ASA(ALT) System of Systems Engineering Processes

CMMI Technology Conference 16 Nov 2010

Implementation Strategy & the CMMI®

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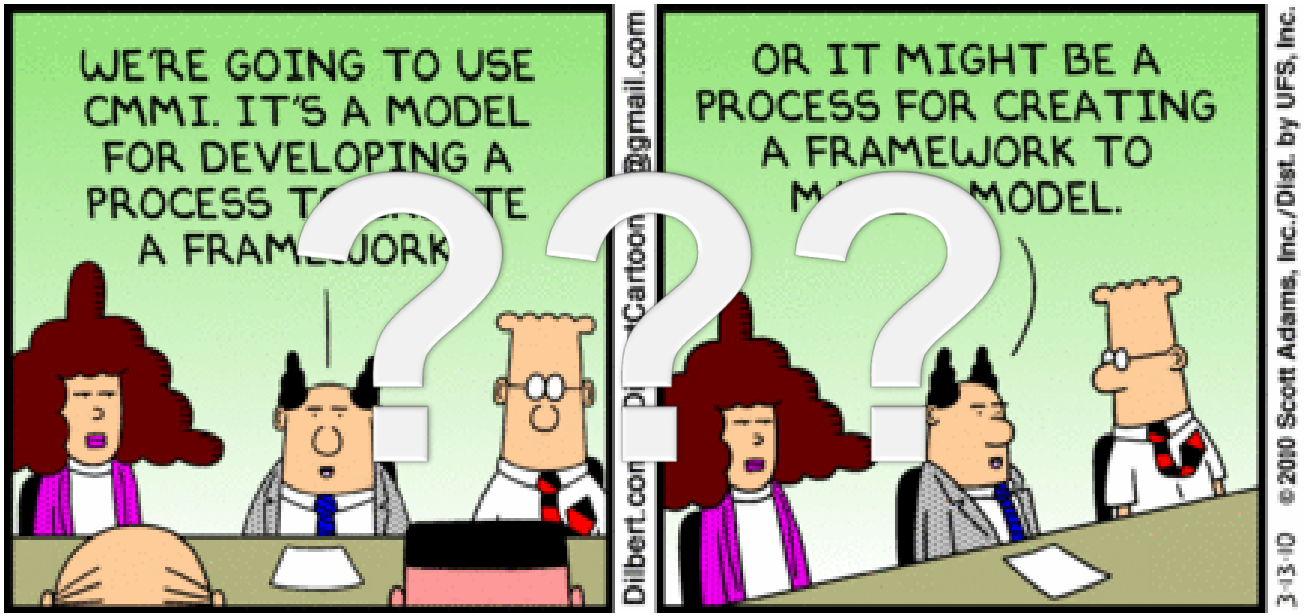
The Army's View of CMMI…



CMMI has arrived, and we have embraced it !!!

Strategic Environment

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- **Operational**
  - ➢ Persistent conflict,
  - ➢ Hybrid threats requiring hybrid solutions
  - ➢ Advanced/improvised technologies targeted against the warfighter

- **Budget**
  - ➢ Pressure to cut defense & other spending
  - ➢ Topline base budget expected to have modest, but steady growth
  - ➢ "Do more without more"
  - ➢ Reduce lifecycle-costs

- **Army Modernization**
  - ➢BCT-centric
  - ➢Buy fewer, more often
  - ➢Incremental fielding of capability thru ARFORGEN

- **Acquisition Reform**
  - ➢Increased competition throughout acquisition process
  - ➢Reduced tolerance for cost/schedule risk
  - ➢Revised Milestone certification reqs
  - ➢Foster innovation

System of Systems Engineering (SoSE) – Environment

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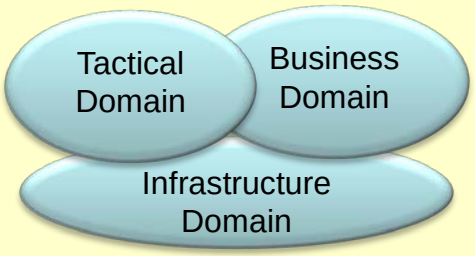
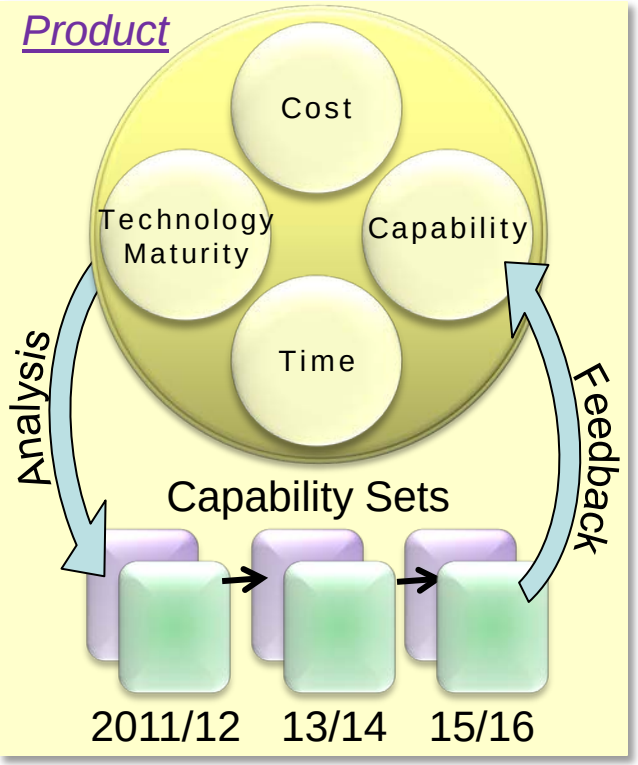
Scope



