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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

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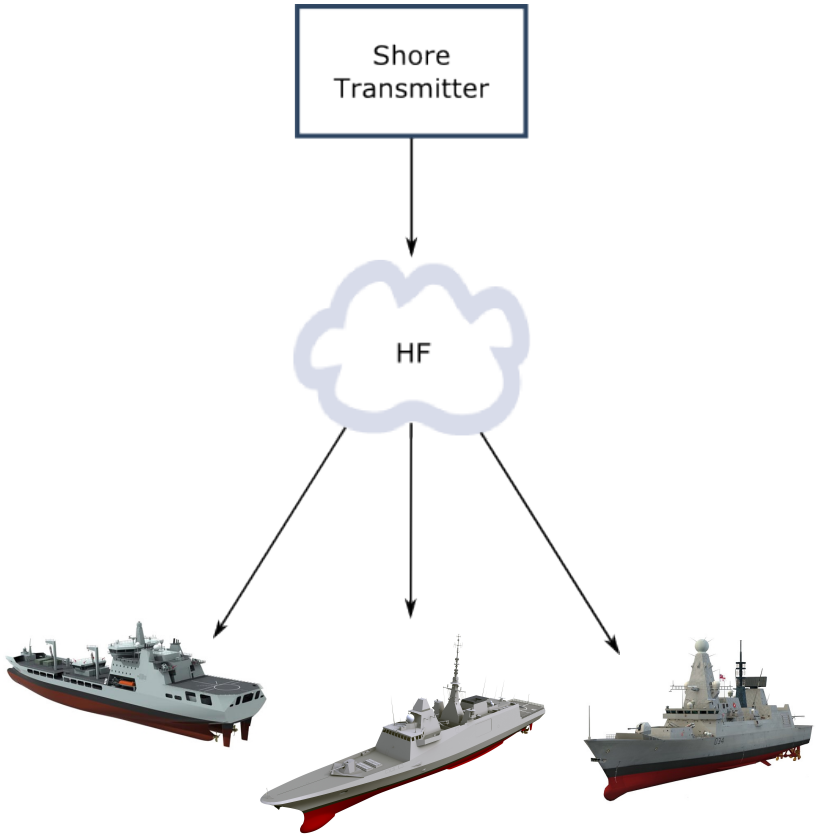
BRASS: Broadcast

- Messages are transmitted from shore station to all ships
- Continuous Broadcast



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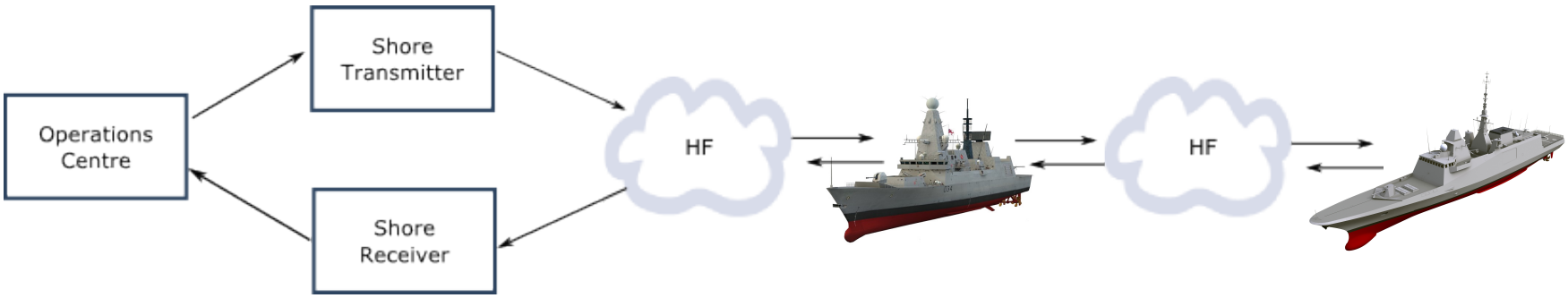
BRASS: Ship to Shore & Ship to Ship



