Thinking…

…*inside* the box

Soar Technology

Cooperative Interface Agents for Networked Command, Control & Communications (CIANC^3)

Jonathan T. Beard

The Challenge

"Complexity makes my head hurt."

-**Maj.Gen. Joseph Yakovac**,
PEO Ground Combat Systems
Army Science Conference, Orlando, 3 Dec 02

Example: C^3 Complexity

- Mixed human and robotic elements
- Ad hoc networks and organizations
- Situational awareness essential

- Large amounts of information
- Rapid decision making necessary
- Requires Efficient performance

Our Solution: Attack Complexity at *All* Levels

- *Entity & Multi-Entity Systems*
  - Intelligent CGF's, UV's, Cooperation, Collaboration
- *Operators & Experimenters*
  - Exercise Management
- *Commanders & Warfighters*
  - Intelligent Interfaces for C2, SA, Training & Reachback
- *Analysts & Policy Makers*
  - Prediction, Visualization, Storytelling
- *Developers*
  - Rapid Modeling and Scenario Creation

CIANC^3

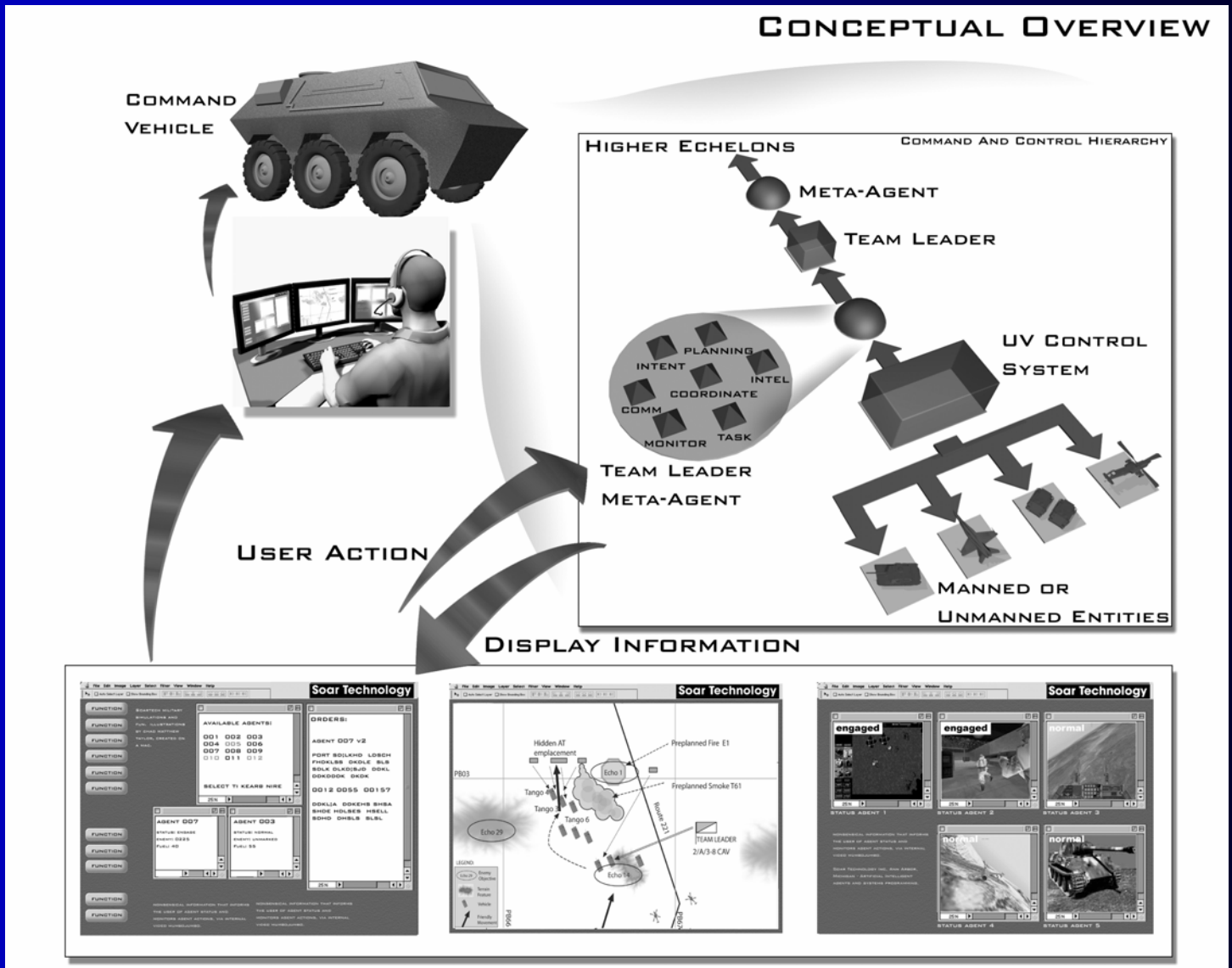
Cooperative Interface Agents for Networked C^3

