice according to actual local conditions.

In order to assist the safe navigation of a vessel, pilots can also give from the shore and with the agreement of the master a service to conduct the vessel to or from the pilot's transfer area. This is called shore-based pilotage (SBP) and it is an extension of the pilot's task to improve efficiency of maritime traffic in certain circumstances but its limitations on safety should be understood.

2.2.1 The terms “VTS” and “VTMIS”

In its original sense a **VTMIS** (Vessel Traffic Management and Information Service) is a combination of a VTS (Vessel Traffic Service) and a MIS (Management Information Service).

A **VTS** is defined according to IALA and provides dynamic positioning data, motion data as speed, ETA details and other dynamic variable vessel’s data as well as current weather data and hydrological measuring data.

A **MIS** provides additional data (e.g. voyage data or planning data) and other services.

The usage of these terms often results in the following problems:

- Divergent VTS/VTMIS understanding in different countries, in respect of Implementation and Regulations of governing authorities at the international, national, regional and local level.
- Different understanding of the meaning of the terms VTS and VTMIS.

Thus

- turning the incorrect but widespread opinion VTMIS = „VTS de luxe“ into a more abstract and general connotation, i.e. a network of systems, services and databases,
- relying on a common system architecture and data dictionary, in which the individual demands of waterborne transport are taken into account,
- not interfering with, or changing, existing systems, services and communication channels, were the main tasks.

The terms VTMIS and VTS are both used in this report not necessarily distinguishing between their functionalities.

2.2.2 Definitions according to IALA

Vessel Traffic Service (VTS): A VTS is a service implemented by a Competent Authority, designed to improve the safety of vessel traffic and to protect the environment. The service should have the capability to interact with the traffic and respond to traffic situations developing in the VTS area.

Competent Authority: A Competent Authority is the authority made responsible, in whole or in part, by the Government for the safety, including environmental safety, and the protection of the environment in the area

VTS Authority: A VTS Authority is the authority with the responsibility for the management, operation and co-ordination of the VTS, the interaction with participating vessels, and efficiency of vessel traffic and the protection of the environment.

VTS Area: A VTS Area is the delineated, formally declared service area of the VTS. A VTS area may be subdivided in sub-areas or sectors.

VTS Centre: A VTS Centre is the centre from which the VTS is operated. Each sub-area of the VTS may have its own sub-centre.

VTS Operator: A VTS Operator is an appropriately qualified person performing one or more tasks contributing to the services of the VTS.

Allied Services: Allied Services are services actively involved in the passage of the vessel through the VTS area.

3 General User Requirements

3.1 User Requirements derived from the Poseidon project /the IALA manual

3.1.1 General requirements on a VTS

VTS Services should be regarded as the product of the VTS. VTS services may be directed at the general traffic or at individual vessels in order to aid the onboard navigational decision making to prevent the development of dangerous situations and to allow optimum use of the resources. (VTS services can also be rendered to allied services, emergency services and/or other land based parties). Full particulars of the VTS including the services rendered and the mode and area in which they are available should be publicised and promulgated. Publications should include full particulars on classes of vessels which are required or recommended to participate, reporting points, procedures to be followed and rules and regulations in force.

3.1.1.1 Information Service

This is a service to ensure that essential information is in time available to the shipboard navigational decision making process. This information may concern:

- vessel traffic:
  - positions,
  - identities,
  - intentions and destinations, or;
- the VTS area:
  - amendments/changes in promulgated information on boundaries,
  - procedures,
  - radio channels or frequencies,
  - reporting points etc., or;
- the variables influencing the navigation of vessels:
  - meteohydrological information,
  - visibility conditions,
  - notices to mariners,
  - status of AtoNs,
  - special transports,
  - congestions or other potential hindrances.

Information is normally provided to the general traffic, by broadcasting at fixed times, at regular intervals or at any other time when deemed necessary by the VTS. Information can also be given to a particular vessel on request of that vessel or when deemed necessary by the VTS. A broadcast will normally contain warnings or other information of importance to all vessels, including small craft or inland traffic participating in the VTS by only keeping a listening watch.

Information to a particular vessel is given as needed and will contain aspects relevant to that particular vessel.

3.1.1.2 Navigational Assistance Service

Is a service to assist the navigational decision making process onboard and to monitor the effects, especially in difficult navigational or meteorological circumstances or in case of defects or deficiencies. The VTS can contribute to the decision making process by giving navigational information such as:

- course made good and speed made good of a vessel;
- position relative to fairway axis and way-points;
- positions, identity and intentions of surrounding traffic;
- warnings to individual vessels.

The VTS can participate in this process by giving navigational advice such as advice on course.

The Competent Authority should be aware of the distinction between navigational information and navigational advice and should determine whether navigational advice can and may be given from the shore, and if so, under what circumstances and to what extent.

Navigational assistance is given at the request of the vessel or if deemed necessary by the VTS and should only be given if positive identification has been established and can be maintained during the process. In the case where navigational advice is given by a pilot, this should be stated by the VTS. The communication should be conducted in accordance with established operational procedures which should include fall-back procedures in case of disrupted communication. The beginning and the end of navigational assistance should be clearly stated by the vessel or the VTS and acknowledged by the other party.

3.1.1.3 Traffic Organisation Service

Is a service to prevent the development of dangerous situations and to provide for the safe and efficient movement of traffic within the VTS area. Traffic organisation concerns the forward planning of movements and is particularly relevant in time of congestion or when the movement of special transports may affect the flow of other traffic. Monitoring the traffic and enforcing adherence to governing rules and regulations is an integral part of traffic organisation.

The service may include establishing and operating a system of traffic clearances in relation with priority of movements, the allocation of space, the mandatory reporting of movements, establishing routes to be followed, speed limits to be observed or taking other appropriate measures which are considered necessary by the VTS authority. Sailing plans are an instrument of traffic organisation and are a major source of information to the VTS. The VTS authority may consider making a procedural distinction between sailing plans established for efficiency reasons, for the coordination with allied services, and sailing plans established for safety reasons, which may affect the general flow of traffic. Authorities should state for which vessels or categories of vessels a sailing plan is compulsory. A sailing plan should be agreed between the vessel and the VTS. Where is execution could affect the general traffic the VTS should promulgate the particulars. The sailing plan should be considered an agreement between the vessel and the VTS which should be adhered to as far as practicable. Its execution should be monitored by the VTS and the vessel. A sailing plan normally includes the estimated time of arrival in the VTS area or the departure from a berth or an anchorage in the VTS area. The VTS authority should specify the additional information required in the sailing plan for all vessels or for special vessels according to the local circumstances. In exceptional circumstances the sailing plan may be amplified at the request of the VTS. The VIS may advise changes to the sailing plan to take account of the traffic situation or special circumstances. Where the VTS is authorised to issue instructions to the vessels, the instructions should be "result orientated" only and leave the details of execution to the vessel.

3.1.1.4 Co-operation with Allied Services, Emergency Services and adjacent VTS

This is a *supporting* activity of the VTS to increase the safety and efficiency of the traffic, the protection of the environment and the *effectiveness* of the VTS without adding to the reporting burden of the vessel. In general this may be achieved through data exchange, common use of data bases and action agreement between parties.

Co-operation with allied services is both safety and efficiency orientated. It should be a continuous process, which is of particular importance in cases where a sailing plan is to be established and action agreement between services is required. Procedures for the co-operation between parties should be established. The co-operation with port operations is primarily efficiency orientated but may be an important factor in establishing a sailing plan.

Incidental co-operation with emergency services such as Search and Rescue and Pollution Control should be conducted in accordance with pre-established contingency plans in which the procedures for the co-operation are laid down and responsibilities established.

Co-operation between VTSs may concern VTSs with common borders where, if a sailing plan is to be established, action agreement is essential. If the VTSs are divided by a sea area it should be recognised that the exchange of data between such VTSs could give reciprocal advance notice of arrivals thus relieving the reporting burden of vessels. It could also given an Administration valuable information (to prepare for environmental emergencies) on traffic - and cargo flows in the intermediate sea area.

3.1.2 VTS COMMUNICATION

VTS communication is the link between VTS and the User. VTS communication should, for that reason, be clear and simple and should contain only essential information so as to avoid imposing an undue burden on masters, officers of the watch and pilots. Due attention should be given to the character of the message and the mode of transmission. When detailed and extensive information has to be exchanged with one vessel which is not relevant to their vessels, the VTS operator may decide to communicate with that vessel using alternative frequencies (or methods), providing a continuous listening watch on the promulgated working channel can be maintained.

3.1.2.1 Reliability

Reliability of communication and the availability of communication frequencies must be assured. The process of communication in a VTS must under all circumstances be reliable.

Communication should, even under severe weather circumstances, be free from interference from adjacent VTS or other users using the same frequencies. The number of VTS sectors should be kept to a minimum, taking into consideration the traffic intensity and the characteristics of the fairway. Every sector should have its own communication frequency. If duplex frequencies are used the VTS authority should consider whether to retransmit the communications from the participating vessels, enabling all vessels to update their onboard "traffic image". Fall back procedures in the case of communication break-down should be established.

3.1.2.2 Conformity with IMO resolutions

Communication should be conducted in conformity with the IMO Resolutions A 648(16) on Ship Reporting using message markers in accordance with IMO Resolution A 380(x) on the use of Standard Marine Vocabulary (SMV) and ITU (International Telecommunication Union) communication procedures.

3.1.2.3 Reliable verbal communication

The VTS operator and the vessel should be alert to the problems involved with verbal communication. Confirmation should be requested whenever doubts exist. The language used

should enable the VTS and the vessel to understand each other clearly. English, using SMV, should be used where language difficulties exist, in particular where requested by the master or the VTS operator. A pilot on board the vessel will increase the reliability of the communication. In local areas the primary language may be the appropriate working language of the country in which the VTS is situated.

3.1.2.4 Message composition

When composing a message attention should be given to elements such as:

- the addressee or addressees;
- the priority of the message;
- the method
- the objective of the message;
- the origin of the message;
- the repetition rate of messages (incidental or periodical).

Any VTS message directed to individual vessel should make it clear whether it contains information, advice or instructions.

3.1.2.5 VHF telephony

At present VHF telephony is commonly used for VTS communication. VTS authorities should remain alert to the development of modern, non verbal, methods of data transfer using VHF frequencies or satellite communication which have great potential for identification, polling, tracking, automatic reporting and reducing the ships reporting burden. Automated data transfer has the capability to reduce the risks involved with verbal communication and relive congested VHF frequencies.

3.1.3 VTS ORGANISATION

A VTS can by its nature be described as a data-handling system involving the different elements: men, machine and method to perform certain tasks essential to the provision of services. A VTS should, at all times, have access to a comprehensive overview of the traffic in its service area and have an insight in all traffic influencing factors. The VTS should be able to obtain, either by plotting or by monitoring and labelling, full information about each participating vessel and its intentions. This so called traffic image is the basis for the VTS capability to respond to traffic situations developing in the VTS area and allows the VTS operator to evaluate the situation and make his decisions accordingly. The accuracy and totality of the traffic image should be in relation to the VTS services to be provided.

3.1.3.1 Data collection

Data collection with the main objective to compile the traffic image, this includes:

- data on the fairway situation, such as meteorological, hydrological situation and operational state of aids to navigation;
- data on the traffic situation, such as vessel movements and vessel conditions with regard to cargo carried and the state of hull and machinery, and;
- data on equipment and manning

Data may be gathered by hydro/meteo sensors, remote control systems, radar, VHF, VHF/DF, ships reports, radiotransponders, databases connected to the VTS and from co-operation with allied services and adjacent VTS's. Where automatic tracking facilities are not available, regular position reporting may be required from vessels.

3.1.3.2 Data Evaluation

Evaluate the data available from the traffic image in order to determine whether action from the VTS is required and if so, to decide on appropriate action.

3.1.3.3 Data Dissemination

Decisions resulting from the data evaluation will need to be communicated to the users. This task includes decisions on composition and character of the message, the selection of the transmission mode and other decisions aimed at obtaining the desired results.

3.1.3.4 Elements

In order to perform these tasks a VTS organisation requires a number of staff, housing and instrumentation and procedures governing operations and interactions between the various elements. The requirements in each field are to a great extent determined by the level of service that is to be provided by the VTS. Additional requirements should be expected in the field of management, maintenance, repair and security required to sustain and maintain the required level of reliability and availability.

3.1.3.5 The Operator and his level of Qualifications and Training.

The competent authority should establish appropriate qualifications and training requirements for VTS operators in accordance with the objectives of the VTS and the services to be provide. Where navigational assistance service is provided the VTS authority should take into consideration the extent to which this service can and may be given by the VTS. A distinction should be made between the provision of navigational information, being the relay of information extracted from the VTS sensors and the traffic image, and the provision of navigational advice, where a professional opinion is included.

3.1.4 Operating Rules and Regulations

The authority establishing a VTS should delineate its area of coverage, declare it to be a VTS area and disseminate to mariners full details concerning the area of operation, including the limits of the areas where participation of vessels is required or recommended, the services provided and the procedures.

A VTS area can be divided into sub-areas or sectors but these should be as few as possible. Area, sub-area and sector boundaries should not be located where vessels normally alter course or manoeuvre or where they are approaching convergence areas, route junctions or where there is crossing traffic.

In establishing the operating framework, great care must be taken to impose the minimum of rules or regulations so that the mariner’s workload is not substantially increased when passing through a VTS area.

Effective and realistic regulations applying to the movement of ships within the VTS area, should be introduced. These regulations should identify the VTS area, describe the subareas and sectors, if any, and the communication frequencies, procedures and times of scheduled routine broadcasts to shipping. The regulations should define the navigational requirements such as traffic routes, speed limits, movement restriction areas, anchorage areas, and set out any special requirements such as the compulsory escort of certain vessels carrying hazardous cargoes to and from their

berths. Matters which need to be taken into consideration when preparing the regulations include all of the following which are within the VTS area:

- Aids to Navigation
- Anchorage Areas
- Areas to be avoided
- Compulsory Pilotage and Pilot Boarding Areas
- Constrained Vessels
- Movement Restrictions
- One-way Navigation Channels
- Patrol Craft
- Precautionary Zones
- Segregation of Small Craft
- Ships' routing systems adopted by IMO
- Ship reporting systems adopted by IMO
- Speed Limits
- Traffic Separation Schemes

The regulations should also include details of all reporting points. The number of reporting points should be kept to a minimum and be separated as widely as possible. They should be clearly identified, for example by number, name and geographical position or description.

A VTS authority should ensure that the local traffic movement rules and regulations in force, the services offered and details of the area concerned are promulgated in a form convenient for use by mariners.

The information may be published as a local publication or as an international publication, or in both forms.

3.1.5 Surveillance Coverage of the area

There is a need to take into account the extent of the VTS area with regard to the surveillance equipment necessary. In principle the equipment should be able to cover an area well in excess of the designated VTS area, so as to allow for any decrease in performance in poor weather conditions.

