AIR AND BALLISTIC MISSILE DEFENSE SYSTEMS

LTC. Associate Professor Eng. Pamfil ŞOMOIAG, PhD.,
CPT. Lecturer Eng. Cristian-Emil MOLDOVEANU, PhD.

Military Technical Academy, Bucharest, Romania, pamvas@mta.ro

Abstract

This paper presents the stage of development of air and ballistic missile defense, consonant with the potential threats of the modern operating theater. The authors are describing in a short presentation the Defense Architecture and Systems as well as, the Technologies applicable to air and missile defense elements. The army of the future must be prepared to operate in theaters where a wide variety of air and missile systems could be used against it.

Keywords: air missile, ballistic missile, defense systems

1. Introduction

The Army has considerable expertise in developing both air defense and ballistic missile defense systems. For many years, it has played a dominant role in developing ground-to-air missiles for air defense.

Because of the multidisciplinary nature of these topics, it was convened to integrate the various aspects of the problem and relate them to Army interests and capabilities for the next years.

2. The Threat Systems

The Army of the future must be prepared to operate in theaters where a wide variety of air and missile systems could be used against it. Achieving a robust defense capability against these threats is both critical and challenging.

In particular, the introduction of stealth capability into opposing forces will become a determining factor in fielding an adequate theater air and missile defense.

Potential threat vehicles can fall into any of the following categories:

• Theater ballistic missiles (TBMs) have ranges varying from about 100 km to more than 2,000 km. They can fly on elevated, depressed, or minimum energy trajectories. They will eventually have some form of penetration aids and pinpoint accuracy.

• Cruise missiles and UAVs may be able to operate at altitudes from less than 25 m up to 25 km and at speeds up to several hundred meters per second. They may use stealth technology and electronic countermeasures. Although their operating envelopes are similar to those of manned fixed wing aircraft, they can be much smaller, less expensive, and more numerous than manned aircraft.

• Standoff tactical air-to-surface missiles are fired from fixed wing aircraft at ground targets while the launching aircraft remains outside the reach of short-range defenses located near the missiles' targets.

• Manned fixed wing aircraft operate at altitudes from less than 100 m up to 25 km and at speeds up to several hundred meters per second. They may use stealth technology, electronic countermeasures, decoys, and infrared countermeasures.

• Helicopters operate at comparatively low speeds and at altitudes from ground level up to 3 to 4 km.

Of these threats, the most challenging appears to be the TBM because of its short transit time, high terminal velocity, and small terminal target size. A TBM can carry any type of warhead, from high explosive to CTBW agents, in either unitary or bomblet configurations. In the hands of an aggressor, the TBM is a coercive weapon.

NATO and its allies will not be credible defenders against aggressive coercion without a defense system capable of countering this threat.

