



# IALA MODEL COURSE

L1.4

## AIDS TO NAVIGATION MANAGEMENT TRAINING LEVEL 1 - GLOBAL NAVIGATION SATELLITE SYSTEMS AND e-NAVIGATION

**Edition 2.0**

**December 2015**



# DOCUMENT REVISION

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Revisions to this IALA Document are to be noted in the table prior to the issue of a revised document.

Date	Page / Section Revised	Requirement for Revision
December 2015	Page 5/ Part B	Inclusion of new Module 3 on GNSS and amendment to lesson plans



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## FOREWORD

The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) recognises that training in all aspects of the management of Aids to Navigation (AtoN) service delivery is critical to the consistent provision of that AtoN service.

Taking into account that under the SOLAS Convention, Chapter 5, Regulation 13, paragraph 2, Contracting Governments, mindful of their obligations published by the International Maritime Organisation, undertake to consider the international recommendations and guidelines when establishing aids to navigation, including recommendations on training and qualification of AtoN managers, IALA has adopted Recommendation E-141 Edition 2 on Standards for Training and Certification of AtoN personnel.

IALA Committees, working closely with the IALA World Wide Academy (The Academy), have developed a series of model courses for AtoN personnel having E-141 Level 1 management functions. This model course on Global Navigation Satellite Systems and e-navigation should be read in conjunction with IALA Recommendation E-141/1 – Model Course on Level 1 Manager Training, which contains standard guidance for the conduct of all Level 1 model courses.

This model course is intended to be delivered by The Academy in conjunction with a national member and other appropriate authorities charged with the provision of AtoN services in a particular region. It contains specific guidance on the training of AtoN managers on Global Navigation Satellite Systems and the principles of the e-navigation concept. Assistance in implementing this and other model courses may be obtained from the IALA World Wide Academy at the following address:

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## PART 1 - COURSE OVERVIEW

### 1. SCOPE

This course is intended to provide aids to navigation managers and other interested parties with the training necessary to have a satisfactory understanding of Global Navigation Satellite Systems (GNSS) and the e-navigation concept.

### 2. OBJECTIVE

Upon successful completion of this course, participants will have acquired sufficient knowledge to explain the development of GNSS and its impact on the e-navigation concept to members of their organisations and associated stakeholders.

### 3. COURSE OUTLINE

This course is intended to cover the knowledge required for an aids to navigation manager to gain an understanding of GNSS and e-navigation and disseminate that knowledge more widely. The course comprises 6 teaching modules.

**Table 1** *Teaching Modules*

Module Title	Time in hours	Overview
The background to e-navigation	1.5	This module describes the inception, adoption and development of the e-navigation concept
Electronic Navigation Charts and ECDIS	1.5	This module describes the importance of valid electronic chart data required to support e-navigation
Global Navigation Satellite Systems	1	This module describes the principles of GNSS and their potential vulnerability
Position Navigation and Timing	1.5	This module describes why an uninterrupted determination of position, navigation and coordinated time is essential to e-navigation
Communications and AIS	2	This module describes the communications systems necessary to support e-navigation
Information Systems	1	This module describes existing and developing information systems and test beds which are designed to improve the flow of information ship to shore; ship to ship and shore to ship
Competency test	0.5	
<b>Total Hours:</b>	<b>9</b>	Two day course

### 4. SPECIFIC COURSE RELATED TEACHING AIDS AND NOTES

- 1 This course will be classroom based with presentations delivered using MS PowerPoint®. Although the course is limited to 24 participants, the classroom should be big enough to permit the participants to sit at desks large enough to operate a laptop computer with room for printed material to hand. Each desk should be provided with a power socket.
- 2 The classroom should be equipped with overhead projectors and screens to enable presentation of the subject matter.



- 3 To enable all participants to receive clear guidance from instructors and to raise questions that can be heard throughout the classroom, lapel or fixed lectern microphones should be provided together with a roving microphone for use by participants.
- 4 Participants should have Wi-Fi internet access.

