"The Net-Centric Foxhole" Perspectives from Army Future Combat Systems

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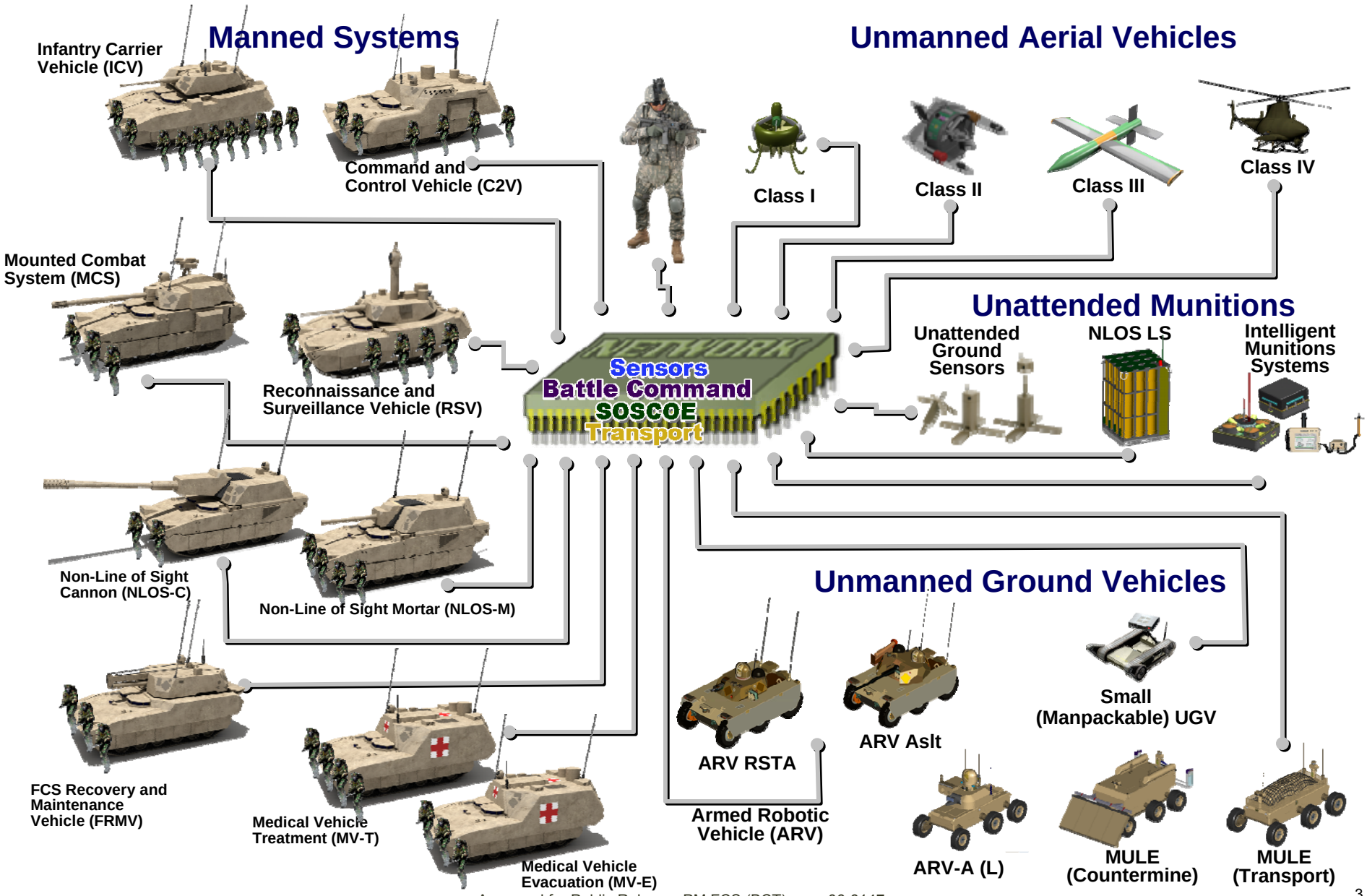
Outline

- FCS Program Overview
- FCS "Distributed System" architecture and Net-Centric Concerns
- Issues from each of the 4 Net-Centric Checklist areas
  - Transport
  - IA
  - Core Services
  - Data & Applications
- FCS approach to the Net Ready KPP
- Lessons Learned

FCS System-of-Systems (SoS)

PROGRAM MANAGER FCS BRIGADE COMBAT TEAM
One Team-The Army/Defense/Industry



FCS Unit of Action Elements
Software resides in all Prime Items

PROGRAM MANAGER FCS BRIGADE COMBAT TEAM
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Manned Ground Vehicles

General Dynamics / United Defense

Infantry Carrier

Command & Control

Mounted Combat Sys

Recon & Surveil.

