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Summer school

SUSTAINABLE DEVELOPMENT OF YACHTING AND CRUISE INDUSTRY

Assessing the main navigation parameters

Lecturer: MSc Igor Petrović, Capt.

Kotor, 21/7/2022

Project no. 609675-EPP-1-2019-1-ME-EPPKA2-CBHE-SP



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Introduction to safe navigation

- Since the inception of IMCO (former IMO), existing international rules have been inherited by it and a whole new series of measures have been introduced, in the form of conventions, recommendations and other instruments.
- The best known and most important of these measures are conventions, three of which are particularly relevant to navigation.
 - **International Convention for the Safety of Life at Sea (SOLAS), 1974;**
 - **Convention on the International Regulations for Preventing Collisions at Sea (COLREG), 1972;**
 - **International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978.**

Source: IMO website:

<https://www.imo.org/en/OurWork/Safety/Pages/NavigationDefault.aspx>

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Introduction to safe navigation

- **Measures dealing with safety of navigation are prescribed mainly in SOLAS chapter V**
 - **Regulation 1 -Application**
 - **Regulation 2 -Definitions**
 - **Regulation 3 -Exemptions and Equivalentents**
 - **Regulation 4 -Navigational Warnings**
 - **Regulation 5 -Meteorological services and warnings**
 - **Regulation 6 -Ice Patrol Service**
 - **Regulation 7 -Search and rescue services**
 - **Regulation 8 -Life-saving signals**
 - **Regulation 9 -Hydrographic Services**
 - **Regulation 10 -Ships' Routeing**
 - **Regulation 11 -Ship Reporting Systems**



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Introduction to safe navigation

- Regulation 12 -Vessel Traffic Services
- Regulation 13 -Establishment and operation of aids to navigation
- Regulation 14 -Ships' manning
- Regulation 15 -Principles relating to bridge design, design and arrangement of navigational systems and equipment and bridge procedures
- Regulation 16 -Maintenance of Equipment
- Regulation 17 -Electromagnetic compatibility
- Regulation 18 -Approval, surveys and performance standards of navigational systems and equipment and voyage data recorder
- Regulation 19 -Carriage requirements for shipborne navigational systems and equipment
- Regulation 19-1 -Long Range Identification and Tracking of Ships
- Regulation 20 -Voyage data recorders
- Regulation 21 -International Code of Signals
- Regulation 22 -Navigation bridge visibility

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Introduction to safe navigation


- Regulation 23 -Pilot transfer arrangements
- Regulation 24 -Use of heading and/or track control systems
- Regulation 25 -Operation of main source of electrical power and steering gear
- Regulation 26 -Steering gear: Testing and drills
- Regulation 27 -Nautical charts and nautical publications
- Regulation 28-Records of navigational activities and daily reporting
- Regulation 29 -Life-saving signals to be used by ships, aircraft or persons in distress
- Regulation 30 -Operational limitations
- Regulation 31 -Danger Messages
- Regulation 32 -Information required in danger messages
- Regulation 33 -Distress Situations: Obligations and procedures
- Regulation 34 -Safe navigation and avoidance of dangerous situations
- Regulation 34-1 -Master's Discretion
- Regulation 35 -Misuse of distress signals

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Introduction to safe navigation

**COLREGS RULE 10
TRAFFIC SEPARATION SCHEMES**

SM
STEAMSHIP MUTUAL



04) This rule applies to traffic separation schemes adopted by the Organization and does not relieve any vessel of her obligation under any other Rule.

05) A vessel using a traffic separation scheme shall:

- proceed in the appropriate traffic lane in the general direction of traffic flow for that lane;
- so far as practicable keep clear of a traffic separation line or separation zone;
- normally join or leave a traffic lane at the termination of the lane, but when joining or leaving from either side shall do so at an acute angle to the general direction of traffic flow as practicable;

10) A vessel shall so far as practicable avoid crossing traffic lanes, but if obliged to do so shall cross on a heading as nearly as practicable at right angles to the general direction of traffic flow.

11) A vessel shall not use an inbound traffic lane when she can safely use the appropriate traffic lane within the adjacent traffic separation scheme. However, vessels of less than 20 metres in length, sailing vessels and vessels engaged in fishing may use the inbound traffic lane.

12) A vessel other than a crossing vessel or a vessel joining or leaving a lane shall not normally enter a separation zone or cross a separation line except:

- in cases of emergency to avoid immediate danger;
- to engage in fishing within a separation zone.

13) Notwithstanding sub-paragraph 08 (i), a vessel may use an inbound traffic lane when en route to or from a port, offshore installation or structure, pilot station or any other place situated within the inbound traffic lane, or to avoid immediate danger.

14) A vessel shall so far as practicable avoid anchoring in a traffic separation scheme or in areas near to terminations.

15) A vessel not using a traffic separation scheme shall avoid it by as wide a margin as is practicable.

16) A vessel engaged in fishing shall not impede the passage of any vessel following a traffic lane.

17) A vessel of less than 20 metres in length or a sailing vessel shall not impede the safe passage of a power-driven vessel following a traffic lane.

18) A vessel restricted in her ability to manoeuvre when engaged in an operation for the maintenance of sailing off navigation in a traffic separation scheme is exempted from complying with this Rule to the extent necessary to carry out the operation.

19) A vessel restricted in her ability to manoeuvre when engaged in an operation for the laying, working or picking up of a submarine cable, within a traffic separation scheme, is exempted from complying with this Rule to the extent necessary to carry out the operation.

