Running XMPP over HF Radio

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Overview

- Why Instant Messaging, Multi-User Chat (MUC), Presence and XMPP (eXtensible Messaging and Presence Protocol) are important for Military
- Problems of and Solutions for running Applications over HF
- XMPP and the special problems posed
- An architecture for XMPP over HF

About Isode

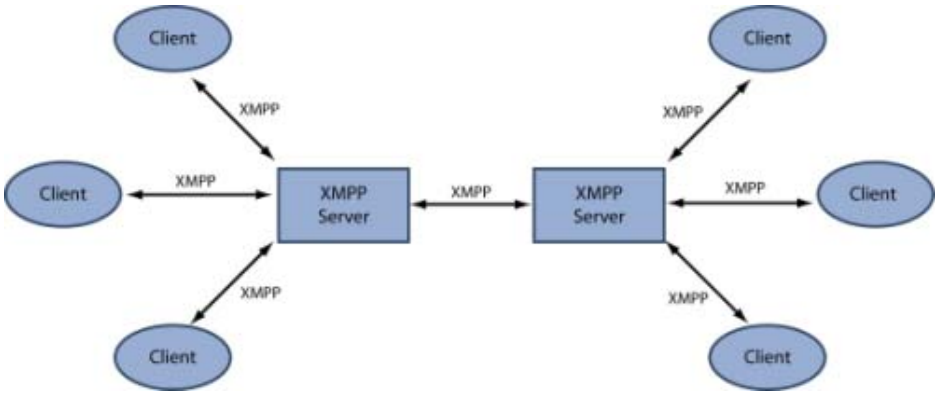
- Software product company based in Hampton, UK.
- Server applications for general Military/Government use and operation over HF and Satellite.
  - STANAG 4406 formal military messaging.
  - Internet Mail.
  - Directory Replication.
  - File Transfer and Database replication.
- Run over both IP and STANAG 5066.

IM and Presence for Military

- One to One Chat
  - Short message transfer complementing voice and messaging
  - Useful when voice is not practical or allowed
- Multi-User Chat
  - Widely used for sharing information in realtime, including:
    - Decisions to engage (Field and HQ involvement)
    - Allocation of targets
- Presence
  - Sharing status information
  - Geo-location and other extended presence information

XMPP for Military

- Open Standard Client/Server & Server/Server
  - Internet standard e**X**tensible **M**essaging and **P**resence **P**rotocol.
  - XMPP Standards Foundation (XSF) sets new specifications.
  - Vendor independence
  - Partner interoperability
- Building block for other services
  - New services such as whiteboarding
  - Basis for interoperable situational awareness



"XMPP Instant Messaging & Presence Solutions for Military and Government"
www.isode.com/solutions/xmpp-solutions-military.html

