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DEFENSE AGAINST THEATER BALLISTIC MISSILES

by

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Background

Live television brought the stark realism of missile attacks into family homes. The lessons to be learned from this aspect of the Southwest Asia War are important for the future of our national security; fortunately, it is not too late to react to them.

The Patriot missile proved that its superb design and outstanding capabilities were not idle claims. Although designed and optimized specifically for shooting down aircraft, Patriot demonstrated that it could also handle the infinitely more complex task of intercepting a speeding "bullet" in flight.

The fact is, we were lucky in our defense against the SCUDs. First, the SCUDs could reach their targets only from launchers located in the southern region of Iraq for attacks against Saudi Arabia and in northern Iraq for attacks against Israel, thus reducing our task of finding them. Second, the very inaccurate SCUD could hope to hit only the bigger targets — such as large air bases and population centers. Therefore, we knew the probable target areas and could position our sensors accordingly. Third, the Patriot can fire at a SCUD missile only if the Patriot is located in the SCUD's intended target area. Since we knew the most likely target areas, we could place the Patriots in the proper firing positions. Fourth, the SCUDs had only conventional explosive warheads — not nuclear, chemical or biological. This was "fortunate" because the Patriot can attack the SCUD only near the target area and where it is relatively close to the ground. Moreover, the Patriot's warhead — designed to explode near, not on, the intended target — will not always destroy a SCUD totally. Therefore, had the SCUDs contained other than conventional explosives, the collateral damage done by partially destroyed SCUD missiles would undoubtedly have been much more lethal and extensive. So in this war we were fortunate to have had the Patriot (PACII) whose admirable results enabled us to defend ourselves and our allies as effectively as we did.

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However, the fact is we had no weapon system specifically designed to destroy tactical ballistic missiles. For the future, we should not again leave to chance such a critical task as being able to defend ourselves against this kind of attack.

The Ballistic Missile Threat

The war with Iraq was short. Nevertheless, all the elements of sophisticated modern warfare were present, including high technology weapons and equipment; joint service operations; multinational alliances; cultural, social and religious constraints; and real-time public news media. The deductions we draw from this very real operational experience are therefore of high value and will serve either to confirm or reject many of our hypotheses which until now have been based solely on simulations.

With regard to theater ballistic missiles (TBM), the implications are many. We confirmed our peacetime analytical assessments that finding mobile SCUD launchers is a difficult task, even with superb sensors and total dominance of the air. Therefore, an enemy can always launch at least some missiles at us (or our friends) before we can silence his launchers. This means that we should — we must — have an active defense against flying ballistic missiles. We also confirmed that the SCUD is very inaccurate and therefore is more a weapon of terror to civilians than it is a weapon of significance to military formations. However, it is clear that TBMs with much improved accuracies exist today and will be found in the missile inventories of many different countries.

