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THE EUROPEAN THEATER MISSILE DEFENSE PROGRAM

- A FIELD FOR INTERNATIONAL COOPERATION -

by

Axel Schmidt, Lieutenant Colonel, German Air Force
Frits Verschuur, Lieutenant Colonel, Royal Netherlands Air Force

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Advisor: Colonel Vic Budura and Colonel Chuck Thompson

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Preface

This research paper recognizes the current and future ballistic missile developments and the proliferation of weapons of mass destruction as a threat to the free world. Despite all political counterproliferation efforts, active missile defense is essential and vital for the US and its European allies. The authors belief that is necessary to develop and deploy an European Theater Missile Defense capability to deter and defend the European Homeland and European forces deployed abroad. Due to the complex issue of an effective and all regions covering ballistic missile defense architecture, these efforts can only be accomplished by international cooperation and common development of systems. We strongly believe that is possible and that the US and its European allies can successfully work together by sharing technology on a fair basis. Despite the current dependence on US early warning and space based information systems, we belief that there is also in this field room for cooperation and technology share. The European nations and their industries have proven their experience and capabilities in the space business. Our paper tries to address some ways of cooperation in developing an European Ballistic Missile Defense capability for Europe and its deployed forces.

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Abstract

One of the primary impact of the Gulf War on Western opinion was to underline the reality of a ballistic missile threat. The USA subsequently gave top priority to the development of a system against tactical ballistic missiles as part of the National Missile Defense program.

NATO and the WEU has agreed it needs capabilities to defend the entire spectrum of air threats including tactical ballistic missiles (TBMs), tactical aerodynamic missiles (TAMs), and manned aircraft (MA) through an extension of the existing Integrated Air Defense System (IADS).

This research concentrates on Theater Missile Defense, compares the US program and the European approaches in NATO and WEU and analyzes the current European dependence on US assets, especially on space assets for early warning and reconnaissance, and the current limited capabilities of the European NATO allies in active ballistic missile defense issues. Furthermore it looks for fields of equal and fair multinational cooperation as a way to reduce costs and to optimize limited resources by sharing technology and capabilities. It shows that the European industries are capable to develop military space assets and able to participate in multinational cooperation's. It also shows, that it is very difficult in Europe and NATO to bring all nations together for the developing of an European Ballistic Missile Defense architecture and to provide the necessary funding.

Chapter 1

Introduction

> *"The use of Theater Missiles can be traced back to the beginning of TBM (Tactical Ballistic Missile) developments by Germany during the Second World War. Initially, the German use of the V-1 and V-2 rockets posed a major challenge to allied forces attempting to protect England from air attack. The primitive radar system could track missiles in flight, but there was no intelligence sources available providing real time information of time and location of launch."*[1]

One of the primary impacts of the Gulf War on Western opinion was to underline the reality of a ballistic missile threat. The USA subsequently gave top priority to the development of a system against tactical ballistic missiles as part of an overall Missile Defense Program.[2]

In the era of confrontation with the Warsaw Pact, NATO[3] had deliberately refrained from establishing a defense capability against ballistic missiles and relied solely on the deterrent potential of nuclear weapons. Now anti-missile defense capabilities are the subject of intensive discussions in various European Nations, NATO bodies and working groups. The notion of a "Theater Missile Defense" (TMD) which is taking shape, however, is mainly focused on the area of active defense measures, particularly ballistic missile defense. Despite all deterrence and counterproliferation means, NATO is willing to build its own capabilities in the context of an Integrated Extended Air Defense.

Against the background of the broadened task spectrum of the German Armed Forces and in view of new risks and new players, Germany for example recognizes the increased role of tactical

missile defense[4] in its conceptual framework and is constantly improving its air defense inventory. Therefore the Bundeswehr Concept/Missions and Capabilities (KdB/TAF)[5] establishes a comprehensive conceptual framework for antimissile defense: "As a joint task it must at least provide limited protection of territory, facilities, and forces - also during deployments in connection with international crisis management...." [6] According to NATO' s threat assessment the ask is to counter the entire air threat posed by ballistic and aerodynamic missiles"[7].

This research concentrates on Theater Missile Defense (TMD). First, after a description of the current and future missile threat and the problems occurring from proliferation, the Ballistic Missile Programs of NATO/WEU (representing the European concept), and the US Missile Defense programs will be analyzed. Following this background, the current European dependence on specific U.S. early warning and space assets will be analyzed. Lastly, this paper will address fields of equal and fair multinational cooperation as a way to reduce costs and to optimize limited resources by sharing technology and capabilities.

While missile defense is a complex issue, this paper, as previously stated, focuses primarily on Theater Missile Defense. According to US definitions, the purpose of TMD is to protect forces, allies and other countries, including areas of vital interest , from theater missile attacks. The TMD mission includes protection of population centers, fixed civilian and military assets and mobile military units.

Due to the above mentioned limitations strategic missile defense issues and international treaty questions are not covered in this paper.

Notes

[1] US Army "FM 100-12 (Draft)", Feb. 1996, p. 1-1

[2] Jean Dupont, " Europe wary of US aims in joint defense programme ", Interavia, January/ February 1996, p. 42

[3] NATO: North Atlantic Treaty Organization

[4] The term "tactical missile" is not clearly defined. In the following text it covers missiles with a range of up to 3,000 km.

[5] The Federal Ministry of Defence (Germany), Chief of Staff/ Armed Forces Staff VI 2, "Bundeswehr Concept/Missions and Capabilities", 15.January 1996.

