Finding the Path Forward to Interoperability of the Emerging Link 16 Upgrades

ViaSat Brings Your Network To Life

Dr. Pete Camana

pete.camana@viasat.com
The Link-16 That Everyone Knows

- Bombers
- F-15
- C2
- ISR
- 5th Gen Fighters
- Fighter/Attack
- Legacy Fighters
- Early Warning
- JSTARS
- B-2
- B-52
- Rivet Joint
- MCE

ViaSat Brings Your Network To Life
Big Changes are Coming in the Link 16 Community
- Like the 2000 move from networks dominated by C2 (JTIDS) to ones dominated by non-C2 Fighter nodes (MIDS)
- There is a coming move to dominance of Edge, Local and Transient users that will be just as transformative

Edge Users will require more “localized” information and less access to today’s Theater-wide NPGs
- Low and Slow, Transient NEW weapons, low power ...
- Comms only, A2AD Nav, Receive-only, specialized Terminals....

Many, if not all, will have alternate comms pathways and/or needs for other Information to correlate/fuse
- BFT/JBC-P and other VMF Data
- Very local networks that need to operate outside the “main net”
- Backbone (Mid-tier, JALN, NIFC-CA) nets will require more than just MIL-STD-6020 “Forwarding”
  - Deal with “Networking Link 16” vice “Link 16 Networking”
New Edge Users to Enter the Net

- **Forward Ground Aircraft Controllers**
  - With the growth of the importance of the Close Air Support (CAS) mission in recent actions
  - Aircraft/Weapon status and target passing

- **Weapons in-flight from extended range**
  - To prosecute moving and moveable targets
  - Redirect weapon to higher value target
  - Better know where the weapon hit

- **Helicopters and Uninhabited Air Vehicles (UAVs)**
  - In the crowded 0-10Kft altitude CAS zone
  - Jointly managed airspace
  - Rapid deployment surveillance platforms
Edge Users are Different

- They all want to be visible to the legacy Link 16 users
  - Fighters, ISR, C2 and to each other
  - Generally lower transmit power than classic MIDS

- They are only interested in receiving updates of local SA
  - Be it based on the ground unit they are supporting
  - The short range of their AOR
  - Their short time on station

- They all want to communicate when there is no “Big Net”
  - Local NTR precedence rules need to be addressed
  - Ability to re-synch rapidly when “Big Net” users show up

- More entry and exit may require a form of Link 16 Network MANET and common loads
Unique Platforms on Network

- Weapons
- UAVs and small ISR
- Helicopters and Cargo
- Ground Vehicles
There are other Link-16 Radios

- **Embedded in Integrated Avionics**
  - F-22 (Rx only) and F-35
- **Multi-Channel Terminals**
  - MIDS JTRS
- **Weapons and Small Platforms**
And Creating more Backbones

- In the Air, Joint Aerial Layer Network (JALN) is expected to be able to connect Nets
- Ground internet connectivity through MNVR & WIN-T
- Ship/Air NIFC-CA sensor connectivity
- All raise new “Networking Link 16” Questions
  - What Role does Link 16 play in these networks
    - Distributing 5th Gen information to “Rest-of-the-World” – TALON HATE
    - Distribution of Cross Network Fused Information -- BACN
    - Redistribution of Data to Other Networks – JBC-P- BFT/Link 16
  - Where across a Backbone is the best entry point to Link 16 Net(s) for a “nugget” of Information
    - Minimize Link 16 network loading
    - Increase Anti-Jam (i.e. nearest)
    - Reduce Probability of Intercept (reduced transmit power)
- Are there Link 16 network management roles for Backbones?
Upgrade Efforts are On-going

- **Frequency Remap-FR**
  - To ease the burden of the operations back home, local interfering frequencies are avoided
    - Next chart
  - In the MIDS JTRS already
  - Will be installed in MIDS-LVT with Block Upgrade 2 (BU2)
    - Required of the terminals by 2020

- **Crypto Modernization-CM**
  - Making the Crypto programmable
  - MIDS JTRS upgrade on contract (Block Cycle 1 - BC1)
  - Part of MIDS-LVT BU2 being awarded soon

- **Link-16 Enhanced Throughput-ET**
  - Add 5 new higher throughput rates to the 4 Link-16 basic rates
    - next chart
  - Available in MIDS JTRS today
  - Part of the MIDS-LVT BU2

- **Dynamic Network Management-DNM**
  - Allows the platform hosts/terminals to negotiate to use parts of pools of timeslots
  - Joint terminal (completed) and platform host (on-going) upgrades
### FR and ET

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Pulses per slot</th>
<th>Words per slot</th>
<th>Formatted Coded Rate (bps)</th>
<th>Unformatted Uncoded Rate (bps)</th>
<th>Unformatted Coded Rate (bps)</th>
<th>Anti Jam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Double Pulse</td>
<td>258</td>
<td>3</td>
<td>26,880</td>
<td>59,520</td>
<td>28,800</td>
<td></td>
</tr>
<tr>
<td>Packed 2 Single Pulse</td>
<td>258</td>
<td>6</td>
<td>53,760</td>
<td>119,040</td>
<td>57,600</td>
<td></td>
</tr>
<tr>
<td>Packed 2 Double Pulse</td>
<td>444</td>
<td>6</td>
<td>53,760</td>
<td>119,040</td>
<td>57,600</td>
<td></td>
</tr>
<tr>
<td>Packed 4 Single Pulse</td>
<td>444</td>
<td>12</td>
<td>107,520</td>
<td>238,080</td>
<td>115,200</td>
<td></td>
</tr>
<tr>
<td>Enhanced Throughput 0</td>
<td>444</td>
<td>40</td>
<td>358,400</td>
<td>384,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enhanced Throughput 1</td>
<td>444</td>
<td>61</td>
<td>546,560</td>
<td>585,600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enhanced Throughput 2</td>
<td>444</td>
<td>93</td>
<td>833,280</td>
<td>892,800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enhanced Throughput 3</td>
<td>444</td>
<td>108</td>
<td>967,680</td>
<td>1,036,800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enhanced Throughput 4</td>
<td>444</td>
<td>123</td>
<td>1,102,080</td>
<td>1,180,800</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Alaskan UAT ADSB**

