Combat Vehicle R&D- Networks

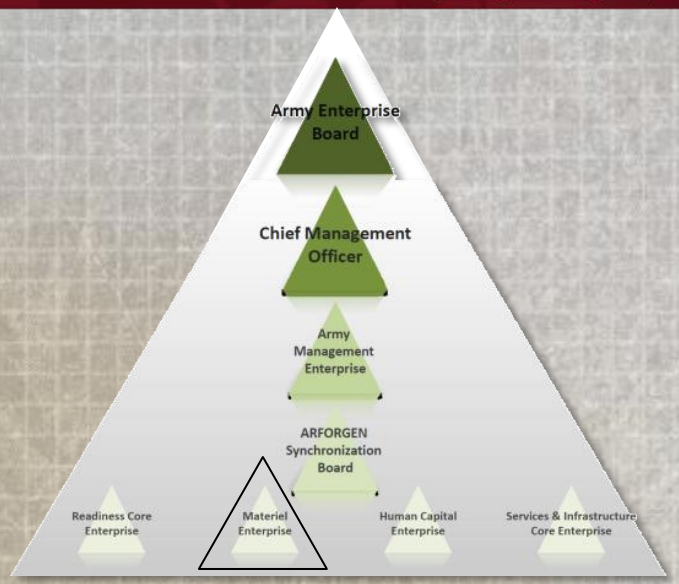
Tank Automotive Research,
Development & Engineering Center
Mr. Magid Athnasios, Executive Director of Engineering

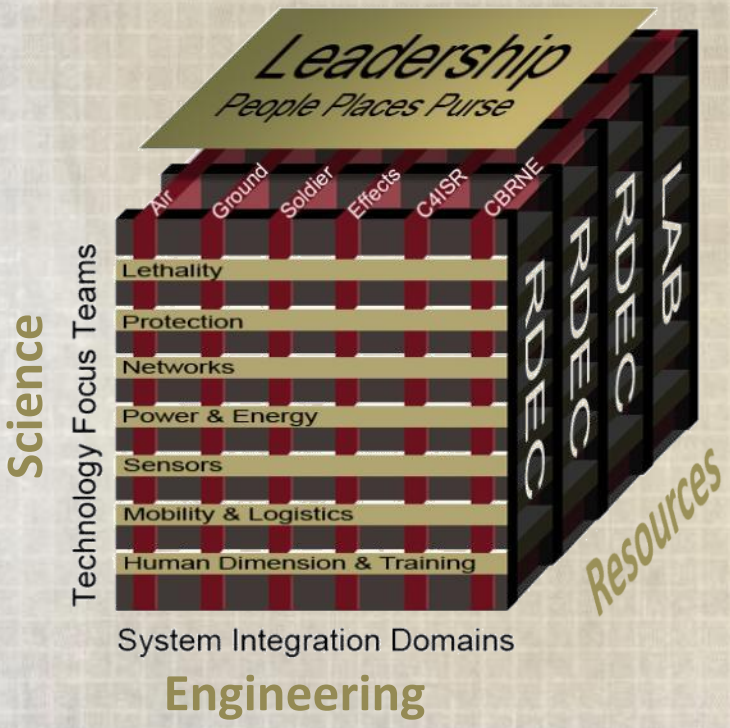
It's All About the Warfighter

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

RDECOM Integration Construct

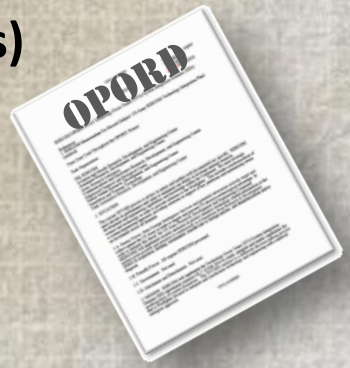
- **Vertical:** System Integration Domains
- **Horizontal:** Technology Focus Teams



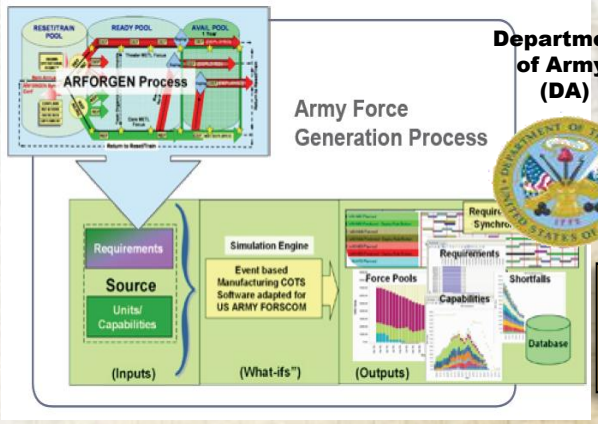


Approach

- **Task Organized**
- **Total Asset Visibility (5Ps)**
  - People
  - Places
  - Purse
  - Processes
  - Products



