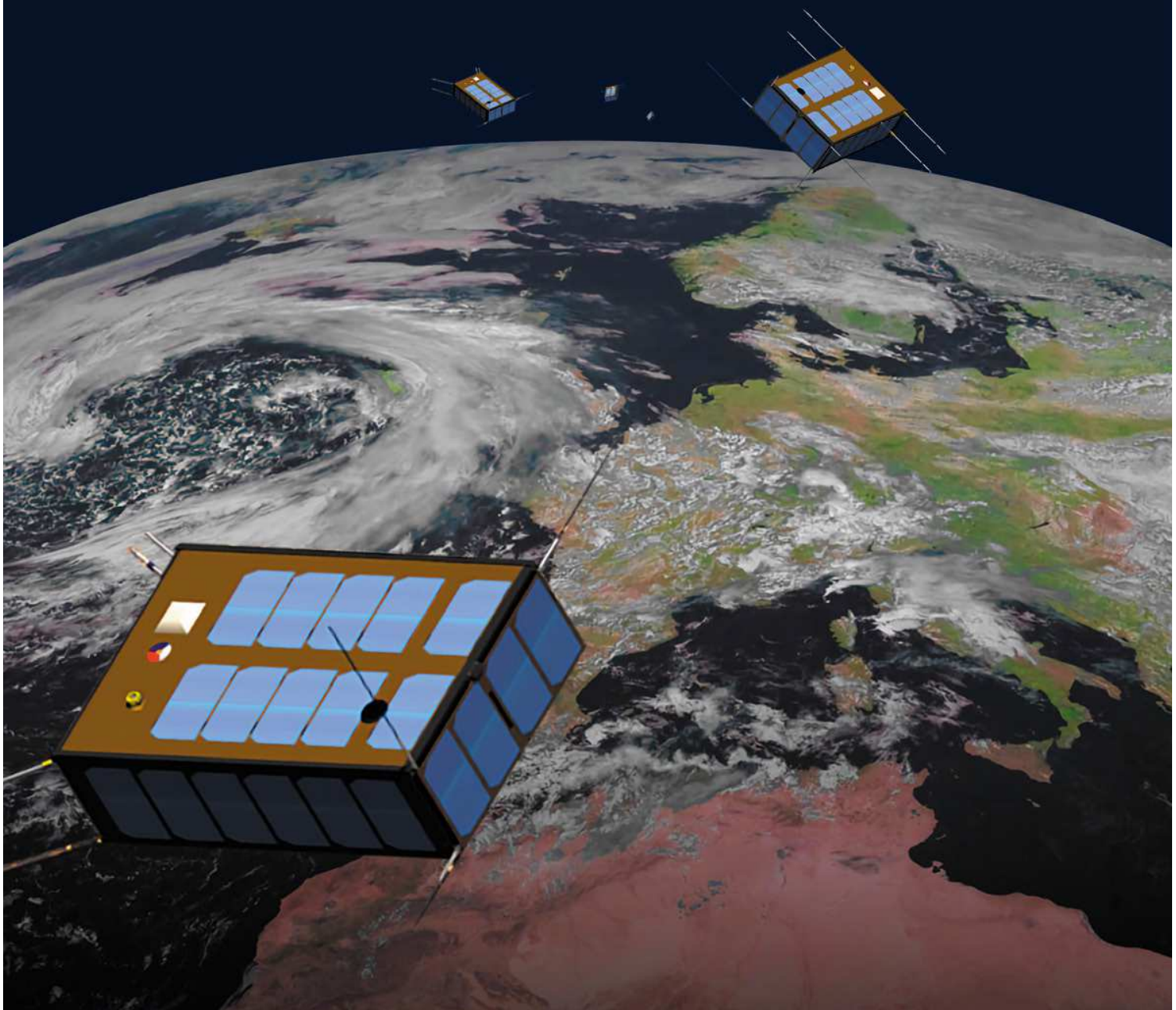
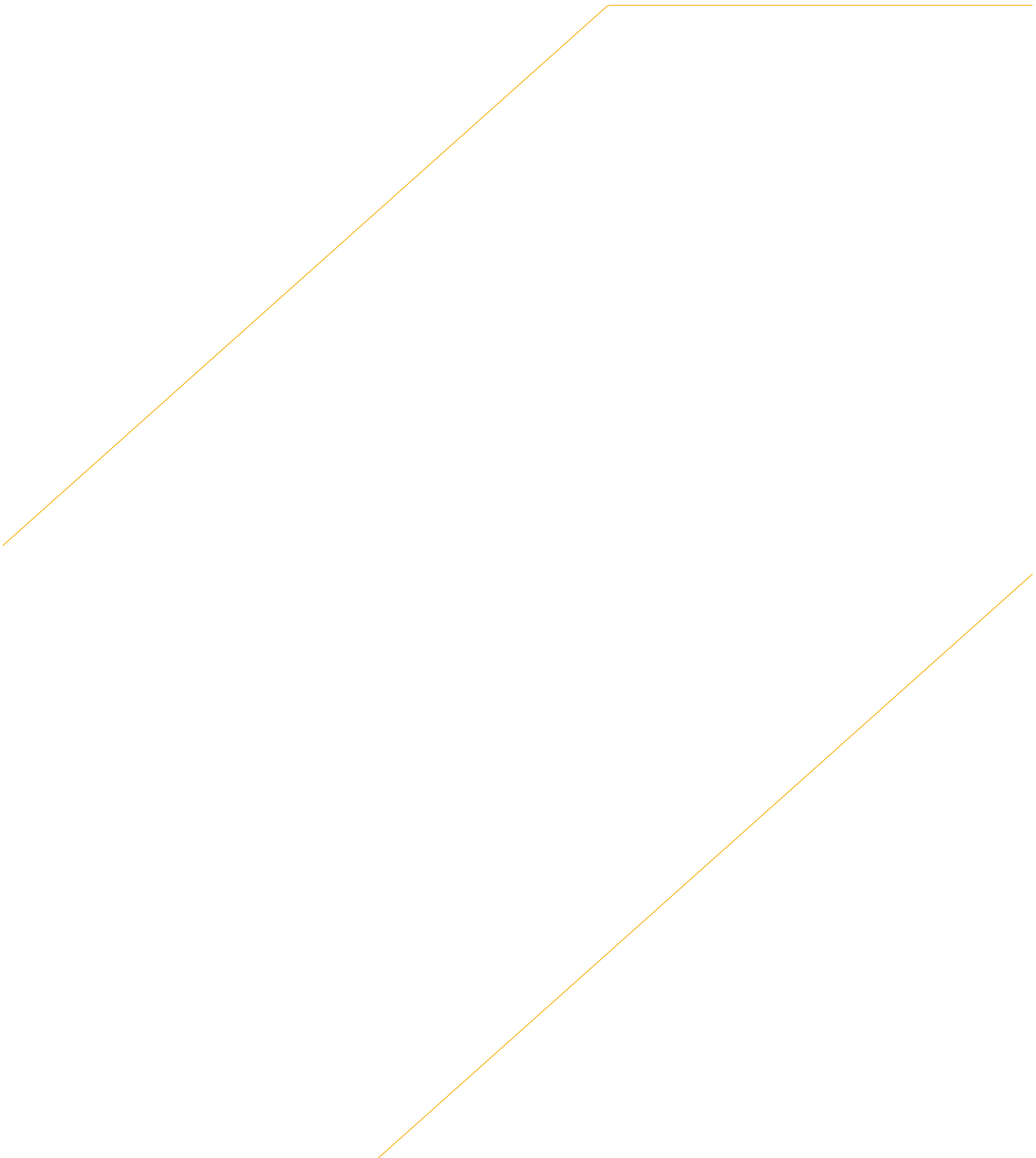
Ministry of Defence