Mission

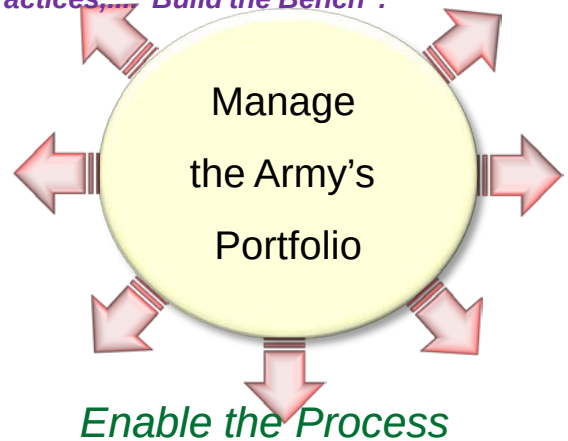
The Mission of ASA(ALT) SOSE:
Provide the Army's leadership and materiel developers with the necessary engineering/architectural products to manage and shape the Army's materiel portfolio, to ensure a System Engineering discipline across the Materiel developer community throughout the acquisition life cycle and grow the System Engineering capability within the Army – through education, engineering policy, guidelines and adoption of best industry practices,…."Build the Bench".

Product



Build the Bench

- Organize the Army Engineering Community
- Establish Technical Authority and engineering expertise/capability
- Pursue accreditation and certifications of organic workforce & organizations



Create Data Transparency

- Establish CM and an authoritative repository for products
- Establish a collaboration environment
- Establish a common operating environment for engineering Products

Enable the Process

- Establish the engineering process to deliver synchronized capability
- Establish the analytical structure with models & simulations
- Establish the engineering compliance structure/process for acquisition execution excellence
- Deliver engineering support to HQ staff and acquisition community

Manage the Portfolio

- Support the prioritization of capabilities within the portfolio
- Set the baseline architecture roadmap over time
- Support the resourcing process
- Synchronize and align the S&T, systems integration, test, and certification activities

Ver. 2.7

Organizing the SoS Space

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ARMY ANALYTICAL FACTORY
G3/5/7 G8 G6 ASA(ALT) TRADOC & OTHER STAFF

LWN GOSC

AAE MilDEP

EXECUTIVE COUNCIL
DAS-M Chair PEOs

ENGINEERING OVERSIGHT COUNCIL (EOC)
SoSE Chair DPEOs

Acquisition Decision Authority

Configuration Steering Board

- PEO
- SoSE
- S&T
- INTEGRATION
- RDECOM
- FFRDC

AVIATION
MISSION COMMAND
FIRES/AMMO
TRANSPORT & NETOPS
SoSE Cross-IPT Integration WGs

NETWORK INTEGRATION
MISSION COMMAND INTEGRATION
INTEG BASE DEFENSE
PLATFORM INTEGRATION
JOINT COMBAT ID

Tactical Vehicle/ Sustainment
Ground Combat Systems
INTEL & SENSORS
SOLDIER
PEO TIER 2 SE GOVERNANCE

DOMAIN SE IPTs
Business
Chem / BIO
SIM & TRAINING

Authoritative Data Sources

Authoritative System Architectures

Acquisition Analysis

DESIGN * DEVELOP * DELIVER * DOMINATE

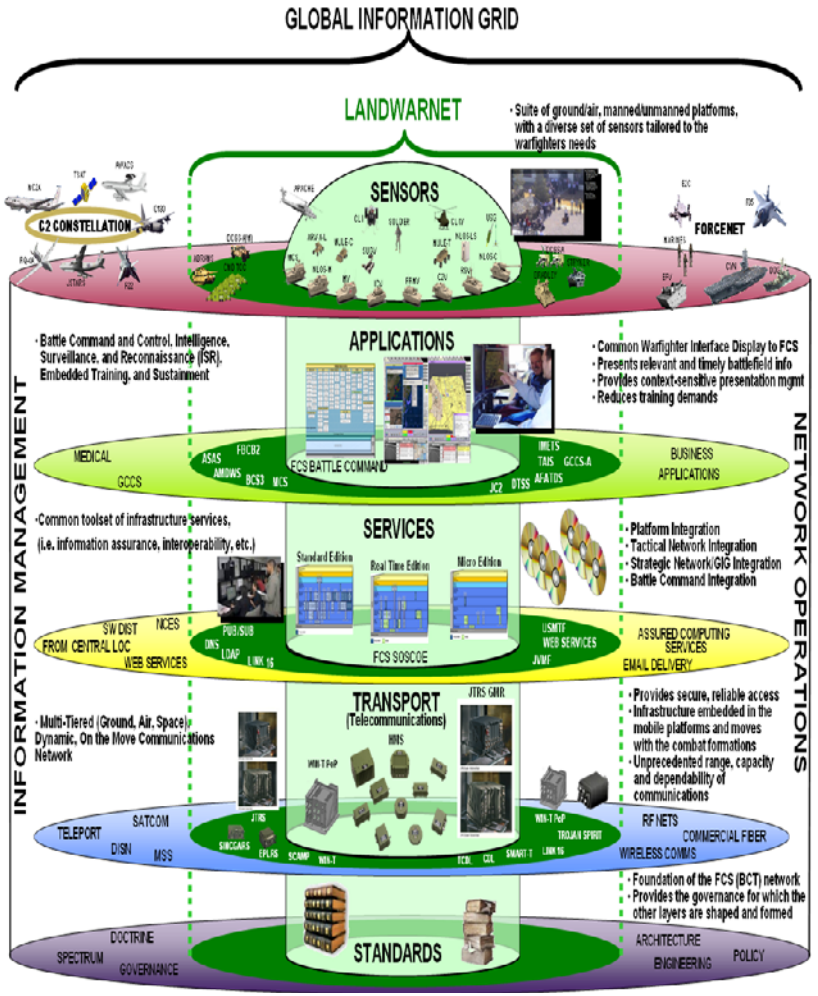
SoSE

The 'Network'