[6] Ibid., p. 1

[7] see illustration in Appendix A, *The AirThreat Spectrum*

Chapter 2

Ballistic Missile Threat and Proliferation

Ballistic Missile Threat and Proliferation

Following the recent historic changes in Central and Eastern Europe the political order of the Cold War is a thing of the past. The danger of large-scale aggression threatening the existence of nations has been banished. The territorial integrity of Germany and NATO countries does not face an existential military threat for the foreseeable future. On the other hand, the situation in other regions of Europe is characterized by war, inhumanity and repression. At the same time, there are increasingly significant global risks and undesirable developments, jeopardizing peace in the international community and the basis of existence of the whole of mankind.[1]

One of the potential serious risks to NATO security results from the proliferation of Weapons of Mass Destruction (WMD) and their means of delivery. Germany's and NATO's approach to security is particularly evident within the context of proliferation where political, diplomatic and economic means will be employed to limit the potential spread of WMD. Should such proliferation control measures fail, a robust military capability, including deterrent forces, could be required to ensure the physical security of NATO.[2]

Delivery means for WMD include Tactical Ballistic Missiles (TBM). According to the US-Army Field Manual 110-12 (Draft) they are launched in ballistic trajectories that can sometimes

be adjusted by additional thrust and/or guidance mechanisms.[3] According to US-Army definitions TBMs are considered to be in-theater weapons systems which can be classified by range:

Short Range Ballistic Missile (SRBM) 30 to 1000 km

Medium-Range Ballistic Missile (MRBM) 1000 to 3000 km

Intermediate-Range Ballistic Missiles (IRBM) 3000 to 5500 km.[4]

The tactical ballistic missile threat to NATO arises from battlefield systems with ranges of tens of kilometers (such as FROG and improved SS 21), to systems with ranges of several hundreds of kilometers (such as improved SCUD and AL Hussein missiles), to potential new medium range systems with ranges over 1,000 km (for example, the 1,000 km No dong missile and 2,500 km Taepo ballistic missile being developed by North Korea) which could be acquired by nations in the Middle East or North Africa. The shorter range systems are a threat primarily to the forces of NATO nations and NATO's Reaction Forces. Systems with ranges over 1,000 km will be a threat to NATO territory and populations. For the foreseeable future, ballistic missile threats to deployed military forces can number in the hundreds, while the longer range threats to NATO territory itself will be much more limited, perhaps a few tens of missiles.[5]

For the next 3 years of the century, only Turkey and the southern-most rim of Europe are threatened by ground-launched ballistic missiles. It is commonly accepted that NATO territory will not be threatened by longer-range ballistic missiles (ranges of 1,000 km or more) until the end of the century. Such missiles, if deployed in Libya or Algeria, would pose a direct threat to portions of all of NATO's Southern Flank countries. Taepo dong-like missiles, with a range of 2,500 km, which could threaten most of the rest of Europe, are not anticipated until after 2005[6].

However, meeting this emerging long-range threat requires NATO and nations to take actions now because of the time it takes to initiate the process for developing, testing, acquiring, and fielding more capable missile defense systems.[7]

During missions outside the NATO area - for example under the mandate of the United Nations - forces are permanently threatened by missiles if the theater of operation lies within the range of missiles that may be launched by conceivable opponents. These missions will generally entail a particularly high degree of political sensitivity. Thus, a possible employment by the enemy of individual missiles armed with conventional warheads - even if the military effect is limited - will already gain considerable political importance. Such missile deployments can very quickly generate sociopolitical pressure which can have an immediate effect on the length of time that European contingents are deployed as well as on the political purpose of the mission. Missiles armed with WMD warheads would increase this risk[8].

NATO's current TMD capabilities are provided by German Air Force (GAF) and Royal Netherlands Air Force (RNLAF) Ground Based Air Defense forces. Most of them are part of NATO's Integrated Air Defense (NATINAD) and therefore NATO command forces. The US participates with EUCOM assets, like PATRIOT units and C4I equipment, which are not under NATO command.

According to the CIA Nonproliferation Center report in 1995 at least 20 countries- nearly half of them in the Middle East and South Asia- already have or may be developing weapons of mass destruction and ballistic missile delivery systems. Five countries- North Korea, Iran, Iraq, Libya and Syria- pose the greatest threat because of the aggressive nature of their weapons of mass destruction program.[9] For a worldwide overview on proliferation of ballistic missile see Appendix C[10].

Basic Missile Defense Concepts

The strategy for dealing with this kind of threat has three different components: preventing and reducing the threat; deterring the threat; or defending against the threat. For example, for preventing or reducing the threat, there are different Non-Proliferation Treaties such as the INF Treaty, export controls and START (Strategic Arms Reduction Talks)

The second line of defense is deterrence. In the case of the strategic missiles threat to the United States, the strategic nuclear forces have been a bulwark of deterrence for now three decades. Now finally, if these two lines of defense do not work, the US or NATO have to be prepared to defend directly against a threat.

Due to the limited focus of this paper, we'll further on concentrate only on the defending part of this complex strategy, while well recognizing the importance of the other two elements. We will discuss and analyze now the basics of theater missile defense in NATO and the US.