The surveillance equipment in most common use is radar although other systems, such as the Automatic Identification System (AIS), can be expected to be used with good effect in the future. Therefore, depending on the services that a VTS is to carry out the radar coverage can be:

- nil (automatic identification systems, voice communication and reporting only)
- partly (covered areas chosen intentionally with some blind sectors)
- totally by one radar sensor (without any blind sectors)
- totally by two or more radar sensors (for large VTS areas and to cover for shadow effects of other vessels).

The required radar coverage of a VTS area should be determined by an assessment of the service to be provided, the safety level to be reached and the needs of the users of the VTS system. Subsequently suitable positions for the radar equipment should to be determined by sitetests to ensure, as far as practicable, that the required radar coverage will be provided.

When determining the position and range of radar equipment, the possibility of malfunction of a radar should be taken into account, and where practicable the arrangements should enable another radar, or AIS where appropriate, to provide cover for the sub-area or sector affected. The maintenance and availability of remote sensors should be given special consideration and adequate redundancy should be provided.

3.1.6 Delineating the VTS Area

3.1.6.1 Local Geography

The local geography will be the determining influence on the size of the area to be covered by a VTS. In the case of ports these vary enormously in their geography. Some ports, are extremely simple and are little more than an indentation in the coast protected by breakwaters. Entry and exit is through a passage between the breakwater heads, which give direct access to the open sea. Vessels are only restricted in their freedom to manoeuvre as they pass through the breakwater and into the port itself.

At the other extreme are estuarial ports, often far from the open sea with long approaches encumbered by shallow, shifting sandbanks. Vessels using these ports will be restricted navigationally and possibly be unable to anchor or reverse course over long stretches of their passage.

3.1.6.2 Local Conditions

The prevailing weather, in particular visibility and wind together with the tidal range and stream, may impose difficulties on the ability to navigate safely. Together with the local geography they determine the degree of navigational difficulty likely to be encountered by a vessel.

An appreciation of these physical factors, plus any interface with local or regional services, leads to a first assessment of services which would be of most benefit to vessels navigating in the area.

3.1.6.3 Numbers of vessels and types

The numbers of vessels, including local traffic, and their type is significant. A simple count of vessels, although of value, is not sufficient. The vessels need to be considered with regard to their size, type, equipment, manoeuvrability, spatial distribution and cargo so that the optimum service meeting the needs of all users and without placing unnecessary constraints on the movement of any of the vessels can be identified.

3.1.6.4 Commercial factors

Any VTS must make due allowance for any potential conflict between safety and commercial operation and pre-empt such conflicts before they arise. Ports must operate in an efficient and timely manner and meet the needs of their users, but this must be done without impinging on the safe operation of the port. The distribution of ship arrivals and departures may be an important factor influencing the port management resources. Unannounced arrivals and departures can have a considerable and adverse effect on the viability of a port. Some ports, such as ferry ports and container terminals, operate to a schedule which has to be maintained in virtually all weathers.

3.1.6.5 Other Activities

Naval operations, oil and gas production and recreational activities may take place within the area to be covered by a Vessel Traffic Service. These activities will also influence the operation of the scheme and must be taken into account. A good working relationship needs to be established and maintained with other users of the area.

3.1.7 Environmental Aspects

Many incidents in recent years have highlighted the hazard to the marine environment presented by large tankers and other vessels carrying dangerous substances and have drawn political attention to VTS, ship reporting systems and vessel identification. As a consequence of these incidents protecting the environment from marine casualties has attracted significant public attention from outside the marine industry. It may be that pressures to protect the environment will continue to grow, causing a change in the balance between efficiency, safety and the environment.

There are areas where the consequences of an incident would be such that extra safety provision, over that normally applied, may be appropriate. These areas must be identified so that the VTS can accommodate them. In this context, suitable measures may include routeing vessels clear of environmentally sensitive areas and the careful organising of traffic flow, so that vessel numbers in particularly sensitive areas are limited.

A VTS will also need to take account of, and probably operate in conjunction with, mandatory ship reporting systems which have been adopted by IMO and are completely or partly within the VTS area.

3.1.8 System users and user requirements

The following list, by no means exhaustive, identifies a number of potential users and participating bodies.

Maritime Users

- Commercial vessels of all types
- Support vessels (buoy tenders, tugs, dredgers)
- Fishing vessels
- Recreational vessels
- Military or other public vessels
- Aircraft (amphibious, seaplanes and helicopters)

Allied Services, Port Operations & Adjacent VTSs

- Pilotage Service, Tugs and linesmen
- Other VTS Terminal Operators

Emergency Services

- Search and Rescue
- Fire Service
- Pollution Control

Other agencies which could be involved

- Terminal Operators
- Foreign Governments (Flag State)
- Port State Control
- State or Municipal Governments
- Shipping Agents
- Customs

- Immigration
- Shipyards
- Industry or Trade Organisations
- Environmental Organisations
- Persons living along the waterway
- International organisations
- Media
- Quarantine services

A requirement analysis should comprise some or all of the following:

- Description of the constraints and context in which the VTS will operate;
- Evaluation of the technology available and determination of the standards to be used;
- Evaluation of the human resources needed for operation of the system and consideration of manning levels, training and skills required;
- Evaluation of the health and safety facilities needed to safeguard staff and other persons associated with the VTS system;
- Preparation of a management plan for the entire development;
- Assessment of the method, or methods, to be used for Quality Assurance;
- Assessment of the probability that the VTS system will be developed, installed, tested and ready for operational use within both the required time scale and the available financial resources;
- Development and evaluation of system design options;
- Determination of the Integrated Logistic Support (ILS) requirements, including the identification of the through-life elements of the system and the means for achieving enhancement and upgrades;
- Evaluation of a Cost-Benefit analysis and the identification of any trade-offs.

3.2 User Requirements by Services rendered

The chapters of this report, derived from the discussions with the various user groups within the Poseidon project, mirrors the original contributions from users and are not absolutely in line with official definitions. Within the following consolidation chapter, however, the requirements expressed by users are reallocated according to the IALA definitions whenever possible and sensible.

3.2.1 Environment (incl. aids to navigation)

The monitoring of the environment includes aids to navigation which are part of the mariners environment.

Users asked for the following information on environment:

- Weather status and forecast. This should include indications of visibility, waves, tide/current, sea ice conditions and traffic.
- Where applicable, results from analyses of local wave and current conditions.
- Where applicable, information related to the presence and condition of ice in the fairways.
- Indications of any malfunctioning equipment along the fairway, such as buoys, lights or waymarks.
- Indications of pollution or significant floating objects which have been observed in the fairway.
- Any VTMIS system should take account of and assist in the monitoring of sites of special scientific interest.

Existing VTS/VTMIS systems in general deal with all information required from users. Surprisingly users did not ask for continuous monitoring of environmental aspects by remote sensors and the possibility of telemetric retrieval of data. This potential requires further discussions with users during the process of definition of functional requirements. The same applies to mathematical models based on available data as e.g. a leeway drift model supporting search and rescue (SAR) operations.

3.2.2 Information Service

According to IALA a VTS information service is restricted to information and warning to support the navigational decision making process provided either to individual vessels or to general traffic. Under Poseidon the scope of information services was seen more general and allows for any source and sink of information.

- The VTS/VTMIS should provide the waterway traffic situation in real time mode with an ability to interrogate process and present a specific number of vessels. This number varies according to the needs per user's category.
- To broadcast radar information to laptop pilots carried on board the vessels only in emergency situations.
- Port and quay conditions.

The user reference to „laptop pilots" is very interesting. In the further process of collecting user requirements there were no further comments of the same nature. However, the possibility of carrying portable devices such as laptops to collect and display necessary information must be investigated more into detail.

3.2.3 Navigational Assistance Service

According to the users a VTMIS should provide the following types of information related to navigational assistance service:

- Present position, speed, and course of a given ship.
- Present position with reference to way points.
- Alerts of deviations between positions derived from GPS/transponders and radar.
- Under special circumstances (like bad weather or faulty equipment onboard the ship), navigational assistance in the form of shore based pilotage should be offered.

It is of interest that transponder technology is mentioned here and further reference made to shore based pilotage. The result of route planning, the so-called „sailing plan“ is an issue which is required within an traffic organisation service.

3.2.4 Traffic Organisation Service

A VTMIS should provide the following types of information related to traffic organisation services:

- Traffic movements, situations, and density, including vessel intentions as reported, estimated time to and geographical position to closest point of approach, and identification of vessels that entail a rise in risk level.
- Local conditions such as ferry traffic, construction work, and temporary regulations.
- Various obstacles for vessel traffic such as fishing farms, fishing vessels, and concentration of leisure boats.
- Assigning fairway, anchorage, waiting locations, etc.
- Instruct vessels regarding entrance to a fairway and allowed speed.
- The related look ahead should be adjustable in time or distance.
- Route planning (vessel movements).

3.2.5 Allied Services

As a provider of general information services a VTMIS should comprise the following functionality:

- Be a central interface to all (i.e. including external) allied services, such as services related to the environment, navigational assistance, traffic organisation and emergencies.
- Support to the management of towage and harbour services
- Local area hazards
- Type of piloting.
- The pilot’s name and number.
- General information about the pilots in the VTMIS area.

3.2.6 Emergency Services

For incident management, the following automated external links are desirable:

- Flow of information during an emergency should be, as far as possible, in a standard format, agreed by all those involved;
- become distributed to many agencies, e.g. via the Internet, such as

- Meteorological Office;
- Marine Pollution Control unit (MPCU);
- Marine Accident Investigation Board (MAIB);
- Search And Rescue (SAR).

A VTMIS should provide the following types of information related to emergency services:

- Accurate position of vessel(s) involved in the incident.
- Positions and general information of any vessels in the neighbourhood of the incident.
- Number of crew members and eventual passengers.
- Communication systems onboard.
- Availability of oil protection equipment on board, bilge system, emergency unloading equipment, dispersives, etc.
- Monitoring and prediction of spread of spills.
- Open communication lines with specialised SAR (Search And Rescue) centres.
- Contingency plans should be more co-ordinated and access to necessary information and not restricted by ownership.
- Name and nationality of a vessel's master.
- Contingency plans are required for each local area. These need to be consistent with the national one and could be held on disk. The Marine Pollution Control Unit (MPCU) shall check that all regional and local Oil Spill Contingency plans are consistent with the National Contingency Plan.
- All contingency plans should recognise that each port/harbour is different in respect of geographical location, installations, responsibilities of the operators of port terminals, shipping traffic and areas of ecological sensitivity.
- The port/harbour should formulate their contingency plan in consultation with local authority emergency planning departments, emergency services, environmental agencies and any other bodies that may be involved (e.g. HM Coastguard and MPCU).
- All contingency plans shall clearly identify responsibilities and lines of communication for its implementation.
- All contingency plans shall be based on an assessment of the worst spill risk and the likely movement and persistence of the contaminant.
- All contingency plans shall provide an early and effective mutual response to an incident, with the principal aim of containing the pollution within the shortest possible time.
- All contingency plans may need to allow for a graded reaction.
- Contingency plans shall identify the following:
  - The person who is to activate the plan and remain in charge.
  - The nominated communications centre.
  - Beach areas that may be used to deflect contaminants from more sensitive areas if the spill cannot be dealt with at sea.
  - A prioritized list of installations and ecologically sensitive areas which may be vulnerable to pollution.
  - A list of counter pollution resources available locally including the location of suitable equipment.

  - A line drawing of the area, indicating distances and the are to be covered by the plan.
  - Procedures for the clean-up operation.
  - Procedures for the evaluation of the operation.
  - Documentation procedures.
  - A telephone directory of organisations and persons involved and who may need to be contacted.
  - Liaison arrangements with other parties.
  - Procedures for training and exercises and for updating the plan.
- The MPCU shall respond to a pollution incident in two ways. Firstly, they have an immediate responsibility to send a Marine Response Unit to the incident site to provide and co-ordinate a 'first response'. Secondly, they may be called upon by the Local Authority to contribute to a Joint Response Centre, led and co-ordinated by the Local Authority. This Centre will take over from the Marine Response Unit in the longer term management of the clean-up operation.
- The MPCU Marine Response Unit needs constant communication with the Incident Command Centre.
- The MPCU Marine Response Unit requires mobile facilities (such as PCs and telephones, along with essential database information) to take on site for incident control.
- The accommodation facilities for the mobile MPCU Marine Response Unit to operate in should be standardised as far as equipment and layout is concerned.
- It would be desirable to have an independent mobile Marine Response Unit containing all required MPCU equipment for the complete operation.
- Obtaining surveillance data for the local area is essential for incident control.
- Access to local map information for analysis and briefing purposes is desirable.
- A semi-automated spill model, the results of which can be superimposed upon a map display is desirable.
- An automated route planner, the results of which can be superimposed upon a map display is desirable.
- Recorded incident data is required for risk analysis, risk planning and training purposes.
- The media team within the Joint Response Centre require access to a large and varied selection of organisations to collect data. A form of EDI could be used to enhance the efficiency of this information collection process.
- A pollution spill information system is required to provide valuable information about the nature of the spill and model where the spill has come from and where it is heading (based on prediction calculations). Actual and predicted data is required to update the model. Inputs to this system may include automatic collection of environmental data from buoys, surveillance intelligence and a chemical information database.
- The surveillance of the occurrence of pollution at sea is required to deter vessels from illegally generating pollution, and to respond to pollution incidents. Systems that can assist in the targeting and planning of surveillance operations are required. GIS based applications may assist this process by mapping key locations. Modelling the occurrence of illegal spills using a combination of criteria such as traffic density, weather, time of day, vessel cargo contents and vessel journey plans may also help to identify key areas to be targeted.

- If a linked European network is being considered, the legal implications need to be explored
- It is desirable that vessels are automatically warned in a timely manner of any incidents or potential incidents in their vicinity.
- The HAZMAT Directive does not currently cover reporting from transiting vessels. Any future tracking/monitoring system should cover these (within radio range) as they present as much danger as vessels coming into or leaving port.
- Chart datum should be common and linked to satellite positioning systems.
- Any future system must be able to cope with the rapid turnaround time of RoRo ferries and the vast amount of cargo information for container ships.
- Any future system must provide for several levels of sophistication if all agencies have to use it. These will vary from a very basic level of automation for small ports that will not use much of the available functionality and do not have sufficient funding to support a more expensive system, to a much more sophisticated level of automation for large or national ports that will use most of the available functionality and are better placed to afford the system.
- A future system could potentially analyse how shipping is conforming to the local tracking rules, and offenders could be automatically targeted for inspection. In addition, a similar system could be used in the enforcement of special areas and exclusion zones (and the burning of high sulphur fuel in these areas).
- Incident plots that could be used as admissible evidence in court would be a useful feature in a future system.
- The marine safety agencies (MSA) require links with many external agencies and an effective means of gathering incident data rapidly would be desirable.
- Database information that is useful for reference is an inspection database and certification database.
- The various SAR centres have to be connected with each other and more specifically with an automatic data transfer system and provide simultaneously radio telecommunication services which are necessary for the insertion of the Global Maritime System of Danger and Security according to the SOLAS agreement.
- With transponders the compatibility with helicopter operations can be improved.
- Up-to-date (real-time) information about which areas have been searched can be automatically obtained as well as info about other duties completed.
- Continuous heel information can be obtained via transponder.
- Transponder can be used as a additional systems when an emergency call / need for help message is sent.
- Real-time information from assisting vessels can be obtained via transponders.