Ground Systems Integration Synchronization of Data



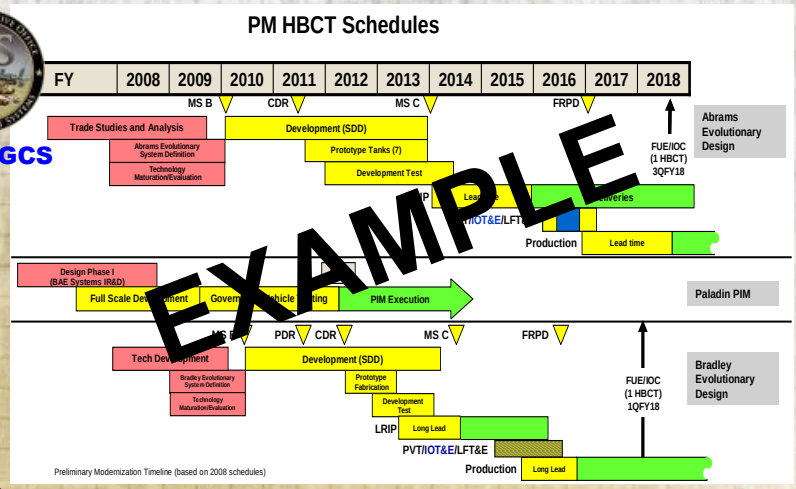
Department of Army (DA)

War Fighter Objectives

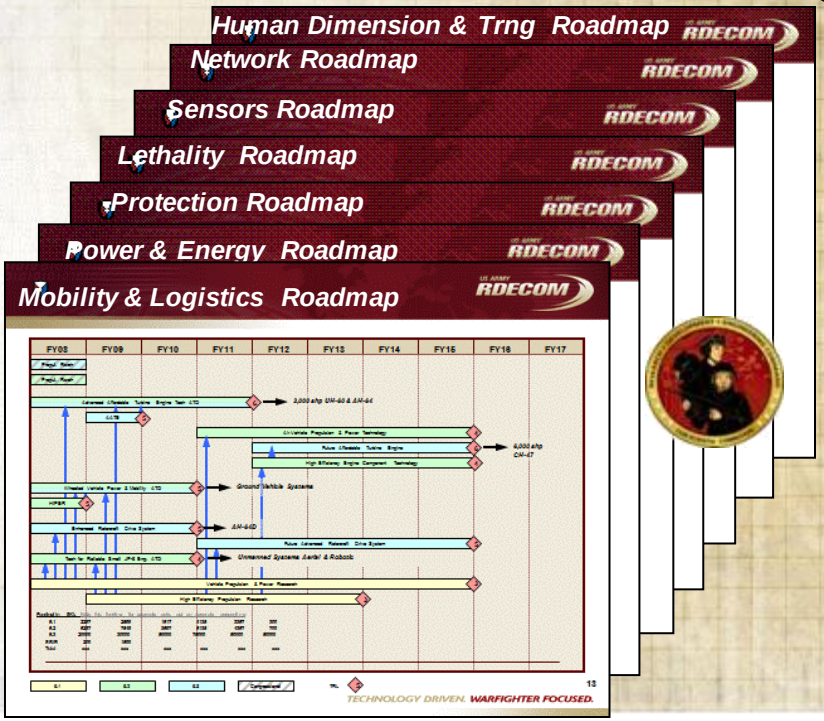
Joint Vision 2020

ONS JUONS

PEO GCS



EXAMPLE



Ground Systems Integration Domain Synchronized Views

- Capability Based
- Time Opportunity Based
- Resource Based

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Ground Systems Enterprise

Research, Development and Engineering Command (RDECOM)

Army Research Laboratory (ARL)

Armament Research, Development and Engineering Center (ARDEC)

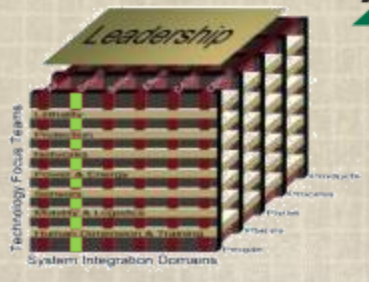
Aviation and Missile Research, Development and Engineering Center (AMRDEC)

Edgewood Chemical and Biological Center (ECBC)

Natick Soldier Research, Development and Engineering Center (NSRDEC)

Simulation and Training Technology Center (STTC)

Communications-Electronic Research, Development and Engineering Center (CERDEC)



Department of the Army (DA)

Army Materiel Command (AMC)

(ASA(ALT))

TACOM LCMC

PEO Integration

ILSC

Contracting Center

Industrial Base

PEO GCS

PEO CS&CSS

PEO Soldier

JPEO CBD*

* DOD Reporting

Reach back to over 8,500 Scientists and Engineers

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Ground Vehicle Areas of Technical Expertise

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Engineering Core Competencies

Sustainment, Standardization, Transportability & Recovery
- Sustainment Requirements Development (OMA, AWCF, SSTS)
- Standardization
- Towing and Recovery
- Qualified Products List (QPL)
- Secondary Item Engineering
- System Improvement and Integration
- * Transportability
- Parts Commonality

Industrial Base, Manufacturing, Logistics & Value Engineering
- Industrial Base Engineering
- Manufacturing Engineering / MRA
- Cost Reduction (VE, OSCR, TOCR)
- DLA Support
- Logistics Engineering
- Engineering Project Management

Security Assistance, Materials, Environmental & Corrosion
- Environmental Management
- Corrosion Prevention and Control
- Materials Engineering
- Welding, Fastening and Adhesives
- Security Assistance Support
  * Weight Management

