Safety and Marine Communications

Chuck Hawley
US Sailing Safety at Sea Course

What are the 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
  - “A distress alert should be transmitted if, in the opinion of the Master, the ship or a person is in distress and requires immediate assistance.”
- 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), mention if you have AIS
- 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, RESPOND, CALC, LOG

- Pause to see if anyone else responds
  - Especially the Coast Guard
- If no one responds, respond to the Mayday
- Calculate 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
  - "You CAN take it with you!"
- 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?

GMDSS

- VHF-FM Marine Radios with DSC
- Survival Craft VHF Portable Radios
- EPIRB
- SART
- NAVTEX Receiver
- SSB Radio
- Inmarsat C and F77 Satellite Terminals

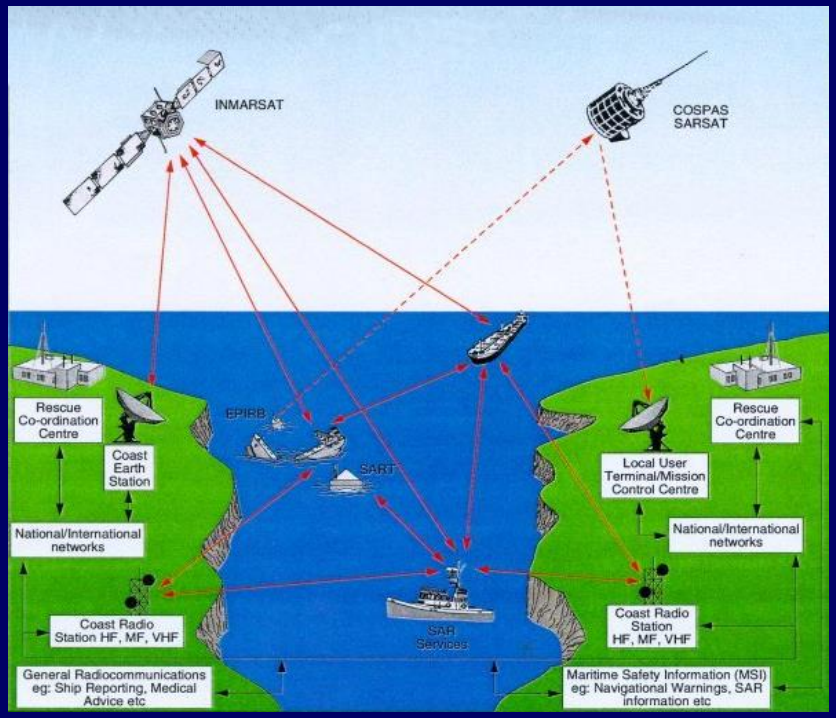
Not GMDSS, but useful

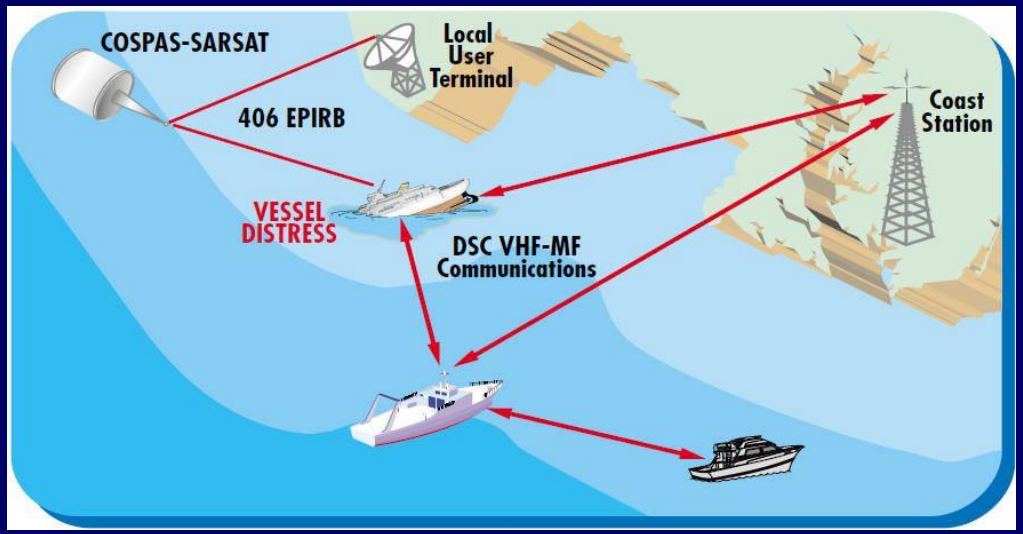
- Conventional HH VHF Radios
- AIS
- SEND Devices
- PLBs
- Satellite Telephones
- Cellular Phones

With GMDSS, you buy this:

And you get this:

When you use GMDSS tools, you get all this:
Ground Stations, Satellites, Networks