## 5. PRE-COURSE READING

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Participants should be encouraged to study IALA Recommendation e-NAV140 on e-Navigation Architecture - the initial shore-based perspective

## 6. CERTIFICATION

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Participants who attend this model course can be presented with an AtoN Level 1 Manager certificate which states that they have completed successfully sub-elements 2a.3.9; 2b.2; 4b.4-5 and 4d.3 of Complementary Modules 2 and 4 which form part of the syllabus for Level 1 AtoN Managers set out in IALA Recommendation E-141/1 on Standards for training and Certification of AtoN Personnel. An example is at Annex A. It should be noted that such a certificate should **not** be considered a Certificate of Competence, as no formal test of competency will be conducted.

## 7. ACRONYMS

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AIS	Automatic Identification System
ASM	Application Specific Message
AtoN	Aid(s) to Navigation
DGNSS	Differential Global Navigation Satellite System
ECDIS	Electronic Chart Display and Information System
ENC	Electronic Navigation Chart
FSA	Formal Safety Assessment(s)
GBAS	Ground-Based Augmentation System
GL	Guideline (IALA)
GLA	General Lighthouse Authority(ies)
GNSS	Global Navigation Satellite System
HEAP	Human Element Analysing Process
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IHO	International Hydrographic Organization
IMO	International Maritime Organization
PNT	Position, Navigation and Timing
Q&A	Question and Answer
RAIM	Receiver Autonomous Integrity Monitoring
RCO	Risk Control Option(s)
Rec	Recommendation(s) (IALA)
SBAS	Satellite-Based Augmentation System



SOLAS	International Convention for the Safety of Life at Sea (SOLAS), 1974 (as amended)
S-100	Geospatial Information Registry (IHO)
VDES	VHF Data Exchange System
VHF	Very High Frequency (30 MHz to 300 MHz)
WWRNP	World-Wide Radionavigation Plan
WWRNWS	World-Wide Radionavigation Warning Service

## 8. DEFINITIONS

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The definition of terms used in this Guideline can be found in the International Dictionary of Marine Aids to Navigation (IALA Dictionary) at <http://www.iala-aism.org/wiki/dictionary>

## 9. REFERENCES

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In addition to any specific references required by the Competent Authority, the following material is relevant to this course:

- The IALA NAVGUIDE
- IALA Information Paper on e-Navigation Architecture
- IALA Maritime Radio Communications Plan
- IALA World-Wide Radionavigation Plan
- IALA Recommendation e-NAV140 on e-Navigation Architecture - the initial shore-based perspective
- IALA Recommendation e-NAV 144 on Harmonized implementation of Application Specific Messages
- IALA Recommendation R-115 on the Provision of Radio Navigation Services (DGNS)
- IALA Recommendation R-121 on the Performance and Monitoring of a DGNS
- IALA Recommendation R-129 on GNSS Vulnerability and Mitigation Measures
- IALA Recommendation R-135 on the Future of DGNS
- IALA Guideline 1072 on AtoN Information Exchange & Presentation
- IALA Guideline 1085 on the Standard Format for Electronic Exchange of AtoN Product Information
- IALA Guideline 1086 on the Global Sharing of Maritime Data
- IALA Guideline 1087 on Procedures for the Management of the IALA Domains under the IHO GI Registry
- IALA Guideline 1088 on an Introduction to Preparing S-100 Product Specifications
- IALA Guideline 1096 on Anticipated User e-Navigation Requirements from Berth to Berth, for AtoN Authorities





## PART 2 - TEACHING MODULES

### MODULE 1 THE BACKGROUND TO e-NAVIGATION

#### 1. SCOPE

This module describes the inception, adoption and development of the e-navigation concept.

#### 2. LEARNING OBJECTIVES

To gain a **satisfactory** (Level 2) understanding of the definition and principles of the e-navigation concept and its development.

#### 3. DETAILED TEACHING SYLLABUS FOR MODULE 1 - THE BACKGROUND TO e-NAVIGATION

*Table 2 Detailed Teaching Syllabus - Module 1*

Module	Element	Sub-element	Subject	Level of Competence	Recommended training aids and exercises	References Rec = Recommendation GL = Guideline	Lecture No.
<b>1</b>	<b>1.1</b>	<b>BACKGROUND TO e-NAVIGATION</b>					
			<b>The Definition of e-Navigation</b>				
		1.1.1	The need for e-navigation	2			1
		1.1.2	IMO definition and scope of e-navigation			NAVGUIDE Chapter 4	
		1.1.3	Key components of e-navigation ashore and afloat			Rec e-NAV140	
		1.1.4	Introduction to the concept of a Common Maritime Data Structure				
		1.1.5	Introduction to proposed e-navigation architecture				
	<b>1.2</b>	<b>The Development of e-Navigation</b>					
		1.2.1	Role of IMO in the development of e-navigation	2			2