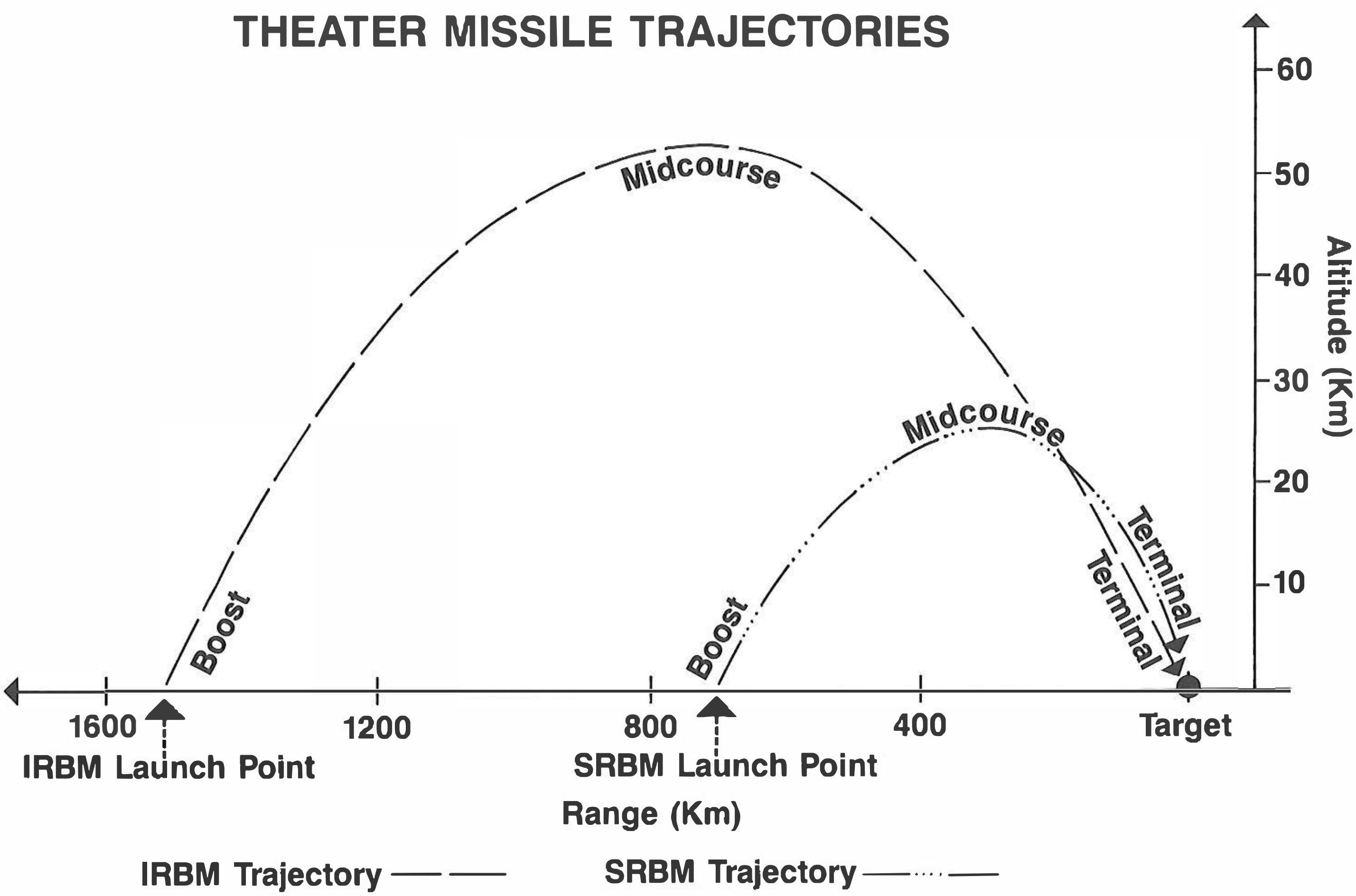
Some 14 Third World countries now have ballistic missiles; within 10 years that could grow to 24 or more. Many of these will have much improved accuracy and better serviceability than we witnessed in the Persian Gulf. Some of these nations are friendly to the U.S., some are not. In either case, today's changing political alignments together with the multifaceted international arms trade imply clearly that our nation cannot guarantee its safety unless we are able to defend ourselves against the best theater ballistic missiles, regardless of who may possess them currently. The TBM threat, then, should be viewed as widespread, sophisticated, readily available even to emerging nations, and improving in its capability to strike effectively at high-value point targets. Moreover, the TBM is fully capable of carrying a warhead with conventional munitions, chemical or biological agents, or nuclear devices. Before assessing the factors necessary to defend against the ballistic missile, it is helpful to know a little more about a ballistic missile itself.

What Is A Ballistic Missile?

A ballistic missile consists of a launching device which could be as simple as a launching rail mounted on a flatbed truck, or as sophisticated as a hardened, protected fixed site. The missile itself will have a large propulsion package which provides its initial thrust from the launcher as well as additional thrust during its boost phase so that it can achieve higher velocities. In addition, the missile body will have a warhead — or more than one — which carries the lethal component of the missile (conventional, chemical, biological, nuclear). Some missiles may incorporate guidance systems, deceptive devices or other aids which make it more accurate, more survivable or more effective. In addition to a launcher and a missile, the ballistic missile system will have a support system which provides the command, control, communications and intelligence that is needed for employment, and also the logistics elements necessary for sustaining operations.

Ballistic missiles are classified generally as short-range (SRBM), intermediate range (IRBM) or intercontinental (ICBM), based upon their maximum achievable travel distance: SRBM - 1,000 km; IRBM - 3,000 km; ICBM - 10,000 km. In these classifications, a theater ballistic missile includes all SRBMs and some IRBMs, depending upon the theater's geographical area.

There are common features of TBMs which directly affect the development of systems designed to defend against them. The sketch below shows some of these features.