NLOS Cannon

NLOS mortar

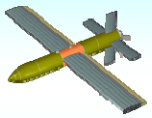
Maint. & Recovery

Medical

C4ISR

Battle Command & Mission Execution – Raytheon
SOSCOE / Warfighter Machine Interface – Boeing
Level 1 Fusion – Lockheed Martin
Sensor Data Mgmt / Planning & Prep – GDDS
Situation Understanding – Austin Info Systems
Network Management – Northrop Grumman
Integrated Computer System – General Dynamics
Unattended Ground Sensors – Textron
Ground Sensor Integration – Raytheon
Air Sensor Integration – Northrop Grumman
Ground Comm & Air Comm – BAE Systems

Unmanned Air Vehicles



Class III

Class II
Class I

Class IV
Northrop Grumman

Logistics & Training

LDSS – Northrop Grumman
PSMRS – Honeywell
Training Support
– Northrop Grumman
– Dynamics Research Corp
– Computer Science Corp

Unmanned Ground Vehicles

Armed
Robotic Vehicle
United Defense

Small UGV
iRobot

Mule
Lockheed Martin

Auto. Navigation - GDRS

Unattended Munitions

NLOS LS (LAM)
Intelligent Munition System

Non-FCS Elements

Trucks
81 mm Mortar
AAFARS HTARS

FCS (BCT) System-of-Systems Schedule

PROGRAM MANAGER FCS BRIGADE COMBAT TEAM
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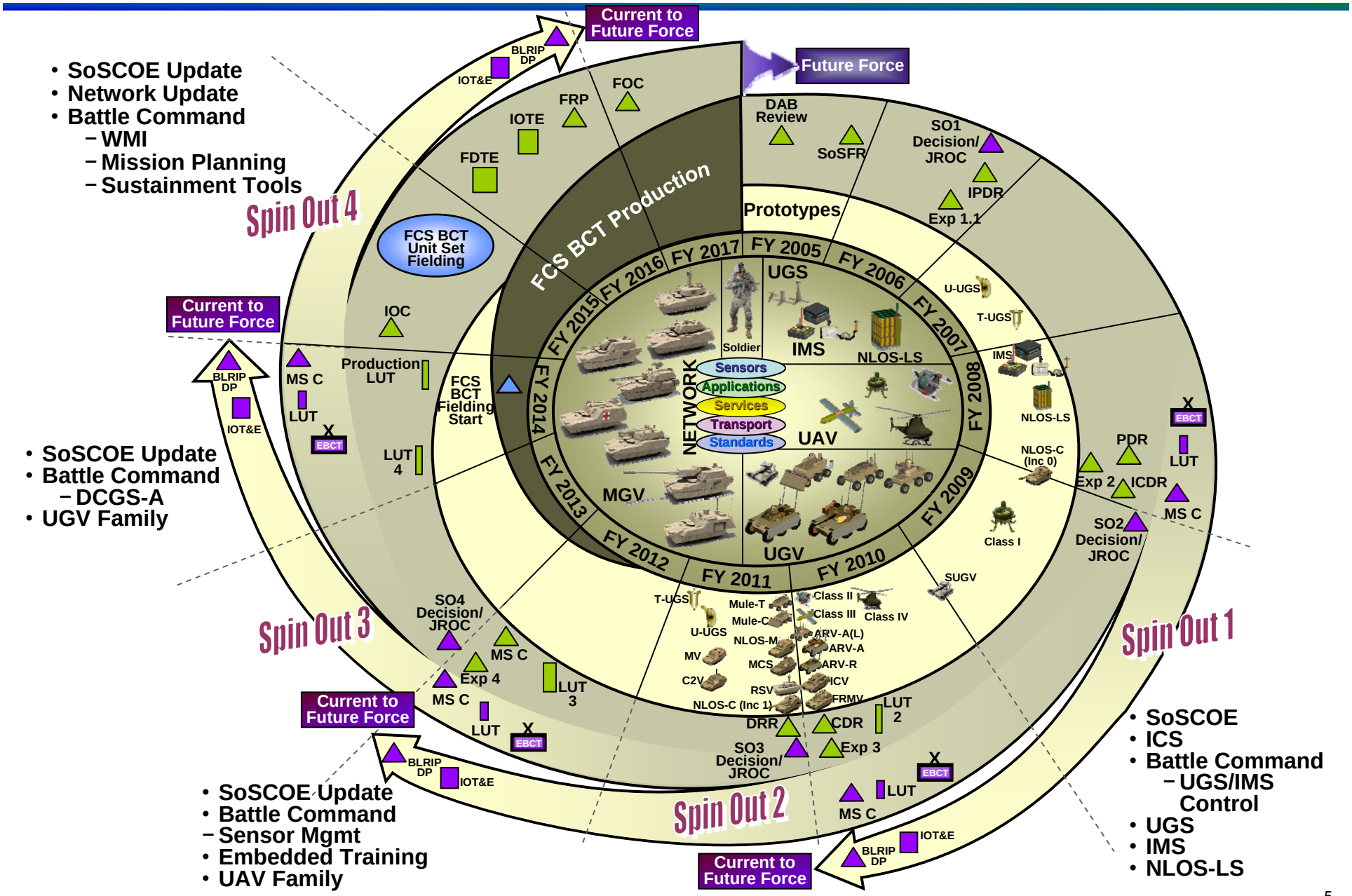