Module	Element	Sub-element	Subject	Level of Competence	Recommended training aids and exercises	References Rec = Recommendation GL = Guideline	Lecture No.	
		1.2.2	Role of IALA and the e-Navigation Committee					
		1.2.3	Strategy Implementation Plan and its status					
		1.2.4	Update on phased implementation programme					
		1.2.5	The user-driven approach to the design of e-navigation elements	1		GL 1096		
		1.2.6	Human Element Analysing Process (HEAP)					
		1.2.7	Risk Control Options (RCO) and Formal Safety Assessments (FSA)					



## MODULE 2    ELECTRONIC NAVIGATIONAL CHARTS AND ECDIS

### 1. SCOPE

This module describes the importance of valid electronic chart data required to support e-navigation.

### 2. LEARNING OBJECTIVES

To gain a **basic** understanding of Electronic Navigational Charts and their use in Electronic Chart Display and Information Systems

### 3. DETAILED SYLLABUS FOR TEACHING MODULE 2 – ELECTRONIC NAVIGATIONAL CHARTS AND ECDIS

*Table 3 Detailed Teaching Syllabus - Module 2*

Module	Element	Sub-element	Subject	Level of Competence	Recommended training aids and exercises	References Rec = Recommendation GL = Guideline	Lecture No.
2	2.1	<b>ELECTRONIC NAVIGATIONAL CHARTS AND ECDIS</b>					
		<b>Electronic Navigational Charts</b>					
		2.1.1	The definition and properties of ENCs				
		2.1.2.	Status of accurate hydrographic data world wide				
		2.1.3	Availability of ENCs and the role of RENCs				
		2.1.4	Problems with datum alignment	1		GL 1085	3
					GL1086		
					GL 1087		
					GL 1088		
		2.2	<b>ECDIS</b>				
		2.2.1	General specifications of an ECDIS	2			4
		2.2.2	IMO carriage requirements				
		2.2.3	Harmonisation of navigation systems on board a vessel				



## MODULE 3 GLOBAL NAVIGATION SATELLITE SYSTEMS

### 1. SCOPE

This module describes the principles of GNSS and their potential vulnerability

### 2. LEARNING OBJECTIVES

To gain a **satisfactory** understanding of global navigation satellite based systems, their vulnerabilities and plans to mitigate against such vulnerabilities.

### 3. DETAILED TEACHING SYLLABUS FOR MODULE 3 – GLOBAL NAVIGATION SATELLITE SYSTEMS

Table 4 Detailed Teaching Syllabus - Module 3

Module	Element	Sub-element	Subject	Level of Competence	Recommended training aids and exercises	References Rec = Recommendation GL = Guideline	Lecture No.
3	3.1		<b>Global Navigation Satellite Systems</b>				
			<b>Review of Determining Continuous Position at Sea</b>				
		3.1.1	Global Navigation Satellite Systems & their current status	2		NAVGUIDE IALA WWRNP Rec R-135	5
		3.1.2	Systems that meet IMO accuracy standards			IMO Resolution A.1046(27)	
		3.1.3	Ground Based Augmentation Systems (GBAS)			Rec 115; R-121	
		3.1.4	Satellite Based Augmentation Systems (SBAS)				
	3.2		<b>GNSS Vulnerability</b>				
		3.2.1	Natural sources of vulnerability	2		Rec R-129	6
		3.2.2	Human sources of vulnerability				
		3.2.3	Mitigation measures				



## MODULE 4 POSITION, NAVIGATION AND TIMING

### 1. SCOPE

This module describes why an uninterrupted determination of position, navigation and co-ordinated time is essential to e-navigation.

