

# SY486K MICS

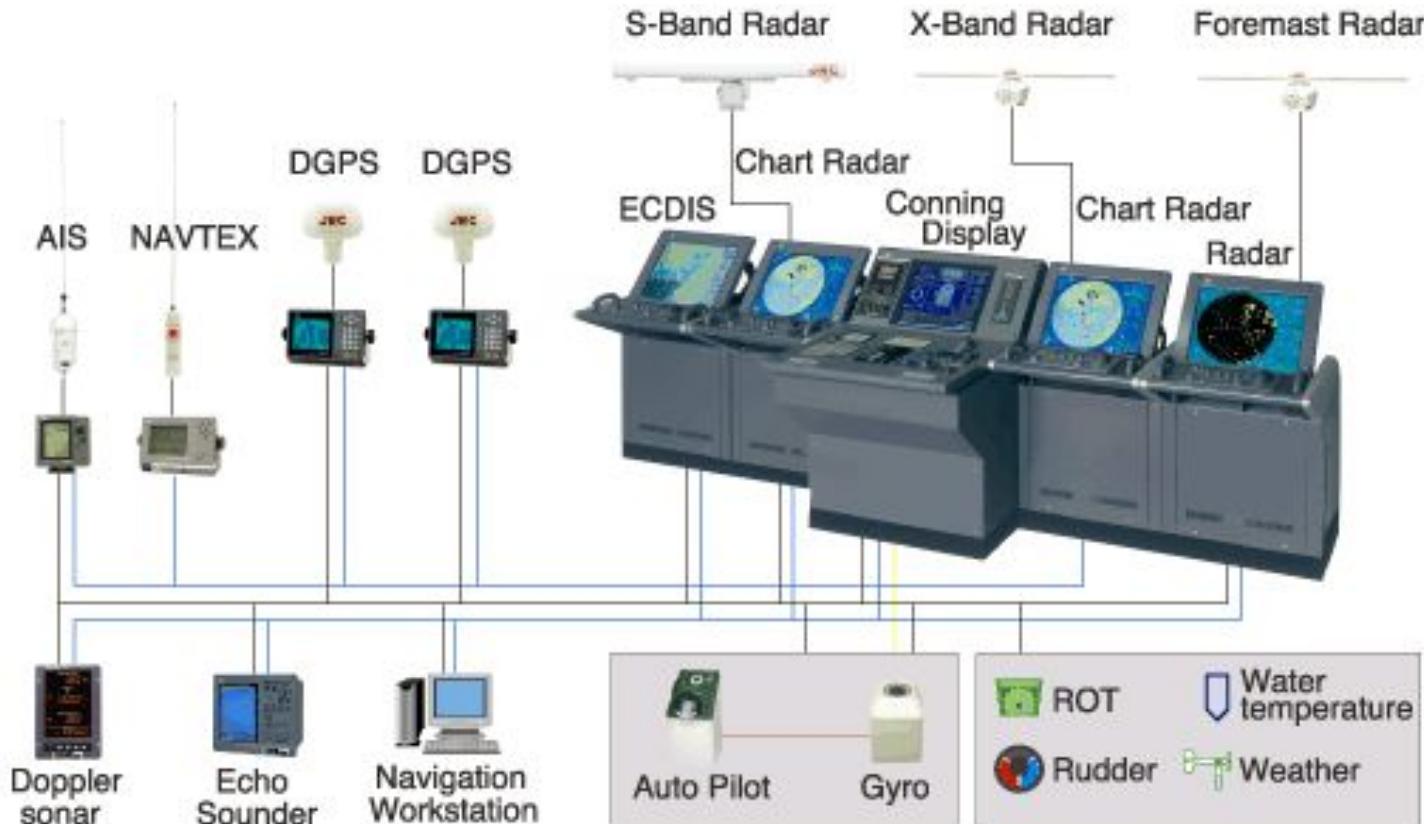
## Lecture 4

### Maritime Bridge Systems

CDR Brien Croteau, USNA Cyber Science Department, January 2023

# Outline

- Definitions
- Manning
- Components
- Automation



# Definitions

An **integrated bridge system** (IBS) is defined as a combination of systems which are interconnected in order to allow centralized access to sensor information or command/control from workstations, with the aim of increasing safe and efficient ship's management by suitably qualified personnel.

The Coast Guard interprets the term “**watch**” to be the direct performance of vessel operations, whether deck or engine, where such operations would routinely be controlled and performed in a scheduled and fixed rotation.

An **officer of the deck** (OOD) is a watchstanding duty officer on a ship in the United States Navy, United States Coast Guard, and NOAA Commissioned Officer Corps who is tasked with certain duties and responsibilities for the ship.