Software Engineering Center
- Software Development
- Software Acquisition & Management
- Tactical Systems Information Assurance
- Software Engineering & Support

Product Life Cycle Data Management
- Configuration Management
- CAD / Model Based Engineering
- Secondary Item Data Management

RAM, Test, Quality & Tire Engineering
- Quality Assurance
- RAM
- Test
- Tire Engineering

Systems Engineering Group
- * System Architecture Design
- Risk Management
- SE Planning
- Technical Assessments & Reviews
- SE Requirements Engineering

Systems Engineering Implementation for Electronics & Software

Full System Lifecycle Support






Systems Engineering Processes

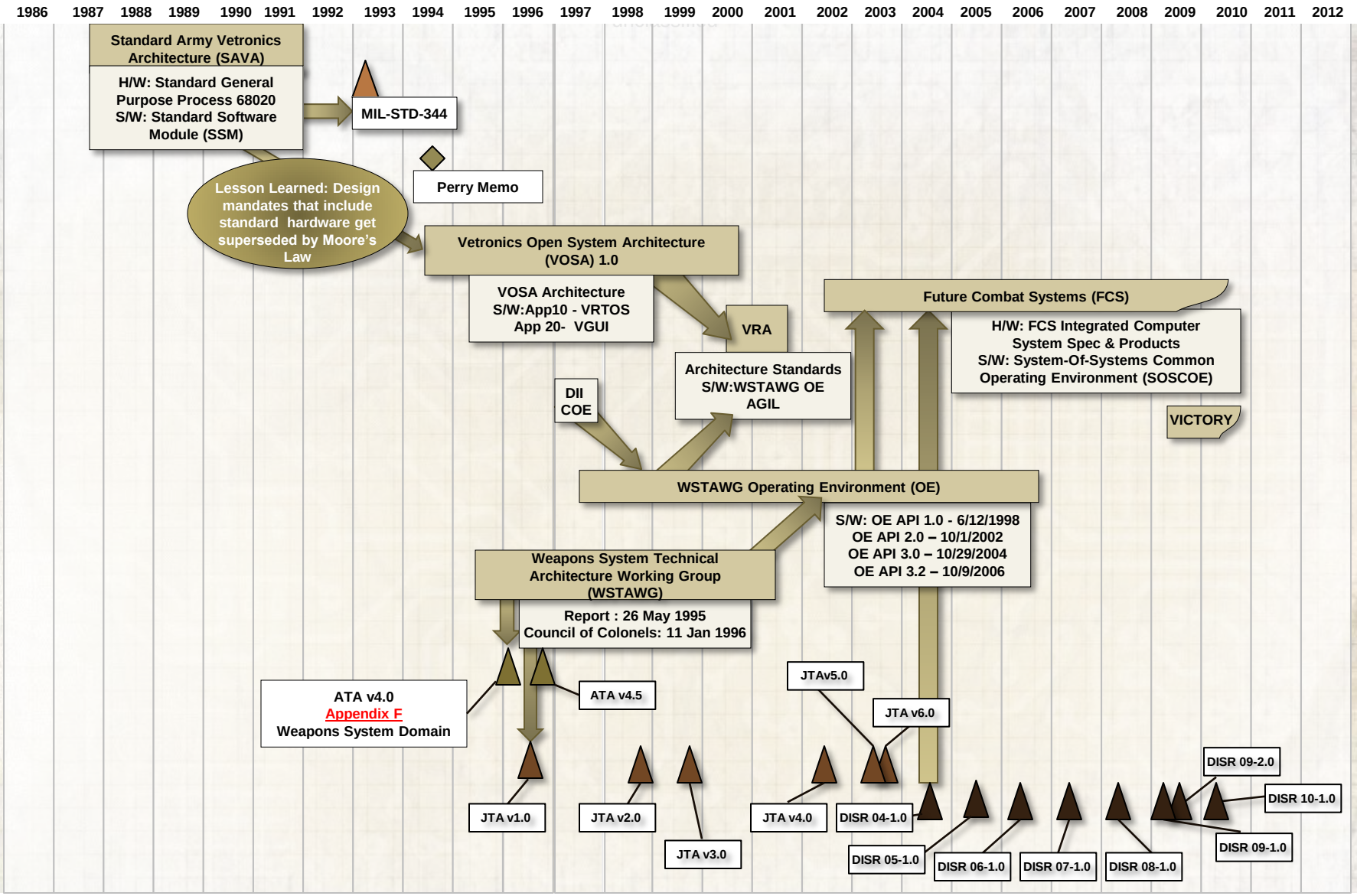
Requirements	Architectures & Standards	Software Development	System Integration	Testing	Field Support	Sustainment

Supporting the Current Force

Enabling the Future Fight

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

History of Past Architecture Efforts



Legend:

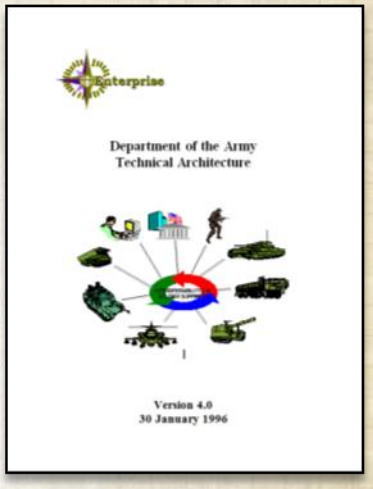
- Military Standards (MIL STD)
- -Army Technical Architecture (ATA)
- - Joint Technical Architecture (JTA)
- - DoD Information Technology Standard (DISR) published by Defense Information Systems Agency (DISA)

