MODERNIZING AIR AND MISSILE DEFENSE

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Introduction

Army transformation challenges all mission areas, and air defense artillery is no exception. In preparing for an ever-escalating and proliferating threat consisting of both "air-breathing" and missile (ballistic and cruise) carriers capable of transporting weapons of mass destruction (WMD), DOD is developing a comprehensive and integrated array of Defense systems designed to protect the United States, its deployed elements, and allied forces. These systems include land-, sea-, and air-based assets and counter-specific threat vulnerabilities in all phases. Traditional development programs produce complete systems for integration into the existing force. We must now consider an alternative acquisition approach for air and missile defense (AMD) modernization that is more responsive to the Army's immediate needs than today's system-centric process.

Background

The Army's systematic, multitiered approach to all land-based AMD is in various stages of development, production, and fielding. The Army currently operates short range air defense (SHORAD) against air-breathing threats in the forward area, including Stinger-missile-based weapons platform, the Sentinel radar, and battle management via Forward Area Air Defense Command and Control (FAAD C2).

More stressing, longer-range targets are addressed by the Army's "lower-tier" PATRIOT missile system. PATRIOT is self-contained and includes an acquisition/track-fixed azimuth radar, missiles on a mobile launcher, and organic command and control equipment. Designed in the 1980s, PATRIOT provides primary air defense against air-breathing threats for fixed assets. However, because of numerous equipment upgrades (most notably the fielding of the PATRIOT Advanced Capability-3 (PAC-3) missile), the system is now effective against all classes of the modern AMD threat. PAC-3 was designed specifically for hit-to-kill lethality against sophisticated threat missiles.

The most stressing and longest range ballistic missiles will be countered by Theater High Altitude Air Defense (THAAD), the Army's "upper-tier" system currently in engineering and manufacturing development. THAAD is also configured with a powerful fixed-azimuth acquisition and track radar, a hit-to-kill missile and mobile launcher, and a tactical operations center (TOC).

SHORAD and upper- and lower-tier systems share a common architecture. Each system requires sensors for acquisition and fire control, "shooters" (missile/launcher combinations) for lethal destruction of the target, and battle management assets such as TOCs to direct the engagement. A significant goal in developing the Army's AMD involves seamlessly integrating all available sensors, shooters, and TOCs within a deployable architecture. The resulting engagements will integrate the best data available from any source and the most cost and operationally effective interceptor. Common AMD components are desirable. Why perpetuate separate TOCs (and military occupational specialties) when a common and configurable hardware and software approach could result in a single AMD TOC?

Missiles that can perform effectively against today's sophisticated threat are inherently expensive. This expense is due to demanding performance envelopes and the advanced onboard sensor, guidance, and processor technologies required to overcome the limits of ground-based guidance systems. Expending a PAC-3 missile against an unsophisticated, inexpensive, but WMD-capable large caliber rocket is not cost-effective. For this reason, the Army requires a low-cost, lethal defense against such short-range threats. Leap-ahead technology shooters such as directed energy or kinetic energy projectiles are an integral part of the future AMD architecture.

Lower-Tier Modernization

Modernizing the Army's lower tier provides the framework for the "system-of-systems" integration of SHORAD, lower tier, and THAAD. The system functionality and capabilities necessary to achieve an integrated and cost-effective AMD are resident in the Army's Medium Extended Air Defense System (MEADS) operational requirements document (ORD). MEADS will provide the required mobility and deployability, be tailorable to the mission, and provide 360-degree protection against all lower-tier ballistic and cruise missile threats and all air-breathing targets. The Army requires that MEADS be fully interoperable in the joint and combined AMD architecture. These capabilities are achieved with a "netted and distributed" system design that eliminates any site- or battery-centered dependencies. The system architecture is designed to be capable of what the Air Defense Artillery (ADA) School has dubbed "plug and fight" functionality. Similar to modern computer peripherals, the system is tailorable to the mission by "plugging in" the necessary mix of sensors, shooters, and TOCs. Once fully netted and distributed, the AMD task force can be flexible and reconfigurable such that no single point failures result from the loss of any single asset. If a sensor or TOC is disabled, another similar asset replaces it seamlessly.