A marine radar with **automatic radar plotting aid** ([ARPA](#)) capability can create tracks using radar contacts. The system can calculate the tracked object's course, speed and closest point of approach (CPA), thereby knowing if there is a danger of collision with the other ship or landmass.

# Manning

<https://www.youtube.com/watch?v=xumcG8FvH7k>

There is a stark difference between the number of personnel required on civilian and military bridge watch crews. Changes have reduced USN footprint in recent years.



Seven Rotation (dog evening) (a)	Watchstander			Day Workers	
	Standard 1 in 3 Watch System				
	Day 1	Day 2	Day 3		
0000-0400	A	B	C	0.5	
0400-0800	B	C	A	3	
0800-1200	C	A	B	3	
1200-1600	A	B	C	1	
1600-1800	B	C	A	1.5	
1800-2000	C	A	B	1.5	
2000-2400	A	B	C	9	
<b>Work</b>	15.5	10	12	9	
<b>Free Time (b)</b>	8.5	14	12	15	
<b>Uninterrupted Period</b>	2.5	6.5	4	8	



Table 11. MSC vs. U.S. Navy bridge watchstanders



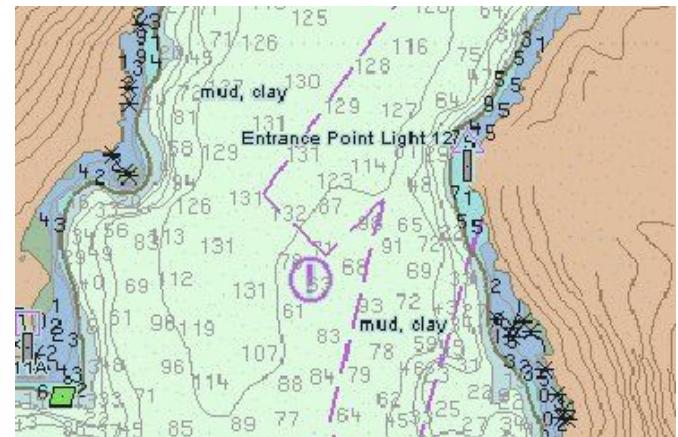
	MSC method	AS-39 (USN old method)	FFG (USN new method)	DDG-51 <sup>a</sup> (USN new method)	CG-52 <sup>b</sup> (USN new method)
Bridge Watch	Mate	OOD JOOD QMOW BMOW	OOD JOOD Bridge Spec.	OOD JOOD Bridge Spec.	OOD JOOD Bridge Spec.
	Helmsman	Helmsman EOT(JV Talker) Messenger JL Talker Lookout Stbd Lookout Port	Control Console	Control Console	Control Console
	Utilityman	JL Talker Lookout Aft Supervisor Recorder	JL Talker	Lookout Aft	Lookout Aft
Signal Bridge	Lookout Fwd	Lookout Aft	Lookout Aft	Lookout Aft	Lookout Aft

a. Type I, Type II, and Type IIA.

b. Smart Ship and Non-Smart Ship.

# ECDIS

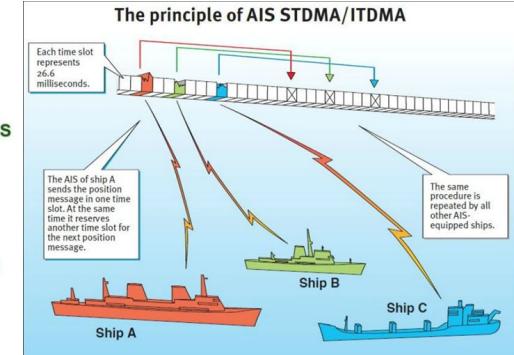
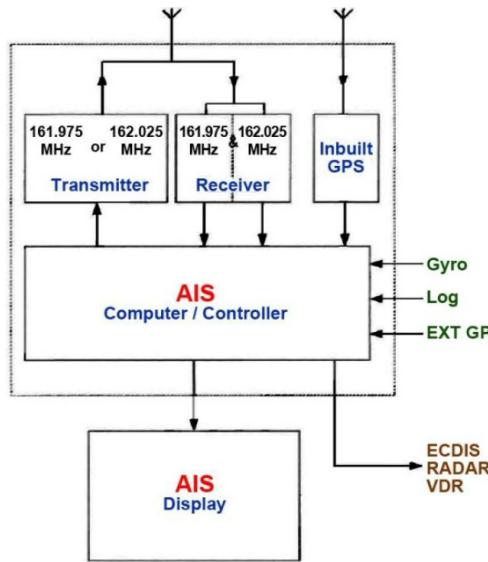
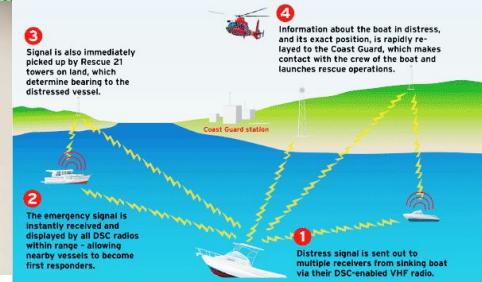
An Electronic Chart Display and Information System (ECDIS) is a geographic information system used for nautical navigation that complies with International Maritime Organization (IMO) regulations V/19 & V/27 of SOLAS convention as amended, by displaying selected information from a System Electronic Navigational Chart (SENC).



