Airborne Networking in a Coalition Environment

Military Communication and Information Systems Conference

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Agenda

• Airborne Gateways
  – Concept Development Programs
  – Battlefield Airborne Communications Node (BACN)
  – Smart Node Pod
  – Joint Aerial Layer Network (JALN)
  – Australia – Plan Jericho/Jericho Dawn
  – UK – Future Integrated Battlespace/Babel Fish

• Implementations and Operations
  – Implications of Coalition Use of Gateways
  – Resilient Network Controller

• Conclusions
Airborne Relay Concept/Development Programs

- **US Army Airborne Comms Node (ACN)**
  - Requirements from Desert Shield, etc.
- **DARPA ACN**
  - Airborne Communications Node Program
    - Ph. 1 (Sanders/LM, Raytheon, TRW)
      - Agile spectrum management
      - Assured access
      - Autonomous wireless networks
    - Ph. 2 (TRW dropped)
      - Renamed Adaptive C4ISR Node
      - Refocused on SIGINT/EW
    - Ph. 3 (Sanders/LM sold to BAE)
      - Adaptive Joint C4ISR
- **Comms Air-Borne Layer Expansion (CABLE)**
  - ONR JCTD ran in parallel with BACN
- **Roll On Beyond Line of Sight Enhancement**
  - ROBE developed for KC-135
  - Provides Link 16/SADL relay
  - First “cousin” to BACN
BACN Historical Technology Roadmap

2005
- Voice Bridging
- TDL Routing
- Remote Payload Control
- CDMA Cellular

2006
Spiral 1
- Voice Bridging
- TDL Routing

2008
Spiral 2
- Blue Force Tracking
- MR-TCDL (LOS, hub, and SATCOM)
- BACN Information Broker

2009
BACN IFDL System
- F22 to Link 16 Translation
- Secure Write Down
- Multi-independent Level Security
- USAF and FAA Airworthiness

BACN JUON
- VOIP Voice Bridging

2013
BACN Operational Improvements
- Integrated AEP
- MR-TCDL (LOS, hub, and SATCOM)
- BAO Kit Support
- Multiple Security Enclaves
- TTNT

2014 and Beyond...
BACN BLOS C2
- MR-TCDL (2 LOS + hub)
- USAF and FAA Airworthiness

Future Operational Improvements
- Improved Low VHF
- Self Protection
- Advanced Waveforms
- Pilot SA

Potential New Capabilities
- MR-TCDL (2 LOS + hub)
- Self Protection
- Advanced Waveforms
- Pilot SA
- Multimission Payloads
  - Sensors/Camera
  - ASIP Integration
BACN In-Theater Role

• BACN supports many missions:
  – Close air support
  – Convoy communications
  – Time sensitive targeting
• BACN services for those missions include:
  – Tactical data link bridging and range extension
    • Providing a unified situational awareness picture, spanning all theater U.S. forces, across Link 16, EPLRS, SADL, and JREAP
  – Voice bridging and range extension
    • Provides bridge voice across frequencies and waveforms.
    • Links voice users in broken terrain to remote users through voice and VOIP channels.
  • Tactical IP

BACN provides certified, persistent services that glue the JALN components in-theater into a single network.
BACN JUON OCONUS Operations

Diagram showing the integration of various communication systems such as UHF, INMARSAT, LINK 16, E11-A, EQ-4B, SADL, GIG, AOC, and UHF/VHF.
Northrop Grumman's BACN solution represents a proven capability to integrate disparate communications links together to produce combat effects and to provide knowledge products to the warfighter.

