HF BRASS (Broadcast and Ship to Shore): Legacy and Modern Approaches

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Overview

What is BRASS and why it is Useful

Why deployed BRASS uses Ancient Technology

The Isode approach to moving things forward

How Legacy BRASS works

New HF Approaches for BRASS
BRASS: Broadcast

- Messages are transmitted from shore station to all ships
- Continuous Broadcast
BRASS: Ship to Shore & Ship to Ship

- Ship to Shore & Ship to Ship (usually) use STANAG 5066 ARQ
- Alternating Transmissions
  - Messages one way; STANAG 5066 Acks back
- Ship to Shore sends:
  - Messages From Ship
  - Resend Requests for Broadcast
- Maritime Rear Link (MRL) has same topology as ship to shore, but messages sent both ways
BRASS: Why Separate Transmit & Receive Sites

- HF Receivers do not like to be close to HF Transmitters
  - A few miles of separation allows simultaneous operation
- Separate Transmit and Receive sites allow
  - Multiple Broadcast Transmit Channels (Transmit Site)
  - Multiple Ship to Shore transmission channels (Received at Shore Receive Site)
  - Multiple Ship to Shore ARQ ack channels (Transmitted at Shore Transmit Site)
  - Use of Antennae optimized for transmission or reception
- Some implications on Ship/Shore
  - Shore STANAG 5066 needs to drive two modems
  - Ship is Simplex (normal HF)
  - Shore is Half Duplex (collision detect possible)
HF Naval Communication

- Surface Wave HF used between Task Groups
  - Good propagation for hundreds of nautical miles
- HF is an important BLOS communications channel for Navies
  - Backup to Satcom
  - Operation in Satcom-Denied and Satcom not available
  - When operational considerations avoid Satcom
- Point to Point SkyWave enables ship/shore and ship/ship communication
  - Managing pool of frequencies between ships means that links put in place “as needed”
  - “Alternating” transmit/receive of up to two minutes increases latency
Why the BRASS Architecture is Good

- Broadcast is a very sensible approach to Naval HF communication
  - Shore to Ship is dominant information flow
  - Many messages go to multiple ships, so natural optimization of slow data link
  - No delays as data flow is continuous
  - Can use optimized shore based transmitters
  - Broadcast can be sent simultaneously on multiple frequencies
    - Different ships may be seeing different propagation characteristics
- Broadcast makes sense as long term HF Naval Strategy
  - Need to evolve the details of how it is done
Current HF Technology for BRASS

- Typical deployed technology and requirements in current procurements
  - STANAG 4285 Modem: 75-2400 bps
  - STANAG 4197 (Voice)
  - Ship to Shore links set up by special mechanism (FAB)
  - Extensive operator involvement
  - Broadcast (and some Ship to Ship) operates application directly over modem
    - Lack of link level error checking causes horrendous problems for the layers above
- A very long way from state of the art
Current Messaging Technology for BRASS

- Messaging based on ACP 127
  - Derived from Teletype protocols
  - No lower case letters
  - No protocol
- Reliability achieved by process and human operators
Why is the BRASS Technology Ancient?

- Fit for Purpose, so no driving reason to change
- Interoperability with deployed systems is fundamental
  - Typical procurement focus
- Systems build with components that do not give a path to new technologies:
  - Customs “one off” software developed by large Systems Integrator
  - “Free” NATO BRASS Software (BICC)
- Procurements based on “least cost compliant” with no mandatory requirements to enable migration to newer technologies
The Isode BRASS Plan

- A COTS Solution to provide everything for BRASS above Modem
  - Support Modems with full range of modern capabilities, including WBHF
  - STANAG 5066
  - Messaging (ACP 127; ACP 142; STANAG 4406; SMTP with RFC 6477 and other military enhancements)
    - Messaging for BRASS to be covered in an upcoming Isode whitepaper
  - Support Legacy operation and give migration path to state of the art Messaging and HF technologies
- Complete in Summer 2015
- Lower total solution cost due to reduced integration costs
How Current Broadcast Transmission Works

- ACP 127 transmits character stream to Crypto
- Splitter enables transmission over multiple frequencies at the same time
- Ships can pick the frequency that propagates best to the ship
Off The Air Monitoring (OTAM)

- Without Link Layer (STANAG 5066) checksums, receiver cannot determine link quality.
- Receivers for OTAM are at Skywave distance from broadcast transmission.
- Receivers on land sites chosen to have reception similar to what ships will see.
- OTAM process compares transmitted (ACP 127) stream with received stream (from receiver getting transmission by Skywave).
- If receive quality has error rate higher than configurable level, OTAM alert is generated.
- OTAM alert will cause management tool to switch broadcast to a different frequency.
- Switch enables one OTAM process to monitor multiple broadcast frequencies.
How Current Ship to Shore Works