- Goals
  - Design C3 system tools that will increase combat effectiveness while reducing training costs.
  - Understand the training implications for C3 of mixed teams of robotic and human elements.
- Objectives
  - Create framework to explore new C3 methods.
  - Develop instrumented system for better understanding human factors involved.
  - Create design and training guidelines for similar interfaces.

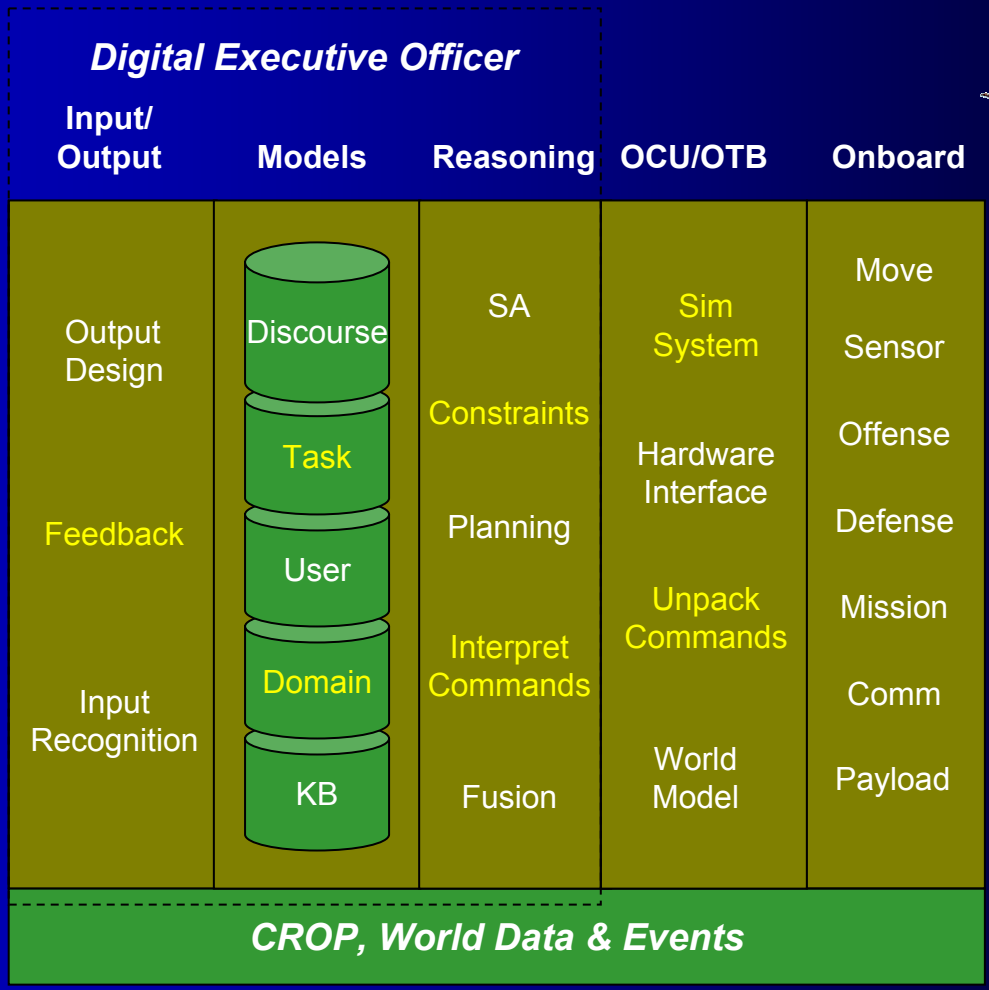
Our Team

- **Dr. Scott Wood** - PI, Human-system interaction, cognitive modeling, human error, software engineering, interface design
- **Jack Zaientz** - PM, User Interface Design, Human-system interaction, task analysis
- **Dr. Marc Huber** - Distributed Artificial Intelligence, Agent Architectures
- **Dr. Rich Frederickson** - SOAR/SAF integration, GUI development, software engineering
- **Jonathan Beard**, Soar behavior modeling, software engineering
- **LTC Scotty Abbott (Ret)** - FCS/domain SME