Current Approach

To achieve the objective, lower-tier modernization could follow various acquisition paths. The current approach involves a full-up, concurrent system development that replaces PATRIOT ground equipment upon fielding. This is the basic construct of the MEADS trinational cooperative development program involving the United States, Germany, and Italy. MEADS resulted from an unprecedented agreement on an international common operational requirement (ICOR) that combined three separate but similar national requirements. Concurrent, full-system development is most acceptable to all three nations. Germany intends to completely replace NATO Hawk while Italy is acquiring MEADS as a new capability. This approach is also highly desirable because all participating nations share development costs.

Because all three nations must agree to make changes, the ICOR is fixed and not subject to the typical programmatic turmoil that results from requirement changes. However, three separate national funding processes also result in little flexibility to make any changes in the acquisition strategy. A full-up system development is expected to result in MEADS fielding in 2010 or later. However, critical ADA system enhancements are required before 2010 to support Army transformation initiatives.

Full system MEADS development focuses (to varying degrees) on developing all components that are guided by system engineering priorities. All components and system engineering elements mature at the necessary rate to arrive simultaneously at a final system configuration. Given sufficient funding, this approach can result in achieving full performance as rapidly as possible. However, because resources must focus across development activities and address the most difficult areas first, there is little flexibility to "spin off" individual system capabilities at the earliest opportunity. In this traditional process, the materiel developer does not need to work or expend resources early on the technical no-brainers (that may result in enhancing capabilities immediately) unless system developments are on the critical path to full performance.

Alternative Approach

An alternative approach is to block upgrade, in phases, the existing AMD systems by considering the most pressing operational needs and relative technology maturity first. This "spiral development" approach is described in the DOD 5000 guidance that governs major acquisitions. In the case of lower-tier upgrades, this approach is enabled by the success of the lower-tier missile. PAC-3 provides lethal, effective, hit-to-kill performance against medium-range ballistic and cruise missiles. The missile itself, typically the "long pole" in a missile system development program, requires only minor modification for system integration.

Phase 1 should address the rapid deployment vision of Army transformation and the overall need to relieve demand on strategic airlift. This first step results in fielding a lightweight missile launcher to accommodate the PAC-3 missile and replaces the current PATRIOT launcher with a MEADS-compliant common launcher. Phase 1 also produces a prototype MEADS X-band fire control radar (FCR) and matures ground-based laser technology for integration into a mobile platform. Phase 1 also marks the beginning of the common hardware and software development for the objective Army AMD TOC.

Phase 2 provides a MEADS FCR and a MEADS TOC replacing the PATRIOT radar and engagement control station. Minor missile modifications are incorporated to accommodate the revised system configuration. Laser technology is demonstrated on a mobile platform. A prototype long-range surveillance sensor is developed.

Phase 3 results in fielding a common Army AMD TOC hardware and software package to implement an AMD-wide netted and distributed system integrated into the Joint Single Integrated Air Picture architecture. A long-range surveillance sensor is fielded along with the laser platform. All components undergo final system integration.

This phased approach introduces increasing capabilities as they mature rather than waiting for an entirely new system to complete development. The phased approach effectively evolves the various AMD elements into a tailorable, integrated configuration. The MEADS ORD is not changed; the acquisition strategy to satisfy that requirement is modified. This approach would also set the stage for a new way to acquire and organize future AMD developments. Now is the time to evolve the acquisition organizations as well. Instead of system project managers (PMs), system component PMs would develop product lines—sensors, shooters, TOCs—that would ensure interoperability across the product lines. New technology enhancements and systematic upgrades could be introduced without the parochialism of individual system proponents.

Conclusion

Critics will undoubtedly respond from a system engineering standpoint and would be right to express concern. Given current organizational structures and today's independent system design approaches, simply reorganizing developments immediately along product lines would be impossible. However, the ADA vision involves a fully netted and distributed, plug-and-fight capable, task-force approach to AMD. Accomplishing this requires common system architectures, technologies, and components to ensure vertical and horizontal interoperability. Future modernization is likely to occur selectively across the force rather than on an individual basis. System engineering is critical but must be focused at the system-of-systems level.

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