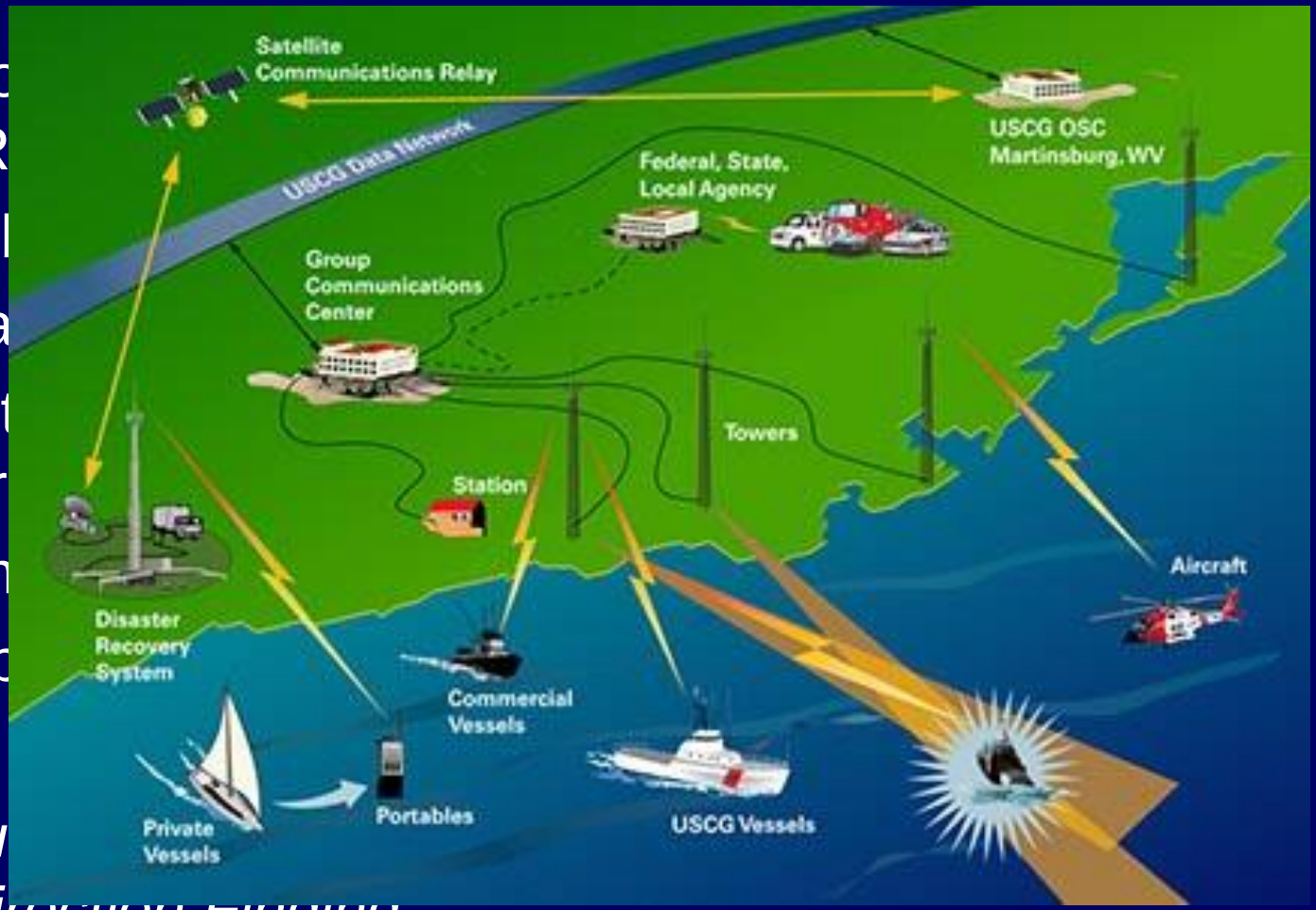




Rescue 21 (USA)

- Part o
(NDR
- VHF-I
- Digita
- Direct
tower
- Auton
- Comp

- *If you*
for Direction Finding.



Rescue 21 Coverage Map

Rescue21 Regional coverage analysis of VHF receive antenna based on geographical line-of-sight.

System requirement: At least 20 nm offshore for a 1 watt VHF-FM Ch 16 signal transmitted form two meters above water surface.

Summary of Marine Communications

How far? What type? How much?

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

Handheld VHF-FM Marine Radio

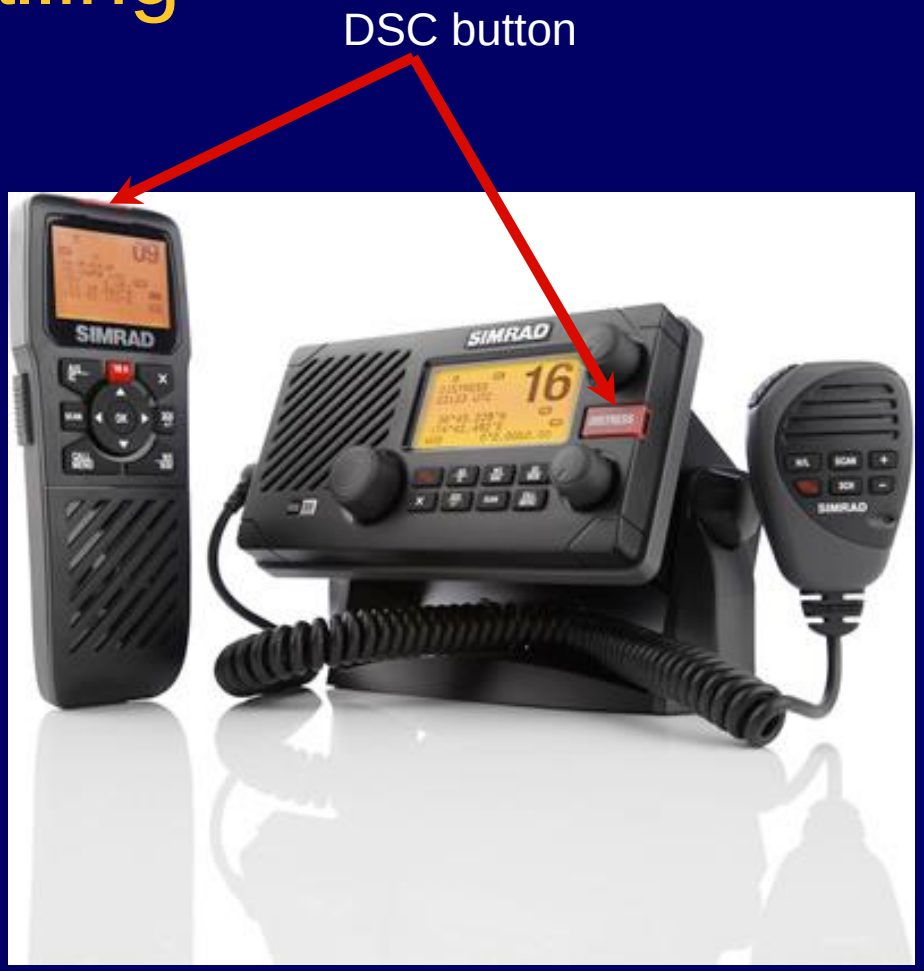
Range:	**3 miles (another boat) to 20 miles (CG tower)**
Cost:	$100 to $300
Best Uses:	Cockpit safety, ship to dinghy, small boats (kayaks, inflatables. Autonomous from ship's systems. ***Strongly consider models with DSC and GPS built-in.***
Limitations:	Some uses are illegal but handy, short range, 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

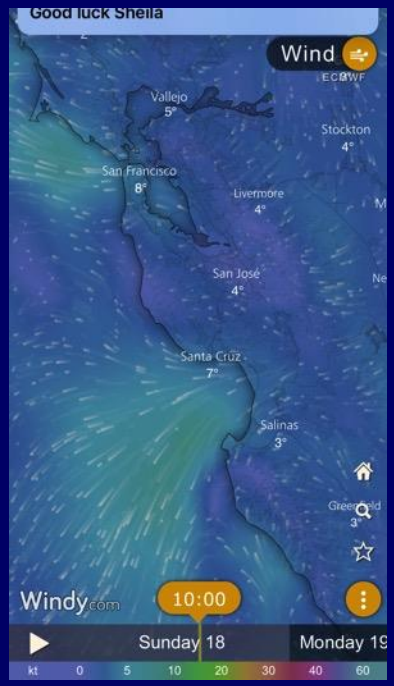
- Flip the Distress cover and press the button for three seconds
- Monitor channel 16 for a response
- Must have:
  - “Modern” VHF Radio
  - GPS interfaced
  - MMSI number entered
- Radio may allow you to indicate the nature of your emergency

