

**MODEL
COURSE
1.34**

**AUTOMATIC
IDENTIFICATION
SYSTEMS**

2006 Edition

Electronic Edition

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IDENTIFICATION
SYSTEMS**

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ELECTRONIC EDITION

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Foreword

Since its inception, the International Maritime Organization (IMO) has recognized the importance of human resources to the development of the maritime industry and has given the highest priority to assisting developing countries in enhancing their maritime training capabilities through the provision or improvement of maritime training facilities at national and regional levels. IMO has also responded to the needs of developing countries for postgraduate training for senior personnel in administrations, ports, shipping companies and maritime training institutes by establishing the world Maritime University in Malmö, Sweden, in 1983.

Following the adoption of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978, a number of IMO Member Governments suggested that IMO should develop model training courses to assist in the implementation of the Convention and in achieving a more rapid transfer of information and skills regarding new developments in maritime technology. IMO training advisers and consultants also subsequently determined from their visits to training establishments in developing countries that the provision of model courses could help instructors improve the quality of their existing courses and enhance their implementation of associated Conference and IMO Assembly resolutions.

In addition, it was appreciated that a comprehensive set of short model courses in various fields of maritime training would supplement the instruction provided by maritime academies and allow administrators and technical specialists already employed in maritime administrations, ports and shipping companies to improve their knowledge and skills in certain specialized fields. With the generous assistance of the Government of Norway, IMO developed model courses in response to these generally identified needs and now keeps them updated through a regular revision process, taking into account any amendments to the requirements prescribed in IMO instruments and any technological developments in the field.

These model courses may be used by any training institution and, when the requisite financing is available, the Organization is prepared to assist developing countries in implementing any course.

E. E. MITROPOULOS
Secretary General

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Introduction

■ Purpose of the model courses

The purpose of the IMO model courses is to assist maritime training institutes and their teaching staff in organizing and introducing new training courses or in enhancing, updating or supplementing existing training material where the quality and effectiveness of the training courses may thereby be improved.

It is not the intention of the model course programme to present instructors with a rigid “teaching package” which they are expected to “follow blindly”. Nor is it the intention to substitute audio-visual or “programmed” material for the instructor’s presence. As in all training endeavours, the knowledge, skills and dedication of the instructors are the key components in the transfer of knowledge and skills to those being trained through IMO model course material.

Because educational systems and the cultural backgrounds of trainees in maritime subjects vary considerably from country to country, the model course material has been designed to identify the basic entry requirements and trainee target group for each course in universally applicable terms, and to specify clearly the technical content and levels of knowledge and skill necessary to meet the technical intent of IMO conventions and related recommendations.

■ Automatic Identification Systems

The Organization has mandated in SOLAS Chapter V the carriage of equipment meeting the requirements of the Universal Shipborne Automatic Identification System (AIS) on all larger ships (as defined in Section 3.1 of this model course) to enhance the safety of life at sea, the safety of navigation and the protection of the marine environment. It does this by identifying vessels and other collaborative targets, assisting in target tracking, aiding situational awareness (and thereby collision avoidance), and in simplifying the exchange of safety and security-related information between ships and between ships and the shore.

The on-board AIS equipment takes inputs from the ship’s navigational sensors and, together with information concerning the ship and its voyage, transmits to surrounding vessels and shore stations. It also receives information from other vessels, shore stations and AIS-fitted aids-to-navigation. The received data is displayed on the ship as alpha-numeric lists on a dedicated display, optionally assisted by showing graphically the position, heading, course and speed of targets. Ideally, AIS targets are displayed on a radar screen or on ECDIS (that can also display radar tracked targets). All radars fitted from 1 July 2008 must be able to display AIS data in this way.

Shore stations use the data for Vessel Traffic Services (VTS) and for national vessel monitoring purposes, including security enhancement. The data is normally displayed with radar at these stations.

The on-board operator has to input accurate information concerning own-ship, some of which is voyage dependent, and hence needs to be kept updated. In conjunction with other navigational information, knowledgeable interpretation of the received data can greatly

enhance situational awareness, but AIS is a complex communications/navigation sub-system that is self-evident neither in concept nor in use. Because of this it is important that an officer in charge of a navigational watch (OOW) on a vessel carrying AIS is well trained in its use.

Courses based on this model course may be stand-alone and as such will be useful for updating existing watch keeping staff. For seafarers who are training to become an OOW it is good practice to ensure an appropriate level of integration between this model course and Model Course 1.07 (Radar navigation, radar plotting and use of ARPA) and Model Course 7.03 (Officer in charge of a navigational watch).

Training colleges undertaking such a course will need a simple AIS simulator and a radar target tracker (ARPA) simulator with AIS display capabilities. System requirements are discussed under “Teaching facilities and equipment” in Part A of this model course. A detailed discussion on simulator exercises is given in the final section of Part D.

■ Use of the model course

To use the model course the instructor should review the course plan and detailed syllabus, taking into account the information provided under the entry standards specified in Part A Course Framework. The actual level of knowledge and skills and the prior technical education of the trainees should be kept in mind during this review. Also, any areas within the detailed syllabus, which may cause difficulties because of differences between the actual trainee entry level and that assumed by the course designer, should be identified. To compensate for such differences, the instructor is expected to either delete from the course, or reduce the emphasis on, items dealing with knowledge or skills already attained by the trainees. The instructor should also identify any academic knowledge, skills or technical training which they may not have acquired.

By analysing the detailed syllabus and the academic knowledge required to allow training in the technical area to proceed, the instructor can design an appropriate pre-entry course or, alternatively, insert the elements of academic knowledge required to support the technical training elements concerned at appropriate points within the technical course.

Adjustment of the course objective, scope and content may also be necessary if the trainees completing the course are to undertake duties which differ from the course objectives specified in the model course.

Within the course plan the course designers have indicated their assessment of the time which should be allotted to each area of learning. However, it must be appreciated that these allocations are only suggestions and assume that the trainees have fully met all entry requirements of the course. The instructor should therefore review these assessments and may need to reallocate the time required to achieve each specific learning objective or training outcome.

■ Lesson planning

Having adjusted the course content to suit the trainee intake and any revision of the course objectives, the instructor should draw up lesson plans based on the detailed syllabus. The detailed syllabus contains specific references to the textbooks or teaching material proposed

to be used in the course. Where no adjustment has been found necessary in the learning objectives of the detailed syllabus, the lesson plans may simply consist of the detailed syllabus with keywords or other reminders added to assist the instructor in preparing the presentation of the material.

■ Meeting the required performance

The instructor must be satisfied that the trainee has attained each specific learning or training objective. In order to achieve these objectives, it may be necessary for the instructor to repeat the presentation of concepts and methodologies in varying ways. The syllabus is laid out in learning objective format and each objective specifies a *required performance* or *what the trainee must be able to do* as the learning or training outcome. Taken as a whole, these objectives aim to meet the knowledge, understanding and proficiency specified in the appropriate tables of the STCW Code.

