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Supporting EMCON Broadcast over HF with ACP127 and ACP142

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Overview

BRASS: Recap from Feb 2015 talk

Demonstration of Legacy BRASS

EMCON Deficiencies of Legacy BRASS

How to improve EMCON Services

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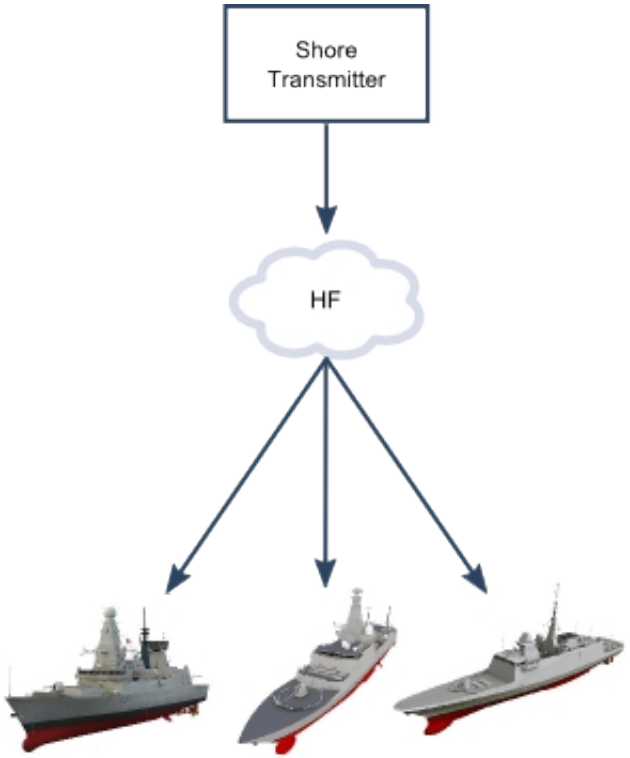
EMCON & BRASS

- Broadcast and Ship to Shore (BRASS)
  - Overview of BRASS given in February 2015 HFIA talk
  - Focus on using newer technologies and reliable multicast
    - ACP142 (including STANAG 4406 Annex E)
    - STANAG 5066 Annex L
    - Frequency Availability Broadcast (FAB)
    - Automatic Link Establishment (ALE)
    - Faster and variable speed transmission
- EMCON (Emission Control)
  - Ships that can receive data, but not send
  - Key part of BRASS deployment
  - Simple concept, with interesting issues

BRASS: Broadcast

- Messages are transmitted from shore station to all ships
- Continuous Broadcast
- EMCON falls out naturally from this architecture
  - Seems much easier than reliable (acknowledged) transfer



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Demo: ACP127 BRASS

- Broadcast of ACP127 Messages (the old messaging format currently used in BRASS)
- “Shore” on Windows PC and “Ship” on Linux VM
- Simulated HF Network
- RECAP Message Broadcast
- FLASH Message Retransmission
- OTAM (Off The Air Monitoring) to measure link quality
  - OTAM allows choice of best frequencies to send on (typically four are used at once)

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Demo: Ship and Shore configuration

- Harrier Web is an Isode Military Messaging client
  - SMTP, IMAP, RFC 6477, RFC 7444
- M-Switch converts to ACP127
  - Enables support of legacy ACP127 protocols with a modern client
  - No ACP127 information lost in conversion
- Connection to modem over serial link

