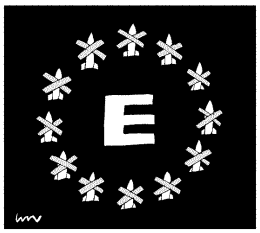

PENN-NL

Theatre Missile Defence

First steps towards global missile defence

May 2001

Martin Broek
Frank Slijper

Working Group Eurobomb
PENN-NL

Theatre Missile Defence

First steps towards global missile defence

May 2001
Utrecht
The Netherlands

(Ed.) K. Koster

This publication was made possible by
the W. Alton Jones Foundation
(Charlottesville, USA)

PENN: Project on European Nuclear Non-Proliferation

Working Group Eurobomb is the Netherlands part of the international PENN network set up with the following aims:

- to monitor official discussions about the future of nuclear weapons in Europe and to help make them more transparent
- to publish analyses and political commentaries on these developments
- to promote further nuclear disarmament steps in Europe and substantial European contributions to nuclear arms control, disarmament and non-proliferation
- to promote full compliance with the Non-Proliferation Treaty by NATO, the European Union and their member states
- to encourage the creation of political obstacles to developments which might lead to a nuclear armed European Union
- and to promote developments encouraging the European Union and all its member states to become non-nuclear members of the NPT.

Working Group Eurobomb/PENN-NL
Obrechtstraat 43
NL - 3572 EC Utrecht
The Netherlands
Tel (+31) (0)30 271 43 76
(+31) (0)30 272 25 94
Fax (+31) (0)30 271 47 95
Email: k.koster@inter.nl.net
Logo: Len Munnik

Introduction

The concept of Missile Defense or more popularly, 'Star Wars' is fairly familiar for a broad public, thanks to the extensive media and political attention given to the US plans for deploying the National Missile Defense system (NMD). This is often understood to refer to a system of anti-missile launchers to be deployed on the territory of the continental United States, in conjunction with outlying long range early warning radar systems built on the soil of US allies. It is generally seen as a (misguided) attempt to protect the US population against limited numbers of ICBM's armed with weapons of mass destruction fired by accident or design at the superpower. Much has already been written on these plans: there is opposition to them, not just from the strategic rivals of the US like Russia and China, but also from the Western allies who are greatly concerned about the destabilising consequences of NMD. It is seen as a first step towards a dangerous new arms race. At present it looks as if the Bush administration will eventually go ahead with the plan, while keeping the allies informed of its progress. In response to the criticism the project is no longer described as a US 'national' plan.

In fact President Bush stated in a policy speech on 1 May that he had "asked Secretary of Defense Rumsfeld to examine all available technologies and basing modes for effective missile defences that could protect the United States, our deployed forces, our friends and our allies."

Clearly, a national missile defence against intercontinental ballistic missiles is not the only plan on the table. Other systems, meant to counter intermediate and short-range ballistic missiles and to protect more limited areas, are being developed, on the basis of existing weapons. The theatre missile defence plans based on Aegis cruisers constitute one of the better known systems, usually in connection with Japanese and Taiwanese defence plans. But in NATO, too, the Patriot and Standard missiles are being upgraded as part of one plan to protect NATO forces operating overseas, or parts of European territory. Some exercises have been taking place for years, development contracts are being signed. It is the development of these theatre missile defences which we believe should be debated as well as the better-known NMD. For that reason PENN-Netherlands commissioned two Dutch researchers to look into the state of development of TMD. Their work has resulted in this paper.

Karel Koster
PENN-Netherlands
May 2001

CONTENTS

Executive summary

The National Missile Defence (NMD) program of the US is widely covered by the mainstream media. NMD is one of the legs of Ballistic Missile Defence (BMD). The other leg, the so-called Theatre Missile Defence (TMD) is not so much part of the debate on BMD. In this essay the argument is made that TMD must be part of the debate on ballistic missile defence as well.. The necessity of this has become evident recently, with the US charm offensive aimed at taking away international concerns about NMD, partly by offering a place for allies under the missile defence umbrella. Secretary of Defense Rumsfeld recently illustrated this development by stating that the U.S. will no longer differentiate between TMD and NMD.

NMD is a system to create a shield over all 50 states of the US to protect against Inter Continental Ballistic Missiles (ICBMs), while TMD is a system against Tactical Ballistic Missiles. TMD is a mobile system created for protecting forward deployed troops as well as smaller countries or regions. There are generally speaking three kinds of TMD systems: systems defending the lower tier of the atmosphere, upper tier systems and systems targeting enemy missiles during their boost phase.

Drawing a line between TMD and NMD is difficult. Russian opposition against the Vardo radar station in Norway becoming part of the US NMD policy, is explicitly connected with the naval Aegis system, which is generally seen as a TMD system. This does not mean that any distinction between NMD and TMD is artificial. Differentiating between both is still possible on technical grounds as well as for military strategic reasons.

Technically TMD is less ambitious than NMD. While NMD is being developed to protect the whole of the United States, including Alaska and Hawaii, TMD is designed to defend ‘areas of operations’, which are smaller in size. NMD will target Intercontinental Ballistic Missiles (ICBMs), while TMD is directed against Tactical Ballistic Missiles (TBMs) with a range of up to 3,500 km. Testing TMD interceptor missiles against ICBMs is not allowed by a protocol to the ABM treaty. However, the US Senate has yet to vote on this protocol.

On the level of military strategic arguments the difference between NMD and TMD is significant. When looking at the balance of power between the U.S. and Russia the advantage will shift towards the US. The thousands of nuclear warheads delivered by ICBMs still deployed by Russia are nevertheless a force to reckon with. These ICBMs cannot be intercepted by TMD, but could in time be countered by an extended NMD, if the technological problems were overcome. Current plans are limited to the deployment of 100 launchers.

In this context it is notable that for East Asia the situation is very different. The Chinese armed forces possess 20 nuclear-armed ICBMs. NMD could be sufficient to neutralise any Chinese attack with those ICBMs. But TMD has even more strategic consequences for China. Their introduction is changing the regional balance of power in favour of US allies South Korea and Japan. US-made TMD systems may also be used to defend Taiwan against China. So NMD as well as TMD have serious effects on a region which already has a very fragile security situation.

TMD however should also be part of the security debate concerning Europe. The strategic impact of TMD on the situation in Europe differs from the effect it has in East Asia. In view of:

- the still increasing capabilities of the weapon systems developed for TMD,
- the close links between TMD and NMD,
- the proposals to have a NMD program evolving from TMD
- and currently implemented and planned capabilities of TMD (like the possibility that a boost-phase intercepting system will be able to counter a ICBM when close enough to the launch point), it can be expected that TMD will be able in the future to target ICBMs also. So in the longer run TMD can turn into a system for national missile defence against missiles with a longer range than 3,500 km.

The distinction between tactical and strategic shields against missiles can be defended if seen from the perspective of defending U.S. national territory, but is a misconception if seen from a non-US perspective. Moreover, TMD also has a strategic value for the US, because it can be used for defending strategic interests abroad.

After this first contextual part of the essay, the ongoing efforts in Europe for creating a TMD capability are examined. The political decision-making process in NATO is crucial in this. Since 1995 serious efforts are ongoing in NATO to create a NATO-wide BMD program. Since the NATO summit in Washington all member states have committed themselves to acquire the necessary means for this task. The Dutch involvement is taken as an example.

When reading through the numerous articles, reports and analyses of TMD, one very often gets the impression that TMD is science fiction. However, the U.S., along with other countries, is currently developing, testing and improving TMD. Among these countries is the Netherlands, which is:

- equipping its new air defence frigates with TMD capable radar and missile systems;
- organising in co-operation with Germany and the U.S. one of the biggest TMD exercises in the world, Joint Project Optic Windmill (JPOW). Part of the JPOW exercise is to practice interoperability and to refine tactics, techniques and procedures – all key aspects of the TMD system. JPOW is meant to integrate new concepts and technologies such as ABL, SBIRS and naval TMD;
- acquiring upgraded the Patriot (PAC-3), while the Ballistic Missile Defence Organisation (BMDO) named the Netherlands as one of the likely future purchasers of the upper-tier TMD Standard Missile SM-3; and
- together with Germany and the US, the Netherlands has formed in 1999 the 'Extended Air Defence Task Force' (EADTF). This task force can deploy air defence units at very short notice and can quickly form a fully integrated combined TMD cluster overseas.

At present the most important step is the NATO feasibility study for an alliance-wide lower and upper-tier TMD system. Major defence companies of Europe and the US, like EADS, Boeing and Raytheon together with several smaller companies from Canada, Greece, Italy, the Netherlands, Spain and Turkey have teamed in four groups to compete for the study.

Looking at ongoing naval programs is shedding some light on the ‘hidden’ tracks toward (naval based) TMD. For example close contacts between US, Dutch and German arms manufacturers and military planners ensures that technology is developed in a way that it needs only minor modifications on German/Dutch vessels to introduce advanced missiles for upper-tier defence which are now developed for the US Navy. Technology is being developed ahead of the political decisions concerning actual acquisition.

Although protecting intervention forces looks like the primary task of TMD, it will be possible in the future to expand it to protect complete countries or regions. The authors are aware of the technological and financial hurdles which have yet to be taken. The programs however do progress and the ‘lesser known anti-missile weapons’ must be monitored closely to prevent creating a destabilising European NMD, as it is already taking shape in East Asia.

Two tables and a list at the end of the essay give an overview of (potential) TMD-capable weapon systems.

Abbreviations:

ABL	= Airborne Laser
ABM	= Anti-Ballistic Missile
ACCS	= Air Command & Control System
BMD	= Ballistic Missile Defence
BMDO	= Ballistic Missile Defence Organisation
CBMA	= Confidence Building Measures Agreement
ICBM	= Inter Continental Ballistic Missile
EADTF	= Extended Air Defence Task Force
JPOW	= Joint Project Optic Windmill
MDAHG	= Missile Defence Ad Hoc Group
MEADS	= Medium Extended Air Defence System
NAC	= North Atlantic Council
NAD	= Navy Area Defence
NADC	= NATO's Air Defence Committee
NMD	= National Missile Defence
NTW	= Navy Theatre Wide
PAC-3	= Patriot Advanced Capability-3
SBIRS	= Space-Based InfraRed System
SBL	= Space-Based Laser
SDI	= Strategic Defence Initiative
TBM	= Tactical Ballistic Missile
THAAD	= Theatre High Altitude Area Defence
TMD	= Theatre Missile Defence
WEU	= Western European Union
WMD	= Weapons of Mass Destruction

Theatre Missile Defence in Europe: Process by Stealth

Martin Broek and Frank Slijper[1]
March 2001

"If you look at world history, ever since men began waging war, you will see that there's a permanent race between sword and shield. The sword always wins. The more improvements that are made to the shield, the more improvements are made to the sword."
Jacques Chirac, The New York Times December 17, 1999

On 30 May 2000, at 2.24.28 PM, a Libyan Al-Fatah missile (an upgraded version of a Scud missile) containing thickened nerve gas is intercepted by a Dutch Patriot missile. Though the interception prevents a large-scale disaster in the densely populated area around Amsterdam and Rotterdam, nerve gas causes deaths throughout the eastern regions of the Netherlands and parts of Germany.

This scenario is part of one of the biggest Theatre Missile Defence (TMD) exercises in the world, Joint Project Optic Windmill. But the scenario is far from realistic, even though the naming of a specific country and a specific missile gave the impression of a real threat. Rotterdam is more than 2000 kilometres from the northern border of Libya and the Al-Fatah missile has an intended range of only 950 kilometres. Furthermore the Al-Fatah missile has been successfully tested to only 200 kilometres.[2] As such, this exercise is based on an overestimated threat perception, effectively used in the media as if this threat is already real.