Typical 'Network' Layers
- Sensors
- Applications
- Services
- Transport
- Standards

Added
- Force Structure
- NETOPS

Applications & Services



"The Network is the singularly most important program to the Army"

-- GEN George W. Casey, Jr. 23 July 2010

Army Network – Enterprise View

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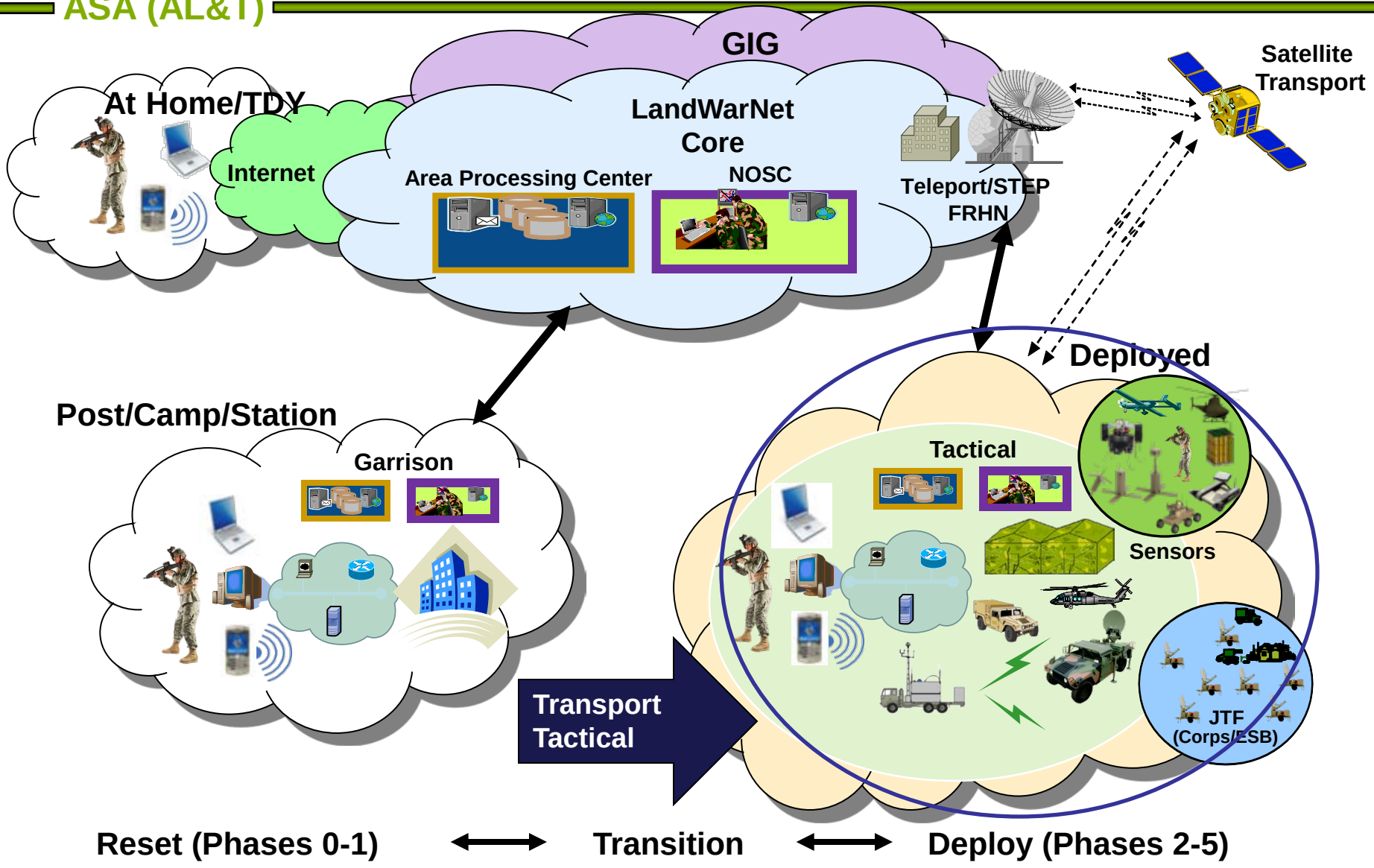

Always Accessible by The Soldier

COE Architecture Guidance

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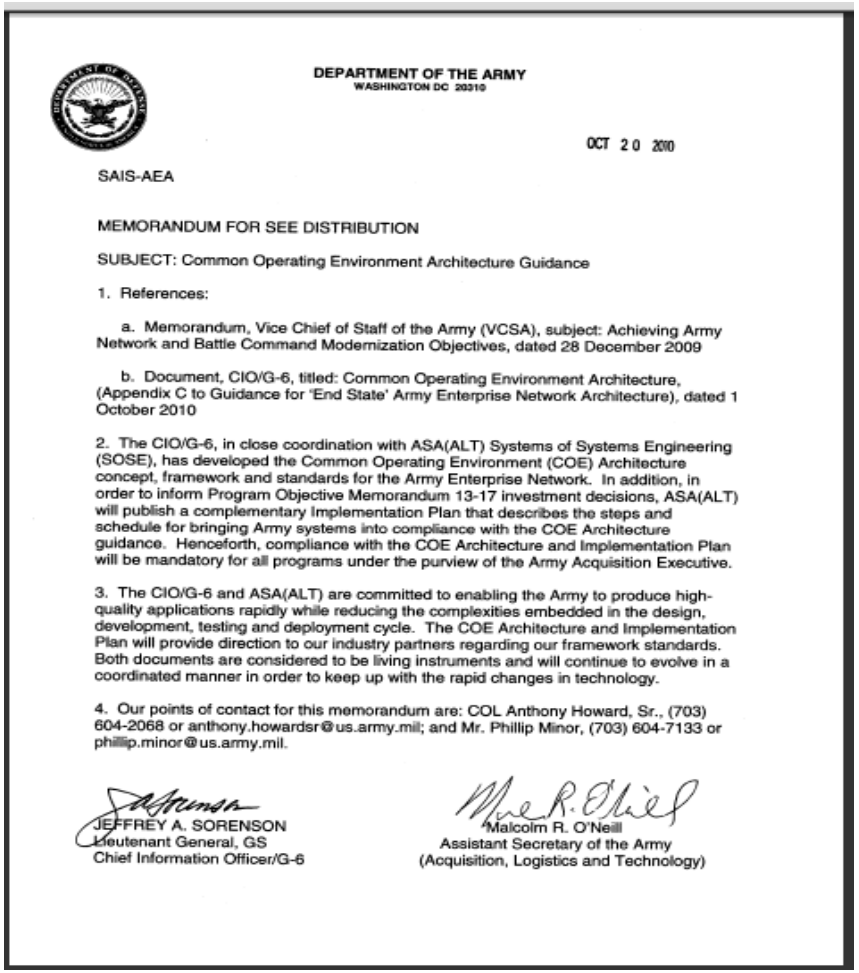