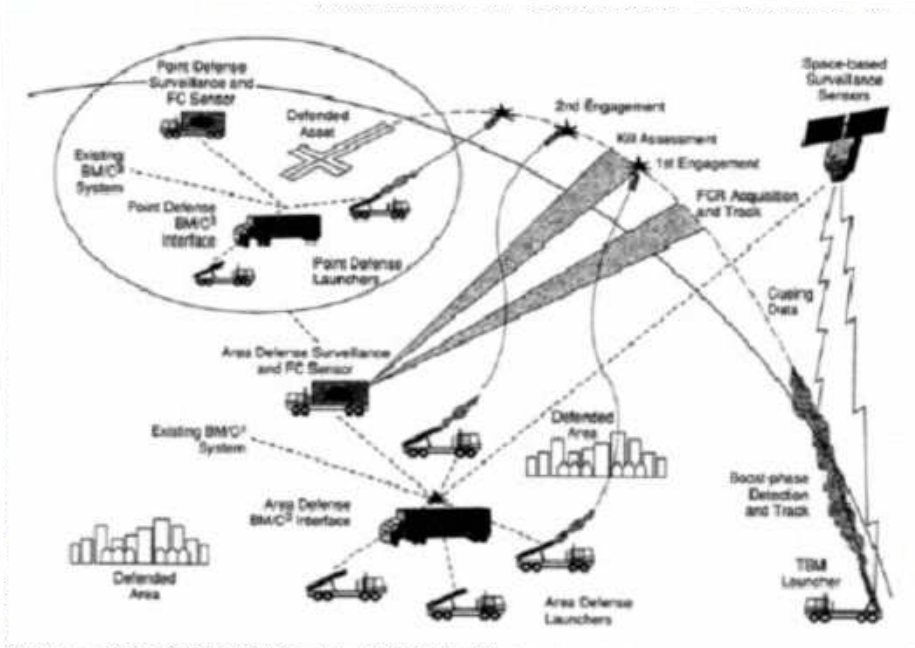

Figure 1. System concept for two-tier (area and point) theater defense against tactical ballistic missiles.

In addition to the range of threat systems, an integrated tactical air/missile defense system also has a sequence of action phases: detection, intercept of incoming missile or craft, and counterstrike attack against remaining launchers, airfields, and so on. The larger network must provide threat warning, command and control of interception, and guidance of counterstrikes. Therefore, although the TBM threat may be the most challenging, the larger defense system must be much broader than just a counter to this threat.

3. Implications for Defense Systems

With such a range of threats to defend against, the rational response is a multiplicity of specific defense systems: a proliferated system for UAVs, an area system for air-breathing cruise weapons or manned aircraft, area coverage for ballistic weapons, and probably point defenses to protect critical installations and respond to stealthy threats that have penetrated other defenses.

Any effective solution will involve other services operating with the Army through a joint command. Therefore, the systems used by

the various services must be designed to work together, regardless of which service is responsible for developing and fielding the hardware for a particular system.

The Army cannot be an effective developer and operator of its share of hardware for this integrated system without participating in the creative analysis of the total problem and the definition of the architecture within which all individual systems must operate. Given the importance of success in this task to future Army operations, the Army must take the lead in what obviously must be an interservice national effort.

4. Defense Architecture and Systems

The above line of reasoning shows the importance of a single overall architecture that integrates all of the future air and missile defense systems into a system of systems. The specifics of this integration await definition.

For defense against TBMs, space-based sensors will be used almost certainly to detect missile launch and possibly to track the missiles' trajectories.

A framework that combines functions of command, control, and communication with battle management must link space-based and ground-based sensors to the system element that controls engagements, commanding the fire units that launch and control the interceptors. A functionally analogous framework will be necessary to defend against air breathers.

Many of the systems that will be needed as elements in an integrated "system of systems" for air and missile defense could evolve as enhancements of systems already fielded. The most important requirement is for the Army to work with the other services to arrive at a common plan for the system's architecture. Among the system elements that will be needed are the following:

- an area surveillance, warning, and tracking system to detect and, if not track, at least cue other systems to a TBM launch (a space-based system appears to be the most likely candidate for this mission);
- a similar area system to locate and track hostile air-breathing aircraft and weapons and to assign interceptor systems;

• an effective IFFN system to permit friendly use of contested air space;

• command, control, communication, and battle management capabilities to use interceptor assets for adequate defense of the battlefield or area to be protected; and

• adequate interceptor weapons and local systems for control of interception.

5. Technologies Applicable to Air and Missile Defense Elements

To achieve an integrated "system of systems," the following advanced technologies would be required:

• High-speed microelectronics are essential to the sensors and high-speed processors.

• Advanced composite materials are needed to construct heat-tolerant, high-speed-flight vehicles that are able to meet the compressed time lines of future intercept systems.

• Bistatic radars may be useful in detecting and tracking stealthy air vehicles.

• Small electronics that can tolerate high acceleration are needed to permit guided projectiles to be gun launched should this form of propulsion prove superior to guided rockets for point defense.

• If guns prove to have advantages over rockets for point defense, pulsed power sources will be needed.

• Multispectral sensors will be essential for extremely fast hit-to-kill interceptors. They may also be the foundation for advanced noncooperative systems.

5. Conclusions

The paper presents a few aspects regarding this topic.

These systems are complex and inevitably expensive. Because the Army will operate most of these systems, it should be a principal architect of the systems it will operate and the means to coordinate them all in a larger system of air and missile defense systems.