Marine Communications and Electronics

Chuck Hawley
US Sailing Safety at Sea Seminar
US Naval Academy, April 3, 2016
Goals of Emergency Communications

- To alert rescue services to your situation
- To get medical or other expert advice
- To alert other vessels of potential hazards
- To relay information regarding another vessel
- To maintain a radio schedule with rescuers
Different levels of severity

• **MAYDAY**
  Use when there is a risk loss of life or vessel
  Man overboard, fire, flooding, collision

• **PAN PAN**
  Use when there is a serious medical issue or damage to vessel
  Loss of rudder, drifting towards danger, injury to crewmember

• **SECURITE**
  Use for safety oriented messages for other vessels
  Debris in water, navigation aid in wrong location, flare demonstration
In a distress communication, what’s important?

- Distress or Urgency Word
- Vessel name
- Position (Lat long if possible; geographic if not)
- Nature of emergency
- Number of people
- Description of vessel
- Life saving equipment
How do you broadcast a Mayday?

“Mayday, mayday, mayday.”

“This is the sailing vessel Surprise, Surprise, Surprise.”

“We are located at 24 degrees 15 minutes north, 151 degrees 56 minutes west.”

“We are taking on water, and we can’t find the source of the leak.”

“Surprise is a 38 foot sailboat with a tan deck and dark blue hull.”

“There are 6 souls on board. We have an EPIRB and a life raft.”

“This is the sailing vessel Surprise, standing by on Channel 16.”
If you receive a Mayday…

• Pause to see if anyone else responds
  Especially the Coast Guard
• If now one responds, acknowledge receipt of Mayday
• Establish whether you’re in a position to help
  Direct assistance
  Standby vessel in distress
  Relay communications
• Log communications in logbook
  Time, name, position, action taken
Portable or fixed mount communications devices?

• Portables:
  - Independence from ship’s systems
  - Antennas
  - Power
  - Convenience

• Fixed mount units:
  - Generally better antenna installations
  - Longer “battery life”
  - Greater transmit power
  - Work from below decks
What is GMDSS and why does it matter to me?

• Global Marine Distress and Safety System
• International maritime agreement to standardize all marine communications
• Required of vessels over 300 T
• These are exactly the guys who may be in a position to rescue you in the middle of the ocean
So, what are GMDSS devices?

<table>
<thead>
<tr>
<th>GMDSS</th>
<th>Not GMDSS, but useful</th>
</tr>
</thead>
<tbody>
<tr>
<td>VHF-FM Marine Radios with DSC</td>
<td>Conventional HH VHF Radios</td>
</tr>
<tr>
<td>Survival Craft VHF Portable Radios</td>
<td>AIS</td>
</tr>
<tr>
<td>EPIRB</td>
<td>SEND Devices</td>
</tr>
<tr>
<td>SART</td>
<td>PLBs</td>
</tr>
<tr>
<td>NAVTEX Receiver</td>
<td>Satellite Telephones</td>
</tr>
<tr>
<td>Aircraft Transceiver</td>
<td>Cellular Phones</td>
</tr>
<tr>
<td>SSB Radio</td>
<td></td>
</tr>
<tr>
<td>Inmarsat Satellite Terminals</td>
<td></td>
</tr>
</tbody>
</table>
With GMDSS, you buy this:

You get this:
When you use GMDSS tools, you get all this: Ground Stations, Satellites, Networks.
Rescue 21 (USA)

- Part of the National Distress Response System (NDRS)
- VHF-based system, coastal PR, and 30 miles out.
- Digitally-based (DSC) system plus voice
- Direction finding ability by Coast Guard using multiple towers or GPS input
- Automated broadcasts
- Completed in the Continental U.S.

*If you don’t have a DSC button, give a long radio call for Direction Finding.*
Rescue 21 Coverage Map

NOTE: Coverage rings are depicted for illustration purposes only.