COLREGS_10 – One of a series of Steamship Mutual Loss Prevention Posters produced by The Ship Safety Trust. For further information please contact the Loss Prevention Department, Steamship Insurance Management Services Ltd., Tel: +44 20 7247 5490, Email: loss.prevention@simsl.com

A poster from steam ship mutual:
<http://www.simsl.com/Posters/COLREGSRule10TSS.pdf>

LOOK OUT



Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision.

A poster from The Steamship Mutual SSM P&I Club

Introduction to safe navigation

- The 1978 STCW Convention was the first to establish basic requirements on training, certification and watchkeeping for seafarers on an international level.
- Each government set its own rules referring to STCW Convention

Pravilnik o vrstama zvanja i ovlaštenja, uslovima za sticanje zvanja i izdavanje ovlaštenja za članove posade broda

Pravilnik je objavljen u "Službenom listu CG", br. [51/2015](#), [44/2016](#), [63/2018](#) i [50/2020](#).

I. OSNOVNE ODREDBE

Član 1

Ovim pravilnikom propisuju se vrste zvanja, ovlaštenja o osposobljenosti i posebnoj osposobljenosti, bježe uslove u pogledu stručne spreme i plovidbenog staža za sticanje zvanja radi izdavanja ovlaštenja, program i način obuke i polaganja ispita za sticanje zvanja, program i način obuke i polaganja ispita o posebnoj osposobljenosti, program, način obuke i polaganje ispita za obnovu ovlaštenja o osposobljenosti i posebnoj osposobljenosti, obrasci ovlaštenja, način izdavanja ovlaštenja i evidencija izdatih ovlaštenja članova posade broda (u daljem tekstu: pomorac), bježe uslove koje treba da ispunjava pomorska školska ustanova i pravno lice za obuku pomoraca u pogledu opreme, prostora, kadra i standarda sistema kvaliteta i uslovi koje treba da ispunjavaju članovi komisije za sticanje zvanja i ovlaštenja i ispitivači.

Prilog A

PROGRAM OBUKE ZA STICANJE ZVANJA I IZDAVANJE ODNOSNO OBNAVLJANJE OVLAŠĆENJA O OSPOSOBLJENOSTI I IZDAVANJE POTVRDA

DIO A1

PROGRAM OBUKE ZA IZDAVANJE OVLAŠĆENJA O OSPOSOBLJENOSTI ZA ZAPOVJEDNIKA BRODA OD 3000 BT ILI VEĆEG (pomorci koji su stekli ovlaštenje prvog oficira palube putem obuke ili priznavanja)

	<i>Područje</i>	<i>Predavanja</i>	<i>Vježbe</i>
1.	Planiranje plovidbe i navigacija u svim uslovima		
1.1	Elektronska navigacija	20	10
1.2	Terestrička navigacija	5	5
2.	Manevrisanje brodom i pravila izbjegavanja sudara na moru	20	13
3.	Sigurnost na moru	15	5
4.	Upravljanje posadom		
		75	33
	Ukupno časova:	108	

Introduction to safe navigation

- There are also local rules that governs navigation in certain areas

ZAKON

O SIGURNOSTI POMORSKE PLOVIDBE

("Službeni list Crne Gore", br. 062/13 od 31.12.2013, 006/14 od 04.02.2014, 047/15 od 18.08.2015, 071/17 od 31.10.2017, 034/19 od 21.06.2019, 077/20 od 29.07.2020)

I. OSNOVNE ODREDBE

Predmet

Član 1

Ovim zakonom uređuju se uslovi za pomorske objekte, posadu i plovne objekte koji plove unutrašnjim morskim vodama i teritorijalnim morem Crne Gore za sigurnost pomorske plovidbe i druga pitanja kojima se obezbjeđuje sigurnost pomorske plovidbe.



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Introduction to safe navigation

Boka Bay area

- Total area 87,33 km²
- Average depth 27,3 m
- Length of the bay is 28 km (from 'Cape Ostro' to 'Kotor')
- Entrance breadth is 2974 m, the narrowest part is 'Verige channel' - 288m
- Consists of 5 smaller bays ('Herceg Novi', 'Tivat', 'Morinj', 'Risan' and 'Kotor' bay) connected with 2 channels: Kumbor and Verige