# AIS

The Automatic Identification System ([AIS](#)) is an automatic tracking system that uses transceivers on ships and is used by vessel traffic services (VTS).

[Information](#) provided by AIS equipment, such as unique identification, position, course, and speed, is intended to assist a vessel's watchstanding officers and allow maritime authorities to track and monitor vessel movements.

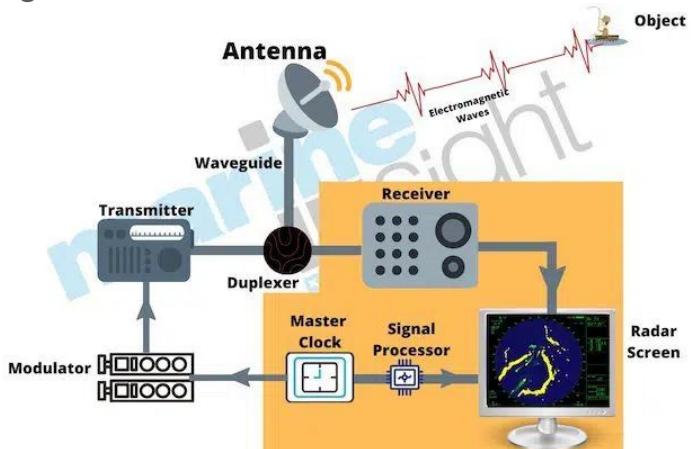


# Radar

[https://www.youtube.com/watch?v=IH\\_zRBzXqgs](https://www.youtube.com/watch?v=IH_zRBzXqgs)  
<https://www.youtube.com/watch?v=gApRsxOagZA>

Marine radars are X band or S band radars on ships, used to detect other ships and land obstacles, to provide bearing and distance for collision avoidance and navigation at sea. They are electronic navigation instruments that use a rotating antenna to sweep a narrow beam of microwaves around the water surface surrounding the ship to the horizon, detecting targets by microwaves reflected from them, generating a picture of the ship's surroundings on a display screen. Required by SOLAS regulation.

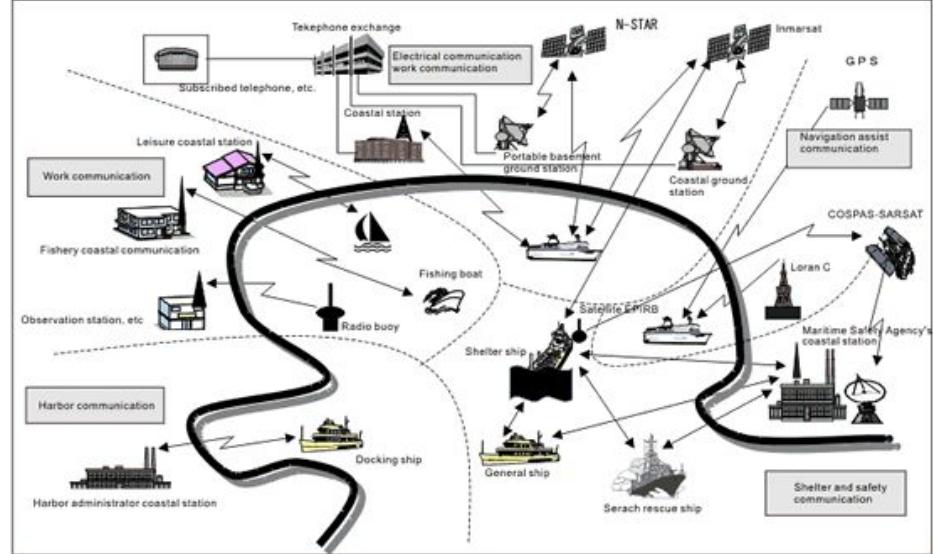
IMO Performance Standards require ARPAs "to improve the standard of collision avoidance at sea: Reduce the workload of observers by enabling them to automatically obtain information so that they can perform as well with multiple targets as they can by manually plotting a single target."