NOTE: Inset maps are not to scale with the US mainland.
## Summary of Marine Communications

**How far? What type? What cost?**

<table>
<thead>
<tr>
<th>Name</th>
<th>Cost</th>
<th>Range</th>
<th>Type of Comms</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH VHF</td>
<td>$100-$300</td>
<td>3-20</td>
<td>Voice</td>
</tr>
<tr>
<td>Fixed VHF</td>
<td>$100-$500</td>
<td>20-60</td>
<td>Voice</td>
</tr>
<tr>
<td>AIS</td>
<td>$500</td>
<td>25</td>
<td>Vessel Data</td>
</tr>
<tr>
<td>EPIRB/PLB</td>
<td>$250-$700</td>
<td>Worldwide</td>
<td>Mayday</td>
</tr>
<tr>
<td>HF SSB</td>
<td>$2000-$3000</td>
<td>25-4000</td>
<td>Voice, Data</td>
</tr>
<tr>
<td>Sat Telephone</td>
<td>$500-$1500</td>
<td>~Worldwide</td>
<td>Voice, Data</td>
</tr>
<tr>
<td>SEND Device</td>
<td>$100-$400</td>
<td>~Worldwide</td>
<td>Data, position</td>
</tr>
<tr>
<td>COB Beasons</td>
<td>$300</td>
<td>~2</td>
<td>Data, position</td>
</tr>
<tr>
<td>Inmarsat M</td>
<td>$3000-$6000</td>
<td>~Worldwide</td>
<td>Voice, Data</td>
</tr>
</tbody>
</table>
Handheld VHF-FM Marine Radio

Range: 3 miles (another boat) to 20 miles (CG tower)

Cost: $100 to $300

Best Uses: Cockpit safety, ship to dinghy, small boats (kayaks, inflatables). Autonomous from ship’s systems. **Strongly consider models with DSC and GPS built-in.**

Limitations: Some uses are illegal but handy, short range, few chat channels
Fixed Mount VHF-FM Marine Radio

Range: 20-60 miles

Cost: $140 to $1000

Best Uses: Calling the Coast Guard
Calling virtually any marine station of interest
Most cost-effective safety item on board.

Limitations: Marine only.
Line of sight range.
Digital Selective Calling

- Flip the Distress cover and press the button briefly
- Scroll down to select the nature of the emergency
- Press and hold the Distress button for 5s
- Monitor channel 16 for a response
- Must have:
  - “Modern” VHF Radio
  - GPS interfaced
  - MMSI number entered
Approved VHF Antenna

15” minimum height
Unity gain
Automatic Identification System: AIS
AIS
Automatic Identification System

- Automatic broadcasts via VHF frequencies
  Vessel MMSI, status (anchor, underway)
  Lat-long, heading, speed, rate of turn
  Calculates CPA, TCPA
  May include name, time to port, draft, size, type of cargo
- Connects to chart plotter or standalone display
- Virtually unlimited capacity of vessels
  Designed for 4500 vessels
  Prioritizes closest ships
Receive only, Class A, or Class B?

Receive only AIS
You see them, but they cannot see you

Class B Transceiver
See and be seen

No Loss Antenna Splitter
Use a single antenna for VHF and AIS
Vessels in SF Bay on Thursday
This application has been tested under Firefox and Internet Explorer. For faster rendering, use Firefox -- this is a GMap2.addOverlay issue.

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EPIRBs

• 406 MHz Beacons
  Category 1
  Category 2
• Unique ID number for each unit
• Register it with NOAA
  www.beaconregister.com
• World wide coverage
• Most now have an internal GPS receiver
• Waterproof, reliable, independent, buoyant, rugged
PLBs

• Smaller cousin to EPIRBs
  Same satellites
  Same frequencies
  Same rescue agencies

• Differences
  24h vs. 48hr transmit time
  May not float
  Won’t sit upright in water

• Best use
  Personal (hiking, kayaking)
  Small offshore boats

• Not recommended?
  Man Overboard
COSPAS-SARSAT System Overview

1. Distress Call Utilizing Emergency Beacon
2. Search & Rescue Satellites
3. Local User Terminal
4. Mission Control Center
5. Rescue Coordination Center
Mobile Satellite Communications
Worldwide Coverage Map
Keep your info current

•DISTRESS. On 22 January 2005, Coast Guard Group San Francisco received a MAYDAY call via VHF-FM CH-16 from the operator of the vessel HAWKEYE stating his vessel was taking on water near Pigeon Point, San Francisco, CA. He manually activated his 406 MHz EPIRBs before making the call. The Coast Guard diverted a helicopter and launched a motor life boat to the area to assist him. The helicopter located and dropped pumps to the vessel. After the vessel was dewatered and the leak was patched, two nearby "good sam" vessels assisted the disabled vessel further. The motor life boat transferred the 2 POBs to the vessel Queen of Hearts and the vessel Raddon towed the distressed vessel into port.