Source: Igor Stanovčić, Article for Maintenance Conference, Budva 2022

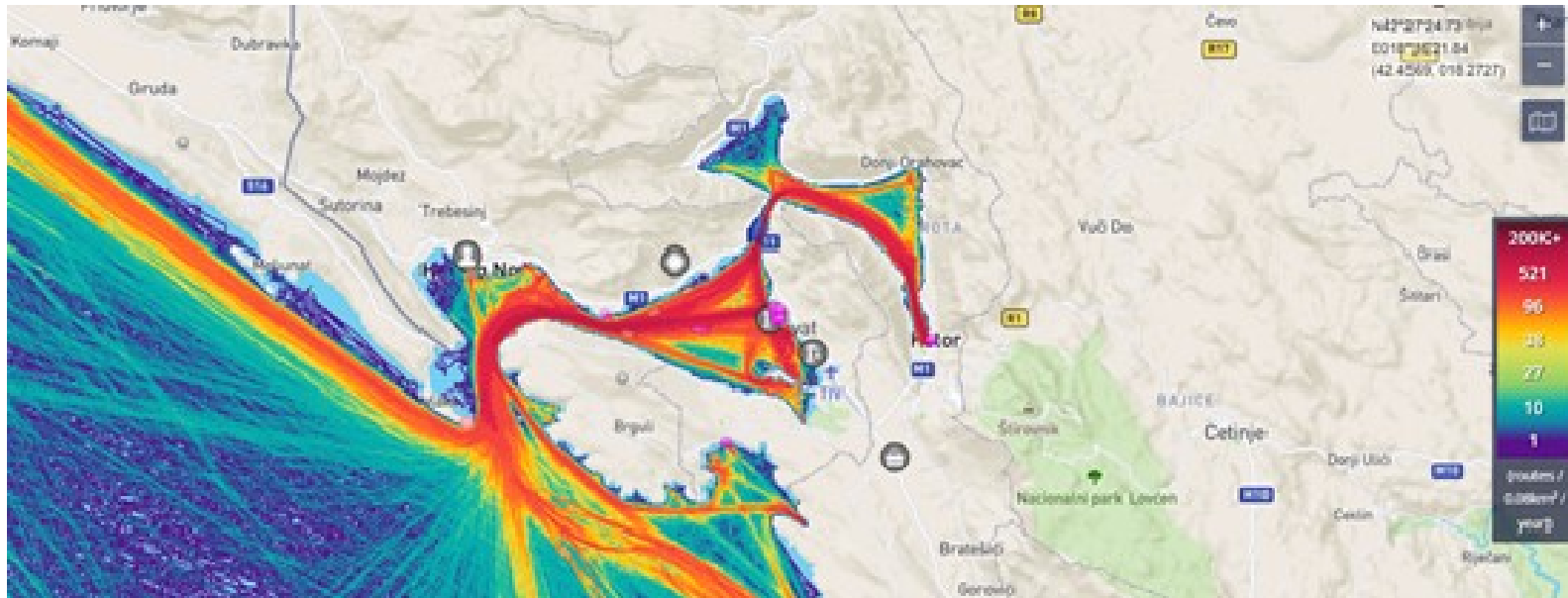
Introduction to safe navigation

Boka Bay area



Introduction to safe navigation

Boka Bay area – traffic density based on AIS database for 2019-2020





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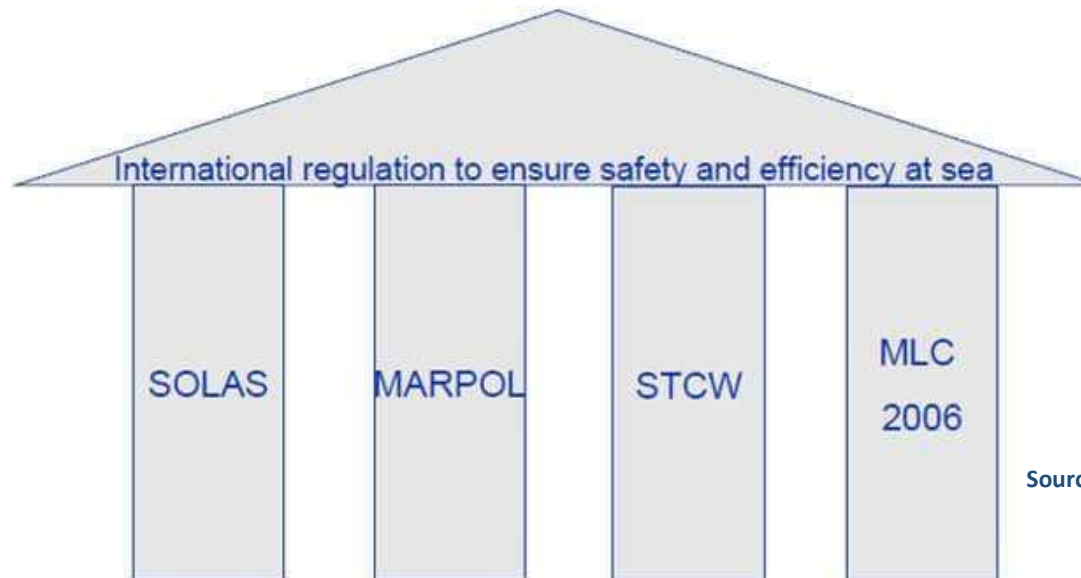
Introduction to safe navigation

Boka Bay area

- **Average number of ships visiting Boka Bay is 427 per year (period 2014-2019)**
- **88% of this traffic is accomplished from April to November**
- **Average number of yachts moored at Kotor was 1692 for period 2014-2019 (1302 with length < 20 m, 390 with length > 20 m)**
- **Number of pleasure crafts registered in Boka Bay ports is 3929 (365 are registered for commercial purposes)**

Introduction to safe navigation

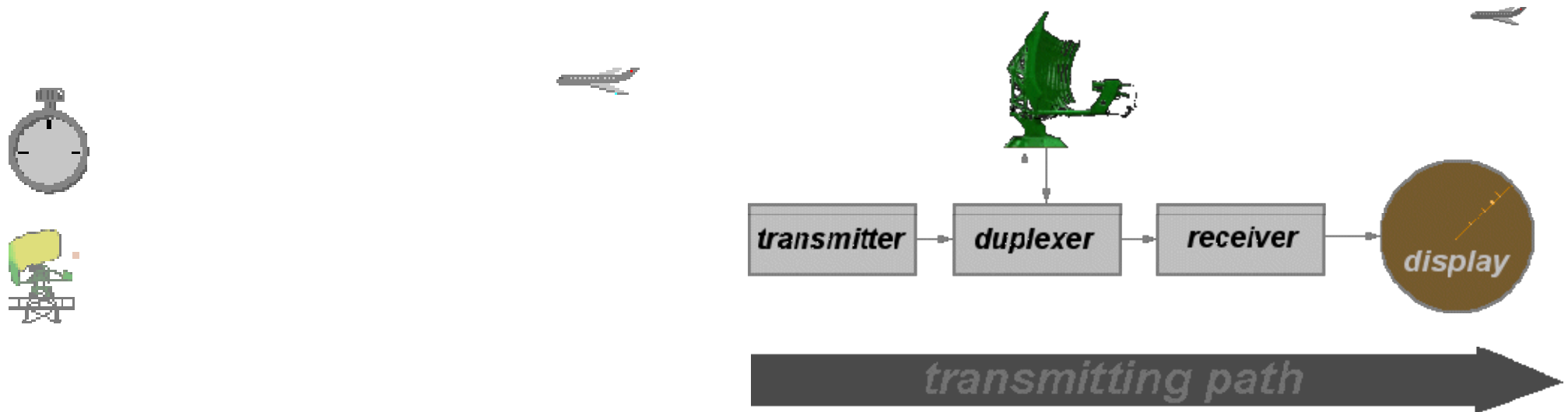
- Finally bear in mind other conventions that directly or indirectly affects safe navigation