■ Course implementation

For the course to run smoothly and to be effective, considerable attention must be paid to the availability and use of:

- properly qualified instructors
- support staff
- rooms and other spaces
- equipment
- suggested references, textbooks, technical papers and other reference material.

Thorough preparation is the key to successful implementation of the course. The IMO booklet entitled *Guidance on the implementation of IMO model courses*, which deals with this aspect in greater detail, is included in this course.

■ Familiarization training

In order to facilitate on-board familiarization training Annex I of this course gives recommendations to manufacturers and companies on the information that should be included within the training.

Part A: Course framework

■ Aims

This course provides information on the generic use of AIS. It is designed for officers in charge of a navigational watch (OOW) on ships that are fitted with such equipment. Its main aims are to increase safety and security and to protect the environment. It does this by giving instruction on the understanding and safe use of such systems, including illustrations of dangerous or improper use. Successful completion of the course enables trainees to acquaint themselves knowledgeably with specific AIS equipment fitted on a ship (familiarization), prior to using the equipment in a safe and beneficial manner at sea.

The course takes into account all relevant IMO resolutions and guidelines on AIS available at the time the model course was prepared, including AIS requirements on new radar and navigational displays, mandated by the Maritime Safety Committee to come into force on 1 July 2008. It also takes into account the relevant sections of the revised SOLAS Chapter V which came into force on 1 July 2002. Where appropriate, it also takes note of common implementation practice, as influenced by Administrations, international standards bodies and manufacturers.

■ Course objectives

Trainees successfully completing this course and meeting the required performance standards, will be able to:

- Understand the objectives of AIS.
- Understand how AIS works as a system.
- Understand the benefits and limitations of the system.
- Understand the decision making process that needs to be applied in using such systems.
- Demonstrate competency in entering and checking ship's AIS data.
- Demonstrate competency in the use of AIS as an additional navigational tool to aid situational awareness and collision avoidance.
- Demonstrate competence in sending and responding to safety and security-related messages.
- Rapidly familiarize themselves with a particular AIS implementation on a ship, prior to use at sea.

■ Entry standards

The course is designated both for candidates for certification as officers in charge of a navigational watch and for experienced nautical officers and other persons with responsible duties in navigation work, such as pilots.

Those wishing to enter this course should have had training and experience in the use of radar and ARPA and be fully conversant with the Collision Regulations.

■ Course certificate, diploma or document

Every master, chief mate and officer in charge of a navigational watch should have completed a course conforming to this model.

On successful completion of the course and assessments, a document may be issued certifying that the holder has successfully completed a course of training in the operational use of AIS in accordance with the recommendations contained in this course.

■ Course intake limitations

The course intake will be limited by the availability of simulator equipment, particularly an ARPA simulator with AIS display facilities. AIS-specific training does not necessarily require a full-mission bridge simulator but if such a simulator is used, when AIS is being taught as part of a wider course, then experience shows that the effectiveness of practical training is optimised when the intake does not exceed four trainees on such a simulator.

See section on *Teaching facilities and equipment*, below.

■ Staff requirements

The qualifications of the instructor should be in accordance with requirements laid down in section A-I/6 of the STCW Code.

The instructor should be thoroughly familiar with the operation of the equipment to be used in the course.

■ Teaching facilities and equipment

For the theoretical part of the syllabus, a classroom equipped with at least an overhead projector and a flip chart (or equivalent) will be required. A computer driven projector is ideal as this can be used to demonstrate AIS features and use to the complete class, utilising a basic software simulator.

For this course AIS training exercises can be adequately performed on single screen simulators running suitable software. The software should have the following simulation facilities:

- AIS minimum keyboard and display (MKD).
- Tracked target (ARPA) radar display with AIS overlay capability.
- Optionally, ECDIS with ARPA and AIS overlay capability.

If this course is used stand-alone, either for OOW-qualified seafarers, or for trainees who have already successfully undertaken a course in the use of radar equivalent to Model

Course 1.07 (Radar navigation, radar plotting and use of ARPA), then the use of a full bridge simulator (with AIS facilities) is not really necessary, although such facilities, where available, offer a good AIS learning experience.

If this course is combined with other training, such as Model Course 1.07 and Model Course 7.03 (Officer in charge of a navigational watch), full mission bridge simulator training that includes AIS, particularly displayed on radar, can be extremely useful.

■ Teaching aids (A)

- A1 Instructor Manual (Part D of this Course)
- A2 Video tape or DVD player
- A3 Video cassettes or DVDs about the use of AIS. For example, *Automatic Identification Systems*, available from Videotel Productions, London
- A4 Simulator software
- A5 Simulator data for an appropriate area

■ IMO references (R)

- R1 Resolution A.917(22), Guidelines for the on-board operational use of shipborne Automatic Identification systems (AIS)
- R2 Resolution MSC.74(69), Annex 3, Recommendations on performance standards for a universal Shipborne Automatic Identification System (AIS)
- R3 Resolution A.956(23), Amendments to the guidelines for the on-board operational use of shipborne Automatic Identification systems (AIS) (Resolution A.917(22))
- R4 SN/Circ. 236, Guidance on the application of AIS Binary Messages
- R5 SOLAS Chapter V, as amended
- R6 SN/Circ. 227, Guidelines for the installation of a shipborne Automatic Identification System (AIS)
- R7 Resolution MSC.192(79), Adoption of the revised performance standards for radar equipment
- R8 SN/Circ. 243, Guidelines for the presentation of navigation-related symbols, terms and abbreviations
- R9 STCW Code and STCW Convention, 1995
- R10 International Safety Management (ISM) Code and guidelines, 2002
- R11 SN/Circ. 244, Guidance on the use of UN/LOCODE in the destination field of AIS messages
- R12 SN/Circ. 217, Interim guidelines for the presentation and display of AIS target information
- R13 SN/Circ. 222, Information on regional operating areas and regional operating frequencies available for AIS use
- R14 SN/Circ. 245, Amendments to the guidelines for the installation of a shipborne Automatic Identification System (AIS)

■ Other references (T)

- T1 A. Parkinson, S. Barker and M. Shorthose, *Understanding SOTDMA applied to AIS*, Proceedings of the Royal Institute of Navigation AIS03

- T2 ITU-R M.1371, Technical characteristics for a universal automatic identification system using time division multiple access in the VHF maritime mobile band, International Telecommunication Union, Geneva
- T3 IEC 61108-1 Global navigation satellite systems Part1: GPS, Second edition, 2003, International Electrotechnical Commission, Geneva
- T4 I. P. A. Stitt, *AIS and collision avoidance – a sense of déjà vu?*, The Journal of Navigation, Volume 57, Number 2, May 2004, pp167–180
- T5 IEC61993-2 Class A shipborne equipment of the universal automatic identification system (AIS), 2001, International Electrotechnical Commission, Geneva
- T6 IEC 61162-1 Digital interfaces Part 1: Single talker and multiple listeners, 2000, International Electrotechnical Commission, Geneva
- T7 *International Safety Guide for Oil Tankers and Terminals*, 4th Edition, 1996, OCIMP/ICS/IAHP
- T8 IEC 62287 AIS Class B equipment for non-SOLAS vessels (under preparation), International Electrotechnical Commission, Geneva

■ Bibliography (B)

Instructors are recommended to visit www.iala-aism.org, the website of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) to obtain the latest reports and information concerning AIS Aids to Navigation and AIS VTS operations. Trainees should be made aware of the usefulness of this website.

