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14. ABSTRACT
Operators in USNORTHCOM's Cheyenne Mountain Operations Center, USSTRATCOM's Global Integration Center, and the National Military Command Center must respond to a potential missile attack on the United States, and perform the Integrated Tactical Warning/Attack Assessment and missile defense missions simultaneously, using multiple command and control systems. Looking at displays from multiple systems, while performing manual correlation between events, is prone to error and can result in a delay in time-critical actions while operators attempt to make sense of differing information from multiple systems. To reduce ambiguity and increase operational effectiveness for the combatant commander, Missile Defense Agency (MDA) initiated the Command, Control, Battle Management, Communications, (C2BMC) - Combatant Commanders' Integrated Command and Control System (CCIC2S) Advanced Concept Demonstration Project (ACD) in June 2003 to demonstrate the integration of missile warning and missile defense systems. The ACD was intended to prove the technical feasibility of integrating the two systems, and providing a combined, correlated display for command center operators. The attached C2BMC - CCIC2S ACD Technical Report describes the engineering processes and design, concept demonstration and successful proof of technical feasibility. This successful proof of concept provided the foundation for implementation of an integrated display in Spiral 6.2 of the missile defense C2BMC system.

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Report

6/14/2004

Command & Control, Battle Management, Communications (C2BMC) – Combatant Commanders Integrated Command & Control System (CCIC2S) Integrated Missile Warning/Mission Defense Advanced Concept Demonstration (ACD) Technical Report

CONTRACT NUMBER SPO 700-98-D-4002, TAT 02-48, DO 167

Information Assurance Technology Analysis Center
3190 Fairview Park Drive
Falls Church, VA 22042

COMMAND & CONTROL, BATTLE MANAGEMENT, COMMUNICATIONS (C2BMC) – COMBATANT COMMANDERS INTEGRATED COMMAND & CONTROL SYSTEM (CCIC2S) INTEGRATED MISSILE WARNING/ MISSILE DEFENSE ADVANCED CONCEPT DEMONSTRATION (ACD)

TECHNICAL REPORT

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14 June 2004

EXECUTIVE SUMMARY

The Command & Control, Battle Management, Communications (C2BMC) – Combatant Commanders Integrated Command & Control System (CCIC2S) Advanced Concept Demonstration (ACD) Project was initiated in June 2003 and was initially scheduled to complete in September 2004. The goal of the ACD was to demonstrate the viability of integrating the C2BMC Missile Defense system and the CCIC2S Missile Warning system.

The demonstration work completed successfully ahead of schedule (June 2004) and under-budget. Additionally, all identified "reach goals" were accomplished. The integrated system solution was demonstrated to a wide audience, including representatives from the operator community and general officers. Positive feedback received from these demonstrations resulted in a change of focus for the second half of the ACD project. Originally a series of on-site demonstrations where planned. However, due the rapid acceptance of the integrated concept, and the impediments associated with using on-site equipment and/or installing and de-installing site-based equipment, the focus of the tail end of the ACD project shifted from demonstration to deployment preparations.

An incremental deployment plan, culminating in a Full-Integration deployment, evolved. The fully integrated system was envisioned to have both systems residing on a single version of a common infrastructure, both hardware and software. It would have been capable of displaying the same information to both sets of mission operators. Each operator would have been given the ability to quickly flip between viewing data from Missile Defense, Missile Warning, or both mission processing capabilities on a single 2D COP display and a 3D Globe display. An association algorithm would have been executed to relate CCIC2S Missile Warning Events to correlated C2BMC representative missile tracks. This association would have been displayed to the operator in tabular form as another column in the C2BMC track table. Situational awareness would have been provided to remote operators through a web server capability serving up the integrated 3D web-enabled client to browser capable clients networked to the sever suite. A common collaboration toolset would have been used to enhance inter-mission communications.

