



Net-Centric Information and Knowledge Management and Dissemination for Data-to-Decision C2 Applications using Intelligent Agents and Service-Oriented Architectures

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

MCG - Mission Command Gateway and C2 Object Library for Coalition Operations

Developer team includes
C2D, VFSD, Drexel U., Soar Tech., CSI,
Raytheon, IHMC, SAIC, L3, DAC, OSU

Presented by Dr. Israel Mayk
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D2D IMD() to the Edge



Per Operation
>1000 Orders
>100000 Reports





Candidate Preformatted, standardized reports



Supported Reports

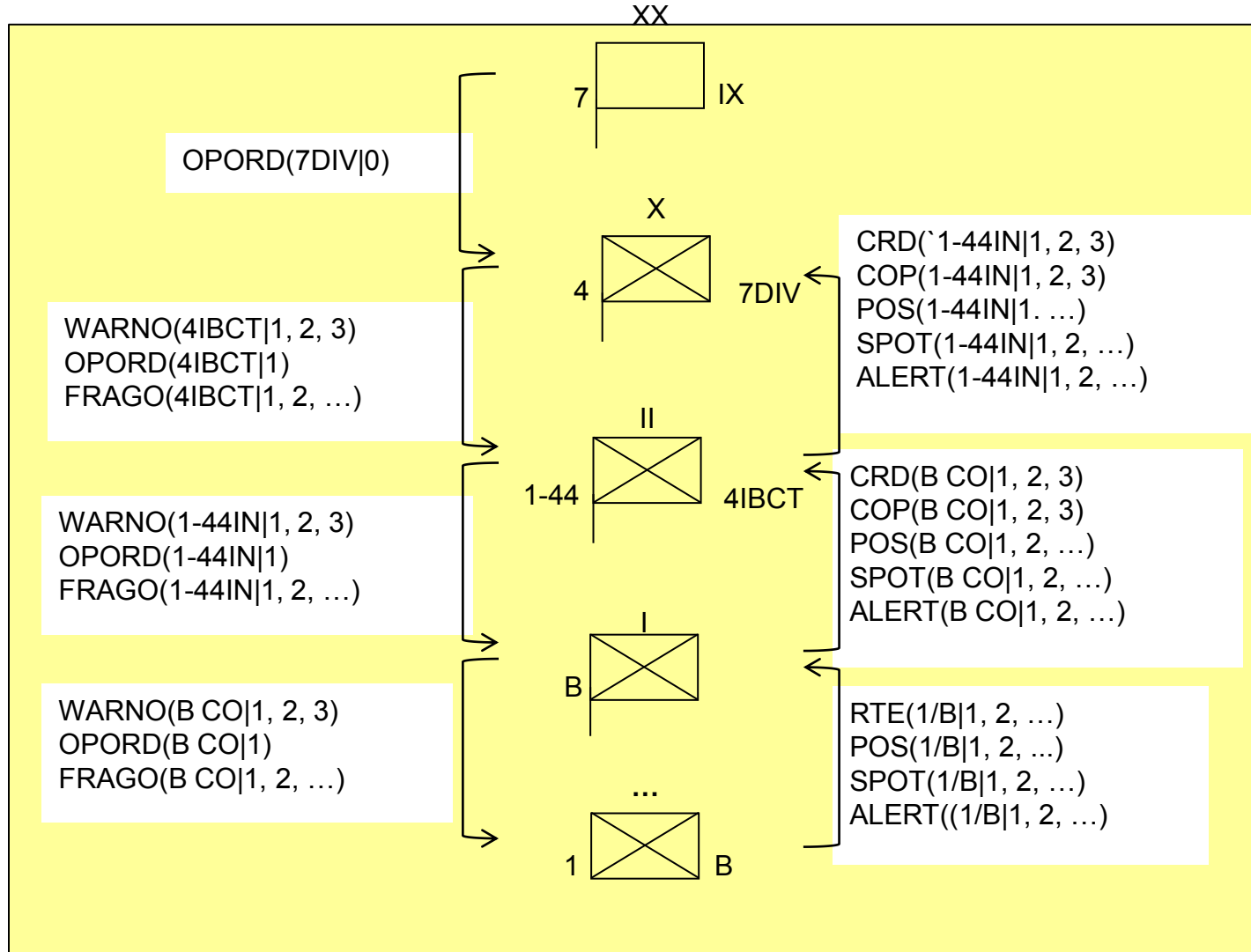
FREE TEXT MESSAGE <input type="checkbox"/>	REDCON ALERT <input type="checkbox"/>
Check Fire ** <input type="checkbox"/>	Situation Report (SITREP) **
Call for Fire ** <input type="checkbox"/>	Field Orders ² *** <input type="checkbox"/>
Observer Mission Updates ¹	Operations Plan *** <input type="checkbox"/>
On-Call Fire Command	Fragmentary Order (FRAGO) *** <input type="checkbox"/>
Message to Observer ¹	Warning Order (WARNO) *** <input type="checkbox"/>
Fire SPT COORD Measures	Minefield Laying
End of Mission/Surveillance * <input type="checkbox"/>	Overlay ** <input type="checkbox"/>
Sequent Adjust	MOPP Alert <input type="checkbox"/>
Observer Readiness Report <input type="checkbox"/>	MEDEVAC Report ** <input type="checkbox"/>
Airborne Fire Mission	Logistics Report * <input type="checkbox"/>
Spot Report * <input type="checkbox"/>	Personnel Report <input type="checkbox"/>
Engagement Report * <input type="checkbox"/>	Supply Point Status
Contact Report * <input type="checkbox"/>	Task Management
Land Route Report * <input type="checkbox"/>	LOG Task Order
Obstacle Report <input type="checkbox"/>	LOG Call for Support **
Bridge Report * <input type="checkbox"/>	LOG Task Status **
Position Report * <input type="checkbox"/>	LOG Task Sync
NBC 1 Report **	Execution Matrix <input type="checkbox"/>
NBC 4 Report ¹	Mayday/911 * <input type="checkbox"/>