Part B: Course outline and timetable

The course comprises lectures, demonstrations and simulator exercises. The outline below identifies the main areas of the course and the approximate time that should be allocated to each activity of teaching. With modern classroom technology these activities can often be merged into a continuous exposition of a particular area of understanding, rather than having to move from room to room.

In particular, the lecture can be digitally projected from presentation material (slides, animation and video) directly from a computer that also runs AIS and radar/tracking simulation software, making it easy for the lecturer to alternate between theory and example. Readily available software tools facilitate this. The use of simulators for demonstration and trainee exercises is discussed in the final section of Part D.

Some simulator exercises emphasising particular skills can be performed beneficially in the classroom on individual personal computers (PCs). If possible, exercises on more complex simulators are very useful towards the end of a course to demonstrate that a complete understanding has been obtained and within a team-working environment.

Learning Objective format is used in the Detailed Teaching Syllabus given in Part C; the outline below is a straightforward summary of the course material. The numbering system used below reflects that of the Detailed Teaching Syllabus.

In the following table all lesson times are given in hours for lectures, demonstrations and simulator exercises. Durations given in bold type are the totals for each section.

Training area	Lecture	Dem	Sim Ex
1 AIS concepts A basic description of AIS at a systems level: ● AIS objectives of the Organization ● Concepts ● Comparison of AIS with radar	1.3	0.2	
2 AIS data Detailed description of AIS data at a user level including safety/security related messages, AIS Aids to Navigation and AIS Binary Messages.	0.8	0.2	
3 AIS ship installations AIS configuration description, including: ● Carriage requirements ● MKD based configuration ● Radar/ECDIS configuration ● Overview of operational problems caused by installation issues	0.8	0.2	
4 Use of AIS at sea The safe use of AIS at sea: ● Bridge procedures ● Data input and checking ● UN/LOCODES ● Use of safety and security related messages ● Use of AIS Binary Messages ● Use of AIS in areas with security or piracy implications ● Use of AIS in oil terminals ● AIS alarms ● Cautions of use of AIS ● Use of AIS to increase situational awareness in for both MKD only and radar/ECDIS installations ● Implications of COLREGS ● Use of AIS AtoN data ● Manual setting of regional operating settings	3.5	0.5	2.0
5 Familiarization training Description of information needed to become quickly familiarized with a ship's particular AIS configuration.	0.5		
Total training duration 10 hours	6.9	1.1	2.0

Simulator exercises are suggested in *Guidance on simulators* in Part D of this model course.

Part C: Detailed teaching syllabus

The detailed teaching syllabus indicates the contents of the course and appropriate references and teaching aids.

■ Learning objectives

The detailed teaching syllabus has been written in learning objective format in which the objective describes what the trainee must do to demonstrate that knowledge has been transferred. This format is an appropriate teaching and assessment tool to express:

- The depth of understanding of a subject and the degree of familiarization with a subject on the part of the trainee.
- What capabilities the trainee should really have and be able to demonstrate.

Every instructor is encouraged to teach learning in an “objective-related” way instead “material-related”. In this context, all objectives are understood to be prefixed by the words, “The expected learning outcome is that the trainee is able to...”.

To indicate the degree of learning outcome of this course, the learning objectives for the Detailed Teaching Syllabus can be classified in three “dimensions”:

- C (cognitive)
- A (affective)
- P (psycho-motor).

Within a dimension, they are hierarchised by increasing complexity (C1 to C6, A1 to A5, and P1 to P5) where the complexity (depth, familiarization) is expressed (following B. Bloom and others) by a typical verb as follows:

Cognitive dimension of learning objectives:

C1	Knowledge	describe, outline
C2	Comprehension	explain
C3	Application	apply, perform, operate
C4	Analysis	analyse
C5	Synthesis	synthesise, construct, plan
C6	Evaluation	assess

Affective dimension of learning objectives:

A1	Reception; notice	recognize
A2	Response	respond
A3	Value	value

A4	Organization	organize
A5	Value characterization	accept, appreciate

Psycho-motor dimension of learning objectives:

P1	Imitation	imitate
P2	Manipulation	manipulate
P3	Precision	move, mark
P4	Co-ordination	co-ordinate (operations, menus)
P5	Naturalization	automate, internalize

■ References and teaching aids

In order to assist the instructor, references are shown against the learning objective to indicate IMO references and publications, bibliographies, textbooks and other references, as well as additional teaching aids, which the instructor may wish to use when preparing course material. The material is listed in the course framework. The following notations and abbreviations are used:

R	IMO reference
T	Text book and other references
B	Bibliography
A	Teaching aid
Ap.	Appendix
An.	Annex
Ch.	Chapter
p.	Page
Para.	Paragraph
Sc.	Section

The following are examples of the use of references:

“R1 Para. 6”, refers to paragraph 6 of IMO Resolution A. 917(22);

“A1 Para. D4.3”, refers to paragraph 4.3 in Part D of this manual; and

“A1 Sc.DSim”, refers to the *Simulator Exercises* section in Part D of this course.

■ Instructor manual

The instructor manual (Part D) is included to provide additional information to instructors. It is designed to help further in structuring and organizing a specific course. At the time of compilation of this model course there were no known text books covering the subject material. For this reason Part D includes extra information on the subject. The instructor is

recommended to gain additional technical material from AIS suppliers. Suppliers of simulators are also good sources of technical information.

The instructor should take pains to present the material within “a-use-at-sea” context. It is not just a matter of imparting technical knowledge. If the instructor has had no sea-going experience in the use of AIS it will be necessary to extrapolate his or her non-AIS experience to incorporate the ideas and disciplines of using AIS.

■ Detailed teaching syllabus

All objectives are understood to be prefixed by the words “The expected learning outcome is that the trainee is able to...”. The Teaching Aid reference to A1 Sc.DSim, refers to the section on Simulator Exercises in Part D of this model course.