Defense Information Infrastructure Common Operating Environment (DII COE)

Vetronics Reference Architecture (VRA)

Hardware (HW)
Software (SW)

Technical Architecture Standards



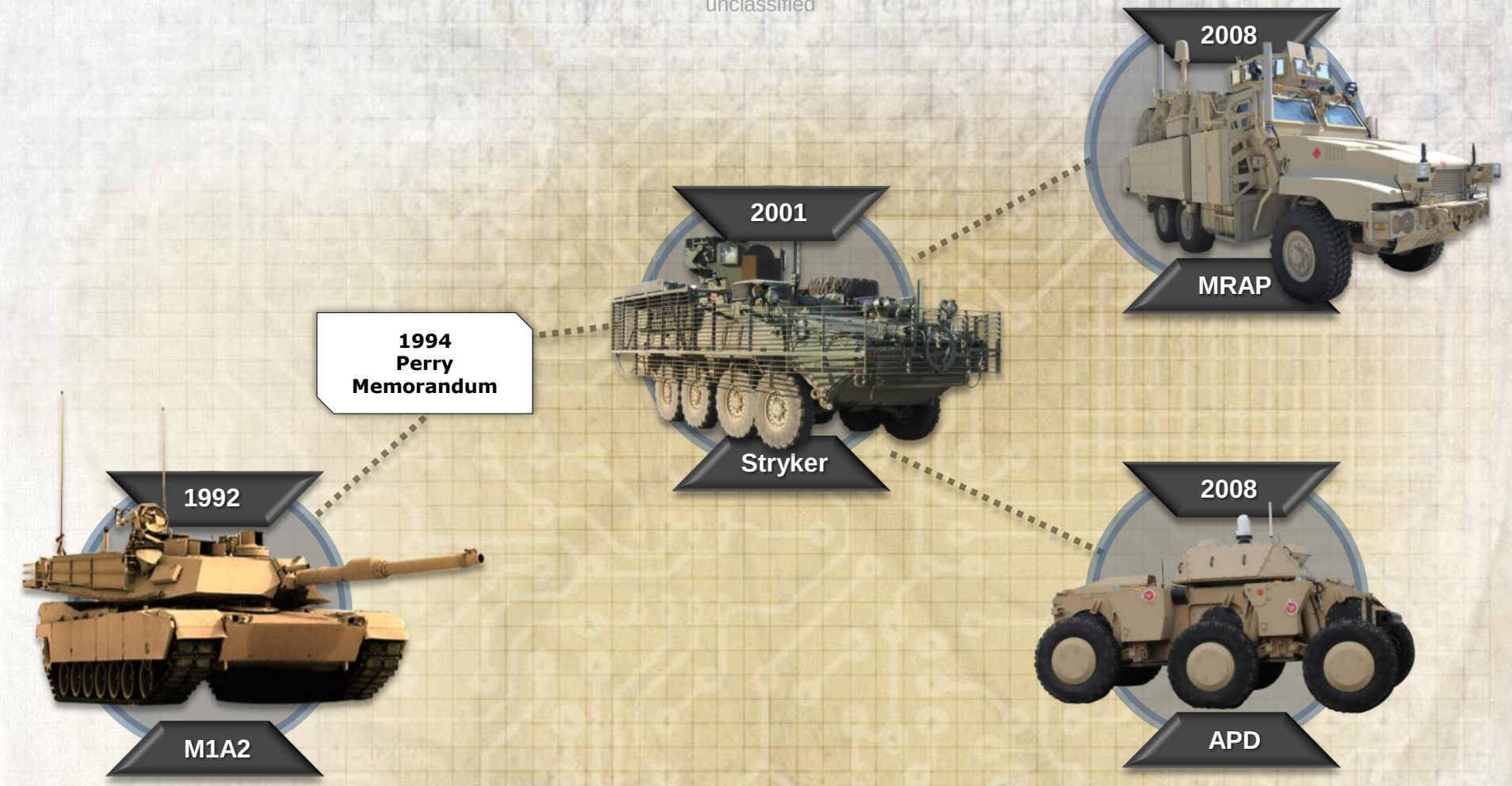
Army Technical Architecture (ATA)

Joint Technical Architecture (JTA)

DoD Information Technology Standard (DISR)