3.2.7 Value added Services

Value added services are services which result in revenues for the information providing agency. The increasing problems of authorities to provide investment and maintenance budgets for large VTMIS systems leads to a search for some compensation of costs by „selling“ the information which is available or further process information to make it valuable for third parties such as terminals, cargo forwarders etc.

- The central interface should be accessible from the various types of clients through clickable user interfaces, like it is known from GIS-applications and World Wide Web

browsers. In this way, information services from different, possibly geographically distributed databases should be easily accessible for the users.

- The various types of clients, or user groups, will require different functionality and information. Hence, the user interface should be adapted to each specific user group.
- For the users that do not have access to a computer and data communication facilities, and generally as a backup, a manual service through telephone and VHF-radio should provide similar information (ship reporting system, available in some areas).
- The vessel reporting system should be connected to a database to ease the retrieval and reuse of stored data, both for statistical purposes and as a service for other users (customs, defends authorities, police, search and rescue, shipping agencies etc.).
- The transmission of this data should be accomplished with a frequency of 15min.

A VTMIS should provide the following types of information related to value added services:

- Needs for unloading garbage or slop.
- Needs for unloading dangerous and polluting goods.
- Plan to load dangerous and polluting goods at harbour.
- Digital map of the port area with all facilities marked.
- Customs related information for crew, passengers, goods, and onboard supplies.
- Ship identification and characteristics labelled by MMSI number and ship name.
- Access to a facility to record ship movements within the local area including; if a ship is coming alongside or going to anchor, an indication of towing, change of destination, returning from anchor, shifting berth or moving from one port to another within the area.
- A facility to monitor and update the movement of hazardous cargo information via an EDI link.
- The provision of a query system to allow the user to obtain summary information e.g. how many tonnes of dangerous goods have there been in the harbour.
- Support to the management of towage and harbour services.
- A financial management support facility which holds information such as invoicing and budgeting details for the organisation and shipping agencies.
- HAZMAT information such as cargo type, status and a copy of the IMDG code.
- Local area hazards.
- Vessel passenger numbers.
- Information arising from a pilot launch autoreporting system and other pilotage information such as pilot rosters and launch availability.
- Source of each item of information.

3.2.8 Others

From the viewpoint of the individual vessel, the following services should be provided:

- If equipped with appropriate transponder equipment (or by other appropriate means of communication) to receive from the nearest VTS, information about targets known to the VTS but not necessarily to the ship (e.g. pure radar targets sometimes not known to the ship due to radar blockage).

- An ability to identify a specific vessel directly by some specific means of communication, to which it can be expected to attain a higher degree of notice than regular VHF (e.g. a special VHF/DSC service or by a mobile phone). The communication address should be obtainable through the information sent from the nearest VTS (e.g. a transponder equipped vessel will be supplied with this info from the transponder broadcast from other vessels. This info could suitably be coupled to the information base on the ECDIS).
- It is assumed that much of the information passed today via fax, letter, agents etc. will be supplied electronically directly from the ship in the future. Thus, a common information server on board should be able to (either upon request or by invocation) supply the necessary info in appropriate format / based on input provided only once (i.e. common info to customs and pilotage should be entered only once but be submitted twice upon need in varying formats).

3.3 The VTMIS-NET User Requirements

3.3.1 Objectives of the VTMIS-NET project

One approach of the task “User Requirement” is to adapt the results of the VTMIS-NET project. Similarities with the ARCOP project might especially arise from the network idea of VTMIS-NET to combine different services which are located on different areas.

The VTMIS-NET (Vessel Traffic Management and Information Services-NETwork) project was co-founded by the Commission of the European Community, DG VII (Transport) - 4th Framework programme. The project period was from 01 January 1998 to 31 December 1999 and was coordinated by the Institute of Ship Operation, Sea Transport and Simulation (ISSUS). 29 partners from universities, research institutes, companies and other institutions were involved.

VTMIS-NET aimed at combining all kind of Vessel Traffic Services (VTS) and Vessel Traffic Management and Information Systems (VTMIS). These services mainly operate on a local (e.g. port VTS) or a national (e.g. coastal VTS) basis. From a European point of view locally or nationally available information could improve the efficiency of such services, assuming improved communication exists between the systems involved.

3.3.2 Proposed functions of the VTMIS-NET project

The User Requirements were mainly gained on workshops and by various site visits.

The proposed functions for VTMIS were indicated as:

- Main functions:
  - Casualty reporting, Waste disposal reporting (MARPOL Annexes);
  - Agent/Ship and Port reporting (HAZMAT);
  - Ship reporting (EUROREP);
  - PSC Inspectorate in one Member State to PSC Inspectorate in another Member State reporting (PSC).
- The main types of users involved in the described functions are:
  - Agent/Ship company;
  - Port Authority;
  - PSC organisation;

  - Ship;
  - VTS centre
  - Port Reception facility
- Type of information exchanged:
  - Ship movements;
  - Cargo data, according to HAZMAT;
  - Ship position, according to EUROREP;
  - VPL-change;
  - Waste Disposal Information;
  - PSC inspection reports.
- More specifically, the following data elements are involved in ship movements:
  - Ship's name, call sign, nationality;
  - Departure from a port: ETD/ATD;
  - Arrival in a port: ETA/ATA;
  - Actual ship's position/course/speed;
  - Actual ship's status and - characteristics;
  - Type of cargo/ passengers/ crew;
  - Dangerous goods on board: yes/no;
  - Accident/incident description;
  - Observed ship's: ship's names, ETA's, their courses;
  - Way points old/new and relevant ETA's at way points;
  - Ship position at VPL change;
  - Meteo- and sea conditions;
  - PSC inspection description.
- Regarding HAZMAT:
  - Voyage planning (VPL);
  - IMO DG codes of cargo;
  - Confirmation of HAZMAT requested list on board;
  - Address(es) for holder(s) of cargo details;
  - Type of cargo/ # passengers/ #crew.

Furthermore the following examples show existing deficiencies when looking at a VTMIS network which could be adapted by ARCOP:

- Vessels navigating along (European) coasts have to exchange the same data with various services repeatedly;
- Individual services request different information from the same vessel;
- Vessels' mandatory reports frequently coincide with locations where navigation becomes difficult because of restricted manoeuvring space and traffic density;

- Requirements to communicate static or semi-static data adds to a vessel's operator's workload;
- Vessel access to allied and support services is restricted to local services and not organised in a standardised way;
- VTMIS centres have a partially incomplete picture of future traffic;
- Background information to assess the individual risk attached to vessels is either not available or cumbersome to collect;
- Exchange of information between services is hampered by a lack of adequate organisational and structural prerequisites;
- Public and private organisations dependent on timely traffic information in order to apply an optimum resource management (e.g. pilots and terminal services) find it difficult to obtain tailor made data;
- Indications of marine pollution resulting from environmental monitoring do not always lead to immediate investigation of causes;
- Information for cross-institutional and cross-border emergency and pollution response services is not always organised efficiently.

When defining the users four categories were chosen. The listed users are only giving examples for the respective user groups:

- Companies, being a component of one or more transport chains:
  - Shipping companies;
  - Inland and sea going ships;
  - Terminals;
  - Truckers;
  - Rail road companies.
- Companies, providing services or products (fuel, stores etc.) to the shipping visiting a port area:
  - Pilot organisations;
  - Tug companies;
  - Lines men;
  - Companies providing ship stores;
  - Companies for maintenance and repair of ships;
  - Institutions for taking care of the material and immaterial needs of ships' crews (incl. welfare organisations)
- Other companies with an indirect interest in shipping (e.g. the service provider of a service provider):
  - Companies producing raw material to be used in shipping industry
- The public:
  - Persons with personal relations with seafarers (family relations etc.);
  - Persons living in the vicinity of port areas;
  - Persons providing services to the crew and passengers.

4 ARCOP Specific User Requirements

4.1 Method for gaining ARCOP specific User Requirements

To gain specific User Requirements for the ARCOP project a comprehensive investigation was performed. Obviously VTMIS organisations and their structures for other areas or harbours are not necessarily applicable to the NSR and the regarded area. So it was important to look for parallels and differences to filter useful information for the specific conditions for VTMIS in the arctic environment.

During this investigation potential users were interviewed, existing services such as ice services were taken into account and previous projects (related to VTS and to sailing in heavy ice conditions) were considered. Furthermore guidelines and principles for establishing and operating a VTS/VTMIS (e.g. IALA) were included.

Projects in means of VTMIS which were considered as important (s. also chap. 2) were in particular:

- Poseidon
- VTMIS-Net
- Waterman

Projects in means of sailing in heavy ice conditions which were considered as important were in particular:

- ARCDEV
- Ice Routes
- INSROP

Further services and organisations and their URLs are listed at Chap. 6.

This information was brought together and is listed in the chapters below.

4.2 Specific ARCOP requirements

The results of the User Requirements specific to the ARCOP conditions were structured in the same way as the *service and operating options* of the IALA *VTS manual*.

4.2.1 Service Options

In the NSR area it is necessary to adopt regular services to the specific requirements. These are especially:

- Entering surveillance and support area
- Transiting
- Convoy navigation
- Ice breaker support
- Anchoring
- Port approach

- Berthing
- Departing
- Maintenance/repair/provisioning
- Unexpected events
- Emergencies.

Thus determination and surveying of the condition of vessels and other floating installations prior they sail along the NSR in order to establish or ensure their conformity to the increasing requirements for safe navigation in ice conditions is required. Also specific characteristics of vessels such as manoeuverability have to be kept into account.

4.2.2 Information Service

An information service is a service to ensure that essential information is available to assist the shipboard navigational decision making process. In the ARCOP context this is:

- Positions, intentions and destinations of vessels; restrictions on the navigation of other vessels, potential hindrances.
- Boundaries, procedures, radio channels or frequencies, reporting points etc.
- Hydrographic support to navigation: navigation charts, manuals, guidelines for navigation; supplying vessels; installation and operation of aids of navigation; pilotage; information to vessels about changes in navigation conditions; forecasts; cartographic support taking into account military areas.
- Legal information (incl. information about location of and behaviour near to military areas).
- Trusted parties as information managers to protect company data.
- Ice service/ice reconnaissance

  Ice observations are acquired from a mix of the following sources:

  - satellite-based visual (e.g. by NOAA, RADARSAT),
  - infrared (e.g. by NOAA) and passive microwave imagery (e.g. SSM/I),
  - fixed wing airborne human observations,
  - helicopter-borne human observations,
  - fixed wing airborne remote sensing (radar imagery, passive microwave imagery, infrared and visual imagery, laser profiles),
  - ship borne human observations, and
  - other surface based observations and measurements,

  taking into account enhancement opportunities by networking of services.

  The provision of **ice charts** can be arranged through governmental organisations. This ice information is presented in chart format and distributed by facsimile, (phone, satellite or radio) or email:

  - Observed Ice Conditions (1:1 000 000 scale) is used to give detailed real time descriptions of the ice as observed.
  - Ice Analysis Charts (1:2 000 000 scale) to give a pictorial representation of the ice conditions at a moment of time.
  - Composite Ice Conditions (1:4 000 000 scale) to show a broader area of coverage.

        - Forecast chart of selected areas (1:2 000 000 scale).
    - ice condition forecasts.

Information bulletins, including descriptions of current (near-term forecast) ice conditions and forecasts of future ice conditions, are produced for ice-infested waters during the appropriate navigational seasons. The forecast periods range from 24 hours to a full seasonal outlook (4-5 months).

Typically, the **ice information** provided includes the following items:

- freeze-up and break-up forecasts,
- ice types and/or stages of development,
- ice concentration and its distribution by type and floe size,
- direction of ice drift and an indication of pressure development,
- presence of ice of land origin (e.g. icebergs).

Thus the provision of specific ice charts could be necessary:

- Recent ice coverage,
- Forecast of ice coverage,
- Ice analysis,
- Iceberg analysis.

Furthermore **advisory service** might be required.

- Hydrometeorological support should include:
    - general weather outlook;
    - forecast data of wind, wave and swell conditions for the intended or recommended route in tabular form or as plotted routes and forecast charts by e-mail; route recommendations and description of possible alternative routes (examples available by SMHI (Sweden) [example for wave heights by AARI].

4.2.3 Navigational Assistance Service

Navigational Assistance Service in the ARCOP context comprises:

- Remote guidance of vessels (a specific kind of shore based pilotage and routing for navigation in ice),
- Ice pilotage (comparable with those of the Canadian Ice Service), undertake ice reconnaissance services to survey and forecast ice conditions (tactical, close tactical and strategic),
- Navigational assistance, advice and operative navigation information:
    - Course and speed made good by a vessel,
    - Position relative to fairways axis and way-points,
    - Positions, identities and intentions of surrounding traffic,
    - Warnings to individual vessels,
    - Navigation notes to Mariners,
    - Coastal preventions (warnings).
- Ice breaking support:

- escort ships and organize convoys to travel through ice-infested waters,
- free beset vessels to allow them to proceed,
- maintain shipping channels and tracks in shore-fast ice, and
- stand by in areas where requests for route assistance are likely,

when requested and/or when the need is deemed to exist, and when resources are available.

4.2.4 Traffic Organization Service

A Traffic Organisation Service describes a service to prevent the development of dangerous situations and to provide for the safe and efficient movement of traffic within the VTS area. For the ARCOP conditions it is anticipated that the traffic density is low. So this service should be related to:

- Traffic organisation, e.g. convoy, escorting;
- Establishing routes to be followed;
- Sailing plans e.g. ETA.

4.2.5 Operating Rules and Guidelines

The Operating Rules and Guidelines are comparable to those of “normal” VTS as described in the IALA manual. The delineation of the area and the required (communication) equipment might vary:

- Regulations within the VTS area:
  - Aids to navigation
  - Areas to be avoided
  - Constrained vessels
  - Precautionary zones
  - Ships’ routing systems
  - Anchorage areas
  - Compulsory pilotage and pilot boarding areas
  - Patrol craft
  - Reporting points
  - Publishing and availability of local traffic movement rules and regulations
  - Delineation of the area: a segmentation of the NSR to gain wide area VTS might be desirable.
- Rules for usage of normal communication equipment such as
  - Radiotelex communication,
  - Satcom,
  - VHF allowing communication with airplanes, helicopters and ships in convoy (112.5 MHz),
  - NAVTEX,
  - Interport communication,
  - Email.

- Enhancement of onboard equipment such as ECDIS (real-time ice condition image, track recommendations, traffic & icebreaker positions image) and data communication (dedicated communication links and information servers).

4.2.6 Co-operation with Allied Services, Port Operations, Emergency Services and adjacent VTS

Generally this is a supporting activity of the VTS intended to increase the safety and efficiency of the traffic, the protection to the environment and the effectiveness of the VTS without adding to the reporting burden of the vessel. In the ARCOP context this comprehends:

- Ice clearance before berthing; harbour breakout:
  - breaking out approaches and clearing ice from wharf faces of port terminals and facilities,
  - assisting shipping within ports and at marine facilities, by keeping ice clear of barge; operations and the ship at anchor, and by streaming petroleum off-loading hoses.
- Tugboat support of berthing operations
- Lighters
- Port services, repair
- Emergency services e.g. search and rescue (SAR)
- Passengers conveyance, e.g. aircraft connection
- Goods supply: food, bunker, technical
- Medical assistance
- Legal support, e.g. provision of necessary legal documents
- Organisation support
- Other services, e.g. mail.

