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

Executive Summary

- The Missile Defense Agency (MDA) continued to mature the Command and Control, Battle Management, and Communications (C2BMC) system with the implementation of Spiral 6.4-2.2.0 (S6.4-2.2.0) software during FY15. The MDA demonstrated C2BMC battle management functions during ground and flight tests in FY15 including threat assessment, threat evaluation, sensor resource management, sensor track data processing, track reporting, target selection, sensor/weapon access determination, and engagement monitoring. The C2BMC engagement planner provided non-real-time performance analysis of the composition and location of U.S. and allied ballistic missile defense (BMD) assets, but does not currently provide a system-level capability to coordinate engagement decisions.
- C2BMC exercised additional sensor management, track processing, and track reporting functionality during real-world targets of opportunity, providing valuable insight into C2BMC operations with multiple sensors, networks, coalition partners, and weapon systems outside the scope of flight tests.
- C2BMC continued to demonstrate the capability for Combatant Command (CCMD) sensor managers to direct AN/TPY-2 Forward-Based Mode (FBM) radars to execute focused search plans and respond to precision cues and reporting of system track data during ground and flight tests. Ground testing demonstrated automated management of multiple AN/TPY-2 FBM sensors. Ground testing further demonstrated the successful tasking/managing of the Kyoga-Misaki AN/TPY-2 (FBM) sensor and boost phase cueing between multiple AN/TPY-2 (FBM) sensors.
- The MDA and Red Teams from the Threat Systems Management Office conducted cyber exercises of future spirals of the Ballistic Missile Defense System (BMDS) elements including C2BMC using the DOD Enterprise Cyber Range Environment (ECRE). The MDA continues to evaluate the results of this event to identify solutions to reduce the likelihood or mitigate the effects of a cyber intrusion. The MDA teamed with U.S. Cyber Command's (USCYBERCOM's) BMDS national Cyber Protection Team (CPT) to conduct specialized testing at C2BMC suites in U.S. Central Command (USCENTCOM) and U.S. European Command (USEUCOM).

System

- The C2BMC system is a CCMD interface to the BMDS. More than 70 C2BMC workstations are fielded at U.S. Strategic Command (USSTRATCOM), U.S. Northern Command (USNORTHCOM), USEUCOM, U.S. Pacific Command (USPACOM), and USCENTOM; numerous

Army Air and Missile Defense Commands; Air and Space Operations Centers; and other supporting warfighter organizations.
  - The current C2BMC provides CCMDs and other senior national leaders with situational awareness of BMDS status, system coverage, and ballistic missile tracks by displaying selective BMDS data for strategic/national missile defense and for theater/regional missile defense, utilizing multiple message formats and diverse terrestrial and satellite communications paths.
  - The C2BMC also provides upper echelon planning at the CCMD and component level. BMDS elements (Aegis BMD, Ground-based Midcourse Defense [GMD], Patriot, and Terminal High-Altitude Area Defense [THAAD]) use their own command and control battle management systems and mission-planning tools for stand-alone engagements.
  - The C2BMC S6.4 suite provides command and control for the AN/TPY-2 (FBM) radar as well as track reporting to support weapon system cueing and engagement operations.
- Using the BMDS Communications Network, the C2BMC forwards AN/TPY-2 (FBM) and AN/SPY-1 tracks to GMD. C2BMC uses the Tactical Digital Information Link-Joint message formats to send system track data for THAAD, Patriot, and coalition system cueing and for Aegis BMD engagement support.
- The C2BMC S8.2 (projected for FY17/FY18) is intended to mature and expand S6.4 capabilities as the next major step toward integrated, automated sensor management and engagement coordination.