•TWO OF THE EPIRBS CARRIED ABOARD THE VESSEL WERE REGISTERED TO THE VESSEL SOLACE. THE OWNER OF THE HAWKEYE WAS USING THEM ABOARD HIS VESSEL.
Single Sideband Radios
# HF, SSB or Single Sideband Radios

<table>
<thead>
<tr>
<th>Range:</th>
<th>50-4,000 miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost:</td>
<td>$2,000 to $3,000 plus installation</td>
</tr>
<tr>
<td>Best Uses:</td>
<td>Long distance ship to ship and ship to shore Coast Guard monitors 4 bands Rugged, marinized designs.</td>
</tr>
<tr>
<td>Limitations:</td>
<td>Learning curve Complicated installation Time sensitive High current draw when transmitting.</td>
</tr>
</tbody>
</table>

Icom AT-130 Antenna Tuner
HF (SSB) Antenna Considerations

- Two general types
  - 23’ fiberglass whip antennas
  - Insulated wire antennas
- Requires an antenna tuner to match frequency to wire length
- Requires a “counterpoise” in contact with water or coupled to water
E-mail via SSB or Ham

- Requires a radio, laptop, and TNC (Terminal Node Controller, $650)
- Slow transmission rates
- Several non-profit services (Sailmail and WinLink)
- 10 minute per day limit (Sailmail)
- Very inexpensive compared to other options
- HAM transmissions limited by non-commercial rules
## Iridium

<table>
<thead>
<tr>
<th>Range:</th>
<th>Worldwide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost:</td>
<td>$1500 plus $20 per month plus $1.50 per minute</td>
</tr>
<tr>
<td>Best Uses:</td>
<td>Portable voice communications where there is no cellular, or where phone calls are prohibitively expensive. Independent of the ship’s systems</td>
</tr>
<tr>
<td>Limitations:</td>
<td>Slow baud rate (2.4k, 9.6k with compression) Ridiculously complicated pricing</td>
</tr>
</tbody>
</table>
**Globalstar**

<table>
<thead>
<tr>
<th>Range:</th>
<th>Continental and Coastal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost:</td>
<td>$500 plus $50 activation plus $1.09 per minute</td>
</tr>
<tr>
<td>Best Uses:</td>
<td>Portable voice communications where there is no cellular, or where phone calls are prohibitively expensive. Independent of the ship’s systems</td>
</tr>
<tr>
<td>Limitations:</td>
<td>Not worldwide, complicated pricing schemes</td>
</tr>
</tbody>
</table>
IsatPhone Pro

<table>
<thead>
<tr>
<th>Range:</th>
<th>Worldwide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost:</td>
<td>$575 plus $50 activation plus $1.43 per minute</td>
</tr>
<tr>
<td>Best Uses:</td>
<td>Portable voice communications where there is no cellular, or where phone calls are prohibitively expensive. Independent of the ship’s systems Free inbound SMS</td>
</tr>
<tr>
<td>Limitations</td>
<td>Complicated pricing schemes “Units ≠ Minutes”</td>
</tr>
</tbody>
</table>
S.E.N.D. Devices

- SMS/e-mail capable
- Standardized or customized messages
- One-way or two-way
- SOS button
- Allows others to track your progress
- May be worldwide
- Integrates with smart phones
S.E.N.D. Devices

- Other options include tracking only (for valuable items)
- Different satellite constellations
- This is changing so quickly that you have to investigate the latest changes.
What about Crew Overboard alarms?