Note that altitude, velocity, range, angle of ascent and descent, and size and number of warheads are all factors which will affect how and where a TBM may be intercepted and destroyed. Note also that attacking the TBM in its terminal phase and at relatively low altitudes (below 10 km, such as is the only capability of our current Patriot system) means that the TBM will already be very close to its intended target when it is engaged by the interceptor.

TBM Defense Concept

The Army's concept for defense against TBMs is the integration of four fundamental parts:

(1) *Passive defense* — that is, those actions taken by our forces to hide, camouflage, conceal, cover, deceive, or otherwise hinder the enemy's target-finding capabilities.

(2) *Attack operations* (counterforce) — attacking the enemy's TBM launchers, reload sites, command and control facilities, and the like. The goal here is to reduce or eliminate the enemy's capability to launch missiles.

(3) *Active defense* — intercepting a TBM while it is in flight and destroying the missile, its warhead, its guidance system and its propulsion package.

(4) *Command, control, communications and intelligence* (C^3I) — the element which brings all the others into focus. It encompasses finding the targets (for attack operations and for active defense); tasking our sensors to produce the target data; and controlling the counterfire and active defense weapon systems.

Each element of the concept is important in itself, and the absence of any one part makes the others significantly weaker.

Passive defense is a vital part of the process. Hardening fixed targets (such as placing aircraft in protective shelters) forces an enemy using TBMs to achieve a poor return on his investment. Dispersing mobile units prevents the enemy from having a target of sufficient size to warrant the use of a large and expensive TBM. Concealing high value installations like command and control nodes, radar acquisition sensors and air defense missile sites make it difficult for the enemy to develop a sufficiently certain target location from his own acquisition sensors that he would be willing to use a scarce and critical weapon like a TBM. So the various passive defensive measures which can be employed by nearly all field commanders play an important role in reducing the impact of enemy-employed TBMs. However, passive defense alone is certainly not sufficient for TBM defense. As was shown in Desert Storm, an enemy who is willing to fire TBMs at population centers is not likely to be deterred by passive measures alone.

Attack operations take the fight to the enemy by targeting his TBMs and their support elements for destruction. This measure has a big payoff, of course, because a launcher, missile or support element destroyed by our attack will not be available to strike back at another time or place. However, attack operations are extremely difficult to carry out successfully.

First of all, the launcher or support site has to be found. Knowing that we are looking for these locations, the enemy takes great pains to hide them from all kinds of sensors, moving the launcher and missile from hide position to firing position only at the last minute needed to prepare to fire. In Desert Storm, for example, we had complete control of the airspace. Even so, we were only partially successful in finding mobile SCUD launchers and bringing in weapon systems to destroy them. So, finding the launcher and missile before it fires is no small feat.

Second, if a TBM is found, the discovery will be made by a remote sensor like a satellite, or aircraft-based synthetic aperture radar, or a combination of sensors. This is so because the TBM uses its long-range capability partly to launch from well behind its own lines. Therefore, direct visual siting of a TBM by a human will be a rare event. This means that the information from the remote sensors has to be correlated and transmitted to some kind of weapon system which has the capability to attack the TBM.

Third, since the TBM is located well behind enemy lines, about the only attack operations means available to us will be aircraft or perhaps the Army's Tactical Missile System (ATACMS). In either case, there is a time gap from the instance of acquiring target information to applying fire to the TBM. And if a manned aircraft is the weapon we choose to use, its own loiter time and vulnerability to enemy air defenses must be taken into account. A key element here, of course, is to acquire the enemy TBM, identify it for what it is, have a weapon system with sufficient range and lethality ready to send it to the attack, and complete the attack successfully before the enemy can launch the TBM.

Obviously, finding and destroying mobile TBMs requires an extremely well-orchestrated system of target acquisition, communications and weapon systems with a premium on time. It is also clear that attack operations will not yield a 100 percent assurance of success. An enemy with sufficient sophistication to use TBMs will undoubtedly have the capability to launch some of them even though large-scale operations are employed against him.

Since we will undoubtedly be subjected to some successfully launched TBMs, the third part (active defense) of the four-partTBM defense plays a vital role. The key here is to have a defensive weapon which can hit and destroy a TBM after it has been launched, but before it can deliver its payload to the intended target. Since a TBM will be travelling at supersonic speed from shortly after its launch all the way to impact, the task of hitting such an object in space is formidable. Depending upon the TBM's range and velocity, there will be only a very few minutes to react to the launch, launch the interceptor, reach the TBM, and destroy it before it reaches its target area. For shorthand, we will call the interceptor an antitactical missile (ATM). The general case in active defense can be described as TBM launch, target acquisition, target tracking, trajectory information transmitted to ATM, ATM launch, ATM travel distance, target kill and feedback damage assessment to ATM control. Clearly, if the active defense aspect of TBM defense is going to work, there must be a finely-tuned and integrated system for battle management of all the parts of the whole.