Challenges unique to FCS

- Goal is to produce a fully integrated Brigade Combat Team
  - LSI contractor performs procurement and integration of material
  - Build to evolving doctrine - increased TRADOC/User involvement
  - Focus on 'Quality of Firsts'
    - See First, Understand First, Act First, Finish Decisively
  - Spin-Outs field selected capabilities to the Current Force BCTs over next 8 years
- FCS is 'born net-centric'
  - First Army system to undergo Net-Centric Reviews, current focus of OSD NII/FCS Network IPT (OIPT at 3-star level)
  - Evaluated against OSD Net-Ready KPP (transitioning from Interop KPP)
  - Implements and extends GIG engineering requirements in a tactical environment
    - Tactical mobile vs tactical 'short halt'
  - Net-Centric information sharing concepts underly the FCS 'Distributed System' architecture
- Massive amounts of sensor data
  - ~400m bits/sec raw sensor data with variety of methods to translate into usable information
- Battle Command on-the-move; no more TOC 'tent farms'
- Transport systems procured outside of FCS
  - JTRS, WIN-T for FCS BCT
  - SINCGARS, EPLRS, JNN for Current Force

FCS is the largest, most complex program in Army history

OV-1: FCS as part of the Joint Fight

FCS BRIGADE COMBAT TEAM
One Team-The Army/Defense/Industry

Figure 1 - Operational View 1 (OV-1)

