Panel Comments: The Future of Software and Software Research

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SDP New Visions Workshop

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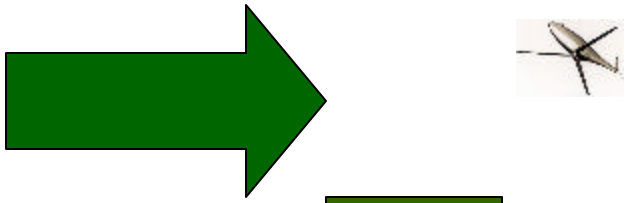
- Emerging software technology needs
- Promising new technologies
- Technology transition barriers and enablers

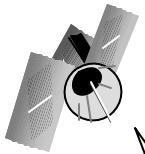
A Network-Centric Example:
Future Combat Systems

From This...

To This...

Network Centric Distributed Platforms





Small Unit UAV

Other Layered Sensors

Network Centric Force

Robotic Sensor

Distributed Fire Mechanisms

Robotic Direct Fire

Robotic NLOS Fire

Manned C2/Infantry Squad

Exploit Battlefield Non-Linearities using Technology to Reduce the Size of Platforms and the Force

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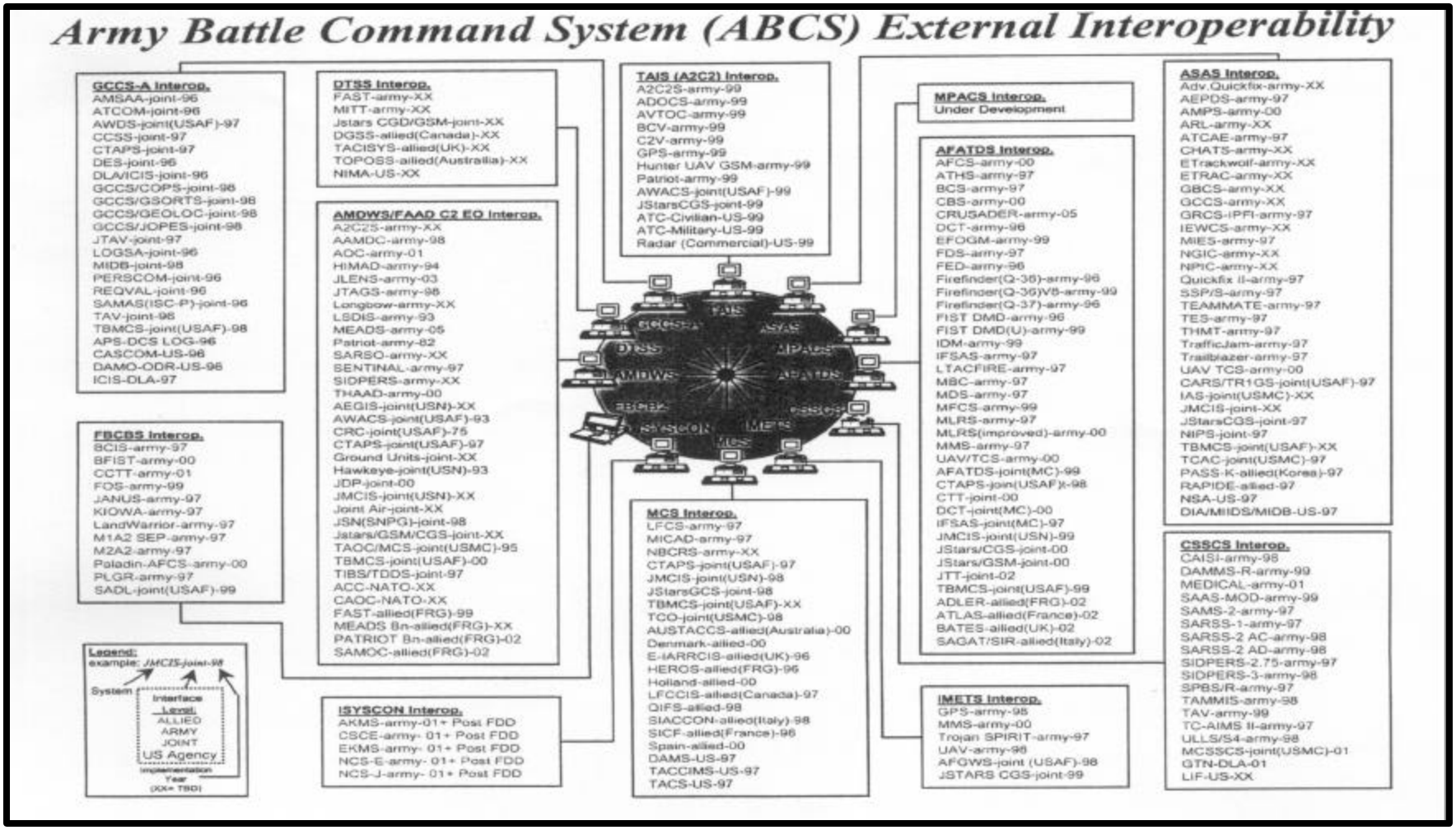
FCS Product/Process Interoperability Challenge



Future Software S&T:
What's Missing?

- Scalable techniques for analysis, definition, development, and management of complex, heterogeneous systems of systems
  - Architectural analysis
  - Multiprocess synchronization
  - Metrics; outcome analysis
  - Distribution, mobility
  - Change propagation
  - Group collaboration
- Techniques for simplifying complex systems of systems
- Integrating opaque, imperfect, uncontrollably changing, externally-developed software components
- Software quality attribute tradeoff analysis
- Integration of multiple software product, process, & property views
- Coordination of automated, semiautomated and human agents
- Doing all of the above in an adversarial, competitive environment

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Promising New Technologies

- Aspect oriented software development
- Value-based design
- Architecture-based performance engineering
- Self-stabilizing software
- Frameworks and Patterns
- Model-based product/process engineering
- Model-based testing
- Lightweight formal methods
- Experience-based process automation

Technology Transition Rate Multipliers

- USC TECTRAMO estimation model

1. Competition-criticality
2. Impact on current operations, power bases
3. Number of concurrent innovations involved
4. Adopter change/risk-aversion
5. Payback realization speed
6. Regulatory obstacles or incentives
7. Degree of executive support
8. Factor Endowment (human, knowledge, capital, infrastructure)

Factor Endowment: Virtual Laboratories

- Example: NASA High Dependability Computing testbeds

- Create virtual laboratories for research and experimentation at scale to accelerate transition by providing early validation
- Assess technology readiness, scalability, generality by experimental use in staged mission-representative testbeds
- Multi-stakeholder participation
- Enable technology validation across lifecycle
- Realism and reality transfer: scale, complexity, (sanitized) artifacts
- Evaluate technologies, artifacts, designs, operational concepts, methods, theories, tools via empirical methods
- Accessible cost, value, and impact date via open-source knowledge repositories