Unmanned Aircraft Systems
Net-Centric Interoperability
Anomalies

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“Rules”

• Please keep all discussion unclassified
  – Observations are generic and hypothetical environments and scenarios

• Ask non-system specific questions

• Do not reveal any mission or operational association
Overview

- Operational Impact of net-centric anomalies
- Network Issues
- Insufficient technical data
- Lack of agile technology and life cycle upgrades
- Integrated operations challenges
• **Operating Environment**
  – Programs produce unique aircraft/ground segments
  – Operators need complete end to end solutions, including Unmanned Arial Surveillance (UAS) combined data and operation centers

• **Impacts**
  – Operators burdened with development
  – End to end network connectivity difficult

• **References/Reports**
  – JITC System Tracking Program (STP)
  – JITC Joint Interoperability Tool (JIT)
Horizontal Integration Working Group (HIWG) Joint Common Unmanned Architecture (JCUA)
Inappropriate IP Addresses

• Inappropriate use of IP network addresses
  – Non-DoD assigned addresses/some addresses actually assigned to foreign countries
  – Addresses hard coded in compiled software
  – Public within private and address repeated
  – Works as a stove-piped system, not as a Global Information Grid (GIG)-enabled system-of-systems

• Suggested solution
  – Appropriate network addresses from respective Services’ Defense Information Systems Agency (DISA) field office
  – Design aircraft and ground segments as actual nodes on the GIG, not isolated entities
Network Issues

• Lack of insight on ports, protocols, and services
  – Who or what am I talking to?
  – No access control lists/systems delivered wide open

• Suggested Solution
  – Full disclosure of assigned ports, protocols, and services in system technical data

• Insufficient consideration for latency and jitter
  – Some payloads require deterministic-like network
  – Pure IP Ethernet solutions may lose payload data

• Suggested solutions
  – Examine complete end to end path - aircraft to user
  – Insertion of deterministic-like network solutions
  – Use resources such as Army’s Common Operating Environment
Insufficient Technical Data

• Lack of full system documentation causes
  – Frustration when it comes to operational system configuration, troubleshooting, and maintenance
  – Delays in preparation of systems for missions

• Suggested solution
  – Need full disclosure of system theory of operation in technical orders
  – Deliver baseline configuration data to facilitate proper network management
Lack of Agile Upgrades

• Inconsistent hardware/software maintenance
  – Data Links slow to modernize to latest standards
  – Diminishing Manufacturing Source (DMS) issues
  – Critical scripts are written at operating system levels requires excessive regression testing
  – COTS operating systems and applications not being updated

• Suggested solutions
  – Code software applications in upper layers
  – Enable viable patch management for Commercial, off-the-shelf software (COTS)
  – Plan for frequent technology refresh
Integrated Operations

• Vehicles and control segments developed as stand alone capabilities
  – Actual use exceeded expectations
  – Operators need integrated systems of systems
  – UAS data and operations centers were born
  – Use of common tools across networks blossomed
  – Interoperability and integration problem surfaced immediately

• Suggested solution
  – Rethink UAS system design philosophy
  – Plan for adaptable baselines for multiple and dynamic integrated operational environments
Summary

• Operators need integrated mission capabilities
  – Avoid designing UAS systems with network issues
  – RF links passing network data are just as much part of the DoD Global Information Grid as land based

• Need to strive for
  – End to end network architecture maintained and documented as operations employs systems to include mapping to end users
  – Complete system design in technical orders
  – Readily updatable and upgradeable system designs
  – Mission partner collaboration
• **Evolving resources**
  - Joint Common Unmanned Architecture (JCUA)/OSD UAS Task Force initiatives
    • [http://interoperabilityipt.org/page/organization](http://interoperabilityipt.org/page/organization)
  - Universal Systems Interoperability Profiles (USIP) for standards
    • [https://software.forge.mil/sf/go/proj1887](https://software.forge.mil/sf/go/proj1887)
    • [https://gtg.csd.disa.mil/uam/homepage](https://gtg.csd.disa.mil/uam/homepage)
  - OSD Unmanned Information Repository (UWIR) for the 29 identified joint interoperability gaps stated in the Unmanned Aircraft Systems Interoperability Initiative Capabilities Based Assessment Final Report
    • [https://extranet.acq.osd.mil/uwir](https://extranet.acq.osd.mil/uwir)
  - JCIDS Net-Ready KPP process
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Back Up Slides
Operational Impact of Net-Centric Anomalies

• Operating Environment
  – Programs produce unique aircraft and ground segments
  – Operators need combined data and operation centers to gain system and data synergies necessary to execute missions

• Impacts
  – Operators burdened with assembling non-baseline solutions to achieve interoperability and mission synergies
  – Anomalies in unmanned system designs exacerbate ability to perform end to end network connectivity
  – Must ensure net-ready key performance parameters vigilance applied throughout life cycle
Network Issues

• **Inappropriate use of IP network addresses**

• **Observations**
  – Non-DoD assigned addresses
  – Addresses actually assigned to foreign countries
  – Addresses hard coded in compiled software
  – Public addresses within private address segments
  – Use of a single address repeated among all similar equipment

• **Suggested solution**
  – Request program office obtains appropriate network addresses from respective Services’ DISA field office
  – Consider the aircraft and ground segments as actual nodes on the global information grid – not isolated entities!
Network Issues (cont)

• Lack of insight on ports, protocols, and services
  – Observations
    • Inability to determine actual remote procedure calls vs assigned ports
    • Systems delivered wide open with no access control lists
  – Suggested Solution
    • Provide full disclosure of assigned ports, protocols, and services in system technical data

• Insufficient consideration for latency and jitter
  – Observations
    • Certain payloads may require deterministic-like network
    • Pure IP Ethernet based solutions may buffer data or drops packets that could lose the sensitive type of payload data
  – Suggested solutions
    • Examine complete end to end path from aircraft to user
    • Consider insertion of deterministic-like network solutions
Observations

- Lack of system insight causes:
  - Frustration when it comes to operational system configuration, troubleshooting, and timely maintenance
  - Delays preparation of systems for missions

- Dependence on Contracted Field Service Representatives
  - May not have obligation to adhere to DISA or service instructions and guidance

Suggested solution

- Need full disclosure of system theory of operation in technical orders
- Deliver baseline configuration data to facilitate proper network management
- No “Proprietary Information” used as a disclosure obstacle
Lack of Agile Technology and Life Cycle Upgrades

• Inconsistent hardware and software maintenance

• Observations
  – Data Link revisions slow to modernize to latest standards
  – Hardware company evolutions/bankruptcies
    • 90’s technology still fielded, plans to replace slow
  – Diminishing Manufacturing Source (DMS) issues
  – Critical scripts are written at operating system levels requires excessive regression testing
  – Commercial operating systems and applications running years without being updated

• Suggested solutions
  – Properly code software applications written in upper layers
  – Enable viable patch management for commercial software
  – Plan for ever advancing technology in system design