With Joint Project Optic Windmill (JPOW), the Royal Netherlands Air Force has hosted since 1996 what is said to be one of the three most important Theatre Ballistic Missile Defence exercises in the world. The Pentagon identifies this exercise as a key research tool for improving TMD. Thus, JPOW 3 in 1998 marked the first deployment outside the United States (US) of the AirBorne Laser (ABL) systems engineering model and the first display abroad of the computer model simulating the Space Based Infrared System (SBIRS) satellite constellation for missile warning, missile defence and technical intelligence gathering.

The latest exercise coincided with 'Clean Hunter 2000' (CN00), NATO's Air Component Command North's largest annual live-flying exercise. The US European Command and the German Luftwaffe co-organised CN00/JPOW-V. Several US missile defence organisations (among them the Ballistic Missile Defense Organization, BMDO) supported CN00/JPOW-V as part of an assessment of TMD by the US European Command. Thousands of military personnel from 15 NATO member states were directly involved in the combined exercise, which took place 22-31 May 2000. The main objective of the JPOW 5 exercise was to develop interoperability and to refine tactics, techniques and procedures – all key aspects of the TMD system. This exercise has evolved from a small-scale, low technology event to a high-tech exercise integrating new concepts and technologies such as ABL, SBIRS and naval TMD.

The defence forces participating in this joint exercise included live and virtual lower-tier land- and sea-based systems like Patriot, Hawk, Aegis and LCF air defence frigates, together with

the USAF ABL. For the intelligence-gathering simulations early-warning planes, surveillance aircraft , unmanned aerial vehicles as well as five types of spy satellites participated. There were several types of exercises: locating and destroying transportable and erectable launchers (TELs) (counter force operations), 'active defence' (destroying incoming missiles), and simulations of 'passive' civil defence against the effects of weapons of mass destruction. As such, the Netherlands-based JPOW exercise has become ".. *a baseline for future NATO and US TAMD [theatre air- and missile defence] developments",* as Dutch Lieutenant Van der Graaff stated.[3]

Purpose

This paper draws strongly on technical information. But it is aimed solely at people closely monitoring the discussions and developments around Theatre Missile Defence (TMD) and National Missile Defence (NMD). The purpose is not to elaborate on all the arguments against TMD. Those arguments against TMD and NMD are expressed quite well in a number of publications and there are numerous elaborate studies from all sides of the political spectrum going into the issue in detail. Our main aim is to show the creeping process in Europe in which an expanded TMD slowly becomes part of the political reality of a combined NMD/TMD system.

When reading through the numerous articles, reports and analyses of TMD, one very often gets the impression that TMD is science fiction. However, with other countries the U.S. is currently developing, testing and improving TMD, as we can see from the Windmill scenario described above. The military is already using a wide range of weapon systems, including real or computer simulated laser weapons and space-based sensors and satellites. TMD is not a finished product, but rather an ongoing project. The purpose of this paper therefore is to highlight the process of European involvement in US, NATO and European TMD programs. Discussions on TMD often ignore the extent to which the project is already under way in Europe and NATO. These ongoing efforts are important because in the long run they will undermine European opposition to the US attempt to build a National Missile Defense system (NMD). TMD discussions in NATO will "*also provide a less volatile forum for the US representatives and companies to sell the missile defence and rogue threat concept to their European counterparts.*"[4] If all European and NATO projects proceed as planned, Europe will have its own 'national' missile defence in ten years time.

If the current US NMD program were to be cancelled or revised the US might focus more on the TMD programs ongoing in Europe and Asia. Some political analysts already propose a policy shift from NMD to TMD: *"We propose an alternative approach that builds on the theatre missile defence (TMD) systems now under development for defence against intermediate-range ballistic missiles. We believe this approach is a more balanced way to address the varied missile threats facing the United States and that it has technical and cost advantages over the proposed NMD system."* According to this proposal TMD will have greater capabilities. The same authors state that: "*A national missile defence capability that evolves from TMD will probably be cheaper, better contribute to defence against both long- and intermediate-range ballistic missiles, and allow for more effective growth in capability as the threat increases"*[5] Others, like the director of the Ballistic Missile Defense Organization (BMDO), are denying that TMD can be used in this way.[6]

Currently TMD and NMD are both part of the Ballistic Missile Defence programs, but not yet the same. We will look into those differences. What is clear is that TMD and NMD are closely interlinked. This is also clear from the budget allocations, as proposed by the BMDO. Those proposals shift money from higher tier TMD systems and NMD to lower tier TMD programs like 'Navy Area Defense' and the Patriot Advanced Capability (PAC-3) program.[7] Furthermore US secretary of defence Ronald Rumsfeld decided to stop differentiating between 'national' and 'theatre' missile defence for reasons of not creating "significant differentials in vulnerabilities between the United States and its allies."[8] So also on the level of US policy NMD and TMD are becoming one.

From Star Wars to NMD

Ballistic missile defence is not something new. In 1983, Ronald Reagan launched the Strategic Defence Initiative (SDI), better known as Star Wars. With the disappearance of the Cold War in the late 1980s, the ambitious program was shelved. However, a program to develop stronger defences against Tactical Ballistic Missiles (TBMs) was reinforced in 1991, when Iraq fired missiles on US troops in Saudi Arabia and cities in Israel. In addition to Iraq, more countries now have access to missile technology. Possession is no longer limited to a happy few, who earlier decided they should have the exclusive right to control missile technology, denying it to others. Besides the proliferation of TBMs, other missile threats have become part of military planning. In May 1987, the US frigate Stark was hit by an Iraqi missile when patrolling the Persian Gulf. A debate started on how to tackle the missile threat.

The US and NATO military reaction to these attacks and perceived increased threats has led to the creation of what are called Theatre Missile Defence systems. In addition, state-of-the-art technologies (especially laser, tracking and imaging technologies) have enabled progress on ballistic missile defence.[9] For Star Wars alone US$ 26 billion has already been invested in research and development (R&D). This has resulted in increased knowledge of high-energy lasers, infrared technologies, satellite communication systems and radar and missile technology. Part of this technology will now be used for further R&D for TMD and NMD, in which the US has invested another US$ 36 billion already.[10]

Has Ronald Reagan's Star Wars, estimated to cost US$ 1 trillion, re-emerged? Not fully. The NMD program proposed today is smaller than the SDI proposal of 1983. For instance, the proposed NMD would only target a maximum of 100 incoming Intercontinental Ballistic Missiles (ICBMs), while SDI was meant to defend against all incoming missiles.
Estimates about the financial costs of NMD vary. It is clear that the costs are enormous. The purchase and 20-year operating costs of just one 20-missile battery with all radars, satellites and ancillary technology has been estimated at $26.6 billion by the Pentagon's Director of Testing and Evaluation.[11] The price tag for Clinton's plan was estimated at $60 billion and an additional $8 billion to $10 billion a year to start with. Although Bush's bigger shield will be even more expensive its price is still lower than that of Star Wars.[12]

Moreover TMD is not yet openly being discussed as a shield against ICBMs. Many analysts consider the current TMD programme as still unfit for that role (see below).

However, most of the original arguments against Star Wars remain valid. The introduction of NMD and TMD will:

- lead to a new arms race;
- increase proliferation of missile and anti-missile technology
- create more tensions among nations; and
- cost enormous amounts of money.

TMD and NMD compared

Outspoken European opposition to NMD and silence around TMD might lead one to believe that TMD development is not going on in Europe or that the NMD and TMD programs have nothing to do with each other. Recently Mark Hewish, technology editor of Jane's International Defence Review, stated that: *"Despite the recent high profile of the NMD program in the United States, TMD programs generally remain the priority throughout the world."*[13] Why has most European and US attention been paid to NMD when many analysts argue that it is difficult to distinguish between TMD and NMD?[14]

Nevertheless most governments make a distinction between TMD and NMD. Most European countries opposed the U.S. NMD initiative but not TMD (although this opposition looks like it is weakening.[15]) Russia even threatened to target its cruise missiles on European capitals and halt future arms reductions if the US went forward with the program.[16] At the same time, Russia expressed interest in participating in a TMD program focused on a system targeting missiles in their boost phase. Russia is not opposed to a system that neutralises TBMs launched by countries hostile to Russian policies (including former Soviet republics). Russia and the US came up with a proposal for co-operation in September and October 2000.[17] China, meanwhile, is mainly focusing its criticism on TMD and the connections between TMD and NMD, not NMD directly (see below for more detail on this issue).[18]

The biggest difference between the two programs is size. TMD is a mobile system that can defend smaller areas. NMD is designed to protect all 50 U.S. states (including Hawaii and Alaska) against primarily intercontinental missile threats. NMD will protect not only the people of the US but also its industrial and military installations, including its thousands of strategic nuclear weapons. While the balance of power has already very much shifted in favour of the US, NMD will totally destroy the 'nuclear balance' between the superpowers. If Russia wants to prevent this from happening, it must improve its missile technology (for example, improving its decoys to overwhelm the NMD system) and expand the number of nuclear missiles and warheads. This renewed strategic competition between the US and Russia will endanger thirty years of all arms reduction agreements. The *Bulletin of the Atomic Scientists* strongly condemns NMD: *"It is bad enough if the [Clinton] administration simply does not understand what it is doing. It is even worse if it does."*[19]

While the US NMD system is larger, TMD is not designed simply to protect small areas. In fact, national defence against ballistic missiles is possible on a national scale with TMD technology. TMD has three different tasks:

1. protecting smaller countries and regions where the systems are based,
2. protecting allies and
3. protecting expeditionary forces against TBMs and cruise missiles.

Thus protecting national territory is not the only aim of TMD, protection of rapid deployment forces is also the goal. During the Gulf War of 1990-91 most of the US military casualties

were caused by an attack with a Scud missile on US troops based in Saudi Arabia, as the Pentagon recently commented.[20] TMD is meant also to create the freedom to intervene despite a missile threat and to reduce the threat to intervening troops. TMD units are already used for this purpose. This happened in April 1999 when the US deployed two TMD units in Bosnia and Southwest Asia (connected to operations against Iraq).[21] Some commentators even assume that TMD is not actually developed for missile defence but is *"being designed to allow the US to not be deterred from intervening militarily in support of an ally in the face of a ballistic missile threat."*[22] More specifically they surmise that the system is useful for sea-based protection of amphibious landing areas and ports of disembarkation[23] or for defending US economic interests in for example the Middle East.[24]

There are roughly three kinds of TMD systems: lower-tier, upper-tier defences and systems designed to hit a missile in the so-called boost phase (this is the period directly after the launch of the missile).

Lower-tier anti-ballistic missiles can intercept a missile in the atmosphere (endo-atmospheric) and can reach altitudes up to 25 km. The PAC-3 missile, for instance, is able to defend an area as large as 6,000km^2. The Navy Area Defence system can protect an area as big as 17,000km^2.[25] Israel, for example, can be entirely protected against TBMs by its lower-tier Arrow system.

Upper-tier missiles, on the other hand, can intercept missiles far into the atmosphere (exo-atmospheric) and reach altitudes of over 50 km. With this last system it is possible to defend a country as big as Italy. Two naval vessels equipped with upper-tier TMD technology and missiles can defend South Korea and Japan.[26] In the case of Europe three or four ships in the Mediterranean Sea, fitted with an anti-air warfare system like that to be introduced on the new German and Dutch frigates *"could protect almost all of Europe against a North African-based TBM threat."*[27] As Hewish states, for smaller countries or regions NMD and TMD become one.[28]. Also article 1 of the ABM treaty states it is prohibited to deploy a missile defence system protecting the whole territory of one state, although a demarcation line is drawn to exclude TMD from the provisions of the ABM treaty (see below).