**Local DME**

**ViaSat Brings Your Network To Life**
BU2 Development Phase

<table>
<thead>
<tr>
<th>CY12</th>
<th>CY13</th>
<th>CY14</th>
<th>CY15</th>
<th>CY16</th>
<th>CY17</th>
<th>CY18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
</tr>
<tr>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
</tr>
<tr>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
</tr>
</tbody>
</table>

Crypto Module (U.S.)

Block Upgrade 2 Development (ViaSat, DLS, EuroMIDS)

HW Contract

SW Contract

Contract Milestones

Integration

Production/ Retrofit

ECP Spec Dev

CM Spec Dev

CM Development

Prototype 1

Prototype 2

CM Production

BU2 Development

Qualification and Certification

ER6A/BC7

BU2 Supporting SW Bind

BU2 Production/Retrofit

BU2 BC

IBR

CDR

CFAQTR

TRR

Approval (CCB)

Service Platform Testing

ViaSat Brings Your Network To Life
Fighter Centric and Multi-net Surveillance

Net 1
Surveillance

Net 0
Surveillance

Link 16 Network

Zone 1

Zone 2
MIDS JTRS Development On-going

**Concurrent Multi-Netting (CMN-4)**
- Link 16 enhancement *adds* three additional receiver channels in the space of today’s one Link-16 channel
- Allows platform to receive four different messages in one timeslot – Concurrent Contention Receive (CCR)
  - Uses the Four Receiver/Synthesizers to receive the First through Fourth transmissions in a contention pool.
  - Platforms – F/A-18, EA-18G, E-2D
  - Operational Benefits:
    - Increases Link-16 throughput and Contention Update rates
    - Satellite forwarding between zones reduced

**Tactical Targeting Networking Technology**
- TTNT is a high-speed, high-capacity, low latency network that can transmit large amounts of data (2 Mbps) over 100 nautical miles
- Standard Internet Protocol (IP) compatible with adaptive networking
  - Operational Benefits
    - Enables high throughput and/or low latency apps
    - Off-load capabilities from over-subscribed Link 16 networks

**Concurrent Multi-Netting-4**

**Without CCR on the Same Time Slot**

**With CCR on the Same Time Slot**

---

Statement A - Approved for public release, distribution is unlimited (14 April 2010)(JTRS_SP2010_048)
On-Going MIDS JTRS Multi-Function Upgrades

- **Concurrent Multi-Net/Concurrent Contention Receive**
  - Primary Driver for F/A-18 upgrades

- **Joint Airborne Network-Tactical Edge**
  - JAN-TE Need IP in the Air and Low Latency
  - Tactical Targeting Network Technology-TTNT

- **F-22 Intra-Flight Data Link-IFDL**
  - F-22 Data to the rest of the fight

- **F-35 Multi-function Advanced Data Link – MADL**
  - F-35 Data to the rest of the fight

- **External Gateway Processing to share all this data**
**Link-16 Upgrade Plan**

- **JTIDS Product Improvement (JPI)**
  - on-going for 2016 deployment
- **MIDS-LVT Block Upgrade 2 (BU-2)**
  - on-going for 2017 deployment start
- **MIDS JTRS Block Cycle-1 (BC-1)**
  - Completed
- **MIDS JTRS Block Upgrade 1 (BU-1)**
  - on-going for 2015/16 deployment
- **MIDS JTRS Block Upgrade 2 (BU-2)**
  - on-going with 2018 deployment

<table>
<thead>
<tr>
<th>Link-16 Terminal Type</th>
<th>Crypto Moderization</th>
<th>Frequency Remap</th>
<th>Enhanced Throughput</th>
<th>Concurrent Multi-Net</th>
<th>Tactical Targeting Network Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>JTIDS Class 2</td>
<td>JPI</td>
<td>JPI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIDS-LVT 1 series</td>
<td>BU-2</td>
<td>BU-2</td>
<td>BU-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIDS-LVT 2 series</td>
<td>BU-2</td>
<td>BU-2</td>
<td>BU-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIDS-LVT 3 FDL</td>
<td>BU-2</td>
<td>BU-2</td>
<td>BU-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHAR URC-138</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIDS JTRS</td>
<td>BC-1</td>
<td>BASELINE</td>
<td>BASELINE</td>
<td>BU-1</td>
<td>BU-2</td>
</tr>
<tr>
<td>Weapon Data Links</td>
<td>YES</td>
<td>YES</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Small Link-16 Terminals| YES                | YES             | YES                 |                      | ??                                    |??
So things are Changing

- **Link-16 is widely deployed for Joint and International Interoperability**
  - Roughly 40 nations

- **User base continues to expand**
  - From the C2 Users with JTIDS
  - To the Fighters with MIDS today
  - To Tactical Edge users with the small terminals

- **Information capacity of the Network is expanding**
  - Enhanced Throughput
  - CMN/CCR

- **New Terminals and Upgrades to old ones boost the penetration to more users**