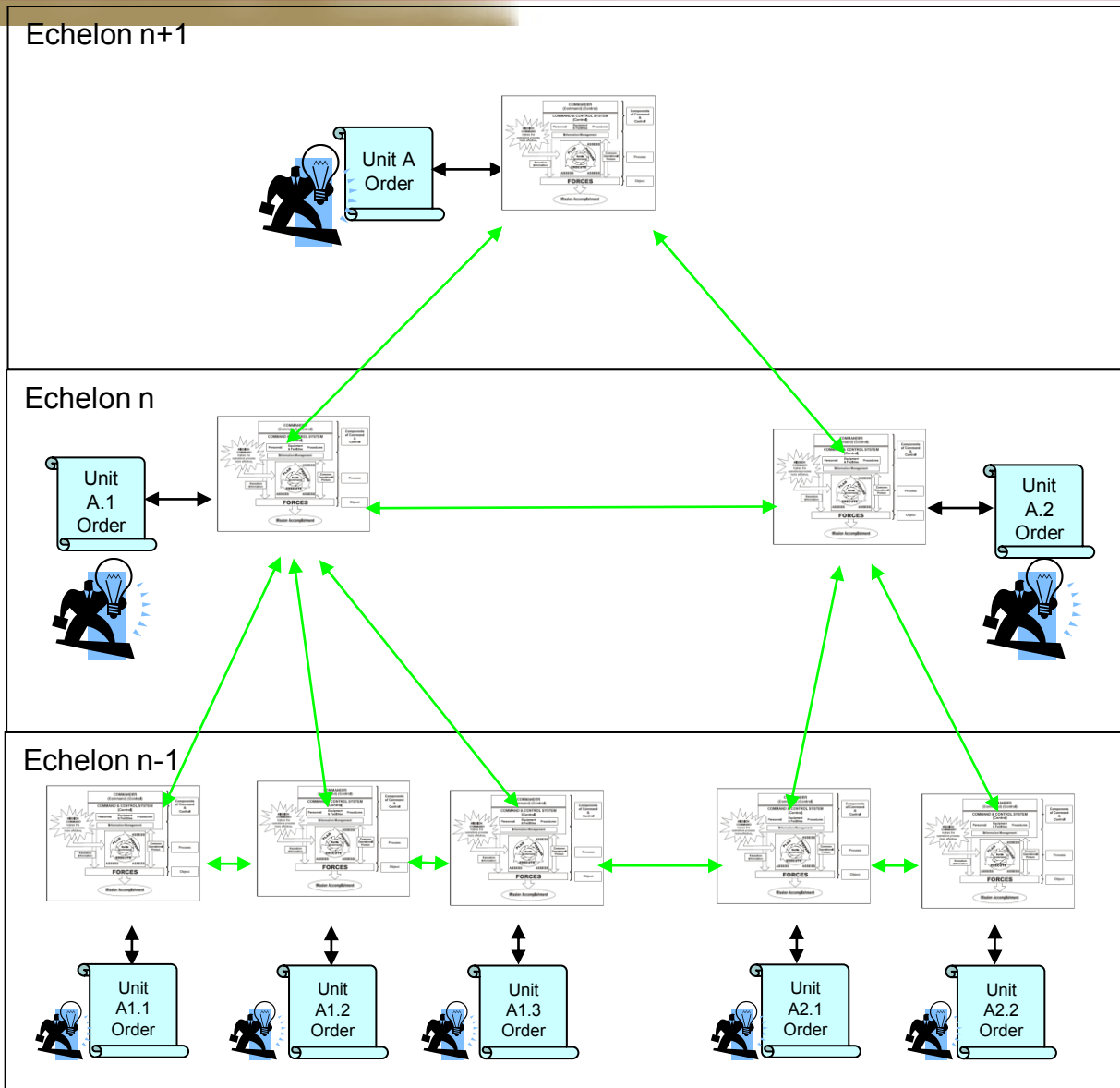
Supported Plans/Orders

FM 3-21.94



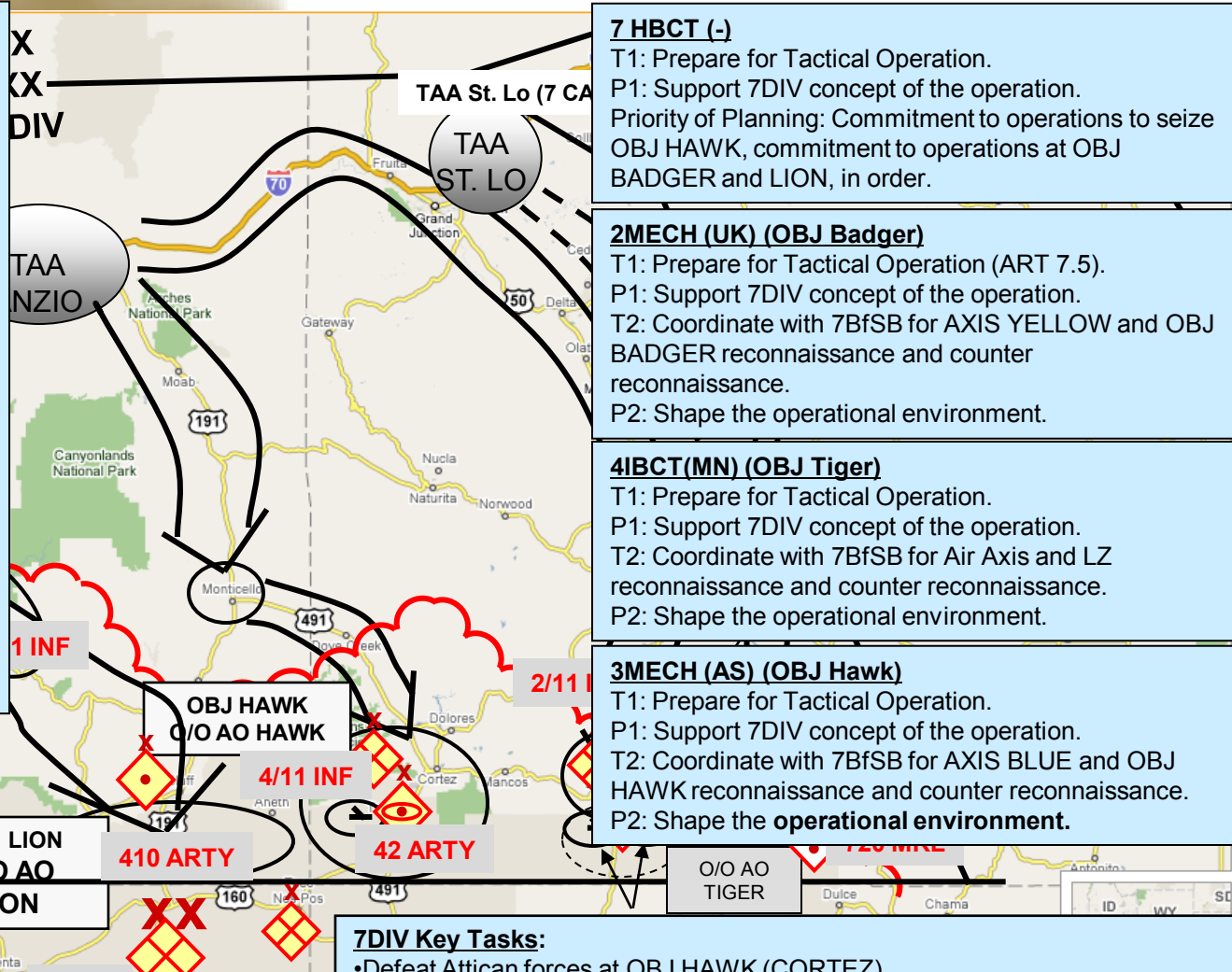
D2D IM&D Message Threads (2011 Experiments)







D2D Context MLS-1, Omni Fusion 08



7 BfSB (ME)
 T1: Prepare for tactical operation.
 P1: Support 7DIV concept of the operation.
 T2: Conduct reconnaissance and counter-reconnaissance fwd of TAA ANZIO and ST.LO along Axes GREEN, BLUE and YELLOW.
 P2: Eliminate enemy recon's ability to disrupt 7ID's offensive actions along those axes.
 T3: Conduct route recon of AXIS BLUE to CHURCH PASS (high ground North of Monticello).
 P3: Provide updated information on route conditions and activities and ensure trafficability along AXIS BLUE.
 T4: Conduct aerial reconnaissance of OBJs KESTREL, HAWK and LION.
 P4: Inform CDRs of enemy disposition, composition, and route status.
 T5: Conduct aerial reconnaissance of AIR AXIS RED.
 P5: Inform commanders of 4IBCT and 7CAB of enemy disposition, composition, and possible ADA ambush sites.

5FBCT (OBJ Kestrel and Lion)
 T1: Prepare for Tactical Operation.
 P1: Support 7DIV concept of the operation.
 T2: Coordinate with 7BfSB for AXIS GREEN and OBJs KESTRAL and LION reconnaissance and counter reconnaissance.
 P2: Shape the operational environment.

7DIV Mission:
 On order, 7DIV attacks to defeat OSC STRIKE forces and terrorist elements, bases and assets IOT reestablish the international border; secures key infrastructure to prevent destruction and human suffering; transitions control of AO to 33rd Elisian Division or other competent authority IOT prepare for continued operations in theater.

7 HBCT (-)
 T1: Prepare for Tactical Operation.
 P1: Support 7DIV concept of the operation.
 Priority of Planning: Commitment to operations to seize OBJ HAWK, commitment to operations at OBJ BADGER and LION, in order.

2MECH (UK) (OBJ Badger)
 T1: Prepare for Tactical Operation (ART 7.5).
 P1: Support 7DIV concept of the operation.
 T2: Coordinate with 7BfSB for AXIS YELLOW and OBJ BADGER reconnaissance and counter reconnaissance.
 P2: Shape the operational environment.

4IBCT(MN) (OBJ Tiger)
 T1: Prepare for Tactical Operation.
 P1: Support 7DIV concept of the operation.
 T2: Coordinate with 7BfSB for Air Axis and LZ reconnaissance and counter reconnaissance.
 P2: Shape the operational environment.