It is for this reason that C^3I is an equal partner in the four-part TBM defense concept. Included here are the sensors to acquire, identify, locate, track and feed back TBM data. Moreover, all of these elements must be accomplished in real time, and the procedures for assessment and decision must be well-established. Any delay in any of the parts of the whole can cause failure of the ATM system. In addition, without a feedback capability, the system will not know whether to launch another ATM or not. The only real operational experience in defending against TBMs comes from Desert Storm. Usually, at least two Patriots were launched at incoming SCUDs in order to increase the probability of success. As pointed out earlier, there were a number of fortuitous circumstances which contributed to our successful use of Patriot against SCUDs. Nevertheless, if the C^3I had not been properly put together, the end game in Southwest Asia could have been catastrophic. For the future, then, as we develop an integrated total concept and capability for defense against ballistic missiles, the battle management aspect must progress and develop in step with the other parts of the whole.

The Future for Theater Missile Defense

In his State of the Union Message on 29 January 1991, President Bush said: "I have directed that the Strategic Defense Initiative program be refocused on providing protection from limited ballistic missile strikes, whatever their source. Let us pursue an SDI program that can deal with any future threat to the United States, to our forces overseas and to our friends and allies." All of that statement is important, but consider these two aspects. First, the concept of "limited" strikes from whatever source means that the emphasis turns away from protecting against a massive attack by the Soviets to perhaps smaller attacks from any number of sources. Second, the president moved SDI from the notion of protecting only the U.S. to one of protecting our deployed forces and our allies as well. The overall effect of this revised policy is to put a much greater emphasis by the Strategic Defense Initiative program on defending against theater ballistic missiles, and on defending against a few — or even a single — missile attack employed as a terrorist measure, or even launched by an unauthorized group or in error.

Congress has directed that specific funds be used only in the development of selected weapon systems, some of which could be key players in the ATM role. For the next several years, the Army and, indeed, many elements of the Department of Defense will be involved in debate and discussion as programs are pursued to develop competing systems designed for active defense against TBMs. Some of these programs and their roles in the TMD are described below.

Patriot

The version of Patriot which performed in Desert Storm is called Patriot Antitactical Missile Capability II (PACII). To overcome its earlier discussed inadequacies, one new research and development program is aimed at an improved Patriot, oriented on the ATM role, with the result that Patriot's lethality and firepower coverage would be increased; its radar could handle more targets and over a wider area; and the launchers in a single fire unit could be spread over greater distances, thereby providing additional target area coverage. If these various enhancements are achieved and produce the projected results, an improved Patriot (P^3I) could be available by the mid-1990s. Some of the advantages to this course of action are: an improved ATM without having to increase the Army's force structure to man it; achievement of the capability sooner than would be the case if we made a new start; and the existence of an experienced training base and support structure already established for Patriot, thus making transition to P^3I much easier than it would be for a totally new system. There are some drawbacks, however, such as the size of Patriot (only a C-5 aircraft can transport it) and the length of time it takes to prepare a Patriot for a subsequent launch after it has fired its missile pack. Moreover, even a P^3I would be attacking an incoming missile in its terminal phase and therefore runs the risk of some collateral damage to friendly areas from the debris resulting from the engagement.

Extended Range Interceptor Technology (ERINT)

This missile program is aimed at destroying a TBM by actual collision with it, well into the atmosphere and before the final part of the TBM's terminal phase. ERINT could employ a kinetic energy projectile whose impact with a TBM would destroy the missile completely — or nearly so — and thus prevent it from scattering a lethal payload on a friendly area. ERINT would be smaller than Patriot and could therefore be deployed to a threatened area in a C-141 or equivalent type aircraft and perhaps the intratheater C-130. However, to fit a C-130 box, the ERINT radar would also need to be smaller than Patriot's. It may also be capable of firing from the Army's High Mobility Multi-purpose Wheeled Vehicle (HMMWV), giving it great battlefield mobility. ERINT integrated within the Patriot launcher would provide as many as 16 missiles on each launcher instead of the Patriot's four missiles. Even with these enhancements to active defense, there will still be the shortcoming of attacking a TBM relatively late in its trajectory and at relatively low altitudes. An earlier intercept of an incoming TBM would have several advantages to include providing time for a second or third interceptor launch if the first one failed to do the job.