In addition, NATO is discussing how to integrate battle management for TMD into the Europe-wide NATO Air Command & Control System (ACCS)[29]. In July 2000 Germany inaugurated a new air defence centre near the Polish border.[30] Plans are being developed to get Central European countries on board.[31] This system will give NATO a theatre missile defence tracking capability over all NATO countries, which is not only crucial for TMD, but also essential for countering ICBMs. According to senior German air force officers, if the quality of missiles improves, then ACCS must be expanded accordingly.[32]

There is another difference between TMD and NMD. NMD basically defends against the threat of strategic intercontinental missiles (ICBMs), while TMD targets shorter range (Tactical) Ballistic Missiles (TBMs). However, the distinction between Strategic and Tactical Missiles is artificial and based on a US-centric viewpoint of defence. The upper-tier systems of TMD are able to target missiles with ranges up to 3,500km. Only Alaska can be reached by potential adversaries using tactical ballistic missiles. For Europe, Taiwan, Korea and Japan, however, missiles with a range up to 3,500 km can be considered strategic because these countries are situated well within range of the same potential adversaries.[33] From an offensive U.S. point of view, defence against tactical missiles is also of strategic interest when it

protects U.S. troops deployed abroad. A TMD capability will change the balance of power in some regions, notably East Asia and Europe, but has fewer implications for the military balance between the US and Russia.

Furthermore, it is also possible for TMD to counter ICBMs (during the boost phase) if the TMD (launching) system is positioned close enough to the ICBM launch point, if there is sufficient information provided on the ICBM's trajectory, and if the intercepting missile is fast enough.[34] The capabilities of missiles are increasing year by year. For example, the THAAD (Theatre High Altitude Area Defense) missile with a speed of 2.7km/s is able to destroy incoming missiles with speeds up to 5km/s.[35] This 5km/s is an important limit set by Yeltsin and Clinton in March 1997[36] to prevent the use of interceptors against ICBMs which have a speed of 6 to 7 km/s.[37] The SM-3 missile designed for upper-tier defence already has a velocity of 4km/s, which is above the 3km/s speed in an earlier agreement (1995) reached by the US and Russia. Following these technological developments Russia and the US agreed in March 1997 an ABM/TMD demarcation line composed of four elements:

- limitation of the velocity of ballistic target missiles to 5 km/s;
- limitation of the flight range of ballistic target missiles to 3,500 km;
- no development, testing or deployment of space-based TMD interceptors or components based on alternative technologies that could substitute for space-based TMD interceptors;
- annual exchange of detailed information on TMD plans and programs.[38]

In September 1997 it was decided to make the higher speed interceptor systems subject to the Confidence-Building Measures Agreement (CBMA). Now interceptor missiles are no longer constrained or prohibited by agreements between the US and Russia, as long as they do not have the capabilities to counter ICBMs. Both parties inform each other on developments. So the September agreement was in line with the provisions made in the demarcation agreement on ABM/TMD of March. However, those agreements have not been endorsed by the US Congress.

Though not irrelevant, the debate on the parameters is certainly highly academic. According to Postol these parameters are not sufficient for setting a threshold.[39] TMD interceptors can be over-designed, like a car whose advertised maximum speed is lower than its real speed. Also, the longer warning time after the launch of an ICBM[40] offers more possibilities for the interceptor, when ground-based and space-based detection systems work closely together. The division between defences against strategic and tactical missiles is at the very least a grey area; the development of new technologies only makes it more difficult to distinguish between the two types of missiles.

Differences in regional military relations

The opposition towards the US NMD systems is outspoken in Russia, Europe (although diminishing) and East Asia. But there are clear differences in the background of this opposition. Highlighting not only the European political developments, but also those in the Asian region and their possible consequences, can give a better understanding of the implications TMD might have for Europe.

Russia

One of the reasons for the differences between Russia and China regarding TMD and NMD may be that TMD systems are not aimed at countering ICBMs, but at shorter-range missiles, in accordance with the ABM treaty, which prohibits missile defence against missiles with ranges greater than 3,500 km.[41] For Russia, with its *6,000 strategic nuclear weapons, this is an essential distinction. Because TMD is not yet able to counter ICBMs, Russia can maintain its capacity to attack the US. However, TMD is slowly transforming into an NMD system by covering ever larger areas and defending against longer-range missiles (although some are proposing policies to prevent these developments).[42] For the near future, Russia is likely to opt for a less capable system than NMD.[43] Russia may also try to drive a wedge between the US and Europe. In any case, Russia is trying to have it both ways:

- working together with the US to develop a system against TBMs that also threaten Russia;
- countering TMD developments that are taking place without Russian participation.

East-Asia

For China, it is a different story. Although NMD can significantly undercut or even neutralise China's small nuclear force[44] , China is chiefly worried about TMD. It fears that further research into TMD will enable the US and its regional allies to implement a system that will disrupt the delicate balance of power in Northeast Asia. Furthermore, TMD:

- would integrate Taiwan into the U.S.-Japan security alliance;
- further elevates the role of Japan in regional security; and
- contributes to US efforts in strengthening its military presence in the region.[45]

China's greatest concern is the effect of TMD on Taiwan policy. Although the US follows a 'one China' policy, this is constantly subject to debate. Moreover, US defence co-operation with most states surrounding China has led to a suspicion that the US is trying to pursue a containment policy. TMD can play a role both in defending Taiwan and containing China. China would face more difficulties in launching a military assault on Taiwan, since the early stages of the assault would involve missile attacks similar to US military tactics during its recent interventions. TMD, because it can act as a national missile defence system for smaller areas, can offer a defence against such strikes. China's Foreign Minister Tang Jiaxuan stated: *"I wish to point out emphatically that if some people want to include Taiwan in the TMD, then that would amount to an encroachment on China's sovereignty and territorial integrity."*[46]

Secondly, distrust of Japan is widespread throughout East Asia, not least in China. Some commentators say China fears a resurgent nuclear-armed Japan under the shield of TMD.[47] Lee Samsung offers another angle on the nuclearisation of military relations in the region by suggesting, among other things, that if China reacts to NMD/TMD by strengthening its nuclear force, Japan and South Korea might follow suit by arming themselves with nuclear weapons. He also states that without confidence among the non-nuclear countries in East Asia it is impossible to control the nuclear ambitions of the major powers. The introduction of TMD will intensify distrust in the region.[48] The NATO Parliamentary Assembly states that the scope and speed of China's nuclear program has also been motivated by any deployment of TMD systems in either Taiwan or Japan.[49] Former US Secretary of Defence William J. Perry noted: *"I share the Chinese concern over the deleterious effect of an arms race in the region,*

but I believe that if an arms race does get underway, it will have been stimulated by the extensive deployment of missiles, not the deployment of missile defences."[50] Such words must be regarded as another sign of the arrogance of the world's only military superpower, not conciliatory rhetoric from a country sincerely looking to improve arms control mechanisms. Further Japanese research into TMD (in co-operation with the US) will certainly exacerbate tension and contribute to deteriorating relations in the region. Japanese Minister for Defence Tsutomu Kawara said in February 2000: *"The Missile defense research just began in August involving joint research on protective missiles, including the kinetic warhead, the seeker, the second-stage rocket motor. It is something the United States and Japan need to make fruitful."* [51] In 1998 Japan decided to spent US$ 7.7 million in fiscal year 1999 and US$ 27 million for the next year on TMD-related developments.[52] Both Taiwan and South Korea are much more cautious on this issue.

For South Korea,[53] good relations with China are important for going forward with the main thrust of Korean politics: the reunification process between North and South. Embarking on TMD would sour Korean-Chinese relations. TMD is also from the military point of view not a solution against the threat of North Korean ballistic missiles because of the very limited reaction time (a North Korean missile can reach South Korea in less than 4 minutes) and because the launching areas are close and can be targeted with other weapon systems.[54]

As for Taiwan the Clinton administration was careful to let it develop its own TMD system because it does not want to create bigger problems with the Chinese mainland. This is however not an absolute position. When the U.S. refused to sell Aegis class destroyers (with radar able to track missiles over a longer distance), Taiwan obtained the software for Aegis anyway.[55] It is also expanding its early warning radar[56] and wants to acquire interceptor missiles like the third generation Patriot (PAC-3). These weapon systems, however, are not the state-of-the-art technology necessary for upper-tier TMD tasks. In order not to increase tensions with China, the US has withheld such technology from Taiwan so far. The Bush administration will decide on the delivery of Aegis in April 2001. ``*Among the arms they have sold or proposed to sell to Taiwan, Aegis is the worst,´´* Chinese negotiator Sha Zukang said.[57], confirming that TMD is what China feared most. In general it can be said that TMD capabilities are not being introduced in Taiwan and South Korea because of the likely overall negative effects on their own national security problems.

Europe

European governments have a different policy than the US "bull in the china shop" approach. For instance, Europe is opposed to NMD for several obvious reasons. First, the introduction of NMD is creating a new cold war with the lame, but still dangerously armed, Russian bear on Europe's borders. Russia may react by withdrawing from the agreement on intermediate range missiles (the INF treaty) and unilateral commitments concerning short-range weapons. This may turn *"Europe into the hostage of the super powers' confrontation,"* because *"the US has much more financial and industrial possibilities to quickly restore its group of intermediate- and shorter-range missiles in Europe,"*[58] according to the Russian newspaper *Segodnya*. The nuclear arms race protested by so many during the eighties will then start again. Europe also fears that NMD will undermine global nuclear stability. An argument specially relevant for Britain and other small-sized nuclear weapon states is that *"if Russia were to develop a ballistic missile defence system herself, British security would be undermined since Russian BMD would reduce the effectiveness of the British nuclear*

deterrent. In order to maintain the value of her nuclear deterrent, the UK would have to spend vast amounts of money resources on this avoidable arms race."[59]

As it is currently being developed, TMD can defend against missiles including Russian up to 3,500 km in range. The TMD track provides a defence against TBMs while leaving open the possibility of defending against long-range missiles in the future. More importantly, TMD research and development is not as confrontational a policy as NMD development.

At the same time, both nationally and bilaterally, European governments are developing TMD capabilities or systems that can be used for TMD. Almost all observers state, however, that European countries cannot develop a TMD capability on their own, so co-operation with the US is essential. The danger, from this vantage point, is that the US will drop NMD in order to co-operate with Europe and Japan on developing an improved TMD system. This trend is already visible with the NATO-wide developments on TMD (see below).

