

Command, Control, Battle Management, and Communications (C2BMC) System

Executive Summary

- Command, Control, Battle Management, and Communications (C2BMC) (Spiral 6.4) participated in two ground tests, four flight tests, and two exercises in FY11. C2BMC demonstrated the ability to control a single AN/TPY-2 (Forward-Based Mode [FBM]) radar, receive and forward tracks, and provide situational awareness by receiving and displaying element status data from a variety of Ballistic Missile Defense System (BMDS) sensors and weapons. C2BMC has demonstrated the ability to control two AN/TPY-2 (FBM) radars in a hardware-in-the-loop (HWIL) architecture only.
- The Missile Defense Agency (MDA) conducted Flight Test Standard Missile-15 (FTM-15) in April 2011. During the test, C2BMC forwarded AN/TPY-2 (FBM) tracks to Aegis Ballistic Missile Defense (BMD). The Aegis BMD ship conducted a launch-on-remote engagement of an intermediate-range target missile using the forwarded tracks.
- The MDA continues to track and correct C2BMC software anomalies, improve data presentation, and enhance situational awareness.

System

- C2BMC is a combatant command's interface to the fully integrated BMDS.
- More than 70 C2BMC workstations are fielded at U.S. Strategic, Northern, European, Pacific, and Central Commands, numerous Army Air and Missile Defense Commands, Air and Space Operations Centers, and other supporting warfighter organizations. The current C2BMC system provides situational awareness to combatant commands and the National Command Authority with information on missile events, BMDS status, and system coverage. C2BMC also provides above-element deliberate planning at the combatant command and component level, permitting a federation of planners across the BMDS. Elements use their own command, control, battle management systems and mission planning tools for stand-alone engagements.
- Currently, C2BMC Spiral 6.4 provides command and control for a single AN/TPY-2 (FBM) radar, with one radar currently located at Shariki, Japan, and one in Israel.
- C2BMC provides track forwarding of AN/TPY-2 (FBM) and AN/SPY-1 tracks to Ground-based Midcourse Defense (GMD). Additionally, it provides track forwarding of AN/TPY-2 (FBM) tracks to Aegis BMD for cueing and engagement.



- The next two significant upgrades will add new capabilities to the C2BMC:
 - Spiral 6.4 – Initial implementation of the Global Engagement Manager is intended to manage multiple radars in the same area of responsibility.
 - Spiral 8.2 – Although not fully defined by the MDA, the intent is to improve and expand the initial Spiral 6.4 capabilities with the addition of boost phase precision cue, engagement assessment and recommendations, and the implementation of the common X-band interface as the next step toward integrated sensor management.

Mission

U.S. Strategic, Northern, European, Central, and Pacific Commands currently use the following C2BMC tools and capabilities to support ballistic missile defense engagements:

- Deliberate and dynamic planning
- Situational awareness
- Track management
- AN/TPY-2 (FBM) sensor management and control
- Engagement monitoring
- Data exchange between C2BMC and BMD elements
- Network management

Major Contractor

Lockheed Martin Information Systems and Global Services – Gaithersburg, Maryland

Activity

Spiral 6.2 (S6.2)

- The operational version of C2BMC software at the U.S. European Command (USEUCOM) and the U.S. Central Command (USCENTCOM) is 6.2.
- C2BMC S6.2 participated in Fast Eagle, an HWIL test conducted in October 2010. The purpose of the test was to demonstrate the integration of AN/TPY-2 (FBM), C2BMC, Space-Based Infrared System (SBIRS), Aegis BMD, and Patriot for the USCENTCOM defense.
- In March 2011, C2BMC participated in a distributed U.S. Strategic Command (USSTRATCOM) exercise, Assured Response 04D (AR 04D), which focused on the Phased Adaptive Approach (PAA) Phase 1 scenarios. C2BMC provided situational awareness to the USEUCOM and USCENTCOM crews.

Spiral 6.4 (S6.4)

- In June 2011, S6.4 became the operational version of C2BMC software at the U.S. Northern Command (USNORTHCOM), the U.S. Pacific Command (USPACOM), and USSTRATCOM. Two Global Engagement Manager (GEM) suites were installed at USPACOM and USNORTHCOM as part of the initial S6.4 deployment.
- C2BMC participated in the global USSTRATCOM exercise Assured Response 04X (AR 04X). AR 04X used both strategic- and theater-level scenarios in the HWIL configuration to exercise the entire BMDS. C2BMC provided situational awareness for both defense of the continental U.S. and PAA Phase 1 scenarios. The USEUCOM sensor managers from the 357th Air and Missile Defense Detachment used GEM to control two AN/TPY-2 (FBM) radars through HWIL architecture.
- Flight Test Ground-based Interceptor-06a (FTG-06a) was an attempted GMD intercept of an intermediate-range target in December 2010. During the test, C2BMC received AN/TPY-2 (FBM) tracks, forwarded the tracks to GMD, and provided situational awareness in multiple locations. C2BMC received and displayed AN/TPY-2 (FBM), Sea-Based X-band (SBX), SBIRS, and GMD summary data, and collected data to support the FTM-15 risk reduction analysis.
- In February 2011, C2BMC participated in Caravan 2 United States Flight Test-4, which demonstrated interoperability between the Arrow Weapon System (AWS) and BMDS elements. C2BMC exchanged messages with Patriot and AWS and provided situational awareness.
- Ground Test Distributed-04b (GTD-04b), which took place in February and March 2011, was a BMDS distributed test focused on the defense of the continental U.S. from North Korean threats. During GTD-04b, the MDA collected data in support of the tri-node fielding decision for the S6.4 software. The USPACOM sensor managers from the 94th Army Air and Missile Defense Command used GEM to command and control a single AN/TPY-2 (FBM). C2BMC provided situational awareness and track

forwarding functionality and demonstrated the integration of the new AN/TPY-2 software with S6.4.