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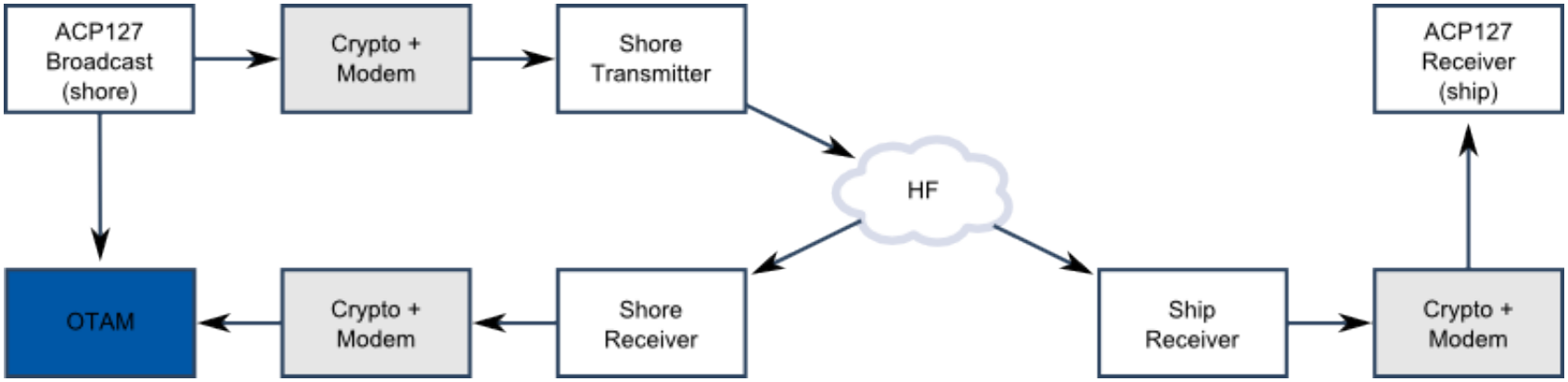
Demo: Network Being Simulated



- Transmit and (OTAM) Receive sites will be a long way apart, so OTAM gets SkyWave data

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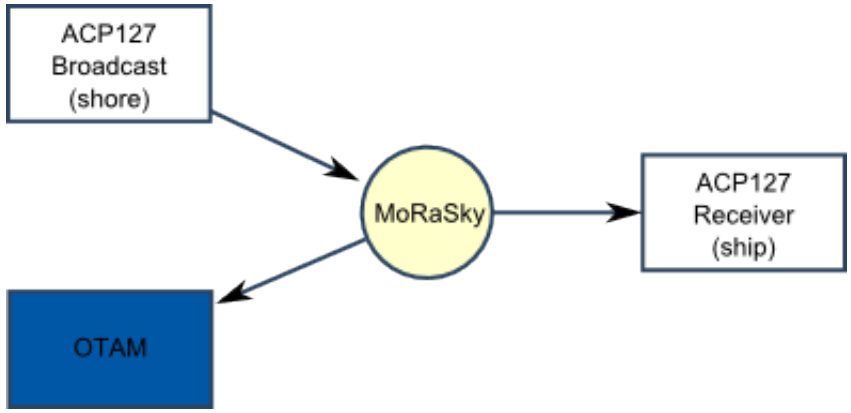
Demo: Network Simulation



- MoRaSky (Modem Radio Sky) simulates HF subsystem
- Access using simulated serial interfaces
- 300bps STANAG 4285 Waveform, with long interleaver
- UK Crypto
- SNR: 0
- CCIR Poor Conditions (channel model)
- Intermediate Term Variation (Walnut Street)

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Problems with EMCON over ACP127

- Errors get though
  - No error checking or checksums (broadcast is direct to modem)
  - Some errors will end up with operator for correction
  - Most end up with end user. Incorrect message may be a big problem
- Retransmission not effective
  - Typically FLASH messages are retransmitted, but nothing else
  - Retransmission will help with message loss
  - Does not help with corruption (user either gets all copies or the first only)
    - System cannot tell which messages are corrupted
- Messages are not compressed (poor use of bandwidth)

A benefit of Receiving Corrupt Messages

- Receiving corrupt messages is bad, BUT….
  - A corrupt message could well be more useful than no message at all
- Operator handling corrupt messages in modern protocols would be much harder:
  - Complex protocols, Compression and Encryption go against this
- With modern messages, the goal needs to be correct reception
  - Retransmission is key to ensuring this