Source: <https://www.captainalbert.com/03-april-2014-the-law-is-there-to-protect/>

Introduction to the Automatic Radar Plotting Aid (ARPA)

- RADAR working principle

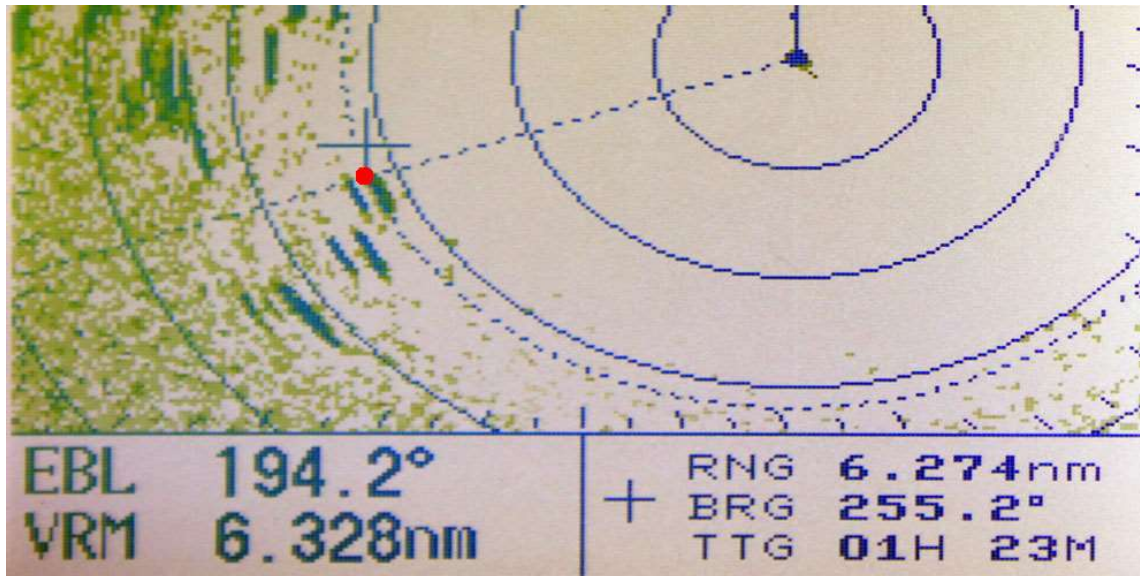


Source:

<https://www.radartutorial.eu/01.basics/Radar%20Principle.en.html>

Introduction to the Automatic Radar Plotting Aid (ARPA)

- Measuring bearing and distance on RADAR



Source:
<https://www.blauwasser.de/radar-sportboote/attachment/ebl-und-vrm-radar>

Introduction to the Automatic Radar Plotting Aid (ARPA)

Position fixing by RADAR:

RADAR fix can be plotted by following combination of position lines:

- By bearing and range from one object
- By two (or more) bearings from two (or more) objects
- By two (or more) ranges from two (or more) objects
- By bearing from one and range from other object

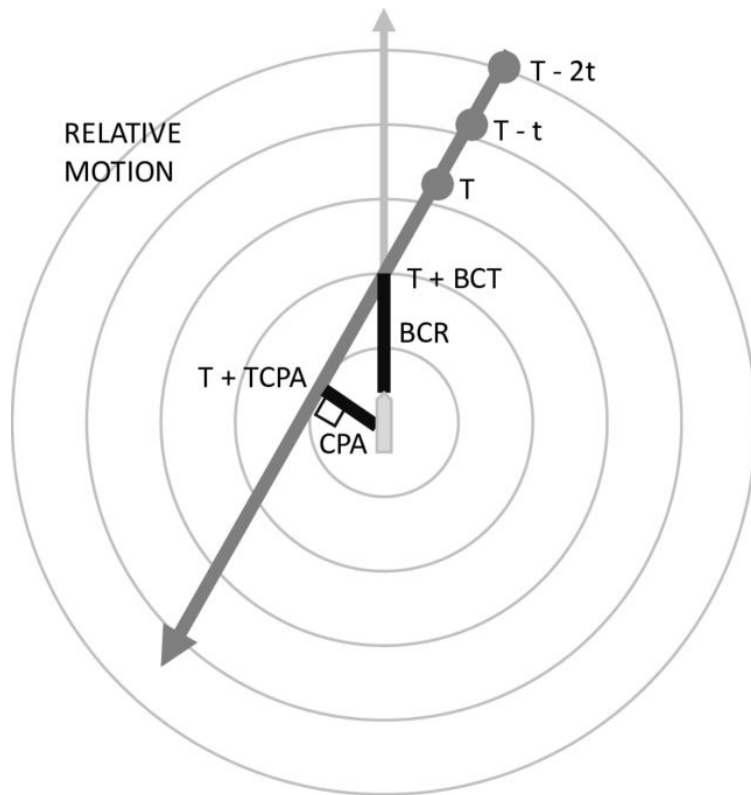
Introduction to the Automatic Radar Plotting Aid (ARPA)

