Networking the Battlespace via Software-Based Communications

JTRS GMR

AMF JTRS

FAB-T

Future Combat System
Communications Transformation Key to Integrating Battlespace

**Today**
- Communication
- Bombers
- Fighters
- Helicopters
- Command & Control
- Launch
- Surveillance
- Transport
- Weapons

**Networked Battlespace**

**Transformational Programs**
- JTRS
- C2C
- NCO
- FCS
- FORCEnet

**Integrated Battlespace of the Future (JV 2020)**

This briefing contains non-technical data reviewed by export Compliance in log number ACK0312 (assigned IAQ PRO-4527)
Common Information & Communications Architecture Approach

Ensuring Interoperability

This briefing contains non-technical data reviewed by export compliance in log number ACK0312 (assigned IAQ PRO-4324).
The Integrated Battlespace Network

Brings the Internet model to military communications

Key Features

• Multiple waveforms form heterogeneous mobile extension to GIG
• Provides interoperability through the capacity to communicate with legacy systems
• Relay and translation nodes ensure Tactical Users have access to required information

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Top Level Airborne Network Architecture

- SATCOM (TSAT, AEHF, MUOS, WGS, ...)
- GIG
- Airborne Backbone (WNW, CDL)
  - A-G G-A Layer
  - Appl Gateway
  - ISR-TE (CDL)
- JAN-TE
- Link 16 (Legacy Non-IP)
- Ground Networks (AEF, MAGTF, FCS, ...)
- Maritime Networks

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Family of Terminals Concept

**Small FF Terminals**
(JTRS HMS, Cluster 2)
- Integrated NIU Transceiver RF
  - Handhelds
  - Manpacks
  - Sensors
- RF BW: < 30 MHz
- Frequency: 2 – 2000 MHz
- Throughput: ~ 10’s - 100’s kbps

**Wideband Terminals**
(JTRS GMR, AMF, MIDS-J)
- Wideband NIU
- Universal Transceiver
- Universal Transceiver
- RF BW: 30+ MHz
- Frequency: 2 – 2000 MHz
- Throughput: ~ 10 - 20 Mbps

**Broadband Terminals**
(e.g. FAB-T, HC3, CDLS)
- Broadband NIU
- Broadband Transceiver
- Broadband Transceiver

Throughput, Size, Weight, Power, Cost

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The JTRS Programs Provide One Joint Solution for Multiple Radio System Needs

Current Systems

- Navigation: AN/PSQ-6A EPLRS
- Positioning: AN/ARC-210
- Location: AN/WCS-3 UHF SATCOM/LOS
- Identification: AN/ARC-210A SINCGARS
- Air to Ground: ANPRC-119 SINCGARS
- Air to Air
- Ground to Ground
- SATCOM: AN/PSC-5

Common Open Standards Architecture & Technology Base

Joint Solution (1 family of radios)

- Space
- Airborne
- Maritime/Fixed Station
- Ground Forces
  - Handheld
  - Dismounted
  - Vehicular

Legacy & Commercial Waveforms
New IP-based networking services layer (WNW)

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Networking Trail Blazing
Wideband Network Waveform

- IP transit network ... battlespace network element of GIG
- Communications on the move for large-node mobile networks
- Internet-like multimedia services ... voice, video and data
- Bandwidth-adaptive data rates, up to wideband
- Environment-adaptive signaling modes
- Flexible addressing ... unicast, multicast, broadcast
- Assured service ... self-forming, self-healing, QoS network
- High assurance network security architecture
- Scalable network services ... RF, platform LAN, GIG WAN
JTRS is a Wireless Router
WNW Mobile Ad Hoc Routing Operations

Partitioned WNW Subnet 1

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JTRS GMR FCS Deliveries

• 50 Units Delivered
  • Wideband Network Waveform (WNW) and SINCGARS Waveforms

• Capabilities
  • Multi channel operation
  • JTRS-to-Legacy radio interoperability
Implementing the Networked SDR

Reusable, Upgradeable Software Implementation

Modular, Upgradeable Hardware Implementation

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JTRS GMR Trail Blazing

- SCA-compliant SDR architecture, with full waveform portability spanning GPP high-level language to FPGA VHDL code
- 2-2000 MHz multi-channel, multi-JTR, simultaneous waveform operation modular radio supporting all JTRS waveforms
- Extensible heterogeneous network architecture, providing waveform routing, bridging and retransmission capability
- Transformational mobile ad-hoc wideband network waveform (WNW), delivering internet capability to the mobile battlespace
- Highly portable legacy waveforms, implemented for portability, including EPLRS, Link-16, HF, and SATCOM
- Multiple Independent Levels of Security (MILS) in a networked software defined radio with simultaneous waveforms

Developed Foundational Elements … Mitigated Risks
AMF JTRS is the Key Network Enabler for the Air Force and Navy

Key Features

• Provides interoperability through the capacity to communicate with legacy systems
• Waveforms will be “portable” between hardware platforms
• Includes relay and translation nodes to ensure Tactical Users have access to required information
• Provides a modular, multi-band, multi-mode networked communication system