Conceptual Overview



High-Level System Architecture for Robotic Control



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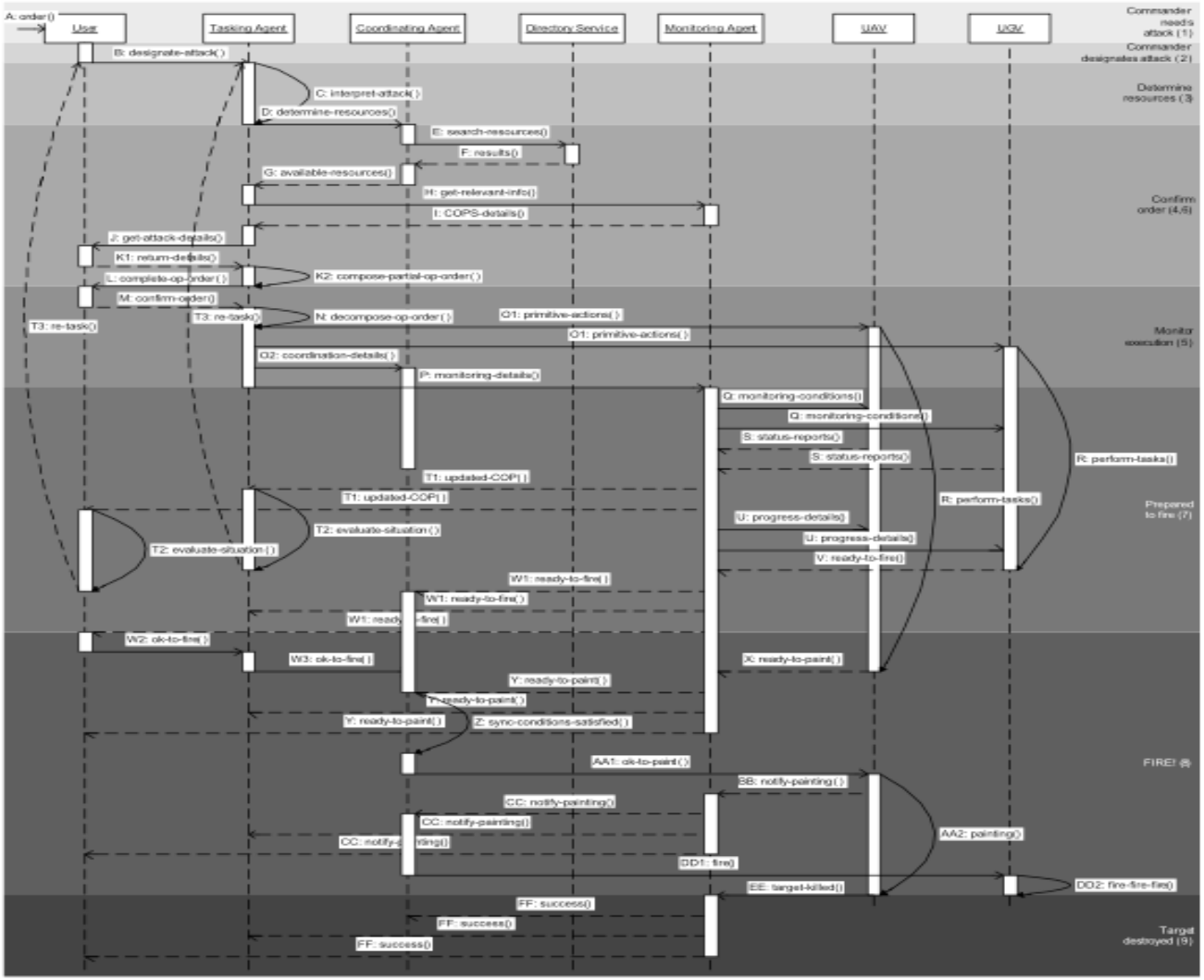
Thinking *inside* the box.