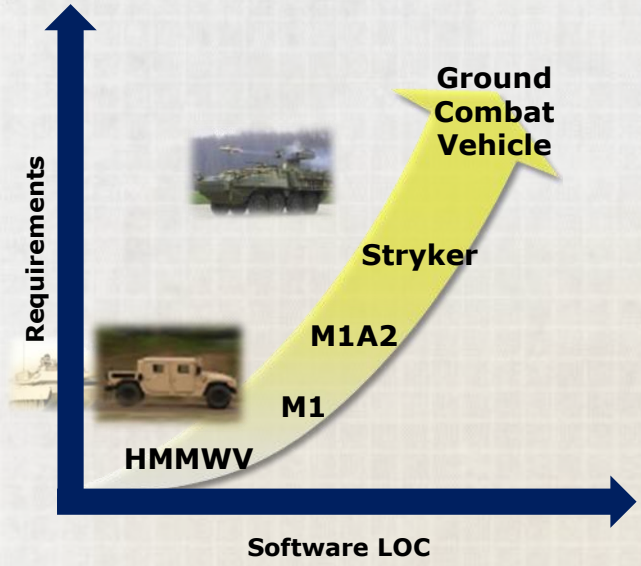
VEHICULAR INTEGRATION FOR C4ISR/EW INTEROPERABILITY (VICTORY) SPECIFICATIONS

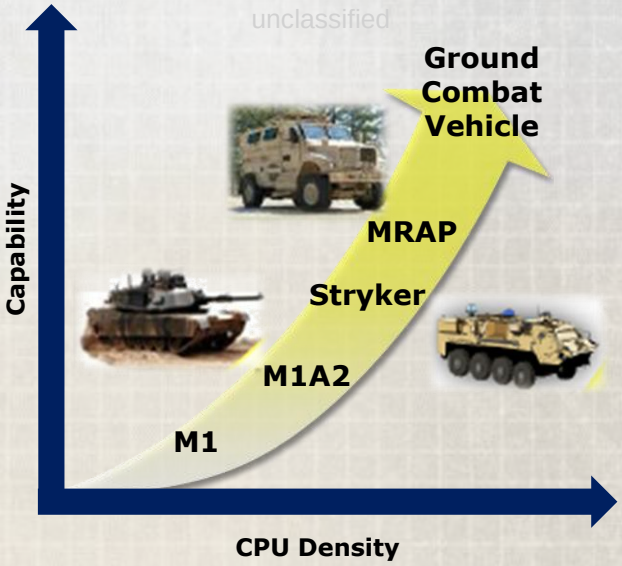
Electronics Evolution



The need for increasing Command & Control functionality has driven the need for more COTS

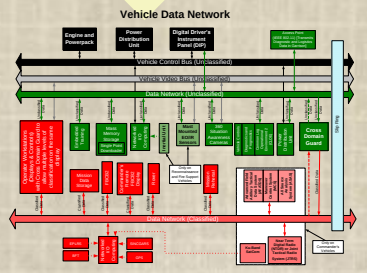
Trends In Vehicle Electronics & Software





Increasing Demands and Operational Flexibility Require Strategic Investments in Key Areas

Vehicle Networks



Architectures

Computers

Software

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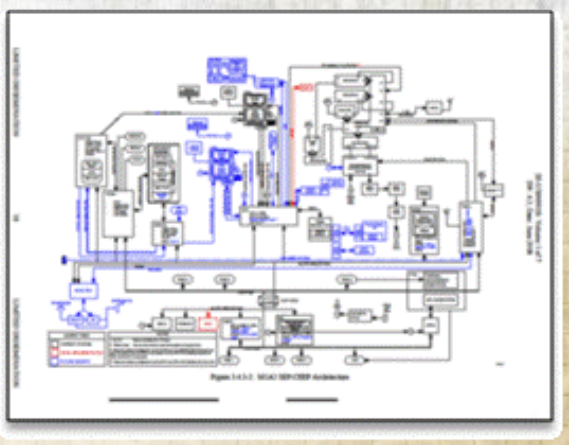
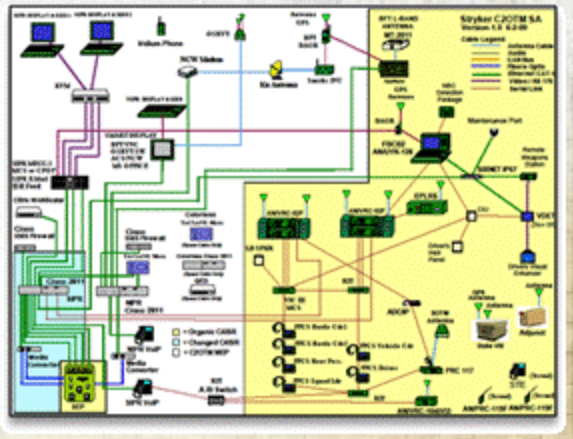
M1A2 Abrams Tank



- **MIL STD 1553-based Architecture**
- **SINCGARS Radios**
- **Digital Command, Control and Communications Capability**
- **Max Speed -** 42 mph (Governed)
- **Power/Weight Ratio -** 21.6 hp/ton
- **Vertical Obstacle -** 42 in
- **Ground Clearance -** 19 in
- **Gross Vehicle Weight -** 69.54 ton
- **Overall Length (Gun Forward) -** 387 in
- **Overall Width -** 144 in

1553 tightly coupled bus schedule

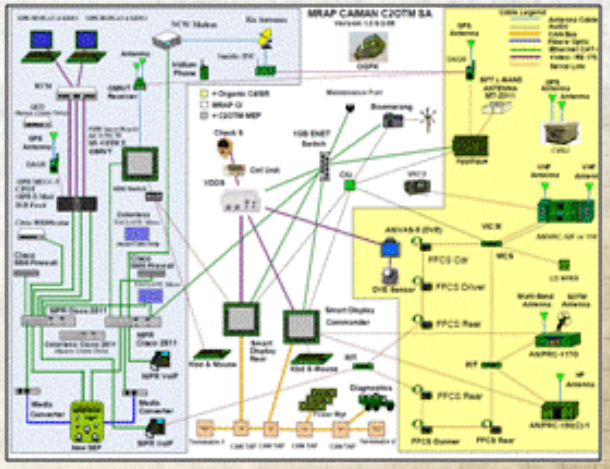
Stryker C2OTM



- **Ethernet**
- **Enhanced Position Location and Reporting System (EPLRS) Radios**
- **Extensive COTS Integration**
- **Max Speed -** 62 mph
- **Max Trench Crossing -** 6.5 ft
- **Gross Vehicle Weight -** 18.12 ton
- **Overall Length -** 275 in
- **Overall Width -** 107 in