So, while opposition to NMD is strong in East Asia and Europe, countries in the two regions take different positions on TMD. With opposition against TMD much more outspoken in Asia, European activists should pay more attention to the discussion there, to better understand the global implications that a world-wide introduction of TMD could have. This should create greater awareness of the similarities between TMD and NMD, as seen from a non-American point of view and stimulate the almost non-existent discussion about it in Europe. Such an exchange between activists need not be limited to East Asia, the US and Europe. Bahiq Nassar from Egypt clearly emphasises the necessity of joint action against NMD as well as TMD. Instead of military answers to the threat posed by 'rogue states', he proposes diplomatic and political responses.[60]

Decisions and history of TMD within NATO

In 1993 the Clinton administration proposed to permit the testing and deployment of new advanced capability Theatre Missile Defence systems designed to defend US Armed Forces and Allied Forces operating overseas.[61] Already in 1991 TMD tasks had been introduced in the so-called 'New Strategic Concept' of NATO. NATO's joint structured approach to TMD started in 1994. In that year NATO's national armaments directors decided that there was a need for continued co-operation on missile defence and created the Missile Defence Ad Hoc Group (MDAHG). The group was formed by Canada, France, Germany, Italy, The Netherlands, Norway, the United Kingdom and the United States.[62] On May 1996, the chairman of this ad-hoc committee recommended a multi-tiered defence system (capable of intercepting enemy missiles at high and low altitudes) based at sea and on land.[63] MDAHG is responsible for developing future TMD programs for all of NATO, which according to a German air force general must be NATO-wide.[64] To create a really effective NATO-wide TMD system NATO's Air Defence Committee (NADC) is advising the North Atlantic Council (NAC) on their defence policy for the organisation. NADC is developing a program for air defence weapons. By following programmed air defence acquisitions by member states it maintains a regular oversight and is able to advise member states on programs, if necessary.[65]

The introduction of TMD is pushed by the United States for reasons of cost-sharing and risk-reduction. This does not mean that the concept of targeting the missile threat is only being introduced in the US. Several European countries have also identified a ballistic missile threat

and embarked on missile defence programs. Often mentioned are MEADS (Germany, Italy and the US) and Aster (France, UK and Italy). For the European countries co-operation with the US has the same advantages as the other way around. Active Co-operation on TMD with the US is also promoted by the West European Union, aiming for an equal partnership with the US on BMD and expanding ongoing TMD efforts like MEADS, in which DASA, Lockheed Martin and Alenia Marconi Systems co-operate.[66]

During the NATO Washington summit in 1999 the Allies agreed to improve their military capabilities, including TMD.[67] It was stated that *"the alliance's defence posture against risks and potential threats of the proliferation of NBC weapons and their means of delivery must continue to be improved, including through work on missile defences."*[68] Early 2000 discussions on TMD in NATO were still going on,[69] but at the same time several programs were running. In its view on strengthening transatlantic security, the US Department of Defense (DoD) summarises TMD systems already fielded or which will be acquired shortly. The Netherlands and Germany are named as countries having the PAC-2 missile, and naval forces of several allies are considering cooperation with the US. National programs without the US may be included (see table; '(Potential) TMD Capable ships'). The creation of a trilateral US-German-Dutch Extended Air Defence Task Force in December 1999 is also mentioned. Exercises like Joint Project Optic Windmill and the plans to acquire PAC-3 by Germany and the Netherlands, the maritime TBMD forum created by Canada, Germany, Italy, the Netherlands and the US have to be added to this summary.[70]

The next step was made in late 2000 with the request to the defence industry for a feasibility study for a layered missile defence architecture[71] This is following NATO conceptual, operational and technological studies of NATO's Panel on Air Defence Weapons and Industrial Advisory Group and studies on possibilities for multilateral industrial Co-operation on TMD systems.[72] At present this is the most concrete NATO development on this issue, which will lead to further implementation of what was agreed during the Washington summit.

So there are already several joint efforts underway in the US and Europe (and between the US and Japan[73]) to develop TMD capabilities. Theatre Missile Defence was identified as the primary candidate for planned US funding boosts in 1998.[74] This is good news for the defence industry. NATO is expected to award two contracts for a feasibility study of an alliance-wide upper- and lower-tier TMD system to defend Europe and intervention forces elsewhere from ballistic missiles with ranges up to 3,000 km. The feasibility studies will not be focused on long-range intercontinental ballistic missiles, according to David Martin, deputy for strategic relations at BMDO, pointing at the controversy on NMD.[75] As the result of the feasibility studies are not (yet) ready or public, it is impossible to comment on this prospect. Given the covert developments and expanded capabilities of TMD so far, Martin's remarks can be taken as a sign that the planners are well aware of the political implications of such a system, not that such an upper-tier system will in the long run be limited to medium-range missiles. Teams competing for the US$ 15 million award are being formed by:

Groups on feasibility study			
Lockheed Martin Missiles and Fire Control (US)	Raytheon/Thales (former Thomson CSF) (US/France)	Science Applications International Corporation (US)	Northrop Grumman's Logicon Unit en Integrated Systems Unit (US)
EADS (France)	EADS (Germany)	Boeing (US)	EADS (France/Germany)
Matra-BAe Dynamics (UK)	Aerojet (US)	EADS (France)	Teledyne Engineering (US)
TRW Space & Electronics	Signaal (the Netherlands)	Industrieanlagen Betriebs	Alenia Aerospazio (Italy)

Group (US)		(state research institute) (Germany)	
EADS (Germany)	Dassault Aviation (Canada	DERA (state research institute) (UK)	Havelsan (Turkey)
Astrium N.V. (French-German-British satellite builder, 75% owned by EADS)	Hunting Defence (UK)	TNO (the Netherlands)	
Stork Aerospace Group (the Netherlands)	Grupo Indra (Spain)		
	Bodenseewerk Gerätetechnik (affiliate of the Diehl Group) (Germany)		
	Info Data (Italy)		
	Elfon (Greece)		
	Tubituk (government owned scientific and technical research institute) (Turkey)		
Sources: "TMD Teamings the four main contenders", Jane's Defence Weekly, 3 January 2001, p. 27. Gopal Ratham en Luke Hill, "Stakes Rise for Studies of NATO Missile Defence; Four Contractor teams Bring together U.S., European Companies To Submit Bids," Defence News, 28 August 2000, p. 22; Luke Hill and Douglas Barrie, "Teams Vie for Tiny Contracts Now, Hope for Huge Payoffs Later," Defence News 26 June 2000, p. 1/74.			

These studies will result, as currently planned, in a decision on a NATO missile defence requirement in 2004.[76]

Other programs are also developing. The European Defence and Aerospace Company (EADS) is co-operating with a South African partner, Reutech Radar, to develop an early warning/TBM radar system. Also BAE Systems is developing an early warning/TBM radar system together with Lockheed Martin.

Some analysts point out that the US is not able to develop TMD alone but has to co-operate because of costs so enormous that even the US cannot afford to bear them alone. [77] Others point out that "*most of the NATO allies are reluctant to buy a US system that does not involve European industries as much as possible."*[78] So, since NATO's TMD has largely to rely on US systems, there is mostly co-operation between European and US companies. This despite the fact that restrictive US export regulations (aimed at defending national security by protecting strategic knowledge) complicate such co-operation.[79]

Why Vardo?

The difficulty in distinguishing between TMD and NMD in the European context becomes clear when considering the reaction of the Russian commander of the Strategic Missile Force Vladimir Yakolev to the establishment of a new radar station near Vardo in northern Norway [80]. The Vardo radar is the most advanced tracking and imaging radar in the world. In an echo of Cold War rhetoric, another Russian general, Ivashov, threatened this radar with a nuclear strike in case of conflict in a broadcast on Norwegian TV in July 2000.[81] In June of the same year Jakolev commented on the radar station: "*There are two radars in Norway, Globus I and Globus II. If they are linked up with the radar in Alaska, they will be able to tackle the tasks of the US ABM system [NMD]. The Norwegian radar controls the areas patrolled by our navy in the Barents Sea and the Northern trajectory between Pletetsk and Kamchatka. (…) If this station works jointly with the radars of cruisers with guided missiles, which Norway will*

receive and which can be hypothetically armed with Aegis and Standard anti-missile systems, the system can be used to liquidate our missiles at the boost phase."[82]

So according to this Russian general, NMD efforts in Europe have already begun with the building of radar stations with NMD capability. But another point he raises is even more interesting with respect to European TMD initiatives. According to Yakolev, naval technology currently sold to European nations, like the Aegis system, can be used for tracking and destroying missiles in their launch phase. NMD and TMD are not simply gadgets of the future. Research and development of the relevant technology is already underway; equipment that can be used for Ballistic Missile Defence is already being used and sold. The development of a TMD system, therefore, is a creeping process, accomplished step by step.

The Dutch view on TMD

Missile defence has been part of Dutch defence policy ever since the Patriot air defence system was procured in the late eighties. With the increased importance of BMD in US and NATO strategy the issue slowly got a more prominent place in the Netherlands as well. The Dutch government, however, says it has always been one of Europe's frontrunners in this regard. "Though not in the Netherlands, the TMD-concept has been very low on the agenda in Europe"[83]. The Dutch involvement in talks at NATO level goes back to at least 1994, at the NATO summit, when it was decided to develop a common TMD-capacity.

That until recently TMD never got much public attention is not very surprising though. In a parliamentary letter on 'high tech' international research projects in early 1995, then-deputy minister of defence Jan Gmelich Meijling described the Dutch involvement in a blunt way: *"It concerns projects within a multinational context, potentially involving a lot of money. These projects are also described as <<ghost projects>>. Because of the associations which this word raises, I prefer to speak of international co-operation projects. (…) The Netherlands takes part in the investigations to get insight into the use, the costs and the industrial interests that are connected with those projects, so that later a proper decision on participation can be taken"*[84]

One of the projects referred to was the Extended Air Defence/Theatre Missile Defence program. At that stage the Dutch recognised the need of a TMD capability, assuming that this could be fulfilled by further upgrading current systems, like the Patriot[85]. The adjusting of SM-2 air defence missiles for the new air defence and command frigates is also foreseen in the near future. Being on a tight defence budget, Meijling promised to judge projects "with restraint".

But only a few months later Meijling informed Parliament about the need to upgrade the Patriot against the increasing threat from tactical ballistic missiles. The proposed modernisation program is part of the Patriot Advanced Capability III (PAC-3) program. For the time being the Dutch government only chooses for a software upgrade, the so-called Post Deployment Build 5/Sweepdown 5 (PDB-5/SD-5), to improve radar capabilities for 75 million Dutch guilders, at that time about US$ 37 million . The other part of PAC-3, improved interceptor missiles, were expected to be procured only after the year 2000. PDB-5/SD-5 should enable a connection with THAAD, "which is currently being developed in the United States. THAAD should counter attacks by TBMs at high altitude, so as to protect

larger areas"[86]. Depending on the evolving of the security risks the option for THAAD is left open[87].

Another two years later the procurement of 64 PAC-3 missiles was proposed. Additional launch systems will also be procured. This upgrade program is budgeted at 260 million guilders, around US$ 130 million at that time[88].

While Dutch MP's went along with PAC-3 with hardly any argument, the introduction of the US-Italian-German Medium Extended Air Defence System (MEADS), which also uses the PAC-3 as interceptor missile, causes one delay after another in Germany. The price of the missile (US$2 million apiece) is one of the major obstacles for signing the US$ 230 million risk-reduction effort contract. Irritation about US unwillingness to share technology, though apparently settled now, also played a role[89]. More importantly German deputy minister of defence Walther Stützle earlier bluntly raised his doubts about the whole project, stating that MEADS "clearly does not satisfy [Germany's] needs"[90]. He seems to have made a turnabout recently though, paving the way for German MEADS funding[91].

The increased emphasis on TMD becomes visible in the Dutch defence white paper *Defensienota 2000* [92], where it gets a prominent role. The Defensienota calls proliferation of weapons of mass destruction (WMD) one of the greatest security risks in the post-Cold War situation. It mentions the 1999 NATO Strategic Concept description of the defence task (“to deter and defend against any threat of aggression”), while acknowledging that proliferation of WMD, arms control and disarmament should be supported by confidence building measures. Nevertheless, deterrence and defence play a dominant role in the Dutch approach. As a member of NATO, the Netherlands wants to make a "significant contribution"[93] to passive and active BMD. The Dutch regard their ground-based air defence capability valuable for protection at home, but even more for deployment abroad, to protect Dutch intervention troops or allied strategic assets, like in Israel during the Gulf War. Exercise Joint Project Optic Windmill (JPOW, see page #) clearly is the Dutch calling card. It is mentioned to allow the Netherlands to play a leading role in the development of doctrines.

The Netherlands has also co-operated closely with Germany and the US, in the 'Extended Air Defence Task Force' (EADTF) since 1999. This task force can deploy air defence units at very short notice and can quickly form a fully integrated combined TMD cluster overseas.