SEE FIRST

UNDERSTAND FIRST

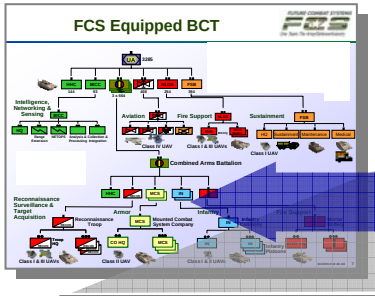
ACT FIRST

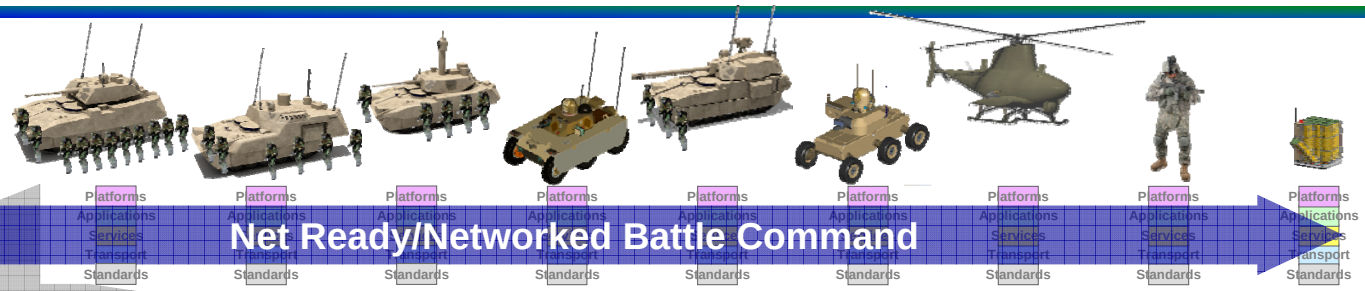
FINISH DECISIVELY

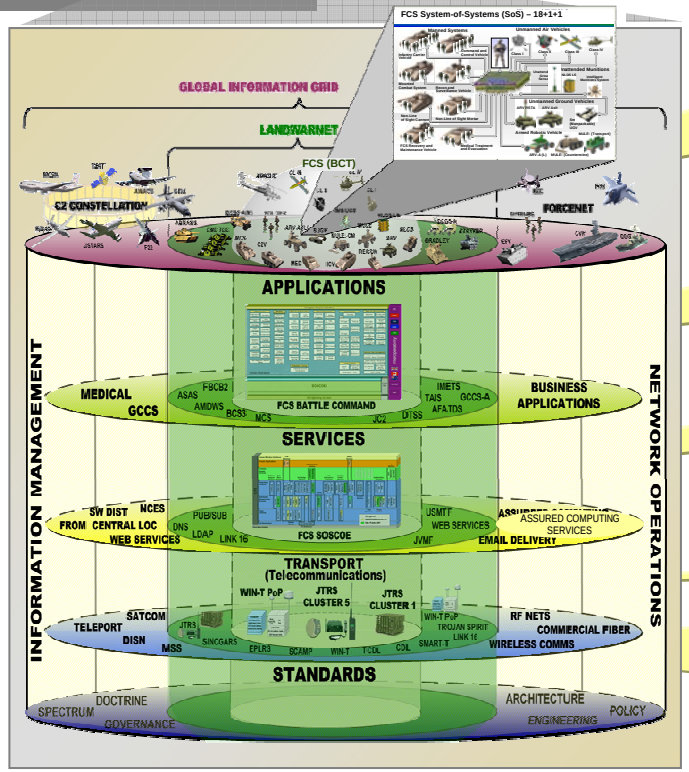
Transition to next engagement

FCS Layered, Networked Architecture

FUTURE COMBAT SYSTEMS
FCS
One Team-The Army/Defense/Industry







- **Command BCT system elements are commonly developed to integrate FCS platforms into a larger geographically dispersed yet Functionally integrated machine**
- **Battle Command incorporates C2, Intelligence, Surveillance, and Reconnaissance (ISR), Embedded Training, and Sustainment**
- **Net ready information management element of service based architecture**
- **Heterogeneous transport layer enables robustness**
- **Networked battle command, embedded training, and supportability developed Technical View (TV-1) integrated into SoS level TV-1 standards supporting integration**

Integrated Architecture Provides Design-Phase Flexibility and Tactical Adaptability For The Networked FCS (BCT)

Supporting Net-centric Operations
(OSD NII Net Centric Checklist, v 2.1.3, 12 May 04)

PROGRAM MANAGER FCS BRIGADE COMBAT TEAM
One Team-The Army/Defense/Industry

- Data Tenets
  - Make Data Visible
  - Make Data Understandable
  - Make Data Accessible
  - Make Data Trustable
  - Make Data Interoperable
  - Provide Data Management
  - Be Responsible to User Needs

- IA / Security Tenets
  - Identify Management and Authentication
  - Mediate Security Assertions
  - Cross Security Domains Exchange
  - Manage Identity and Privileges
  - Encryption and HAIPE
  - Employment of Wireless Technologies

- Service Tenets
  - Service-Oriented Architecture
  - Open Architecture
  - Scalability
  - Availability
  - Accommodate Heterogeneity
  - Decentralized Operations and Maintenance
  - Enterprise Service Management

- Transport Tenets
  - IPv6
  - Packet Switched Infrastructure
  - Layering, Modularity
  - Transport Goal
  - Network Connectivity
  - Concurrent Transport of Information Flows
  - Differentiated Management of QoS
  - Inter Network Connectivity
  - DISR
  - Joint Net Centric Capabilities
  - Operations and Management of Transport and Services