European Theater Missile Defense (NATO)

Based on US experiences and already developed TMD systems, the European NATO nations views the function of an active Theater Missile Defense as a complex and interactive architecture. Therefor a TMD architecture[11] requires a system consisting of 3 major components:

- **Sensor** for early warning and surveillance of ballistic missile attack/missile launch.
- **Interceptor** to destroy a ballistic missile in flight (from boost phase to descent phase by offensive or defensive means).

- **Battle management /C^{4}I** for sensor management, data processing and dissemination, cueing command & control and communications.

TBMs can be effectively engaged and destroyed in multilayered Lower and Upper Tier[12] defense; the concept can be characterizes as follows:

Lower Tier (0-35 km altitude/endo-atmospheric/terminal phase interception) defense provides the capability to defense against the air breathing threat and the short range TBM. Against short range TBM (300-1000 km range) the Lower Layer can provide a "Point Defense" and "Limited Area Defense" capability with defended footprints of 25 km radius today and up to 40 km radius with SAM systems foreseen over the next two decades.[13] Within the Alliance, only German, Dutch, and deployed US PATRIOT systems have the capability to engage both the classical air threat and the shorter range type TBM threat. These assets are Lower Tier systems. The Lower Layer SAM systems can also provide a "Third Shot" capability against long range TBM leakers not intercepted in the Upper Layer. Against these long range (>1000 km range) TBMs the defended footprint radius would be much smaller (of the order of 10-25 km radius depending on the TBM range).[14]

Upper Tier (35-500+ km altitude/ endo-/low exo-atmospheric/midcourse phase interception) defense is designed primarily for defense against the long range TBM although it is possible to design some systems to have limited defense capability against the shorter range TBM. The state-of-the-art as it is known today and in the foreseeable future will support two basic types of systems:[15]

•those with an “endo-exo” battlespace are capable of intercepting the TBM in the upper part of the atmosphere and into space and,

•those with an “exo” only battlespace where all intercepts occur above the atmosphere.

The Upper Layer defense system provides a “Wide Area Defense” capability with defended footprints of 100-500 km radius depending on several key parameters (interceptor burn-out speed, amount of early warning provided and degree of separation of interceptor launch site and early warning sensor).[16] Right now there are no upper layer systems in NATO available or deployed by the US in Europe.

Due to limited financial resources and other priorities, NATO will focus first on the development of a lower tier capability and the integration of a missile defense concept in its current Integrated Air Defense Structure[17]. The Upper Tier defense - the most effective one - continues to be the ultimate goal.

On the other hand the US has or will have in the near future all necessary elements to fulfill all necessary functions of both tiers of the above described system. This includes the use of space based sensors provided by the Defense Support Program (DSP) for early warning and missile tracking, and the essential BMC4I elements like JTAGS (Joint Tactical Ground System) and JTIDS (Joint Tactical Data Information Dissemination System) for dissemination of attacking missiles and cueing of ground based interceptors. For defense in the Upper Tier, the US Army Theater High Altitude Air Defense (THAAD) system will give the US significant operational flexibility and almost full coverage for their forces. These elements are exclusively being developed[18] and fielded by the United States and not deployed to NATO. It can be assumed however, that in a crisis in NATO’s area of responsibility, or where NATO forces are involved, the US will support NATO or selected Allies with these capabilities.

Due to the fact that Lower Tier missions right now can only be accomplished by GE and NL PATRIOT units (as NATO Command Forces) or in-theater deployed US forces, NATO's TMD capabilities are limited. PATRIOT as an interceptor for TBM engagements is able to engage and destroy incoming TBMs in the Lower Tier and to protect a limited area. Due to the system configuration, the effectiveness in TBM missions will be increased dramatically by using early warning and cueing information. This information gives the PATRIOT system more reaction time. For the European PATRIOT units (GE and NL),this information must be provided by the US via external support elements. Only the US has these elements in their inventory (EUCOM will support with JTAGS (Joint Tactical Ground System)[19] and JTIDS (Joint Tactical Data Information Dissemination System) for the European Theater and will use early warning information from DSP satellites).

The US as the major partner of NATO provides the Alliance with this support. But these forces are not NATO forces or part of the NATO command structure. The use is based on agreements between NATO and the US government.[20] As long as non-US SAM (Surface to Air Missile) forces (European) are operating under NATO command and under conditions of compatibility with these elements, the US can and will provide the required information. Under these conditions, there will be no significant operational impact.

If Germany or the Netherlands, however, have to deploy their forces in UN or WEU missions with little or no US participation/support, the effectiveness of the German and Dutch PATRIOT units in TBM missions will be limited. In these circumstances the described above external

support must be negotiated case by case. This dependence on US national support, especially when dealing with space based information, can not be tolerated in the long run.

Taking this into account, Germany and France are currently negotiating combined projects to build and use their own space based early warning and reconnaissance systems by developing the HELIOS II and HORUS satellite systems[21]. These projects must also be seen in the context of the European approach to consolidate their way to a real political union (European Union) and the finding of a European security identity within NATO and WEU.

Britain on the other hand is currently considering the development of a national BMD network, including early warning satellite and shipboard and airborne interceptors[22]. According to a prefeasibility study, collaborating with Europe and the US are essential for economic and political reasons[23].

US Missile Defense Program

According to the US Ballistic Missile Defense Organization, the US Ballistic Missile Defense Program is structured to respond to existing and emerging ballistic missile threats to the United States, its forward deployed forces, allies and friends around the world.[24] The highest priority is Theater Missile Defense/TMD; the next highest priority is National Missile Defense/NMD; and the third priority is an investment in BMD advanced technologies in order to enhance future BMD capabilities for both TMD and NMD[25].