In another development, research is taking place to evaluate a naval TMD capacity by adapting the APAR radar of Dutch air defence and command frigates (LCF) to TMD tasks. Roughly US$ 118 million is being reserved for the development and modification of this naval TMD capacity. Because of financial constraints, the Dutch navy works together with the US and German navies. A follow-up Memorandum Of Understanding (MoU) for a concluding concept-validation study on TBMD on board LCFs was signed with Germany in December 1999 and is expected to be finished in 2003, after which a decision on procurement will be made (see also below).

Sea-based systems

In the US there are two different naval TMD programs: Navy Area Defence and Navy Theatre Wide. Navy Area Defence is mainly designed to protect military forces, airfields, ports and other valuable assets. Its weapon systems are for lower-tier defence. Missiles for this program

are already in service (the SM-2) and have been modified for improved capabilities. Navy Theatre Wide is under development and will be able to destroy enemy ballistic missiles at altitudes higher than 100 km. For this purpose the SM-3 and Airborne Laser (ABL) is being developed. The ABL will destroy TBMs during their boost phase. (See more in annex **Some systems for TMD tasks**) Interceptor missiles can be either the THAAD or SM-3 missile. The future role of the navy in TMD hinges on successful tests. The program is supported by more and more opinion makers in the US including former secretaries of defence Harold Brown and William Perry.[94] The budget is now US$ 383 million for FY 2001 and totals US$ 1.9 billion for FYs 2000-2005. [95]

Sea-based TMD systems have several advantages over land-based systems. They are flexible and can be deployed outside territorial waters without the co-operation of a host nation and also without necessarily raising international tensions. At the same time they can cover a vast area of land. These systems consist of a combination of:

- missiles (for air warfare and for destroying launch stations),
- combat data systems (for processing incoming information from satellites, early warning aircraft and the ships' own radar systems), and
- radar technology (for finding the TBM and guiding the missiles to their targets.)

European anti-missile programs sometimes fall under the heading TMD and sometimes not, perhaps because TMD is often not distinguished from conventional anti-air-warfare tasks. For example, British research and development of TMD is rarely mentioned in this context. On questions in parliament concerning British involvement in TMD research, the government claims that it spends only £ 12.5 million.[96] The British White Paper on defence states: *"We continue, however, with a program of work to understand the technology needed for active defence against ballistic missiles (…) Consistent with our defence priorities, this work is directed towards the protection of deployed forces and focuses on Theatre Ballistic Missile Defence."*[97] This is, however, more than an attempt to merely 'understand' the technology and Britain is spending far more than £ 12.5 million on this. Besides co-operation between the US and Britain on Ballistic Missile Defences since 1985 (research experiments, flight trials and information exchanges both at industry and government level[98]), the projected Type 45 destroyers – a multi-billion pound acquisition program - will be equipped with technology suitable for TMD tasks. So the UK budget for TMD is radically underestimated. In February EUROPAAMS, the builder of the missile system PAAMS, won a contract worth US$ 2.15 billion for full-scale engineering development and initial production. Other contracts for the Type 45 destroyer cover fire control and command systems and are worth US$ 26 million and US$ 66 million respectively. These contracts are not solely related to TMD, and do not show up in "TMD" budgets. As is the case in many similar European programs, the technology produced under these contracts will be part of TMD.

Currently most reports on sea-based TMD systems focus on the US Aegis systems. TMD discussions generally tend to be more prominent in the US compared to Europe. Most of the technology is being developed by U.S. companies (as far as we know, only France will solely rely on systems developed in Europe – see table 1). Finally, US naval TMD capabilities are also much greater than Europe's. It has been estimated that projected US TMD systems on board destroyers and cruisers, equipped with altogether 6,000 vertical launching cells that can be used for firing either THAAD, SM-2 or SM-3, will be worth US$ 40 billion. This far outnumbers the projected European capabilities.[99]

The exclusive focus on US Aegis overshadows some smaller, but important programs. One possible form of co-operation between European and U.S. industries is for the US to develop missile systems while Europe concentrates on the radar systems. Co-operation on radar technology among the US, Germany, The Netherlands and the United Kingdom is already taking place and will proceed.[100] In addition to political considerations, Europe's focus on radar makes technological sense, since European radar technology by some estimates is better than U.S. technology.[101] Active phased-array technology, for instance, is reputed to be better than Spy-1 radar, which is connected to the Aegis combat data system; for this reason, the US Ballistic Missile Defence Organisation was testing the UK-developed Multi-function Electronically Scanned Adaptive radar (MESAR, its operational version is SAMPSON). An employee of the Hollandse Signaal Apparaten in the Netherlands - producing ship-based radar technology - stated that given the range and quality of its systems it is not necessary to have access to information from the US early warning system (either space or air-based).[102] The same company is also working with the US on implementing its Sirius sensor system for TBM. US and Dutch studies have shown that Sirius can detect TBMs during the boost phase at a range of hundreds of kilometres; and to detect TBMs re-entering the atmosphere at an altitude of approximately 70 km. One of the Sirius systems will be delivered to Lockheed Martin Integrated Systems for supporting the development model of US Infra-Red Search and Track system (IRST)[103]. According to one report, the Japanese Asuka trial ship originally fitted with the US SPY-1 system is now testing Dutch technology.[104] Paradoxically however, the Dutch government acknowledges the dangerous effects that proliferation of TMD systems elsewhere can trigger. It says it hopes the US will show "restraint" in its TMD ambitions in Southeast Asia, particularly around Taiwan, "to prevent the danger of an arms race in this region as much as possible"[105].

In the future British, Dutch, French, German, Italian, Japanese, Norwegian and Spanish vessels of frigate size and larger will be equipped with technology capable of handling TMD tasks. Dutch, German, British and Spanish vessels need only slight modifications to the already developed systems. According to the head of operational requirements of the Dutch Navy (RNlN), Pim Bedet, the US Aegis Cruisers and Dutch LCF-frigates are almost the same in terms of weapon systems, firing installations, command and sensor systems.[106] Lockheed Martin and Alenia Marconi Systems are currently involved in studies to develop an antenna with TMD capabilities for installation aboard the Italian Horrizonte-class frigates. Many ships are fitted with technology to fire the SM-2 missile and its successors which can be used for upper-tier TMD defence.

The Dutch and German frigates, for the time being, will be equipped with missiles for lower-tier defence. But the navy is anticipating the acquisition of SM-3 or naval THAAD missiles for upper-tier defence (as did the US Secretary of the Navy in a chart outlining a TMD scenario). These missiles will intercept TBMs in their ascending, descending and mid-course flight. Close contacts between US and Dutch/German arms manufacturers and military will ensure that technology is developed in such a way that only minor modifications will be needed to use either a naval THAAD or SM-3 missile developed for the US Navy aboard the German/Dutch vessels.[107] The programs for the upper-tier systems are ongoing. The technology develops in advance of the political decisions concerning actual acquisition.

Conclusion

This paper would never have been written without the dedicated, inventive and skilled labour of people working in the field of applied physics who are developing the weapons, transmitters, satellites, radar technology etc. needed for a shield against ballistic missiles. When addressing the concepts behind Theatre Missile Defence (TMD), one realises how much skill and knowledge is devoted to developing the tools of destruction and war. Some would claim that this major effort is required for defence against the missile attacks of rogue states, like North Korea, Iran and Iraq. Others, however, take a more sceptical view: *"Nevertheless, the community that scans the skies hoping for a missile threat to appear still pins its hopes on North Korea (…) they [North Korea] can hit several million empty hectares of Alaskan wilderness."*[108]

In a world where so many people live in life-threatening circumstances that could be remedied by focused scientific research, it is incredible that so many precious resources and such high-level skills are going into this military research. Of course, TMD is not the only field of military research, but its sheer size and ambitions make the waste of money and talent so striking.

This paper is a contribution to the debate surrounding the NMD and TMD programs. We have noted that TMD technology is being developed in Europe at several levels -- national, multilateral and through NATO – and with close co-operation between US and European industries. However, discussion on the TMD program is limited to financial and technological debates surrounding the acquisition of weapons systems which may become part of TMD. Such debates generally take place when expensive new arms are acquired and do not tackle the political implications of the introduction of TMD. Ongoing research projects – of the defence industry, the military and research institutes – go almost unnoticed..

More research on the differences between TMD and NMD still remains to be done. Much more technical information is needed to make better comparisons between the two programs, and further research is needed on national programs, weapon systems used in NATO-TMD exercises and current developments in the defence industry. Given the opposition to NMD and the efforts by key actors to transform TMD into a national missile defence system, it is important to track the projected capabilities of both programs.

'Raytheon is a major player in all aspects of TMD and already received $2 billion in bookings,'[109] the company states on a slide for its shareholders. The arms race predicted following the introduction of NMD applies to the introduction of TMD as well, as can be seen from China's reactions. The result will be growing defence-industry revenues and higher tensions in international relations.[110] In the end, the defence industry and the armed forces will be the only parties who profit from the race between sword and shield.

The scenario of Joint Project Optic Windmill must be kept in mind when opposing TMD developments. Civil society may well applaud the defence of Rotterdam or Rome from showers of nerve gas. But TMD does not in the first place defend against threats or reduce threats to world peace. Instead, with arrogant military powers protecting their weapons of mass destruction, TMD increases the number of threats. Rather than supporting military responses like TMD, civil society should be supporting diplomatic solutions and arms reduction.

Non-military solutions, however, become less relevant – or of less interest to the major powers – when NMD or expanded TMD are being developed. It is not at all unlikely however that in the future the world will have to deal with threats or attacks with weapons of mass destruction, delivered by other means than ballistic missiles. As is already the case in some countries, new programs will then emerge to specifically counter suitcase bombs or other threats. Such a scenario shows that a military approach will not create the safe environment its proponents are suggesting, despite the huge amounts of money spent on it.

Jacques Chirac forgot to remind us that the person carrying the most lethal sword is usually the one carrying the best shield as well. To win the war you must have not only the best offensive systems, but also the best defensive ones. This has become even more true given that body-bags are not acceptable to public opinion. TMD will become an essential part part of a rapid reaction force in regions where a threat of ballistic missiles exist.

Although protecting intervention forces looks like the primary task of TMD, it will be possible in the future to expand it to protect complete countries. David Martin, deputy for Strategic Relations in the US Ballistic Missile Defense Organisation, already said that *"(…) as the delivery range of ballistic missiles grows longer, NATO will have to consider multi-tiered, wide area defences for the protection of NATO territory and population."*[111] In other words: an area-wide missile defence system for Western and Central Europe. We are aware of the technological[112] and financial hurdles which yet have to be taken. However, the programs do make progress and the 'lesser known anti-missile weapons' must be closely followed to prevent creating a European NMD, as is already taking shape in East Asia.