Multi-Agent Communications

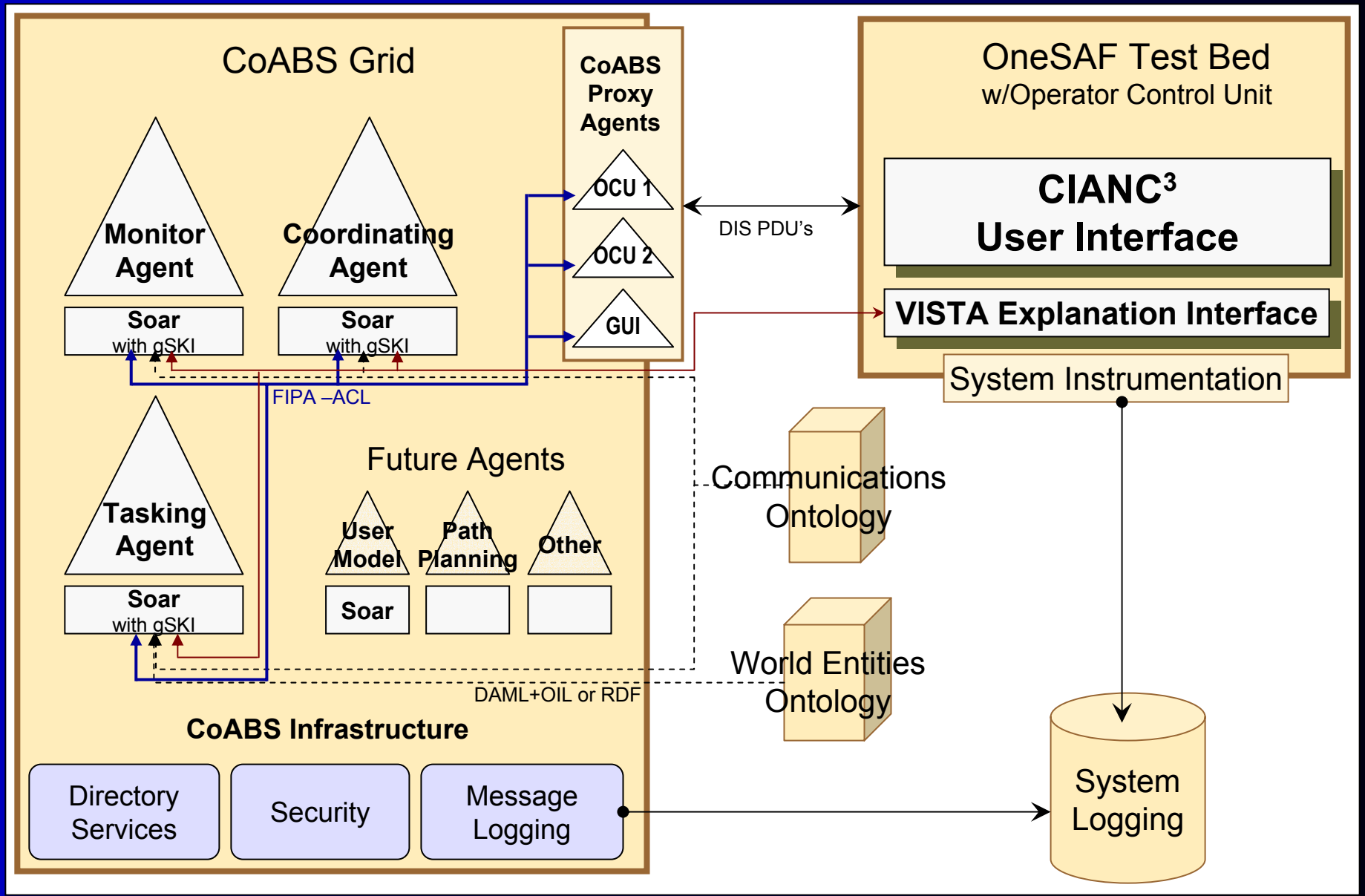


UML Sequence Diagram of Agent Communications

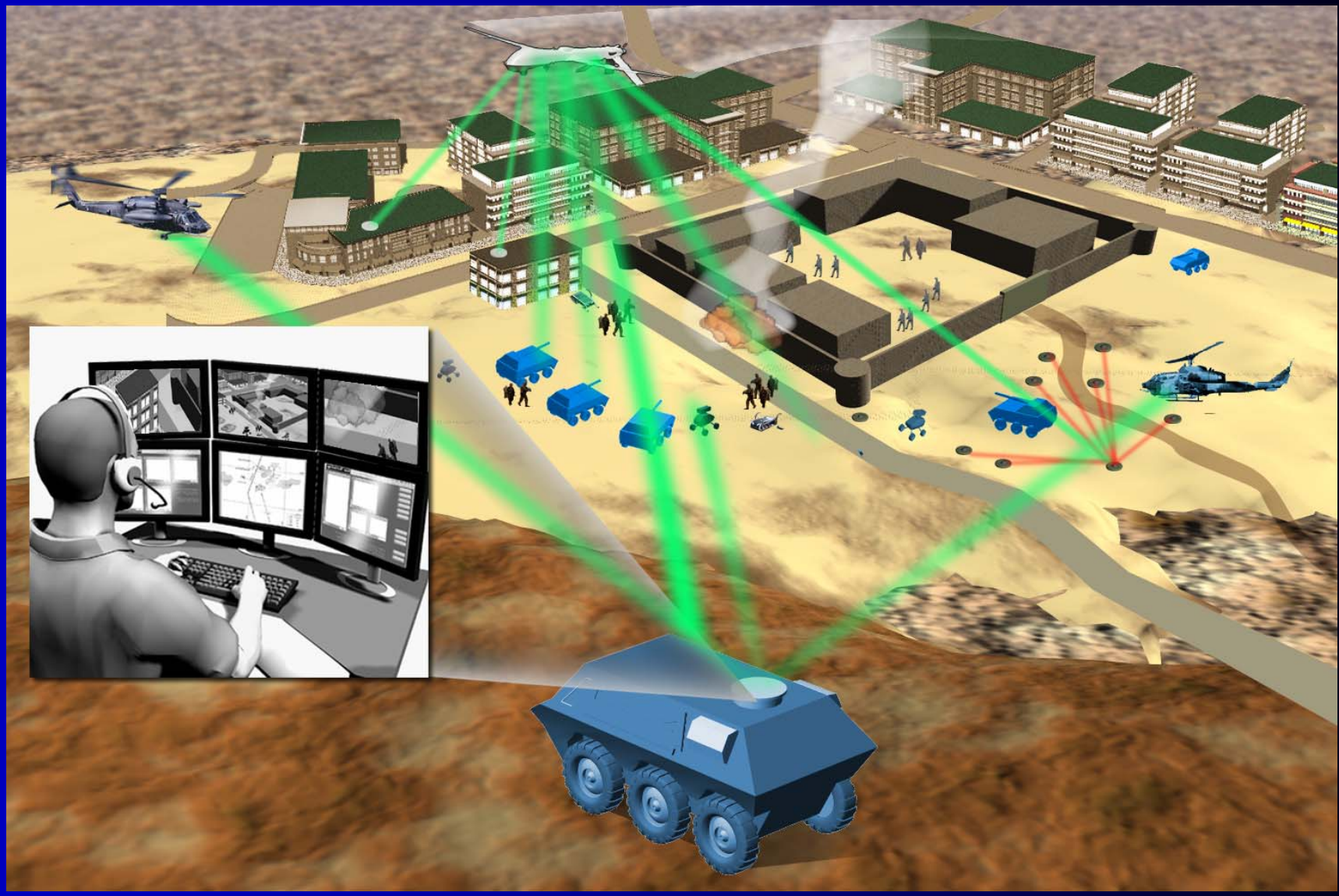
Current Work

- Scale system to scope of Future Combat Systems (FCS) Platoon/Company
- Examine user needs for tasks and develop user models
- Develop behaviors & extend domain knowledge
  - Derived from plausible sources, such as: AUTLs, JUTLs, MTPs, ARTEPs, and SMEs
- Incorporate high-level knowledge abstraction tools and techniques (ontologies, deontics, heuristic formalisms, HLSR, ACLs, etc…)
- Develop plausible demonstration scenario
  - Rapid operational tempo (OPTEMPO)
  - Mobile Operations in Urban Terrain (MOUT)
  - FCS Robotic CONOPS
  - High-stress multi-tasking and high-volume event stream

Evolving System Architecture



Evolving FCS Scenario



Future Work

- Human Subject Testing
  - Small-scale usability testing at Soar Technology
  - Integration into existing robotic control (OF-OTB UC) and/or C^2 (SC4, MC2) applications
- Battle Lab Deployment for experimentation
  - Individual user evaluation at Army Research Institute (ARI) or Unit of Action Mounted Battle Labs (UAMBL)
  - FCS Platoon/Company level training & evaluation at UAMBL

NUGGETS

- Defined the problem
- Defined a multi-agent framework
- Defined an initial vignette
- Implemented enough of the framework to develop a prototype for the vignette
- Prototyped development and user interfaces
- Demonstrated technical feasibility of the approach
- Won Phase II SBIR follow-on effort

COAL

- Fixed partitioning of tasks and between human commander and system
- Agent communication and world knowledge is rigid and hard to update (but abstract knowledge representation should help alleviate this problem)
- Agent development is slow; hard to encode doctrine and ROE, hard to validate and reuse components
- Training implications not directly or rigorously addressed