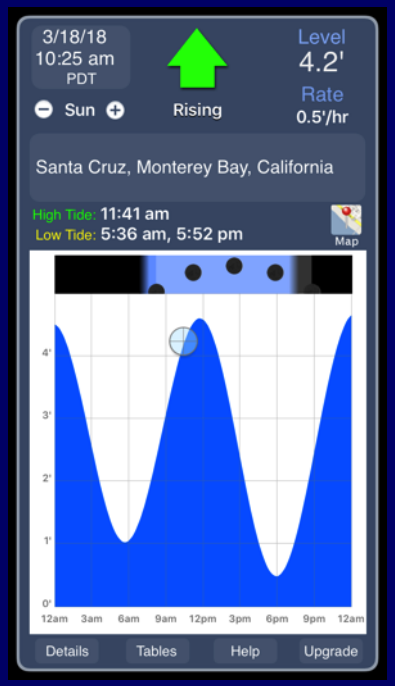


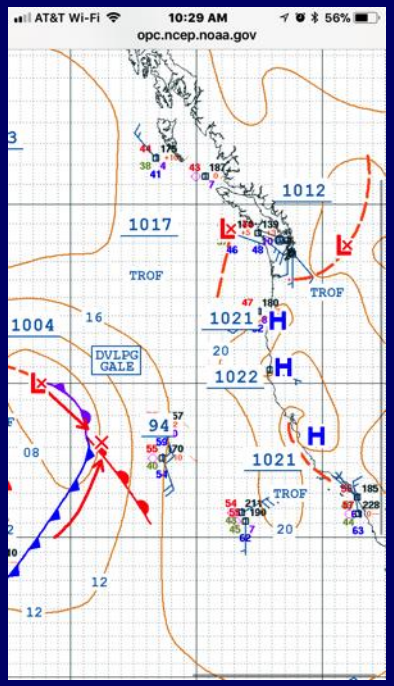
Why not use a smart phone?

VHF	Smart Phone
Marine only; meets the needs of boaters	Ability to call any phone number
Direct line to the Coast Guard	Simple user-interface
Can communicate with vessels and aircraft	Must be used with a shore network
Greater range	Very short range
Broadcast	Narrowcast
Waterproof	Not waterproof

That isn't to say that smart phones are really useful...

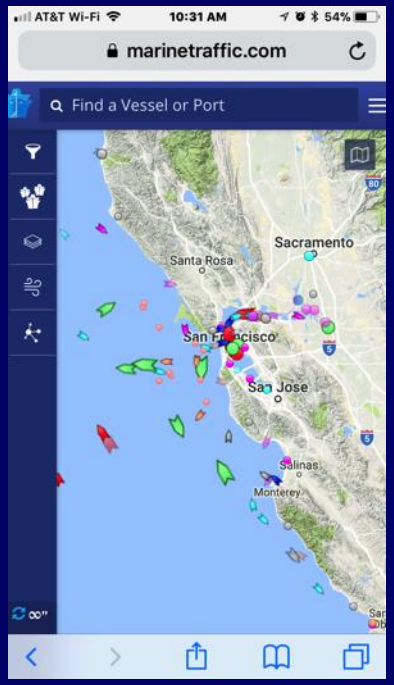

Good luck Sheila
Wind
Vallejo
Stockton
San Francisco
Livermore
San José
Santa Cruz
Salinas
Windy.com
10:00
Sunday 18
Monday 19


3/18/18
10:25 am
PDT
Level
4.2'
Rate
0.5'/hr
Sun
Rising
Santa Cruz, Monterey Bay, California
High Tide: 11:41 am
Low Tide: 5:36 am, 5:52 pm
Map
12am 3am 6am 9am 12pm 3pm 6pm 9pm 12am
Details
Tables
Help
Upgrade


AT&T Wi-Fi
10:29 AM
56%
opc.ncep.noaa.gov
1012
1017
TROF
1021
1004
DVLPG
GALE
1022
1021
TROF


AT&T Wi-Fi
10:30 AM
54%
United States Coast Guard
U.S. Department of Homeland Security
Home
Profile
State Boating Information
Request Safety Check
Review Safety Equipment
File Float Plan
Rules of the Road
NOAA Buoys
Report Hazard
Report Pollution
Report Suspicious Acti...
Emergency Assistance


AT&T Wi-Fi
10:30 AM
55%
FIXED BRIDGES
VERT CL 18FT
WOODS LAGOON
DISPOSAL AREA
Route
Start
Menu


AT&T Wi-Fi
10:31 AM
54%
marinetraffic.com
Find a Vessel or Port
Sacramento
Santa Rosa
San Francisco
San Jose
Salinas
Monterey

Approved VHF Antenna

15” minimum height

Unity gain

Make sure to use a waterproof coax connector at the masthead

World Special Offshore Spec. Regs
US Sailing Safety Equipment Regs

- Radio shall have 25W output
- Masthead antenna
- No more than 40% power loss due to cable