Table 1

(Potential) TMD Capable ships

Country	No	Type	(commissioned)	Missile systems	Combat Data Systems	Main radars and optronic sensors	Comments
Canada	12	Mod Halifax frigates	2002		?	APAR after modernisation	Possibly Standard missile
France	4	Horizon	2006	64 cells for ASTER-15&30 and DCN Sylver VLS.	DCN/Elenia Senit 8	Thomson-CSF DRBJ, SPG-51C PAAMS (Principle Anti-Air Missile System)	Alenia Marconi believes S1850 radar (see under UK) will also become the standard for the French Navy. (JDW 16/02/00, p. 53.)
Germany	3	F-124	2002	32 cells for SM-2 Block IIIA and ESSM	SEWACO FD	APAR, Smart-L and Sirius IRST	Providing a potential TBMD capability
		F-125	2010	SM III	?	Id.	
Italy	4	Orizzonte	2005	PAAMS 48 cells for ASTER-15&30 DCN Sylver VLS.	DCN/Elenia Senit 8	EMPAR, S. 1850M, VAMPIR IRST	Expected to be fitted with SM-2 and SM-3 forward of Sylver. PAAMS is meant for medium-range area protection, close range defence and self-defence of the carrying vessel (Communiqué issued by the French Ministry of Defence 11/08/99).
Japan	4	Congo		SM-2MR (SM-3 in due course)	AEGIS	SPG-62, JRC OPS, RCA SPY 1D	Asuka trials APAR (Mil. Tech 3/2000)
Netherl.	4	LCF	2002	40 cells for SM-2MR Block IIIA and ESSM. SM-2 Block IVA is a later option.	SEWACO IX	APAR, Smart-L and Sirius IRST	Providing a potential TBMD capability. APAR detected the Mir space station 600km outbound and 600km inbound at a height of 450km.
		Q	2010	Believed to be SM III	?	Id.	
Norway	5	SMP	2005	Kongsberg NSM, ESSM,	MSI-2005F	SPY-1F	Could result in a later expansion to the TMD role.

Spain	4	F-100	2002	48 cells for SM-2MR Block IIIA and ESSM. This class has the potential to carry both Tomahawk SLCM and SM-2 Block IVA ATB systems, although neither are currently intended.	AEGIS	SPY-1D, 2 Mk99, Sirius IRST	Could result in a later expansion to the TMD role.
US	27	Ticonderoga		SM-2MR, SM-2 Block IIIB, SM-2 Block IV SM-3 firings exercised.	Aegis	High Power Discriminator (HPD), developed by Raytheon for THAAD can be added.	A combination of Aegis and an upgraded Standard missile is to give the first naval defence against ballistic missiles.
	57	Arleigh Burke	91-99	SM-2MR, SM-2ER		SPY-1D, Mk 99, SPG-62	To be converted to Aegis
U.K.	12	Type 45	2007	48 cells for ASTER-15&30 and SM-2/SM-3 or 6 DCN Sylver A 50 VLS (later versions will probably be equipped with US Mk 41 launchers for land attack missiles. JDW 19/07/00, p. 21)	BAe systems	Sampson, S.1850M (SMARTELLO) PAAMS	Built for extended area defence (400 max range). The Royal navvy is actively co-operating with the US and Lockheed Martin in order to evaluate the possibility of using SAMPSON in anti-ballistic missile roles for which the SM-2 Block IVA and SM-3 are to date the only feasible weapons. Smarttello is based on the SMART-L radar of Hollandse Signaal. See for PAAMS also JDW 05/07/00, p. 28-29.
Sources: Massimo Annati, European AAW Frigates; the New Generation, Military Technology 3/2000, pp 10-22 Jane's Fighting Ships 2000/01							

Table 2:

Missile Systems (TMD capable)

Name	Task/Range/comments	Sources
ASTER 15	Ship self-defence and area defence. Range: 3 to 80 km. Mach 3 in 2.5s. Using PAAMS.	Aerospatiale Nature of business: Aeronautic, http//www.france.org.my/commerce/enterprises/aerospatiale/en/page4.htm Jane's IDR 12/1996, p. 48
ASTER 30	Medium range land/naval area defence. Range: 1.7 km to 30 km. Mach 4 in 3.5s. Using PAAMS.	See: ASTER 15
(Standard Missile) SM-2 SM-2 MR (Medium Range) SM-2 ER (extended range)	Surface to air missile 40-90 nautical miles (46-104 statute miles) 65-100 nautical miles (75-115 statute miles)	
(Standard Missile) SM-2 Block IVA	Retains SMs anti-air warfare capability, while adding the ability to engage short-range theatre ballistic missiles in atmosphere. It is enhancing US littoral warfare capability by allowing Aegis ships to provide TBMD for ships at sea and ground force embarkation areas ashore. The blast fragmentation technology must be improved compared to PAC-2 Patriot missiles used during the Gulf war 1990-91. For Navy Area Wide program.	News release Raytheon, Standard Missile-3 Successfully Completes First test Flight. http://wwww.raytheon.com/press/1999/sep/sm3first.html RIM-66 / RIM-67 Standard missile http://www.fas.org/man/dod-101/sys/missile/sm-2.htm Naval TBM defence matures, IDR 1/1998, pp. 28-34
(Standard Missile) SM-3 (equipped with a Lightweight Exo atmospheric Projectile (LEAP)	For NTW-program. SM-3 combined with Aegis comprises the NTW ballistic missile defence system. SM-3 is designed to intercept an incoming medium or long range ballistic missile (TBM) before it enters the earth's atmosphere for protecting US and allied forces. Japan will co-operate with the US in improving this missile. For US Navy Theatre Wide program.	News release Raytheon, Standard Missile-3 Successfully Completes First test Flight. http://wwww.raytheon.com/press/1999/sep/sm3first.html http: www.esys.com/finance/1997/annrprt/yr_01a1.htm IDR 9/2000, p. 30
THAAD	2.7 km/s (probably also in a navalised version	

Appendix: **Some systems for TMD tasks**

Space Based InfraRed System (SBIRS High and Low)

SBIRS twin satellite system is successor of the Defense Support Program System. Relays data to destroy missiles. Tough planned as part of NMD, now also mentioned as option for TMD tasks. Program is under Air Force control.

system: SBIRS-High is a program for the development of early warning satellites designed to track the hot plume of enemy missiles during their boost-phase. Must be able to calculate the launching spot.

status: The first launch is delayed for two years until 2004 and the second will take place in 2006. The whole system consists of four satellites and a spare one and must be operational in 2010. Simulations of SBIRS were already used during TMD exercise JPOW-V (see text).

industry: Lockheed Martin Space Systems selected as prime contractor in 1996, among subcontractors are Aerojet and Silicon Graphics (SGI).

costs: originally put at $1.8 billion, but will increase to $4.2 billion, due to the delay.

system: SBIRS-Low (30 satellites, of which 24 active and 6 test), operating in low earth orbit, must be able to track attacking missiles during the whole flight, to distinguish decoys from real warheads and to calculate the enemy's missile's target with relative exactitude.

status: Requirements Definition Phase completed; moving into Design Phase. Will become operational at the same time as SBIRS-High. Some in the Department of Defence doubt its need. 28 February 2001 General Accounting Office report says that "the Air Force's current SBIRS-Low acquisition schedule is at a high risk of not delivering the system on time or at cost or with expected performance."

industry: SBIRS-Low is currently being developed by 2 teams. One is the Spectrum Astro/Northrop Grumman Team (www.SBIRISLow.com), with also ITT, Litton, Lockheed Martin and Boeing; and a consortium led by TRW and Raytheon with a.o. Aerojet, Ball, HP/Agilent, Motorola and Honeywell participating.

costs: life cycle costs (through 2022): $11.8 billion. Some argue that this 1998 figure is greatly underestimated.

Space-Based Laser (SBL)

system: Boost-phase intercept system, that should counter ICBMs. SBL program must bring a satellite carrying a high-energy laser into space.

status: Current SBL consists of a 18-month, first phase of a technology demonstration program of $127 million awarded to joint venture comprising of Lockheed Martin, TRW and Boeing. Contract for second phase ($97 million) was awarded in November 2000. Integrated Flight Experiment (IFX) will launch an experimental laser into space in 2012 to shoot down a ballistic missile in 2013.

industry: joint venture of Lockheed Martin, TRW and Boeing.

costs: estimated value of the SBL-IFX program is about $3 billion.

Airborne Laser (ABL)

system: The ABL is a US Air Force TMD program. According to a Pentagon chief it is "a radically new weapon system in a high-risk development program"[113]. It consists of a Boeing 747 equipped with a powerful Chemical Oxygen Iodine Laser to destroy enemy TBMs while they are in their boost phase. ABL will also carry a beam and fire control system, and a BMC4I system. Boeing claims that no effective countermeasures are possible against the ABL.

status: The only major program both on schedule and within budget. After earlier budget cuts, ABL got a cash-injection in late 2000. Its first live test flight is planned for 2003. Initial deployment must occur in 2007. At the moment the program is in its initial design and risk-reduction phase, which should be halfway at the end of 2000.

industry: Boeing is the ABL program integrator. Other team members are TRW (laser) and Lockheed Martin Missiles & Space (beam control and targeting system).

costs: When complete the USAF will have seven modified Boeing 747-400 aircraft in operation and support for twenty years at a cost of $11 billion. Total costs through April 2000 amounted to $750 million. For 2001 $234 million has been budgeted.

Theatre High Altitude Area Defence (THAAD)

system: THAAD is the upper-tier leg in the US Army's TMD plan. PAC-3 (see below) is the lower-tier leg, complemented with MEADS when available. THAAD will provide theatre-wide protection for ground forces and 'critical assets'. It is a mobile land system that can perform both endo- and exo-atmospheric hit-to-kill intercepts; it's most effective at heights between 40 and 100 kilometres ('high-endo band'). As a result of the long range covered by the interceptor missiles, any attacker seriously increases the risk that NBC (nuclear, biological, chemical) material and debris will fall down on its own area. Because the interceptor must hit the targetted missile in its early stages of flight.

THAAD consists of a ground-based X-band radar (XBR), BM-C4I system, truck-mounted launcher and single-stage interceptor missiles carrying a kill-vehicle that separates before intercept.

status: After two successive hits and a lot of effort, the Pentagon decided in August 1999 to move the program to the Engineering and Manufacturing Development phase[114]. The current phase (with 14 planned intercept tests, starting only from 2004) is considered to be "low-risk". First entry of a THAAD unit is planned for 2007. A complete THAAD won't be ready before 2013. In September 2000 the US Army announced the redesign and simplification of the missile architecture. This would resolve quality control deficiencies in the manufacturing of the THAAD interceptor missile, which were a major factor in all but one of six previous intercept test failures in its previous risk reduction phase from 1995 to 1999. Moreover, the

cost of the missiles will be reduced to $1.8 million each, compared to $5 to $7 million in the earlier stages.

industry: Lockheed Martin Missiles & Space is the main contractor for THAAD. It won the contract to continue with the engineering and manufacturing development (EMD) in June 2000; the value of the EMD contract is $3.96 billion. Lockheed Martin is also proposing a “marinized” version for the US Navy Theatre Wide (NTW) requirement, plus an international version for sale to US allies. Raytheon develops the High Power Discriminator (HPD) 'active-array' X-band radar, of which it also develops a variant for the NTW system. Boeing develops the THAAD Divert and Attitude Control System (DACS), a hi-tech propulsion system. Sanders (a LM company) will provide an advanced missile seeker, mission checkout console and logistics support.

costs: THAAD program is estimated to have cost $23 billion when fully complete in 2013.

Medium Extended Air Defence System (MEADS)

system: Lower-tier system, which is being developed by Germany, Italy and the US, under the umbrella of a NATO MEADS Management Agency. Will replace Hawk and Patriot systems. Must guarantee protection against attacks from short-range ballistic and cruise missiles and other aerial threats. For use at home as well as abroad.

Developed to be air-transported completely with C-130 Hercules. MEADS uses PAC-3 (see hereafter) hit-to-kill interception missiles and is seen as successor of current Patriot and Hawk air defence systems.

status: started in 1995. The current so-called Risk-Reduction Effort (contract worth $230 million, spread over 3 years) began in May 1999. American reluctance to share anti-missile and stealth technology, for example, has delayed the development process considerably. Another setback is the reported rise in costs in the PAC-3 program, which may slow down the MEADS program. Another delay has come from the German military, which keeps stressing one-on-one replacement of the Hawk, which is politically/financially unrealistic and also operationally unnecessary. According to MEADS the German demand for 2600 PAC-3s is three times higher than needed. However, parts of the German political establishment seem unconvinced of the need of MEADS (see also under “The Dutch view on TMD”). Design and Development contract now expected in 2002. Planned date of entry: 2010 at its earliest.

industry: MEADS International is a consortium of Lockheed Martin, DASA and Alenia Marconi Systems (work share resp. 55:28:17)

total program costs: $3 billion.