# Communications

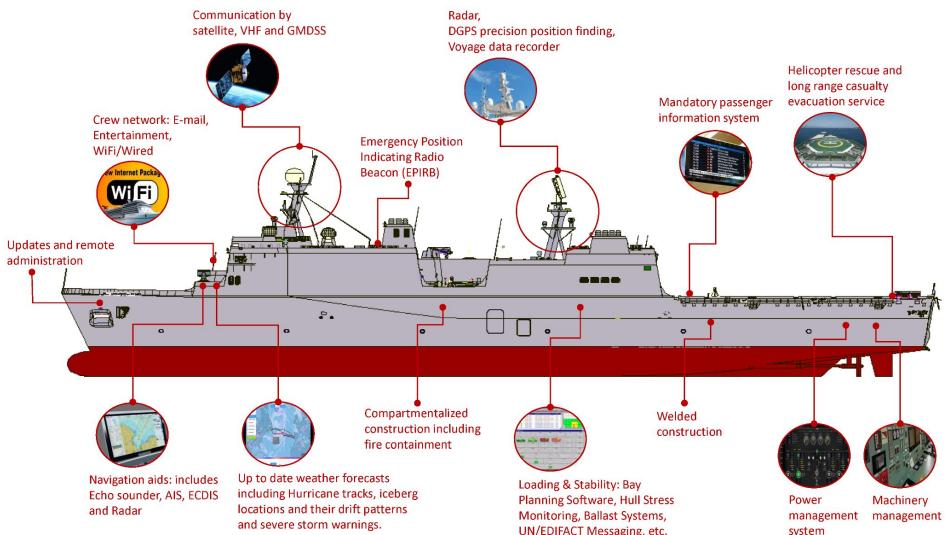
<https://www.youtube.com/watch?v=Q5cZ6v3Buks>

Marine VHF radio is a worldwide system of two way radio transceivers on ships and watercraft used for bidirectional voice communication from ship-to-ship, and ship-to-shore (for example with harbormasters). It uses FM channels in the very high frequency (VHF) radio band in the frequency range between 156 and 174 MHz.



# Other Systems

- GMDSS (Global Maritime Distress and Safety System)
- Satellite Navigation Equipment (GPS)
- Loran C Navigation Assist Radio System
- Inmarsat Mobile Satellite Communication
- N-STAR Mobile Satellite Communication
- Cordless Telephone



Frequency of the radio wave used for the maritime communication

30kHz	Loran C	100kHz
Long frequency (LF)	Medium frequency beacon Radio telegraph NAVTEX Radio telegraph, cordless telephone Radio buoy	288 - 316kHz 410 - 525kHz 424 / 518kHz 1.6 - 3.9MHz 1.6 - 2.0MHz
300kHz	Cordless telegraph at the high frequency band, cordless telephone, DSC, NBDP, Facimile	4 - 22MHz
3MHz	Cordless telephone at the 27MHz band	26,760 - 27,988kHz
30MHz	Cordless telephone at the 40 MHz band Radio buoy Bidirectional cordless telephone for the vessel and the aircraft	35.5 - 36.0 / 39.0 - 40MHz 42 - 44MHz 121.5 / 123.1MHz
Very-high frequency (VHF)	International VHF, Marine HF, DSC Shipboard communication equipment Bidirectional cordless telephone	156 - 162MHz 156.75 / 156.85MHz 156.75 - 156.85MHz
300MHz	Marine phone Cordless telephone at the 400 MHz band Shipboard communication equipment	342 - 360MHz 357MHz Band 457 - 468MHz
Ultra-high frequency (SHF)	Satellite EPIRB GPS Inmarsat (user) N-STAR (user)	406.025 / 406.028MHz 1,227.6 / 1,575.42MHz 1,525 - 1,559 / 1,626 - 1660MHz 2,505 - 2,535 / 2,660 - 2,690MHz
3GHz	Vessel radar Inmarsat (feeder) N-STAR (feeder) Search Rescue Radar Transponder RAMARK beacon	3,050 / 5,540 / 9,375 - 9,445MHz 6,425 - 6,454 / 3,599 - 3,629MHz 6,349 - 6,421 / 4,124 - 4196MHz 9,350MHz 9,375 - 9,435MHz
30GHz		