- 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

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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

```
ZCZCDEF231 HH
PP RIJPO
DE RWRR 0238 2341302
ZNY SSSSS EX REFORGER
P 221258Z AUG 14
FM CIC
TO JPO
BT
S E C R E T
SIC SIC
SUBJ: GENERAL GRANT
EXERCISE REFORGER NINE
WHAT TIME IS GENERAL GRANT EXPECTED?
DOES HE REQUIRE TRANSPORT TO THE NEXT
VENUE?

BT
NNNN
```

- Messaging based on ACP 127
  - Derived from Teletype protocols
  - No lower case letters
  - No protocol
- Reliability achieved by process and human operators

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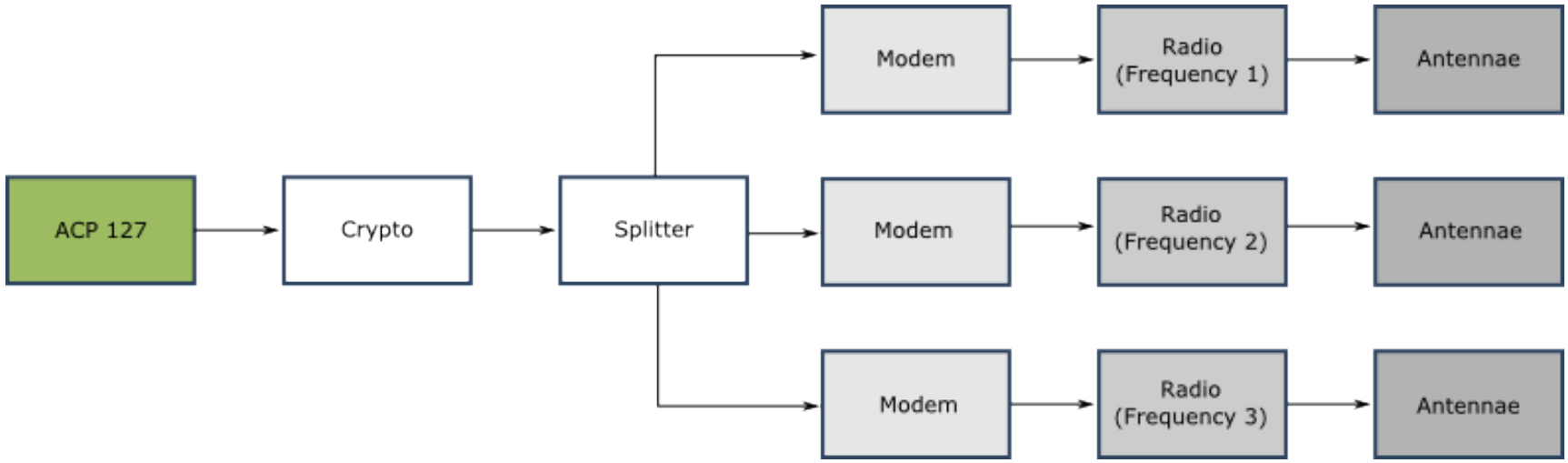
Why is the BRASS Technology Ancient?

- 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

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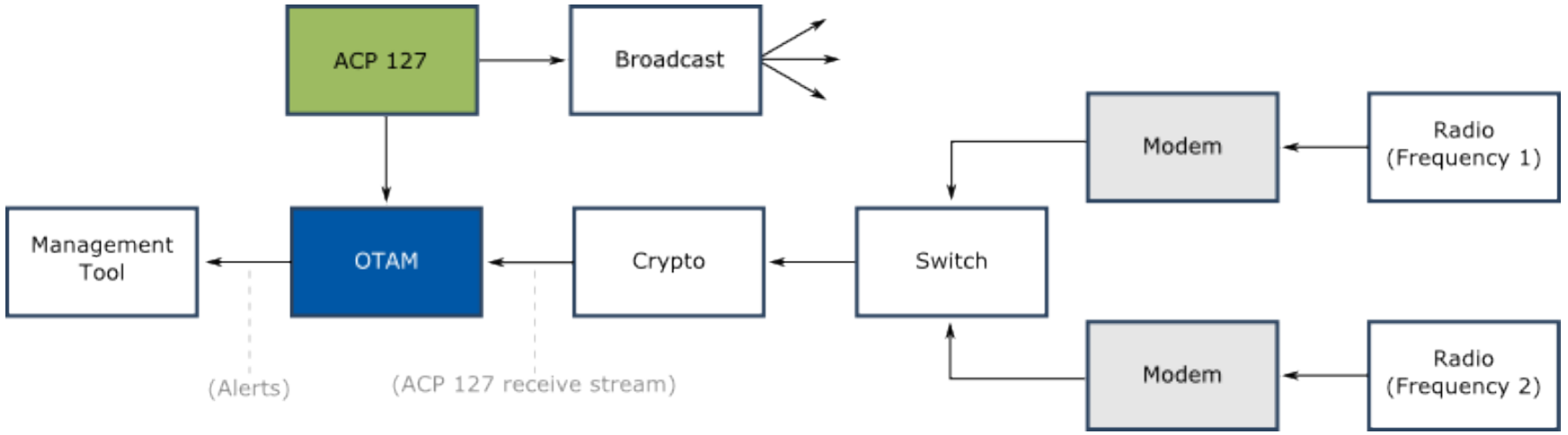
Off The Air Monitoring (OTAM)