XMPP Adoption by Military

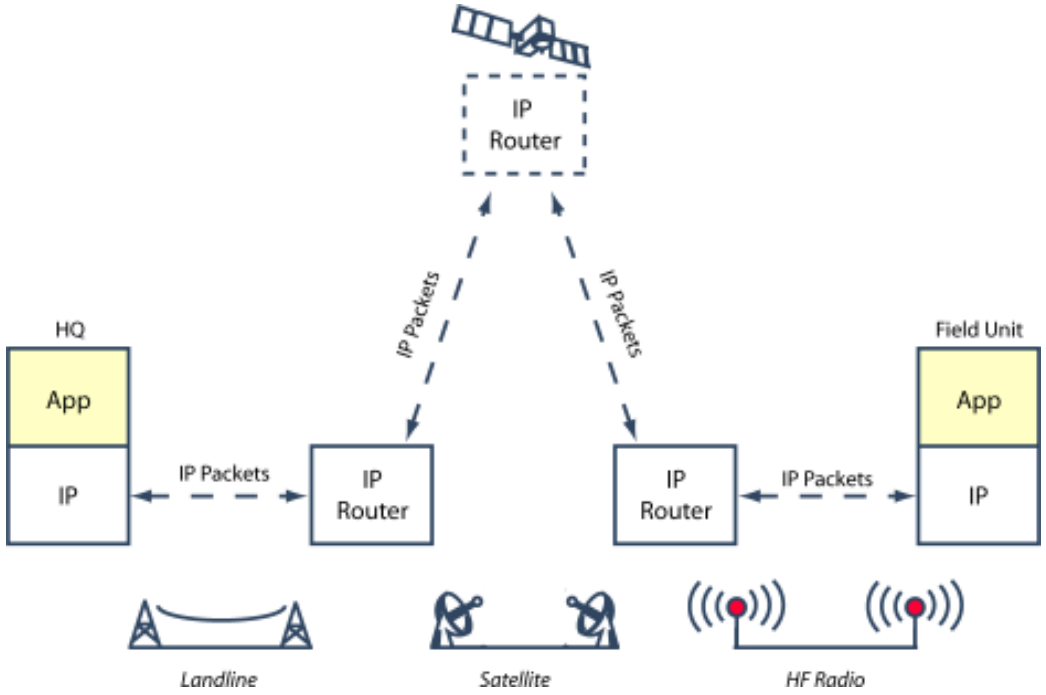
- NATO Jchat (Joint Tactical Chat) service used extensively in ISAF uses XMPP
- US Government now mandates XMPP
- Significant US purchases and deployments (DISA & Marines)
- JFCOM plays leading role in XMPP Standard setting and advancement

Why XMPP over HF?

- Short IM messages seem natural for communication over HF networks
  - Point to Point messages
  - Broadcast
    - MUC, Presence & Geo-Location
- Extending XMPP services over HF desirable
- DISA looking to XMPP for use in constrained bandwidth situations

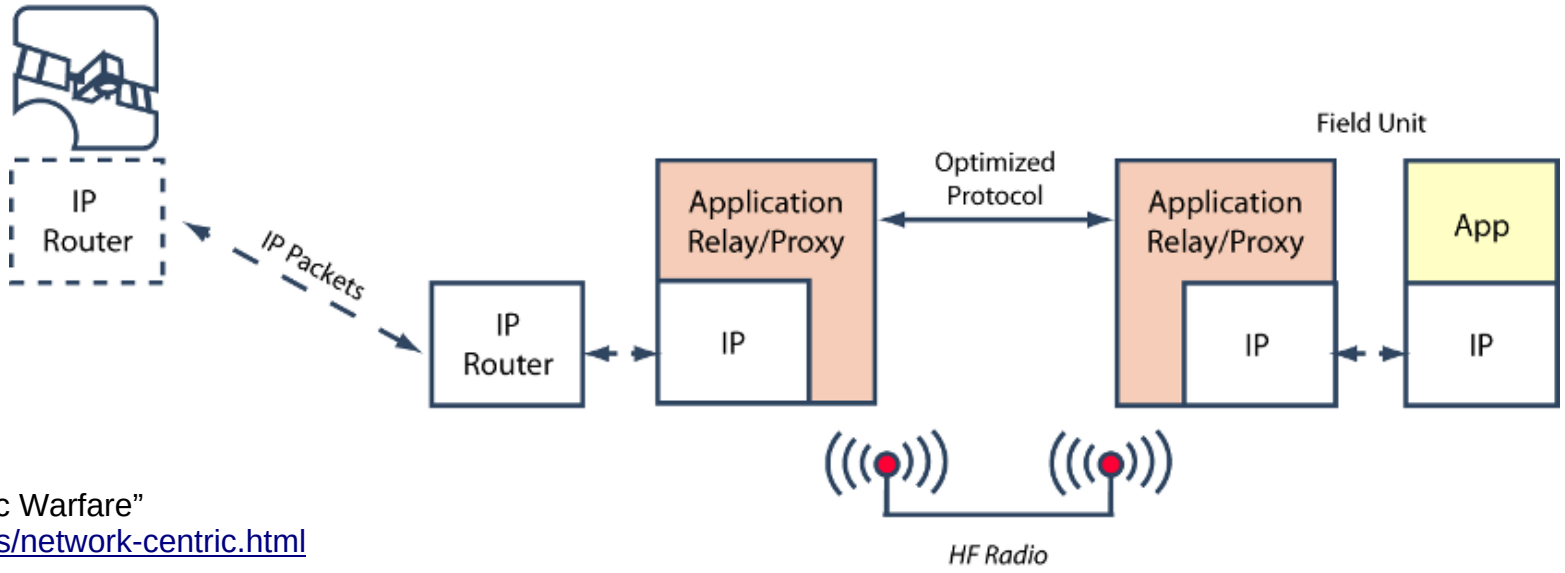
The HF Architecture that some would like