### 2. LEARNING OBJECTIVES

To gain a **satisfactory** understanding of how continuous timing and position at sea can be obtained

### 3. DETAILED TEACHING SYLLABUS FOR MODULE 4 – POSITION, NAVIGATION AND TIMING

*Table 5 Detailed Teaching Syllabus - Module 4*

Module	Element	Sub-element	Subject	Level of Competence	Recommended training aids and exercises	References Rec = Recommendation GL = Guideline	Lecture No.
4	4.1	<b>Position, Navigation and Timing</b>					
		<b>Considerations for Resilient PNT</b>					
		4.1.1	Systems dependent on PNT	2		GLA Jamming video - effects	7
		4.1.2	Augmentation systems and Integrity aspects (SBAS; GBAS and RAIM)				
		4.1.3	Review of all terrestrial based systems				
		4.1.4	Considerations for bringing together different data sources to achieve resilient PNT			GLA Jamming video – potential solutions	
	4.2	<b>Resilient PNT Discussion</b>					
		4.2.1	Tutor lead discussion and Q&A session on topic	2	GNSS and PNT Q& A session	GL 1053, IMO Resolution A.1046 IALA WWRNP	8



## MODULE 5 COMMUNICATIONS AND AIS

### 1. SCOPE

This module describes the communications systems necessary to support e-navigation.

### 2. LEARNING OBJECTIVES

To gain a **satisfactory** understanding of the function of communications systems, including the Automatic Identification System on which e-navigation is dependent.

### 3. DETAILED TEACHING SYLLABUS FOR MODULE 5 – COMMUNICATIONS AND AIS

**Table 6** Detailed Teaching Syllabus - Module 5

Module	Element	Sub-element	Subject	Level of Competence	Recommended training aids and exercises	References Rec = Recommendation GL = Guideline	Lecture No.
5			COMMUNICATIONS AND AIS				
	5.1		IALA Maritime Radio Communications Plan				
		5.1.1	Review of communications required to support e-navigation	2			9
		5.1.2.	Bandwidth availability				
		5.1.3	Advantages and disadvantages of communication via satellite				
		5.1.4	Modernisation of the use of VHF channels				
		5.1.5	Examples: VDES; ASM channels				
		5.1.6	Overview of GMDSS				
	5.2		Automatic Identification System				
		5.2.1	Review of AIS	2		Rec A-123; Rec A-126	10
		5.2.2	Limitations of AIS			Rec A-124 and its suffixes	
		5.2.3	The role of AIS in e-navigation			GL 1028; 1029	
		5.2.4	Base stations and chaining			GL 1050; 1059; 1062	
		5.2.5	AIS messages specific to e-navigation			GL 1082;1084; 1095; 1096	
		5.2.6	Satellite AIS				



## MODULE 6    INFORMATION SYSTEMS

### 1. SCOPE

This module describes existing and developing information systems which are designed to improve the flow of information ship to shore; ship to ship and shore to ship

### 2. LEARNING OBJECTIVES

To gain a **satisfactory** understanding of how both existing information systems and those under development will improve the flow of maritime and safety information between stakeholders and a **basic** understanding of geospatial information registries and test beds.

### 3. DETAILED TEACHING SYLLABUS FOR MODULE 6 – INFORMATION SYSTEMS

*Table 7    Detailed Teaching Syllabus - Module 6*

Module	Element	Sub-element	Subject	Level of Competence	Recommended training aids and exercises	References Rec = Recommendation GL = Guideline	Lecture No.	
6	6.1	<b>INFORMATION SYSTEMS</b>						
		<b>Information Architecture</b>						
		6.1.1	Existing information systems ship to ship; ship to shore; shore to ship and shore to shore		2		11	
		6.1.2.	Limitations of existing information systems					
		6.1.3	Information systems under development					
		6.1.4	Maritime Service Portfolios					
		6.1.5	The role of Vessel Traffic Services in e-navigation					
		6.1.6	Considerations for the management of information					GL 1086
		6.2	<b>Data Modelling</b>					
		6.2.1	Concept of a universal Marine Information Registry		1		12	
	6.2.2	S-100 Framework and the IHO Geospatial Information Registry						
	6.2.3	Development of product specifications						
	6.2.4	AtoN information						



Module	Element	Sub-element	Subject	Level of Competence	Recommended training aids and exercises	References Rec = Recommendation GL = Guideline	Lecture No.
	<b>6.3</b>		<b>Test Beds</b>				
		6.3.1	Concept of test beds				13
		6.3.2	Review of existing and planned test bed data				
		6.3.3	Guideline on the reporting of test bed results				