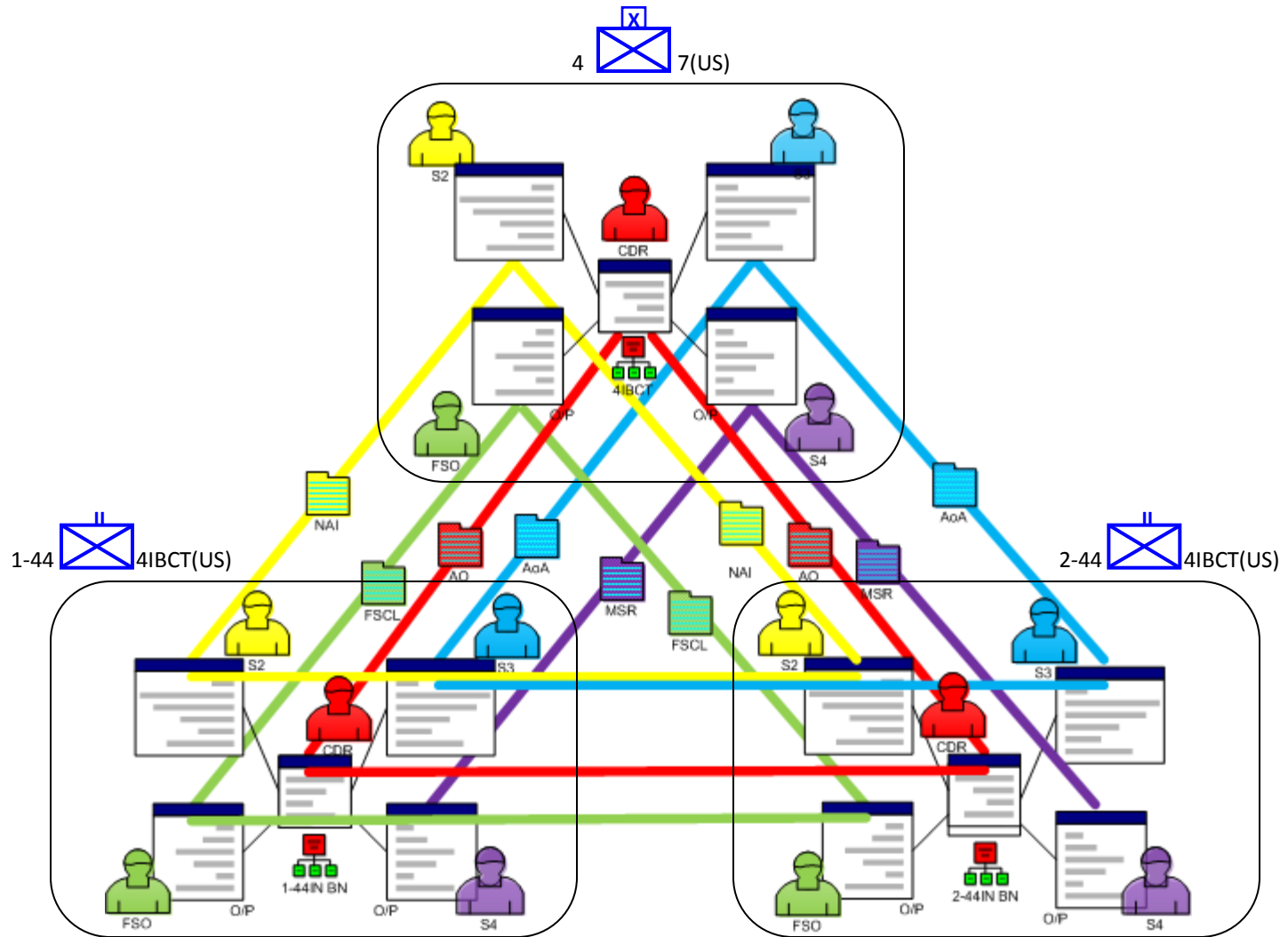
3MECH (AS) (OBJ Hawk)
 T1: Prepare for Tactical Operation.
 P1: Support 7DIV concept of the operation.
 T2: Coordinate with 7BfSB for AXIS BLUE and OBJ HAWK reconnaissance and counter reconnaissance.
 P2: Shape the operational environment.

7DIV Key Tasks:

- Defeat Attican forces at OBJ HAWK (CORTEZ).
- Seize the HITE DAM intact at OBJ KESTREL.
- Destroy enemy long range fires and coordinate for joint fires destruction of those assets immediately adjacent to the division AO.
- Secure bridge crossing sites throughout AO. Conduct concurrent Stability Operations.
- Prepare for follow-on operations.



Multi-Role / Multi-National Staff & Agent Collaboration



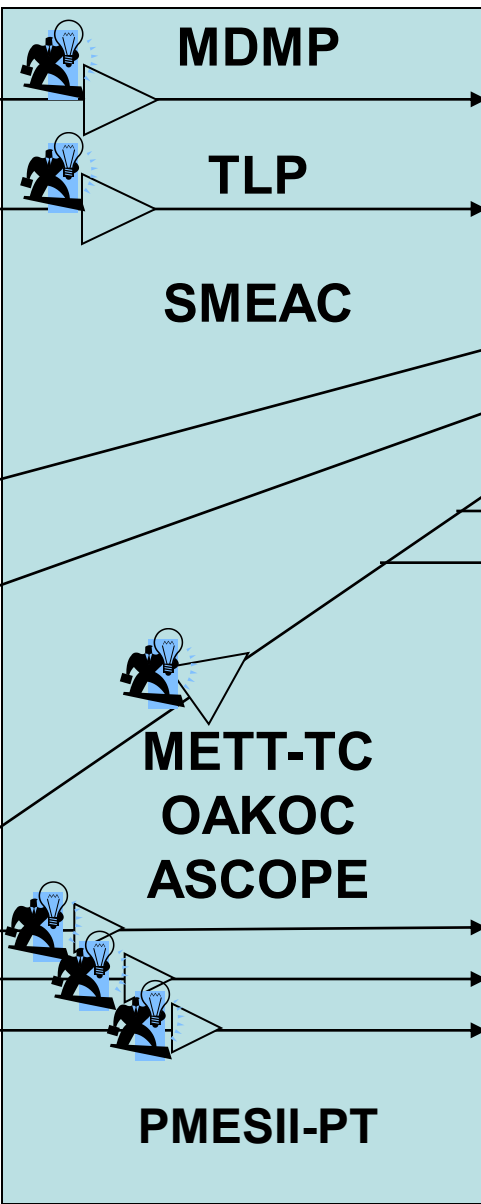


COMBAT ORDERS FLOWCHART



ORDER ISSUED TO YOU

- I. SITUATION
 - A. Enemy Forces
 - B. Friendly Forces
 - 1. Higher
 - (a.) Mission
 - (b.) Intent
 - 2. Adjacent
 - 3. Supporting
 - C. Attach/Detach
- II. MISSION
- III. EXECUTION
 - A. Cmdr's Intent
 - B. Concept of the Op
 - (a.) Scheme of Maneuver
 - (b.) Fire Support Plan
 - C. Tasks
 - D. Coordinating Instructions
- IV. ADMIN/LOGISTICS
- V. COMMAND/SIGNAL