OSD's Checklist frames the FCS approach

Transport Radio Systems

PROGRAM MANAGER FCS BRIGADE COMBAT TEAM
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JTRS GMR

- Provides ground vehicle based terrestrial connectivity with Advanced Waveforms (i.e. WNW, SRW, ANW*)
- Programmable Waveforms to Support Multiple Missions

*Airborne Network Waveform

AMF*

- Provides airborne vehicle based terrestrial connectivity with Advanced Waveforms (i.e. WNW, SRW, ANW)
- AMF will meet SWAP requirements for FCS CLIV UAV comms relay package
- ARC-210 Form Factor

*Airborne Maritime Fixed Station

WIN-T Point of Presence (PoP)

- Provide reach, reach back, interoperability
- Functionality
  - NCW
  - HNW
  - GBS receive
  - Interoperability gateway

JC4ISR Radio

JTRS HMS

- Provides small form fit (SFF) for integration into FCS platforms:
  - Dismount Soldier
  - Unattended Ground Sensors (UGS)
  - Unmanned Aerial Vehicle (UAV) control
  - Intelligent Munition Systems (IMS)
  - Small Unmanned Ground Vehicle (SUGV)
  - Non Line of Sight – Launch System (NLOS-LS)

SFF-B (Soldier)

SFF-A (IMS/UGS)

SFF-D (UAV)

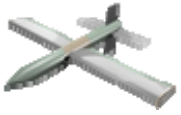
Range Extension

- Provide communication relay through the WIN-T PoP vehicles

Recon and Surveillance Vehicle

ARV RSTA

Class II



Class III

Class IV

Provides the Warfighter with superior Interoperability, Flexibility, and Adaptability

Transport Considerations

- BCT supported with a two-tier 'network of networks'
  - JTRS for lower echelons, multiple waveforms and radio form factors
  - WIN-T for upper echelons and connectivity to the GIG
  - Spin-Outs use existing and interim/prototype radios (e.g. JNN, JTRS surrogates)
- IPv6 capable, will have to support IPv4 for current force/coalition issues after conversion
- Throughput concerns
  - Throughput (including error rates) for each waveform: predicted vs delivered/actual
  - Spectrum allocations for the waveforms across the BCT area are likely to limit theoretic throughput for the BCT
- Mobile Ad Hoc Network (MANET) requires tailoring of GIG standards
  - GIG upper protocols like HTTP over TCP don't work in MANET environment
  - Throughput, availability, network topology stability/rate of change
- Voice, Video and Quality of Service concerns
  - Demand far exceeds supply
  - Need for transport-level QoS and then application level network management
  - Integration of FCS net management with Joint NetOps

Transport is oversubscribed - must get right info to right user to right time

IA Considerations

- Cross Domain Solutions – provide interaction between classified, unclassified, and coalition networks; issues include:
  - Metadata standards needed to ensure interoperability
  - Data sharing policies to allow automated release and provide for need-to-share and need-to-know
  - Improved certification procedures for multiple instantiations
- Key Management Infrastructure – provide automated cryptographic key distribution; issues include:
  - Specific interface requirements for KMI capabilities
  - Size, Weight, and Power constraints on KMI compliant equipment
  - Timely delivery of national KMI capabilities to support FCS needs
- Public Key Infrastructure (PKI) – provide authentication capabilities in line with DoD PKI strategy; issues include:
  - DoD Standard Token suitable for battlefield use
  - Use of token for classified networks
  - PKI protocols and architecture suitable for mobile ad hoc networks