ACP127 Broadcast over STANAG 5066

- STANAG 5066 is often used for point to point links
  - Broadcast is always deployed “direct over modem”
- STANAG 5066 COSS (Character Oriented Serial Stream) can be used for Broadcast
  - M-Switch supports this
- STANAG 5066 checksums ensure only correct messages get through
- Retransmission becomes essential to deal with errors
- Problems with messages over 2048 bytes (STANAG 5066 APDU size)
  - Because COSS is a stream you get into a mess with message fragments getting lost

Using STANAG 5066 “with Errors” Service

- STANAG 5066 non-ARQ gives a “with errors” service
  - Allows S5066 service to give application data received with errors
- Could be used to deal with the “ ACP127 large message” issue noted
- Could also give fall-back to operator correction in event that only corrupt messages received
- Seems the best option to deploy ACP127 broadcast
  - But preferable to move to modern protocols

Size of Modern Messages

- Use of modern protocols allows compression to be used
- ACP127 overhead about 100 characters
- STANAG 4406 overhead (using ACP142) around 200 bytes
  - SMTP equivalents have slightly higher overhead
  - If 200 bytes is too much, there is potential to reduce the overhead with a new protocol
- Assume text compression is 50% (a reasonable assumption)
  - STANAG 4406 will be smaller for messages of greater than 200 bytes of information (a very small message)
  - If comparing to ITA2 (5bit encoding) the breakeven is 300 characters
- For anticipated usage, modern protocols will reduce message size

ACP142 EMCON Support

- ACP142 “P_MUL - A PROTOCOL FOR RELIABLE MULTICAST MESSAGING IN BANDWIDTH CONSTRAINED AND DELAYED ACKNOWLEDGEMENT (EMCON) ENVIRONMENTS”
  - Operates directly over STANAG 5066
  - Base for STANAG 4406 Annex E (NATO standard for constrained deployment)
  - Can be used with SMTP messaging
  - Message split into independent APDUs
  - Enables higher priority messages to “overtake”
- EMCON Support
  - Retransmits complete messages:
    - Configurable number of times
    - Configurable interval between transmissions

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Maximizing EMCON Reliability

- 100% reliability is not possible
  - You can get as close to 100% as desired
  - Trade-off between reliability and throughput
- Chose transmission speed sensibly
- Maximum length interleaver (minimize errors)
- Auto-baud waveform (e.g., STANAG 4539)
  - STANAG 4285 is current “norm” for broadcast
  - Autobaud enables selection of best speed for conditions (e.g., day vs night)
  - Can slow down when traffic levels are light

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Importance of Retransmission

- More retransmission increases reliability
  - There is no reason to have gaps in broadcast transmission
- Handling based on priority is desirable
  - Behaviour should be configurable for each priority
- Higher priority traffic is generally more important and so should get
  - More retransmissions
  - Earlier retransmissions

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ACP142 Forward Error Correction

- ACP142 supports application level Forward Error Correction
- Messages may be sent as “m” PDUs with “n” needed to correctly decode the message
- Benefits:
  - Can control effective percentage of retransmission
    - So can do 50% retransmission if FER is 5%
  - Improves latency over “classic” retransmission
  - Avoids problem of same PDUs being corrupted in repeat transmission
- Most useful for longer messages
  - Most current BRASS traffic is short messages
  - May be desirable to send some longer messages (e.g., images)

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Multiple Broadcast Frequencies

- BRASS broadcast generally sent over multiple frequencies (4 is a common choice) selected from a larger pool
  - OTAM used to select the best set of frequencies to use
  - Ship will pick “best frequency” to listen on
- STANAG 5066 + ACP142 permits ship to receive on multiple frequencies
  - STANAG 5066 FER enables ship to examine frequencies and pick the best ones
  - ACP142 PDUs can be received over multiple channels
    - Duplicates eliminated
    - Error PDUs on one frequency may be received correction on another frequency

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QUESTIONS?