DEFENCE SPACE AGENDA

NOVEMBER 2022





Contents

Reader's guide

The purpose of this document is to inform readers on how the Netherlands Ministry of Defence (hereinafter: Defence) will fulfil its need for (further) developing the capabilities required in the space domain in the coming years. This will be implemented nationally in close cooperation with Dutch knowledge institutes, industry and ministries, and internationally with the EU, NATO and strategic partners. To this end, after the introduction, Chapter 1 will first explain relevant developments in the space domain. Chapter 2 will then describe what Defence's interests are in the military use of space. Chapter 3 will describe the capabilities that Defence intends to invest in the coming years. Finally, the agenda will conclude with a summary in Chapter 4.

Introduction

Following the 2022 Defence White Paper, the release of the Defence Space Agenda is in line with the globally increased military importance and use of space and the resulting threats. The use of space has become indispensable for the proper functioning of our armed forces. In particular, this involves the use of satellites essential for communication, positioning, navigation and timing (PNT), Earth observation and Intelligence, Surveillance and Reconnaissance (ISR) in the information-driven operations of our armed forces. With in-house capabilities, we can independently access information and monitor what is happening in space. In-house capabilities ensure the availability of space capabilities for military operations, enable secure communications between units and enable us to play a role internationally. In this respect, we must be aware that during conflict and crisis, the demand for space capabilities exceeds what is available and the Netherlands will not be able to access vital resources if we fail to make a relevant contribution ourselves.