The **NMD program** is concerned with the possibility of a limited ballistic missile strike against the US homeland. Planned TMD systems are Ground Based Interceptors, Ground Based Radars and Battle Management/Comand, Control, and Communications elements.[26] Due to the focus on TMD systems, NMD systems are second in priority and will be developed. There are no fielded TMD systems right now.

The **TMD program** on the other hand concentrates on the immediate ballistic missile threat and has the highest priority of the BMDO programs because this current threat holds the highest risks to US forces.[27] BMDO is working to develop both land and sea based TMD systems to give US forces the greatest flexibility and provide the most effective TMD.[28]

Similar to NATO, the US TMD area is divided into an upper and a lower tier, basically defined by the altitude at which intercept takes place, the speed of the interceptor and the speed of the incoming missile. TMD systems are built to operate best in one tier, although there may be some crossover capability. This allows the system to best match and negate specific types of missile threats. Moreover, this arrangement gives TMD forces multiple opportunities to destroy an incoming missile as it passes through the tiers.[29]

Different systems are assigned to each tier. The Theater High Altitude Area Defense (THAAD) system, Navy Theater Wide Defense (NTWD) system and the Airborne Boost-Phase Intercept (BDI) system will operate in the upper tier while the Patriot Advanced Capabilities (PAC 3) system, the Navy Area Defense and the Medium Extended Air Defense System

(MEADS) cover the lower tier. Only three of these systems - PAC 3, THAAD and the Navy Lower Tier - are now in the acquisition phase.

Therefore the US has or will have in the future the whole inventory at their disposal to fulfill all major tasks/missions for an effective missile defense system. From satellites and eventually future space based laser, to deployable BM/C4I elements and various sea and land based interceptors, the US is able to cover the whole spectrum in national and theater missile defense as well. The current and future major projects are listed in Appendix F.

The Dependence on US Earl Warning Assets

Since one of the areas of focus of this paper is on the essential need of space based assets for early warning, surveillance, tracking and communication in a Missile Defense System we will concentrate now on the early warning and sensor systems available for missile defense. While the US is very well developed in this area, the European countries have concentrated more in the past on weapon systems like PATRIOT or MEADS as the future medium extended air defense system, a trinational cooperation (US/IT/GE).[30]

Regarding space assets NATO, uses information from US assets and they are available for all members. In the WEU context, without the deployment of US forces or the use of US space and BM/C^4I assets, the European nations are without any missile defense early warning and tracking capability.

In a 4 Nov 94 letter to NATO, US Deputy Secretary of Defense offered to share ballistic missile early warning information from its space-based Defense Support Program (DSP) with NATO and individual alliance members. DSP can provide regional launch warning to include: launch time, launch location, azimuth, impact location, missile type, and number of missiles. Such early warning information satisfies two main objectives:

- to make global proliferation more visible and focus attention on preventing and countering the proliferation of missile technology and WMD; and
- support passive defense measures and enhance TMD capabilities by assuring Alliance TMD forces receive space-based missile launch early warning.

Higher fidelity space-based early warning information, available from refinements of processing techniques and deployment of next-generation systems, will be available to NATO and individual Alliance members who acquire and field advanced TMD systems which will benefit from the more precise information.[31] The US European Command, with support from US Space Command, has been tasked to work with NATO and nations to develop system requirements, a concept of operations, and an implementation plan. USEUCOM will initiate discussions with NATO and individual Alliance members as necessary to develop these plans[32]. However since the Gulf war there is a growing tendency in Europe to be independent from the USA for early warning assets and to develop an European independent missile defense capability.

Notes

[1] NATO, Extended Integrated Air Defence, NADC D/171, 14. May 1996, p. 5
[2] Ibid., p. 5

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[3] US Army, Army Theater Missile Defense Operations, FM 100-12 (Draft), February 1996, p. 2-3

[4] Ibid., p. 2-3

[5] The Heritage Foundation, Defending America: A Near- and Long Term Plan to Deploy Missile Defenses, 1995 , p. 17-20

[6] see illustration in Appendix B, *Ballistic Missile Threat*

[7] see also Keith B. Payne, Missile Defense in the 21st Century Protecting Against Limited Threats, 1991, p. 38-44

[8] for a worldwide proliferation of WMD overview see: The Office of the Secretary of Defense, "Proliferation: Threat and Response ", April 1996

[9] the Heritage Foundation, p. 17-18.

[10] Appendix C, *Worldwide Ballistic Missile Proliferation*

[11] FM 100-12 (Draft), p. 1-7

[12] for an illustration see Appendix D, *The Two Tier Concept (Detection and Tracking; Engagement)*

[13] NATO, NATO Industrial Advisor Group (NIAG), Multi-Layer Defense of Europe Post 2000, AC/259-D/1630, Nov. 1995, p. 9-10

[14] Ibid., p. 9-10

[15] Ibid., p. 9-10

[16] Ibid., p. 9-10

[17] David Martin, Toward an Alliance framework for extended air defense/theater missile defense, NATO Review, No. 3, May 1996, p. 32

[18] for an excellent overview on US Systems and Capabilities see: Mark Hewish, Providing the Umbrella , International Defense Review, 8/1995, p. 28-36