4.2.7 Further issues

Additionally to the IALA manual structure further issues must be considered in the ARCOP context.

4.2.7.1 Applicable Criteria

The following criteria must be considered in an operational context when deciding whether services can be effectively and efficiently provided:

- ability of the subject vessel to safely navigate in ice;
- experience of vessel's master in ice navigation; and
- willingness to cooperate and comply with (routing) advice.

4.2.7.2 Quality of Services

The quality of service must comprise:

- Reliability
- Readiness

- Response Time. There are several variables which will affect the response time for route assistance requests:
    - location of the vessel requiring assistance;
    - conditions of ice and weather;
    - availability and capability of a resource, e.g. in case of ice breaker support;
    - proximity of a resource to the vessel, e.g. in case of ice breaker support.

4.2.7.3 Limitations of Services

The limitations which may affect delivery of “physical” assistance (such as ice breaker support) services are:

- Weather restrictions: services may be reduced when current and forecast meteorological conditions will not permit successful delivery of the services;
- Severity of ice season: services may be reduced when current and forecast ice conditions will not permit successful delivery of the services;
- Physical restrictions: services will not be provided when hydrographic and/or geographic features of the area under consideration prevent safe;
- Safety restrictions: services will not be provided when conditions would unduly endanger service crew, ships or equipment, and/or those requesting the services; and
- Availability of resources: services will be provided when sufficient service units are available.

5 Conclusion, Outlook

For ARCOP it is proposed to define a VTS/VTMIS covering the total voyage on the NSR through arctic waters by combining

- a wide area VTS based on vessel tracking plus
- additional local or thematic services according to the vessels‘ actual needs.

All regular VTS services should be offered tailor-made for the trade‘s special requirements based on a network of local/regional VTS and related services. The VTMIS feature means to enhance a classical VTS by transport-related information services.

It might be necessary to work with an exemplary range of specified ports and terminals.

Specific areas of consideration are:

- Efficiency (cost – benefit)
- Safety (avoidance of casualties, SAR)
- Security (against acts of terrorism and sabotage)
- Environmental protection (coastal zones)
- Contingency planning
- Navigation (planning, executing and monitoring of track including external assistance)
- Vessel management (crew, provisions, maintenance etc.)
- Cargo management
- Law and rules enforcement.

Further items of investigation are:

- Remote guidance of vessels (a specific kind of shore based pilotage for navigation in ice);
- Potential of current and future ice reconnaissance by satellites and enhancement opportunities by networking of services;
- Enhancement of onboard equipment such as ECDIS (real-time ice condition image, track recommendations, traffic & icebreaker positions image) and data communication (dedicated communication links and information servers);
- Trusted parties as information managers to protect company data.

6 References

Bibliography

- IALA: *Vessel Traffic Services Manual* (VTS manual), 2002: http://www.iala-aism.org
- IMO resolution A 857(20): Guidelines on Vessel Traffic Services
- VTMIS-NET, *User Requirements*, Deliverable of Workpackage 03, 09.12.1998.
- VTMIS-NET*, Potential Enhancements*, Deliverable of Workpackage 04, 10.02.1999.
- Poseidon, Consolidated Report on the specific User Requirements, Deliverable 2.1, 26.07. 1996.

Ice Services, Institutes, State Services:

- Arctic and Antarctic Research Institute of Russia (AARI), (Department of satellite, ice and hydrological forecasts (IHMIC)): http://www.aari.nw.ru/index_en.html
- Canadian Coast Guard, ice breaking programme: http://www.ccg-gcc.gc.ca/ice-gla/main_e.htm
- Canadian Ice Service: http://ice-glaces.ec.gc.ca/
- Federal Maritime and Hydrographic Agency of Germany (BSH), ice service: http://www.bsh.de/en/Marine%20data/Observations/Ice/index.jsp
- Norwegian Meteorological Institute (MET): http://met.no//kyst_og_hav/iskart.html
- Swedish Meterological and Hydrographic Institute (SMHI: ice charts and weather routing): www.smhi.se
- US National Ice Center: http://www.natice.noaa.gov/

Projects

- ARCDEV: http://arcdev.neste.com/
- Ice Routes: http://www.cordis.lu/transport/src/iceroute.htm
- INSROP: http://www.fni.no/insrop/
- Poseidon: http://hermes.civil.auth.gr/poseidon/poseidon.html
- Waterman: http://www.waterman-ts.net/
- VTMIS-NET: http://www.issus.haw-hamburg.de/iss_web/projekte/vtmis-net/index.htm

7 Annex I: Examples of Charts and Services

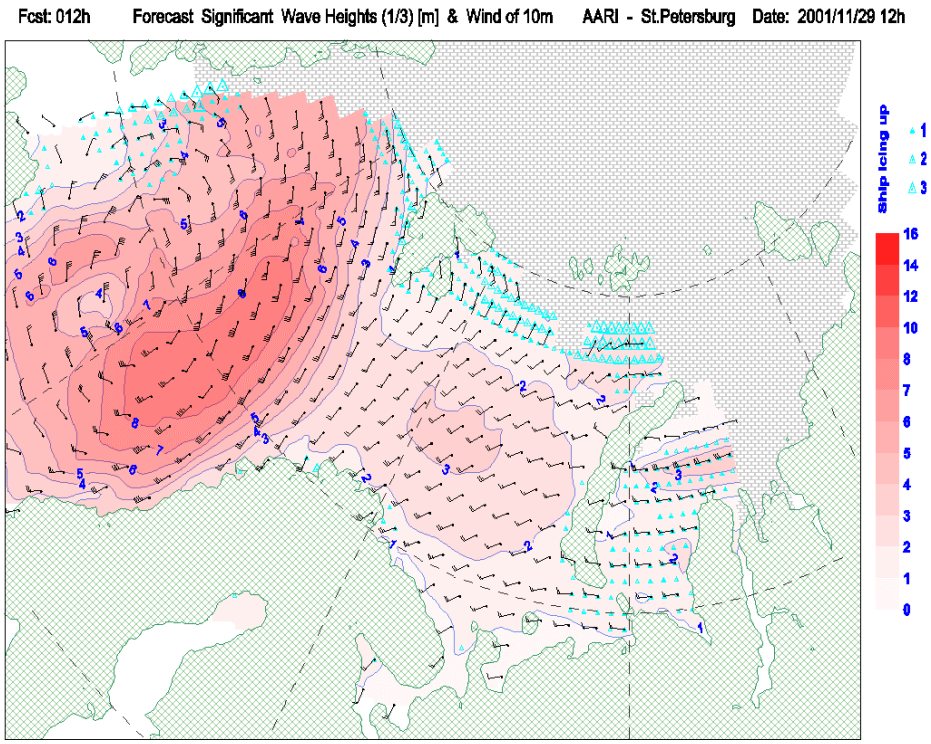


Figure 1: Example of waves, wind and current forecast (by AARI)

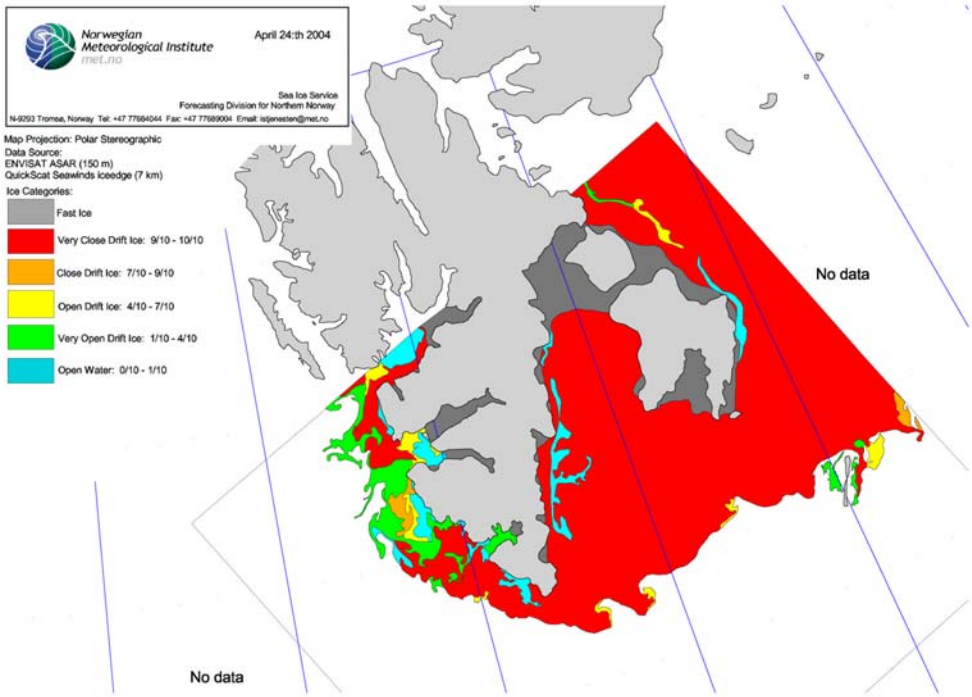


Figure 2: Example I of Ice Analysis Charts (by Norwegian Meteorological Institute)

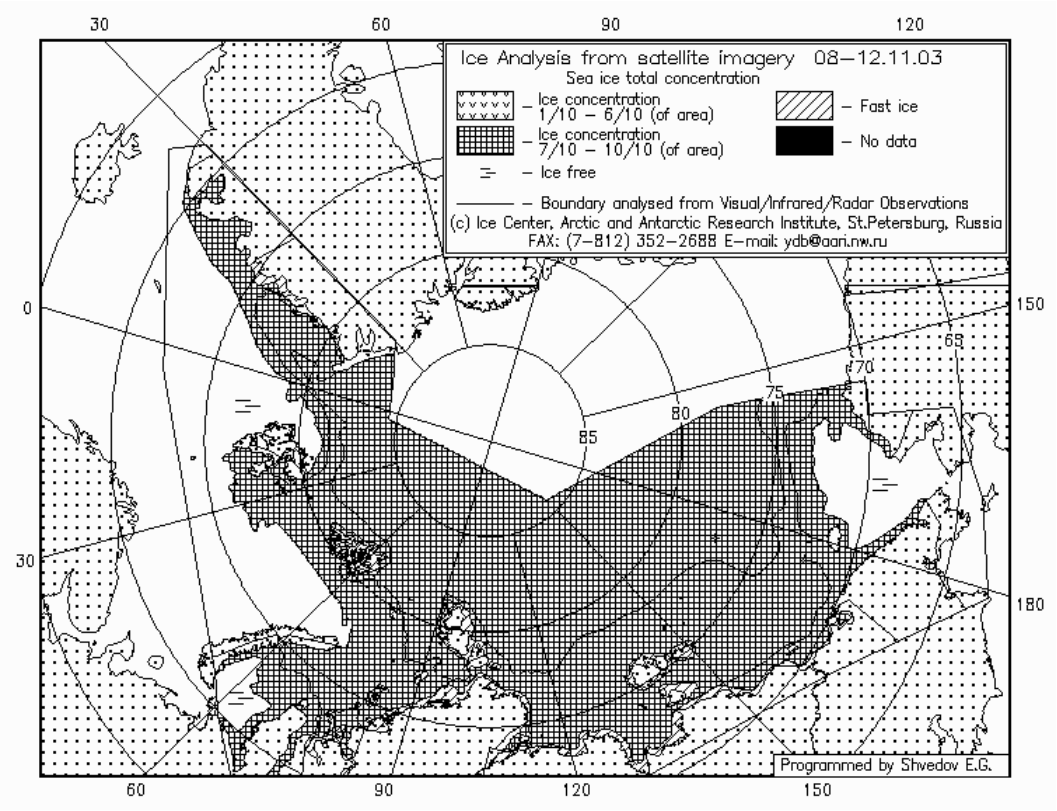


Figure 3: Example II of Ice Analysis Charts (by AARI)

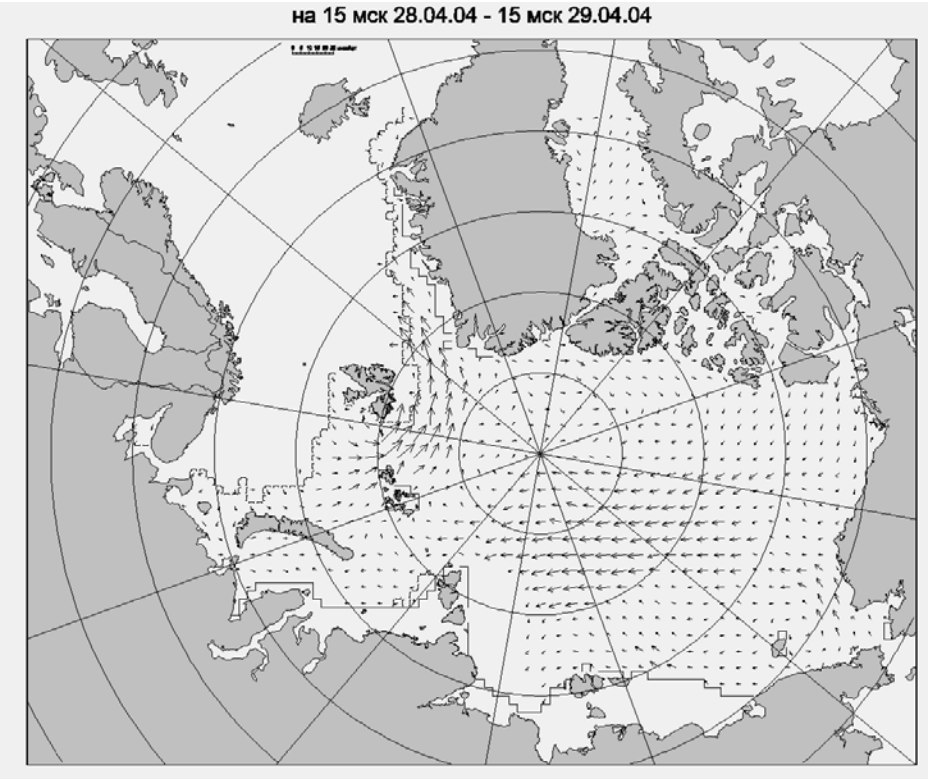


Figure 4: Example of Forecast of mean daily drift of sea ice (by AARI)