DEPARTMENT OF THE ARMY
WASHINGTON DC 20310

OCT 20 2010

SAIS-AEA

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Common Operating Environment Architecture Guidance

1. References:

a. Memorandum, Vice Chief of Staff of the Army (VCSA), subject: Achieving Army Network and Battle Command Modernization Objectives, dated 28 December 2009

b. Document, CIO/G-6, titled: Common Operating Environment Architecture, (Appendix C to Guidance for 'End State' Army Enterprise Network Architecture), dated 1 October 2010

2. The CIO/G-6, in close coordination with ASA(ALT) Systems of Systems Engineering (SOSE), has developed the Common Operating Environment (COE) Architecture concept, framework and standards for the Army Enterprise Network. In addition, in order to inform Program Objective Memorandum 13-17 investment decisions, ASA(ALT) will publish a complementary Implementation Plan that describes the steps and schedule for bringing Army systems into compliance with the COE Architecture guidance. Henceforth, compliance with the COE Architecture and Implementation Plan will be mandatory for all programs under the purview of the Army Acquisition Executive.

3. The CIO/G-6 and ASA(ALT) are committed to enabling the Army to produce high-quality applications rapidly while reducing the complexities embedded in the design, development, testing and deployment cycle. The COE Architecture and Implementation Plan will provide direction to our industry partners regarding our framework standards. Both documents are considered to be living instruments and will continue to evolve in a coordinated manner in order to keep up with the rapid changes in technology.

4. Our points of contact for this memorandum are: COL Anthony Howard, Sr., (703) 604-2068 or anthony.howardsr@us.army.mil; and Mr. Phillip Minor, (703) 604-7133 or phillip.minor@us.army.mil.

JEFFREY A. SORENSON
Lieutenant General, GS
Chief Information Officer/G-6

Malcolm R. O'Neill
Assistant Secretary of the Army
(Acquisition, Logistics and Technology)

- CIO/G-6 in close coordination with ASA(ALT) Systems of Systems Engineering (SOSE) has developed COE Architecture Guidance
- COE Architecture Guidance:
  - Defines the COE and Computing Environments
  - Describes the CEs architecture and services
  - Specifies COE principles and technical architecture standards
  - Details a maturity model for cost-benefit analysis trades and to evaluate programs' alignments with COE
- ASA(ALT) will develop COE Implementation Plan:
  - Inform Program Objective Memorandum (POM) 13-17 investment decisions
  - Identify the implementation strategy, time lines, effective dates and key milestones for moving Army systems to the COE

"Establishing 'left and right limits' . . .
Chiarelli Touts Common Operating Environment Architecture At AUSA
- By Tony Bertuca, Inside the Army, October 29, 2010

Army needs a Software "Eco-System"

Software Ecosystem defined as a set of businesses functioning as a unit and interacting with a shared market for software and services, together with relationships among them. These relationships are frequently underpinned by a common technological platform and operate through the exchange of information, resources, and artifacts – David G. Messerschmitt and Clemens Szyperski (2003). *Software Ecosystem: Understanding an Indispensable Technology and Industry*. Cambridge, MA, USA: MIT Press.

An Army Eco-System would need to provide:

- Improved agility
- Reduced life cycle costs
- Adaptability
- Means to address cyber threats

Realizing the Army Software Eco-System

Eco-System Realization: A Common Operating Environment (COE)

Common Operating Environment:

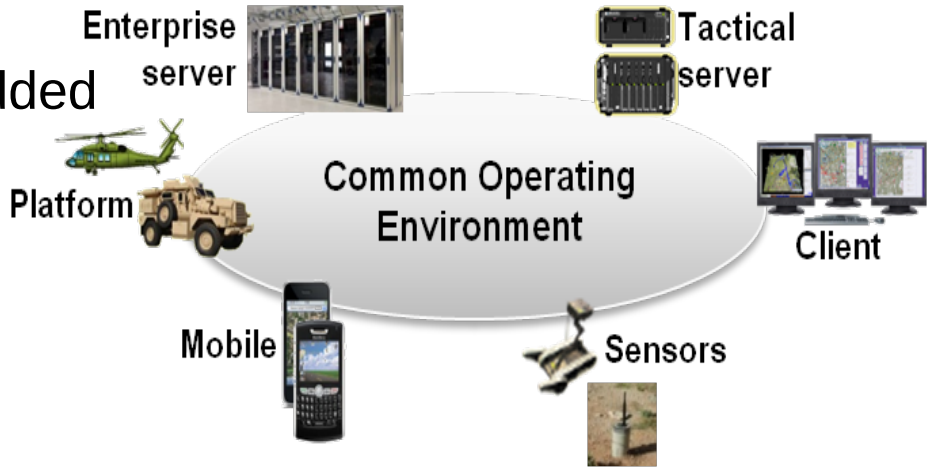
Automation services that support the development of the ***common reusable software modules*** that enable interoperability across multiple combat support applications. This includes segmentation of common software modules from existing applications, integration of commercial products, development of a common architecture, and development of common tools for application developers.