- 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

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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

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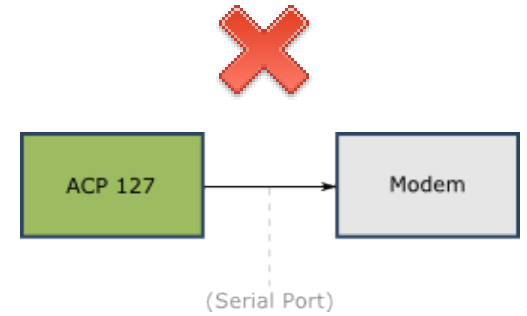
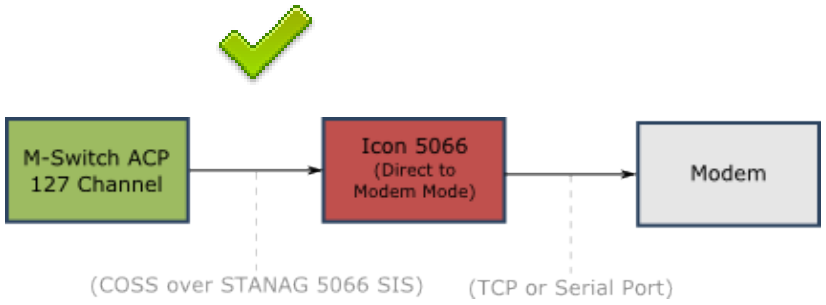
Supporting Direct to Modem