Learning objectives	IMO Reference	Other Refs	Teaching Aid
1 AIS concepts <i>Section objective: to understand the objectives of AIS, the concept and relevant aspects of the technology relevant to its use.</i>			
1.1 Explain the objectives of AIS.	R1 Para. 4, R2 Para. 1.2		A1 Para. D1.1
1.2 Outline the system concepts of AIS.	R1 Para. 5-10	T2	A1 Para. D1.2, A3
1.3 Outline the self-organizing time division multiple access concept of AIS.	R1 An. 2	T1, T2	A1 Para. D1.3, A3
1.4 Describe the modes of operation.	R2 Para. 2.1	T2	A1 Para. D1.4
1.5 Outline the principles of regional operating settings.		T2, T5	A1 Para. D1.5
1.6 Describe the major constituents of an AIS shipborne system.	R1 An.1		A1 Para. D1.6, A3
1.7 Outline AIS Class B systems.		T8	A1 Para. D1.7
1.8 Outline the propagation characteristics of AIS transmissions and compare with radar.	R1 Para. 9		A1 Para. D1.8
1.9 Outline the facility for long-range communication.	R1 Para. 48		A1 Para. D1.9
1.10 Recognize and accept the IMO requirements and guidelines for AIS.	R1, R2, R3, R4, R6, R7, R8, R11, R12		A1 Para. D1.10

Learning objectives	IMO Reference	Other Refs	Teaching Aid
2 AIS data <i>Section objectives: to understand the data transmitted and received by AIS.</i>			
2.1 Explain the information included in static data and the associated transmission intervals.	R1 Para.11-13	T2	A1 Para. D2.1, A4
2.2 Explain the information included in dynamic data and the associated transmission intervals.	R1 Para.11-13	T2	A1 Para. D2.2, A4
2.3 Explain the information included in voyage-related data and the associated transmission intervals.	R1 Para.11-13	T2	A1 Para. D2.3, A4
2.4 Explain the functionality of safety and security-related messages.	R1 Para.14-15		A1 Para. D2.4, A4
2.5 Explain the functionality of AIS aids to navigation.	R1 Para. 50		A1 Para. D2.5, A4
2.6 Explain the purpose of AIS Binary Messages.	R4	T2	A1 Para. D2.5
3 AIS ship installations <i>Section objectives: to understand AIS ship installation options and the common operational problems that can arise from poor installation.</i>			
3.1 Define the carriage requirements.	R5 Reg.19 Sec. 2.4		A1 Para. D3.1
3.2 Describe a typical MKD installation.	R1 An.1		A1 Para. D3.2, A3
3.3 Describe a typical ARPA/ECDIS installation.	R7		A1 Para. D3.3, A3
3.4 Explain common detrimental effects given by poor installation or the retrofitting of interfering systems.	R6		A1 Para. D3.4
4 Use of AIS at sea <i>Section objectives: to understand the safe use of AIS at sea.</i>			
4.1 Describe the need and use of bridge procedures for AIS.			A1 Para. D4.1
4.2 Describe what static data needs to be entered, recognize the need to check this data and <i>demonstrate</i> competency in the procedures.	R1 Para.12, 23		A1 Para. D4.2, A4
4.3 Describe what voyage-related data needs to be entered, including the use of UN/LOCODES, <i>recognize</i> the need to check this data and <i>demonstrate</i> competency in the procedures.	R1 Para.12, 22, 26 R6 An.2, R11		A1 Para. D4.3, A4

Learning objectives	IMO Reference	Other Refs	Teaching Aid
4.4 <i>Recognize</i> the need to check dynamic data, describe the need to enter the navigational status of the ship as part of the dynamic data and <i>demonstrate</i> competency in the procedures.	R1 Para.12, 24, 26		A1 Para. D4.4, A4
4.5 <i>Describe</i> the use of safety and security-related messages and <i>demonstrate</i> competency in the procedures.	R1 Paras.14-20		A1 Para. D4.5, A4
4.6 <i>Describe</i> the use of AIS binary messages.	R4		A1 Para. D4.6
4.7 <i>Describe</i> the use of AIS in areas that may have security or piracy implications.	R1 Para. 21, R3		A1 Para. D4.7
4.8 <i>Explain</i> the special precautions on using AIS in oil terminals.		T7	A1 Para. D4.8
4.9 <i>Outline</i> AIS alarm conditions.		T5	A1 Para. D4.9, A4
4.10 <i>Explain</i> the cautions that should be used when using AIS and <i>demonstrate</i> this understanding.	R1 Para. 2, 31-43		A1 Para. D4.10, A3, A4
4.11 <i>Describe</i> how to enhance situational awareness on an MKD based system and <i>demonstrate</i> competency in this understanding.	R1 Para. 39-43		A1 Para. D4.11, A3, A4
4.12 <i>Describe</i> the Organization's mandated AIS symbology for use on radar and other navigational displays and how to enhance situational awareness on ARPA/ECDIS based system. <i>Demonstrate</i> competency in these areas.	R8 Ap., R7		A1 Para. D4.12, A3, A4
4.13 <i>Explain and demonstrate</i> the application of the COLREGS when using AIS data.		T4	A1 Para. D4.13
4.14 <i>Explain</i> the display of AIS aids-to-navigation on shipborne AIS equipment and demonstrate competency in recognizing such AtoNs.	R8 Ap.		A1 Para. D4.14
4.15 <i>Demonstrate</i> the manual entering of regional operating settings.		T2, T5	A1 Para. D4.15
5. Familiarization training <i>Section objective: to understand the familiarization responsibilities in the use of AIS in order to operate a specific installation.</i>			
5.1 <i>Describe</i> a familiarization checklist.	R9, R10		A1 Para. D5

Part D: Instructor manual

■ General

This manual reflects the views of the course designers on methodology and organization, including the:

- Selection of principal AIS subjects.
- Relative importance of these subjects.
- Interrelations between these subjects.
- Learning objectives.
- Necessary teaching tools.
- Time allocated to achieving the learning objectives.

The guidance given is intended to give the instructor a baseline on which to work out and develop a course that will meet the particular local requirements and the instructor's own experience and ideas. As the course develops the instructor should refine and develop what is successful and discard those ideas which do not work.

Guidance is provided in *Guidance on the implementation of IMO model courses*, which includes a checklist for preparation of courses. Preparation and planning constitute an important factor, which makes a major contribution to the effective presentation of the course.

■ Theory, demonstration and exercises

Theory lectures

The safe use of AIS requires good knowledge and understanding of the concept and basic principles of AIS, taught as classroom lectures. Special emphasis should be laid on giving information about typical ship configurations of AIS, including its common interconnection to other equipment such as GNSS, radar and ECDIS. Guidance on the practical use of AIS should be given, particularly the input and checking of ship-related data and the use of AIS to improve situational awareness and as a further aid to assist collision avoidance decisions.