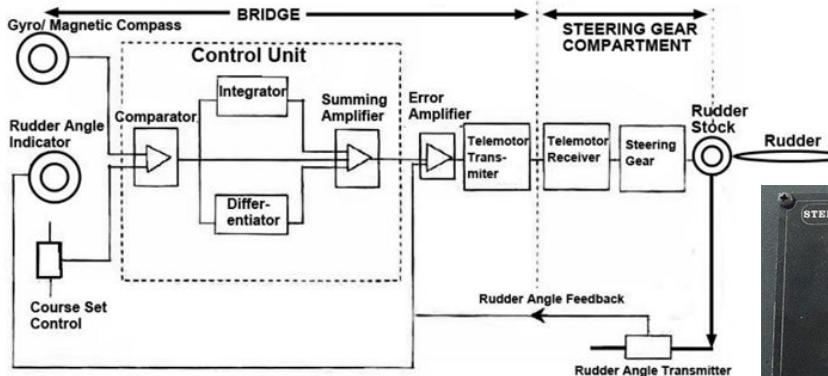
# Automatic Steering



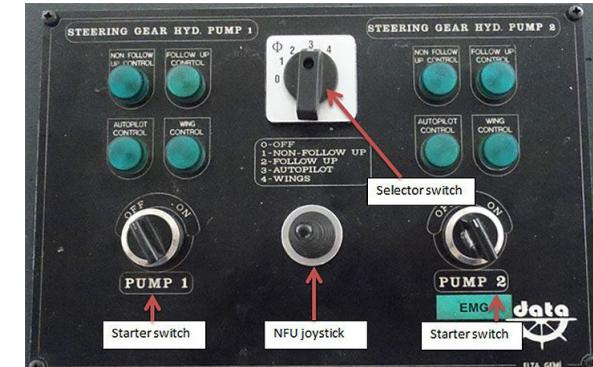
<https://www.youtube.com/watch?v=3T-wFfPm37U>

Innovation for hands-free steering for sailing vessels initially came from model ship competitions and was used during solo Transatlantic journeys in the 1930s.

Modern autopilot systems use electronic gyro inputs and have several modes of operation and follow a course entered in the integrated ECDIS system.



SIMPLIFIED BLOCK DIAGRAM OF AUTO-PILOT

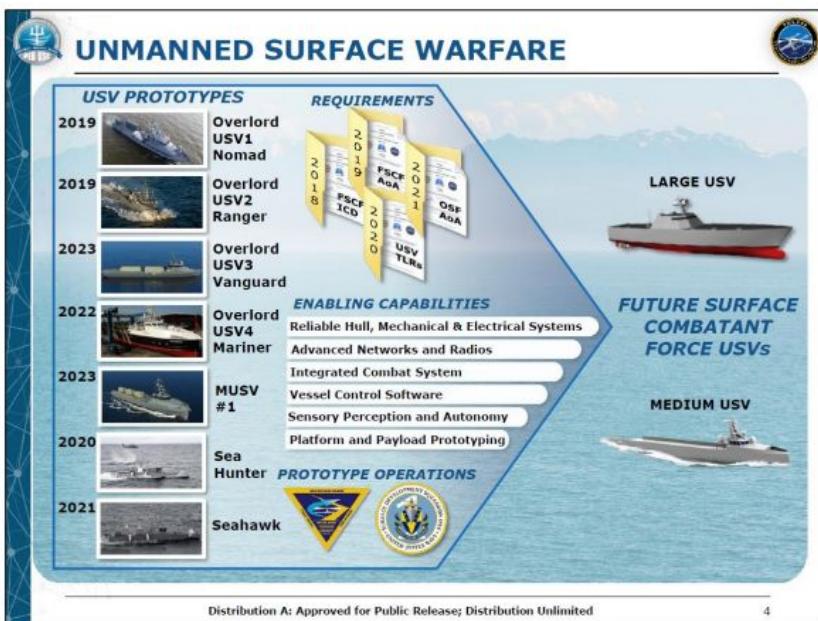


# More Automation



The [US Navy](#) and others are rapidly advancing the technology required to field fully autonomous vessels for a variety of missions.

Norway is testing a autonomous cargo ship, [MV Yara Birkeland](#). Commis. in 2022.



# Research Topics

# Potential Research Topics

1. ECDIS
2. AIS - Sahsa
3. Radar - PJ
4. Communications
5. Auto Pilot - Ariel

Or marine incidents?

1. 2014 Grounding of tanker *Halit Bey*, Quebec
2. 2017 *USS John S. McCain* and *Alnic MC* collision
3. 2021 contact of Bulk Carrier *Jalma Topic* with Office Barge
4. ... or another that you can find (and run by me)

Example Slides shell