- STANAG 5066 used
- Pool of HF Frequencies allocated to Ship to Shore
- Connections always initiated by Ship
  - So not sensible to use link to send data from Shore to Ship
- Shore broadcasts available frequencies and noise level on each Ship/Shore channel – “Frequency Availability Broadcast” (FAB)
  - Options for one channel (SIMPLE/IFAB) or two (DUPLEX/CFAB)
- Ship picks a frequency to send on
- Shore detects frequency is being used and updates the FAB
  - Helps avoid another ship using the frequency
Serial Ports and Circuits

- How the BRASS world currently thinks of configuration
  - Everything is a hardware box with two serial (or audio/RF) ports
    - ACP 127 and Antennae just have one port
  - Build circuits by connecting (serial) ports
- Need to live with this to some extent (as many components currently do have two ports) but want to move towards modern world where:
  - Devices (even Crypto boxes) connect with Ethernet interfaces
  - Software can switch dynamically – external circuit configuration should not be needed
Supporting Direct to Modem

- Isode needs an approach to run ACP 127 direct over modem
  - For Broadcast and some Ship to Ship
- Added mode to Icon 5066 (our STANAG 5066 server) to not do STANAG 5066 protocol over the modem and go direct to modem
  - Re-uses modem drivers in Icon 5066
  - Enables direct to modem using a TCP based modem interface
  - Avoids needing to put a serial port driver in our M-Switch ACP 127 Channel
  - ACP 127 connects using Character Oriented Streaming Service (COSS) in same way as for operation over STANAG 5066
Serial Links & Circuit Management

Need to build Circuits to support current BRASS world

Tool to manage circuits (Antennae, Modems, Radios, Crypto, Serial Hubs) is needed

NATO systems call this “RSC” (Remote Supervision & Control)

Messaging Circuit end points are ACP 127 and ACP 142

Isode provides COTS API to add Messaging, OTAM, and Icon 5066 into circuits

M-Switch HF Circuit Management (MHFCM) API
Improving HF Broadcast

- Use STANAG 5066 (non-ARQ)
- Use modern broadcast messaging (ACP 142 based)
  - Per Message Acks and FEC can optimize retransmissions (and latency)
- Go Faster (STANAG 4539; WBHF)
  - Lower delays (avoids back-log)
  - Enables sending larger messages
- Make intelligent use of multiple broadcast channels
  - Can do better than just sending the same data on each
  - Use knowledge of which frequencies reach which ship
- Variable Speed
  - To make best use of higher speeds need to adapt to conditions
  - Need information on SNR and FER from each ship
Variable Speed Broadcast Architecture

- Use Ship to Shore links to send information from each ship back to shore
  - Only small amounts data
  - Link Quality information is the same as needed for STANAG 5066 Data Rate Change
  - Also need to indicate which frequency this information applies to
- Shore system correlates information to determine
  - Which speed to use
  - Which frequency to send which messages on
- Auto-baud Waveforms allow shore system to pick best speed and ships will adapt
Improving Ship to Shore

- Need to get small amounts of information (fairly) frequently from Ship to Shore:
  - Message Acknowledgments
  - Ship Broadcast Reception Quality
  - As well as real messages from Ship to Shore

- Can do better than FAB
  - There are not usually enough frequencies for each ship to have a dedicated ARQ link
  - ALE is an obvious direction
  - Perhaps use STANAG 5066 Annex L Wireless Token Ring
    - Shore in each “ring”
    - Use multiple (fixed frequency) rings to keep ring size moderate
ALE for BRASS

- Could use standard ALE or an approach optimized for BRASS architecture
  - Aspects of the FAB design make sense
  - Unclear which is the best approach
- Use the broadcast channel to share channel information in the way FAB does
  - Should run FAB+ over STANAG 5066 non-ARQ
  - Could multiplex FAB+ with messages on single broadcast channel
  - Could use FAB+ to communicate shore-initiated requests for Ship-Shore links
- Multiple shore transmitters allows possible new frequencies to be tested easily
  - Shore to Ship propagation information could be easily shared on Ship to Shore communication (same information as for variable speed broadcast)
- Ship to Shore could be used to schedule reservations
  - Reservations can be shared over FAB+
  - Could work for Ship-Shore and Ship-Ship
Annex L Pool for Ship to Shore

- STANAG 5066 Annex L gives multi-node communication using Token Ring
- Will enable efficient sharing of a single frequency between a group of ships
  - Address limited number of frequencies for Ship-Shore and Ship-Ship
- Potential advantage of enabling other communication in the group of ships (and shore) which point to point (set up by ALE) does not
Applications for Future BRASS

- Organizational Messaging (ACP 127 Service with modern protocols) remains central
  - Use ACP 142 to support STANAG 4406, SMTP with military extensions and EMCON (ships in Radio Silence)

- Natural additions
  - XMPP Real Time Chat (e.g., NATO JCHAT+ Service)
  - Images and Documents (as message attachments)

- Probably Achievable with Narrow Band HF
  - Video (as message attachment)
  - Voice memos ("push to send" style)

- With WBHF
  - Video Streaming to Ships