First use of Ethernet as an interface to C2 systems

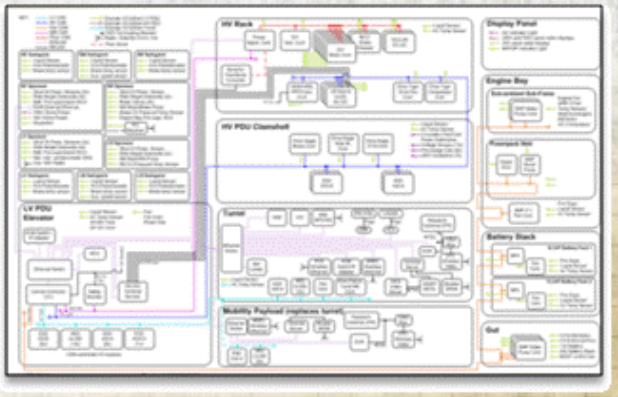
MRAP

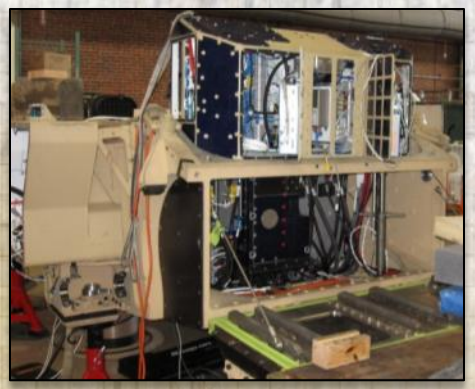


- Gigabit Ethernet Backbone
- Data Radios and Satellite Communications
- 19” COTS Multifunction Smart Displays
- Power Management
- Video Distribution
- Max Speed - 65 mph (Governed)
- Gross Vehicle Weight - 23 ton
- Overall Length - 257 in
- Overall Width - 102 in

Extensive use of Ethernet & COTS equipment

Autonomous Platform Demonstrator (APD)





- **Multiple CAN Busses & Gigabit Ethernet** (GbE)
- **COTS Data Radios – 802.11 Based**
- **Extensive COTS Components**
- **Max Speed -** 50 mph
- **Generator Output -** 197 hp
- **Battery Energy -** 21.8 kW-hr
- **Battery Max Power -** 282 hp
- **Power/Weight Ratio -** 112 hp/ton
- **Peak Torque -** 41,368 ft-lb
- **Vertical Obstacle -** 39 in
- **Trench -** 39 in
- **Fording -** 20 in
- **Gross Vehicle Weight -** 9.3 ton
- **Overall Length -** 182 in
- **Overall Width -** 98 in