<50’	RG-8X
50-90’	RG-8U
90-140’	9913F
140-230’	LMR600

- Handheld VHF in addition to fixed mount

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

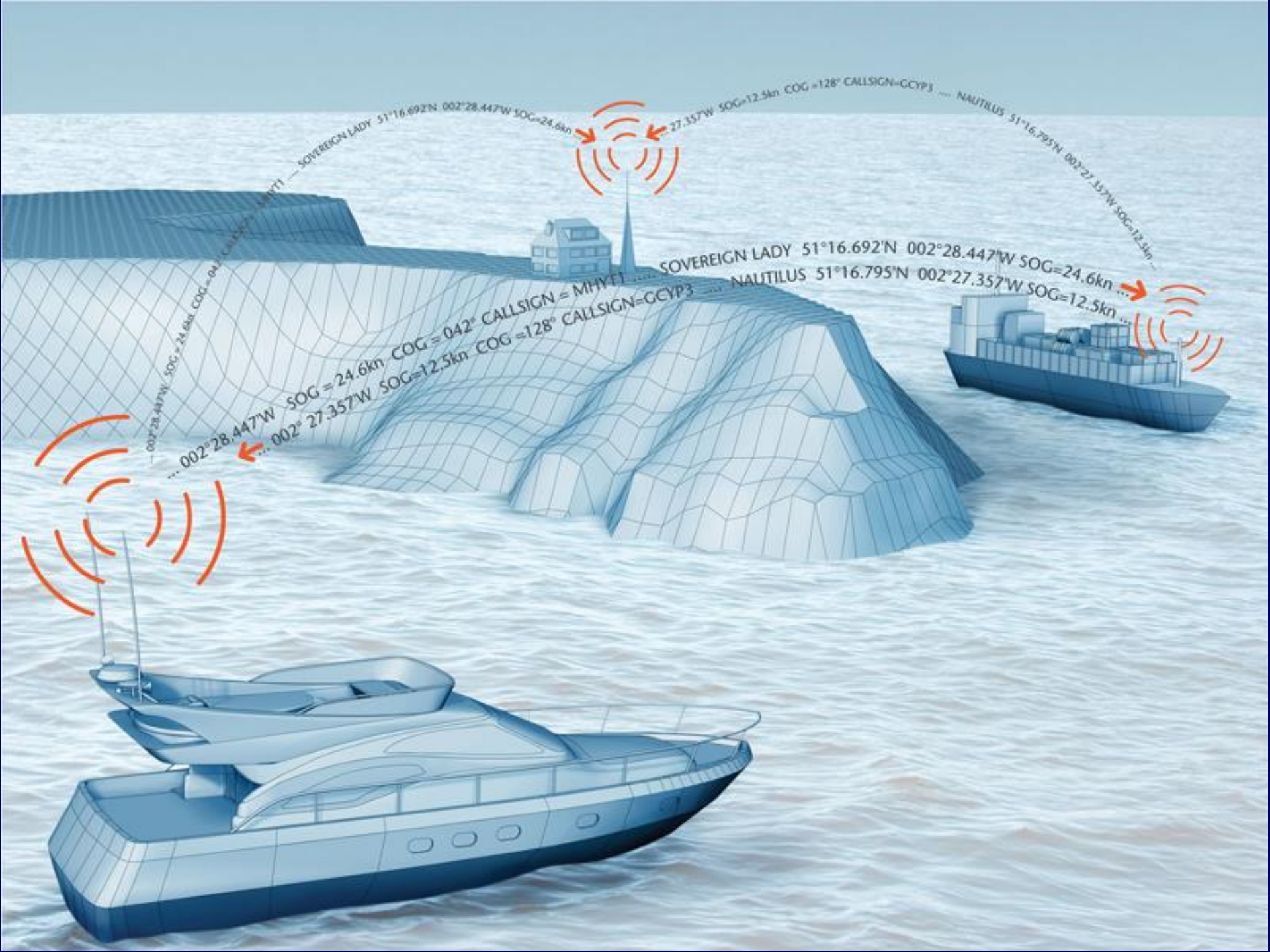
Class A/B Transceiver
See and be seen

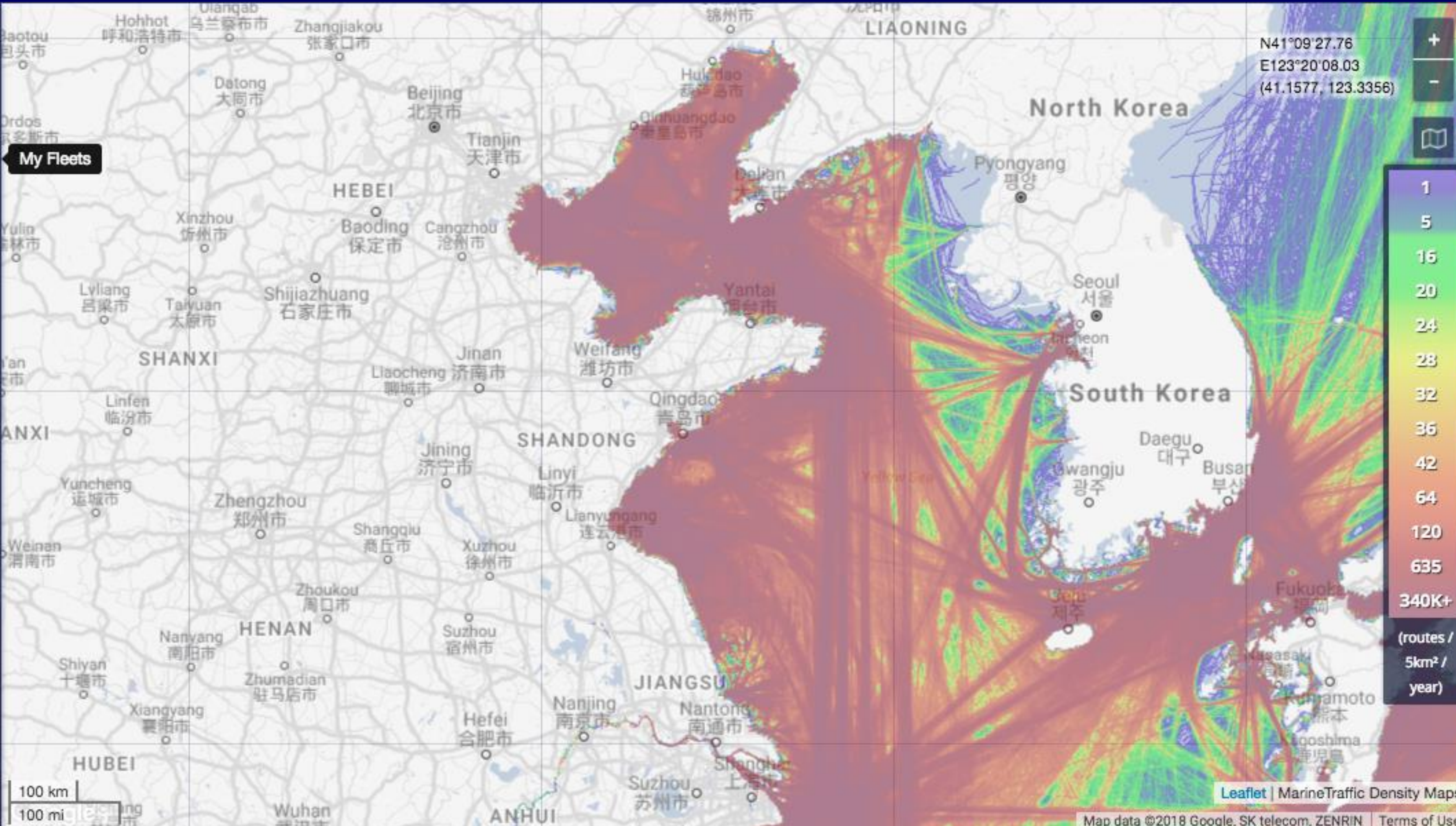
No Loss Antenna Splitter
Use a single antenna for VHF and AIS

Comparison of AIS Types

AIS Class	Class A (SO-TDMA)	Class B SO-TDMA	Class B CS-TDMA	Receive Only
Transmit Power	12.5W	5W	2W	Zip
Includes Display?	Yes	Some do	Some do	No
Xmit Interval Nav Information	2-10 seconds and 6 minutes	5-30 seconds, 3 minutes if moored.	30 seconds, 3 minutes if moored.	N/A
Vessel Data	6 minutes	6 minutes	6 minutes	N/A
Best Use	Commercial	Serious Recreational	Casual Recreational	Only cause it's free

SO-TDMA: Self Organizing Time Division Multiple Access
CS-TDMA: Carrier Sense Time Division Multiple Access


SOVEREIGN LADY 51°16.692'N 002°28.447'W SOG=24.6kn
NAUTILUS 51°16.795'N 002°27.357'W SOG=12.5kn
... 002°28.447'W SOG = 24.6kn COG = 042° CALLSIGN = MHYT1 ..... SOVEREIGN LADY 51°16.692'N 002°28.447'W SOG=24.6kn ...
... 002° 27.357'W SOG=12.5kn COG =128° CALLSIGN=GCYP3 .... NAUTILUS 51°16.795'N 002°27.357'W SOG=12.5kn ...