Man Overboard Beacons have gone through phases
• Mini-Class B EPIRB
• Cessation of Transmission Device
• Personal Locator Beacon
• Personal MOB Alarm using AIS/DSC
But faster boats have a problem…

<table>
<thead>
<tr>
<th>Time</th>
<th>5 kts</th>
<th>7 kts</th>
<th>10 kts</th>
<th>14 kts</th>
<th>20 kts</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 sec.</td>
<td>84’</td>
<td>118’</td>
<td>169’</td>
<td>236’</td>
<td>338</td>
</tr>
<tr>
<td>20 sec.</td>
<td>169’</td>
<td>236’</td>
<td>338’</td>
<td>473’</td>
<td>675’</td>
</tr>
<tr>
<td>30 sec.</td>
<td>253’</td>
<td>355’</td>
<td>507’</td>
<td>709;</td>
<td>1013’</td>
</tr>
<tr>
<td>60 sec.</td>
<td>507’</td>
<td>709’</td>
<td>1013’</td>
<td>1418’</td>
<td>2026’</td>
</tr>
<tr>
<td>10 min.</td>
<td>0.8nm</td>
<td>1.2nm</td>
<td>1.7nm</td>
<td>2.3nm</td>
<td>3.3nm</td>
</tr>
</tbody>
</table>

So how do you find sailors who fall overboard?
121.5 MHz Beacons
Cessation of Reception Beacons
Personal Locator Beacons
AIS/DSC Beacons
AIS/DSC Beacons
Final thoughts

• Rescue 21 works best with DSC: meet the CG halfway
• AIS is also effective for finding vessels (and avoiding collisions)
• Don’t compromise on your VHF antenna installation
• A SEND device has its place, but start with EPIRBs
• A MOB beacon will allow your vessel or the fleet to find your MOB
• Don’t be too creative: use the stuff the pros use
Big Changes in Marine Electronics

- NMEA 2000
- Cheaper cartography
- Make your own charts
- Wireless connectivity
- Move towards “Glass Cockpit”
- Intuitive sonar presentations: down, side, forward
- High speed GPS sensors
- Graphics for the Sailor!
- New software via Wifi or downloads
What about navigation?

- Standalone products
- Dual function products
- Multifunction displays
Which cartography?

**Insight Genesis**
Insight Genesis is an innovative, cloud-based service that empowers you to create custom coastal and inland maps from sonar data recorded with your own transducer. It’s also your portal to the crowd-sourced Insight Genesis Social Map, a global, online database of coastal and inland maps generated in part by the B&G community of sailing and cruising enthusiasts.

**C-MAP by Jeppesen Max-N BDS**
Exclusive regional cartography, covering large areas for a complete navigation solution featuring accurate depth contours, bottom type, anchorage areas, wreck, obstructions and more.

**C-MAP by Jeppesen Max-N Wide**
The MAX-N WIDE charts contain the same fantastic features as the MAX-N BDS charts, but also have detailed harbour data, cover inland lakes that are not available on the MAX-N BDS charts and receive more frequent updates.

**Navionics® Gold**
Navionics Gold Charts are extremely popular with yachtsmen from across the globe. The additional benefits of this optional upgrade are clear to see on any Zeus Touch or Zeus series chartplotter/multifunction display and will undoubtedly enhance all of your navigational needs.

**Navionics® Platinum Plus**
Platinum+ charts offer the ultimate navigational experience with multidimensional 3D viewing, integrated aerial image overlay, port photos and more. Compatible with all our Zeus Touch and Zeus series chartplotters/multifunction displays. Platinum+ is an optional upgrade that provides you with the highest level of navigational detail possible.

**Nautic Insight HD East v16**
High-Definition detail Eastern U.S. coastal and offshore sea maps for sailing, cruising and fishing with high-definition shaded relief that provides an enhanced view of underwater structure.

**Nautic Insight HD West v16**
High-Definition detail for Western U.S. inland lake maps for fishing and cruising, with high-definition shaded relief that provides an enhanced view of underwater structure.

**Nautic Insight Pro v16**
U.S. coastal and offshore maps with detailed navigation and fishing information.
Recommendations

• The clarity commandment*
• Judge a display on the distance from which you’ll see it
• Are you a helm hog?
• Do you sail at night?
• A system is only as good as its sensors

* Hershel Gordon Lewis