- HF Radio provides and IP Subnet
- Transparent switching between different network technologies
- Run Standard Applications
- Enable easy failover to HF
- Elegant architecture
- However it does not work



AN HF Application Architecture that will work

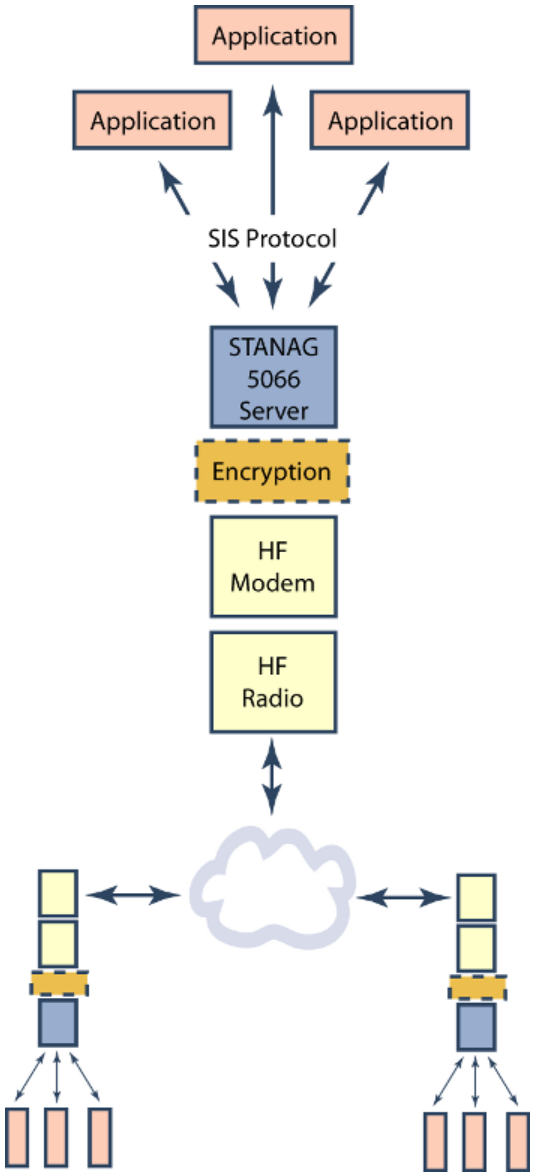
- Use optimized protocols over HF
- Use application relay at server level
  - Easy integration with standard servers
  - Isolates clients from HF network (problems)
  - Enables use of standard clients



"HF Radio & Network Centric Warfare"
www.isode.com/whitepapers/network-centric.html

STANAG 5066

- STANAG 5066 SIS protocol provides clean application separation and modem sharing
  - Works with STANAG 5066 or STANAG 4538 data link
  - A wonderful building block for HF applications
- Provides two useful layered services
  - UDOP (Unreliable Datagram Oriented Protocol)
  - COP (Reliable Connection Oriented Protocol)



"STANAG 5066: The Standard for Data Applications over HF Radio"
www.isode.com/whitepapers/stanag-5066.html

The Big Problem with running applications over HF

- Long Turnaround time
  - Typically 5-30 seconds
  - A consequence of HF simplex nature and other characteristics
  - Compounded by interleavers (which are often key to HF performance)
- Problem made worse by other HF characteristics
  - Low speed
  - Highly variable speeds
  - High error rates