[19] for an illustration see Appendix E, *The Joint Tactical Ground System*

[20] NATO, NATO Extended Air defense/Theater Missile defense AdHoc Working Group, Final Report, AC/259-D/1630, 28. March 1995, p. 11-19l

[21] Peter Selding, European Military Satellite Plan Stalls, Space News, May 6-12, 1996, p. 1

[22] Charles Miller, British Defense Panel Pushes BMD Network, Defense News, January 13-19, 1997, p. 1

[23] Ibid., p. 26

[24] BMDO, FY 1998 President's Budget Press Release, 1997, p. 1

[25] Ibid., p.1

[26] BMDO, U.S. Ballistic Missile Defense Program Focus, BMDO Fact Sheet 96-001, March 1997, p.2

[27] Ibid., p.1

[28] Ibid., p.1

[29] Ibid., p.1

[30] for further information on missile defense cooperation programs see: J.D. Martin, Ballistic Missile Defense Cooperation in NATO, Military Technology, 10/95, p. 36-39

[31] NATO, NATO Extended Air defense/Theater Missile Defense AdHoc Working Group, Final Report, AC/259-D/1630, 28. March 1995, p. 11-19

[32] Ibid., p. 11-19

Chapter 3

European Independent Ballistic Missile Defense

European Independent Ballistic Missile Defense

It is striking that in the early '80's like the US, even Europe was thinking of a ballistic missile defense concept, supported by a Dutchman. After President Reagan created his Strategic Defense Initiative (SDI), the Netherlands Member of the European Parliament, Mr Janssen van Raay, founded in 1984 the High Frontier Europe Foundation. It's purpose was to examine the need for missile defense for NATO-Europe. [1] Since that time Europe has not done anything impressive to build its own ballistic missile defense capability.

What capability does Europe have against the missile threat of today? So far only a few countries have limited capabilities against the current and future missile threat. Chapter 2 of this paper analyzed and showed the dependence on US assets. However these systems are off an older generation and limited in their air transportability. Furthermore Europe has no space related missile defense support capabilities. To cover the total range of possible missile threats, Europe needs a complete TMD architecture covering all tiers (all missile defense elements as described in Chapter 2), including the upper tier (such as THAAD) defense and spaced based early warning and tracking capabilities including the ones generated from space.

Does Europe needs an independent ballistic missile defense? Several countries openly hostile to the West including Libya, Iran, Iraq and Syria, have the capability to develop ballistic missiles, as well as a range of nuclear, chemical and biological warheads. Also Algeria could be a danger in the future, looking at the violent Islamist insurgency. [2] Therefore and according to NATO and WEU the answer is yes, because of the uncertainty of whether the US in the future will continue to share their capabilities (information & weapons) with the European Forces. However there is a big gap between defining the requirements and filling in those requirements. The political will is there but not the 'political money' despite the threat of today and even more tomorrow. MEADS is the first missile program to be transatlantic with a common US-European development and production. MEAD will be air-transportable by C-130 - unlike the Patriot, which can only be transported on airlifters in the C-5 or C-17 class.[3] This program is an offshoot from an initial US Army/USMC requirement, called Corps SAM, and Germany's Taktisches Luft Verteidigungs System (TLVS) requirement. France and Italy joined this program in 1995 without abandoning their own SAMP/T program. [4] After the France dropped out of the program, the remaining MEADS partner are looking for new participants. The development costs are more than 3 B$, now having to be divided between US (60%), Germany (25%) and Italy (15%). The Netherlands and Turkey are showing some interests and requested information on this program. [5]

In the upper tier area where the US Navy will have its Aegis system and the US Army is developing its THAAD system, it is surprising that Europe up until now ever translated their requirements for missile defense in the upper tier into specifications (they acknowledged the

need for upper tier, but initially try to realize a lower tier defense) . Probably Europe (NATO) is more or less reluctant given their awareness of the US umbrella protection.

Finally an independent early warning system as foreseen for Europe (NATO/WEU) is still far away. Even if the need is defined (WEU), the development never materialized. Also the probability of having the US umbrella and the awareness that the US is willing to share this information with their alliances is taken into account.

Having defined the need for an independent ballistic missile defense the question raises if Europe has the capability to develop their own systems and/or cooperate with existing and future developments in the USA or elsewhere.

European Industrial Capabilities

Europe has the capabilities to develop and produce their own ballistic missile defense capabilities. No doubt, countries like France, UK, Italy and Germany have well known defense industrial capabilities and their space industries responsible for launch vehicles and satellites (such as DAIMLER BENZ, MATRA, DORNIER, and THOMSON) are respected worldwide. Even the Netherlands, a small country, has its space industry capabilities such as Delft Sensor Systems, Fokker Space and Urenco.

Outside the USA there are only a few nations involved in the use of satellites for military purposes. As reflected in Flight International[6], mainly Russia has the same capabilities as the US.

Looking at the European countries, one can see that France, UK, Spain and IT have some assets, where Spain and Italy are coupled to the French Helios 1 program. Based on the Gulf experience where France, like all other allies depended on US military and commercial information, France decided to develop their own space assets to be independent in the future. Italy and Spain have purchased a combined 21 percent share in Helios 1. The Helios 1A satellite has operated since July 1995. The Helios 1B will be launched in 1997. The image center is located at Torrejon in Spain. Today's European military satellites are for communication (France, Spain, UK, NATO), for intelligence (France, Spain, Italy, UK) and for reconnaissance (France, Spain, Italy). There capabilities are limited in relation to the threat of today.