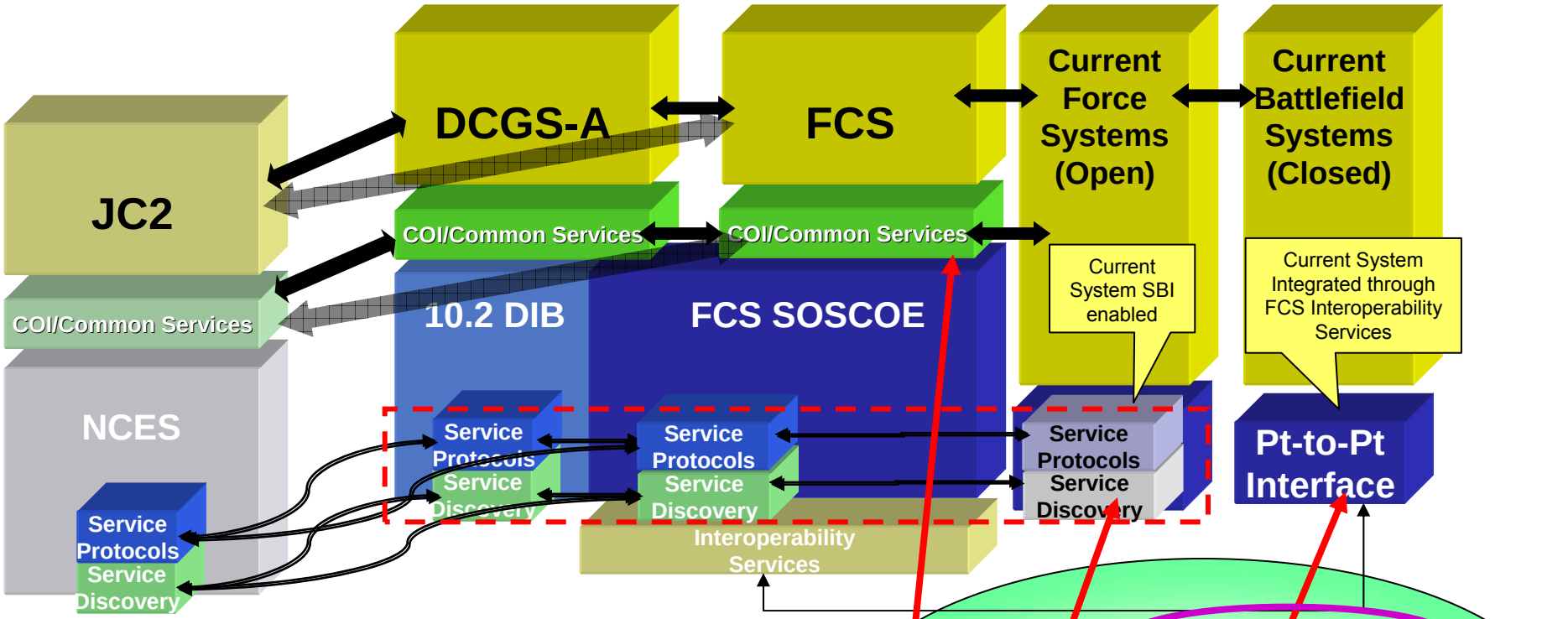
Distributed tactical systems provide challenges to current IA approaches

Core Services - SOSCOE

- System of Systems Common Operating Environment - SOSCOE - provides the Core Service implementation for FCS
  - SOSCOE fills 4 functions within FCS
    - Integrates info over tactical networks according to net-centric tenets
    - Extends and federates FCS with GIG (I.e. NCES) Core Services
    - Product line weapon system/embedded software applications
    - Infrastructure for FCS Battle Command/Distributed Systems applications
  - SOSCOE is developed by the LSI, and is 85% COTS (by SLOC)
- Multiple OSD evaluations have focused on SOSCOE
  - Implicit starting point has been “Does SOSCOE duplicate NCES?”
  - Each study has concluded tactical transport considerations limit potential code reuse between NCES and SOSCOE
    - Limited bandwidth, effect of ad-hoc networking, rate-of-change on the network
    - FCS safety-critical & real-time processing requirements
  - Most recent study emphasizes federating core services across the GIG
    - Study examined multiple programs of record that implement GIG Core Services
    - IA, Collaboration (e.g. chat/IM), service management are high payoff targets
    - NCES has privileged role to drive the core service Key Interface Profiles (KIPs) for GIG integration