The implications of Long Turnaround Times

- If you have long turnaround times you need long transmit times to get reasonable network utilization
- A typical efficient model would be each mode transmitting in turn for 30 seconds to 2 minutes
  - STANAG 5066 is designed to help provide this
- Standard applications protocols are not designed to work over this sort of pattern
  - Anything running over TCP is bad news
- Most application protocols do not support Multicast or EMCON

Point to Point Communication

- Many HF technologies designed to optimize point to point communications
  - ALE (Automatic Link Establishment)
  - STANAG 5066 Frequency Changing
  - STANAG 4538 ARQ
- STANAG 5066 RCOP (Reliable Connection Oriented Protocol) provides an application oriented interface
  - Reliable transfer of blocks of application data, piggybacking the acks

RCOP as the building block for Point to Point

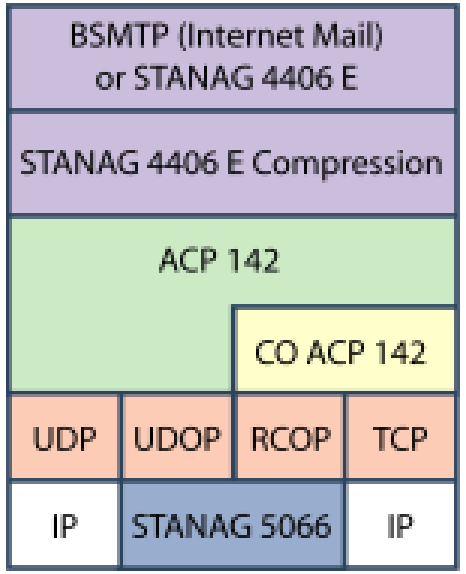
- Deployed applications use STANAG 5066 directly:
  - Battle Force Email (using STANAG 5066 CFTP)
  - ACP 127 (using STANG 5066 COSS)
- RCOP seems an ideal building block for applications over point to point HF
  - Reliable data transfer optimized for HF
- Running an unreliable datagram service (IP) over carefully engineered reliable transfer over a very low grade link is a poor architectural choice

Multi-Point Communication (and EMCON)

- Multicast and EMCON HF Networks give unreliable datagram service
- Special application protocols needed
- Provided to the user as STANAG 5066 UDOP
  - Application flow control provided by STANAG 5066 SIS Protocol
- UDP/IP could be used but much poorer because:
  - No flow control so hard to “fill the pipe” efficiently
    - ICMP Source Quench inadequate and not allowed for multicast
    - A big deal because of variable data rate and multiplexing
  - Also, less efficient network use

Supporting Email & STANAG 4406

- Use standard protocols
- Common architecture for Email and STANAG 4406
- Point to Point and multipoint
- IP or STANAG 5066