The current arrangement between the Helios 1 participating countries and WEU could be a basis for the European answer with Helios 2 (multispectrum) in combination with Horus (radar) supported by a relay station (DRS), and ground stations for processing and mission control.

Helios 2 is distinguished from Helios 1 by two features, the addition of an infrared imager and a sharply higher optical resolution. With the $2.2 billion Helios 2 led by France and the $2.4 billion Horus by Germany, the two programs are intended to free Europe from its dependence on US military satellite imagery and to pave the way toward a pan-European military space effort[7]. Both programs however are delayed because of political and financial problems in France and Germany.

One of the major problems in Europe in 'armament' cooperation is the rising cost factor. More members will make it more difficult than with only two to achieve the cost-effectiveness

and efficiency sought from a bilateral framework[8]. This problem should be solved and solutions should be found in the direction of an 'offset' not necessarily related to the space program itself.

So it is obvious that Europe has the capability and technology to develop any ballistic missile defense system and space related supporting systems. The technology, development, and production capabilities are there, but on the political side, it is hard to bring all nations together and to decide what to do and to fund such programs.

How could Europe improve their military budget constrains and in the same time build on an independent missile defense capability? Because of the political diversity among the several European countries the answer can not easy to be found. One thing is sure, money is an extremely important issue. If Europe could reorganize its military financial management, this might lead to the right answers.

Financial Management

Why is Europe far behind on their ballistic missile air defense ? Like with so many other issues, lower budgets are the main reason for not defining or slowing down existing developing programs. Next to space development we have the same situation in developing areas like weapons (land, sea and air related), in fact in all areas where profit is not the prime goal. Governments of today are not willing anymore to provide unlimited funding for any program that their departments, industries or even science agencies are proposing. Industries who are not depending on government contracts are less vulnerable. There are only a few companies who can

continue their developments without government support; those involved in communications are a good example.

All departments are facing a period where they have to do more with less money and there will be no change in the near future. This means that everyone has to be more flexible and creative in spending their money. This is the moment where we have to think how we still can fund developments and support at the same time the prime needs as foreseen by our governments.

A solution is the combination in the use of assets developed for military and all other departments, and the use of these assets for commercial purposes. Within existing satellites, communication equipment, even helicopters and fixed wing air planes, are areas which can be used both for commercial as military purposes. Why not sell images produced by military satellites? Why not sell flying hours for commercial purposes? Why not contract out all support for military assets? With the right approach (and solving all legal constraints because of certain limitations!) this would have a positive effect on military expenses. The next step would be the development of new systems to be used for both military and commercial purposes. Both requirements can be incorporated in the design and both would be responsible for the R&D (Research & Development) costs. Again certain limitations will remain. In fact the military development of today in Europe is more commercial related than in the USA; examples in Europe are the development of military satellites (Matra, Daimler Benz, Dornier), which had a commercial (civil) base.

The opponent will always argue that for security and availability reasons he needs a complete independent system to be developed according to his own requirements. However we

should not forget that the ‘civil’ technology of today is already passing the ‘military’ technology and therefore it is better to link up with the civilian developing process.

The question if commercial satellites and their commercial output (such as imagery) can work for the military can not be answered in a simple way. Military (space) leaders have different opinions about this. Donald Lionetti, a former Army Lt. Gen. (commander Army Apace and Strategic Command) stated that commercial systems have advantages but still military systems are needed. Weather, remote sensing, global broadcasting services and battlefield paging lend themselves to commercial purchase, but missile warning, signals intelligence and operationally important imaging systems do not.

The main reasons for not going commercial are[9]: DoD could be 'out-prioritized by someone else'.

Commercial is not always cheaper and the intelligence community or tactical operators have special needs that preclude use of commercial systems. 'Commercial' is not working in all places around the world the DoD needs to go. International commercial organizations have clauses in their contracts which preclude Defense from using its assets in certain times or for certain uses.

Some (military) leaders deny the need of high resolutions because they are more interested in a big overview of a certain area than in a 'spot' view (however precision bombing needs accuracy data, thus high resolution data). Nevertheless it is sure that the military did use a lot of commercial images during the Gulf war and it is foreseen that in the future there will be an increasinge in the purchase of commercial images[10]. As Robert Davis, Defense Department Deputy Under Secretary for Space, said: 'Commercial systems, ... are likely to play roles in a military space strategy being assembled to guide spending during the next 20 years'[11]. Already today commercial imagery can do 80 percent of the jobs tasked to the spy satellites. Photos from spy satellites cost about 10,000 times more per picture than commercial satellites[12].

As is normal, the truth is somewhere in between. As an answer to budget cuts however, the opponent has to think about cooperation and might even be forced to open his doors for commercial interests. Already today there is a significant civilian part that supports the military needs. In the future this part will even grow.

Next to a better use of civil assets and support by civil agencies for military needs, the best way to have a financial acceptable independent ballistic missile defense capability is looking for

international cooperation. Special for those systems which cannot be developed in Europe on short notice or for those systems which are already available elsewhere in the world. International cooperation will reduce the costs by using existing limited resources efficiently (European - European with US - European with Russia). But how can international cooperation with technology sharing and spin-off for European industries be realized?

International Cooperation

International cooperation and common developments of weapon systems (F16, TORNADO, PATRIOT, ROLAND and STINGER) are well known in NATO. These cooperations are European based only or transatlantic. But has there been a real technology share and an offset? Yes all these programs were based on sharing technology and/or offset, so it has been proven that it can work.

