Cruise Missile Defense

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Summary

Congress has expressed interest in cruise missile defense for years. Cruise missiles (CMs) are essentially unmanned attack aircraft—vehicles composed of an airframe, propulsion system, guidance system, and weapons payload. They may possess highly complex navigation and targeting systems and thus have the capability to sustain low, terrain-hugging flight paths as well as strike with great accuracy. CMs can be launched from numerous platforms—air-, land-, or sea-based—and they can be outfitted with either conventional weapons or weapons of mass destruction (WMD). The Department of Defense is pursuing several initiatives that seek to improve capabilities against an unpredictable cruise missile threat. This report will be updated as events warrant.

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Background

The National Defense Authorization Act for FY1996 called on the Department of Defense (DOD) to embark upon an initiative to develop cruise missile defense (CMD) programs emphasizing operational efficiency and affordability. Advanced cruise missiles (CMs)—those designed with stealthy capabilities to evade detection—were noted as a prominent threat prompting the need for effective CMD. This CMD initiative was to be coordinated with other air defense efforts; that is, with "cruise missile defense programs ... and ballistic missile defense programs ... mutually supporting" each other.[1] Three years later, in conjunction with the National Defense Authorization Act for FY1999, the Senate Armed Services Committee noted: "[T]he committee does not believe that the Department of Defense has adequately integrated its various cruise missile defense programs into a coherent architecture and development plan."[2]

DOD has indicated a commitment to developing CMD capabilities—within its larger strategy of air defense requirements—that demonstrate operational effectiveness. Unlike past approaches to CMD that critics assert were "stovepiped"—individually driven by the Services' respective objectives—current and future programs are meant to emphasize effectiveness based on inter-Service synergy, or jointness. Whether or not the Pentagon will be able to integrate CMD plans to a point of effective interoperability is an important question. Many analysts believe that no mission area will rely more on jointness than detection and intercept of advanced CMs. An examination of CMD development, therefore, offers some insight into the progress DOD is making in terms of increased joint warfighting capability.

CMD today is primarily an issue of force protection for U.S. troops deployed in a theater of conflict. The CM threat to the United States appears lower than the theater CM threat, but it also seems likely to grow. Given ongoing proliferation challenges, there is general consensus that CM technology will continue to spread.[3] Many claim that the United States' dominance of manned military aviation will drive many countries to adopt CMs as the "poor man's air force." By 2015, the CIA estimates that up to two dozen nations will be able to pose a serious CM threat—primarily in theater but also through forward-deployed weapons platforms.[4] Also, the U.S. failure to detect several Iraqi CMs launched against American assets during Operation Iraqi Freedom has led some in DOD to now deem CMD a "critical mission area."[5]

CMs present many operational challenges.[6] Effective CMD requires rapid and accurate performance of a series of military tasks collectively known as the "kill chain." First, surveillance radars must detect manned and unmanned aircraft; including CMs. The second major step involves continuously tracking the aircraft along its course, a process complicated by what may be an elusive flight path. Next, the aircraft must be identified. It must be concretely determined whether the airborne object is a CM, or a friendly or neutral aircraft. This process, called combat

[1] *National Defense Authorization Act For Fiscal Year 1996*, H.Rept. 104-450, p. 57.

[2] *National Defense Authorization Act For Fiscal Year 1999*, S.Rept. 105-189, p. 154.

[3] For more information, see CRS Report RL30427, *Missile Survey: Ballistic and Cruise Missiles of Selected Foreign Countries*, by (name redacted) and CRS Report RL30699, *Nuclear, Biological, and Chemical Weapons and Missiles: Status and Trends*, by (name redacted).

[4] Michael C. Sirak, "US DoD Seeks to Bolster Cruise Missile Defences," *Jane's Defence Weekly*, Sept. 2, 2002.

[5] "Joint Officials Plan 2nd Annual Cruise Missile Defense Conference," *Inside Missile Defense*, June 23, 2004.