Mission

USSTRATCOM, USNORTHCOM, USEUCOM, USPACOM, and USCENTCOM use C2BMC to support ballistic missile defense engagements. CCMDs use C2BMC for:

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

Major Contractor

Lockheed Martin Corporation, Information Systems and Global Solutions – Gaithersburg, Maryland

Activity

- The MDA conducted C2BMC system and sensors testing during FY15 in accordance with the DOT&E-approved Integrated Master Test Plan.
- During 1QFY15, the MDA and Red Teams from the Threat Systems Management Office conducted cyber exercises of future spirals of the BMDS elements, including C2BMC, using the DOD ECRE. The MDA continues to evaluate the results of this event to identify solutions and/or procedures to reduce the likelihood of occurrence or mitigate the effect of a cyber intrusion. The MDA teamed with USCYBERCOM's BMDS CPT to conduct specialized testing at C2BMC suites in USCENTCOM and USEUCOM.
- In January 2015, the MDA conducted Ground Test Distributed-04e (GTD-04e) Part 2, an operational assessment of new USPACOM and USNORTHCOM C2BMC and AN/TPY-2 (FBM) radar functionality. The C2BMC managed two AN/TPY-2 (FBM) radars using operational communications. The radars detected and tracked simulated intermediate-range ballistic missile and intercontinental ballistic missile threats to support regional and strategic defense. The C2BMC also tasked the Kyoga-Misaki AN/TPY-2 (FBM) radar, managed boost phase cueing between the two AN/TPY-2 (FBM) radars, and exercised updates to the focused search plans and threat enumerations.
- In May 2015, the MDA exercised C2BMC in the Ground Test Integrated-06 (GTI-06) Part 1 test, a hardware-in-the-loop event to provide data on mutual sensor support between multiple AN/TPY 2 (FBM) radars equipped with updated search plan configurations and debris mitigation capabilities (radar software CX-2.1.0). C2BMC software version S6.4-2.2.0 managed multiple AN/TPY-2 (FBM) radar representations in a cross-area of responsibility (AOR) data sharing environment between USEUCOM and USCENTCOM. The AN/TPY-2 (FBM) radar representations detected and tracked simulated medium-range ballistic missile threats and forwarded the track data to the C2BMC.
- The BMDS Operational Test Agency and the MDA attempted Flight Test, Operational-02 (FTO-02) Event 1 in June 2015 at the Pacific Missile Range Facility on Kauai, Hawaii. The MDA intended to demonstrate the operational capability of the regional/theater European Phased, Adaptive Approach Phase 2 BMDS, anchored by the Aegis Ashore Missile Defense System (AAMDS), to defend Europe against medium-range ballistic

missiles. The test was to be the first target intercept by the AAMDS and the first flight for the Standard Missile (SM)-3 Block IB with threat update guided missile. C2BMC software version S6.4-2.2.0 was to have managed an AN/TPY-2 (FBM) radar (software version CX-2.1.0) during the event. Due to a target malfunction, the test was not completed and the SM-3 guided missile was not launched. The MDA plans to attempt this test again in December 2015.

- In July 2015, C2BMC software version S6.4-2.2.0 participated in GTI-06 Part 3, a test designed to assess BMDS performance and interoperability across the USNORTHCOM mission space. C2BMC managed one AN/TPY-2 (FBM) radar (software version CX-1.2.3) and demonstrated track data forwarding to GMD Fire Control and cueing of Aegis BMD using AN/TPY-2 (FBM) track data.
- The BMDS Operational Test Agency and the MDA conducted FTO-02 Event 2 and Event 2a in September and October 2015 at Wake Island and the broad-ocean area surrounding it. The MDA designed the test mission to demonstrate a layered BMDS with multiple combat systems sharing common defended areas and shot opportunities against two threat-representative ballistic missiles. The primary test objective was to assess Aegis BMD system capability to prosecute a ballistic missile threat engagement in the presence of non-organic post-intercept debris, while simultaneously conducting Anti-Air Warfare. The THAAD combat system, using Lot 4 interceptors for the first time, generated the non-organic post-intercept debris scene for Aegis BMD. C2BMC software version S6.4-2.2.0 managed one AN/TPY-2 (FBM) radar, track reporting of sensor data to Link 16, and forwarded track data between Aegis BMD and THAAD systems.
- At-Sea-Demonstration-15 (ASD-15) was a multinational interoperability demonstration of coalition Integrated Air and Missile Defense. The event used new NATO data-sharing gateways in a live fire event. C2BMC software version S6.4-2.2.0 participated as a data-sharing component between U.S. Aegis BMD and three NATO partners.
- The BMDS OTA and the MDA conducted GTD-06 Part 1 in October 2015. The test assessed the BMDS European Phase, Adaptive Approach Phase 2 architecture against short-range and medium-range ballistic missile engagements in USEUCOM and USCENTCOM. C2BMC software version

S6.4-2.2.0 managed multiple AN/TPY-2 (FBM) radars and exercised cross-AOR data sharing.