According to the NATO's Industrial Working group there are a couple of current and future cooperation projects based on European and US industrial capabilities. The two current TMD projects (ground based systems) to improve early warning and surveillance capabilities in the context are:

The Existing improved Ballistic Missile Early Warning Systems (BMEWS) have been optimized for the detection of long-range strategic missiles, but the fundamental qualities of these radar's can provide useful early warning capability against shorter range TBMs. Also, these systems have not been fully integrated into the air defense structure of NATO.[13] It has, therefore, been proposed in US/NATO working groups that radar's, such as BMEWS, should be considered

as a potential TMD early warning system. In order to do this, a better understanding of their capability with respect to TMD and associated TMD tracking algorithms is required. A joint UK/US program will examine the application of advanced tracking algorithms and schemes to the BMEWS data.[14]

Another joint program is the *Early Warning (EW) Sensor Integration (UK/US/NATO-STC).* Ballistic missile early warning and cueing is an essential part of any integrated TMD system. Early warning information can come from a variety of sources, including space-based assets, such as DSP, long-range ground-based radar's, such as BMEWS, and forward based naval surveillance and tracking platforms, such as AEGIS/SPY-1. Verification and coordination (data fusion) of this data in real time is essential if the information is to be of greatest tactical use. Several analyses have shown that integration or netting of sensors can provide a more robust capability to provide Alliance early warning.[15]

But in the sensitive business of intelligence and the use of space based sensors, technology sharing and military cooperation with the US are rare. When WEU first announced their intention to develop their own space capability, the US offered to sell Lockheed satellites to European allies. But these trades off the shelf are not an international cooperation and common development.

Having described the basics about theater missile defense as a complex system in chapter 2 , it is obvious that the development of a whole TMD architecture from spaced based sensors to two

tier capable interceptors will take a long time and will be very expensive. Single European nations can not afford this.

Future Fields of Cooperation - Global Cooperation

Should Europe in the future look for international cooperation? The answer is yes. The European Space Agency (ESA) both military and commercial is going through some difficult years. Agreement on several programs was very difficult and is still a major problem. ESA is facing an (internal) organizational problem[16] and financial problems mainly caused by the Ariane 5 failure. Furthermore space business in Europe is rapidly changing, new actors emerging, priorities are evolving and science may become a secondary factor of development for space activities in Europe. ESA recognizes the necessity of international collaboration to maximize the efforts of the scientific teams and to avoid redundant overlaps. [17]

No doubt, no country can afford anymore to fund their national complex defense and space programs, cooperation in the future is a must. More and more it is obvious that the European nations are not able to fund the development and production of a theater missile defense capability on their own. It is even doubtful if Europe alone can afford a missile air defense architecture which is covering the total continent of Europe. For that reason transatlantic cooperation will be necessary. [18] The European (NATO) countries are looking traditionally in the first place to the US for cooperation. However a European nation(or other nation) participation in US programs is always a risk for those nations. Yearly funding of programs in the US always needs Congressional approval. History teaches that often programs were killed because of US domestic financial problems. Thus any nation who wants to cooperate with the US has to take this

into consideration. MEADS is an example where it almost went wrong during the debates in Congress in 1996 - MEADS was almost killed, but thanks to a certain lobby it survived for 1997 & 1998. After 1998 is still an open question! [19]

Beside cooperation with the US, Europe should also consider to increase her cooperation with Russia. The available (rocket) technology is state of the art and the labor prices are low. Already today there are benefits, on rocket engines, communication satellites and launchers. Russia collaborates already with France and Germany. [20]

Future Fields of Cooperation - Global Cooperation is the ultimate solution to minimize costs. Duplication in developments is the major waste of money on our globe. For years the US, former Soviet Union, some European countries, and part of the eastern world were duplicating their development of weapon systems for entering and exploiting space. Today no country and almost no industry are able to continue the duplication. An answer should be found to avoid these duplications. Spreading research and development, prototyping, production and support of space assets (including subsystems and assembly) over the world's nations would be the most simple solution. This is maybe wishful thinking today, but necessary tomorrow.

A formula has to be developed where on a competitive base all the nations of the world can participate in future space programs. A major condition will be that all participating nations will contribute in R&D, production and support in these programs on an equal share; future benefits will be also shared on an equal base. Compensation for contribution is not necessarily related to the program itself. Compensation can be found in indirect areas, particular in those areas where

the related country can be very competitive to other nations (e.g. ship, car industry, medical industry, agriculture).

Besides the earlier mentioned projects BMEWS and UK/US/NATO-STC, there are more examples of existing cooperations. A European example is the Ariane 5 program where 12 European countries did develop and produce the Ariane 5 launch vehicle, the successor of the well known Ariane 4. Despite the failure of the Ariane 5 launch in 1996, the program will continue this year with a launch in July of the second Ariane 5.

The space station program is an example for global cooperation. USA, Russia, Canada, several countries from Europe (ESA), and Japan are involved, however, national interests still prevails above global interests.

