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AIR AND BALLISTIC MISSILE DEFENSE SYSTEMS

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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.

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1. Introduction

The Army has considerable expertise in developing both air  
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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.  
  
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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.  
  
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\* 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.  
  
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\* 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.  
  
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from ground level up to 3 to 4 km.  
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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.

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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

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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.  
  
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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  
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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.  
  
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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:  
  
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\* an area surveillance, warming, 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.

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5. Technologies Applicable to Air and Missile Defense  
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advanced technologies would be required:  
  
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\* 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

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air vehicles.  
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\* 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  
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The paper presents a few aspects regarding this topic.  
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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.

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