- Position fixing by
RADAR using
bearing and range

<https://www.myseatime.com/blog/detail/position-fixing-the-most-important-element-of-passage-planning>



Introduction to the Automatic Radar Plotting Aid (ARPA)

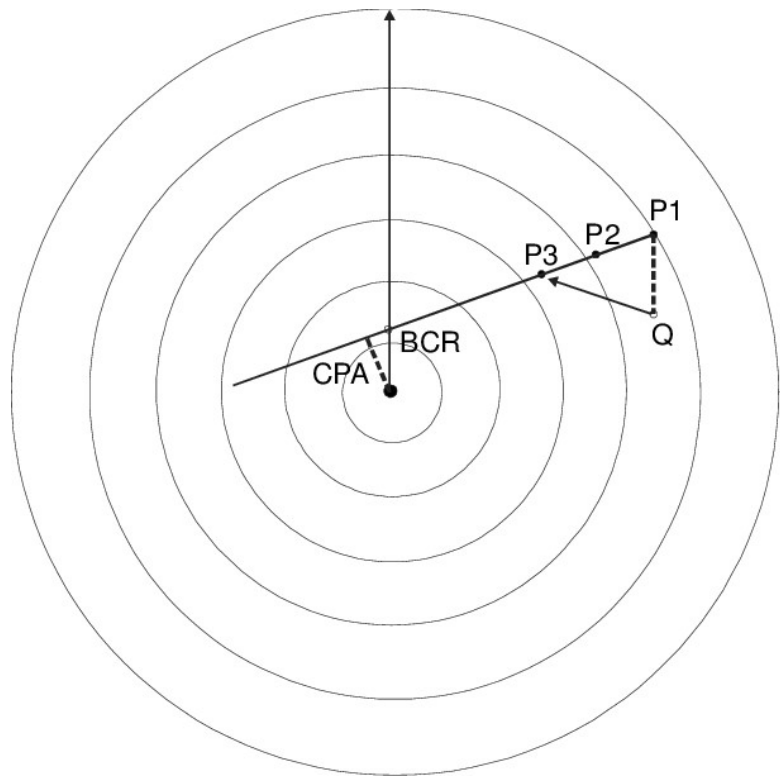


ARPA Working principle

- Step 1 finding CPA, TCPA

Source: Fredrik Olinderson - Development of a software to identify and analyze marine traffic situations

Introduction to the Automatic Radar Plotting Aid (ARPA)



ARPA Working principle

- **Step 2 finding target course and speed**

Source: Michael May - Cognitive aspects of interface design and human-centered automation on the ship bridge: The example of ARPA/ECDIS integration



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Introduction to the Electronic Chart Display and Information System (ECDIS)

What is a ECDIS?

ECDIS is an abbreviation for Electronic Chart Display and Information System. It is a full system that consists of many parts and is controlled under a strict performance standard. As the name states it is not only a chart system but also an information and a common interface system of a variety of sensors known in navigations. Creates a very powerful Navigation tool.

Source: Transas presentation for electronic charts



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(ECDIS)

ECS (Electronic Navigation System)

- Electronic chart software
- Unofficial charts (e.g. Transas TX-97)
- None approved hardware

**CAN BE USED AS AN
AID TO NAVIGATION**

ECDIS (Electronic Chart Display and Information System)

- Type-approved hardware
- Type-approved ECDIS software
- Approved installation
- Official charts (ENC/SENC/ARCS)
- Chart corrections subscription
- The crew has been trained for the usage

**CAN BE USED FOR
PRIMARY NAVIGATION**

Source: Transas presentation for electronic charts

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(ECDIS)

Types of charts

Matrix	Raster	Vector
Private		TX-97
Official	ARCS	ENC

Source: Transas presentation for electronic charts



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(ECDIS)

Raster charts

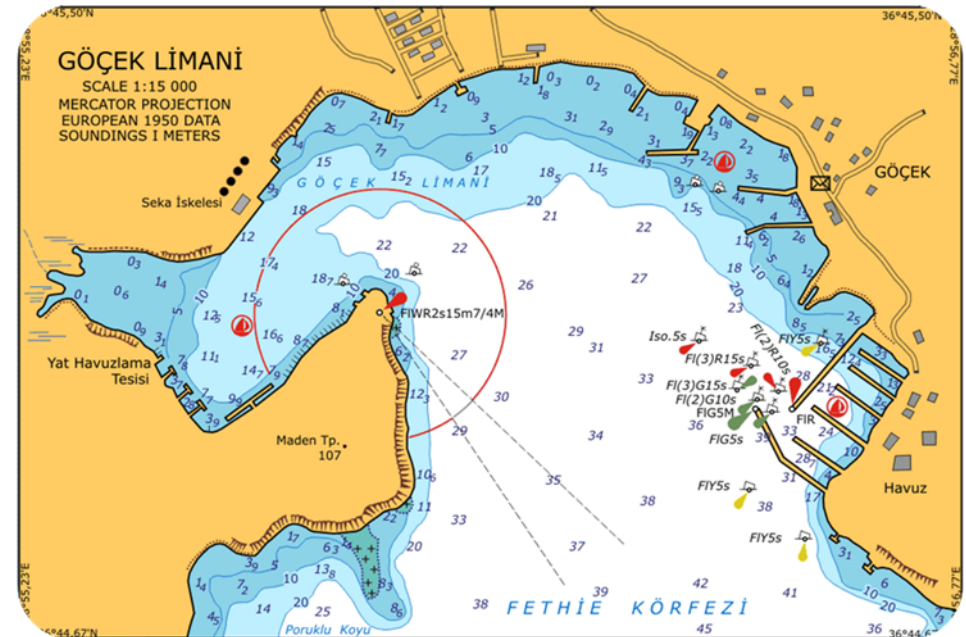
- Full-color digital images of the corresponding paper charts.