Multiple CAN busses & Gigabit Ethernet as vehicle backbone

Key Considerations for Vehicle Electronics & Software

Collaboration

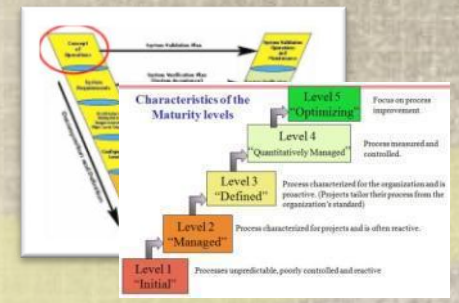
Standards & Requirements

Commonality

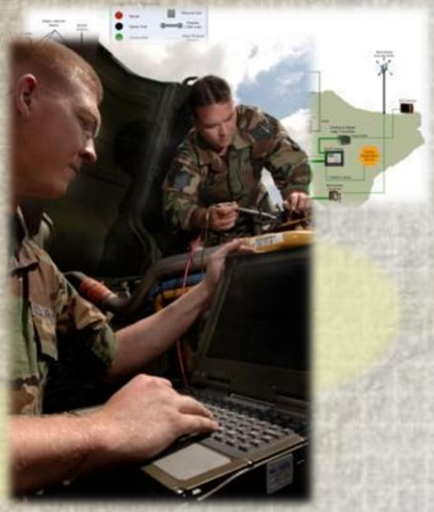
Architectures

System Integration Laboratories

Systems Engineering & CMMI



Sustainment



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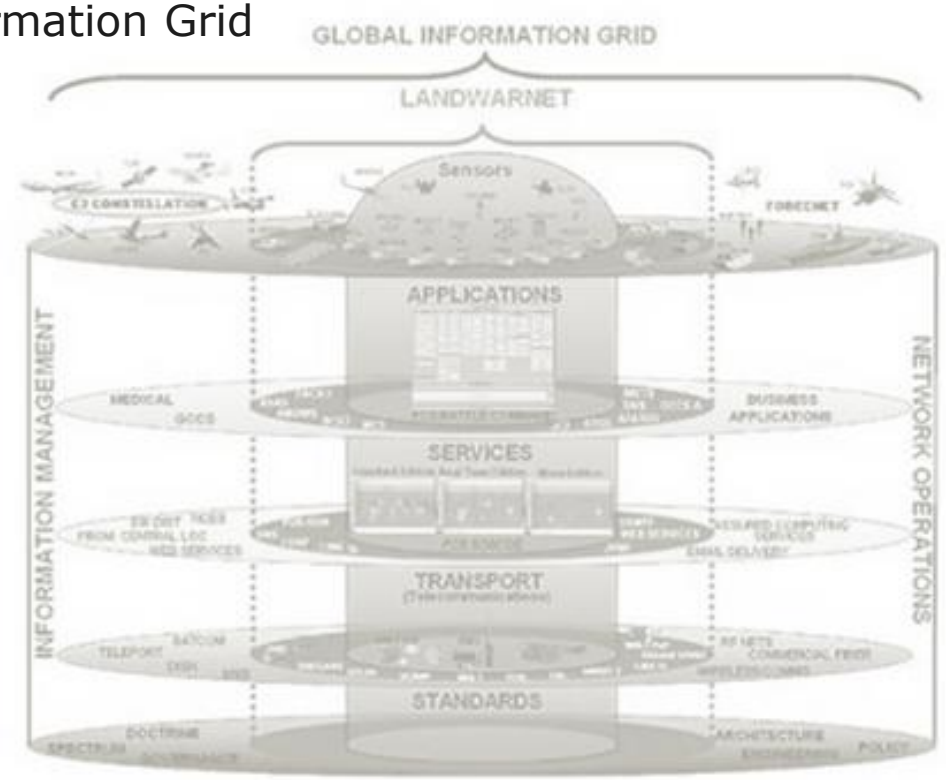
Future Trends

- Vehicle backbones will be based on 10 Gigabit Ethernet (GbE).
- Increase use of software Application Programming Interfaces (APIs).
- Need for increased radio throughput (10 megabyte/sec).
- Global Information Grid



We need to get Ethernet level throughput via radio networks if we want to get truly connected

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BACK UP

Ground Vehicle Integration Center
Electronics Integration

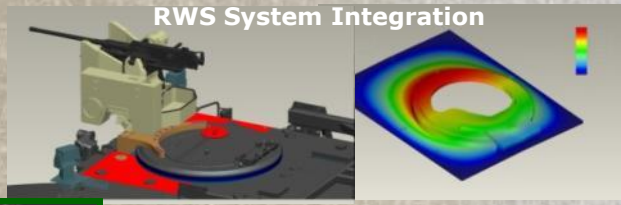
Description

- Leverages RDECOM and DoD capabilities in a repeatable process to apply rigorous systems engineering to ground systems integration
- Provides customer partners a single entry point for cost, schedule, performance and risk management of system integration projects

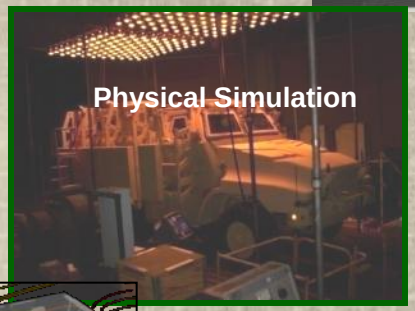

Updated Architecture

Accomplishments

- Accelerated Remote Weapon Station Integration with ARDEC for the Caiman, MaxxPro and RG-33 systems
- Completed Full Capability Insertion Integration for Caiman Systems


RWS System Integration

Employs TARDEC organic Concepts, Analysis, Systems Simulation and Integration (CASSI), System Engineering (SE), Prototype Integration Facility and significant contributions from other RDECs and Organizations


Physical Simulation

MRAP Capability Insertion

- **Vanguard** (ARDEC)
  - —CROWS II RWS (ARDEC)
  - —Boomerang **(**ARDEC)
  - —Double Shot **(**ARDEC)
- **OGPK Overhead Protection** (ARDEC effort)
- **LRAS3**
- **Check 6 Camera**
- **Overhead Wire Mitigation**
- **IBIS TEK Lights**
- **RPG Protection**
- ***Power Upgrade (derived requirement)***
- ***C4I Architecture (derived requirement)***
- **Thrown Object Protection System**

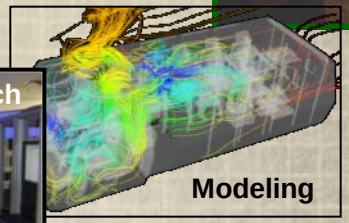
GVIC Projects :

- *MRAP Capability Insertion*
- *C2OTM* – MRAP*
- *C2OTM* – Stryker*
- *LAV-R Upgrade*
- *RS-JPO*

*Command & Control On The Move


User Jury


C4 Integration Bench


Modeling

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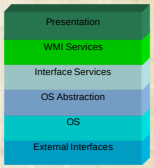
DB Overview – What is Digital Backbone

- The Digital Backbone is an architecture, with a set of C4ISR components, and Software that integrates communications, navigation, C2, video and other on-board electrical/digital systems into a common environment for enhanced user operation and local Situational Awareness.