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The Boeing Team Provides the Broad Expertise Needed for the AMF JTRS Program

Prime System Integrator
Systems Engineering
Airborne Integrator
Network Architecture

Maritime Integrator
Information Assurance
JTR Design
JTRS Production

Maritime Platform Integrator
Control & Management Subsystem

Fixed Station Integrator
JTR Design
JTRS Production

Support

Analysis & Trades for Network Architecture Development

Develop Network Management System

Maritime Installations

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Family of Advanced Beyond line-of-sight Terminals (FAB-T) Program

Transforming Communications
FAB-T Overview

- Software re-programmable SCA-based terminal
- Provides warfighters with SCA-compliant software waveforms
  - Increment 1 -- EHF (LDR/XDR)
  - Increment 2 -- Ka/Ku and CDL for AISR applications
  - Increment 3 – Lasercom, Processor Ka, Transformational Comm

Network Centric Family of Terminals with HW/SW Commonality Providing Planned Incremental Warfighter Capability for Robust, Secure, Global Strategic & Tactical Communications

Aligning OSD & TC Visions with Warfighter Needs
Current EDM Airborne Platforms

B-2
E-6B
RQ-4
MQ-1/9

B-52
RC-135

INCREMENT 1
INCREMENT 2

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# Targeted Platforms

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<th>AMC</th>
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<tr>
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<td>VC-25</td>
<td>EC-130E-CS</td>
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<td>AC-130H</td>
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<td>F-35 (JSF)</td>
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FAB-T Industry Team

Prime Contractor
System Architecture/Network SW
Requirements Management
Terminal Core/Services SW

System Test
Platform/Site Integration
Operator Interface SW
Integrated Logistics Support

Support Subcontractors:

L3 communications
Modem Processor HW IPT Lead
MPG HW Int. and test
Modem/Processor HW
Antenna Dish/Pedestal - multiple
AEHF Modem SW
Increment 1 Antenna T&E
Ka/CDL Waveform
Terminal I&T support

viaSat
Inc1 INFOSEC HW
Inc1 INFOSEC SW
IA System Eng Support

Rockwell Collins
A/EHF Waveform SW
A/EHF Waveform Int. and Test
MPG HW – CHIF/TFRS
Antenna Group RF Components
Increment 1 Data Set Manager
ILS Support
Misc Operator Equipment
AEHF Sys Engr Support

RADANT TECHNOLOGIES, INC.
Radome

Large Aircraft Aperture

FMS Secure Solutions
ILS Support

Radoncomm

Pratt & Whitney Rocketdyne
ILS Support

International
Ground Site Installation

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Airborne Network Video

Airlift of supplies to combat air zone

- **Airborne assets**
  - E3 AWACS for Airborne Battle Management
  - RC-135 RIVET JOINT
  - F-18 with Link-16 and TTNT
  - C-17s (Globemaster 3 aircraft)
- **Ground asset**: CAOC with GMR JTRS and GIG-BE reachback
- **Common Operating Picture (COP)**
  - Enabled on all airborne platforms
  - Global assured connectivity
  - Allows for early threat detection and warning: SAM missile (SA-11) and enemy jammer
  - WNW reroutes through FAB-T to keep disjoint networks interconnected around jammer
Airborne Network Video

- **SEAD mission**
  - No manned strike assist available
  - X-45s available
  - Rapid geo-location by JAN-TE network
  - Battle damage assessment imagery passed via JAN-TE and CDL
  - Passed to WNW for network reachback

- **Blue Force Tracking data**
  - Routed via WNW & broadband reachback to CAOC
  - Enables clearing and assigning airspace

- **Voice communication**
  - Extended over WNW and broadband reachback

- **Airborne Network tied to advanced On-board Maintenance System (OMS) for Logistics support enroute**
  - Location of available parts and assets for delivery (30 min by V-22)
  - Back-fill of parts (will ship in 12 hours)
  - Re-fueling coordination
Airborne Network Video

• Target track data
  • F-18 gets jammer location from AWACS over Link-16

• Jammer is neutralized
  • Network automatically reconfigures to use shortest routes

• Refueling is coordinated through airborne network
Summary

- **Architecture supports intelligent migration into the GIG**
  - Strategies for integrating legacy systems into network
  - SDR allows incrementally deployed host terminals that will later on be enabled with emerging networked waveforms (e.g. WNW, MUOS)
- **Architecture designed to mitigate effects of integrating highly dynamic edge networks into larger networks**
  - Create persistent ad hoc backbone with platforms of opportunity that are in the air space, so no fixed infrastructure required
  - Stabilizes networked access for highly dynamic edge networks
  - Deployment of dynamic distributed gateways maximizes connectivity and robustness
- **Common architecture across multiple programs**
  - Provides interconnectivity into the Global Information Grid
  - Maximizing portability and reusability, to include high performance applications
- **Software based communications systems continue to be the key to transformation**
  - Initial expectations on complexity and technology readiness were overly optimistic
  - Need to add hardware architecture interface standards
- **Applying many lessons learned to Airborne Network**