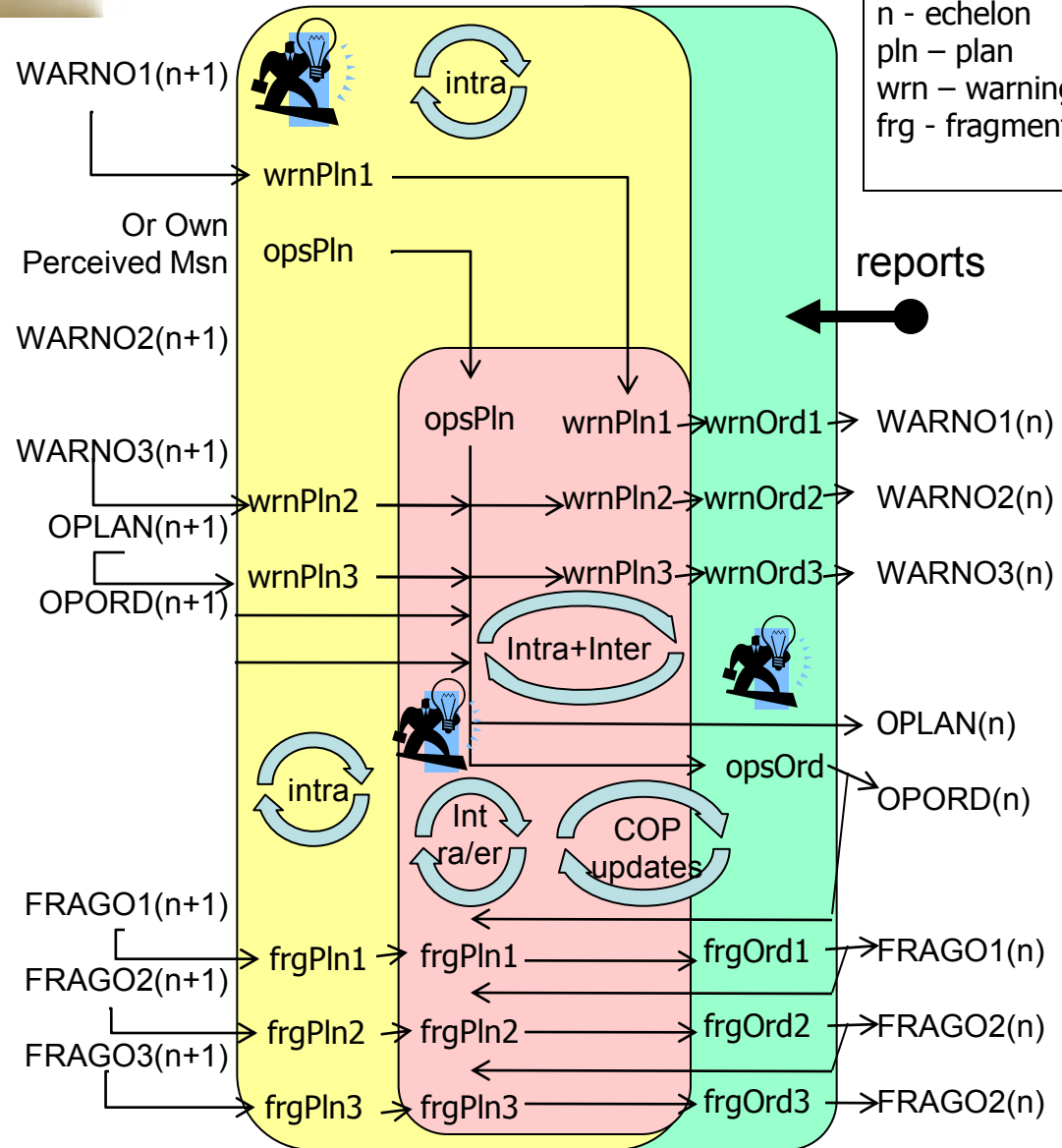
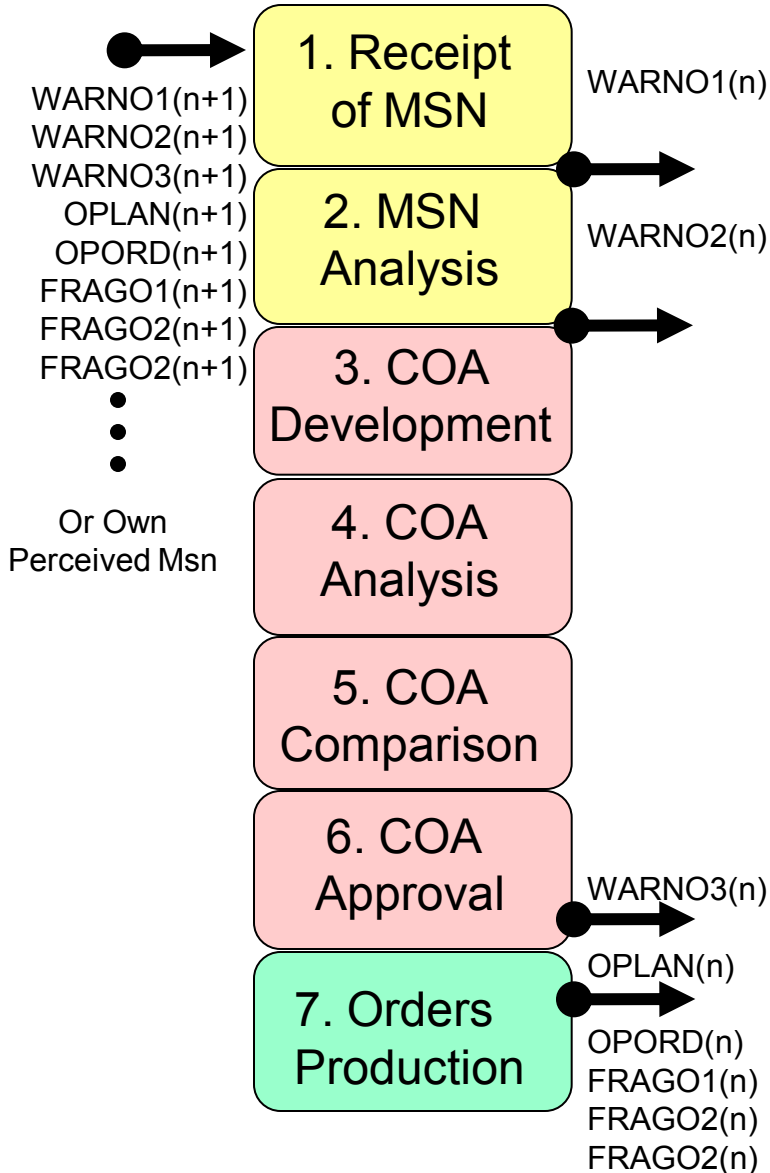


ORDER YOU ISSUE

- I. SITUATION
 - A. Enemy Forces
 - B. Friendly Forces
 - 1. Higher
 - (a.) Mission
 - (b.) Intent
 - 2. Adjacent
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 - A. Cmdr's Intent
 - B. Concept of the Op
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Integrating/ Synchronizing the Art of MDMP and Science of IMPD



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C2 Plan/Order Product State Diagram A Single IMDP Session