As far as possible, such lessons should be presented within a familiar context and make use of practical examples. They should be well-illustrated with diagrams, photographs and charts where appropriate, and be related to matter learned or reinforced during simulator exercises. The use of an overhead projector, if possible computer-based, will greatly enhance the value of these lectures. Distribution of copies of the presentation screens as trainee handouts contribute to the learning process.

The guidance on specific subject areas included in Part D included many "bulleted" lists of information. The Instructor may wish to include these in projected "slides", suitably modified to fit the specific teaching requirements.

Demonstration

During presentation of the theory many of the concepts can be shown as a computer simulation, ideally projected as part of the overhead presentation, but possibly shown on a computer screen, or screens, easily viewable by participants.

Simulator exercises

It is an essential part of the course that sufficient practical experience is gained on suitable simulators. Many aspects can be learnt on single screen simulators running suitable software, simulating an MKD. (The MKD is described in Section 1.6 below.) Some time should be spent on a more complex simulator that allows AIS data to be displayed on a radar with tracking facilities (e.g. ARPA), which is also displaying appropriately co-ordinated radar data. Display of this data on an ECDIS simulator would also be useful. For real time navigation exercises of this type, navigation simulators that co-ordinate the radar tracking and AIS data are necessary.

■ Evaluation

The outcome of the training course should be evaluated. Because the course includes theoretical knowledge as well as practical skills and guidance in proper decision making, the method of evaluation and the criteria for evaluating competency (correctness of method, correctness of outcome, duration, compliance, effectiveness, etc.) should take all these aspects into account. The learning objectives used in the detailed syllabus should provide a sound basis for the construction of suitable tests for evaluating trainee progress. The effectiveness of any evaluation depends upon the accuracy of the description of what is to be measured.

Further guidance on method of evaluation, validity, reliability, subjective testing, objective testing, distracters and guessing (if using multiple choice tests) and scoring is provided in *Guidance on the implementation of IMO model courses*.

■ Lesson plans

The instructor should draw up lesson plans for the individual lessons based on the course objectives and the detailed syllabus taking account any necessary revision of course content to suit the trainee intake. An example of a lesson plan (60 minutes) is shown below. The lesson plans may simply consist of the detailed syllabus with keywords or other reminders added to assist the instructor in making the presentation of the material. The lesson plans may contain specific references to the teaching method, IMO references, bibliography, textbooks and other teaching material proposed for use in the course, instructor guidelines and time (in minutes) allocated to a specific learning objective.

■ Guidance on specific subject areas

This section contains guidance to the instructor on the coverage of the AIS subject areas listed in the course outline and the detailed teaching syllabus. The scope and depth of the subject areas are reflected; essentials are pointed out.

Example of AIS Lesson Plan

2	AIS data	Teaching method	IMO reference	Bibliography textbooks	Instructor guidelines	Time in minutes
2.1	Explain the information included in static data and the associated transmission intervals	Lecture, Dem	R1 Para.11-13	T2 (if additional information is required)	Demonstrate as projected simulator image	10
2.2	Explain the information included in dynamic data and the associated transmission intervals	Lecture, Dem	R1 Para.11-13	T2 (if additional information is required)	Demonstrate as projected simulator image	10
2.3	Explain the information included in voyage-related data and the associated transmission intervals	Lecture, Dem	R1 Para.11-13	T2 (if additional information is required)	Demonstrate as projected simulator image	15
2.4	Explain the functionality of safety and security-related messages	Lecture, Dem	R1 Para.14-15		Demonstrate as projected simulator image	10
2.5	Explain the functionality of AIS aids to navigation	Lecture, Dem	R1 Para. 50		Demonstrate as projected simulator image	5
2.6	Explain the purpose of AIS binary messages and other relevant AIS messages	Lecture	R4	T2 (if additional information is required)		10
Total						60 minutes

Many of the subjects contain objectives which are relevant to different exercises at different levels. Their inclusion in any exercise can reinforce the learning process. A methodology based on the instructor's own experience should be developed bearing in mind that the IMO references help to indicate the required training under each heading.

The paragraph numbering scheme matches the course outline and syllabus, defined in Part C and D, respectively.

1 AIS concepts

1.1 The objectives of AIS

Within Reference R1¹, the Organization has defined the objectives of the shipborne Automatic Identification System (AIS), namely:

AIS is intended to enhance:

- Safety of life at sea.
- The safety and efficiency of navigation.
- The protection of the marine environment.

It also states that the purpose of AIS is to:

- Help identify vessels.
- Assist in target tracking.
- Simplify information exchange (e.g. reduce verbal mandatory ship reporting).
- Provide additional information to assist situation awareness.

Within Reference R2 the “top-level” functional requirements for AIS are stated as:

The AIS should improve the safety of navigation by assisting in the efficient navigation of ships, protection of the environment and the operation of Vessel Traffic Services (VTS), by satisfying the following functional requirements:

- In a ship-to-ship mode for collision avoidance (but see the discussion below).
- As a means for littoral States (coastal States) to obtain information about a ship and its cargo.
- As a VTS tool, i.e. ship-to-shore and shore-to-ship (traffic management).

Instructors should ideally include the IMO (*italicised*) definitions as part of the presentation material. Several points may need to be addressed and expanded, depending on the experience and knowledge of the trainees.

Some comments should be made on the use of AIS for collision avoidance. Importantly, Reference R1 does not use the term “collision avoidance” when stating the purpose of AIS

¹ Reference R1 as modified by Reference R3 is reproduced in Annex II of this model course.

but uses “situational awareness”. This emphasis in improving situational awareness should be reinforced continually by the Instructor; it is not safe to use AIS as the sole information for collision avoidance decisions. Reference R1, Paras. 39–43, amplifies this warning. Section 4.10 below gives additional cautions when using AIS.

Instructors should note that Reference R2 is a recommendation on equipment performance standards. The reference to collision avoidance in Reference R2 emphasises that the equipment needs to be designed to assist this function safely. In actual use AIS data must be used in conjunction with visual and radar data when collision avoidance actions are being determined. The Organization makes it quite clear in Reference R1 that although the potential of AIS is recognized as anti-collision device it is not yet recommended for this use.

1.2 The concepts of AIS

AIS is based on automatic communication between “stations” using very high frequency (VHF) radio communications. The information communicated is primarily concerned with the safe navigation of vessels and also includes information of use to authorities, such as hazardous cargo identification. Communication stations include ships (and in the future small craft – see Section 1.7), shore stations (such as VTS centres), search and rescue (SAR) aircraft, and in the future AIS aids-to-navigation (AIS AtoNs), which will give position and other data concerning navigational marks.

Ships using AIS automatically and continually transmit up-to-date navigational data. This includes:

- Non-changing data such as ship’s name and length (called “static” data).
- “Dynamic” data such as current position, speed and course over ground (SOG and COG).
- “Voyage-related” data, which includes destination, estimated time of arrival (ETA) and draught.