Dictionary of Military and Associated Terms. US Department of Defense 2005.

But, an Army COE Must

Operate across families of computing environments (CE):

- Data Center / Cloud
- Command Post
- Real-Time, Safety-Critical, & Embedded
- Mounted
- Mobile/Handheld
- Sensors



AND

- Improve agility: In development, acquisition & operations
- Reduce life cycle cost: In both new and legacy applications
- Be adaptable: To changing standards across all Army systems
- Address cyber needs: Keep pace with ever changing threats

Computing Environment Example

(Mobile Handheld)

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Data Center-CE/Command Post-CE

FaceTime | Email | App Store | XMPP | PKI | RSS | GRSS

Mobile Hand Held CE

NETOPS

App Usage

Remote MGNT

User-Specified Apps Could be PEO/PM purchased/developed
Could be User configured/programmed Could be unique unit service
LandWarNet 2010 Apps4Army

Standard Apps
Internet, Native, Hybrid, Web

Runtime Application Framework & SDKs — SDK — PDK=Standard set of core assets, APIs, libraries, product builders, documentation

Core Services /Data
Data Caching SVCs | Transmission SVCs | Ucore SVCs | Web Tech SVCs | Map SVCs | VME SVCs

Operating System — iPhone | ANDROID

CORE Physical

Ruggedized

Wearable
COTS
Capability

Peripherals

SECURITY

PKI

User-Logon

Data at Rest

Encryption

http://iase.disa.mil/stigs/checklist/index.html

Transport/transmission

PAN | Wi Fi | 3G | Tactical Cell

DELIVER *

DOMINATE

CE Relationships and Boundaries

Data Center-CE / Command Post-CE

FaceTime | Email | App Store | XMPP | PKI | RSS | GRSS | Map Imagery | UTO

Command Post - CE

DATA Center-CE

Enterprise App Store

Services

(Map, BlueForce, VMF)

Payload upload

Data Gateway Payload upload

SOAP, REST, KML, UCORE, VMF RSS, SMS

Platform-CE

Mounting, Power

Data Gateway payload upload

Wearable / Ruggedized / HYBRID

COTS

Android/iPhone

Mobile Hand Held CE

Function Objectives: Connect, Communicate, Collect,

Share, collaborate, local Situation Awareness

Sensor-CE

Heart beat monitor

Biometric capture

USB
Serial
Ethernet
WiFi
Blue Tooth
ZiGBE…..

COTs

Peripherals

Keypad, smart pen, visualization

Adaptability Game Changer

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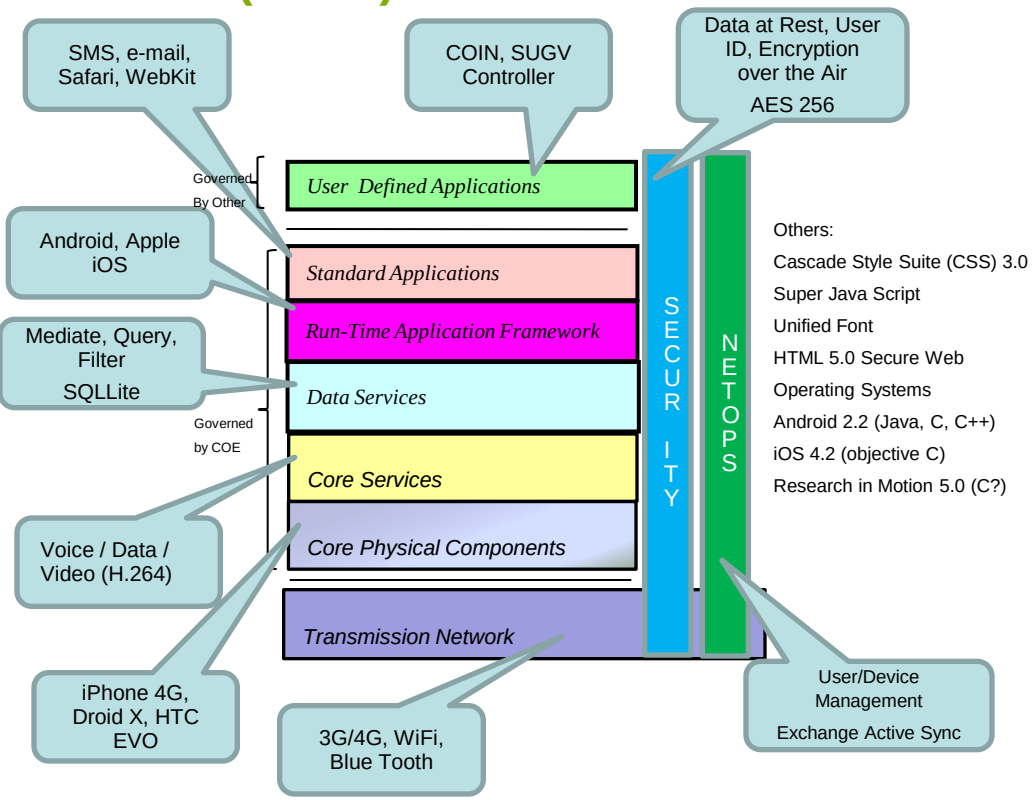


Adaptability Game Changer Attributes

- Provides ability to **access enterprise application store**
- Provides ability to **rapidly deliver** mission specific/soldier centric capabilities
- Provides the ability to let the soldier tailor **different applications, widget** to meet their function, task, condition, standard for mission success
- Enables **short release cycles** of functional capability (deployed as apps)
- Enables **flexible delivery of capability**
- Enables user or **3rd party contributions** of capability (through the Enterprise App Store)

Will a COE work?