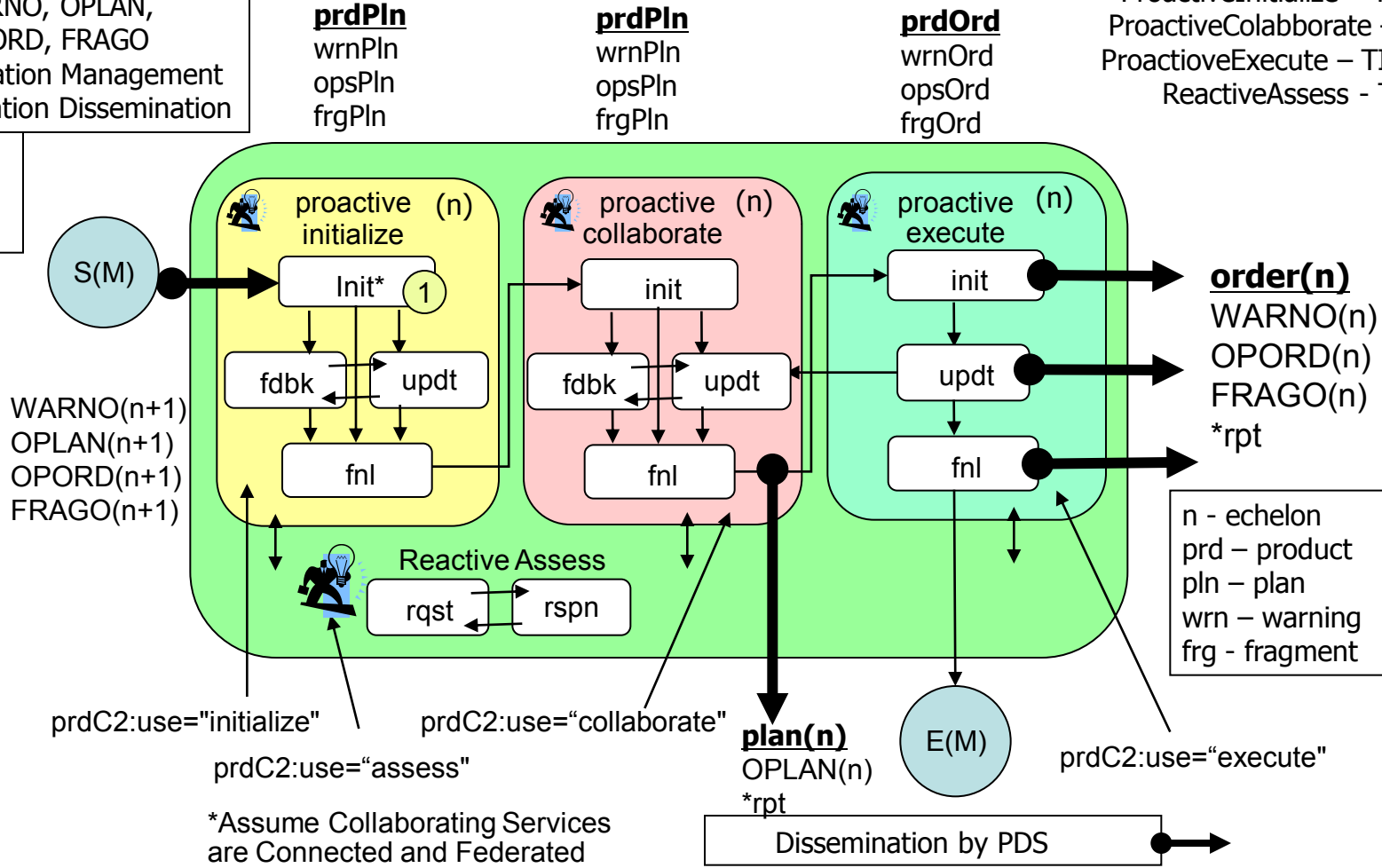


prdIM: prdPln, prdOrd
 prdID: WARNO, OPLAN, OPORD, FRAGO
 IM: Information Management
 ID: Information Dissemination

IMDP States –TITAN Topics

ProactiveInitialize – TITANcontrol
 ProactiveCollaborate – TITANplan
 ProactiveExecute – TITANexecute
 ReactiveAssess - TITANassess

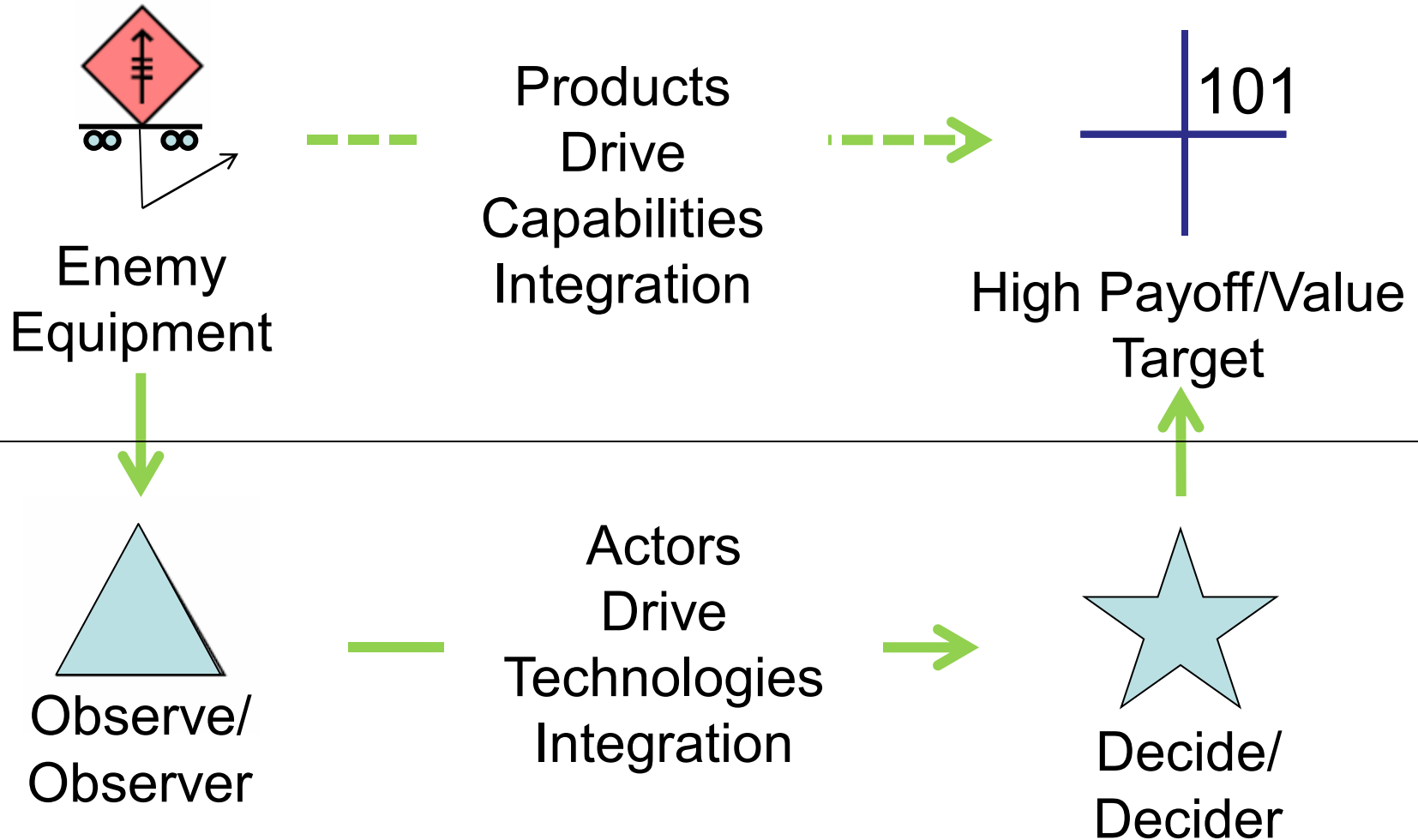
S – start
 E - end
 M - mission



Collaborative planning is the real-time interaction among commanders and staffs at two or more echelons developing plans for a single operation.