N41°09'27.76
E123°20'08.03
(41.1577, 123.3356)
My Fleets
LIAONING
North Korea
Pyongyang
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Seoul
서울
South Korea
Daegu
대구
Busan
Gwangju
광주
Fukuoka
Nagasaki
Beijing
北京市
Tianjin
天津市
HEBEI
Baoding
保定市
Cangzhou
沧州市
Shijiazhuang
石家庄市
Hohhot
呼和浩特市
Zhangjiakou
张家口市
Datong
大同市
Xinzhou
忻州市
Lvliang
吕梁市
Taiyuan
太原市
SHANXI
Linfen
临汾市
Yuncheng
运城市
Huludao
Qinhuangdao
秦皇岛市
Dalian
Yantai
烟台市
Weifang
潍坊市
Qingdao
青岛市
Jinan
济南市
Liaocheng
聊城市
SHANDONG
Jining
济宁市
Linyi
临沂市
Lianyungang
连云港市
Zhengzhou
郑州市
Shangqiu
商丘市
Xuzhou
徐州市
Zhoukou
周口市
HENAN
Nanyang
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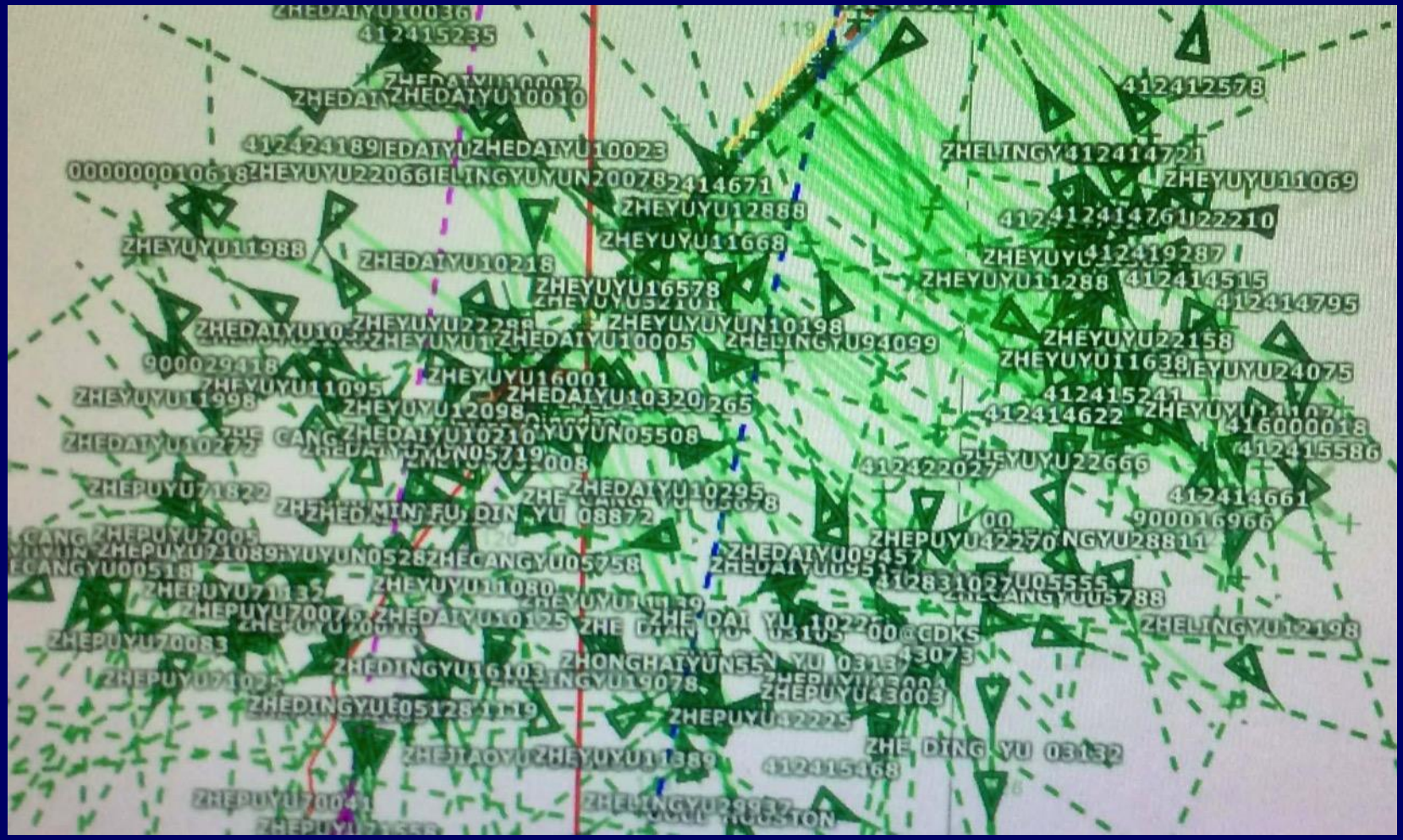
Zhumadian
驻马店市
Suzhou
宿州市
JIANGSU
Nanjing
南京市
Nantong
南通市
Hefei
合肥市
Shiyan
十堰市
Xiangyang
襄阳市
HUBEI
Wuhan
ANHUI
Suzhou
苏州市
Shanghai
上海市
Weinan
渭南市
Kumamoto
Kagoshima
1
5
16
20
24
28
32
36
42
64
120
635
340K+
(routes / 5km² / year)
100 km
100 mi
Leaflet | MarineTraffic Density Maps
Map data ©2018 Google, SK telecom, ZENRIN
Terms of Use