Advantages:

- Inexpensive to produce
- Similar to paper charts

Disadvantages:

- "Dead chart", no Alarms
- Limited zoom options
- Requires large memory capacity
- Expensive to correct (a new chart)
- Easy to read only in north-up orientation

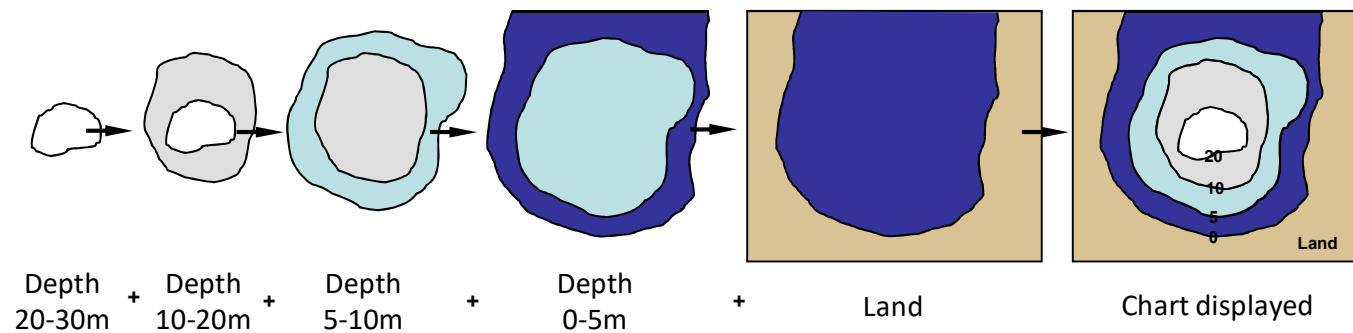


Source: Transas presentation for electronic charts

(ECDIS)

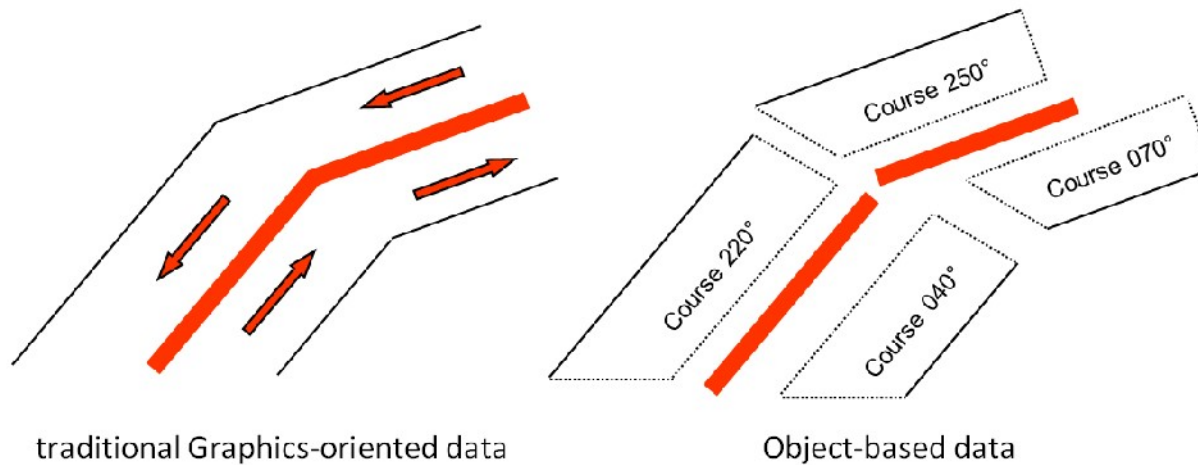
Vector charts

A vector chart is a database, where different objects are encoded. Chart's software may sort these objects in categories and display them in layers.



Source: Transas presentation for electronic charts

(ECDIS)



Raster

Vector

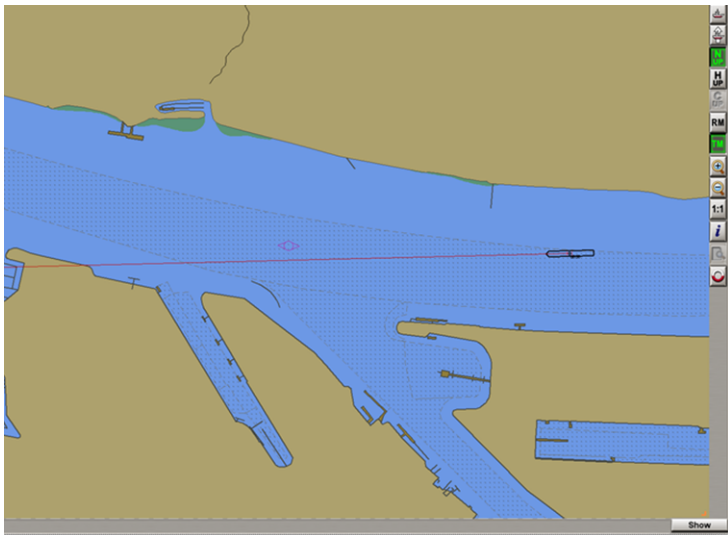
Source: Transas presentation for electronic charts