It has to, because today…

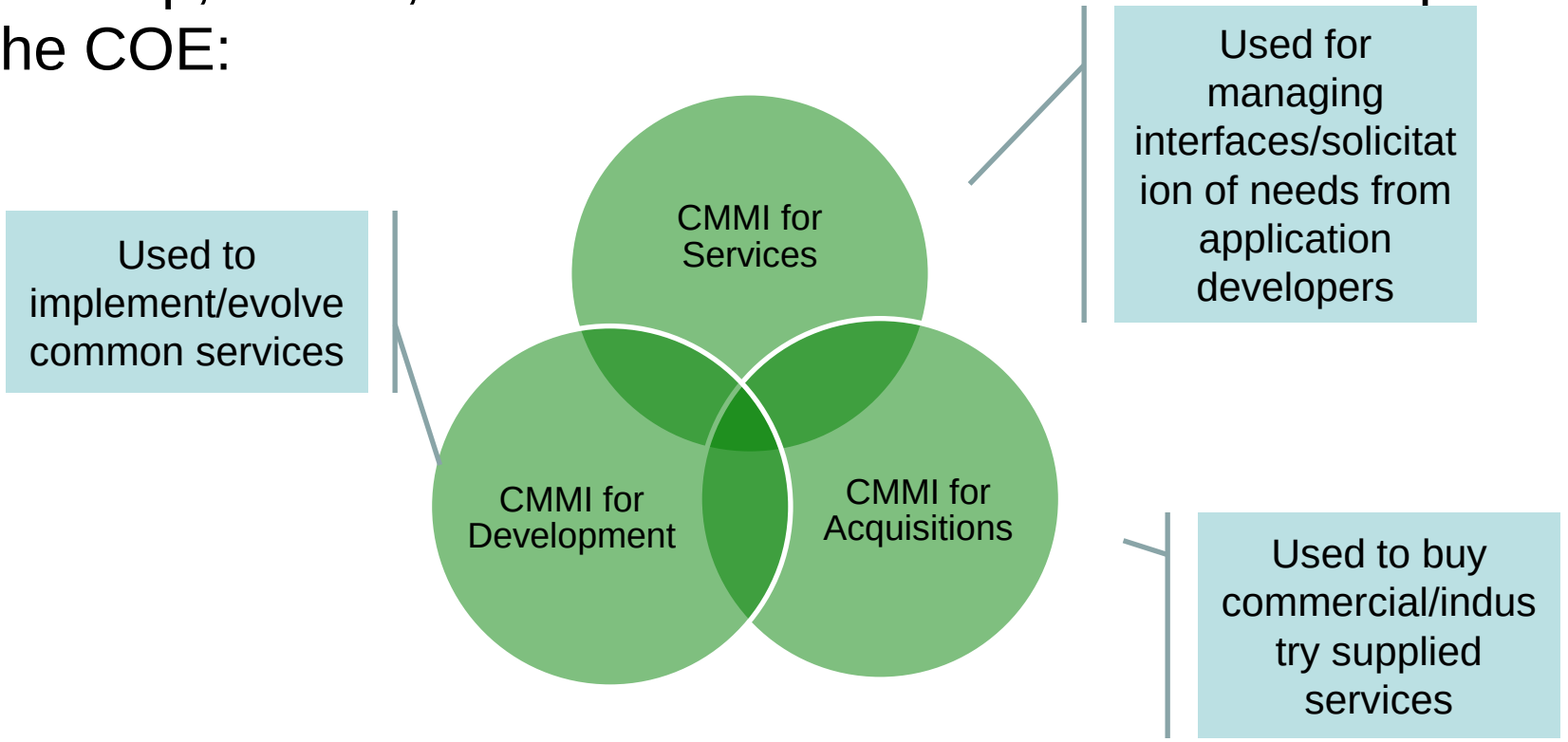
- Software has value only in the context of the system it was developed to support (and the contractor who developed it)
- Software Integration & Interoperability have become intractable
- It takes too long to capitalize on commercially available solutions/innovations

It can if…

- The implementation starts with a minimum set of standards
- Standards & common services are planned to evolve continuously (with appropriate resources) aligned with Army goals & objectives
- Compliance is incentivized (and enforced)
- The processes for managing the COE are disciplined, transparent and support application developers

How CMMI Can Help

CMMI provides a model that can support the disciplined enterprise-level implementation of the processes needs to develop, evolve, and deliver the common services required by the COE:



CMMI – The Value Proposition (1)

