Systems 2020
Strategic Initiative Overview

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Need for Systems 2020

• Adversary can use commercial technologies and new tactics to rapidly alter the threat to US forces
  – Increasing uncertainty in future Defense missions & environments

• DoD engineering, and business processes not structured for adaptability
  – Sequential, single step progression from fixed requirements
  – Individually designed, monolithic systems
  – Vulnerabilities from global supply chain

• New research, tools, pilot efforts needed to determine best methods for building adaptable defense systems
The Urgency of Anticipation, Flexibility and Rapid Adaptability

Life Cycle of Technology Underpinning Adversary Systems

Extremely Fast (Weeks to Months)

Slow (Years to Decades)

Observability of Adversary Systems

Potential Impact on US System/Capability

Large Investment; Open-air Testing; Distinct Observables

Low barrier to entry; Limited or no Observables

US system rendered ineffective; substantial cost to buy back

Little Impact; relatively inexpensive mods to counter

Large Investment; Open-air Testing; Distinct Observables
The Urgency of Anticipation, Flexibility and Rapid Adaptability

Life Cycle of Technology Underpinning Adversary Systems

Potential Impact on US System/Capability

Observability of Adversary Systems

- “Static” environment; threats change slowly with early indications (e.g. new military platforms in Cold War era)
- Little Impact; relatively inexpensive mods to counter
- US system rendered ineffective; substantial cost to buy back
- Large Investment; Open-air Testing; Distinct Observables
- Low barrier to entry; Limited or no Observables

Extreme Fast (Weeks to Months)
Slow (Years to Decades)
The Urgency of Anticipation, Flexibility and Rapid Adaptability

21st century “dynamic” environment - globalized technologies enabling dangerous threats that change rapidly and without warning... demanding anticipation, flexibility and adaptability

Life Cycle of Technology Underpinning Adversary Systems

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Potential Impact on US System/Capability

- cyber
- IEDs
- bio
- EW
- UAVs
Designing DoD Systems for Adaptability

**Design Disciplines**
- Platform Based Engineering
  Using a common core platform to develop many related systems/capabilities
- Trusted System Design
  Developing trusted systems from untrusted components

**Design Framework**
- Model Based Engineering
  Using modeling and simulation for rapid, concurrent, integrated system development and manufacturing

**Adaptable DoD Systems**
- Capability on Demand
  - Real-time Adaptive Systems
  - Rapidly Reconfigurable Systems
  - Pre-planned Disposable Systems
Systems 2020 Scope

• **Systems 2020 technologies could apply to many domains**
  – Platform Based Engineering (PBE), Model Based Engineering (MBE), Trusted Systems Design (TSD) are relevant to microelectronics, software, enduring defense platforms

• **Focus of Systems 2020 is on system engineering disciplines and frameworks to build adaptable defense systems**

• **Significant business process challenges in addition to technical challenges**
  – e.g., Challenging the requirements community to avoid specifying a fixed point solution, enforcing open architectures
  – Primary S-2020 focus is on the technical challenges

**Faster delivery of adaptable systems that are trusted, assured, reliable and interoperable**
Platform-Based Engineering and Trusted Systems Design Disciplines

**Notional Defense System**

**Today**

Point design to address fixed, static requirements

**PBE**

Inherently adaptable design to address dynamic, uncertain requirements

**PBE + TSD**

Inherently adaptable and robust design to address dynamic, uncertain requirements

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ex, y, z, etc – subsystems and/or components
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**Monolithic, Complex, Rigid Design**

Threat and mission changes require extensive re-work or start from scratch

- Expensive, slow to field

**Enduring Core Platform**

Core platform capable of rapidly accommodating threat and mission changes

- Well-defined architectures, interfaces allow a variety of systems configurations

**Rapidly Changeable Subsystems**

Additional partitioning of untrusted components and subsystems

- Allow rapid response to trust violation
Model Based Engineering Framework
Designing for Adaptability

Today
Model selected critical subsystems
Lots of design – physical prototypes

Stage 1
Segmented Virtual:
Concept Modeling
Product Modeling
Model Driven Manufacturing

Early Design Lock In
- Design decisions and interactions captured on paper, lost in personnel turnover.
- Lack of iterative concept design environment.
- Manual integration across product design seams.
- Custom manufacturing solutions.

Iterative/ Adaptive Process - Entire Life Cycle
- Emergence of open virtual design environment, interoperable tools and design data/artifacts.
- Early analysis of PBE and TSD system trades in concept, product, manufacturing models.

Stage 2
Fully Integrated Process Flow:
System Concept, Design, Build, Field, Adapt

Adaptive Transparent Systems
- Robust end-to-end open multi-scale design environment, tools, data, patterns & virtual/physical verification.
- Support full system PBE & TSD trades, responding to dynamic threats & trust scenarios.
Trusted Systems Design

- Designing trusted systems using components or subsystems of unknown or suspect trustworthiness
  - Desire to leverage commercial technologies to provide enhanced warfighting capability, however...
  - Current patchwork of defensive methods are not adequate for using commercial technologies from across the globe

- Use Platform Based Engineering tools, techniques to design the system to address trust
  - Suspect components are isolated, not part of the enduring core

- Research gaps identified in three key areas:
  - Architectures to make systems less transparent to the attacker
  - Methods, models for implementing trusted system design throughout system lifecycle
  - Trustworthiness assessment tools and methodologies
System 2020 Workflow to Achieve Adaptable Systems

Input

Warfighter Needs, Opportunities, Defense Strategies

Adaptable Systems

System 2020 Design and Manufacturing Environment

Platform Based Engineering
Using a common core platform to develop many related systems/capabilities

Model Based Engineering
Methods – Processes – Tools

Concept Models - Engineering

Model-Driven Design, Engineering

Model-Driven Manufacturing

Trusted System Design
Developing trusted systems from untrusted components

Output
We are seeking input on key technical gaps and opportunities to shape research projects and pilots
**Systems Engineering Gaps and Critical Needs**

**Summer 2010 Studies**
Identified deficiencies and gaps in systems engineering

**SE Research Center**
**S-2020 Study**

**Booz Allen Hamilton**
**S-2020 Study**

**Analysis of these reports categorized gaps into 3 areas**

- **Gaps**
  - Need for a conceptual design environment
  - Lack of tools to integrate system modeling capabilities across domains
  - Lack of open, virtual, realistic environment for validation, testing and manufacturing

**An integrated framework for concept, design and analysis of systems**
- Accomodates custom and commercial tools based on open architectures and standards
- Common conceptual environment and design tools for seamless interoperability
- Capabilities to verify system integrity, promote modularity and re-use, and design for trust
- Enhanced multi-scale Mod/Sim tools that support cross domain testing
Overview of S-2020 Path Ahead

Research and Development
- PBE Research
- MBE Research
- Other Research

Pilot Projects - Demos
- Pilot-specific R&D (New and Leveraged)
- Pilot Demonstrations

Business Processes, Standards, Transition
- Phase I
- Phase II
- Phase III
Summary

• DDR&E’s Systems 2020 initiative develops the design disciplines and framework to build adaptable Defense systems

• Program consists of research, pilot projects and transition efforts to advance key technologies
  • Platform Based Engineering, Model Based Engineering, Trusted Systems Design
  • Rapidly reconfigurable systems

• Execution performed through partnership with Services, Government, Industry, Academia

We look forward to broad community engagement
Systems Engineering: Critical to Program Success

Innovation, Speed, and Agility

http://www.acq.osd.mil/se