[6] For more information on air defense issues and challenges, see CRS Report RS21394, *Homeland Security: Defending U.S. Airspace*, by (name redacted).

identification, is vital to lowering the chances that a friendly or neutral aircraft might be erroneously identified as a threat, and attacked—a scenario that unfortunately played out several times during Operation Iraqi Freedom. Once a CM threat is identified, a decision on how to engage the CM must be made: Which defense assets—naval, ground, or airborne platforms—will be used to try to intercept the CM? The final step of the kill chain involves actually intercepting or neutralizing the CM with weapons—missiles and gunfire being the only two current options. Other technologies, such as directed energy weapons, are being studied.[7]

The U.S. military has historically fielded Service-oriented CMD systems—independent land-, air-, and sea-based weapons platforms with CMD applications.[8] Although this strategy has yielded fairly effective point defense capabilities against conventional airborne threats, most analysts agree that an advanced CM threat will require more effective defenses. The North American Aerospace Defense Command (NORAD), for example, is attempting to augment its sensor coverage capabilities, and link with Service weapons systems for target engagement of low flying CMs.[9] Efforts are also underway to marry military sensors and radars employed by the Federal Aviation Administration (FAA) to provide comprehensive air surveillance of the United States.[10]

Increased effectiveness against advanced CMs will require improved joint surveillance, tracking and combat identification capabilities, and increased weapons range.

Key DOD CMD Efforts

The Pentagon's efforts to improve CMD capabilities are addressed through multiple offices and strategies. Some of the most prominent ones are described below.

Joint Theater Air and Missile Defense Organization (JTAMDO)

JTAMDO was established in 1997 to ensure the coordination of CMD and ballistic missile defense programs as well as to integrate DOD's theater air and missile defense requirements. As a result of restructuring under the Unified Command Plan of 2002, U.S. Strategic Command (STRATCOM) took responsibility of global missile defense and JTAMDO was tasked with a support role to STRATCOM. JTAMDO's current mission is to develop joint capabilities and structures for an air and missile defense family of systems. JTAMDO's current activities also include force protection, homeland air security, assessing ballistic missile defense architectures, and chemical, biological, radiological, and nuclear defense requirements.

[7] Robert Wall, "Sketching the Future; Developers Mull Upgrading USAF Bombers with Laser Weapons," *Aviation Week & Space Technology*, vol. 160, issue 23, June 7, 2004.

[8] Major examples of these platforms are as follows: the Army's Patriot air defense system, the Navy's Aegis missile defense system, and the Air Force's surveillance and tactical aircraft.

[9] "NORAD-Sponsored ACTD Promises Enhanced Cruise Missile Defense," *Inside the Air Force*, Aug. 13, 2004.

[10] Michael Fabey. "National air defense system behind schedule, over budget, AF says." *Aerospace Daily & Defense Report.* Oct. 25, 2006.

Single Integrated Air Picture (SIAP)

SIAP Joint Program Office (JPO) is tasked with leading efforts to develop a SIAP—the integration of the Services' air defense technologies into a total, shared environmental awareness. Presently, the platforms of any one Service are only able to provide a partial picture of the total threat environment. A SIAP is intended to detect and continuously track all airborne objects and ensure that all allies within a theater have the same tracking data. Within a theater, where a myriad of assets—friendly, hostile, and neutral—may be concurrently airborne, a SIAP would be central to timely decision-making regarding threat responses. The level of awareness offered by a SIAP will be most dependent upon newer data linkages, and the ability to track every object with one clear signature. SIAP JPO has conducted technical assessments to develop an integrated architecture for data sharing. The technology is primarily aimed at accelerating the interoperability of those systems designed for airborne threat detection and those designed for intercept—commonly known as the "sensor to shooter" linkage. JSSEO projects fielding this technology in September 2005.[11] It estimates SIAP development costs to be around $160 million from FY2004 to FY2009, and the Services will need to spend $600 million to incorporate SIAP technology into their existing weapons platforms.[12] DOD hopes for a SAIP initial operational capability (IOC) by 2012.[13]

Joint Combat Identification Evaluation Team (JCIET)

JCIET was deactivated in February 2005. When active, JCIET assessed issues associated with combat identification and finding doctrinal, technological, and procedural solutions to reduce the incidence of fratricide.[14] JCIET coordinated joint exercises in which multiple Service platforms are tested for performance in detection, tracking, and identification of airborne threats—CMs being among them.[15] The data collection and evaluation from these exercises aids in determining how to address the advanced CM threat. JCIET efforts aided combat identification capabilities and can therefore contribute to a clearer air picture.