### Warfighter Capabilities Enabled By BACN

**Precision Engagement**
- Digital Close Air Support (D-CAS)
- Time sensitive targeting
- Offensive/defensive counter air
- Combat Search and Rescue (CSAR)
- Ground convoy support
- Special Ops Forces (SOF) support

**Information Superiority**
- C2 link services
- Net-Centric Enterprise Services (NCES)
- Commercial and military LOS/BLOS
- High capacity backbone
  - TCDL/MR-TCDL
  - Video
  - Imagery
  - VoIP, RoIP
  - Data Services

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BACN in Theater Operations

4 BACN E-11A Aircraft

- Delivered Late 2013
- 2008, >15,000 Combat Hours
- March 2010, >15,000 Combat Hours
- June 2010, >15,000 Combat Hours

Deployed BACN Aircraft Supporting Missions

- Integration flight at MCAS Miramar
- Preparing for deployment
- Payload - looking at
- First mission, 3 days after OCONUS arrival

BACN Global Hawk First Flight (5 Aug 10)

BACN Mission System Operations at RICC

- Regional Interface Control Center
- RICC Operations
- BACN Mission Operations
- Mission Coordinator
- Voice Comms
- Payload Operator

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BACN Potential Future Capabilities
Smart Node Pod Capabilities

Product Description
High TRL airborne networking capability, expands coverage and connectivity in support of communications, C2, cyber or ISR missions enabling rapid response to battlefield needs and humanitarian crises.

SNP System Capabilities
- Single and Multi Pod Architectures (SPA and MPA)
- High bandwidth data transfer, air-to-air cross links (CDL)
- Voice Communication/Bridging/TAC C2 (via VHF/UHF)
- Exchange of Real Time Tactical and Situational Awareness Data (Link 16, SADL)
- Support for Special Operations Forces (BAO Kit)
- Full Motion Video & Imagery (Vortex)
- Local Weather Monitoring

Smart Node Pod (SNP) provides an affordable mid-tier airborne networking capability, extending the value proposition and mission options for various aircraft.
Joint Aerial Layer Network (JALN)

- JALN Purpose:
  - National and Defense senior leaders, CCDRs, and Joint forces at all echelons require robust, multi-layer (space, aerial, and surface), high capacity communications networks at all security levels to employ military capability across the range of military operations (ROMO) in support of national security objectives.

- JALN Defined:
  - JALN is augmentation and extension of tactical networks using a variety of communications capabilities that will support operations in challenging or degraded communications environments within a joint operations area (JOA). Its primary purpose is to connect/reconnect warfighters executing specific missions and tasks. As a high demand/low density resource, JALN employment must be prioritized.

Source: Joint Concept for Command and Control of the Joint Aerial Layer Network (JCC2JALN), 20 March 2015 (Distribution A – Public Release)
Australia - Plan Jericho

• RAAF Jericho Vision
  – To develop a future force that is agile and adaptive, fully immersed in the information age, and truly joint.

• What is Plan Jericho?
  – Plan Jericho will transform Air Force into a fifth-generation enabled force that is capable of fighting and winning in 2025; a modern, fully integrated combat force that can deliver air and space power effects in the information age.

• Key Objectives
  – Harness the Combat Potential of an Integrated Force
  – Develop an Innovative and Empowered Workforce
  – Change the Way we Acquire and Sustain Capability

"In order to exploit our new capabilities and win in challenging operating environments, we need to transform ourselves into an integrated, networked force."

- Air Marshal Geoff Brown, Chief of Air Force (2014)
Jericho Dawn 16-3 Summary (March 2016)
All Tasks Accomplished Successfully!

• System Design & Development
  – Developed software translation for Tiger helicopter (Eurogrid) and AFATDS (artillery)
  – Combined new code with existing software for Link 16 in Resilient Network Controller

• Risk Reduction Testing
  – System Integration Lab testing
  – Ground testing at Eurogrid software lab
  – Flight testing with relevant platforms

• Live exercise participation
  – Exercised an operational scenario using both “as is architecture” and “with gateway”
  – Gateway architecture significantly shortened the timeline for desired mission effects

Contract award to Successful Live Demo in 6 Months
UK – Future Integrated Battlespace (FIB)

- Future Integrated Battlespace (FIB) facilitates integration of F-35 through airborne gateways
  - 5th gen. gateways to bridge F-35 sensor data
  - 4th gen. gateways for range extension/translation
  - Beyond Line of Sight (BLOS) data distribution

- UK is one of the 9 original F-35 partner countries and is looking to fully integrate the F-35 into its force structure.
  - US, UK, Italy, Netherlands, Australia, Canada, Denmark, Norway, Turkey