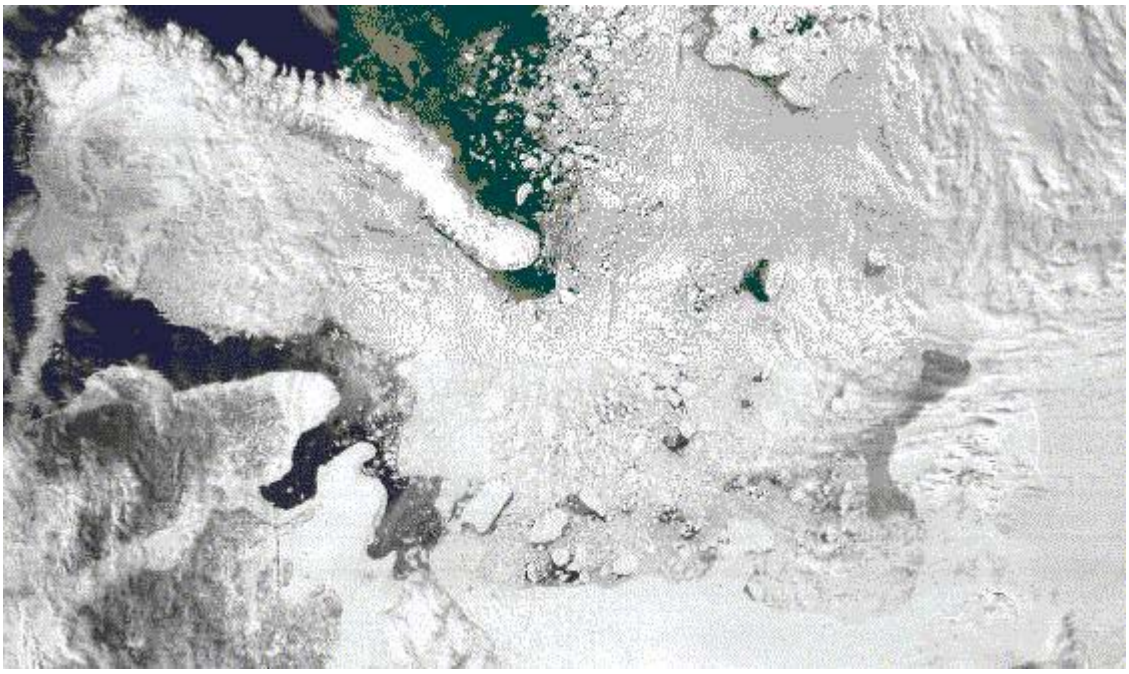


Figure 5: Example of Arctic Satellite Image (by AARI)

8 Annex II: Contribution by CNIIMF to User Requirements for VTMIS

8.1 Foreword

This Annex presented by CNIIMF has been carried out taking into account early received ISSUS draft Deliverable D3.6.1 issued 28.05.2004 (Prof Froese, Karsten-Schuler). Same positions of above mentioned report were used and counted in attention.

Central Marine Research and Design Institute (CNIIMF) as a participant of WP 3.6 intends to substantiate VTMIS for Arctic area providing the background gained for the long period of activity in this field.

Over the last 45 years we have been working on the development shore-based vessel traffic systems (VTS). The VTS in St.Petersburg (1960) and Murmansk (1965) ports were constructed. Before USSR demise we participated in construction of 27 VTS of different complicity.

In 1995 we developed the VTMIS project for russian territorial waters in the Gulf of Finland. All the objects are linked with one VTMIS Centre. It ensure uninterrupted ship surveillance along the channels and routes in the russian ports of the Gulf. The modern technologies were applied in the system (GNSS, radars, AIS, GMDSS). At the same time ship separation sehemes were corrected and deep water way was established. These innovations were adopted by IMO.

Our participation in EU RTD Project VTMIS-NET (1998-2000) had broadened outlook and we were nearing the European Community goal. In the project (WP 14) CNIIMF presented the layout of the future VTMIS-NET for the whole Gulf of Finland. This VTMIS is being constructed now with plan to put it in operation during 2005. The RF Ministry of Transport is supporting the construction of the integrated VTMIS for the Gulf admitting its role in safety of navigation of big oil tankers in extremely vulnerable region.

Arctic region is the area where consequence of incident would be such that extra safety provisions over that normally applied may be appropriate.

As for ARCOP project the task requires to find solutions available to ensure as all legitimate as commercial interests.

8.2 Vessel Traffic Management and Information Services (VTMIS) for the Gulf of Finland as a new EU VTMIS-NET Version

Construction of new port complexes and modernization of existing port complexes in the Gulf of Finland (Primorsk, Ust-Luga, Vysotsk and St.-Petersburg in Russia, Muuga in Estonia and Porvoo in Finland) attracted public and the Baltic countries governments attention. Drastic increase of oil and other dangerous cargo transportation from ports of the Gulf of Finland, as expected in the nearest future, also development of the passenger transportation (Tallinn-Helsinki) with the traffic crossing main shipping lanes in the Gulf indeed increases risk of casualty.

In 2000-2001, Russian Ministry of Transport at different levels (Russian-Finland Intergovernmental Committees, Land Parlament Mecklenburg - Vorpommern (Germany) Auditions and others presented to the world shipping society proven evidence of safety shipping provision in the territorial waters of Russia as a result of construction in the eastern part of the Gulf of Finland the Regional system of safety shipping using modern technologies of satellite navigation, radar surveillance and IT [1] (Figure).

In 1998-2000, CNIIMF took part in European organisations consortium on development project VTMIS-NET (Net of the Vessel Traffic Management and Information Services) within the frameworks of “Transport RTD Programme” organised by EC DG 7. CNIIMF in the project report created basefor the principles and approaches to the problems of national VT(MI)S in the frame of the following Gulf of Finland system integration [2].

19 September 2000 representative of Finland (Mr. Esa Eerikainen), at the IX-th ICC Meeting of TEDIM Programme (Lubeck, Germany) in partnership with delegation of Estonia, Finland, Germany and Russia made a suggestion on inclusion in to the TEDIM Programme the works on creation of the Vessel Traffic Information System VTIS - Gulf of Finland) [3]. At the end of 2000, Center of the research investigation of Finland (VTT Industrial Systems) in frameworks of the TEDIM Programme worked out feasibility study (FS) on the implementation of the VTMIS - system for the Gulf of Finland [4]. VTT was assisted by Central Marine Research and Design Institute of Merchant Fleet (CNIIMF) and Estonian institutions. The main ideas of the FS were to discuss and obtain support on the three countries experts workshop which took place 10.26.2000 and 06.06.2001 in Helsinki.

“MEMORANDUM OF UNDERSTANDING between the Ministry of Transport and Communications of Estonia and the Ministry of Transport and Communications of Finland and the Ministry of Transport of the Russian Federation on strengthening the cooperation to further enhance the maritime Safety in the Gulf of Finland” was signed in October 2001 [5]. Main directions of project implementation - adjusting of Traffic Separation Schemes (TSS), creation of Ship’s Reporting System in the international waters of the Gulf utilising Automatic Identification System (AIS), improvement of Vessel Traffic Service (VTS) role in traffic management, etc. are indicated in the Memorandum. Article 1 of the Memorandum reads “The aim of joint cooperation is the development of regional system of traffic management and their informational provision (VTMIS) in the Gulf of Finland”. Launch of system into operation was planned in July 1, 2004.

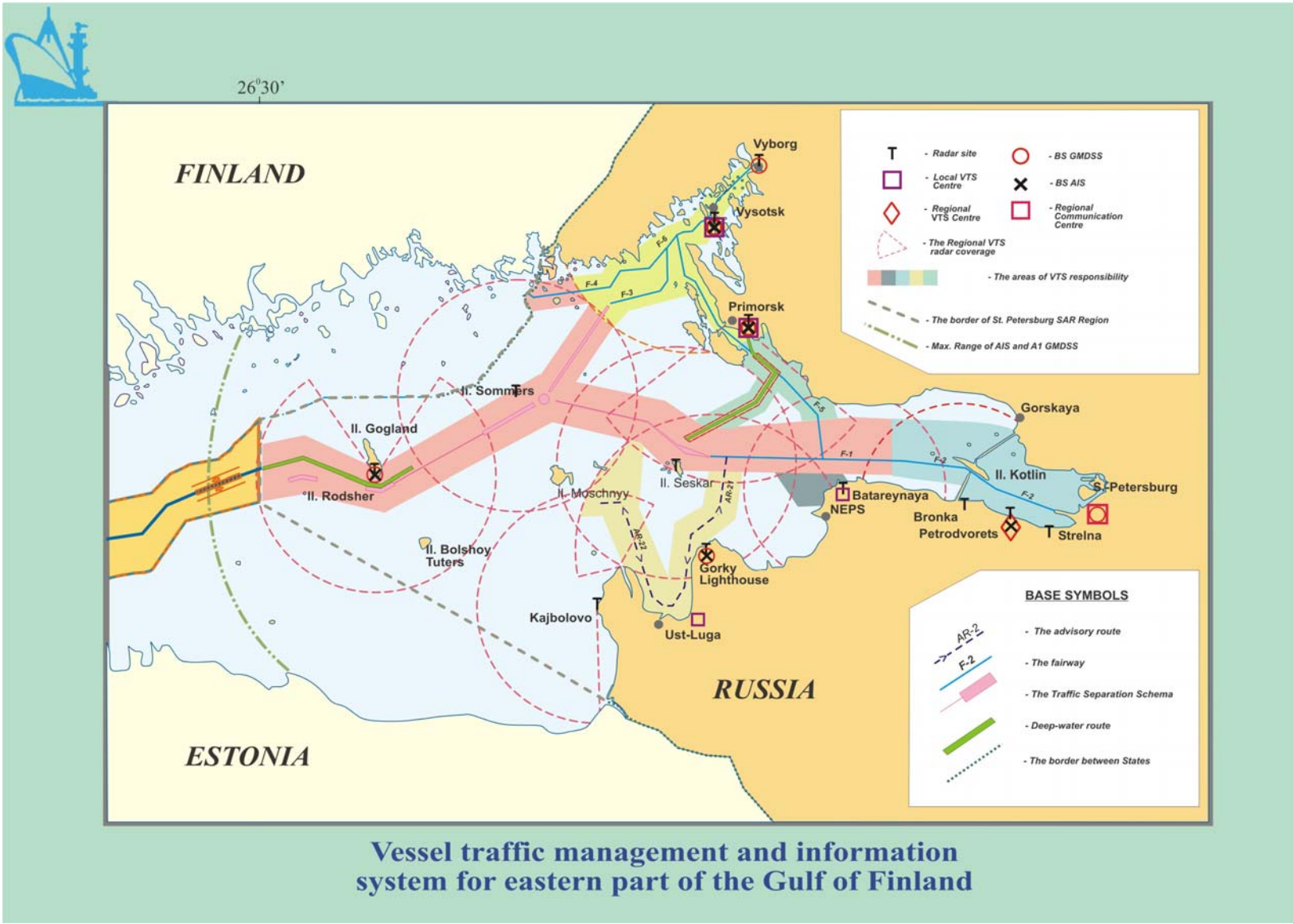


Figure 6: VTMIS for Eastern Part of the Gulf of Finland

During the 4th Baltic Sea Countries Summit which took place in St.-Petersburg June 10, 2002 countries leaders stressed significance of “assistance to the development of VTMIS in the Gulf of Finland”.

Nowadays every country works on development of national safety shipping systems and preparation of their integration. IMO approval obtained Russian side made intervention on changes made in TSSs and creation of deep water route in territorial waters of Russia. Coastal infrastructure of AIS is being developed. GMDSS was created. All VTSs of Russian ports are integrated in united computer network which provides solid database and information on traffic exchange. Planning of traffic by VTMIS in Petrodvorets (St.-Petersburg) is introduced. Thus Russian side has created and implemented first stage of Russian VTMIS by installation of new radars, AIS and means of radiocommunication on the most part of the aquatorium. Preparation to construction of island objects is on the run.

Estonia, Finland and Russia presented to IMO changes in the TSSs in international waters of the Gulf and creation there mandatory Ships Reporting System (SRS) in accordance with the new Rule 11 of the Chapter 5 of the SOLAS-74 convention which were adopted. SRS Centres of Finland (westbound traffic) and Estonia (eastbound traffic) control vessels traffic in the international waters on. Centre line of TSSs is the central borderline.

Tremendous work of experts of tree countries on VHF frequencies utilised in SRS and VTS was done beforehand.

The use of VTMIS concepts find their approval in Formal Safety Assessment (FSA) made by VTT Industrial Systems [6].

The outcome of the FSA study clearly indicates that the implementation of the proposed system in the Gulf of Finland is highly recommendable. The operation of the system significantly reduces the risk of collision. The analysis suggests that with the implementation of the VTMIS a reduction of 80% can be achieved in the number of collisions in which at least one of the vessels is an oil tanker. The positive effect of the system extends to the control of the consequences of marine accidents. The volume of oil spills as a result of collision will also reduce 80 %. From an economic point of view, the investment in the VTMIS system can be recommended based on the cost-benefit analysis. An important issue is the number of human lives saved as a result of reduction in accidents at sea. According to the study, in every third collision, the other party is a vessel carrying passengers.

Safety of life at sea increases with the reduction of accidents number. The study proves necessity of combined usage of SRS with continuous radar surveillance and AIS monitoring for the vessel traffic in the international waters of the Gulf, COLREG control and informational support for the ships, especially during ice navigation.

Finish side worked out national VTMIS topology based on Port@Net system, wide usage of AIS and international information exchange via Internet.

Estonian side carried out work on implementation of the marine region A1 GMDSS in SAR coordination zone. VTSs were built in Tallinn and Muuga, coast AIS stations were partly installed.

When Estonian and Finish objects would be in operation as well as coast object in Russia, VTMIS integration would be possible.

Three parties workshops of expert groups are regular with instant discussions on current problems for joint decisions.

One question is to be accurately analysed and discussed. Main frame of it is understanding of VTMIS definition resulting in definition of system and used in Ministers Memorandum of understanding which is the background document for performing of joint works.

VTMIS abbreviation is conceptually based on VTS. The Rule 12 of new (December, 2000) SOLAS-74 Convention and Guidelines for Vessel Traffic Services [7] defines aims, tasks

organisation and services which are provided by VTS. Requirements for recruitment qualification and training of VTS operators is defined ibid.

VTMIS definition was created by DG7 of EC in the early 1994 while creating of tasks for EC research project which was named Vessel Traffic Management and Information Systems (VTMIS)". Initial recommendations for carrying of works had well known research COST 301 [8] as a background. Main points of future VTS were stated in it:

- development of information exchange between VTS and search and rescue services as well as ecology service,
- reporting to the port of authorities required information on vessels etc.

For establishment of terminology DGVII initiated a committee in 1996 which consisted of experts - EC members so called "Concerted Action (CA) on VTMIS". Committee suggested several versions of terminology.

The official definition is as follows [9]:

> Vessel Traffic Management: the set of efforts (measures, provisions, services and related functions) which, within a given area and under specified circumstances, intend to minimise risks for safety and the environment , whilst maximising the efficiency of waterborne and connecting modes of transport.
>
> Vessel Traffic Management and Information Services intend to respond to public and private demand for facilitating Vessel Traffic Management. Vessel Traffic Management and Information Services include services distributing in given areas (at regional, national or trans-national level- the pertinent information to be used both in real time and in retrieval modes by actors involved (s. Figure 7: VTMIS Data Flows [9]).