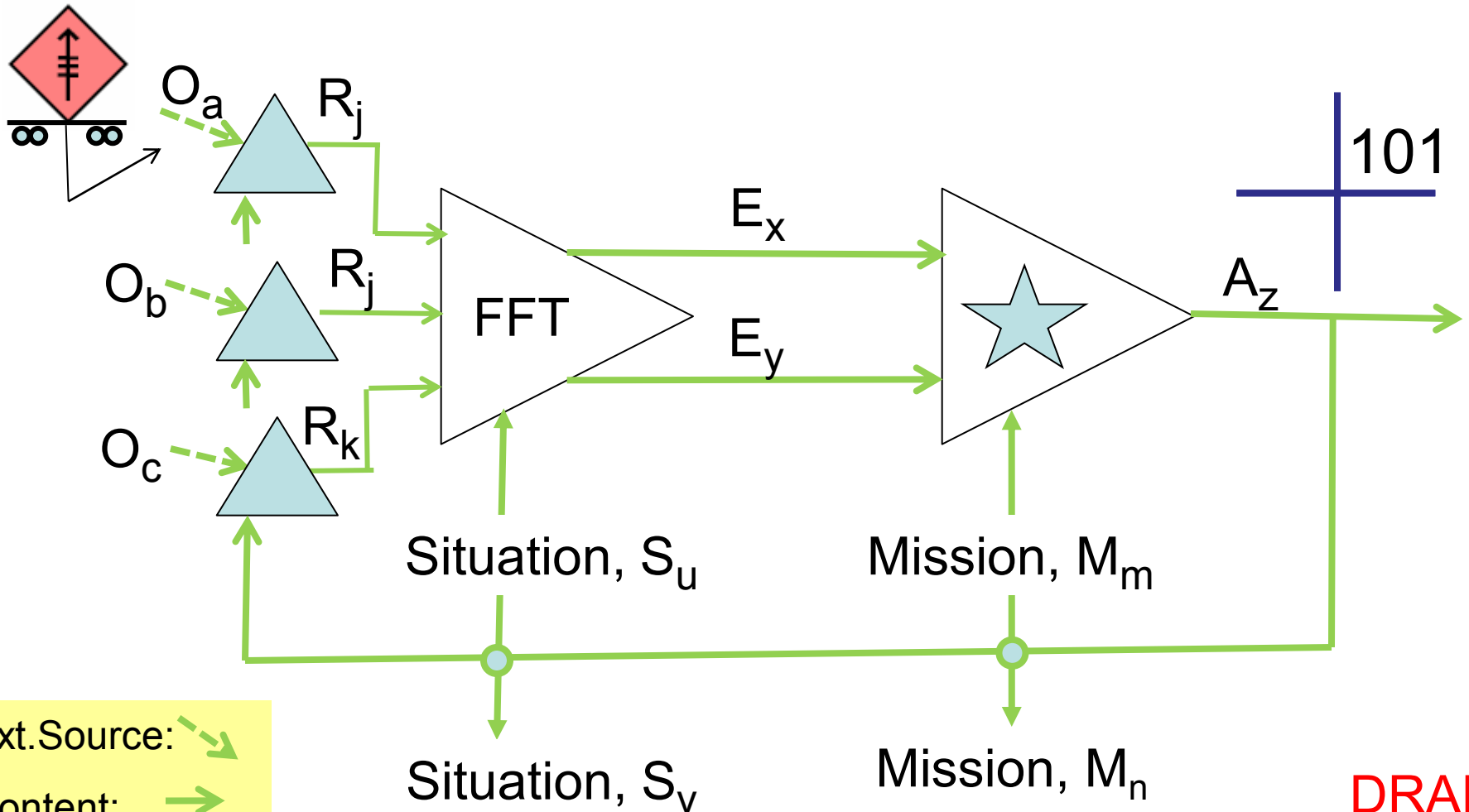
Integrated Technologies providing Integrated Capabilities

(Information/Knowledge Management by TITAN)



Supporting Full Spectrum of Contexts and Contents

(Information/Knowledge Management by TITAN)



Ext.Source:
 Content:
 Context:

DRAFT



MC Warfighter Screen Capture TUGS spotReport



BCW - Raymond Doane [S4] 1-44IN BN/4IBCT(US)

1-44IN BN/4IBCT(US)'s FRAGO 6 OPERATION 1-44_STX5-7C/9142_15 July

Signature Date 7/15/11 6:49 PM

Message Reference Number

References Save

Timezone Used Throughout

Task Organization Select a value is Select a value to Select a va... Save

1. Situation

A. Area Of Interest

B. Area Of Operations

1. Terrain

2. Weather

C. Enemy Forces

SPF cells have been conducting reconnaissance in AO Tiger to determine 4IBCT locations, disposition and readiness levels. SPF is expected to conduct limited harassment attacks using mortars and snipers to test 4ICT defense and reaction capabilities. SPF will likely attempt to pass 4IBCT vehicle checkpoints to test procedures and assess vulnerabilities.

D. Friendly Forces

1. Higher Headquarters' Mission and Intent

A. Higher Headquarters Two Levels Up

1. Mission

2. Commander's Intent

B. Higher Headquarters

1. Mission

Time Reported: null
Location: 18TWK3774429993
Target ID: FUS9G117...POST S.358308.00

