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Pacific Offshore Academy Communications Primer

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Scope: Communications options for a passage making vessel. Explore equipment costs, airtime cost, installation, ease of use, bandwidth, etc. so participants understand their alternatives. Discuses Sailmail and alternatives.

Assumptions: Voice and data operation required. Coastal and mid-ocean use.

The Technology

SSB and Pactor modems

- SSB (also known as HF or Ham radio) is a radio signal that is sent and received by land based stations. The SSB network is massively redundant with many shore based stations around the world. Common service providers are Sailmail and Winlink.

- SSB is widely used and respected but often it is shrouded in mystery. SSB works very well for most users, but the technology is most effective when the user has "seat time" (experience) with a radio. Station selection, frequency selection, noise conditions and installation requirements all contribute to an effective SSB system.

- SSB has the unique attribute that it is a "one to many" transmission. One to many describes the broadcast nature of SSB where multiple stations can receive a single transmission. This is put to use when traveling with a group of boats that all want to share information on the "party line" – also called cruising "nets". Nets can be an important source of information and social time with other sailors.

- SSBs mated to a data modem will send email and optain weather data via services like Sailmail. The most effective modems are SCS Pactor mode modems supporting Pactor III or Pactor 4. A modem and PC control the radio transmission to make a connection with a shore station and pass data.

  o Pactor modems are very efficient and with a good connection rival/exceed an Iridium or Isatphone data connection.

Iridium

- Iridium is a low earth orbit satellite system with hardware manufactured by Motorola. The satellites rise and set as they pass over in their orbit. There are two offerings: handheld phones and the Iridium GO!,

- Iridium is used to make phone calls and data connections. The data connection is slow at 2400/bps and is billed by the minute – a combination that can get expensive, ~$25/MB.

- The external antenna for Iridium is compact at about 5" tall and the diameter of a GPS antenna. It is an omni directional antenna. **NOTE: Antenna signal strength is VERY important for Iridium performance. The antenna, coax and connectors connected to the radio must be of high quality. The best antenna system will have big coax cable custom made to the shortest length practical.**

    o Models 9555 and the Iridium Extreme handheld radios are very similar. The primary differences are the Extreme has an integrated GPS and an SOS button that will send a SMS to up to three programmed contacts.

        - The handhelds may be mounted below deck attached to an external antenna and ships power.

        - The author considers the handheld phones a high priority for any ditch kit. If Iridium is not the primary means of ships communications, a low cost prepay "top-up" can be applied to an Iridium phone for 30 days.

    o Iridium GO!: The GO! is a hybrid system that is designed to utilize a smartphone (Iphone) as the phone handset and a "base station" containing the Iridium radio. The smartphone and base station connect via wifi with VOIP for a voice call. The GO! appears well suited for a boat installation with its base station permanently mounted below deck with an external antenna and ships power.

        - The GO! is offered with data centric rate plans that offer unlimited data. This is a relatively new offering and feedback from the field is limited. The GO! is still an Iridium radio at 2400/bps, so "unlimited data" expectations should be researched.

        - The GO! has limited use with a PC, it is primarily designed to work with apps for Iphone etc. Sailmail and Global Marine Networks are both GO! partners and offer email services for a PC with the GO!, but general web access is not known to be possible with the GO!

Inmarsat
- Inmarsat is the granddaddy of satellite communication on the open ocean. The company operates a network of geostationary satellites that covers the globe from 80n to 80s. Inmarsat terminals are a requirement of SOLAS (Safety of Life at Sea) on large ships. The vessel mounted terminal connects to one of three satellites located over the equator.

    o Inmarsat Isatphone Pro is a handheld phone similar to Iridium phones in form and function. The Isatphone is also a 2400/bps modem, but it is not widely used as a data modem. It may also be mounted below deck with an external antenna and ships power.

    o Fleet Broadband (FBB) is the go-to solution for a true IP connection to the internet with data speeds that almost feel like you are at home: 150, 284, 432/kbs depending on the model.

        - There are three models of FBB, the 150, 250 and 500. The 150 and 250 share similar directional stabilized antennas at ~11" in diameter and 13" tall and 8.6 pounds (150 is slightly smaller). The 500 is significantly larger and only seen on 80' and larger vessels.

        - FBB data is billed by the megabyte (MB), regardless of how fast your system connects or how long it takes to send and receive data.

        - Rate plans for FBB range from pay as you go (www.linkwav.com), prepaid and post paid. The latter is expensive and not suitable for most yacht owners.

    o Fleet One is a new 100kbs offering from Inmarsat that has world coverage for phone and Coastal coverage for data worldwide with wide areas of total data coverage such as the Caribbean and Australia to New Zealand. The hardware is the same as the FB150.

VSAT
- Vsat is a high speed near global satellite system that is attractive for its low data cost (airtime). The downside to Vsat is the hardware is expensive, power intensive and bulky. We compare Vsat to the other solutions in the cost analysis section, but we generally dismiss Vsat as an option for sailing vessels under 80'

Globalstar
- Globalstar is has a satellite system similar to Iridium but the design of the system does not give Globalstar worldwide coverage, thus it is dismissed from this article.