- Throughout FY15, the MDA exercised C2BMC sensor management, track processing, and track reporting during real-world targets of opportunity. The system demonstrated dual radar management and track processing/reporting utilizing operational C2BMC suites and communications. These events also demonstrated USEUCOM-USCENTCOM cross-AOR data flows, and track correlation and reporting for AN/TPY-2 (FBM) and other elements (e.g., Aegis BMD, Arrow, and Patriot).

Assessment

- The C2BMC software version S6.4 Global Engagement Manager (GEM) suite provided automated management of multiple AN/TPY-2 (FBM) radars in a single AOR and enhanced track processing and reporting while requiring less operator involvement as compared to the S6.2 software and the S6.4 Combatant Command (COCOM) suite.
- C2BMC demonstrated dual AN/TPY-2 (FBM) sensor management in the USPACOM AOR and USEUCOM AOR during ground tests in FY15. Dual radars were not available for assessment during flight tests; however, C2BMC did exercise dual radar management, precision cueing, and system track formation during real-world targets of opportunity in both the USPACOM and USEUCOM AORs.
- During GTD-04e Part 2, C2BMC demonstrated boost phase cueing capabilities and focused search plan tasking while managing two AN/TPY-2 (FBM) radars in USPACOM, and demonstrated the AN/TPY-2 (FBM) radar's ability to support GMD engagement of intermediate-range ballistic missile and intercontinental ballistic missile threats. The radars provided data on the simulated missile threats to the C2BMC system that supported BMDS situational awareness, BMDS sensor tasking, and GMD engagement planning. C2BMC experienced limitations in its ability to task focused search plans during the test. The MDA is addressing the focused search plan limitations and will demonstrate the fixes in GTI-06 Part 2 in FY16.
- The MDA tested new data exchange conditions between USEUCOM and USCENTCOM during GTI-06 Part 1 and assessed data on new cooperative search fences. C2BMC generally performed nominally, receiving AN/TPY-2 (FBM) and Link 16 data and forwarding system tracks on Link 16. In addition, real-world events demonstrated NATO and Israel data flows, interoperability, and track correlation with C2BMC that could not be assessed in the ground test.

- The MDA demonstrated C2BMC software version S6.4-2.2.0 battle management functions during ground and flight tests in FY15 including threat assessment, threat evaluation, sensor resource management, sensor track data processing, track reporting, target selection, sensor/weapon access determination, and engagement monitoring. The C2BMC engagement planner provided non-real-time performance analysis of the composition and location of U.S. and allied BMD assets but does not currently provide a system-level capability to coordinate engagement decisions. CCMD sensor managers can use C2BMC to manually task a single AN/TPY-2 (FBM) radar to execute focused search plans, respond to a precision cue, or automate radar tasking of up to two radars.
- During test execution preparation for FTO-02 E1, a networking problem was discovered with the AN/TPY-2 (FBM) radar software version CX 2.1.0 that forced the Soldiers to use non-operational radar management tactics, techniques, and procedures. The problem was fixed and demonstrated in GTD-06 Part 1.
- The majority of FY15 testing used the C2BMC GEM suite. In the event of a GEM suite failure, C2BMC has an option to use the COCOM suite for management of a single AN/TPY-2 (FBM). This option was tested during FTO-02 E1a hardware-in-the-loop and GTI-06 Part 1 testing and demonstrated nominal performance.

Recommendations

- Status of Previous Recommendations. The MDA has addressed 12 of 13 previous recommendations for the C2BMC program and should continue to include cybersecurity assessments in BMDS-level testing. The MDA made progress on a C2BMC cyber testing strategy by performing basic testing and system scans during GTI-06 Part 1, investigating and demonstrating cyber testing techniques during multiple ECRE events, and teaming with USCYBERCOM's BMDS CPT to conduct specialized testing at C2BMC suites in USCENTCOM and USEUCOM.
- FY15 Recommendation.
  1. As the Warfighter BMDS concept of operations continues to evolve, the MDA should periodically assess the COCOM suite for its ability to provide adequate quality of service in cases of GEM suite failure.