The CA has also made this further clarifying statement:

> The implementation of or participation in a VTMIS in a given area does not presuppose the existence of any specific type of equipment as long as it is adequate for the tasks to be performed. However it implies that all services which are or will be implemented in the area, such as VTS, Allied Services and other information services, are interlinked and co-operate according to commonly harmonised procedures.
>
> Although still much discussed, the definition has been frozen by the CA, as it is believed to be comprehensive enough. The functional definition provided above has turned out to be most useful if one gets lost in discussing what VTMIS really is. One important point is that the CA has determined that VTMIS is not a system, but the concept for a scope of services.

VTMIS is not VTS replacement nevertheless CA accepts it as a mainframe. If VTS is subject of the hardware market VTMIS consists of parts selection of which is defined by the system under construction structure. For example VTMIS of the Eastern (Russian) part of the Gulf includes GMDSS but in some countries GMDSS is under operation of the Coastguard.

VTMIS are characterised by one or both of the following elements:

- Electronic exchange of information with services of the same kind in the neighbourhood, region or more distant locations (horizontal information integration) (s. Figure 7: VTMIS Data Flows [9]).
- Electronic exchange of information with other maritime services of an official or commercial nature (vertical information integration).

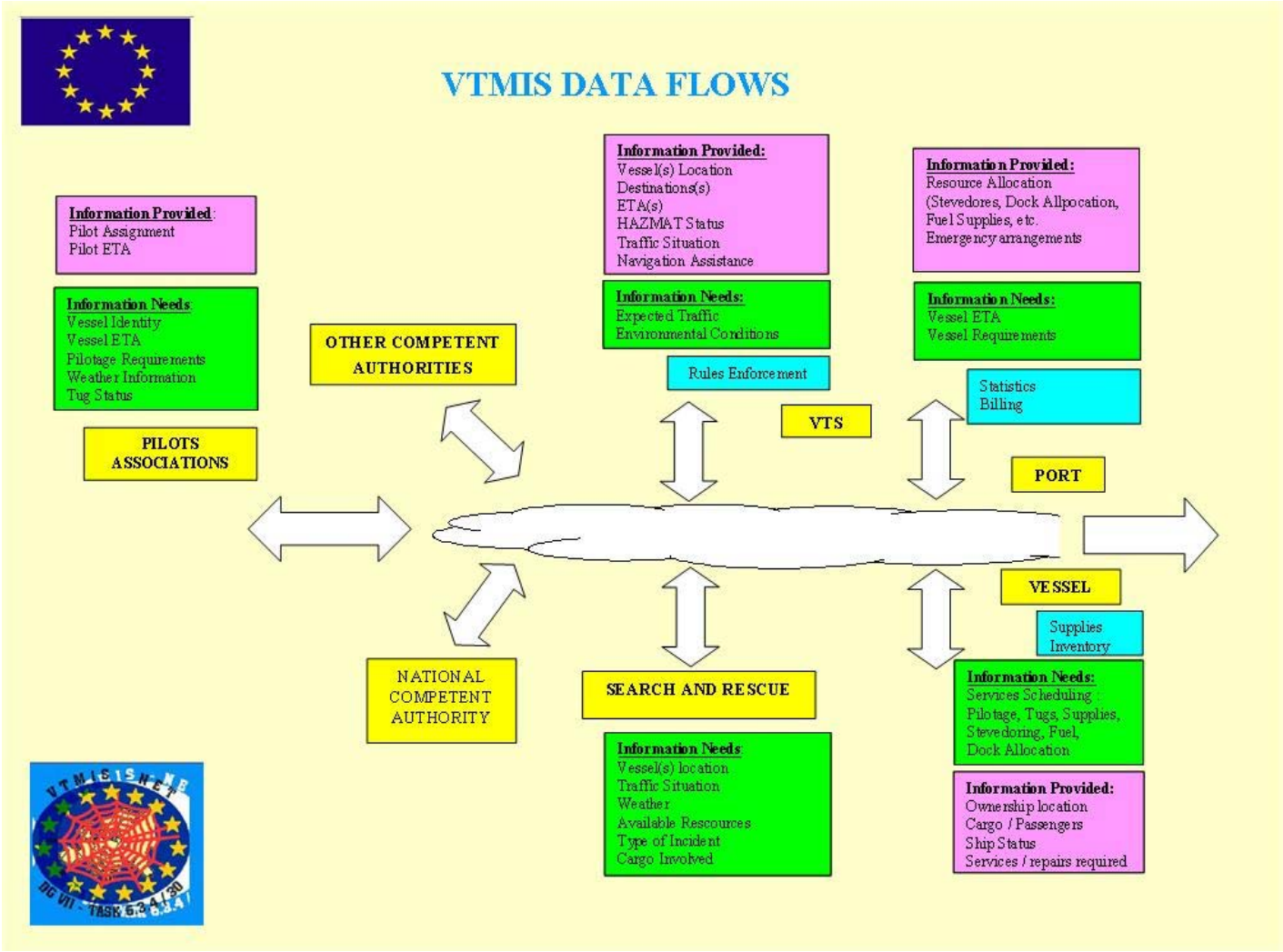


Figure 7: VTMIS Data Flows

By promoting VTMIS and thus stimulating value added services the EC has created something like a brand name as a synonym for more safety and efficiency through existing technology. European equipment manufacturers meanwhile use the term VTMIS in order to demonstrate that their system functions go beyond those of the classical VTS. The IT-oriented VTMIS concept, emphasising information and communication technologies therefore contributes to improved competitiveness of European industry. This, however, will not last very long until under this umbrella new features and services are created to keep Europe always at least one step ahead of its competitors. Application-oriented research and development therefore should contribute to such new features and services.

From experience new and improved information services result in extended new business activities. It can therefore be expected that also “new concepts for the improvement of efficiency in waterborne transport operations” will generate new jobs in the transport service industry. In order to exploit opportunities and produce optimum benefits for all stakeholders, training of existing staff needs to be improved. This should follow a European approach to ensure a maximum uniformity that international vessels need to familiarise only once.

Utilization of such definition as VTMIS for the management system of traffic in the regions of highly developed information support and exchange is worldwide. We can find such examples in mass media reports.

- Irish ports Cork, Shannon Estuary, Waterford and Rosslare have signed a contract for installation of modern VTMIS. It includes modern means of VHS communications, coastal radar network, CCTV, transponder system of automatic identification. Fairplay,13th August 1998, p.41.
- American company has signed a contract with government of Turkey for installation of VTMIS in the Turkish Straits. This company also announced VTMIS installation in the Costantza port. Cargo systems, November 2001, p.34.
- According to the report of the biggest Norwegian company it has sold 19 VTMIS worldwide. Safety at Sea International, August 1998, p.18.
- It is reported about installation of VTMIS in several ports of Australia. Marine Log, August 2000, p.56.

Simultaneously well known VTS abbreviation is widely used, that proves some inaccuracy in VTMIS and VTS definitions.

VTMIS of the Gulf of Finland consolidates efforts of Estonia, Finland and Russia in creation of safety shipping of dangerous cargo conditions on rather tough routes in the Gulf. To reach this VTMIS, utilizing VTS and AIS provides monitoring of shipping on all the Gulf routes, fixing cases of violation and providing information support to vessels in distress.

VTMIS is created in a way to utilize the possibilities of AIS system monitoring in the Baltic Sea. Intergovernmental information exchange (on the VTMIS centres level) contributes to coordination of VTS and SRS operators actions in the neighbouring countries.

Studying aims, technical means of location and monitoring of fleet, methods and aims of information exchange we can prove necessity of regional system of safety shipping in the Gulf of Finland under creation as a version of EC VTMIS network.

8.2.1 Conception

Conception of Vessel Traffic Management and Information System (VTMIS) consists in:

- Consolidation the Estonia, Finland and Russia efforts in ship traffic management in the Gulf of Finland especially during transportation dangerous cargos, along the all shipping routes helping to reduce the rate of collisions and groundings and improving the safety of human life and decreasing risk of oil spills;

- External supervision of maritime traffic flow with the purpose of surveillance for observance of the navigation rules and to organize the help in form of recommendations for ship movement at route cross-ways mitigation the effects of ship accidents etc;
- All vessels irrespective of the flag fitted with radio and navigation equipment provided by SOLAS Convention sailing in the Gulf should be available of precise position determination at any condition of visibility and be in time supplied with meteorological, navigational and ice information;
- The VTMIS should be compatible with Baltic Sea Monitoring System (BSMS) which includes the Gulf of Finland and based on the use of AIS. BSMS national AIS servers should be integrated with VTMIS. AIS information should be stored in separate servers and be used for presentation on VTS display in accordance to draft standard 60936-5 (TC 80 IEC);
- Unification of national shore based infrastructures to simplify its joint use. For this purpose the sides have been implementing the following complexes:
    - vessels traffic services which should ensure the full coverage of the Gulf of Finland including international waters;
    - development and implementation of common mandatory Ship Reportion System (SRS) in the international waters of the Gulf, providing unified procedures of ship report with establishment of agreed frequency allocation;
    - implementation of DGNSS chain of stations (Finnish, Estonian, and Russian) with unified correction rate (100 bit/s) which creates full coverage of the Gulf with ship position accuracy determination less then 10 metres;
    - implementation of shore-based infrastructure of Automatic Identification System (AIS) which is the base of Baltic ship monitoring system and the important component of SRS in the Gulf of Finland ensuring non-verbal ship reports;
    - construction of GMDSS in Eastern (Russian) part of the Gulf to ensure the full coverage of Area 1 GMDSS in the Gulf;
    - aids of interstate information exchange between countries involved which greatly conducive to ship traffic organization and surveillance.

8.2.2 Operational aspects

- Surveillance of the ship sailing in the territorial waters is being carried out by corresponding national VTS`s. For this purpose the shore-based radar's, AIS-infrastructure u VHF radio communication are used. Operational explanations are included in the by-laws and master guides of each port,
- International waters of the Gulf are served by Finland and Estonia with division line in the middle of recommended ways and ship separation schemes,
- Aquatory which covered by Ship Reporting System (Figure) har been ensured with radar coverage with all ship autotracking as well as AIS monitoring,
- Nowdays situation with AIS implementation is drastically changed under the IMO MSC 76 and Conference Resolution 1 (12.12.2002) decisions to correct Regulation 19 of the Chapter V SOLAS Convention replacing the final date full AIS fitting on 1Jule 2004. This date concise with the date of enter in action the integrated the Gulf of Finland VTMIS.

The early AIS implementation contributes to

- decreasing verbal mode of ship reports when crossing the reporting lines,
- stable and reliable ship monitoring and autotracking,

- International waters of the Gulf have to be divided on VTS areas (sectors) for servicing by Finland and Estonia VTS`s Correspondantly the VHF channels for each area (sectors) have to be allocated for communication with VTS operator who engages in supplying the navigational, meteorological ice information etc. to ensure the safe navigation,
- Full information concerning the ship crossing the reporting level may be supplied to the corresponding Centers by the port of departure,
- The VTMIS Centres of the countries of the Gulf have to be provided with separate aids of communication to exchange the date,
- Each Center stores in data base all information including ship reports received by VHF communication, AIS and radar information,
- Reasonably for operation the system of such complicity the Document of Join Procedure is needed and presented together with the draft of Intergovernmental agreement. Join Procedures have to provide prompt fulfillment of instructions by the VTMIS operators. Besides sophisticated technical aids they use own experience as mariners. Personal responsibility of operator in his area (sectors) of service remains the key element of safe shipping.

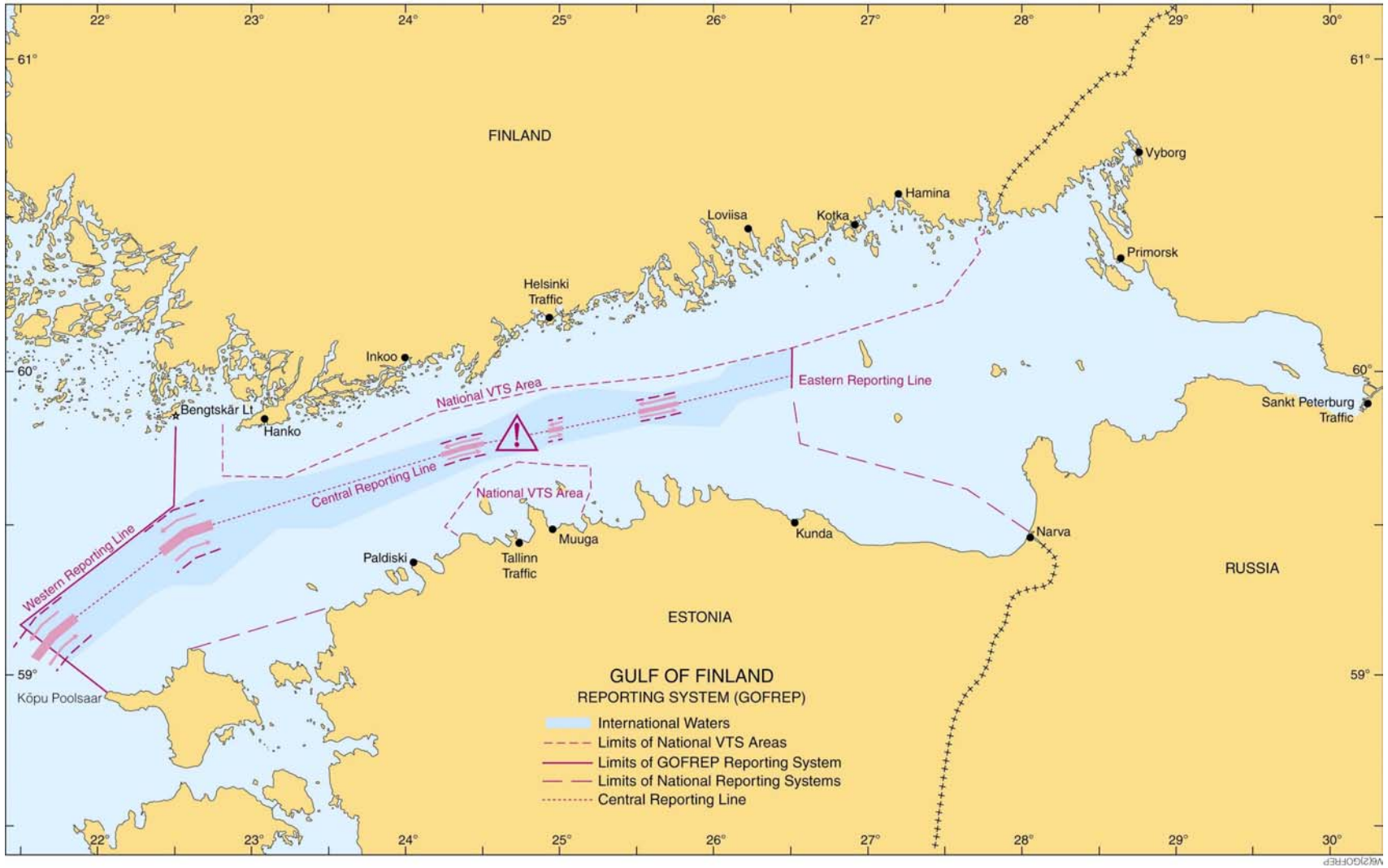


Figure 8: Chart of Gulf of Finland Reporting System

8.3 The Perspective Cargo's Flow in Western Arctic

The role of traffic management service (VTS, VTMIS, RIS, AIS etc) for waterborne operations under the extreme conditions in northern Europe had been assessed and accordingly adapted, based on the results made in the VTMIS-NET project. Recommendations for enhancement and traffic operations have been substantiated.