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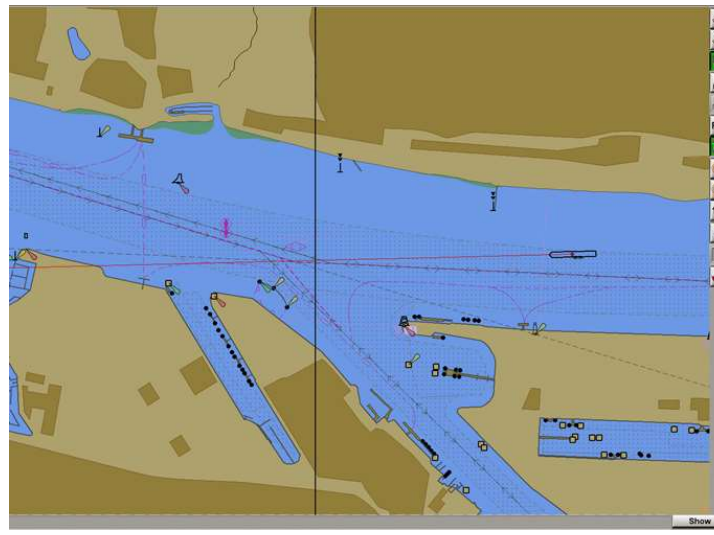


(ECDIS)

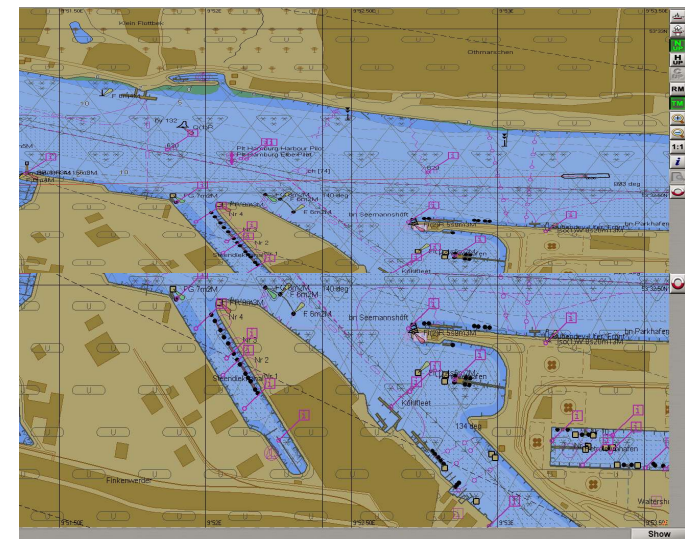
Types of display



Base



Standard



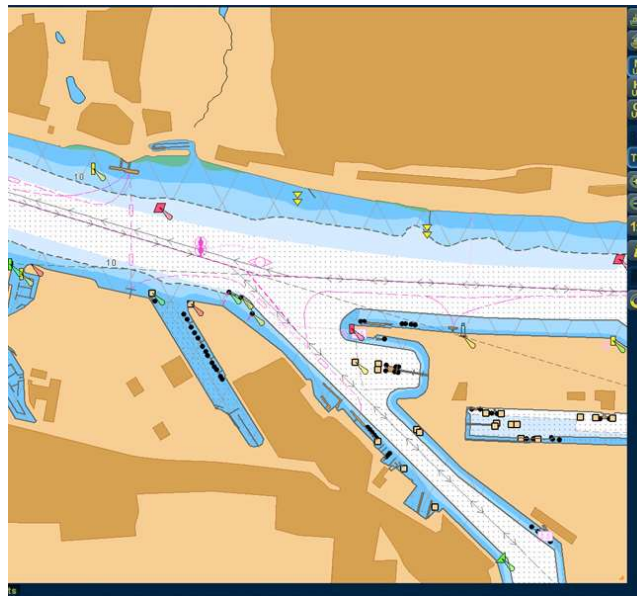
All Layers

Source: Transas presentation for electronic charts



(ECDIS)