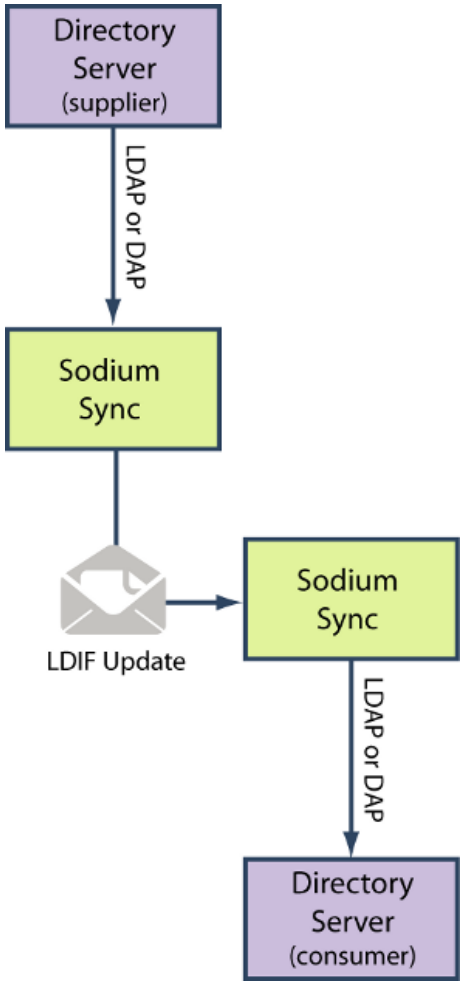


	Internet Messaging	STANAG 4406
Point to Point	HMTP CFTP BSMTP & CO-ACP 142	STANAG 4406 Annex E & CO-ACP 142
Multi-point (inc. EMCON)	BSMTP & ACP 142	STANAG 4406 Annex E & ACP 142

"Messaging Protocols for HF Radio"
www.isode.com/whitepapers/messaging-protocols-for-hf-radio.html

Directory Replication and File Transfer

- Messaging provides reliable data multicast
- Directory replication is an ideal application
  - Sequenced LDIF files
- Can also be used for file transfer and database replication
  - Messaging is a great building block for data transfer type applications
- Unfortunately this is a poor choice for XMPP



Directory Replication by Email and over 'Air Gap'
www.isode.com/whitepapers/email-directory-replication.html

File Transfer by Email
www.isode.com/whitepapers/file-transfer-by-email.html

XMPP Characteristics

- XMPP is XML encoded, for example:

```
<message from='juliet@example.com'
   to='romeo@example.net'
   xml:lang='en'>
   <body>Art thou not Romeo, and a Montague?</body>
   </message>
```

- Typical Characteristics:

	Size	Compressed	Exchanges
Message	300 bytes	120 bytes	0
Presence (IQ)	70 bytes	50 bytes	0
Startup	30kbytes	8 kbytes	9

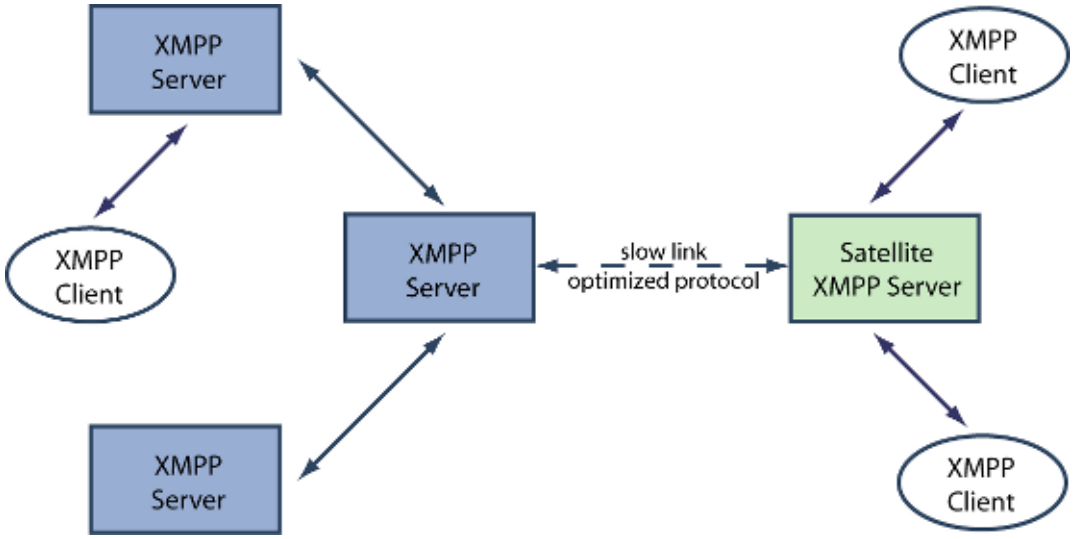
"Operating XMPP over Radio and Satellite Networks"
www.isode.com/whitepapers/low-bandwidth-xmpp.html