The dynamic data is taken from the ship’s own data being used for navigation. Position, SOG and COG are normally taken from the ship’s Global Navigation Satellite System (GNSS), such as GPS or GLONASS.

The transmitted data is received by all stations in range of the transmitting ship station. Therefore data about that ship is available to these other stations, including VTS stations, other vessels and SAR aircraft. This data can be displayed on ships or onshore in a number of ways. In particular it can be shown as additional information on a radar display or ECDIS. In this way ships can be shown by symbols indicating their AIS transmitted position, heading, course and speed. Other information, such as ship’s name, can sometimes also be displayed near to the target position. By selecting an individual target further detailed information concerning the target can be displayed in a text box.

Transmissions comprise of bursts of data from each station according to an automatically determined time-ordered sequence. This avoids two stations transmitting at the same time and therefore, in principle, all transmissions could be on the same VHF channel. In practice this would overload a single channel in some busy areas and so two VHF channels are used, doubling the number of stations that could use a single channel system.

The VHF channels used are known as AIS1 and AIS2. Consecutive transmissions from each station normally alternate between the AIS1 and AIS2 frequencies. In most waters Channels 87B (161.975 MHz) and 88B (162.025 MHz) are used for AIS1 and AIS2. Some states have adopted other channels to avoid interference with pre-existing non-AIS services. Shore station commands automatically instruct ship stations on the frequencies to use for AIS1 and AIS2, removing any normal need for channel adjustment by the operator.

1.3 Self-organizing time division multiple access

The method of operation where each station uses defined time slots for its transmissions is known as Time Division Multiple Access (TDMA). The time slots for AIS transmissions are all precisely aligned to Co-ordinated Universal Time (UTC). Global Navigation Satellite systems are used to give each station precise UTC. One UTC minute is divided up into 2,250 equal slots, allowing 2,250 transmission bursts to be made on each channel per minute.

Individual ships at sea (when not anchored or moored) transmit on average about once every 6 seconds – i.e. 10 times per minute (the actual rate of transmissions varies for different data, see Section 2 below). If these were the only transmissions an ideal system could cope with $2,250 \times 2/10 = 450$ stations in any one area. (The factor “2” in the calculation accounts for the use of both AIS1 and AIS2 channels.) Assuming the validity of this rather oversimplified analysis it is seen that the system has the theoretical capacity to cope with 450 ship stations in any one area.

Instructors should note that the above analysis is highly simplified as it does not take all factors into account. It is included to help illustrate the inherent power of time division systems to distribute data continually between a large number of stations, while utilising a small amount of the frequency spectrum (just two VHF channels).

Each station has its own effective area, normally limited by the range of the VHF transmissions. This can be 20–30 miles or more, depending on many factors. These factors are discussed in Section 1.8.

Each AIS station determines its transmission slots by initially “listening” to the existing traffic to establish which slots are free. It then uses defined algorithms (formulae) to choose suitable slots. This method of selecting the transmission slots is known as self-organizing TDMA (SOTDMA). The principles of SOTDMA are illustrated in Figure 1.

By using the features of SOTDMA, together with the inherent properties of the established maritime Frequency Modulated (FM) VHF radio system, AIS has the inbuilt ability to “degrade gracefully” as the number of stations using the system increases. This means that the range of contacts around a specific ship will increase or decrease according to the local traffic density. Because of this, closer vessels (that are normally the most important to situational awareness) remain in AIS contact even when station overload is reducing overall system performance

If instructors or trainees are interested in learning more about the use of SOTDMA for AIS the use of Reference T1 is recommended. The details included within Reference T1 are not necessary to be included as part of this course.

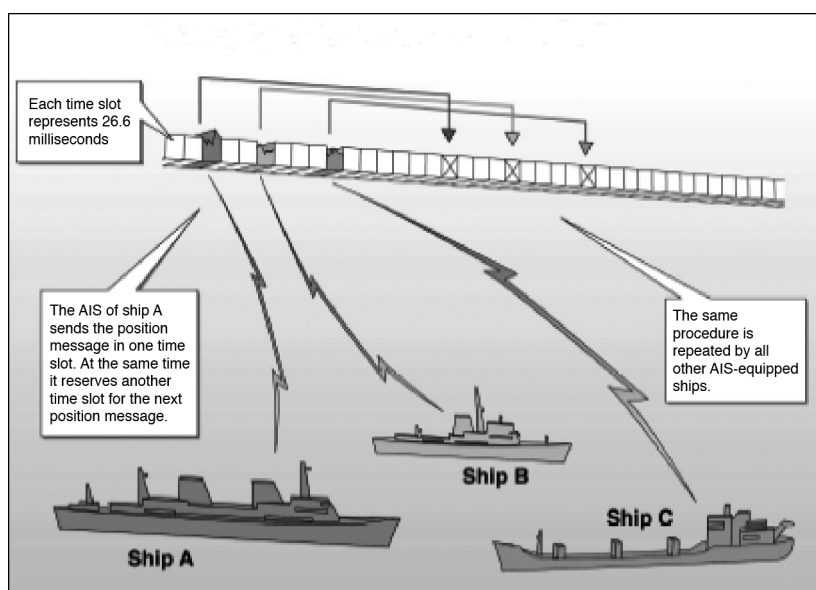


Figure 1 Principles of SOTDMA

1.4 Modes of operation

The self-organizing mode of operation of AIS described above is termed *Autonomous and Continuous*. There are two other modes of operation which may be set by the competent authority. AIS equipment on a ship will automatically switch to these modes on receiving the transmitted electronic instruction from a controlling station. No manual intervention on the ship is required.

The *Assigned Mode* allows the competent authority to assign individual ship stations their data reporting intervals and time slots. This mode can be useful if there are circumstances causing system overload, which may need intervention by the competent authority.

A possible scenario for this is a major SAR operation near a busy port. A SAR aircraft, because of its height, has an extremely long AIS range. Therefore, with a number of these aircraft in operation, together with an influx of emergency AIS-fitted craft, the potential system overload may be averted by the competent authority using Assigned Mode.

When ship stations are switched to the Assigned Mode the ship's system will revert to the (normal) Autonomous Mode after a random interval of between 4 and 8 minutes. (Randomness is introduced in order to reduce the number of ships trying for new time slots at any one time, which could confuse the system.) Clearly, if necessary, the competent authority may re-switch ship stations immediately back to the Assigned Mode, until the situation is normalized.

A further mode of operation is known as *Polled*. This allows competent authorities to request specific data directly from ship stations. For instance, ships' static data (which includes the ship's name) and voyage-related data is only broadcast in the Autonomous and Continuous Mode every 6 minutes. A VTS station may wish to access this data as soon as the ship comes into AIS range using the Polled Mode, without waiting for an up-to-6 minute delay that would be incurred when using the Autonomous and Continuous Mode.