Integrated Fire Control (IFC)

IFC attempts to decouple Service-specific and platform-specific fire control radars from their weapons to create over-the-horizon and joint CMD intercept capabilities. Presently, fire control radars control specific weapons.

The Navy, for example, can intercept a CM with a surface-to-air missile guided by the ship's Aegis radar. A Patriot missile can intercept CMs based on its radar's information, and an F-15's radar would guide its air-to-air missiles to intercept a CM.

IFC would enable an airborne surveillance platform such as an E-2C Hawkeye, E-3 AWACS, or the Joint Land Attack Cruise Missile Defense Elevated Netted Sensor (JLENS) to relay CM

[11] "Common Aerospace Capability Standard to be Released in 2005," *Aerospace Daily & Defense Report*, July 28, 2004.

[12] "Pentagon's SIAP Office Expects to Deliver First Capability Set in FY-05," *Inside Missile Defense.* Feb. 18, 2004.

[13] Sebastian Sprenger. "Key 'Single Integrated Air Picture' Document Delayed Until Year's End." *Inside Missile Defense.* Sept. 13, 2007.

[14] For more information on JCIET, see http://www.jfcom.mil/about/com_jciet.htm.

[15] Sandra I. Erwin, "Air Warfare's Holy Grail: A 'Single Integrated Picture,'" *National Defense*, Sept. 1, 2002.

tracking information to either ground- or air-based assets for engagement.[16] Furthermore, once ground-based weapons, for example, have been sent to intercept the CM, radars external to the launch platform will be able to direct the weapons towards the CM. These objectives of IFC would remove the horizon or line-of-sight limitations that currently exist for CMD, thus increasing the time and distance for intercept. Decoupling the fire control radar from the weapon could improve capabilities against stealthy CMs by providing numerous and supporting surveillance perspectives.

Combined with the goals of a single integrated air picture, IFC would create a much wider and more defensible area of coverage against advanced CMs. IFC efforts for missile defense are now being undertaken within the Army's Integrated Fire Control Product Office and the Navy's IFC counter air program office.

Congressional Considerations

Generally at issue is whether or not DOD has adequately responded to congressional directives on CMD. This question is best addressed by examining the three main parts of the 1996 congressional CMD initiative: a suitable coordination of CMD with ballistic missile defense (BMD) efforts, the development of CMD for near-term as well as advanced CM threats, and affordability and operational effectiveness for all CMD efforts.

Congress directed DOD to undertake BMD and CMD efforts in a mutually supportive fashion. Some argue that Pentagon efforts on CMD have taken a back seat to BMD efforts. In terms of resource allocation, much more focus has been placed on ballistic missile defense than on CMD. In its budget request for FY2005, for example, DOD sought $9.2 billion for the Missile Defense Agency—the office tasked with BMD—and asked for $239 million toward the development of CMD.[17] On the one hand, it can be argued that BMD must remain paramount given the known ballistic missile threat—nuclear missiles are already targeted at the United States and enemy ballistic missiles have already taken a toll on U.S. troops during wartime. On the other hand, some contend that the current level of prioritization may be too lopsided. As noted by the Defense Science Board, the CM threat is highly unpredictable and advanced CMs could emerge quickly and unexpectedly.[18]

In relation to the congressional directive to address near-term and future airborne threats, DOD has stressed effective theater and air missile defense as a prime objective. In addition to upgrading many of the Services' individual CMD weapons platforms, DOD is working toward many of the strategies relevant to future CMD—a single integrated air picture, better combat identification, and integrated fire control among them. DOD anticipates that such building blocks will enable the employment of a joint engagement zone (JEZ) for theater war fighting between 2015 and 2020.[19] Currently, theater commanders try to reduce the chance of fratricide by

[16] For more information on JLENS, see CRS Report RS21886, *Potential Military Use of Airships and Aerostats*, by (name redacted).

[17] Prepared testimony of U.S. Secretary of Defense Donald H. Rumsfeld before the Senate Appropriations Committee, Defense Subcommittee, May 12, 2004. DOD was not able to provide more contemporary estimates for the update of this report.