- Digital Backbone components are common across MRAP FoV
  - 2 Smart Displays 
  - High Speed Network 
  - Video and Data Distribution/Processing 
  - Power Management 
  - Software 

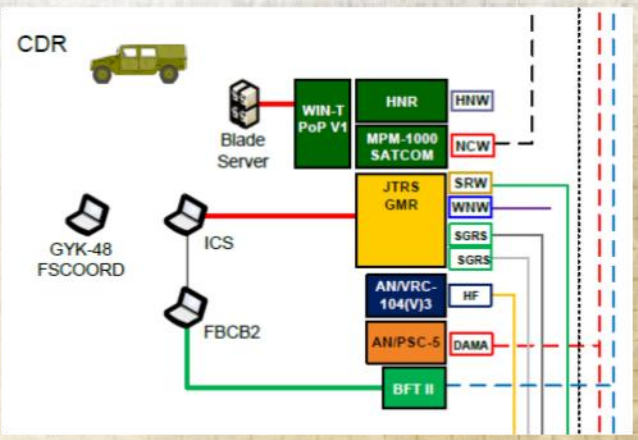
Digital Backbone Features

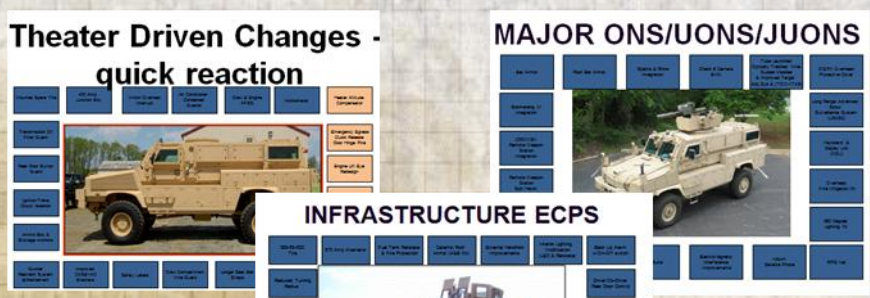
- Modular and open to manageable competitive configuration item level
- Scalable Software defined as services for applications and support
- Well defined and limited dependencies between components of software, hardware, and software to hardware
- COTS based at the component level
- User access to all functionality with common look and feel
- User task sharing/collaboration enabled and redundant back up
- Initial BIT and CBM concepts

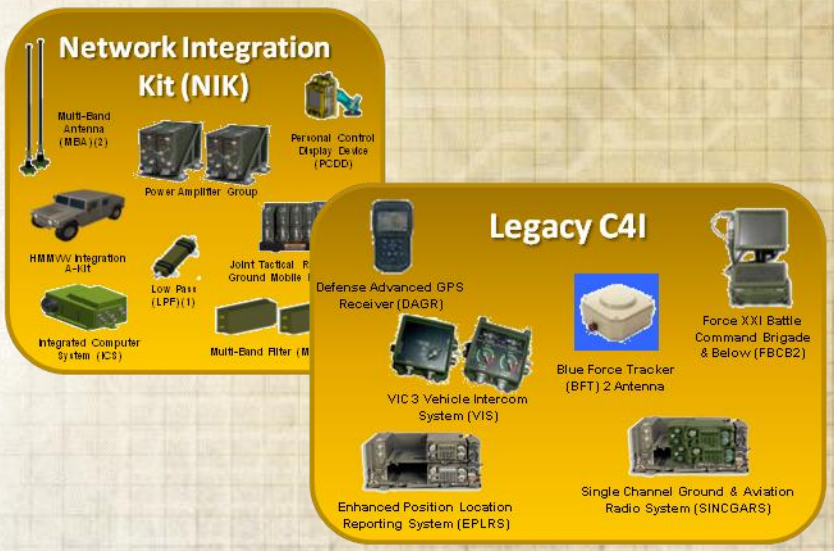
- Digital Backbone enables future capability insertion further forward with reduced SWaP

Capability Package (CP) 11-12 Integration

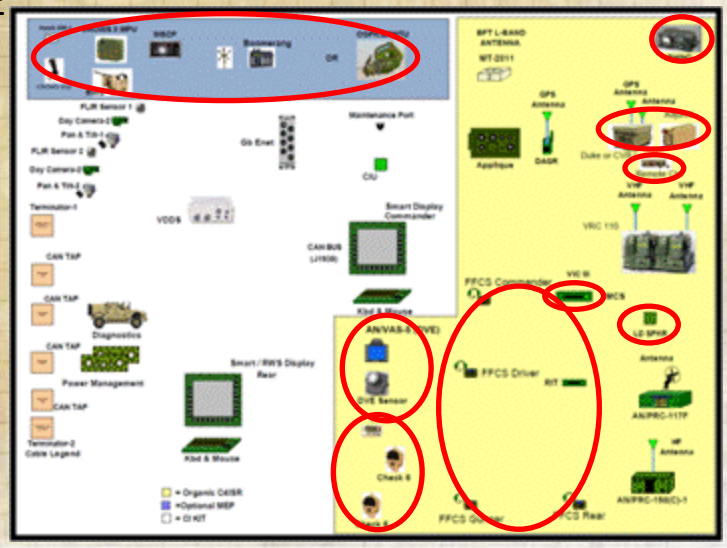
CP 11-12







TPE



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