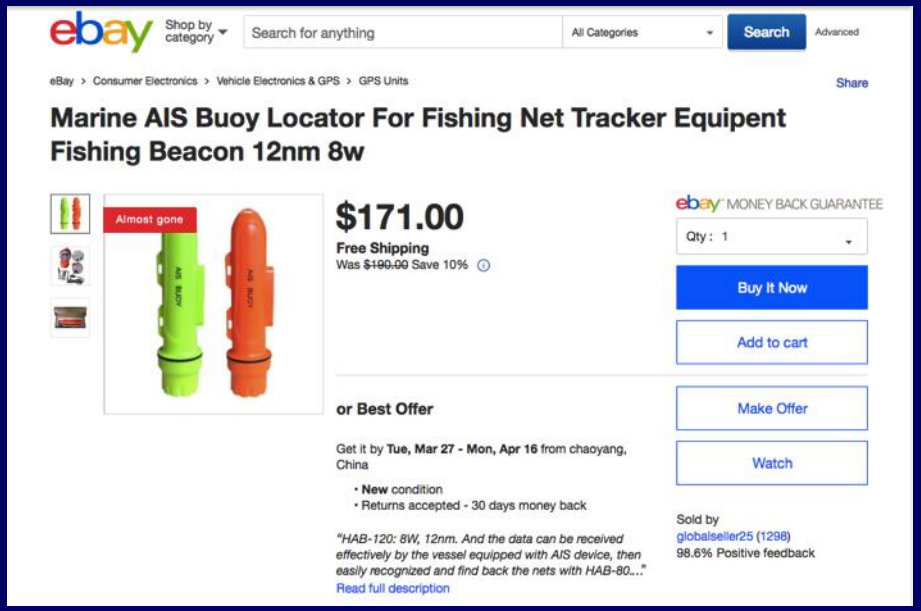
To much of a good thing…

AIS targets on the way to Qingdao



AIS Net Buoys to Track Fishing Gear

- 8W of power
- Very inexpensive
- Widely available



EPIRBs and COSPAS SARSAT

- 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

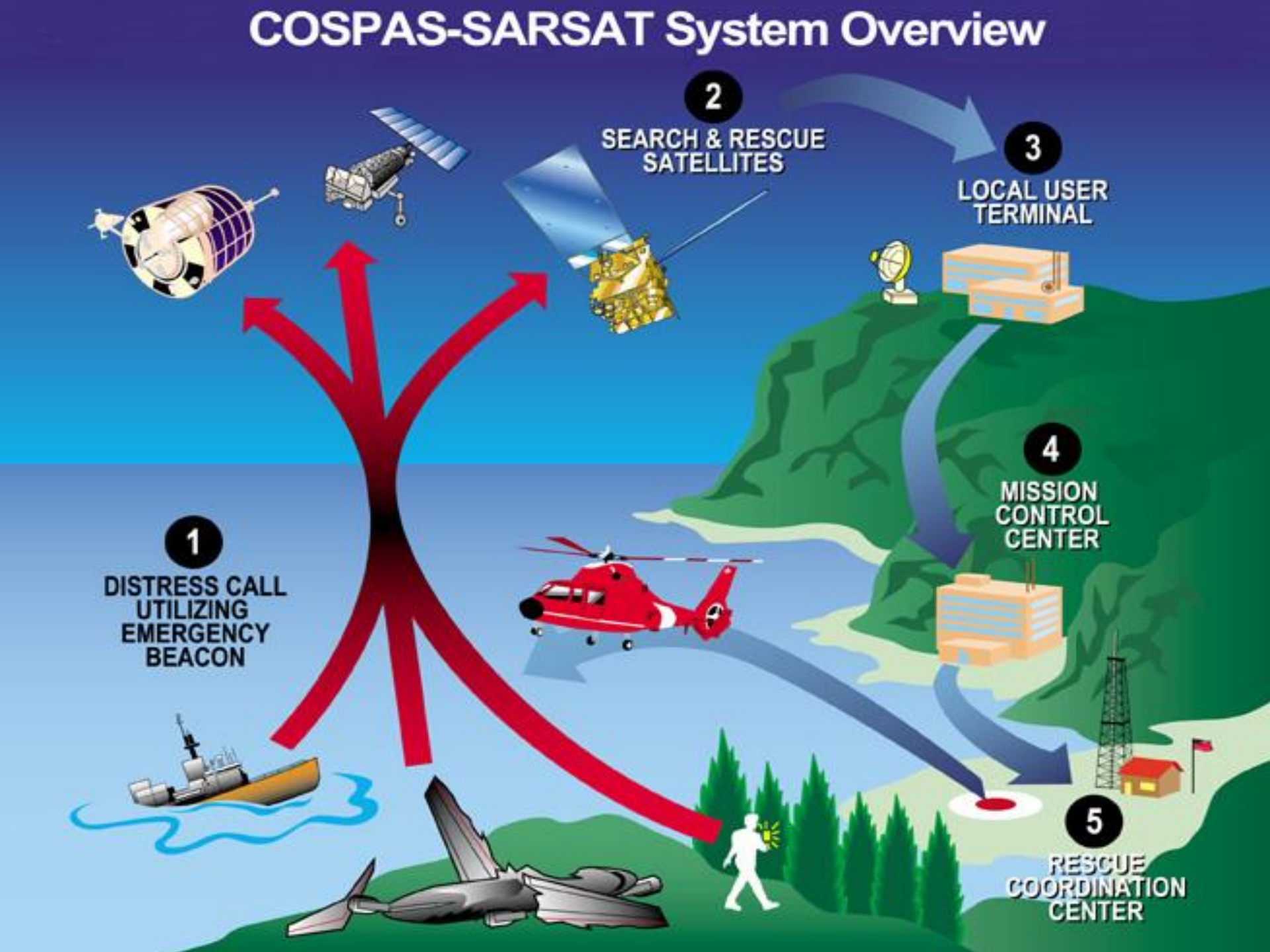
PLBs

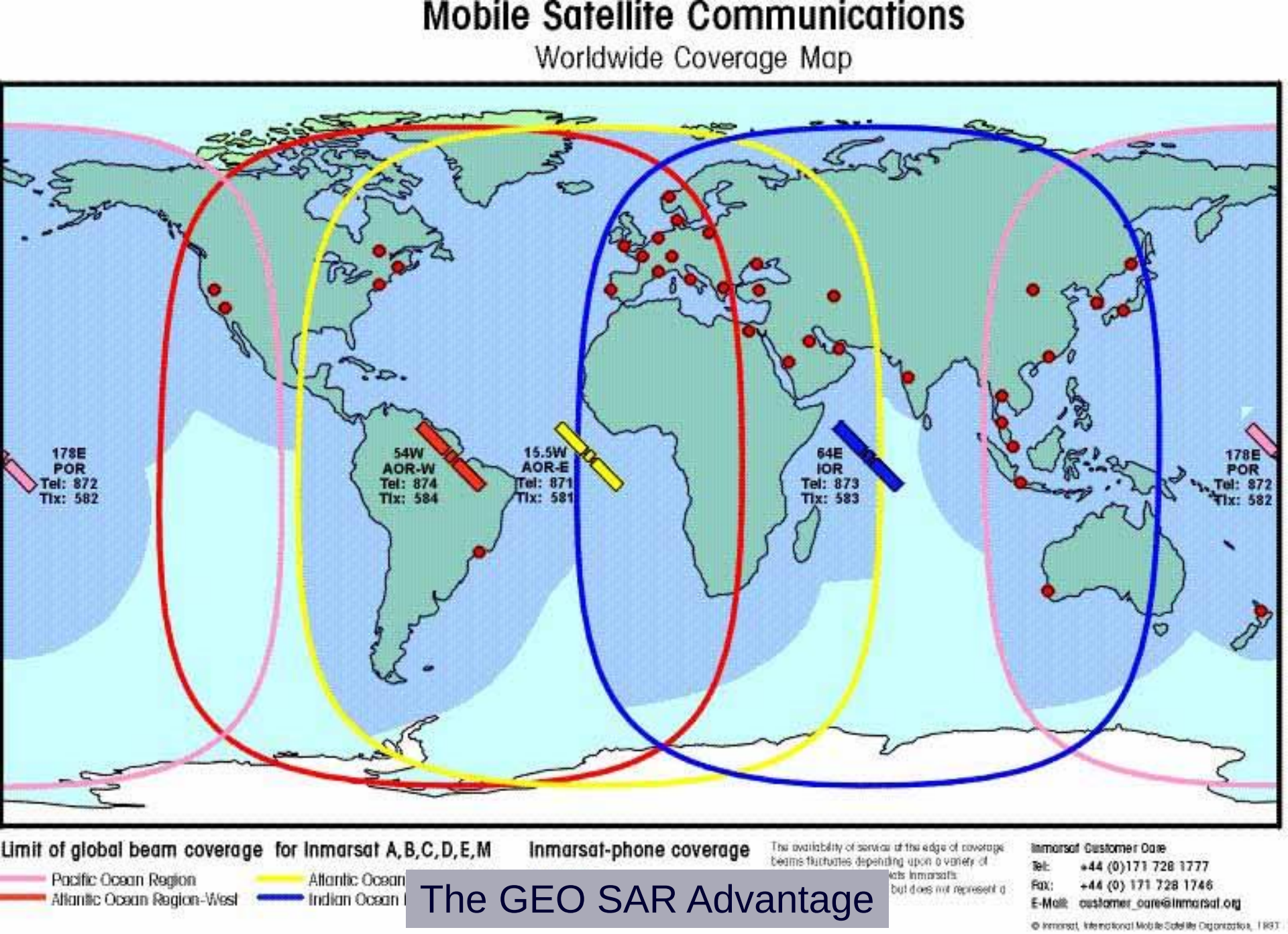
- Smaller cousin to EPIRBs
  - Same satellites
  - Same frequencies
  - Same rescue agencies
- Differences
  - 24h vs. 48hr transmit time
  - May not float
  - Won’t sit upright in water
- Best use
  - Personal (hiking, kayaking)
  - Small offshore boats
- Not recommended?
  - Man Overboard

Multiple technologies in one device: SARLink

- Combines the functions of a PLB with an Iridium SEND device
- More on SEND devices in a minute...