- C2BMC S6.4 participated in AR 04D with S6.2 in March 2011. Both software versions provided situational awareness to the USEUCOM and USCENTCOM crews. The USEUCOM sensor managers from the 357th Air and Missile Defense Detachment again demonstrated concurrent control of two AN/TPY-2 (FBM) radars in an HWIL architecture.
- In April 2011, the MDA conducted FTM-15, which was the first launch-on-remote engagement of an intermediate-range target with Aegis BMD. The USPACOM sensor managers from the 94th Army Air and Missile Defense Command controlled the AN/TPY-2 (FBM) radar. C2BMC received AN/TPY-2 (FBM) tracks; processed, down-selected, and forwarded the tracks to the firing Aegis BMD ship; and provided situational awareness to the USPACOM crew. The ship launched an interceptor based on the track information received from C2BMC and successfully intercepted the target.
- Ground Test Integrated-04d took place in July 2011. It was a theater-level HWIL event intended to support the PAA Phase 1 assessment. The members of the 357th Air and Missile Defense Detachment controlled two AN/TPY-2 (FBM) radars using two GEM terminals. C2BMC provided situational awareness for the defense of Europe and Israel.
- The MDA conducted BMDS Technical Assessment-04 (TA-04), a fully-digital simulation, in 4QFY11 to assess the status of BMDS element-level digital simulations and BMDS-level integration of those simulations. TA-04 provides risk reduction for Performance Assessment-04, which is planned for 4QFY13. Multiple simulated threat scenarios stimulated digital representations of the BMDS and its elements within the defined PA-04 architecture. A digital C2BMC S6.4 representation primarily simulated PAA Phase 1 functions.
- The MDA conducted FTM-16 Event 2 in August 2011. In an HWIL environment, C2BMC forwarded target tracks from a deployed AN/TPY-2 (Terminal Mode) radar and Space Tracking and Surveillance System to the Aegis BMD simulator at the Navy's Space and Naval Warfare Systems Command.
- C2BMC participated in FTM-15, FTM-16 E1, FTX-16 E1, FTT12, FTM16 E2, and FTX-17 with prototype software to evaluate future capabilities the MDA plans for future deployment.

Assessment

- Apart from already existing C2BMC roles in providing situational awareness and some planning capability, S6.4 introduced the GEM suite at USPACOM and USNORTHCOM with a backup at Missile Defense Integration and Operations Center. GEM allows for automated management of multiple AN/TPY-2 (FBM) sensors located in a single area of responsibility. It also provides greater automation of sensor

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management and improved track processing and reporting while requiring less operator involvement as compared to S6.2 software.

- C2BMC has limited battle management capabilities allowing combatant command sensor managers to direct an AN/TPY-2 (FBM) radar to execute focused search plans or respond to a precision cue. S6.4 demonstrated command and control of a single AN/TPY-2 (FBM) radar in ground and flight tests. S6.4 demonstrated command and control of two AN/TPY-2 (FBM) radars in an HWIL test environment. The MDA plans to demonstrate this capability in a distributed test with deployed assets in December 2011.
- The February 2011 Caravan 2 United States Flight Test-4 revealed international interoperability and situational awareness problems that the MDA is addressing.
- Despite the participation of the USEUCOM sensor managers in several ground test events in FY11, the MDA has not yet tested the S6.4 suite at USEUCOM, which is part of the PAA Phase 1 capability. The MDA has scheduled this testing for November to December 2011.
- The MDA tested C2BMC S6.4 interactions with theater and strategic elements during GTI-04b and GTD-04b events in FY11. C2BMC S6.4 demonstrated interoperability with BMDS elements, but requires more extensive tests in order to support development of tactics, techniques, and procedures

(TTPs). The MDA identified S6.4 software problems and improvements and continues to address them.

- During FTM-15, C2BMC S6.4 demonstrated the ability to forward AN/TPY-2 (FBM) tracks and support Aegis BMD launch-on-remote engagements of intermediate-range ballistic missiles. The MDA will continue to test the S6.4 interoperability with Aegis BMD in FY12 as part of the PAA Phase 1 assessment.
- The MDA is currently analyzing the data from TA-04. The MDA identified several integration and execution issues in TA-04 that the MDA will need to address prior to PA-04.

Recommendations

- Status of Previous Recommendations. The MDA addressed 8 of the previous 10 recommendations. The MDA continues to make progress on the FY06 recommendation to include assessments of information assurance during BMDS-centric C2BMC testing. The MDA has not yet addressed the FY10 recommendation to conduct theater flight testing with S6.4 software with multiple threats and multiple weapon elements.
- FY11 Recommendation.
 1. The MDA should demonstrate the C2BMC S6.4 capability to control at least two operationally-deployed AN/TPY-2 (FBM) radars using operational communications architectures, personnel, and TTPs.

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