In the first quarter of 2004, the Missile Defense Agency (MDA) decided not to pursue full integration of C2BMC and CCIC2S systems in the immediate future. Instead, the focus was switched to a lighter degree of integration that addresses enhancing user situational awareness displays, rather than developing and deploying common software infrastructures on common server hardware suites. The work accomplished under the ACD is currently planned to be utilized to field a Missile Defense / Missile Warning Light Integration (MW/MD-Lite) display-level-only integrated capability with the CCIC2S system in early 2006.

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1. MANAGEMENT

This section describes the management approach employed during ACD. For a description of the technical approach, and other technical considerations, see section 1.

1.1 Why Integrate

Looking at displays from multiple systems, while performing manual correlation between events, is prone to error and is time consuming. To reduce ambiguity and increase operational effectiveness for the combatant commander, Missile Defense Agency (MDA) initiated the C2BMC-CCIC2S Advanced Concept Demonstration Project (ACD) in June 2003 to demonstrate the integration of missile warning and missile defense systems: CCIC2S and C2BMC. The output of the ACD was a proof-of-concept that the two systems can be integrated. The project completed in June 2004, with the integration of C2BMC 4.3 and CCIC2S 4.1 demonstrated. This final report contains the managerial and technical insights gained during the project

Missile Warning, as a mission, has been operational for decades. Its basic goals are to verify when North America, or U.S. forces overseas, is under missile attack, to determine where the attack has emanated from, assess where the attack is aimed, and characterize attributes of the attack. Currently, Missile Warning command and control capabilities are provided by the Command & Control Processing Display System – Replacement (CCPDS-R) system which will be replaced by the Missile Warning Increment 1 (MW1) released with Combatant Commanders Integrated Command and Control System (CCIC2S) Spiral 2 (CS2). CCIC2S is presently under development by a team led by Lockheed Martin under contract to the Electronic Systems Center (ESC) Strategic Command and Control, System Program Office under the direction of the Secretary of the Air Force.

In comparison to Missile Warning, the Missile Defense mission is a relative newcomer. The Missile Defense Agency (MDA) of the Office of the Secretary of Defense has been charged by the President to develop a Ballistic Missile Defense System that can defend the U.S., deployed forces, and allies and friends around the world from ballistic missile attack. The system is required to employ multiple layers of defensive capabilities and technologies to intercept missiles in all phases of their flight (i.e., boost, midcourse and terminal) against all ranges of threats (i.e., short, medium, intermediate and intercontinental). Command and Control capabilities for integrated global missile defense will be provided by the Command and Control Battle Management and Communications (C2BMC) system. This system, being procured by the Missile Defense Agency, is under development by a Missile Defense National Team, which is also led by Lockheed Martin.

Given this brief background, the following are fundamental reasons why the functionality of these two systems should be integrated:

a. Implement Commander's Intent.

b. Improve Combatant Commanders' Operational Effectiveness.

c. Provide Enhanced Acquisition Value.

1.1.1 Implement Commander's Intent

On 25 July 2001, then USCINCSPACE published a letter, which defined the Commander's Intent to "field a command and control system that fully integrates the ITW/AA and BMD command and control systems." Subsequently, the Unified Command Plan for 2002 (UCP 2002) transferred the missions of US Space Command (USSPACECOM) to USSTRATCOM. Specifically, change 2 to UCP 2002 further expanded USSTRATCOM missions to include Integrated Global Missile Defense, Missile Attack Warning, and Space Attack Warning and Assessment – in effect, tasking USSTRATCOM with a majority of the key mission elements described above in the Commander's Intent.

To execute their expanded missions effectively, USSTRATCOM needs an integrated capability that will allow the Combatant Commander to exercise command and control simultaneously over multiple mission areas, using a single command and control suite. Additionally, USSTRATCOM responsibilities to coordinate with theater commanders makes this enterprise capability a natural basis for developing requirements for North American Aerospace Defense Command (NORAD), US Northern Command (USNORTHCOM), and other Regional Combatant Commanders (RCCs).