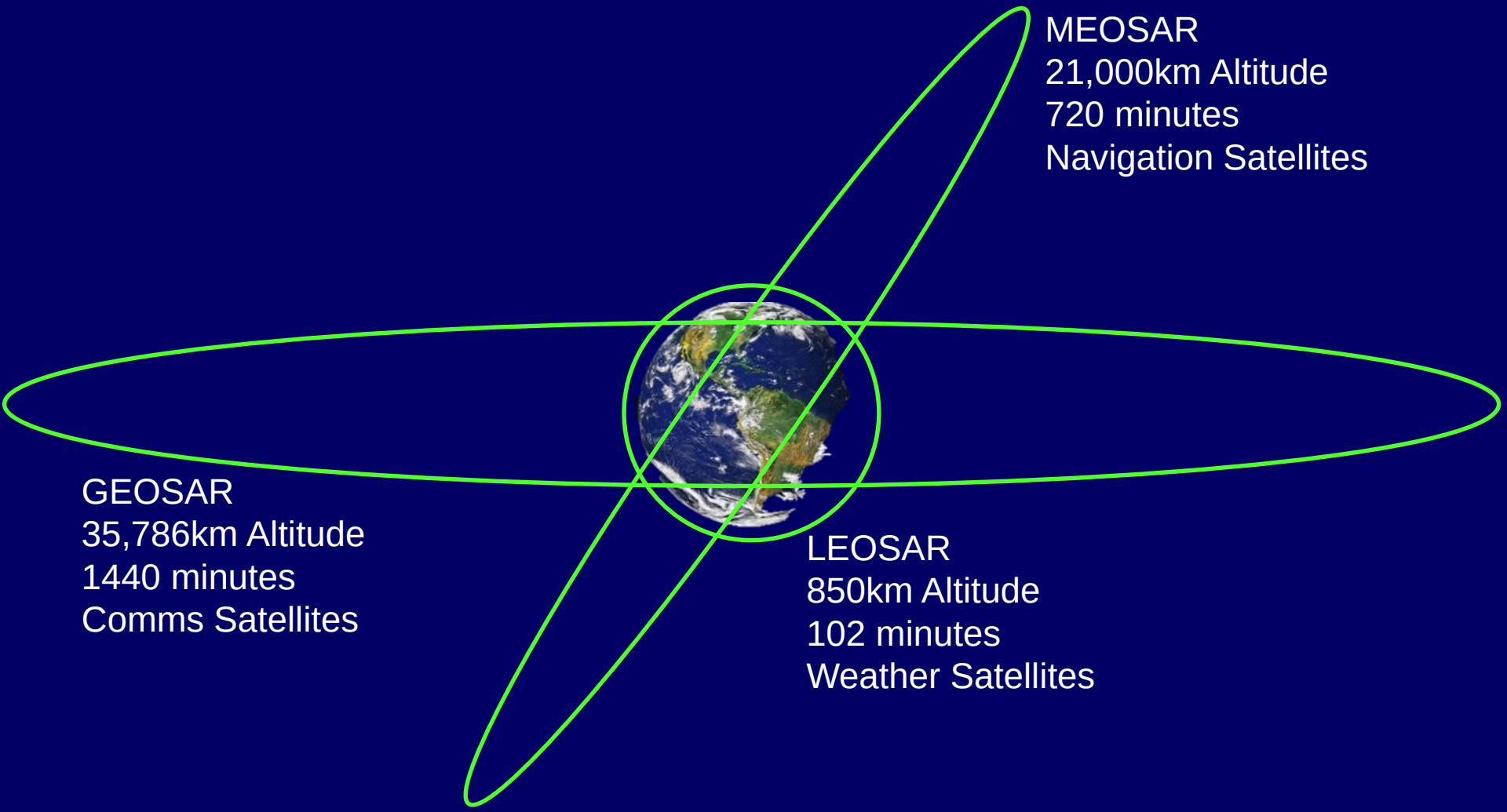
COSPAS-SARSAT System Overview





The GEO SAR Advantage

Now three different satellite constellations



Comparison of SAR Satellite Systems

Satellite Type	Computes Location?	Always in Sight?	Global Coverage?	Two-way Messages?
LEOSAR	Yes, using doppler, but two solutions	No, periodic	Yes	No
MEOSAR	Yes, using TDOA and FDOA	Yes, lots of birds	Yes	Yes
GEOSAR	No, unless self-locating	Yes	Up to 70°	No

Modern EPIRB/PLBs have built-in diagnostics and displays

Save Time! Register your beacon online at: www.beaconregistration.noaa.gov

Official 406 MHz PLB Registration Form

Mail or Fax to:
NOAA/SARSAT
NSOF, E/SP3
4231 Suitland Road
Suitland, MD 20746
Fax No. 301-817-4565

PLB Information

Beacon ID (Unique Identifier Number)

(15-digit character ID provided by PLB manufacturer)

PLB Manufacturer _____ Model No. _____

PLB Registration

☐ New PLB Registration
☐ Renewal of PLB Registration
☐ Change of PLB Information or Ownership
☐ Replacement of PLB Decal
☐ Check here if this PLB is a replacement for a previously registered PLB.
Please enter the old PLB unique ID number _____

Owner/Operator Information

Name _____
(Last, First, Middle Initial)

Mailing Address _____

_____

City _____ State/Province _____

ZIP (Postal) Code _____ Country _____

E-mail _____

Telephone

( ) _____ ☐ Home ☐ Work ☐ Cellular ☐ Fax ☐ Other
Area Code

( ) _____ ☐ Home ☐ Work ☐ Cellular ☐ Fax ☐ Other
Area Code

( ) _____ ☐ Home ☐ Work ☐ Cellular ☐ Fax ☐ Other
Area Code

( ) _____ ☐ Home ☐ Work ☐ Cellular ☐ Fax ☐ Other
Area Code

General Use Data

Usage
☐ Commercial ☐ Non-commercial ☐ Government Military ☐ Government Non-military

Specific Usage
☐ Hiking ☐ Hunting ☐ Fishing ☐ Other _____

Type
☐ Land Vehicle ☐ Boat ☐ Aircraft ☐ None ☐ Other _____

Additional Data

_____

_____

_____

_____

Emergency Contact Information *(Please indicate someone other than the owner)*

Name of **Primary** 24-Hour Emergency Contact:

_____

Telephone

( ) _____ ☐ Home ☐ Work ☐ Cellular ☐ Fax ☐ Other
Area Code

( ) _____ ☐ Home ☐ Work ☐ Cellular ☐ Fax ☐ Other
Area Code

( ) _____ ☐ Home ☐ Work ☐ Cellular ☐ Fax ☐ Other
Area Code

( ) _____ ☐ Home ☐ Work ☐ Cellular ☐ Fax ☐ Other
Area Code

Name of **Alternate** 24-Hour Emergency Contact:

_____

Telephone

( ) _____ ☐ Home ☐ Work ☐ Cellular ☐ Fax ☐ Other
Area Code

( ) _____ ☐ Home ☐ Work ☐ Cellular ☐ Fax ☐ Other
Area Code

( ) _____ ☐ Home ☐ Work ☐ Cellular ☐ Fax ☐ Other
Area Code

(709) _____ ☐ Home ☐ Work ☐ Cellular ☐ Fax ☐ Other
Area Code

Signature _____ Date _____

If you have any questions about this form or with PLB registration in general, please call 1-888-212-SAVE (7283) or 301-817-4515.
For information on the U.S. Search & Rescue Satellite-Aided Tracking system, please visit: www.sarsat.noaa.gov

OMB (0648-0295) Expires: 31JAN 2008

Check your battery when you check your registration…

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

Range:	**50-4,000 miles**
Cost:	$2,000 to $3,000 plus installation
Best Uses:	Long distance ship to ship and ship to shore Coast Guard monitors 4 bands Rugged, marinized designs.
Limitations:	Learing curve Complicated installation Time sensitive High current draw when transmitting.

Icom AT-130 Antenna Tu

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

Range:	**Worldwide**
Cost:	$1500 plus $20 per month plus $1.50 per minute
Best Uses:	Portable voice at sea Calls where there is no cellular, or where phone calls are prohibitively expensive. Independent of the ship's systems
Limitations:	Slow baud rate (2.4k, 9.6k with compression) Ridiculously complicated pricing

Globalstar

Range:	**Continental and Coastal**
Cost:	$500 plus $50 activation plus $1.09 per minute
Best Uses:	Portable voice communications where there is no cellular, or where phone calls are prohibitively expensive. Independent of the ship's systems
Limitations:	Not worldwide, complicated pricing schemes

IsatPhone Pro

Range:	**Worldwide**
Cost:	$575 plus $50 activation plus $1.43 per minute
Best Uses:	Portable voice communications where there is no cellular, or where phone calls are prohibitively expensive. Independent of the ship's systems Free inbound SMS
Limitations:	Complicated pricing schemes "Units ≠ Minutes"

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.

Iridium GO Satellite Wifi Hotspot

- Allows you to use your mobile devices anywhere in the world.
- Voice, text, data.
- SOS button connects you to GEOS in TX.
- Battery operated for portability.
- Up to five devices
- $.80 to $1.15/min for voice

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

Today's faster boats have a problem…

	5 kts	7 kts	10 kts	14 kts	20 kts
10 sec.	84'	118'	169'	236'	338
20 sec.	169'	236'	338'	473'	675'
30 sec.	253'	355'	507'	709;	1013'
60 sec.	507'	709'	1013'	1418'	2026 '
10 min.	0.8nm	1.2nm	1.7nm	2.3nm	3.3nm

So how do you find sailors who fall overboard?

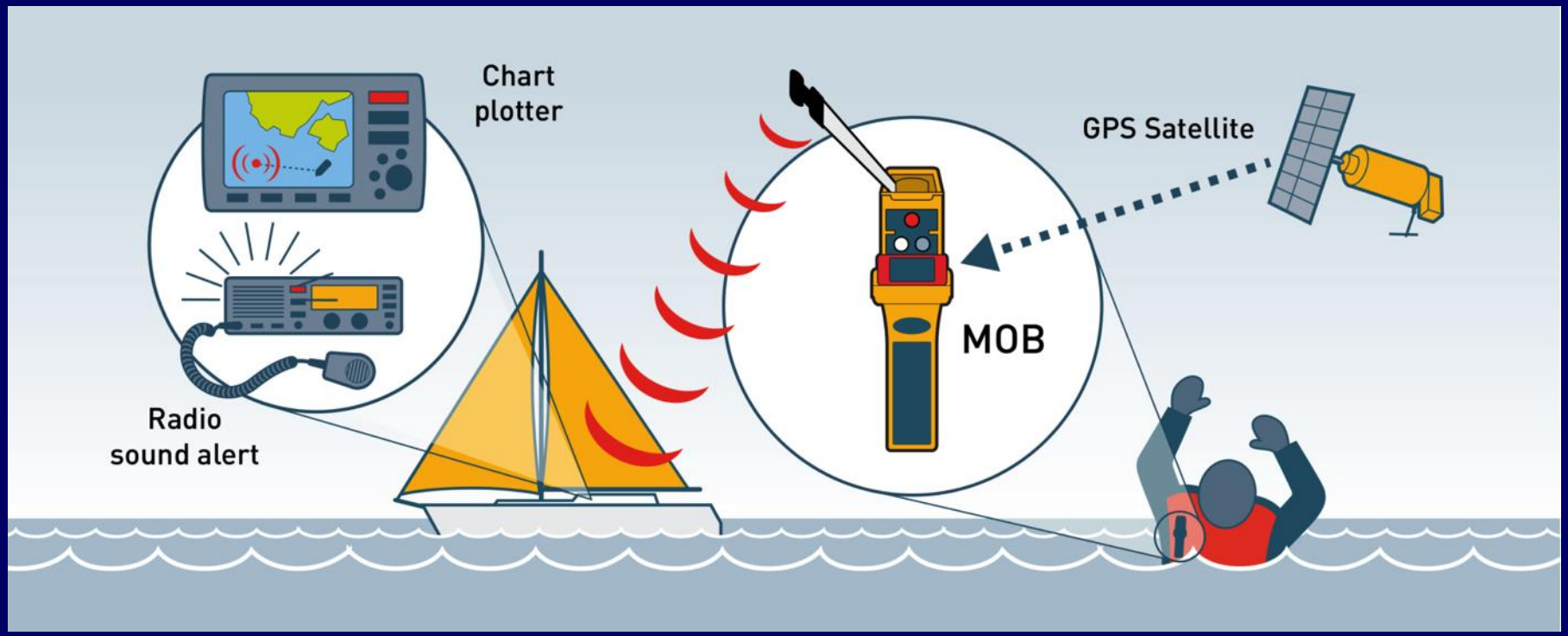
121.5 MHz Beacons

Cessation of Reception Beacons

Personal Locator Beacons

AIS/DSC Beacons

AIS/DSC Beacons



Please enter your MMSI into the box below, and select any DSC options you want to enable

Enter MMSI: MMSI

Enable DSC Relay

Enter Group MMSI: GROUP MMSI

Next Help Me! Restart Load

Final thoughts

- Rescue 21 works best with DSC: meet the CG halfway
- AIS is an excellent anti-collision tool, presuming the other guy has it.
- Don’t compromise on your VHF antenna installation
- A SEND device has its place, but start with an EPIRB
- A MOB beacon will allow your vessel and the fleet to find your MOB
- Don’t be too creative: use the stuff the pros use