- Command and Control (C2) of the FIB is based on network connectivity and data sharing across Air, Land and Maritime domains
  - Improved Situational Awareness
  - Real-time connectivity to coalition partners and NATO allies

- Exercises have successfully demonstrated concept with F-35 & Typhoon
  - 5th generation to 4th generation transfer of operationally relevant data
**Babel Fish**


### Activity Overview

- Joint communications interoperability trial involving F-35B Lightning II and Typhoon FGR4 aircraft and an Airborne Gateway
  - Two-week trial, funded by the Ministry of Defence (MoD), conducted Oct. 19-27 in airspace above the Mojave Desert, CA, as part of the RAF’s Exercise Highrider

“We saw the true potential of the gateway”
- F-35 Joint Operational Test Team

First ever 5th to 4th Gen flight test of International (non-US) platforms; A trailblazer for F-35 countries

### Results & Accomplishments

Successfully achieved all objectives:

- Sent F-35 derived position, targets, and aircraft status through Airborne Gateway to Typhoon
- Confirmed receipt, proper format
- Validated timeliness and accuracy consistent with desired end-state usage
- Demonstrated operationally effective Airborne Gateway payload for potential 5th to 4th Gen operations in the UK as well as other F-35 countries
Coalition Use of Airborne Gateways

- Operation Enduring Freedom (Afghanistan) grew from US, UK, Canada, Australia, and Germany into ISAF with 14 members
  - Coalition members provide both air and ground support but have different requirements for airborne gateway services
  - Operation Resolute Support has over 22 countries supporting current training mission

- Multiple ISAF coalition members observed BACN operation in Afghanistan and have developed their own requirements for Airborne Gateways

- Information sharing implications and considerations
  - Information Security (5 Eyes, NATO, ISAF, etc.)
  - Crypto (keys, distribution, etc.)
  - Compatible radio waveforms, equipment, etc.
Resilient Network Controller

- Optimizes information exchange between applications on disparate platforms across airborne, ground and maritime domains.

- Adaptive RF Network-of-Networks Manager
  - Real-time Mission Situational Awareness
  - Mission Planning
  - Automated/Manual Control of Remote Payloads
  - Network Performance Data

- Capabilities
  - Common browser-based GUI
  - Uses real-time mission IERs to define QoS and data delivery parameters
  - Provides an application and content server in any RNC-enabled node in the battlefield,
  - Gateway capability (message and frequency translation) for interoperability between disparate radio, SATCOM, wireline networks
RNC Optimized Link Selection based on LOS

• Optimized Link Selection
  – Predicts future position
  – Probability of link interruption
  – Expected duration of comms outage
  – Determines best alternate link to use
  – UI supports manually selecting links, shows current active and available links

• LOS Outage Prediction
  – Calculates whether path between transmitter and receiver will be blocked by terrain features
  – Uses the DTED level 1 dataset provided by NOAA for terrain information
  – Knowing aircraft model and antenna placement adds fidelity to the prediction
RNC Bandwidth Allocation and Adaptive Routing

- Quality of Service (QoS)
  - RNC is able to categorize traffic into 5 prioritization groups with policies
  - Ingress inspects incoming packets and marks them according to the packet type
  - Egress identifies the packet marking and places the packet into an outbound category

- Link Switching allows the user or cognitive agent to influence IP routing by cost
  - When a link is favored, un-favored, and or set to bias the router on both ends are modified with predetermined values.
We must be able to work
• between layers
• across networks
• with different message sets
• between coalitions
Conclusions

- Airborne Gateways are the glue that interconnects legacy and emerging platforms and radios for interoperability in a warfare-centric network.

- For coalition operations, Airborne Gateways provide critical message and waveform translation, and enforce security boundaries.

- Airborne Gateway technology is proven and has been endorsed by warfighters as a cost-effective force multiplier.

- As in-theater emphasis on IP links increases, Airborne Gateways will provide an essential link for interoperability with legacy voice and TDL connections.

Airborne gateway platforms, providing range extension and protocol conversions, are a demonstrated, certified, quantifiable, and cost-effective force multiplier.
Questions?