1.1.2 Improve Combatant Commander's Operational Effectiveness

Since both systems are dealing with missile events, many of the capabilities between the systems overlap or complement each other. The Missile Defense Agency recognized this, and, on 31 Oct 2002, commissioned Lockheed Martin to perform a study to identify the opportunity to capitalize on synergies between the systems. That study's results were published in May 2003. Among the findings of the study were that integrating the two systems' functionality would enhance operational effectiveness.

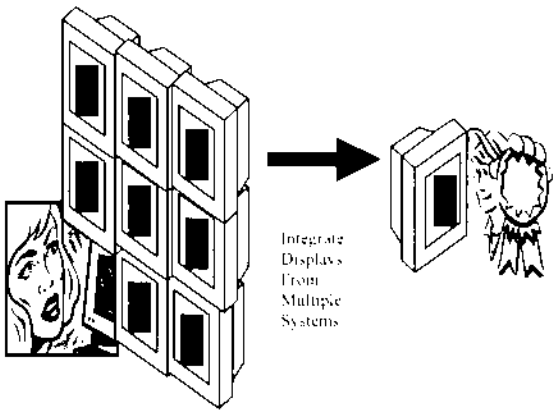

Figure 1. Integrating Multiple Display to form A Common Display

Operational enhancements identified by the study and subsequent analysis include the following:

a. Common displays and automatic association of missile warning events with missile defense tracks reduce ambiguity and decrease response time.

b. Integrated situational awareness, planning, collaboration and decision support tools increase battlespace awareness and enable decision superiority.

c. Single integrated suite of equipment reduces operator complexity, reduces manual cross-system correlation, and reduces training time.

d. Smaller footprint and correlated system alerts reduce operator overload and enhance the human-machine interface.

1.1.3 Provide Enhanced Acquisition Value

Many centers that will have a C2BMC system will also have a CCIC2S system. By integrating the two systems, hardware requirements can be significantly reduced, easing the complexity of installation and hardware sustainment.

Potentially, even more important than hardware consolidation is the reduction in software complexity that can be achieved with an integrated solution. Both C2BMC and CCIC2S are being developed from a common commercial and government standards-based infrastructure. This common infrastructure culminated from the CCIC2S Air Mission Release. It was used as the starting point for both systems. However, there had been no process in place to track changes to this common infrastructure, and other potential software sharing, development, and integration activities between these separately procured systems.

One significant process the study identified and Lockheed Martin is currently implementing is a coordinated configuration management process. A coordinated configuration management process allows for a controlled process to capture the resultant requirement deltas and overlaps between the two programs. Additionally, it supports the identification of potential software component reuse to address similar requirements. Finally, by mapping software components to the operational and technical requirements, the potential for creating duplicate functionality is reduced, risks are limited, and schedule is saved.

