Creating C4ISR Applications With Composable, Component-Based Architectures

Mr. Ken Graves

CHI Systems, Inc.
11838 Bernardo Plaza Court Suite 102A
San Diego, CA 92128
kgraves@chisystems.com

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The Problem

♦ Architectural limitations in current and future C4ISR systems
  ♦ Stovepipe design
    ♦ inflexible, non-modular
    ♦ costly, time consuming to modify
    ♦ difficult to adapt to new threats or environments
    ♦ unable to support rapid test of new adjunct technologies
  ♦ Declining R&D funding base to replace current systems
  ♦ Separate, agile technology needed to integrate stovepipes

♦ Need rapidly tailorable, scaleable, & cost-effective approach
  ♦ Reusable technology components
  ♦ Compose custom applications in rapid development process
Component-Based Approach

- Solves problems of stovepipe architectures
- Provides flexibility and agility for new applications
- Component-based architecture for C4ISR
  - Component Repository of loosely coupled services and components
  - Lightweight backplane for service/components registration
  - Domain-specific databases combined into database repository
- Create unlimited space of custom C4ISR applications by combining repository components/database through the backplane
- Careful design allows components/databases to be used in other architectures
Component-Based Rapid C4ISR Application Development
C3Core: A Component-Based C4ISR Architectural Framework

♦ Under development for last 7 years at CHI Systems

♦ Motivated by C4ISR community’s needs for flexibility, tailorability, and cost effectiveness

♦ Extensible, scaleable, and reconfigurable architecture of reusable software components that supports:
  ♦ Rapid C4ISR application design, development, testing & deployment
  ♦ Experimentation with advanced concepts in C4ISR, network-centric fires & effects, wearable computing, and embedded computing

♦ NOT a software application, but architectural framework with reusable infrastructural services and components
  ♦ Tools to support rapid spiral development and maturation of C4ISR applications, components and concepts
  ♦ Levelized architecture yields no component interdependencies and provides extreme flexibility
C3Core Component Space

- ~300 different plug-ins and services
- Arranged into ~30 major components
- Components can be configured to mimic legacy C4ISR systems
  - support evaluation of new tactics, techniques, procedures & C4ISR capabilities
- Other configurations address future force C4ISR requirements
- Component testing/refinement at multiple levels
  - initially within C3Core environment or application simulation
  - then in higher fidelity environments such as battle labs
- Battle labs testing often identifies components or C3Core configuration that are ready for operational use
Rapidly Addressing Customer Requirements

Rapid Custom Requirement

Commander Need

Feedback

Warfighter

Custom Package

Quick Turn Around
Requirement Analysis and Selection of Components
Example C3Core Configurations and Environments

- Map Display/GIS System
- Terrain/Mobility Analysis System
- Wireless Site Security System
- Netted Fires & Effects Control
- Vehicle Mounted C2
- Wireless Handheld C2
- Vehicle or UAV Crewstation

C3Core Applications

C3Core Platforms
- Linux
- Unix/Solaris
- LynxOS
- VxWorks
- WinNT/2000

Platforms
- PDA
- Notebook PC
- Micro PC
- Embedded VME/Power PC
- Desktop PC
Example Current and Prior C3Core Applications

- Terrain components fielded with US Marine Corps (2001)
- Fires component used in Future Force Warrior (FFW) program (scheduled fielding, 2008)
- Individual soldier ‘blue force’ tracking configuration currently in soldier evaluation
- Fires and Logistics components used in Army RDECOM’s MATREX M&S program to model networked fires/effects and logistics
- Future Fires Command & Control (F2C2) experiments at the D&S ABL, Fort Sill
- Future Combat Command & Control (FCC2) experiment at the UAMBL, Fort Knox
- FFW User Evaluations at the DBBL, Fort Benning
Supporting Rapid Experimentation: Battle Lab Case Study

- Seven battle lab experiments from 1999-2004
- Served as a user-reconfigurable C4ISR workstation, allowing role players to use different configurations
  - Brigade Commander, Intelligence, Operations, and Plans Officers
  - Artillery Forward Observer
  - Fires and Effects Control Officers and NCOs
  - Logistics Officers and NCOs
  - Mortar Platoon Leaders and Artillery Battery Commanders
  - Recon team leader
  - FFW soldier, squad leader, and platoon leader
- Enabled communication & collaboration in a common environment for information sharing
  - Provided logisticians, fire supporters, maneuver commanders, and intelligence officers with a common operational picture facilitating rapid planning and execution.
- Experiments showed clear benefits in eliminating stovepipes
C3Core supported 18 different role players and configurations during F2C2 experiments at Fort Sill.
Supporting Rapid Experimentation: Battle Lab Case Study (3)

Soldiers used tailored C3Core components for collaborative planning during FFW Combat Decision Aiding System (CDAS) User Evaluations at Fort Benning.
Supporting Rapid Development: Individual Blue Force Tracker

PDA Transponder Configuration

- GPS Antenna
- UHF Packet Radio
- BA-5590 Radio
- Battery
- IMU
- Sharp Zaurus PDA

Total Weight (less battery) Approximately 2.5 lb.

PDA transponder allows sending of wearer’s location to the Commander C3Core.

Implementation of a text messaging capability is underway to allow simple messaging from PDA to Commander C3Core.
Supporting Rapid Development: Individual Blue Force Tracker (2)

C3Core Commander Configuration

- GPS Antenna
- UHF Packet Radio
- IMU
- BA-5590 Radio
- Battery
- OQO Computer

Total Weight (less battery) Approximately 3.0 lb.

Commander C3Core can receive PDA transponder location transmissions. Can also share graphics, messages with subordinate C3Core/OQO applications.
Current Applications Overview

Building Applications with C3Core’s Component Based Architecture

C3Core Backplane Services

C3Core DB Repository

Component Repository

Application A Components

Comp. 1
Comp. 2
Comp. 3
Comp. 4
Comp. 5
Comp. n

Application B Components

Application A

Application B

Major C3Core Components

- Map Server
- Terrain Services
- C4I Database
- Weapon System Knowledge Base
- MIL-STD-2525B Symbology
- Distributed Data Services (DDS)
- Database Replication/Sharing
- Fire Control
- Communications Interface
- Simulation
- Logistics Monitoring
- Visual Representation
- View Management
- Backplane

C3Core SDKs/APIs

- Terrain Services API
- Map Server API
- Knowledge Base API
- Extended Graphics API
- C4I Database API
- Plug In Interface API
- Network Comms API
- Event Notification API
- Direct Drawing API

Future Fires Decision Support System

USMC C2PC Decision Support Tool Box

USMC MAGTF Intelligence Collection Application

Objective Force Warrior Netted Fires

DBB OFW C4I Surrogate System

Logistics Support Analysis Tool

Security & Emergency Response Information System
C3Core: Conclusions

♦ Shows path to filling technology gaps for legacy systems in providing “component-ware” solutions for future needs

♦ Provides practical code reusability, reducing both risk and cost in system development

♦ Basis for rapid development of mature yet custom C4ISR capabilities

♦ Supports all phases of the C4ISR software development cycle, from initial concept to support of fielded systems