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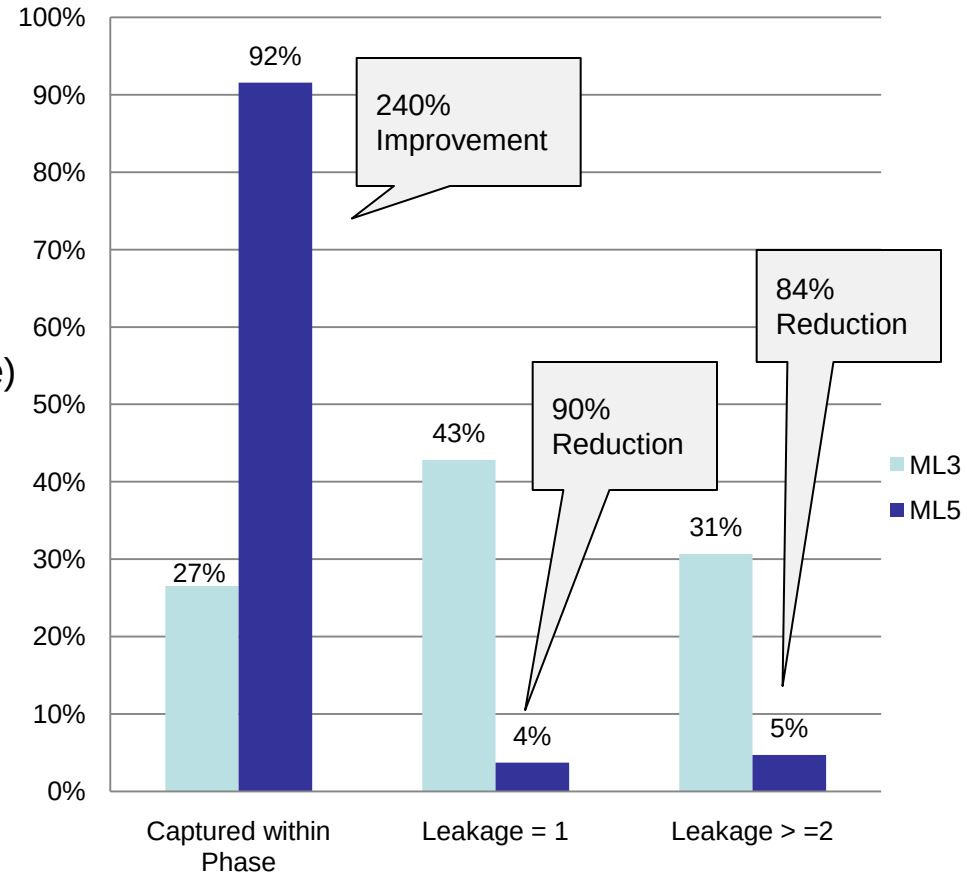
Goal – Reduce Armament SEC software life cycle costs by identifying and fixing defects closer to phase of origin (requirements, design, code, integration, test)

- Established Armament SEC baselines and models using industry-standard Defect Containment Matrix (DCM) methodology
  - Tracked defect "phase leakage" (finding defects in phases after the originating phase)

		Life Cycle Phase Discovered						
Originated		L	R	D	C	I	T	In the red
	Legacy 10%	29%	7%	4%	29%	17%	14%	64%
	Requirements 60%		75%	5%	16%	2%	2%	20%
	Design 4%			67%	16%	0%	17%	17%
	Code and Unit Test 22%				89%	3%	8%	8%
	Integration Test 2%					66%	34%	
	Test 2%						100%	
	100%	3%	46%	6%	32%	5%	8%	

- Maturity Level 5 projects' focus:
  - Optimize within-phase verification processes (*e.g.,* Peer Review, Unit Testing, etc)
  - Leverage reuse of mature code
  - Increase automation of testing

Defects Phase Containment / Leakage (High Severity Defects - Priority 1, 2 & 3)



Cost avoidance realized:
- *Less rework late in life cycle when it is most expensive to repair*
- *Resulting in reduced schedule risk*

CMMI – The Value Proposition (2)

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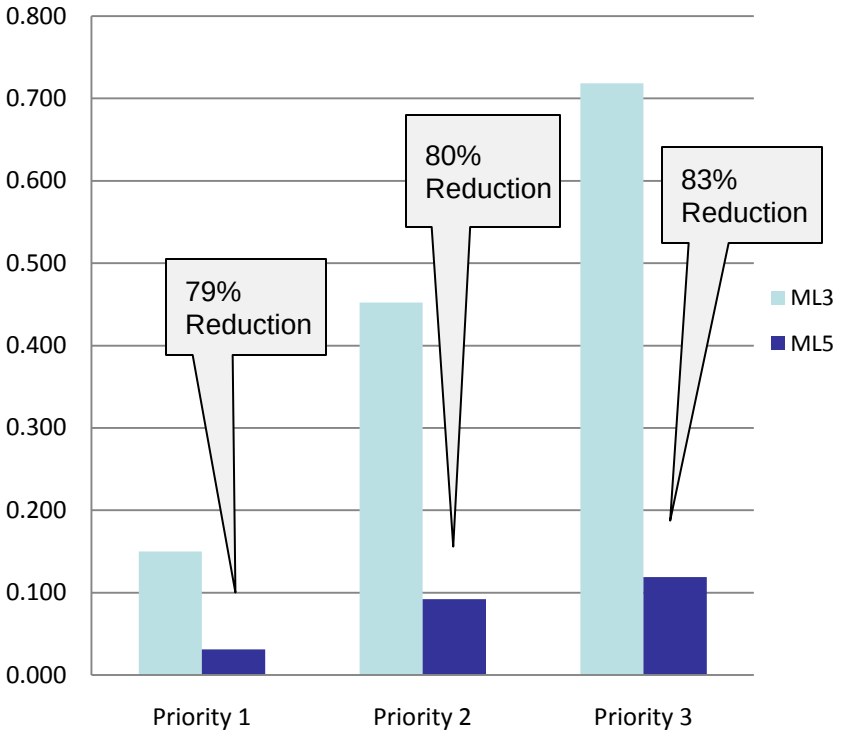
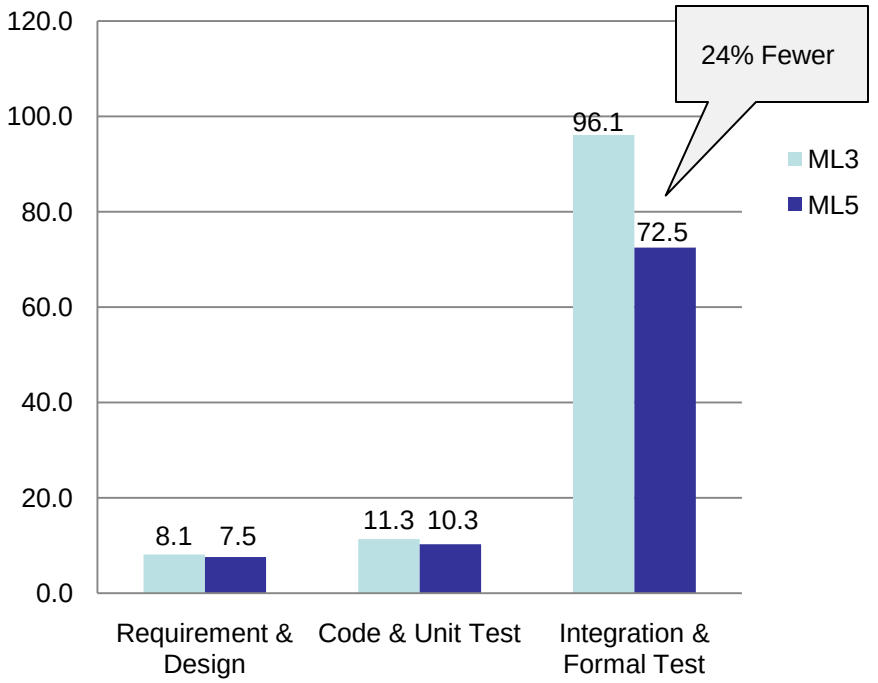
Defect Density by Priority (PCR) (High Severity Defects Only) (Ave Project – 219 KSLOC)