A competent authority may also use DSC channel 70 to poll information from the shipborne AIS, rather than using the AIS frequencies. DSC may also be used to send AIS1 and AIS2 channel information and other data to the ship. All shipborne AIS equipment includes an inbuilt DSC facility for this mode of operation.

The inclusion of the Polled Mode perpetuates the common name of AIS *Transponder* being given to AIS equipment. It *transmits* information to *respond* to an interrogation.

No action is required by ship station operators, whatever the mode set by competent authorities.

1.5 Regional operating settings

When in the range of a shore station the broadcast parameters set to be used by an AIS ship station can be remotely controlled by the shore station. These are known as regional operating settings. The shore station can broadcast the geographical coordinates where the settings are to be used, together with the following parameters:

- The VHF channels to be used for AIS and their transmit/receive sequences.
- The transmit power to be used (low or high power).
- The transitional area, during which the ship's AIS is responding to the two adjacent areas according to well-defined rules (which do not have to be understood by the user).

The defined geographical region can extend outside the range of a shore station and therefore can effectively control the VHF channels to be used over a very wide area. In particular, this enables the control of frequencies to be effected in regions not using the international AIS frequencies. The AIS can store at least eight regions and so these areas will be memorized when next in the region but not necessarily in the range of a shore station.

All AIS shipborne units can have regional operating settings manually input by users. This can, for instance, be useful when a ship is entering a large region, well away from shore stations, that has special frequency allocations for AIS. Such settings should only be made when required by the Administration.

As previously stated, Channel 70 DSC can also be used to set transmission parameters remotely including area definitions. Manually input areas will be “overwritten” by automatic channel management data, whether received by normal AIS transmission from a shore station or by DSC. The Organization has invited Governments setting regional frequencies requiring manual switching, to notify the Organization of such areas and designated frequencies, for circulation of that information. Only the Government of Japan has notified the Organization before the requested date of 1 April 2002. The response is contained within the Annex to Reference R13.

1.6 AIS shipborne equipment

In order to meet the system requirements a ship's AIS will effectively consist of the modules illustrated in Figure 2.

An internal GNSS receiver, such as GPS or GLONASS, is required to determine UTC accurately. This is connected by cable to its own GNSS antenna. The GNSS antenna and receiver are part of the shipborne AIS equipment, additional and separate to the ship's other GNSS equipment (external). If a loss of positional information occurs from the ship's external GNSS equipment the AIS will transmit position and other GNSS data from this internal GNSS. Normally AIS will use positional and other data from the GNSS that is actually being used to navigate own ship (primary GNSS).

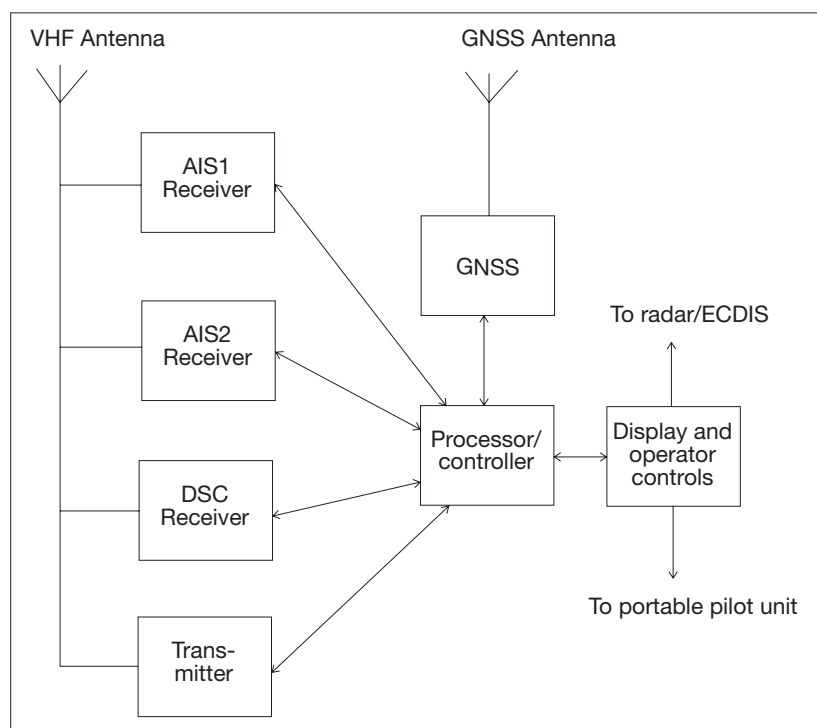


Figure 2 Modules within AIS

Two VHF receivers are required to be able to receive data on the AIS1 and AIS2 channels simultaneously. In addition, one DSC receiver, capable of operating on Channel 70, is required in order to be able to receive polling requests and other data sent over Channel 70. DSC operation is automatic and requires no operator intervention.

A single VHF transmitter is required, capable of operating on all marine VHF channels and responding to Channel 70 DSC interrogations. At any one time AIS data is only being transmitted on one channel; the system automatically selects the correct transmission channel (AIS1, AIS2 or DSC Channel 70). No operator intervention is required.

A single VHF antenna is connected to the AIS unit, which is used by the transmitter and the three receivers. This VHF antenna is separate from the other VHF antennas used on the ship.

A processor sub-system controls the operation and handling of the data concerning the internal GNSS, VHF receivers and VHF transmitter. This also performs all other AIS data handling and computational operations, including the interfaces to the navigational equipment on the ship, the entry of user supplied information and the display of information. These are described in full in later sections of this manual.

The processor sub-system also controls the “built-in integrity tests” (BIIT) of the unit. These provide monitoring of any failures in the equipment, detecting the availability of data and error checking of both the transmitted and received data.

The shipborne unit includes a display and keyboard. The keyboard is used to control the operation of the unit, normally aided by displayed menus. The keyboard is also used to input user derived information into the unit, such as voyage-related data and safety-related messages.

The display included with the unit is also often used as the only means of showing AIS received data to the user. Together with facilities to input data manually, this basic configuration is known as a Minimum Keyboard and Display (MKD). The display of an MKD can, as a minimum, consist of only three lines of data, just showing bearing, range and name of ship.

In practice most MKDs display rather more lines of data and may have a simple graphical display showing targets geographically placed, replicating the form of a radar display. Possibly because it is unclear what the word “minimum” is referring to, manufacturers do not tend to use the acronym “MKD” in their manuals, referring instead, for instance, to the display and keyboard.

In common use, the term “MKD” refers to the inbuilt display and keyboard provided on an AIS unit, distinguishing it from the display of AIS targets on a radar screen or ECDIS. This is the meaning used in this course and therefore the use of “MKD” below does not imply reference to a truly minimum display, (with only three lines of data, for instance).