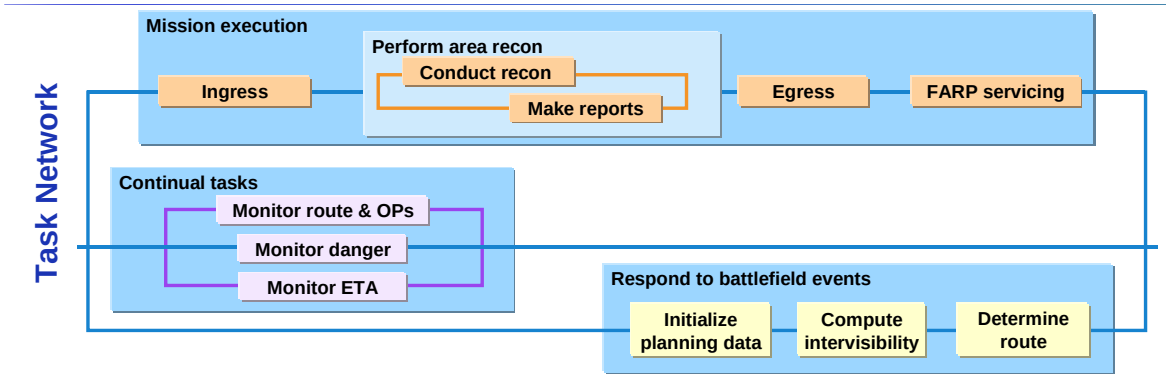
Common infrastructure within FCS and to the rest of the GIG

FCS Open Architecture Provides Multiple Levels of Interoperability and potential for early "spiral out"



FCS approach to Service Oriented Architecture (SOA) - Task Integration Networks (TINs)

- FCS implements its SOA using Task Integration Networks
  - A Task Integration Network is the definition of a job (the work to be performed by a user) as a network of tasks that must be executed in some order
  - Controls and Sequences Services (both FCS-hosted and Services provided by other parts of the GIG) via a 'scripting language'
  - Separates doctrinal considerations from hard-coded software implementations
  - Executed by SOSCOE TIN Services
- In FCS, a TIN is associated with a user role (e.g. Bn Cdr, Bde XO)
- FCS TINs federate with Web-Service based SOA infrastructures
  - E.g. NCES UDDI/WSDL
  - Federation occurs at WIN-T PoP (where we can best support transport assumptions



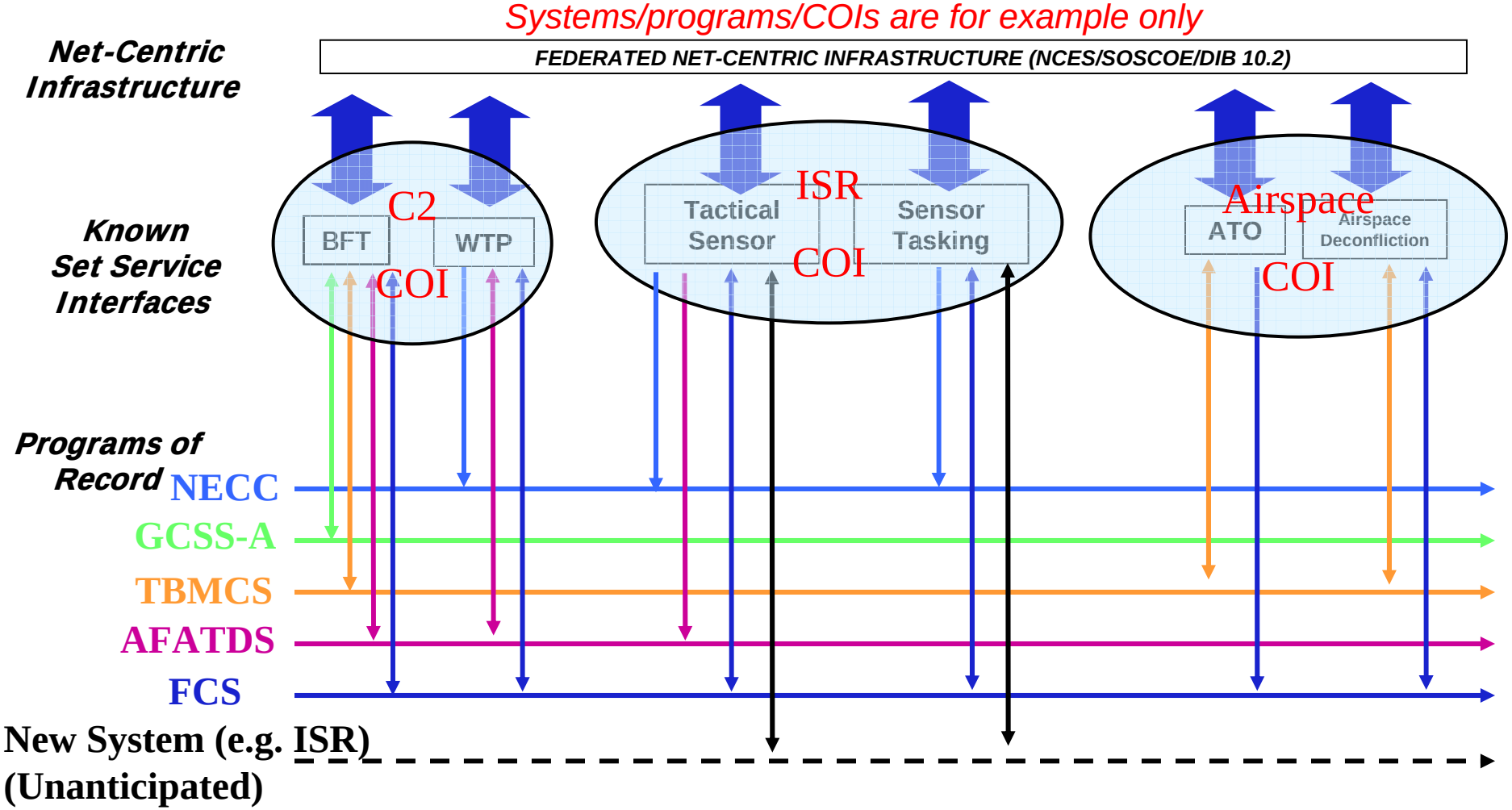
TIN-based SOA implements FCS Battle Command, Training and Sustainment