During the last ten year the extractive industry of Russia has shifted to the zone of the Far North. The richest deposits of mineral raw materials, first of all of energy resources are concentrated here. Rational exploration of these natural resources is the national priority in the economic strategy of Russia.

The Arctic Marine Transportation System (AMTS) provides for all the needs of the country in the arctic freight traffic. It is based on the icebreaker fleet the impact power of which is determined by nuclear icebreakers.

During the whole previous period of the exploration of the Arctic the energy resources, primarily petroleum products, were brought to the Arctic to meet requirement of the local industrial enterprises, transport and satisfy social needs. Such delivery was made mainly by water through the Northern Sea Route and northern rivers flowing into arctic seas.

And only now, as oil and gas deposits in the arctic zone including shelf of arctic seas are being developed the export transportation of energy resources from the Arctic begins.

Export transportation of oil and gas condensate will be carried out predominantly by sea both directly from deposits and with preliminary delivery to terminals by pipelines of river vessels (by railway) for subsequent transshipment to sea ships.

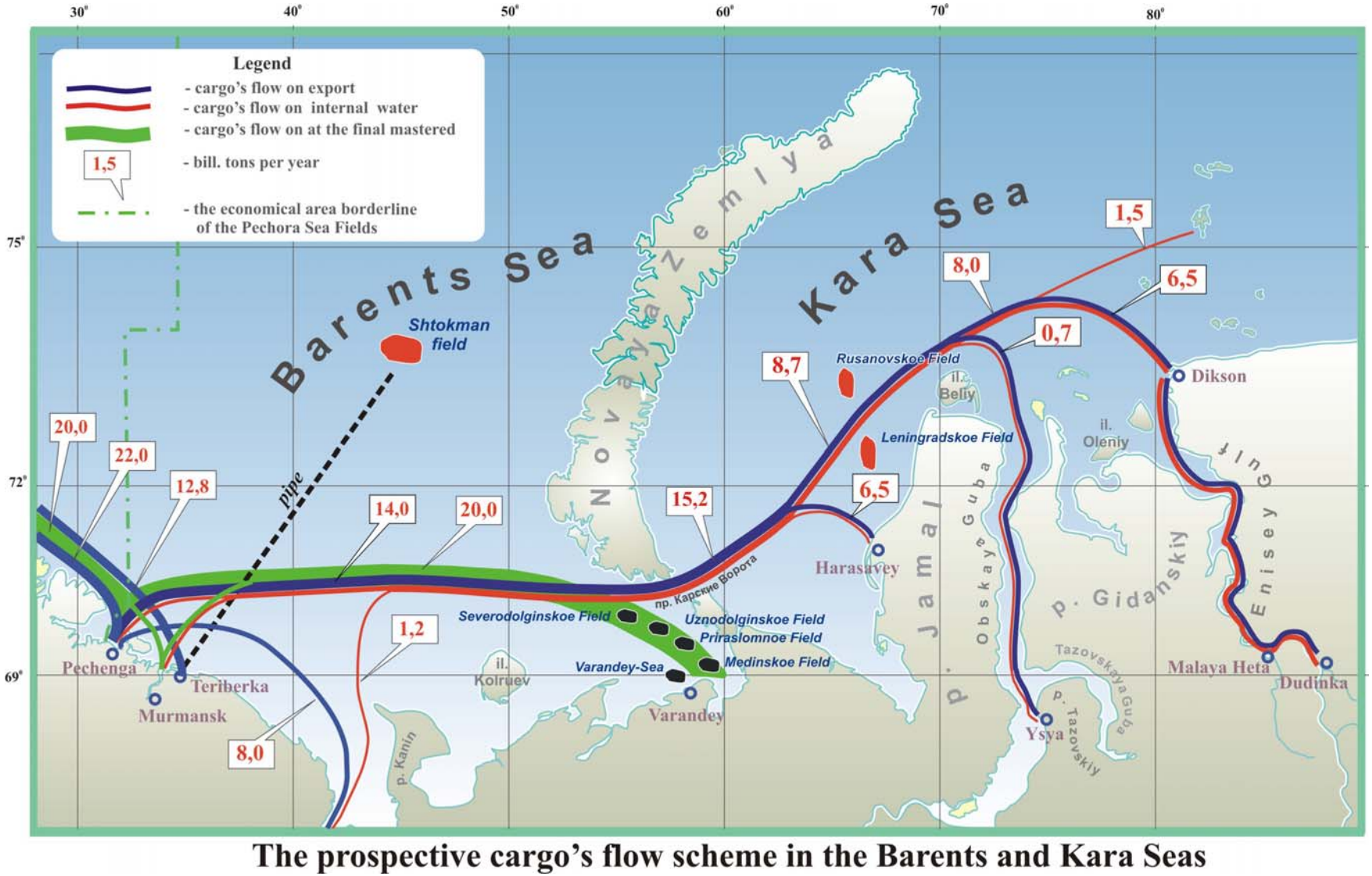
Marine transportation of oil export from deposits of the Varandey group by 2006 will reach 5 million t and by 2015 may exceed 12 million t per year. In 2006-2007 the first oil for export will taken from the Prirazlomnoye by 2015 reaching 8-10 million t.

By 2015, the volume of oil and gas condensate from deposits of the Kolguev Island, Ob, Yenisei and Lena river basins will exceed 1.5 million t per year.

About 6 million t per year will be shipped for export via Vitino, Arkhangelsk, Belomorsk.

When plans of the construction of factory for the liquefaction of natural gas near capee Kharasavey on the Yamal Peninsula are implemented, by 2020 up to 5 million t of liquefied gas from the Yamal deposit will be exported to the world market.

Substantial changes in the geography of the export of oil may be introduced with the construction of the northern export pipeline Siberia-Murmansk and of a powerful oil terminal near Murmansk thus providing for the export of 80 million t of oil a year. It will be a non-freezing terminal in an enclosed bay with depths sufficient for the yeas round shipment of oil by tankers with a deadweight of 300000 t this being am important advantage ensuring profitable economic conditions for the delivery of oil to the world market including the North American one. This terminal will have substantial advantages in comparison with ports of the Baltic and Black Seas, as ships operating here will be not concerned with the necessity of passing through international Baltic and Black Seas straits with their serious restrictions.



The prospective cargo's flow scheme in the Barents and Kara Seas

Figure 9: Prospective Cargo's Flow Scheme in the Barents and Kara Seas

The most important aspect substantiating the advisability of the construction of an oil-trunk pipeline in this direction is the possibility of connecting this pipeline to new perspective deposits situated in the West Siberia in the area of Ob and Tazovskaya Gulfs, on the Yamal Peninsula as well as in the European North of the Russian Federation. Route of the oil pipeline runs also through the Timan-Pechora oil and gas province to be intensively developed.

As a result, the marine transportation of considerable volume of export energy resources may by switched over from deposit areas to the Kola Inlet terminals and from there would be transferred to the west. The prospective of cargo's flow scheme in the Barents and Kara seas are presented on the slide above.

8.4 The Main Goals and User Requirements for Arctic Operational Platform

THE MAIN GOALS OF VTMIS DEVELOPMENT

- A strong resilient system fully capable of handling traffic surveillance plays a crucial role in traffic management helping to reduce the rate of collisions and groundings essentially improving the safety and decreasing risk of oil spills
- Interface between VTMIS and port data processing services might be expected to have the sound impact on improving the port efficiency
- Port daily traffic schedule may be considered as one kind of information exchange between port authorities.

CONCEPT OF SHIPPING MANAGEMENT IS BASED ON THE FOLLOWING ASSUMPTIONS

- All vessel irrespective of the flag and mission should have the opportunity of precise position determination by day and at night at any conditions of visibility;
- External supervision of maritime traffic flow with the purpose of control the observance of navigation rules, assistance in vessels positioning, mitigating the effects of ship accidents, recommendation for the ship movements at route cross-ways;
- All vessel should be in due time supplied with meteorological and navigational warnings;
- Shore-to-ship and Bridge-to-Bridge reliable communications linked with shore-based communication network;
- Integration of radionavigation, communication and surveillance aids with automatic data exchange may essentially improve the efficiency of shipping management.

VTMIS MAIN TECHNICAL AIDS

- Differential GPS/GLONASS reference station for high accuracy positioning.
- Shore-based radar stations net for uninterrupted surveillance of the routes and port approaches.
- Automatic identification system.
- VHF-radiocommunication to create sea areas A1 and A2 GMDSS and to assure multipurpose reliable communication.
- Radio links network for integration all sites information.
- Local and Wide areas network for information processing and dissemination.
- "Western Safe Sea NET" system integration with Russian component of the NET to assure uninterrupted navigation information.
- INTERNET as means to exchange navigation information.

ADDED VALUE

- Improved safety of traffic (lower risk of collision and stranding) in the most congested part of sea ways where navigation is limited with fairways and channels with island and shallows at close distances to traffic routes.
- Improved efficiency due to reduce transit time for ships and cargo handling operations in ports.
- Better use of port waterways by avoiding delays and optimizing traffic flow.

8.5 Vessel Traffic Management and Information Services for Western Arctic

Marine accidents with enormous oil spills highlighted the hazard to the coastal environment presented by tankers and other vessel carrying dangerous substances. Protecting the environment from casualties has recently attracted significant public attention.

In this study Arctic region covers Kola Inlet, costal waters and shelf of Barents sea from meridian 31°00` E to meridian 59°00` E (Kara Sea).

Kola Inlet and Kara Sea are the areas where the consequences of incident would be such that extra safety previsions, over that normally applied, may be appropriate. The eastern part of Arctic is limited with fairways and channels with islands and shallows at close distances to ship routes. The perspective of new oil and gas terminals will involve in operation large size ships and create new cross-ways. Environmental vulnerability of the region is strengthened with operation nuclear icebreakers participating in guidance operations.

The goal of development infrastructure of coast and seabed of Kola Inlet and Barents sea is to speed up the perspective modernisation existing and constructions of new port in the region. In the nearest future setting up the oil and gas rigs on the shelf's of Norwegian and Kara Seas with forecasting big output of oil and it's products will lead to augmentation of shipping density and to increase of accident risk.

Based to worldwide experience safety at sea is maintained by use ship-born and coastal equipment in accordance to Conventions SOLAS-74, COLREG, IALA. External (from shore) surveillance of shipping to exclude any violence of rules now considered as important.

To defend the environment and to defend ships from collisions the ARCOP project stipulates the use of complex of aids to navigation. They amalgamated in Vessel Traffic Management and Information Services (VTMIS).

VTMIS consist of the following hardware:

- Vessel Traffic Services (VTS). A VTS is a modern technology instrument ensures that shipping traffic in handled safely and quickly. A good VTS, in combination with an information system, helps to reduce risk of accidents not only at sea but into the port. It allows one, with a high degree of precision, to locale the ships and see what cargo they are carrying. Limitation-limited coverage (horizon range).
- Automatic Identification System (AIS) assure the ship to obtain high accuracy position (3-10 metres). Shore-based AIS stations create the Net, which supply shore-based VTS additional information concerning the ship position and other navigational data (see Figure).
- Global Maritime Distress and safety System (GMDSS) serves for ship to ship and ship shore communication during the distress.
- Differential Global Navigation Satellite System (DGNSS) which uses GPS (USA) and GLONASS (Russia) satellite systems. Required accuracy of at least 10 m of 95 % probability is available.
- Ship reporting system (SRS) which enter in force in Regulation 11 Adoption of Amendments to the Convention SOLAS-74. In project ARCOP SRS is recommended in marine Area A1 (see slide) and A2 GMDSS. Information is used to many purposes, including search and rescue, VTS and navigational support to ships. General scheme of the Safety navigation Systems at the Northern region see on slide attached.