1.7 Class A and Class B AIS

There are two types of AIS, named Class A and Class B. AIS Class A is the one described fully in this course. The Organization has mandated that larger ships, as defined in Section 3.1 below, carry and use Class A AIS.

AIS Class B is designed for other vessels, such as leisure and fishing vessels. It is not a mandatory fit. It is designed to co-operate with Class A units but not to provide a burden on the available time-slots so as to interfere with the proper operation of Class A. At the time of writing this model course the technical standard for Class B equipment was being prepared by the International Electrotechnical Commission (Reference T8).

The use of data generated by a Class B unit but displayed on a Class A unit is discussed in Section 4.10, below.

1.8 AIS and radar compared

AIS complements radar and use of the two together is of great benefit in improving situation awareness. However, it should always be remembered that AIS is fundamentally a ground stabilised system while radar information is fundamentally relative to the motion of own ship, including sea motion. Systems can automatically convert between the motion states but sometimes this conversion cannot be totally accurate. This can sometimes lead to a real

target appearing in somewhat different positions depending on whether its positional data is based on radar or AIS.

The main advantages of radar are as follows:

- Radar is able to “see” a vast range of targets, all of which can be “passive” and need no electronic devices on them to generate a “return”.
- All received data is relative to own-ship and its effective use does not fundamentally require any knowledge of own-ship’s geodetic position.

The main disadvantages of radar are:

- Targets of interest are easily obscured in clutter and by line-of-sight shielding.
- Information on targets, apart from their present position and past (relative) track is sparse and open to confusion with other targets. (Is that the buoy I am looking for or is it a stationary small vessel?)
- Movement of targets has to be inferred (even by a tracking radar such as ARPA) from consecutive returns. When a target is turning this causes time delays in the presentation of data. Additionally, the effective centre of the radar return from a large target can also change with target orientation, causing speed and course errors as the target turns.
- Target heading is not strictly given by radar. In some situations the displayed course of a target may not be reflected by its actual heading relative to own-ship. This may give different interpretations of the collision regulations depending on whether radar or visual data is being used to assess heading.

On the other hand the main advantages of AIS are:

- “Co-operative” targets can give a vast amount of useful data about themselves, including absolute positional, velocity and heading data potentially far superior to that obtainable by radar.
- AIS does not suffer from clutter problems and is relatively capable under conditions where the radar “line-of-sight” is compromised (shielding by headlands and islands, etc).

Conversely AIS has these main disadvantages:

- It relies on the co-operation of targets to respond. That is, the target must be fitted with an AIS transponder and it must be switched on.
- It relies on the target to provide accurate data.
- It relies on all targets and own-ship continuing to have accurate positional data referenced to a common geodetic datum (WGS84). GNSS failures at a system level, e.g. satellite failure, intentional or unintentional jamming of GNSS signals or a global failure in GNSS, will have varying degrees of severity, including the total failure of AIS.

1.9 Propagation of AIS signals

AIS is basically a VHF radiocommunications system, operating on marine-band frequencies. It therefore behaves similarly to VHF radios in terms of communications range under various conditions. Its transmission power differs from standard marine VHF radios, being 2 watts (low power) and 12.5 watts (high power). Typically, VHF marine radio works on 1 watt (low power) and 25 watts (high power).

Simple theory indicates that a power reduction of 50% results in an effective range reduction of 25%. Therefore on the high power mode the range will typically be 25% less than with VHF radio operating at 25 watts. Experience is showing that typically the range of AIS is around 30 nautical miles or more, when the AIS system is not overloaded with an excess of users.

As previously discussed, AIS transmission power of shipborne equipment can be set remotely by the shore station and is a tool that is sometimes used to prevent overload of the system by reducing the effective range. It requires no user action.

The range is not normally affected by weather conditions but it is affected by shielding of the transmitted signal by land masses and buildings. However, this shielding is less significant than is experienced with radar and therefore AIS will often give a signal from a target that is shielded by line of sight, such as around a headland.

The reason for the better performance is because the wavelength of transmission of AIS signals is significantly larger than that used for radar transmissions. This means that useful energy is diffracted and reflected around obstructions. Also radar relies on picking up small reflections from its own transmissions, while AIS is a two-way transmission system, giving an inherently better transmission/reception path.

The actual location of the AIS VHF antenna on a ship can affect AIS range significantly. If the antenna is shielded by the ship's superstructure its range will be compromised. This may mean that in some directions AIS range is minimal, perhaps down to a few miles or less, while in other directions good range is still possible. This is further discussed in Section 3.4.

As with radar, under certain unusual atmospheric conditions, VHF range can extend to hundreds of miles (anomalous propagation).

A more quantitative description of propagation effects rapidly grows beyond the scope of the course and is not relevant to most users.

1.10 Long-range communications

All AIS shipborne units have been designed to enable long-range communications as an option for long-range security reporting. This is evidenced by a special connector port on the equipment and the likelihood of menu options within the system for such a use.

It was initially envisaged that the facility could be used for the Organization's emerging requirement for Long-Range Identification and Tracking for Ships (LRIT). This is still under discussion by the Organization.

1.11 IMO requirements for AIS

The Instructor should check to see whether there have been any updates or additions to the Organization's requirements for AIS, relevant to this course. All IMO references listed in Part A of this manual have all been taken into account during the compilation of the course.

Trainees should be made particularly aware of the existence and content of the Organization's guidelines for the on-board operational use of AIS. At the time of writing this model course these are embodied within Reference R1, as amended by Reference R3. This amended document is included as an Annex to this model course.

2 AIS data

At a basic system level AIS communicates between stations by means of standard (digital) message types. These message types have been internationally agreed within the International Telecommunication Union (ITU) and those interested in this detail are referred to Reference T2. Many of these messages are not directly relevant to the operation of a commercial vessel and deal with such aspects as:

- Allocation of operating frequencies and powers.
- Management of the assigned and polled modes.
- Search and rescue operations.

Other messages contain information of specific interest to the mariner, such as the name, position, course and speed of nearby vessels. Fortunately, the structure and content of the standard message format does not need to be understood by the operator because the AIS shipborne equipment turns relevant received data into understandable and ordered information. Similarly, the organization of operator input information into the correct message type is automatically accomplished by the ship's AIS equipment, prior to transmission.

For this reason it is best to consider information to be organized into five "user-relevant" groups:

- Static data (ship-related information which rarely changes, such as ship's name).
- Dynamic data (data which is continually changing, such as position and speed over ground).
- Voyage-related data (data which is specific to the voyage, such as destination port and estimated time of arrival).
- Safety and security related messages.
- Other user-relevant AIS messages (AIS has a vast future potential in dealing with other maritime information).

Each group is looked at in more detail in the following sub-sections. It should be understood that not all manufacturers have divided up their operating menus exactly into the categories defined here. However, this categorization is based around the functional use of AIS and follows that used by the Organization.