[18] Report of the Defense Science Board Summer Study on Cruise Missile Defense, Undersecretary of Defense for Acquisition & Technology, Washington, DC, January 1995, p.14.

[19] Information provided to CRS by JTAMDO.

separating CMD forces into distinct zones: missile engagement zones and fighter engagement zones. This separation, however, also reduces effectiveness. A JEZ is intended to enable interoperability among the Services' sensors and weapons systems for offensive and defensive operations. Will the CMD challenges inherent to creating a JEZ really be overcome by 2010? To do so would require adequate investments of time and effort by the Pentagon. However, JTAMDO, for example, estimates that as little as 20% of its time and manpower is currently going toward CMD efforts. At the same time, it estimates that upwards of 40% of its resources are being put toward support of the initial defensive operations of BMD.[20] Moreover, JTAMDO resources are being expended toward homeland air security coordination, force protection, and WMD defense requirements. Although some measure of action toward addressing the CM threat is being taken, the level of urgency remains an issue—as DOD may now deem other defense activities more pressing.

Congress noted that CMD measures should be undertaken with operational effectiveness as a core criterion. Since interoperability of resources remains the paramount feature in the Pentagon's activities to develop effective CMD, consequences associated with jointness are a key factor to monitor. Further, several CMD objectives will likely enable other mission areas. An effective SIAP, for example, not only will offer CMD applications but also will enable counter-air operations and battlefield interdiction efforts. Increased jointness associated with CMD efforts may also create some level of organizational friction, and Congress may come under pressure to provide oversight to resolve Service "turf battles." As CMD efforts become more integrated, Service control over traditionally clear boundaries may get cloudier. With enhanced IFC, for example, Air Force or Navy assets may be able to direct ground-based weapons that are currently under Army control. It is possible that narrow Service interests may hinder the implementation of—and thus effectiveness of—future joint CMD capabilities. Moreover, will the Services' CMD operational overlap lead to a reorganization of which Services control—and are funded by Congress for—certain weapons systems and programs?

The congressional directive to develop affordable CMD measures is an important issue in terms of procurement. Current cost-exchange ratios associated with CMs favor attackers over defenders; cruise missiles can be cheap and defenses are costly. For example, Patriot missiles, bought at roughly $2.5 million apiece, can be effective interceptors for incoming CMs, but those CMs may be simple designs costing only a couple hundred thousand dollars apiece.[21] Moreover, intercept costs are only one of many kill chain expenditures that can make CMD forces much more expensive than the CM threat. On the whole, the Pentagon seems to have promoted the pursuit of advanced CMD programs to combat sophisticated CM attacks. In terms of simple CM threats, however, more resources may be needed to produce less costly but nonetheless effective defenses. DOD's Defense Advanced Research Projects Agency (DARPA) has a low-cost cruise missile defense program that focuses on countering low-tech CMs by reducing the cost of interceptors. DARPA hopes to develop CMD interceptors that would cost as little as $40,000. Even cheaper intercept technologies may be required for cost-effective CMD, especially if faced with large-scale attacks by cheap CMs. Inexpensive but proven "jamming" technology (e.g., high-power microwaves) that can disrupt CM guidance systems might be a potentially useful approach. Also, point defense weapons, such as radar-guided machine guns with high rates of fire, could be employed against less sophisticated CMs.

[20] Estimates provided to CRS by JTAMDO.

[21] Kathy Gambrell, "Senate Begins 2nd Day of Debate on Fiscal '05 Defense Budget," *Aerospace Daily & Defense Report*, May 19, 2004.

A final consideration pertains to the deactivation of JCIET. Combat identification remains, and is likely to remain one of the most challenging aspects of CMD. Overseers of DOD's activities may wish to ask why the department deactivated the only organization dedicated specifically to improving joint CMD combat identification capabilities. It is not evident that other organizations, such as JTAMDO, have increased their work on CMD combat identification issues to make up for JCIET's demise. Nor is it clear that improvement in other facets of CMD will make up for ineffective combat identification. If a friendly or neutral manned aircraft is inadvertently shot down by U.S. CMD platforms in the future, DOD's decision to deactivate JCIET may come under intense scrutiny.

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