Data & Applications - COI interfaces

- OSD's intent is for Communities of Interest (COIs) to drive application integration
  - COIs are to be collaborations of users, material developers, Service/Agency oversight, etc.
  - COIs specify data items/data relationships of interest to that COI
  - COIs should also specify services of interest to a COI
    - E.g. Blue Force Tracker COI may specify a "deconflict-this-target" service interface that each program would implement
    - A Battle Command application would invoke the common interface across the systems on the GIG, asking each "OK to shoot here?"
- COIs will define a 'data and service bus' that each program of record will implement
- However, COI governance is still a concern
  - What exactly does a COI produce? Schemas, Services, CONOPS?
  - When and how will COIs produce their products? (including schedule & funding)
  - How is a COI 'good idea' translated into formal program requirements?
  - How will overlaps/conflicts between COIs be adjudicated?
  - How will COI guidance be maintained/evolve over time (including changes to existing systems)?
  - How many COIs are there, and how do you find the right COI?

COIs are critical to the success of the DoD Data Strategy

COI based Net-Centric Service Interfaces (our end-state vision)



Each System Implements Service Interfaces
Coordinated Through COI Activities
KNOWN INTERFACES – UNANTICIPATED (but validated) USERS

Net Ready KPP approach

- NR KPP has four components
  - Required DoDAF Architecture Products
  - IA
  - KIPs
  - NCOW-RM
- FCS is actively working with J6, OSD and DISA (e.g core service standards) on selecting KIP standards and validation approaches
  - KIP definitions are in flux; J6 has a schedule for the first set of KIPs
  - Test and evaluation of KIP conformance is still evolving
  - FCS is working with JITC, CTSF and ATC on who and how FCS established KIP conformance
- NCOW-RM is a useful tool for organizing net-centric information
  - 'Conformance' being worked - current expectation is a mapping of program/system components to each leaf node
  - Some NCOW-RM nodes are not just 'material solutions' - e.g. "Manage the network" (where there is both a material component and a DOTL PF component for who/when/where the tools get used)

NR-KPP consolidates activities FCS was already executing

FCS Lessons Learned

- Net Centricity has been a major impact on FCS
  - Net-Centricity is really a property of the System-of-Systems, not of any individual platform
  - Approaches within DoD (e.g. Web Service SOA) need to be tailored to work in a tactical transport and platform environments
  - FCS has had to defend its approach across multiple OSD reviews
    - Net-Centric Review/Net-Centric Checklist
    - Program Networks IPT structure
    - PA&E/QDR/PDM-III challenges on potential duplication of core services
    - All of these take PM and contractor time to support
- Net-Centric Review focuses on 4 areas
  - Transport, IA, Core Services, Data & Apps
  - These are not easily supported from DoDAF products or other standard formats
- COI impacts are a big unknown
  - Governance, schedule, content of COI recommendations not clear
  - COIs are key to the Data Strategy, so we have to make them successful

"Be Joint or Die" - Net-Centricity is a PM survival imperative