Patriot Advanced Capability 3 (PAC-3)

system: PAC-3 is a tactical antimissile system based on hit-to-kill technology. With an onboard guidance system, its missile is designed to seek and collide with short-range ballistic and cruise missiles, as well as aircraft. The system includes multi-function phased-array radar, and a fire control unit. Will also be integrated into MEADS (see above).

status and program costs: 16 October 2000 the PAC-3 conducted its sixth successful intercept in a row. Another twelve tests are planned. This Patriot upgrade is however plagued by cost increases. A 31 July General Accounting Office (GAO) research paper reported a 77% rise from $3.9 billion in 1994 to $6.9 billion in 2000, largely due to underestimated hit-to-kill technology development costs. More cost growth (by as much as $500 million between now and 2004) is likely to occur as the Pentagon's test and evaluation office requires extensive additional testing of the PAC-3 missile. In response to the cost increases the number of missiles procured may be cut from an initially planned 1,200 to 800. However, decreasing numbers will eventually cause a rising unit price. Also, PAC-3 is under pressure because of competing naval TMD systems.

Follow-on phase is planned to start in 2001. Greece and the Netherlands may consider purchase, the latter as an upgrade of their current Patriot system. Qatar, South Korea, Saudi Arabia, Taiwan and Kuwait have also expressed interest.

industry: Lockheed Martin Missiles and Fire Control is prime contractor. Boeing is among subcontractors.

Internet sources for further research

Websites:
Most of them supported by a good search engine

- The Acronym Institute http://www.acronym.org.uk/
- British American Security Information Center http://www.basicint.org/wtindx.htm
- Center for Defence Information http://www.cdi.org/hotspots/issuebrief/
- Defense News http://www.defensenews.com/home.php
- Federation of American Scientists http://www.fas.org
- Global Network Against Weapons and Nuclear Power in Space http://www.globenet.free-online.co.uk/
- Hessische Stiftung Friedens- und Konfliktforschung http://www.hsfk.de/abm/
- Jane's Information Group http://www.janes.com/
- NATO http://www.nato.int
- NATO Parliamentary Assembly http://www.naa.be/
- START Web Site http://www.armscontrol.ru/start/
- US General Accounting Office http://www.gao.gov/
- WEU http://www.weu.int/assembly/

Email information:

- Berlin Information-center for Transatlantic Security (BITS)
  BITS Information Service news-project@bits.de
  (Information on a wide range of military related issues, included TMD and NMD)

- Global Network Against Weapons & Nuclear Power in Space globalnet@mindspring.com
  (Day to day stream of information, mainly on NMD, but also TMD)

Note on the authors

Martin Broek (1962)
Works for the 'Campagne tegen Wapenhandel' (Dutch campaign against arms trade) and has published extensively on arms trade and the defence industry. The most important publications authored or co-authored are: 'STOP Arming Indonesia' (1994);'Indonesia: arms trade to a military regime' (1997) (both also published in Indonesian and (partly) in Dutch); 'Turkije Connectie' [The Turkey Connection], (1993) (translated and published in German and English); 'Europe-Asia Arms Trade Challenges', ASEM Security Dialogue (1998); 'Nederlandse Wapenhandel in de jaren '90 ' [Dutch arms trade in the nineties] (1998); and 'Up in arms; Europe's Arming of South Korea and its implications for Peace in East Asia' (2000) (also being translated into Korean).

Drs. Frank Slijper (1970)
Graduated as economist on the Dutch arms trade offset policy. Works at AMOK-Noord [Dutch acronym for 'anti-militarist research collective'] since 1993. Main focus is research on developments in the Dutch and international arms trade. He is a member of the board of the Landelijke India Werkgroep/India Committee of the Netherlands. Besides numerous publications in papers and magazines he wrote: 'Compensatiebeleid in Nederland: de aankoop van de Patriotraket' [Offset policy in the Netherlands: the acquisition of the Patriot missile] (1993). He is also co-author of 'Nederlandse Wapenhandel in de jaren '90 ' (1998).

Notes

[1] This is the first result of a study into TMD. We want to thank Brid Brennan of the Transnational Institute, Amsterdam and John Feffer of the American Friends Service Committee, Tokyo for their editorial support and John and Karel Koster, PENN-Netherlands for their valuable comments. Additions, criticism and other comments on this article are welcome.
[2] See for an up-to-date overview of TBMs: http://www.ceip.org/programs/npp/bmchart.htm#13
[3]Mark Hewish, "Raising the ballistic shield; the latest advances in ballistic missile defence are emerging," Jane's International Defence Review no. 9 2000, pp. 30-35.
[4] Stephanie Connor, 'NATO steps ahead with Theatre Missile Defence Plans,' NATO Notes (Centre for European Security and Disarmament, CESD) Volume 2, no. 2, p. 1
[5] John Deutch, Harold Brown, John P. White, "National Missile Defence: Is there Another Way?" Foreign Policy, Spring 2000. A similar vision is put forward in Jack Spencer and Joe Dougherty, 'The Heritage Foundation Backgrounder, No. 1384, The Quickest Way to Global Missile Defense: First from the Sea," 13 July 2000. Opposition to this viewpoint is growing see e.g.: Rodney W. Jones, 'Taking national Missile Defense to sea: a critique of sea-based and boost phase proposals,' October 2000, the Council for a Liveable World Education Fund http://www.clw.org/ef/seanmd.html and Charles Pena, 'From the Sea; National Missile Defense is neither cheap nor easy,' 6 September 2000 CATO Institute http://www.cato.org/pubs/fpbriefs/fpb-060es.html.
[6] 'Ballistic missile Defense Organisation Director Answers Critics,' BMDO statement 16 June, 2000.
[7] Robert Holzer and Gopal Ratham, 'Missile Defense on Budget Battlefield; Differing Priorities Presage Clash Between Pentagon Agency, Bush Administration,' Defense News, 22 January 2001, pp. 1 & 28.
[8] Jim Garamone, 'It's Not 'National' or 'Theater,' It's Just Missile Defense,' American Forces Press Service, 9 March 2001.
[9] Frank Barnaby, "Restrained reply: defying a limited ballistic missile attack; Resurgent interest prompts a rethink on ballistic missile defence," Jane's International Defence Review no. 6 1998, pp. 69-73.
[10] Mr. Arnau Navarro (reporter), 'The gap in defence research and technology between Europe and the United States,' Assembly of WEU report, 15 November 2000, p. 16.
[11] BASIC Press Release, THE CONSERVATIVE MISSILE DEFENSE PLAN: AT WHAT COST?, 9 February, 2001.
[12] Roberto Suro, 'Pie in the Sky,' Washington Post 12 February 2001.
[13] Hewish (2000).
[14] See for example "Theatre Missile Defences in the Asia-Pacific region," A Henry L Stimson Centre Working Group Report no. 34, June 2000 (internet version) which states: "TMD and NMD programs are not easily distinguishable in the Asia-Pacific region"; John Deutch et.al. (2000) talk about "the artificial boundary between national and theatre missile defence systems." This is also illustrated by a proposed design change to enhance the capabilities of the NMD SBIRS (Space Based Infrared System) to detect theatre missile attacks (see Jeremy Singer "Design Change To Heighten SBIRS Missile- Launch Spotting", Defense News, 4 December 2000, p. 8).
[15] See for example: Barry Schweid, 'Solana: U.S. Can Deploy Shield,' AP 5/2/01; 'Missile shield is a debate for the US alone: British minister Cook said,' AFP, 4/2/01; John Vinocur, 'France Shifts to Softer Stance as U.S. Plans Its Missile Shield,' International Herald Tribune, 10 March 2001; and 'Germany's Schroeder takes wait-and-see stance on NMD,' AFP, 7 March 2001.
[16] "Verhärtete Russische Position im Raketenstreit. Moscau betrachtet die Missile Defense als Bedrohung," [Hardened Russian position in missile dispute; Moscow is regarding Missile Defense as threat] Neue Zürcher Zeitung, 23 June 2000
[17] "Tortured Ideas On Missile Defence," New York Times, Editorial, 19 June 2000; See for detailed information: The White House – Office of the Press Secretary, Joint Statement: Strategic Stability Co-operations Initiative between the United States of America and the Russian federation, New York, 6 September 2000
[18] Michael R. Gordon, Steven Lee Myers, "Risk of Arms Race seen in U.S. Design of Missile Defence, "New York Times 27 May 2000.
[19] Theodore A. Postol "The target is Russia," the Bulletin of the Atomic Scientists, March/April 2000, pp. 30-35.
[20] Linda D. Kozaryn, 'Scud Alert: After the Blast,' American Forces Press Service 27 February 2001.
[21] Mark Farmer, "Northern Edge boasts firsts in TMD," JDW, 14 April 1999, pp. 29-30.
[22] "Missile defence: A Pipe dream," Defense News Early Bird news service for 2 August 2000.
[23] Mr. Atkinson (Chairman and Rapporteur), 'Transatlantic cooperation on anti-missile defence,' Assembly of Western European Union WEU, 15 November 2000, p. 20.
[24] Mr. Atkinson (Reporter) 'Transatlantic cooperation on European anti-missile defence – Part II,' Assembly of the Western European Union, 4 November 1997, p. 2.
[25] Frank Barnaby (1998)
[26] William D. Smith and John E. Carey, "A Naval Ballistic Missile Defence Solution for Europe?" Naval Forces no. 3 1999, pp. 8-14
[27] Mark Hewish (1998), p. 34
[28] Mark Hewish (2000). Discussions are ongoing between Israel and Turkey for the sale of the missile as part of the two-tier system Turkey wants to acquire. See also: note 16 (JDW, 16 February 2000, p. 3).
[29] See: NATO handbook 1998 edition "Programs and Activities: 'Air Defence,' on: http://www.nato.int/docu/handbook/1998/v132.htm