Average Hours per Defect per Phase to Repair (High Severity Defects)



***Highest severity** defects leaked are decreased by at least 79%:*

- *More rigorous peer reviews focusing on systemic issues*
- *Broadened participation and tailored role-based review criteria*

Defects discovered in ML5 projects cost less to repair in all phases on average – in particular, Integration & Test phases achieved a 24% reduction of hours expended

Build the Credentials of the Organization

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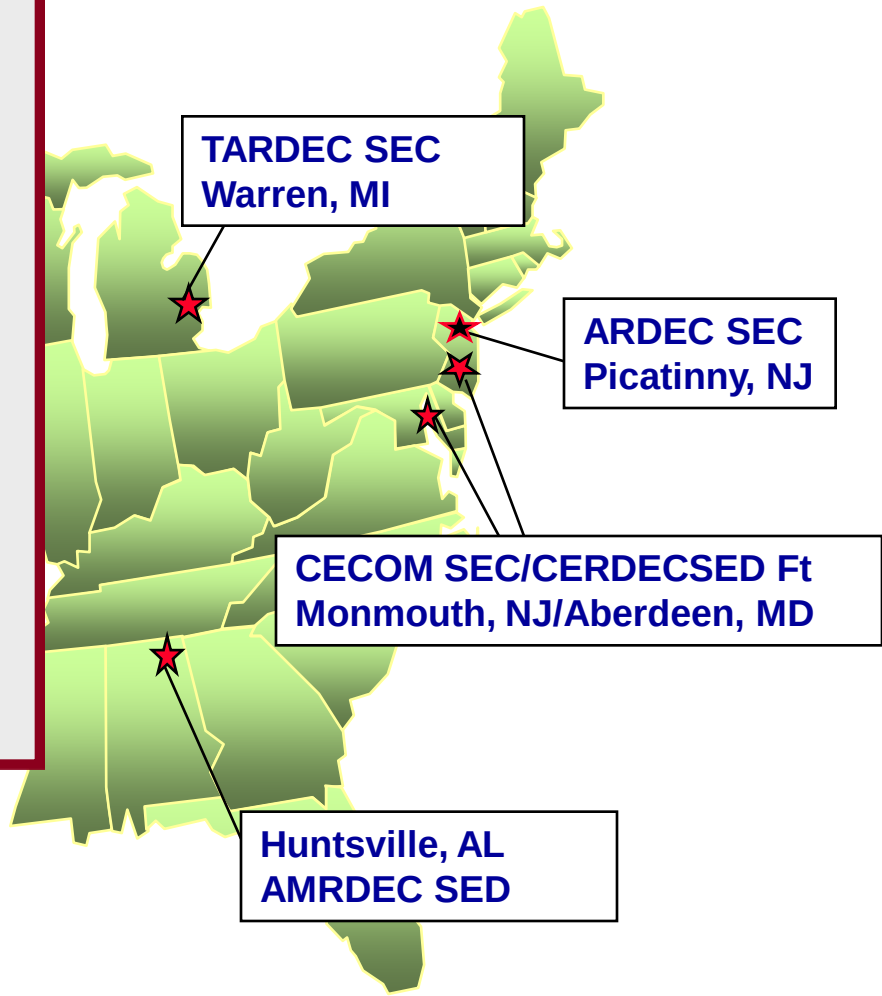
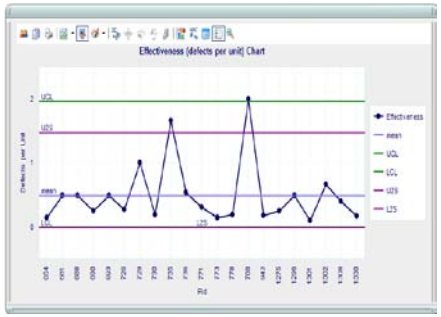
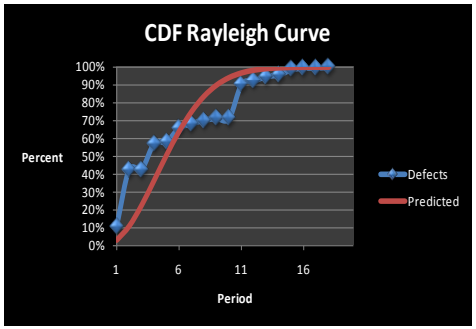
- Pursue improvement opportunities across the Army acquisition/engineering community
- Share best practices among diverse Army acquisition/engineering organizations
- Leverage high performing acquisition/engineering organizations
- Army Systems Engineering Forum
- Army Strategic Software Improvement Program







BUT – This is Uncharted Territory

- There is scant data about actual use of the CMMI constellations in common operating environments, which suggests
  - It hasn't been done before
  - If it has been done, the results are being held proprietary

We'd love to hear your thoughts & experiences…