European theater missile defense related examples are the Helios 2 and Horus programs, now delayed mainly because of budget problems. Budget sharing is the key solution to this problem. However if, as an example, all nations of the WEU and/or all nations participating already in the Ariane 5 programme (space related work) would take a share of the total program costs of the Helios 2 and Horus program (important for the European defense architecture), these programs could continue today. Based on a share per head per country, calculations can be made and shows that the costs for France and Germany are significantly reduced (more than 40%) and the program could continue.[21]

One step to further the ability to develop a theater missile defense system by and for Europe against acceptable costs encompasses an approach where all European nations would equally share the costs as a percentage of their GNP as shown before. For those systems already on the market or in development (such as MEADS, THAADS, Early Bird), cooperation should be found with the US where equal share of work (offset) is again guaranteed. Important for the European countries is to keep in touch in quality and productability. The result would be a (mobile) missile

defense system which can be used as a defense for Europe and as a missile defense for all those European forces deployed around the world fulfilling their WEU, NATO or UN missions. Coming back to the question, does Europe needs its own theater missile defense capability, where the answer is yes, all nations should share the (financial) consequences.

Cynically if the world would be willing to develop a worldwide early warning and reconnaissance system, and a related missile defense architecture open for all nations in the world, there would be almost no chances for any major conflict in the world. A global early warning and reconnaissance architecture would be a perfect tool for the UN.

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[21] See Appendix F, *Cost Sharing in the Helios 2 & Horus program*

Chapter 4

Conclusion

The danger of proliferation and wide spread of Ballistic Missiles, especially Tactical Ballistic Missiles are recognized by the US and the European NATO partners. While the US are way ahead in developing and deploying a multi-tier defense architecture against Tactical Ballistic Missiles, NATO and its European countries are at the beginning. Appropriate programs and actions are discussed to protect the Alliance against a TBM threat for homeland defense and deployed forces in out of area operations.

However in the field of ground based interceptors the Europeans have some capabilities with their PATRIOT systems. To fulfill all necessary functions in a TBMD architecture NATO still relays on US assets, especially on space based assets. The importance of space based assets, owned and operated by the US is well recognized. Information from space based systems for early warning, detection and tracking of TBM are available for the European partners.

But there are no international cooperation's to develop and deploy sensitive early warning and detection assets for TBMD purposes. International cooperation in defense matters however has been successful in the past and will be in the future. Several cooperation programs -except in space technology- are initialized in NATO to develop an effective TBMD system.

The European civilian industries had proven their capabilities to develop satellite systems and have the technology expertise and capacities to do that. To develop an European independent political and defense identity in the WEU, especially for operations without or very limited US participation, it is necessary to operate own and independent space assets for reconnaissance, intelligence, early warning and surveillance. Helios and Horus are the first steps to develop such a kind of independence. These European cooperation programs can be later trade in for a global use of space assets and a technology share across the Atlantic.

International cooperation on an equal and fair basis - even in the sensitive area of space issues - are a way to use efficient limited resources and to reduce cost as well, especially in times of budget restrains. Furthermore it is a signal for common goals and political willingness to deter a worldwide TBM threat and the proliferation of WMD and their delivery means.

TBMD and international cooperation in all aspects of Defense are furthermore effective counterproliferation means and will enable the free world to establish a solid Tactical Ballistic Missile Defense not only for Europe. This can even be a realistic and possible way to build a Global Missile Defense for the future.

Appendix A

The Air Threat Spectrum

Due to the complexity and space consuming fact of this graphic, it is only available as a hard copy.

Appendix B

The Ballistic Missile Threat

Due to the complexity and space consuming fact of this graphic, it is only available as a hard copy.

Appendix C

Worldwide Ballistic Missile Proliferation

Due to the complexity and space consuming fact of this graphic, it is only available as a hard copy.

Appendix D

The Two Tier Concept (Detection and Tracking; Engagement)

Due to the complexity and space consuming fact of this graphic, it is only available as a hard copy.

Appendix E

The Joint Tactical Ground System/JTAGS

Due to the complexity and space consuming fact of this graphic, it is only available as a hard copy.

Appendix F

Cost Sharing in the Helios 2 & Horus program

Program costs for Germany and France of Helios 2 and Horus: $4.68 billion (the German share of this part would be today $1.97 billion).

Projected costs: Situation today:	Helios 2	$2.20 billion
	Horus	$2.30 billion
	Ground station	$0.18 billion

By equal sharing, based on $ per capita in Europe, the financial share per nation would be:

Country	population	GDP bill$	per capita	Equal share $	%%%
Austria	8,100,000	149.8	19,000	117,438,434	2.51
Belgium	10,200,000	177.5	20,597	139,154,353	2.97
Denmark	5,200,000	95.6	18,500	74,947,359	1.60
France	58,100,000	1,050.00	18,200	**823,166,595**	17.59
Germany	81,700,000	1,476.10	18,133	**1,157,215,439**	24.73
Ireland	3,600,000	48.13	13,480	37,732,389	0.81
Italy	57,700,000	739	13,000	579,352,489	12.38
Luxembourg	400,000	9	22,000	7,055,714	0.15
Netherlands	15,500,000	262.8	17,200	206,026,839	4.40
Norway	4,324,577	89.5	20,800	70,165,153	1.50
Portugal	9,900,000	91.2	9,200	71,497,899	1.53
Spain	39,300,000	498	12,700	390,416,156	8.34
Sweden	8,900,000	153.7	17,600	120,495,910	2.57
Switzerland	7,000,000	149.1	21,300	116,889,656	2.50
United Kingdom	58,600,000	980.2	16,900	768,445,616	16.42
	368,524,577.00	5,969.63		4,680,000,000	100.00

Reference: 1996 Almanac[1]

(support costs and additional satellites not included)

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