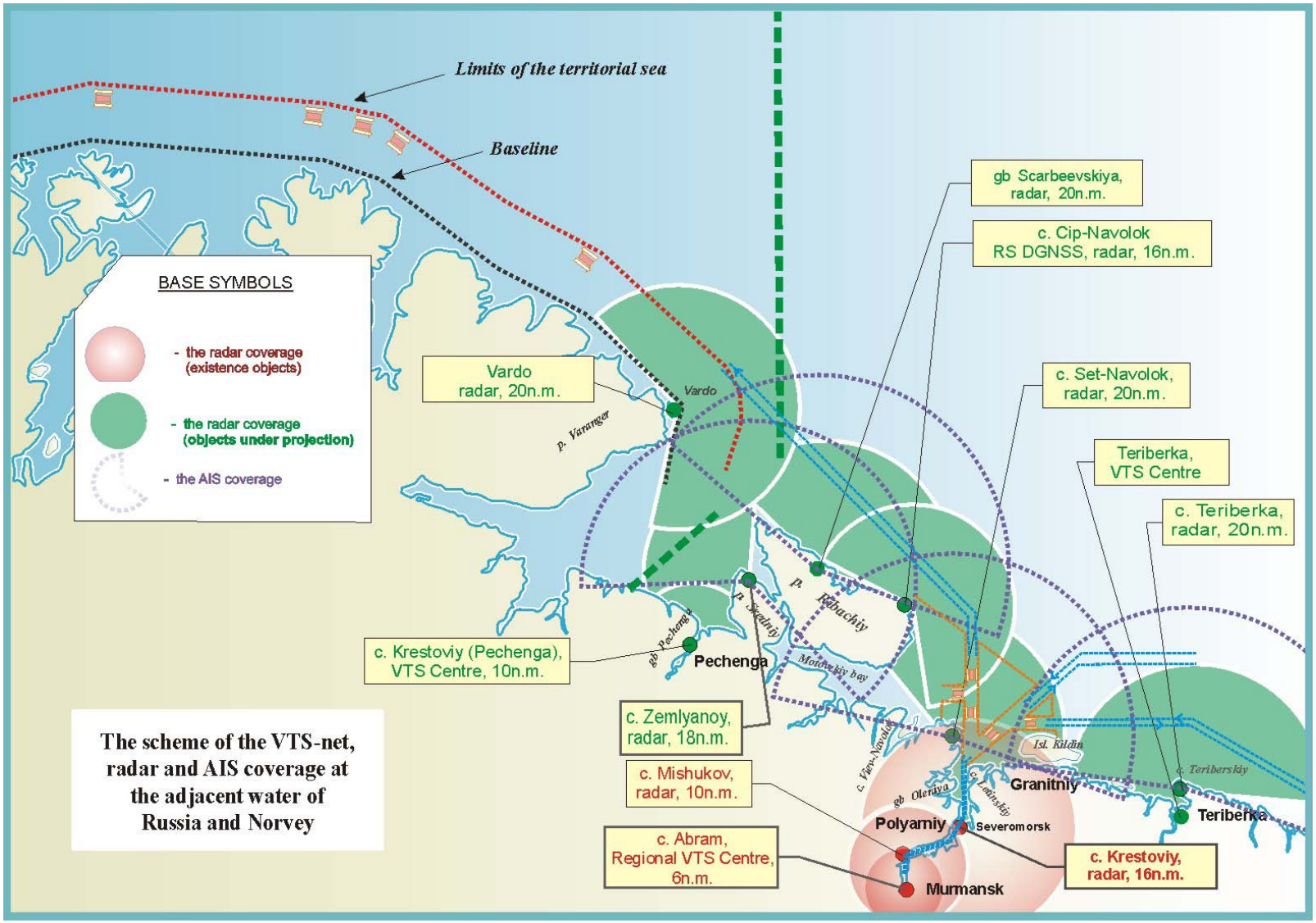


Figure 10: Scheme of VTS-net in Norwegian-Russian Water

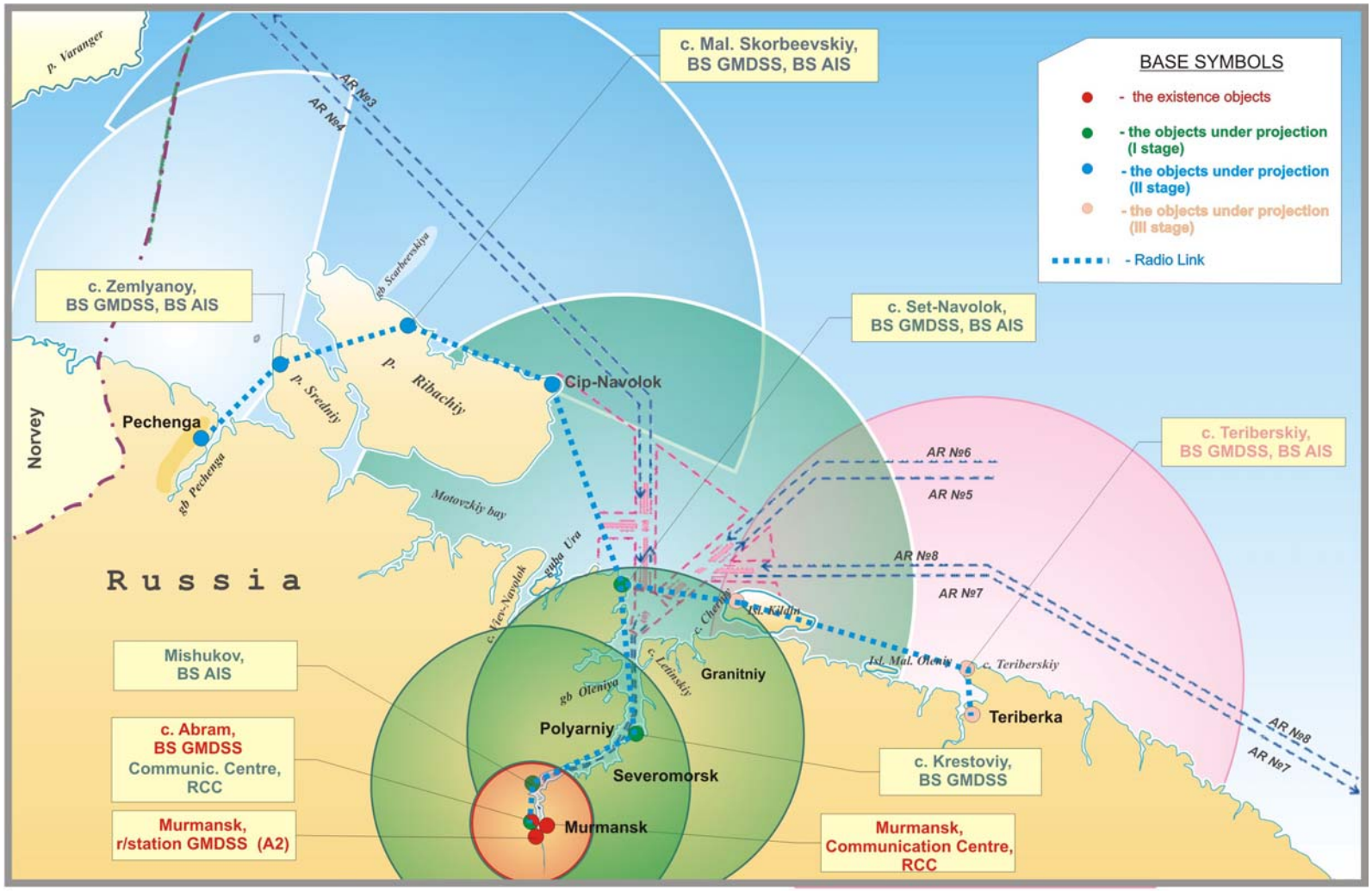
Structure of the System of safety of navigation of this region will include:

«Regional VTS of the Kola Inlet with the VTS centre on Abram-cape (port of Murmansk) and remote control automatic radiotechnic posts (ARPs) on points»:

- Mishukov cape, Krestovy cape, Set-Navolok cape, m.Tsip-Navolok cape, Maly Scorbeevsky cape;
- VTS in Pechenga Bay with the VTS Centre combined with ARP on Krestovy cape and remote ARP on Zemlinoy cape;
- VTS on Teriberka port with the VTS Centre and ARP Teriberca cape;
- Base stations of AIS, included in structure of VTS, placed on objects:
    - Mishukov cape.
    - Set-Navolok cape,
    - Tsip-Navolok cape,
    - Maly Scorbeevsky cape,
    - Zemlinoy cape,
    - Teriberca cape
- Control and adjusting station DGPS on the Tsip-Navolok cape.
- Base station of GMDSS for sea area A1, placed on objects:
    - Abram cape,
    - Krestovy cape,
    - Set-Navolok cape,
    - Maly Scorbeevsky cape,
    - Zemlinoy cape,
    - Teriberca cape
- Base station of GMDSS for sea area A2, placed in the Fishing port of Murmansk;
- Radio Links, connecting all objects VTMIS of region with the Centre .
- The control of all objects of VTMIS will be carried out from the regional VTS centre, located on Abram cape in Murmansk.

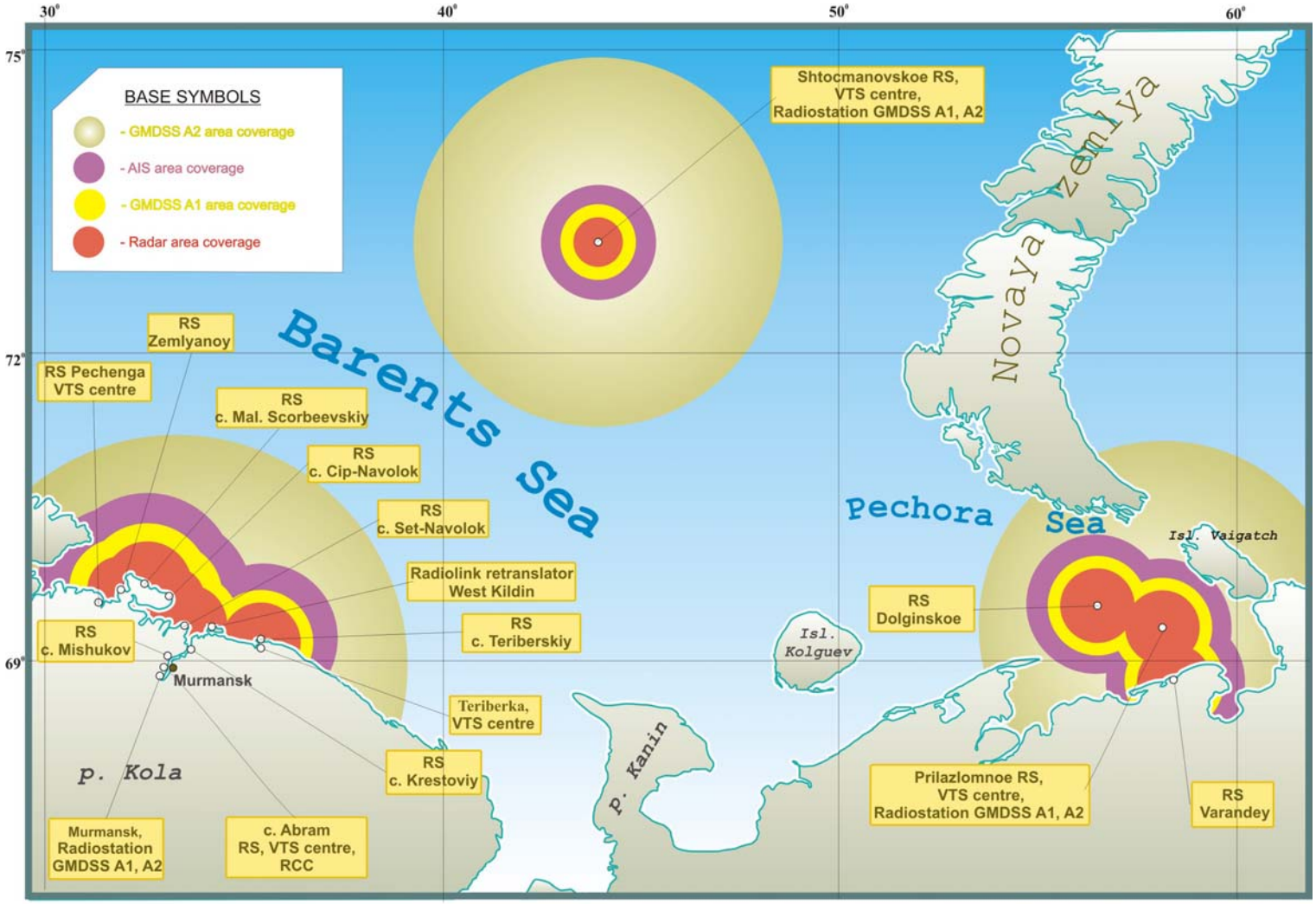
The Marine administration of the port of Murmansk under the assignment of the Ministry of Transport of Russia is carrying on design and construction works for modernization of objects, which are already working, and for the creation of some new objects for regional VTS in the Kola Inlet. A VTS centre in Murmansk (Abram Cape) is under exploitation. This Centre organizes the operation of unman remote-controlled radiotechnical Posts in capes Mishukov and Krestovy

The commissioning of all objects VTS Kola Inlet, Pechenga gulf and coast of Barents sea will create the preconditions for realization of integrated Russian-Norwegian VTMIS, which should supply an effective control and management of navigation in this region with the purpose of the safety of navigation, efficiency of search-rescue operations, protection of an environment, bioresources, and also protection of courts and ports within the limit of measures on struggle with terrorism, the decision on which realization was accepted on 76 Sessions of Committee on safety at the sea by IMO.



The scheme of GMDSS (A1) Base Stations and AIS Base Station at the Kola Inlet and Barents Sea

Figure 11: Scheme of GMDSS and AIS Base Stations at the Kola Inlet and Barents Sea



General scheme of the Safety Navigation System at the Northern region

Figure 12: Scheme of Safety Navigation System at the Northern Region

Integrated Russian-Norwegian VTMIS should be based on the already active VTMIS stations and on the realization by Russia and Norway of the projects of the national VTS stations.

Under condition of duly financing, all objects of regional VTMIS will be in commission and the organization of Russian-Norwegian VTMIS may be carried out in 2006.

For the decision of technical and organizational questions of creation Russian-Norwegian VTMIS, the working groups of the representatives of the competent representatives of the Russian and Norwegian organizations are formed, and the plans of measures on realization of the project are worked up.

In January, 2003 in Murmansk the meeting under presidency of the Chairman of Government of Russian Federation was held, where the questions of the safety of navigation and protection of an environment were discussed as well. As a result of the decisions of this meeting, the Ministry of Transport of Russia has developed the concept of creation of the system of the safety of navigation in region from Pechenga Bay to Dudinka, the basic ways of this realization will be considered. And the volumes of financing for creation of such system will be determined.

In addition to realization of the projects for creation of local and regional monitoring systems and management of navigation, according to the order of the Minister of transport of Russian Federation, 2000, the Global automated system of monitoring and control of the Russian vessels position was created. The system provides global monitoring and positions control for vessels which are registered in the system.

The system is based on the complex use of traditional sea satellites (means GMDSS, and in the prospect - as a complex with AIS) and channels of communication within a combination with satellite navigation technology. The system provides vessels at world ocean with the bilateral automated communication and implements the vessel monitoring in real time mode (in a regular mode - 2 times per day, if necessary - every 10 minutes), and also gives general information about vessel. For the collection and transfer of the information, the standard conventional ship INMARSAT–C equipment and equipment, that is established at the centre of monitoring (Ministry of Transport of Russia) with the specialized software is used in the system.

Nowadays monitoring system server supplies Ministers of Transport RF with information from 700 registered ships. System server serves almost 100 foreign ships too on voluntary basis.

There is a plan of modernization the system Safe Sea Net aiming to develop possibility on line stream of navigational information with coverage from Pechenga to Dudinka. It will enhance the safety of navigation essentially. Safe Sea Net adopted to be integrated with another satellite systems planed to implement by Norway. It will permit to develop the net with enhance services including uninterrupted monitoring and tracking the ships sailing on Arctic sea routers. Consequently it will contribute of decreasing accident risk, improving the safety at sea and increasing cargo transportation.

8.6 Conclusions

1. On-coming development of Arctic Shelf resources will put the enhancement the shipping activity in Arctic seaways. By all expectations more than 50 % of ship passed will be tankers and gas carriers.
2. Russian Maritime Administration take measures to improve the aids of navigation projecting and implementing the up-to-data ship-borne and shore-base equipment. The technology to implement VTMIS is largely in place.
3. Cooperation with Norway in development high effective VTMIS-NET is considered as positive.

8.7 References

1. Landesparlament Mecklenburg – Vorpommern. Maritime Safety in the Baltic Sea Area. I., Schwerin, 25.04.2001.
2. VTMIS-NET COMPENDIUM. 2000. «Transport RTD Programme», Project number: WA-9-SC2135, Vessel Traffic Management and Information Services network. Design and Production: ISSUS.
3. The IX-th ICC Meeting of TEDIM Programme, 19-th September 2000, p.5(8), Lubeck, Germany.
4. VTT Industrial Systems, 2000 a. The implementation of the VTMIS-system for the Gulf of Finland. Research report VAL34-013153. VTT Industrial Systems, Espoo, Finland, 2002.
5. MEMORANDUM OF UNDERSTANDING between The Ministry of Transport and Communications of Estonia and The Ministry of Transport and Communications of Finland and The Ministry of Transport of The Russian Federation on strengthening the cooperation to further enhance the maritime safety in The Gulf of Finland. October 2001.
6. IMO. NAV 48/3/1, 28 MARCH 2002, ANNEX 4 FSA STUDY OF THE RISKS OF TRAFFIC IN THE GULF OF FINLAND. FORMAL SAFETY ASSESSMENT. VTT Industrial Systems, 2002.
7. IMO Resolution A.857(20) adopted 20.11.1997. Guidelines for Vessel Traffic services.
8. COST 301, Shore – based marine navigation systems, Executive report, EUR 11250 EN, 1987.
9. VESSEL TRAFFIC MANAGEMENT AND INFORMATION SERVICES (VTMIS). Mike Hadley, DERA, UK and Ingo Harre, STN ATLAS ELECTRONIC, Germany (s. ref.[2]).