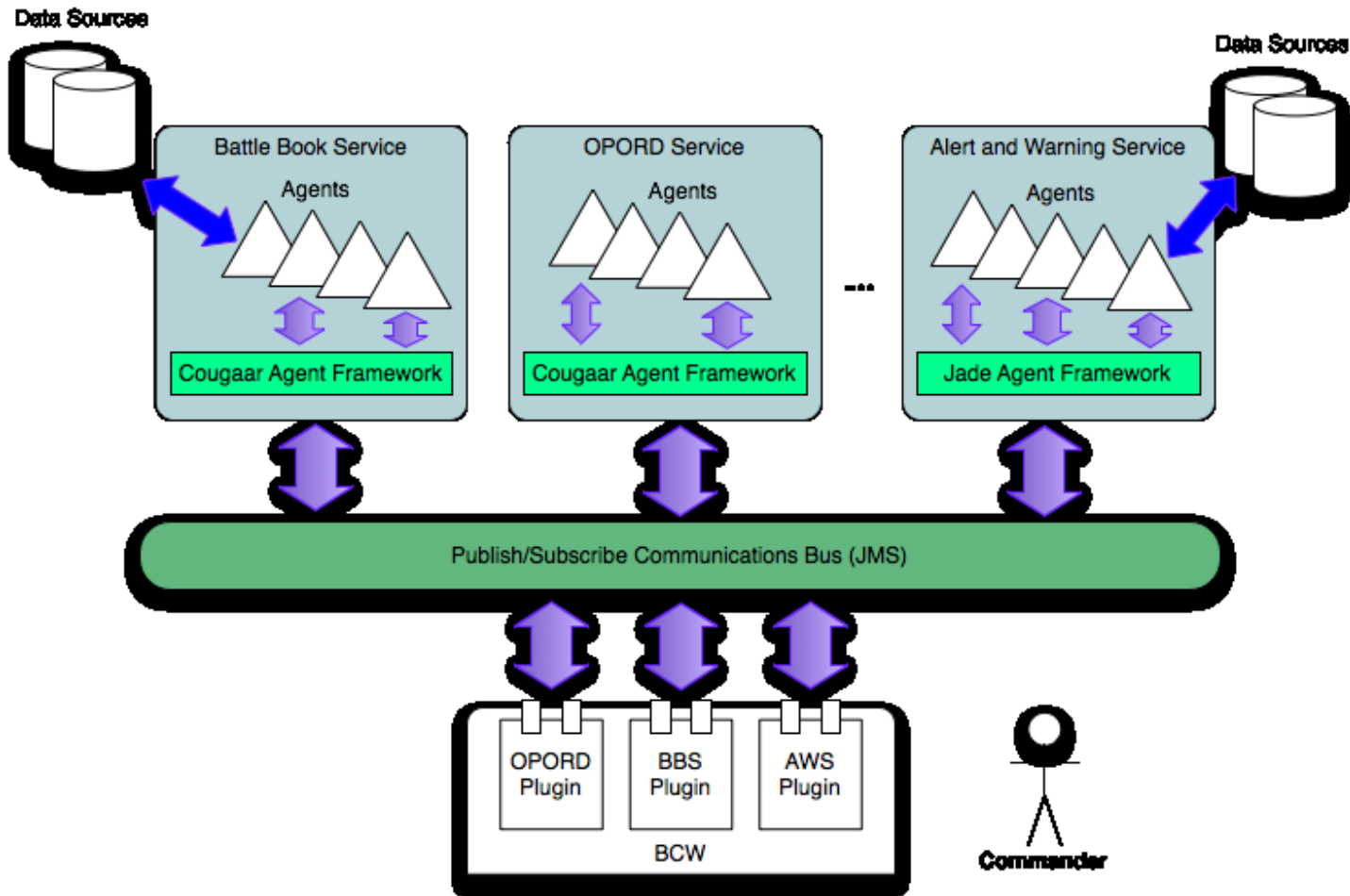
Orders

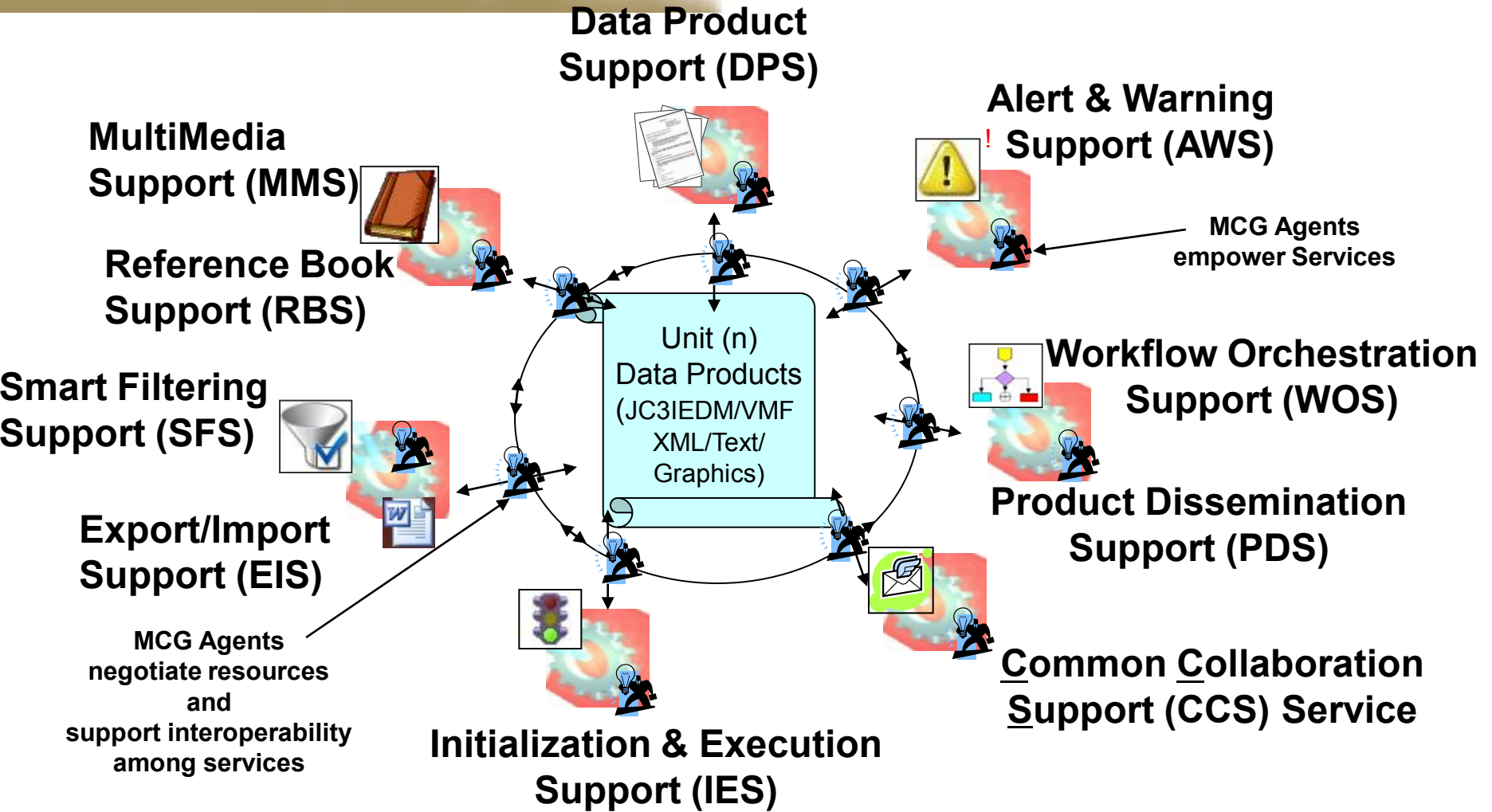
Show Orders From: All Units

Type	Number	Owner	Codename	Classification	Issued
FRAGO	1	4IBCT(US)7...	FRAGO 1 to ...	Unclassified	<input type="checkbox"/>
FRAGO	4	4IBCT(US)7...	STX 4-B/59E	Unclassified	<input type="checkbox"/>
FRAGO	5	1-44IN BN/4...	1-44_FRAG...	Unclassified	<input type="checkbox"/>
FRAGO	1	4IBCT(US)7...	STX5-7C/9142	Unclassified	<input type="checkbox"/>
FRAGO	6	1-44IN BN/4...	1-44_STX5-...	Unclassified	<input checked="" type="checkbox"/>

Create Order

0 km Lat: 40.022355° Lon: -74.568332° 100 m No Network





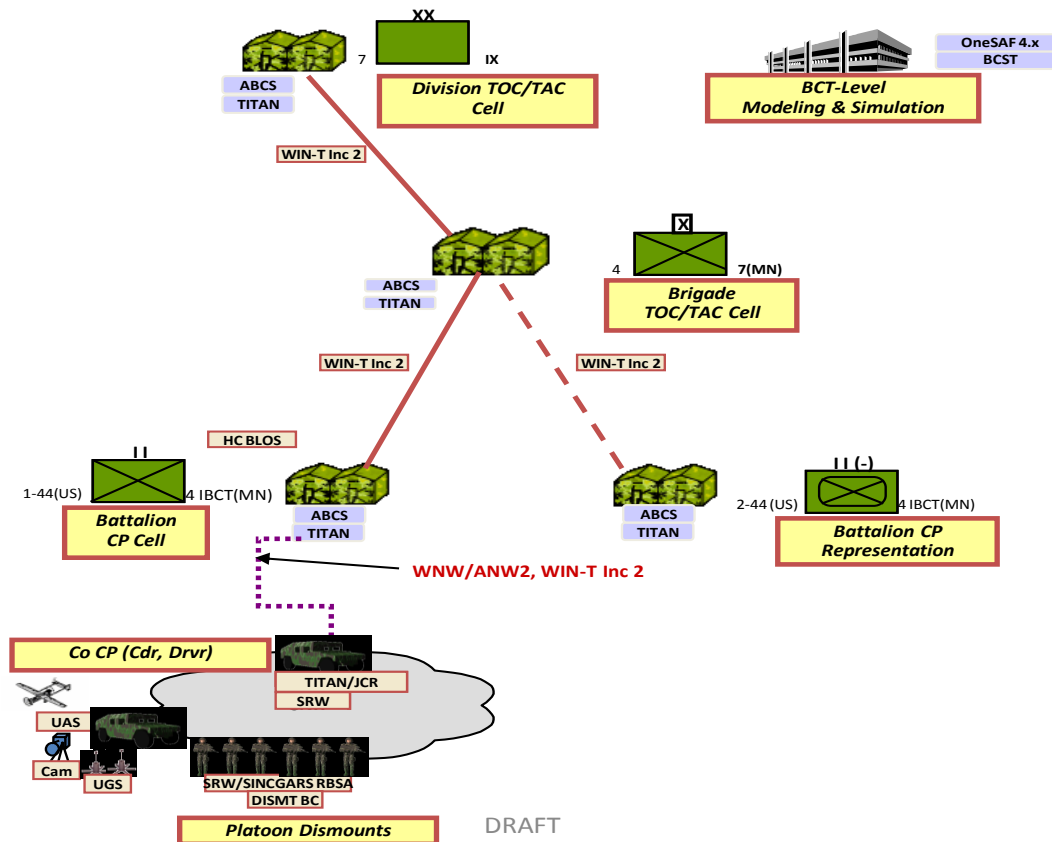
MCG Services support Web Service Standards and utilize POR Infrastructure

HICON/
DIV/JTF

Brigade

Battalion

Company & Below



5/5/2011


DRAFT




PM C4ISR On the Move



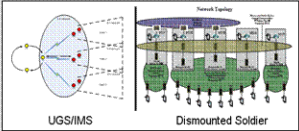
Provides a relevant environment/venue to assess emerging technologies in a C4ISR System-of-Systems (SoS) configuration to enable a Network Centric environment IOT reduce and mitigate risk for FCS Concepts, Future Force capabilities, and accelerate technology insertion into the Current Force in support of the Army Brigade Combat Team Modernization Plan and the Future Force






PM WIN-T Increment 2&3 DT/EFT/LUT 2008/09

- Technology Maturity
- Critical Technology Elements
- Network Scalability




JTRS - SRW 2007/08 Technical Field Tests

- SRW maturation
- Transition to JPEO JTRS
- TFT#2 Risk Reduction



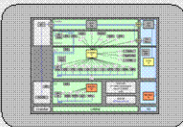
CL IV UAS Capabilities 2008

- EO/IR Sensor Cross Cue
- COMMS Relay
 - EPLRS
 - WIN-T
 - TCDL



PM FCS (BCT) NSI 2008 Technical Field Tests

- SUGV Tele-Operation
- T-UGS & U-UGS
- SOSCOE/BC
- NEC2 ATO Technology Transition - NEBC & CZORE