Considerations

Installation complexity – the hardware and a PC
- All but the handheld phones require infrastructure on the vessel to use as a basic phone. Many race rules require a sat phone to be a below deck installation powered by ships power and an external antenna. If a handheld sat phone is the primary comms device, the extra parts for a below deck installation with external antenna are needed.
    - **Simple installation**. Inmarsat Fleet Broadband (FBB) and Iridium GO! are regarded as the easiest systems to install.
        - Below Deck Unit (BDU), can be mounted out of sight
        - Antenna requires a single coax to the BDU
        - Connection with the ships network (FBB) or wifi to Smartphone (GO!)

    - **Moderate installation**. Iridium and Isatphone handhelds.
        - Docking station for the handhelds need to be in view, typically in the nav station. The docking stations are bulky and expensive.
        - External antenna with single coax. If the Iridium radio is at the nav station, particular attention is needed to coax size and connectors. Iridium works MUCH better with good signal strength.
        - Interfaces with a PC via USB.

    - **Complex installation**. SSB is the hardest to install. The radio and tuner are bulky, requires a ground system that runs to many parts of the boat and an antenna that is typically part of the rigging (insulated backstay etc.). Coax and control wires run from the transceiver to tuner.

- **Size / weight**
    - Iridium solutions and the Isatphone are the smallest and lightest, however if a docking station is used for the handheld units, size and weight rival the Inmarsat Fleet Broadband.
    - Inmarsat Fleet Broadband BDU is a modest size and mounts in the middle of the boat. The antenna is bigger than Iridium or SSB.
    - SSB overall is bigger and heavier that the rest.

- **Portable / fixed mount**
    - Iridium handhelds, the Isatphone and the Iridium GO! are battery powered and can be used as portable units. The GO! requires and Iphone or similar device to use as the phone handset.
    - Pac Cup rules require a sat phone to be permanently mounted below deck with an external antenna. The Iridium and Isatphone can be mounted below with additional hardware. SSB and Fleet Broadband are designed for below deck install; Fleet Broadband has a telephone style handset.

- **Annual cost of ownership, overage costs.**
    - Understand the annual costs of whatever system / service provider you choose. The typical recreational vessel needs service for a couple of months a year where annual fees become a burden.
    - Service providers that offer annual plans usually have data and voice allocations per month for the plan you choose. If you exceed the monthly allocation, fees can be exponentially more expensive.

Operation
- **Ease of use voice / data**
  - All of the sat phones are easy to use as phones. The dialing sequence is like making an international call. SSB to landline phone calls is a thing of the past.
  - All of the equipment in this article require set-up with a PC to have a data session on the PC. The set-up is usually an involved process, but some service providers have created step by step cheat sheets to get end users connected. Other service providers rely on professional installers to set up PC for their clients.
  - Iridium tends to be a more involved set up. It appears as a "dial-up modem" to the PC and needs to be dialed an "hung up". Sailmail software when properly configured will perform the entire session.
- Reliability
- Service providers
- Ways to reduce data traffic
  - Software helpers
  - Service providers

	Iridium Extreme HH	Iridium GO	Isatphone	Fleet One (world phone & coastal data)	FBB 150	FBB 250	SSB with Pactor modem	KVH Mini Vsat
Equipment cost	$1,300	$800	$849	$4,500	$6,500	$11,000	$4,500	$20,000
Typical 40'er for Pac Cup	$1,200	$1,200	$1,200	$1,200	$1,200	$1,200	$4,200	$3,000
Add'l equipment for Pac Cup	$400-1600	$500	$1,800	$200	$200	$200	$1,000	$1,500
Operation cost (monthly)*	$0.00	$200.00	$0.00	$0.00	$0.00	$0.00	~$20	$49.00
Phone call cost / min	$1.50*	$1.29**	$1.43***	0.50****	0.76****	0.76****	n/a	$0.49
Data cost per Mb	~$25	$0.00		$7.00	$10.00	$10.00	$0.00	$1.00
Data rate (kbps)	2.4	2.4	2.4	100.0	150.0	284.0	0.5 - 5.0	128 - 528+
Data reliability	med	med	med	high	high	high	med to high	high
Below deck size								
Below deck size								
Antenna size								
Antenna weight								
Standby power								
Transmit power								

* Assumes using prepaid minutes, 500 minutes, $750 good for 1 year
** Unlimited data rate plan
*** Costs vary depending on pre-paid package
**** Assumes using prepaid rate plans

Case Examples

- Minimal cost
- Middle of the road
- I want it all

A word about Bits, Bytes and Baud

Connection speed is of keen interest to know how long a transmission will take or the cost if you are being billed by the minute.

- **Bit**. The most granular unit, usually referred to in kilobits **(Kb or kb)**
- **Baud**. Baud is Bits per second. 2400 Baud = 2400 Bits per second
- **Byte**. Roughly 10 Bits make a Byte, usually referred to in kilobytes **(KB)**
- **Megabyte**. Typical unit of measure for files sizes, hard drive and USB stick size **(MB)**

One character (e.g. the letter "A") is roughly ten bits in size, or one Byte. A 2400 baud modem is able to send 2400 Bits per second = 240 Bytes = 240 characters per second.

GRIB files are measured in kilobytes (KB). A 30KB files will take roughly 125 seconds using a 2400 baud modem (assuming no lost packets).