Implications of Standard XMPP for HF

- XMPP over medium speed net (28 kbits/sec) will work fine
- Typical HF (say 2400 bits/sec or 300 bytes/sec)
  - Message sizes just about usable (but seems a lot of overhead at that speed)
  - Startup is a big problem
    - Data sync would take a long time
    - 9 protocol exchanges unacceptable given typical HF turnaround
    - Often not possible or desirable to hold connection open
- Standard XMPP protocols are a non-starter for HF

Point to Point XMPP

- Use Satellite XMPP Server
  - Typically supporting small number of XMPP clients on satellite
- Optimized XMPP Satellite Server Protocol
- Network Mappings
  - RCOP for HF (or VHF)
  - IP for Satellite Network

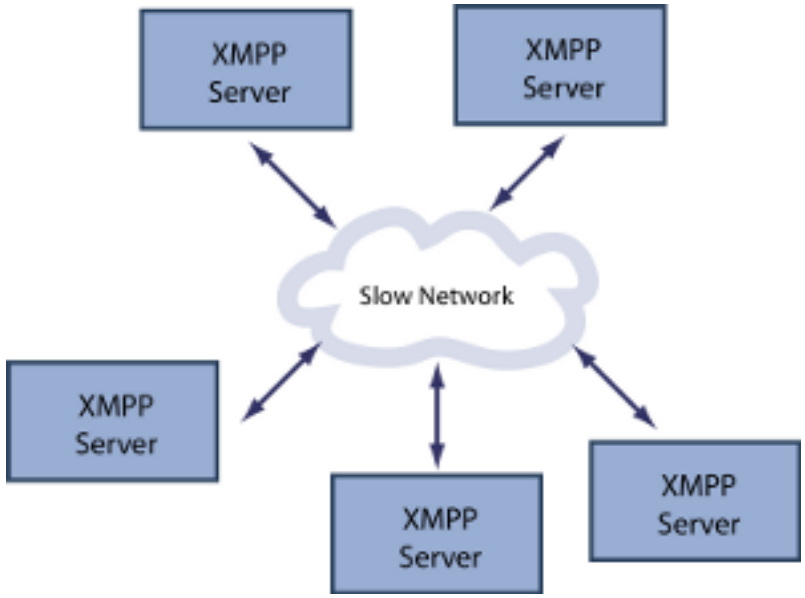


Satellite XMPP Server Protocol Features

- No connection establishment
- Optimized encoding and compressions
- Reliable Message and MUC transfer
- Share MUC delivery on Satellite
- Filtered and optimized presence update
  - Short timeout
  - Don't resend presence, always update
  - Don't send presence status from MUC rooms

XMPP over Multicast HF and EMCON

- Needs a different approach to point to point
- In Multicast deployment, all servers equal
- Whole system can connect as Satellite Server to external system
- Everything is broadcast: IM; MUC; Presences
- Mapping onto STANAG 5066 UDOP and UDP/IP



Broadcast, Reliability and EMCON

- Everything is sent and receivers take what they need
- Presence is never retransmitted (only updated)
  - Only interested in latest status and geo-location
- Reliability is essential for messages and MUC. Options:
  - Repeat transmissions (essential if sites are in EMCON)
  - Ack from all receivers (better if small number of sites)

Flexibility and Faster Networks

- Deployments may get access to faster networks
- Switch needs to be controlled by application (e.g., move from STANAG 5066 to IP)
  - Must be dynamic switchover
- Detailed protocol behaviour may depend on network speed
  - Level of filtering to be done
  - Service reliability (e.g., presence updates)

XMPP over HF Summary

- Direct mapping onto STANAG 5066 is best (true for all applications)
- Point to Point mapping uses Satellite XMPP Server and STANAG 5066 RCOP
- Multipoint and EMCON use broadcast over STANAG 5066 UDOP
- Application needs to deal with switch to IP and faster networks
- Isode products later this year

Questions?

- steve.kille@isode.com
- Presentation on Isode website
  - www.isode.com/hfia.pdf
- Whitepaper for further reading
  - www.isode.com/whitepapers/xmpp-low-bandwidth.html