[30] Craig Hoyle, "NATO to sign $500m ACCS contract," JDW, 21 July 1999, p. 5 and Luke Hill, "Air Defence Centre Offers Glimpse Of Access", Defense News, 26 June 2000, p. 62
[31] "The Czech Republic, Hungary and Poland will be fully involved in implementing the first military requirement on the Alliance priority list, the Air Command and Control System (ACCS)." NATO Update 17-23 March 1999: http://www.nato.int/docu/update/1999/u990317e.htm
[32] Joris Janssen Lok, "Ballistic missile defence 'should be NATO-wide," JDW, 5 March 1997, p. 5
[33] In the past NATO used the term sub-strategic for those missiles.
[34] John Deutch (2000) Until now we have not been able to do in-depth research into the issue of the speed of incoming missiles and the needed velocity of the interceptors.
[35] Holly Porteous, "China's view of strategic weapons," Jane's Intelligence Review, March 1996, pp. 134-137.
[36] Frank Barnaby (1998), p. 73.
[37] Mr. Atkinson (Rapporteur) Transatlantic co-operation on European nati-missile defence, WEU Parliamentary Assembly Document 1435, 9 November 1994, , p. 21
[38] From Anti-Ballistic Missile Treaty Chronology, Federation of Atomic Scientists (http://www.fas.org/nuke/control/abmt/chron.htm)
[39] Holly Porteous (1996), p. 135, op.cit.
[40] A Scud TBM with a range of 300 km reaches its target in 4 minutes; a TBM with a range of 1,000 km after 15 minutes; and an ICBM after 30 minutes.
[41] Although it is often stated otherwise, the TMD program can also violate the ABM treaty depending on its scope and the capabilities of the weapon systems deployed.
[42] John Deutch, Harold Brown, John P. White (2000); see also Spencer/Dougherty (2000) op.cit. for a good overview of proponents of this track.
[43] Andrew Koch, "Stop and START summit," JDW, 21 June 2000, p. 19
[44] See for example: Hui Zhang, 'US must consider how missile defense plan will play in China,' Boston Globe Online, 18 January 2001 http://www.boston.com/dailyglobe2/018/oped/US_must_consider_how_missile_defense_plan_will_play_in_ChinaP.shtml
[45] Greg May, "China's Opposition to TMD is More About Politics Than Missiles," Foresight Magazine, no. 2 2000; see also David J. Smith, "Sun Tzu and the modern art of countering missile defence," Jane's Intelligence Review, no. 1 2000, pp. 35-39
[46] Greg Seigle, "Russia and China worried over US plans for NMD system," JDW, 24 March 1999, p. 5.
[47] Holly Porteous (1996)
[48] Lee Sam Sung, "A Nuclear Weapons Free Zone in Northeast Asia: the Political and Security Context", in ASEM 2000 (Security Workshops Booklet).
[49] Mr. Karl A. Lamers (Rapporteur), 'Draft Interim Report: NMD and Implications for the Alliance,' NATO Parliamentray Assembly, 6 October 2000, p. 17.
[50] "Op cit in Stimson Center (2000), p. xviii).
[51] Philip Finnegan, "ONE ON ONE," Interview with Tsutomu Kawara, Japanese Minister Of State For Defense, Defense News, 28 February 2000.
[52] Philip Finnegan and Naoki Usui, "Japan, U.S. Near pact on Missile Defence Shield; Growing North Korean Threat Provides Incentive for Move," Defense News, 9 August 1999
[53] "S Korea refuses participation in TMD," JDW, 17 March 1999, p. 16.
[54] This does not mean TMD is absolutely out of the South Korean discussion. See e.g. a recent report in the Korea Times on the acquisition of (outdated) Patriot missiles: Kim Kwant-tae, "Defense Ministry Urged to Withdraw SAM-X Project," Korea Times, 8 November 2000.
[55] Taiwan however got the software so it can practise its use, see: Peng Hui, "Analyzing Chen Shui-bian's Moves Concerning the Taiwan Military Ever Since He Came to Power," Hong Kong Chiao Ching (in Chinese), 16 September 2000 (translated by FBIS)
[56] Wendell Minnick, "Taiwan targets $30 m radar upgrades", JDW, 1 November 2000.
[57] Paul Eckert, 'China Open to Missile Shield Talks with U.S.,' Reuters 14 March 2001.
[58] "Putin offers to reduce Strategic Weapons to 1,500," Segodnya, 22 June 2000. (translated by FBIS)
[59] Claus Telp, "The British Government's Position in the Ballistic Missile defence Debate," Hessische Stiftung f ür Friedens- und Konfliktforschung (HFSK), June 2000;
[60] Bahig Nassar (Co-ordinator, Arab coordination Center of NGOs), "Reviewing Clinton Remarks on NMD," 17 September 2000
[61] Alexei Arbatov, 'The ABM Treaty and theatre ballistic missile defence,' SIPRI Yearbook 1995.
[62] Mr. Atkinson (1994), p. 28, op.cit. p. 28
[63] David Martin, "Towards an alliance framework for extended air defence/theatre missile defence," NATO Review (web edition) no. 3 – May 1996, vol. 44 – pp. 32-35.
[64] Joris Janssen Lok, "Ballistic missile defence should be NATO-wide," JDW, 5 March 1997, p. 5. For a summary of ongoing NATO programs on TMD see: U.S. Department of Defense, 'Strengthening Transatlantic Security; a U.S. Strategy for the 21st century,' December 2000, p. 53.
[65] Atkinson (1997), p. 5-7. This is a very good overview of the history of the introduction of TMD in NATO and the

structures created for implementing the program.
[66] Atkinson 2000, op.cit. Mr. Atkinson (Chairman and Rapporteur), 'Transatlantic cooperation on anti-missile defence,' Assembly of WEU, 15 November 2000, pp. 1- 2.
[67] 'Background briefing on Cohen's upcoming trip to Munich, Germany,' Defense LINK, 1February 2000.
[68] 'The Alliance's Strategic Concept,' 23rd and 24th April 1999 (http://www.nato.int/docu/pr/1999/p99-065e.htm) paragraphs 28, 43, 44, 53.h. and 56.
[69] WASHINGTON FILE, 24 January 2000.
[70] For the Maritime BMDO Forum see: Richard Scott, 'USA woos naval TMBD partners,' JDW, 1 November 2000, p. 5.
[71] Department of Defense (US), Strengthening transatlantic security; A U.S. strategy for the 21st century, December 2000, p. 53.
[72] Atkinson (1997), p. 5-6, op.cit.
[73] Information on the involvement of the Japanese defence industry has not been included in this paper.
[74] Brian Bender, "USN missile defence is prime target for cash injection," JDW 11/11/98, p. 11. See William D. Hartung / Michelle Ciarocca "Nuclear Missile Deception," (World Policy Institute, 17 July 2000) for a critical review of the role of the US defence industry in NMD.
[75] Gopal Ratham and Luke Hill, "Stakes Rise for Studies of NATO Missile Defence; Four Contractor teams Bring together U.S., European Companies To Submit Bids," Defence News 28/08/00, p. 22.
[76] Mr. Jan Hoekema (Rapporteur) 'Draft general report; national missile defence and the alliance after Kosovo,' NATO Parliamentary Assembnly Report on defence and security, 3 October 2000, p. 17.
[77] "Koninklijke Marine wil steentje bijdragen aan Theatre Missile Defence; LCF contra ballistische raketten" [Dutch Royal Navy wants to contribute to TMD; LCF contra BMs], Alle Hens, no. 6 1998, pp. 8-11.
[78] Stephanie Connor (note 4) and see also Gopal Ratnam, "NATO will Review Theatre Missile Defence Needs," Defense News 26 June 2000, p. 20.
[79] See William D. Hartung / Michelle Ciarocca "Nuclear Missile Deception," (World Policy Institute, 17 July 2000) for a critical review of the role of the US defence industry in NMD.
[80] See for information on this radar system: Inge Sellevag, 'Vardo Exposed,' The Bulletin of Atomic Scientists, March/April 2000, pp. 26-29; Thedore A. Postol, 'The Target is Russia,' The Bulletin of Atomic Scientists, March/April 2000, vol. 56, no. 2, pp. 30-35; and Elisabeth Becker, 'Russians Challenge U.S. Over Radar in Norway,' The New York Times, 22 February 2000.
[81] "Russia threatens nuclear attack on radar," JDW, 26 July 2000, p. 6.
[82] Nicolai Proskov, 'The World is Tottering on the Edge of Nuclear Anarchy,' Interview with Colonel-General Vladimir Yakolev (Commander of the Strategic Missile Force), Vek, No. 25, June 2000 (translation from RIA Novosti, provided by CDI Russia Weekly).
[83] "Account of a general consultation", 27 October 1998 (Tweede Kamer, 1998-1999, 26051 nr.3); author's translation.
[84] "Letter of the Secretary of State of Defence", 18 April 1995 (Tweede Kamer, 1994-1995, 23900 X 57); author's translation.
[85] At that time The Netherlands was finalising the Product Improvement Program (PIP), including PAC-2 missiles.
[86] "Letter of the Secretary of State of Defence", 4 July 1995 (Tweede Kamer, 1994-1995, 23900 X 96); author's translation.
[87] "List of questions and answers", 7 November 1995 (Tweede Kamer, 1995-1996, 24400 X 29).
[88] 64 planned to be introduced between 2001 and 2005, plus an option for 64 more, costing another 160 million guilders, to be exercised around 2002 and to be introduced from 2005 ("Letter of the Secretary of State of Defence", 3 September 1997 (Tweede Kamer, 1996-1997, 25000 X 99).
[89] Defense News, 29 May 2000.
[90] See for example Defense News, 4 December 2000, 8, 15 and 29 January 2001.
[91] "MEADS Team Wins Approval From Key German Official", Gopal Ratnam and Amy Svitak, Defense News, 9 April 2001, p3/44.
[92] "Defensienota 2000" [Dutch Defence White Paper 2000], 29 November 1999.
[93] "Hoofdlijnennotitie", Dutch MoD policy paper, January 1999.
[94] Frank J. Gaffney Jr., "Missile Defence for Us and our Allies," 01 June 2000 http://intellectualcapital.com/issues/issue379/item9572.asp; see also Spencer (2000).
[95] Robert Holzer, "Warhead Glitch Threatens NTW Schedule," Defence News, 19 June 2000, pp. 1/28.
[96] Questions by Ann Clwyd, source: Hansard (House of Commons Debates), 26 June 2000.
[97] Op cit. In Claus Telp, "The British Government's Position in the Ballistic Missile defence Debate," Hessische Stiftung für Friedens- und Konfliktforschung (HFSK), June 2000.
[98] Atkinson (1994), p. 32, op.cit.
[99] A rough estimate based on information in Jane's Fighting Ships brings the European total to around 1,000. On the financial value of those ships we did not make an estimate.
[100] An overview of current co-operation can be found in Robert Holzer, "Trans-Atlantic Alliances Prepare to Meet Radar Demand," Defense News, 28 August 2000, p. 6.
[101] It is stated that active phased-array technology is ahead of the Spy-1 radar, which is connected to the Aegis combat data system, and the US Ballistic Missile Defence Organisation was testing the UK-developed Multi-function Electronically

Scanned Adaptive radar (MESAR, its operational version is SAMPSON) for this. In: David Foxwell and Joris Janssen Lok, 'Naval TBM defence matures; Area and theatre-wide naval theatre ballistic missile defence,' Jane's International Defence Review, no. 1 1998, pp. 28-34.

[102] IDR, no. 1 1998, p. 34

[103] Joris Janssen Lok, 'Sirius sensor system integration delayed to 2001,' IDR 10/2000.

[104] Jane's Fighting Ships 2000/01, p. 386 and Military Technology, no. 3/2000.

[105] Answers to parliamentary questions on the Defence White Paper ('Defensienota 2000'), 28 January 2000.

[106] "Koninklijke Marine wil steentje bijdragen aan Theatre Missile Defence; LCF contra ballistische raketten" [Dutch Royal Navy wants to contribute to TMD; LCF contra BMs], Alle Hens, no. 6 1998, pp. 8-11.

[107] See for more details "Maritieme Samenwerking bij 'Ballistic Missile Defence'," [Maritime Cooperation on Ballistic Missile Defence], Marine Nieuws no. 450, 1999, p. 3 and IDR, no. 1 1998, p. 33.

[108] Jane's Defence Weekly, 15 March 2000, p. 19-23.

[109] http://www.raytheon.com/finance/analysts/0900/msdw/tsld016.htm

[110] This arms race is even forecast by US intelligence, see also: Andrew Koch, JDW 21 June 2000)

[111] Atkinson (1997), p. 7

[112] Pointing at the failed tests of NMD systems is a way of criticising, but will be downplayed. In the case of TMD, 1999 alone saw two successful THAAD intercepts, three PAC-3 intercepts, and one Israeli Arrow System intercept. (See for more details on the development of TMD systems the Statement of Lt. Gen. Ronald T. Kadish (Director BMDO), before the Senate Appropriations Committee; Defense Subcommittee,' 12 April 2000.

[113] Defense News, 3 April 2000.

[114] The acquisition process consists of four phases: concept testing; risk reduction; engineering and development; and production.