DCGS-A & DARPA RAID 2008

- Transition to PM DCGS-A
- Integrated with DMFWS v3.1

- An **R&D Program of Record** chartered by the CG, RDECOM and the Army Acquisition Executive
- Conducts **integrated Live, Virtual, and Constructive** technology demonstrations
- Provides technology maturity **evaluation and assessment services** to R&D and POR's
- Employs a **state-of-the-art instrumentation, data collection & reduction (IDC&R)** tool suite that supports the quantification of vertical and horizontal SoS & Network Centric Warfare activities
- Employs **SoS Engineering and Integration** methods that promote **rapid SoS reconfiguration** and enable repeatable assessments
- A proven **Technology Transition Venue**

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Trial Run Daily Battle Rhythm



Technical

Operations

0800

Systems Preparation

Morning Brief (0800)

0830

Systems Ready

Issue Order

0930

Technical Support

Trial Run 1 (0830-1200)

1200

Systems Re-set

Operations Re-set

1300

Systems Ready

1430

Technical Support

Trial Run 2 (1300-1630)

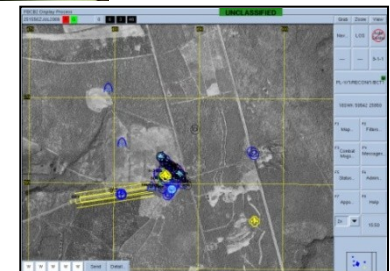
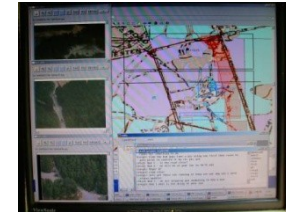
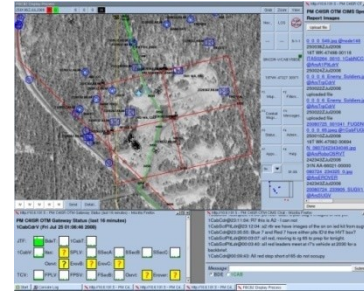
1600

Data Harvesting

1700

System Shutdown

AAR










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Technology Demonstrated



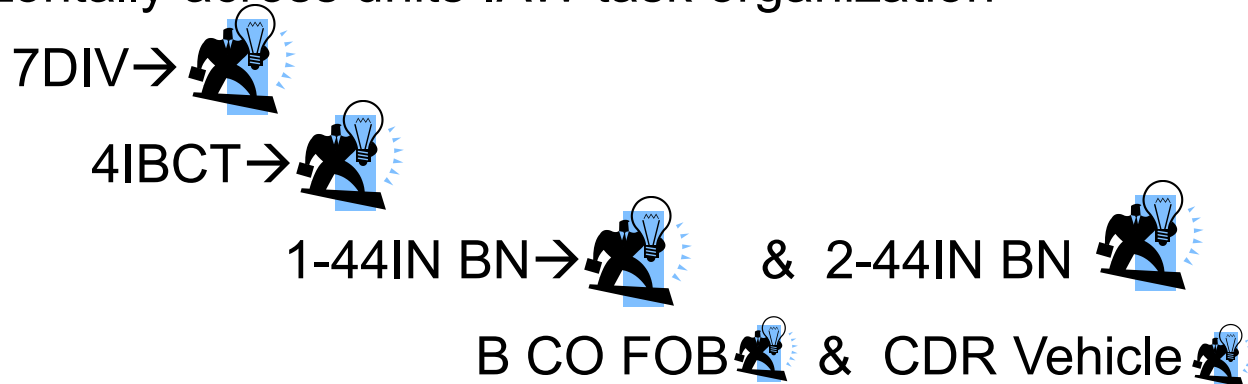
-  An open-system / Government open-source Managed-objects Intelligent Agents and Web Services enabling automation in support of Mission Command Data-to-Decisions threads
-  Highly modular scalable heterogeneous intelligent agents Frameworks
-  Harmonized C2 products with common contexts and domain objects to reduce user workload, human errors and duplication of effort among collaborating users and services
-  Enabled integrated Army-wide, Joint, Inter-Government, Inter-agency and Coalition interoperability using shareable data and shareable services.
-  Reduced time from receipt of higher HQ OPORDs to transmission of own HQ OPORDs.
-  Common intelligent seamless information management and dissemination to the tactical edge
-  Improved support to data filtering, fusion and transformation (FFT)
Improved situation awareness, assessments and understanding.



Employment in C4ISR & Net Modernization E11



- ❖ Provided the means to create, initialize, collaborate and issue plans and orders for execution vertically and horizontally across units IAW task organization



- ❖ Provided the means to visualize, filter, aggregate and share information with Current Force ABCS environment (JCR and CPOF) for execution monitoring at all live C2 locations.



Demonstrated maturity of advanced concepts and SW implementations at TRL 6 using realistic operational settings



Observed users in charge using SW in an operational context



Obtained performance measures using a realistic communications infrastructure to include JTRD(SRW) and Satellite



Enabled opportunity of assessments of integration with other advanced technologies involved in Data-to-Decision applications:

C2MINC/3G

CERBERUS

EBAL

Biometrics

TUGS

UAS



C2 Managed Object Library (C2MOL)

for Net-Centric Information and Knowledge
Management and Dissemination including
Data-to-Decision C2 Applications using
Intelligent Agents and Service-Oriented Architectures

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C2MOL



- The C2MOL is a consolidation of contributed ideas from participating C2 applications developers
- Reduce duplication of effort by creating the synergism essential to develop a SW library of coherent, consistent and comprehensive SW Objects in Java and C++
- Harmonized to comply with existing message, display, database standards and Application Program Interfaces (APIs) extensible to compatible interim non-standard specifications that are required to support new capabilities.



C2MOL Objectives



- High quality, open source message parsers
- Extensible ontology, translation framework
- Reusable in the context of Army, Joint and Coalition applications



C2MOL Motivation



- Software systems need to process common message formats to operate in a modern networked environment
 - Time, effort, and money are wasted when multiple contractors each duplicate the work of interfacing with these common formats
 - A well documented, open source implementation could quickly pay for itself
 - Reduce integration difficulties stemming from incompatible implementations



- There will always be new message formats
 - No one schema can meet the needs of all stakeholders
 - No one schema can anticipate all future requirements
- Many message formats represent common objects
 - Position/spot reports, graphical control features, imagery, etc
 - Parsers should share code and simplify translation of these common objects



C2MOL Goals



- Build and publish message parsers
 - Popular message formats that lack good software support
 - Popular programming languages
- Good documentation exists for most widely used message formats
 - Embed this documentation and make it easily available to developers
- Rigorous test suite



C2MOL Goals (cont'd)



- Define mappings between objects in two or more common message formats
- Develop extensible framework to translate parsed messages from one format to another leveraging the ontology mappings
 - Exploit transitive properties to minimize duplicated effort
- Follow an open governance model
 - Make it easy for 3rd parties to add support for additional message formats



Leverage Lessons Learned (e.g. TITAN)



- TITAN was an Army Technology Objective 4 Year program focused on information management and dissemination for command and control
- Leverage intelligent agent and web service technologies
- Focus on interoperability
 - Existing programs of record
 - Other research systems
 - Joint and coalition systems



- Ten contractors building agents and services
- Common set of object bindings
 - Message parsing and validation
 - Enforce business rules
 - Shared application objects
- Eliminated large amounts of duplicated effort
- Improved integration between components



Translation



- Need to interact with many different message formats and APIs
 - prdC2, JVMF, CoT, JC3IEDM, MIP, etc
- Developed several translation components
 - Difficulty sharing code
- Messages that were translated multiple times often lost data
 - Representation mismatches
 - IED vs. Boobytrap vs. IED explosion 'event' vs. Landmine...
 - Message provenance
 - Sender (person/time/system), free text comments



Conclusions



- C2MOL has the potential for significant cost savings by
 - eliminating large amounts of duplicated effort
 - Development costs
 - Testing and integration costs
- C2MOL will enable R&D by enabling coexistence of existing, evolving and non-standard objects.
- C2MOL was successfully implemented in the TITAN ATO and is scalable to many more C2 Standards and developers similar to other Open Source efforts