Theater High Altitude Air Defense (THAAD)

Theater High Altitude Air Defense (THAAD) is a research concept designed to attack a TBM during its midcourse phase in the high altitude regime. THAAD will be capable of multiple engagements at high altitudes, will offer a much larger defended area coverage and will be integrated with existing area air defenses. Although THAAD is just completing its concept definition phase, most of the technology is already well proven. If successful, THAAD would provide a high altitude overlay to systems like Patriot and ERINT whose area coverage capability will be rather limited. A request for proposal on the demonstration and validation phase is expected by mid-FY 1992.

Hawk Replacements or Corps Surface-to-Air Missile (Corps SAM)

The Hawk surface-to-air missile system is now 35 years old and it has been upgraded five times in its life cycle. Moreover, it is very manpower-intensive and has little potential against the TBM of the future. The Army and Marine Corps have proposed and OSD has approved that a system be developed for corps-level air defense which would replace the Hawk. This new system, currently referred to as Corps SAM, would be highly mobile and less manpower-intensive than Hawk, and would be designed to integrate in a single weapon both air and missile defense. Concept definition of a Corps SAM weapon system is planned to be initiated in FY1992 and offers the promise of a much-needed dual capability for land forces operations in any contingency situation.

Arrow and Arrow Continuation Experiments (ACES)

The Arrow missile is an Israeli/U.S. initiative for a TBM interceptor. ACES, a series of flight experiments, is expected to begin as a joint U.S./Israel program when negotiations are completed on a Memorandum of Agreement between the two countries. The plan for ACES includes smaller, lighter-weight designs, extended range and improved lethality.

Congressional Funding and Direction

Congress has recognized the critical need for improving all aspects of the U.S. TMD capability. This recognition and the president's charge to redirect the SDIO program have resulted in a comprehensive plan with significant funds allocated to the various parts of the TMD program. The aim is to develop an initial operating capability in the mid-1990s, and a fully integrated system by the turn of the century.

The National Defense Authorization Act for Fiscal Years 1992 and 1993 provided direction for a multi-site defense to protect the U.S. against limited ballistic missile attacks. While it did not authorize any actions that do not comply with the ABM treaty, it stated that the administration should pursue negotiations to amend the treaty. Strong emphasis was given to the early development of theater missile defense systems. Of the $4.15 billion authorized for funding all elements of SDI for FY 1992, $828.7 million was directed specifically for theater missile defenses.

Summary

The president has called for new emphasis on countering ballistic missiles. His words encompassed not only protecting the U.S. and our armed forces wherever they might be deployed, but also our friends and allies. The language describing the overall concept for meeting this challenge has now emerged.

The umbrella concept is called Global Protection Against Limited Strikes, or GPALS. Only one part of the umbrella concept refers to defending against tactical ballistic missiles; other parts of the concept involve defending against intercontinental ballistic missiles. This paper has focused solely on the tactical ballistic missile issue and not the broader concept of GPALS. Clearly, the programs and systems adopted for TMD must be able to link to the larger GPALS effort.

The TMD concept may be described by two categories: (1) achieving a viable near-term improvement for defense against TBM; and (2) developing an objective system which integrates air defense and TMD in two tiers — a lower tier with point defense and small area coverage, and an upper tier which aims at a broad area coverage. The lower tier will consist of engagements of TBMs at lower altitudes and late in their trajectory. The upper tier will consist of engagement of TBMs at higher altitudes and earlier in the TBM flight path. Both tiers of this active defense will support and be supported by a robust and integrated C^3I system, passive defense measures and attack operations from a variety of ground, air and naval systems.

It is patently clear that the nation and the military services must be prepared to allocate resources, operate together and synchronize their efforts both to achieve the necessary hardware and software for TMD and to employ them wherever the next need arises. Surely this is a challenge which must be met head-on — and soonest.

From an Army point of view, the need is to build on the president's directive to insure that the TMD program developed under SDIO leadership results in an integrated system of C3I, passive defense, attack operations and active defense. The active defense system should be strategically mobile so that it can be deployed rapidly to a threatened area, and it must be ground-mobile so that it can be shifted to alternate sites within a theater in a reasonable time period. With this kind of focus, the Army and the nation will be better served in meeting what is now and will remain a continuing threat to our security and to that of our friends and allies.

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