Types of display

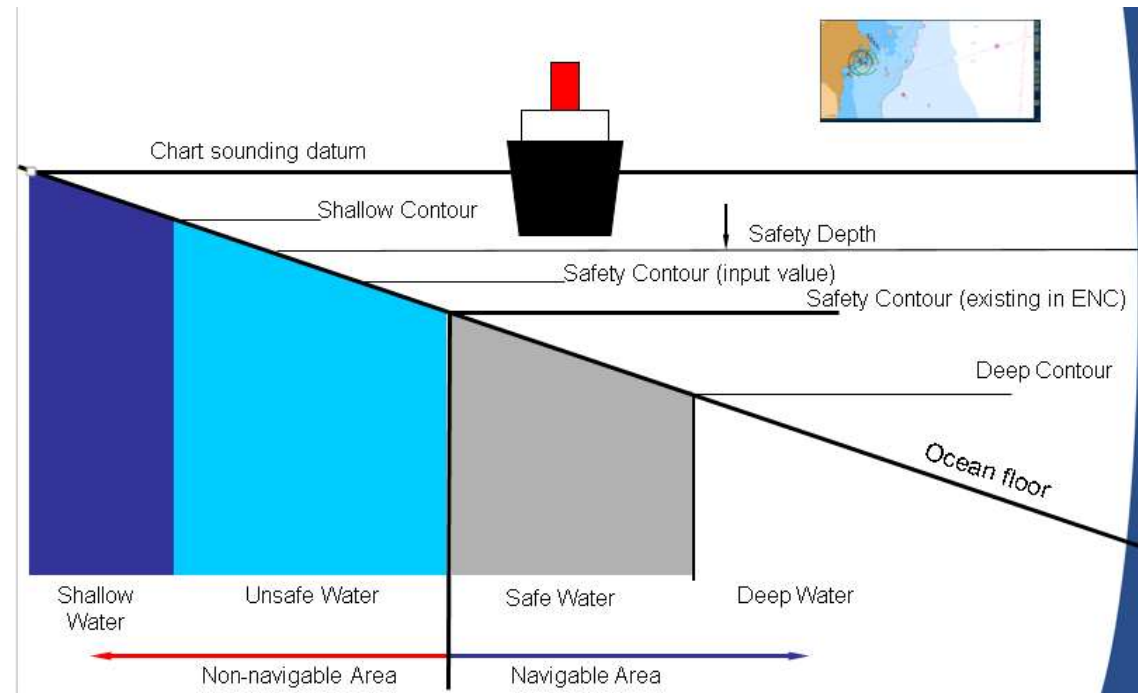


Custom

Source: Transas presentation for electronic charts

(ECDIS)

Safety parameters



Source: Transas presentation for electronic charts



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(ECDIS)

Route planning

- Navigation is defined as a process to read and control a crafts movement from one point to another. Arrive safely, quickly and easily at your destination is the main aim of ship born navigation.
- Enabling a quick and easy route planning operation is the task of ECDIS developers

Source: Transas presentation for electronic charts

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(ECDIS)

Route planning

Passage Planning consists of four stages

- **appraisal**
- **planning**
- **execution and**
- **monitoring**

Poor route planning and deviation of the plan can lead to grounding and ship loss.

Source: Transas presentation for electronic charts

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(ECDIS)

Route planning

WPT	Name	LAT	LON	RL/GC	Distance	Course	Total Distance	PORT XTD	STBD XTD	Arrival Circle	Tu
6		07° 08.360' N	081° 52.273' W	RL	74.86 NM	278.4°	232.78 NM	0.10 NM	0.10 NM		0
7		18° 22.439' N	105° 54.062' W	RL	1558.39 NM	295.5°	1791.16 NM	0.10 NM	0.10 NM		0
8		34° 47.296' N	139° 48.710' E	GC	5898.50 NM	310.9°	7689.67 NM	0.10 NM	0.10 NM		0
9		35° 00.790' N	139° 40.989' E	RL	14.89 NM	334.8°	7704.56 NM	0.10 NM	0.10 NM		0
10		35° 12.746' N	139° 47.320' E	RL	13.02 NM	023.5°	7717.58 NM	0.10 NM	0.10 NM		0
11		35° 15.351' N	139° 46.938' E	RL	2.62 NM	353.1°	7720.20 NM	0.10 NM	0.10 NM		0
12		35° 18.000' N	139° 43.000' E	RL	5.40 NM	001.0°	7725.60 NM	0.10 NM	0.10 NM		0

Main Dual Monitoring Route Editor Charts

Source: Transas presentation for electronic charts

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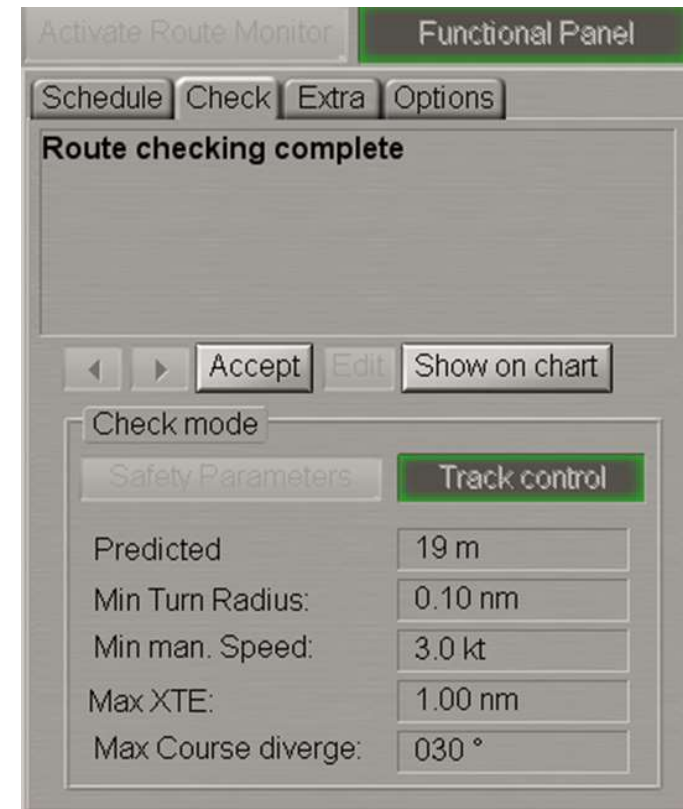


(ECDIS)

Route planning – SAFETY CHECK !!!

When the route is completed, there is a feature whereby an automatic safety check might be made for the entire route and all the charts that are affected.

The safety check will be made using **pre-set safety parameters and pre programmed maneuvering parameters**



Source: Transas presentation for electronic charts

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Summary

- Safe navigation is set by many rules and regulations (Conventions, Resolutions etc.)
- Navigation equipment is just an aid to navigation (it is useful ONLY if correctly used)
- Knowing which navigation parameters are safe and knowing safe limits is essential
- RADAR is a tool that assist navigator in position fixing and collision avoidance, especially in reduced visibility
- ECDIS is a system that gives navigator knowledge of his position and assist in passage planning and passage execution (monitoring)



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Thank you for your attention!

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