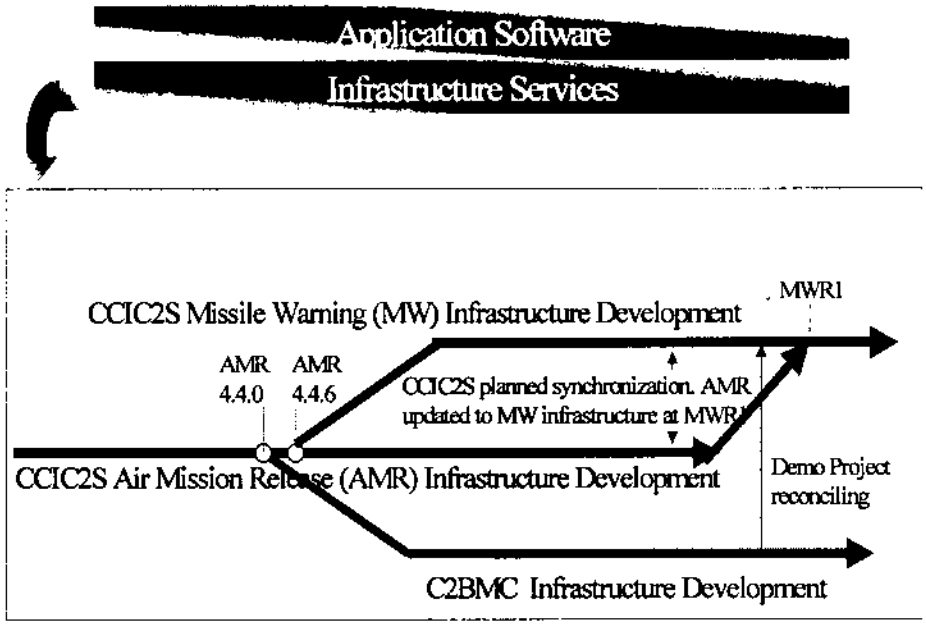

Figure 2. Common Infrastructure Lineage

As shown in Figure 2, CCIC2S was used as the common infrastructure on both programs because it provided the future standards-based, interoperable architecture for a NORAD/USSTRATCOM Battle Management/C4I system of systems that complies with the Network Centric Enterprise Services (NCES) Common Operating Environment (COE), Joint Technical Architecture (JTA) standards, and provides for DoD/Joint Command and Control (C2) interoperability. Additionally, the CCIC2S infrastructure is based on modern commercial standards, including E-commerce open system Java Enterprise technology.

Given this background, CCIC2S formed the natural foundation on which to build C2BMC capabilities. C2BMC has made tailored changes to the CCIC2S software infrastructure it started with, but has mainly focused its development efforts on evolving the missile defense application functionality. Simultaneously, the CCIC2S development effort has evolved the infrastructure to continue to support all its mission areas.

Bringing the two systems together would have yielded increased medium and long term benefits including the following:

a. *Shared (rather than modified common origin) code means software maintenance and* enhancements do not need to be duplicated by each program independently.

b. Construction of a single, unambiguous COP display across both systems becomes realistic and achievable.

c. Rationalization of redundant capabilities would have allowed each program's development efforts to focus on truly operationally value-added synergistic capabilities. The result would be enhanced capabilities delivered to the warrior quicker.

d. Maintaining a common infrastructure allows for scaling mission capabilities, providing the true union of the two systems' capabilities.

1.2 History Leading to the Initiation of the ACD

Figure 3 illustrates the history leading up to the ACD, and the overall initial vision on where the ACD fit in the roadmap to an integrated system.

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APPENDIX A. WARFIGHTER DEMONSTRATION

This appendix contains information form the Warfighter Demonstration Event conducted on February 18 2004. Specifically the following items are included:

a. Attendance List

b. Warfighter Evaluation Results

c. Powerpoint Presentation

Last Name	First Name	Rank	Organization	Title	Phone #	e-mail	Session
(b)(6)			Architecture & Systems Engineering IPT Missile Defense National Team C2BMC (MDNTB)		(b)(6)		
		Northrop Grumman Mission Systems		Systems Engineer			Morning
		Major	21 SW/XPP	Chief, Program Management Branch			Morning
			MDNTB				Tentative
			MDNTB FFRDC/UARC Team	Acting A&SE IPT FFRDC Lead			Afternoon
		MITRE Corporation		STARS			Afternoon
			N/NC/J653				Morning
		Lt Col	USNORTHCOM/J5M	Chief, Missile Defense Future Concepts			Afternoon
			MDA/A&SE				Afternoon
		Capt	USSTRATCOM/PR17	Chief, PR17 Integration Division			Afternoon
		CAPT	CMOC/J3C				Afternoon
		Cber	NORAD/J36I & USSTRATCOM/OPS03				Morning
		Lt Co	HQ AFSPC/DRM				Morning
		Lt Co	CMOC/J5S				Afternoon
		MITRE Corporation	MDA/BC-FFRDC	Missile Defense Systems & Technology			Morning
		FFRDC Lead (MITRE)	MDNTB Development IPT				Morning
		Major	NORAD/J36I	Chief, TW AA Functional Management Branch			Morning
		Maj	USNORTHCOM J5M				Afternoon
		GS-13	USSTRATCOM/CL19	Chief, Strategic Warning and Defense Sector			Afternoon
		Capt	STRAT/CL19	Missile Warning CE Certification			Afternoon
		Capt	USSTRATCOM/PR16				Afternoon
		Maj	USSTRATCOM/CL155	Deputy, Global C2 Integration Br Acquisition & Contract Mgt Div			Afternoon
		KTR	USSTRATCOM/PR16				Afternoon
		KTR	MDA X-Lab				Morning
							Morning
		KTR	AFSPC/DRNC				Morning
		Col	CMOC/DS				Afternoon
		Lt Col	USSTRATCOM/PR16	Chief, Capabilities and Integration Global Missile Defense Division			Afternoon
		KTR	MDNTB	Block 04 Manager			Morning
		KTR	MDNTB	Block 04 Manager			Morning
		BAH	N-NC/J665	C4I Architecture Analyst			Morning
		KTR	MDNTB				Tentative
		KTR	USNORTHCOM J665 LMIT				Afternoon
		CTR	SAF/AQPC				Morning
		CIBER	STRAT/OPS032-N/J36I	TW AA Functional Managers Office			Morning
		GS 07	USNORTHCOM J5M				Afternoon
		COL	CMOC/J6				Afternoon
		MITRE Corporation	ESC/NDC				Morning
		KTR	AFC2ISRC/DOIA				Morning
		Lt Co	CMOC/J5S				Afternoon
		CAPT	CMOC/J3V				Afternoon
		KTR	ISC2	Strategic Threat Analysis and Reporting System (STARS			Afternoon

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APPENDIX B. GENERAL OFFICIER DEMONSTRATION

This appendix contains information form the General Officer Demonstration Event conducted on March 2 2004. Specifically the following items are included:

d. Attendance List

e. Minutes

f. PowerPoint Presentation

Last Name	First Name	Rank	Organization
(b)(6)		KTR	LMIS&S (ACD)
		LTC (P)	USNORTHCOM/J5B
		KTR	LMIS&S
		KTR	ISAG
		KTR	MDNTB
		MG	USSTRATCOM/DS
		SES	ESC/ND
		Col	MDA
		KTR	MDNTB
		KTR	MDA/BCD
		Brig Gen	MDA/TR
		KTR	LMIS&S
		KTR	LMIS&S (ACD)
		Maj	exec for Maj Gen Obering
		CAPT	USNORTHCOM/J31
		KTR	LMIS&S
		KTR	LMIS&S
		GS-15	ESC/NDC
		MITRE	ESC/NDC-FFRDC
		KTR	LMIS&S
		KTR	LMIS&S
		Lt Gen	ESC/CC
		KTR	MDA/BCD-SETA
		CIV	ESC/NDC
		KTR	MDA/BCD-SETA (ACD)
		KTR	MDNTB
		KTR	LMIS&S (ACD)
		Maj Gen	MDA, Deputy Director
		Dr	ISAG
		Maj	exec for Brig Gen Dehnert
		KTR	LMIS&S
		SES	MDA/BC
		GS-12	ESC/NDC
		KTR	LMIS&S (ACD)
		KTR	LMIS&S (ACD)
		KTR	LMIS&S
		KTR	LMIS&S
		KTR	MDA/BCD-SETA (ACD)
		KTR	MDA/BCD-SETA (ACD)
		GS-15	MDA/BCD
		KTR	LMIS&S
		KTR	LMIS&S (ACD)
		Lt Col	MDA/BCD (ACD)

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APPENDIX J. ACD KICK-OFF BRIEFING

This Appendix contains a copy of the kick-off briefing for the ACD project.