- 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





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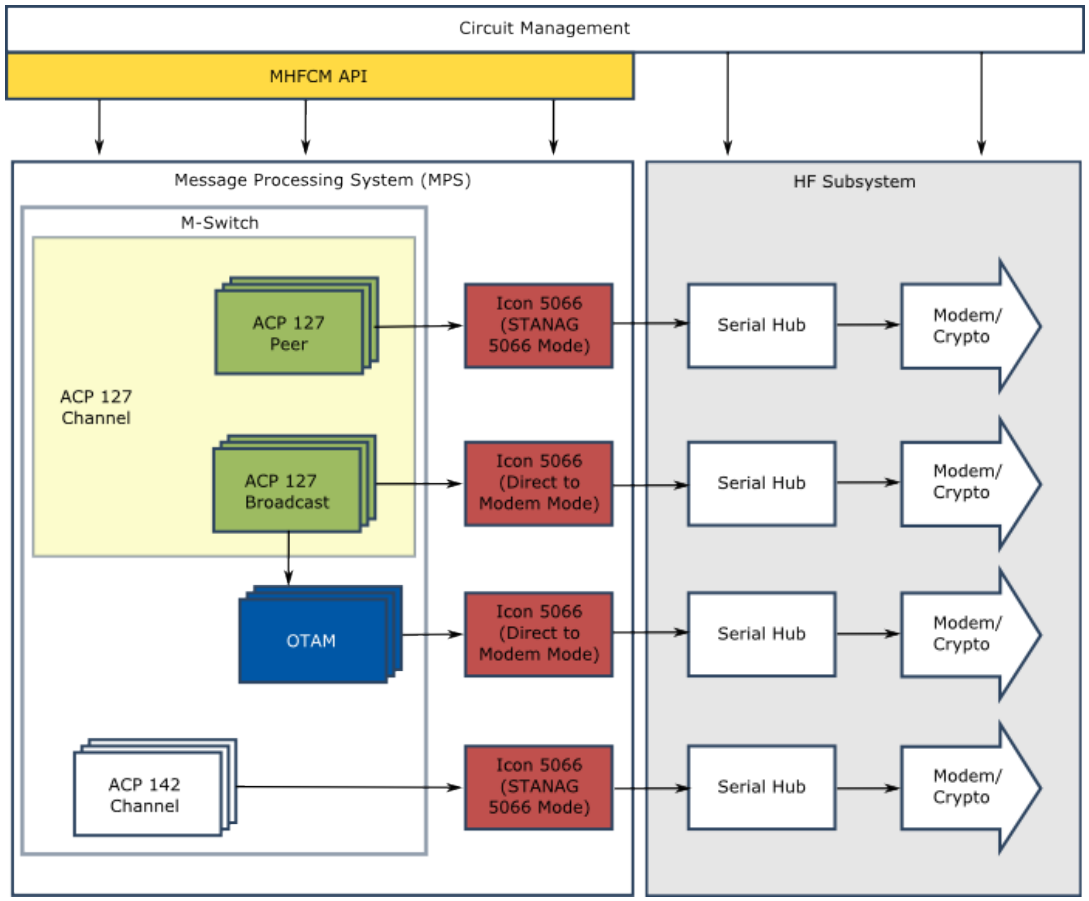
Serial Links & Circuit Management



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

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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

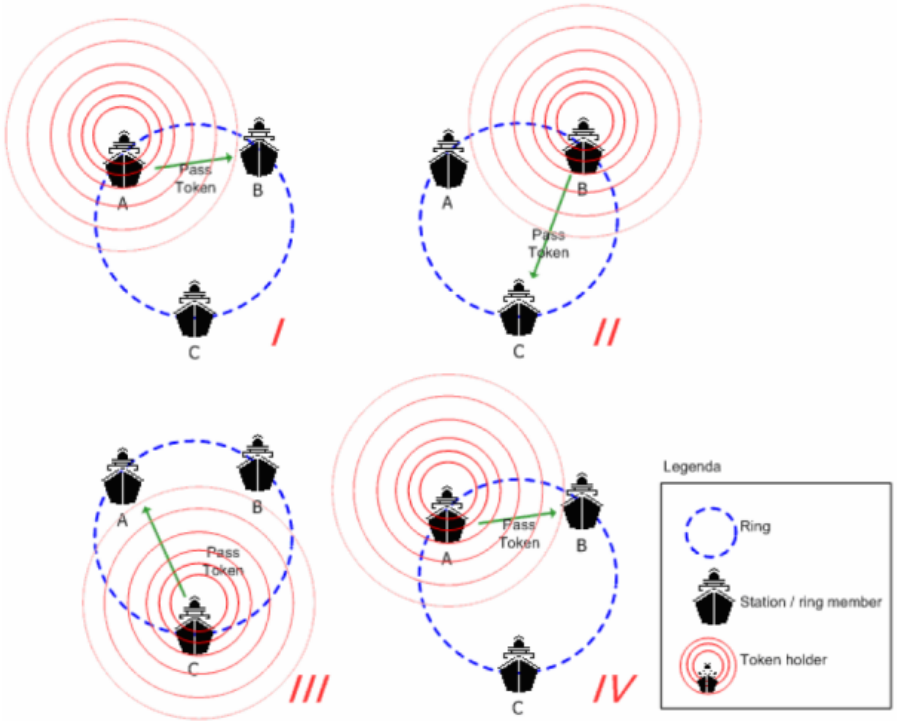
- Need to get small amounts of information (fairly) frequently from Ship to Shore:
  - Message Acknowledgments
  - Ship Broadcast Reception Quality
  - As well as real messages from Ship to Shore
- Can do better than FAB
  - There are not usually enough frequencies for each ship to have a dedicated ARQ 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



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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

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Questions?