Publishing this agenda is also urgent because of the deteriorating global security situation and the resulting need for the Netherlands and Europe to improve our ability to protect our own security interests. The war in Ukraine illustrates the importance of space capabilities to enable the availability of reliable information and to share that information with others in a timely manner.

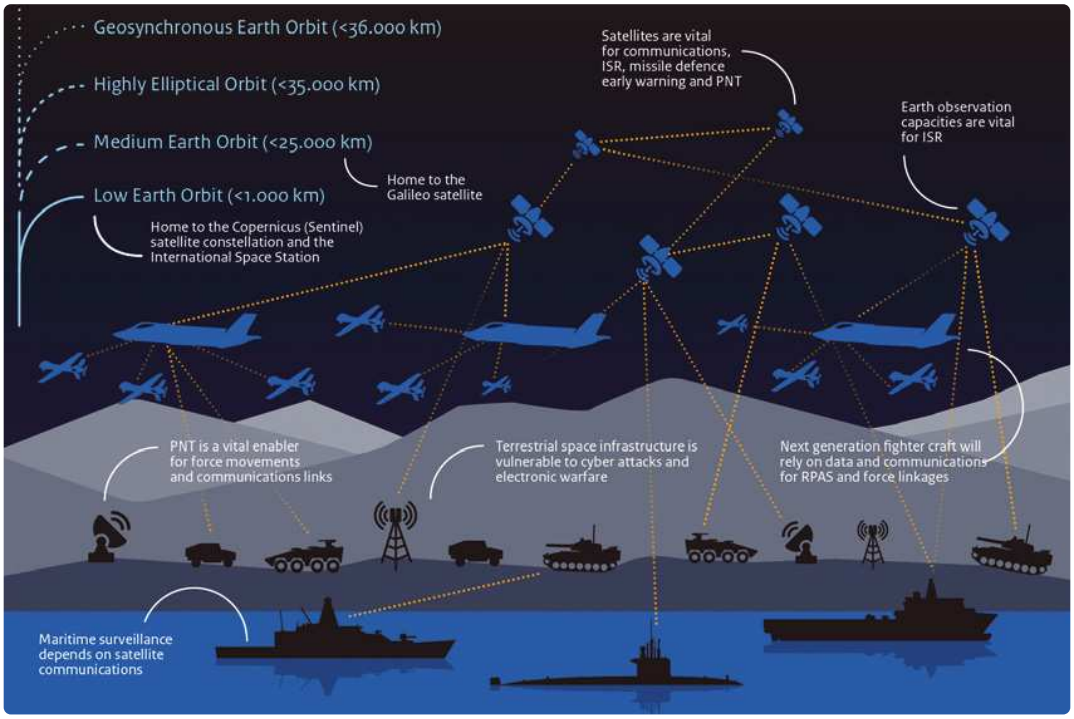
NATO recognises space as the fifth military domain (alongside land, sea, air and cyber) and the EU endorses its importance in the Strategic Compass and through the EU Space Strategy for Security and Defence paper, to be published in 2023. The focus areas of the agenda presented here are in line with the Commission's discussions with EU member states on the EU's space strategy. That also applies to the space security policy developed by the Minister of Foreign Affairs, including the explanation of new initiatives on space security awareness and space situational awareness[1]. As part of the UN framework, the Ministry of Foreign Affairs on behalf of the cabinet actively engages in international discussions on responsible behaviour in space (COPUOS) and the prevention of an arms race in outer space (PAROS).

Setting up space as the fifth operational domain is an urgent issue and important for all Defence elements. In the future, our armed forces, whether they are operating above or below water, on the ground or in the air, whether they are using manned or unmanned systems and whether they are operating in the physical or digital world, will use capabilities in space even more than they do today. The graphic on the next page illustrates this.

This agenda thus also contributes to the changing role of Defence in the national space cluster. Due to the growing social relevance, the vulnerabilities of the use of space and the rapid military, civilian, technological and legal developments in the field, the Ministry of Defence, together with other ministries involved in the space domain and the Netherlands Space Office, will develop an integral space policy and an integral long-term space agenda by 2023. At the same time, the Advisory Council on International Affairs will be asked for an appreciation of the space domain.

With the 2021-2025 Coalition Agreement, the 2022 Defence White Paper and the 2022 Spring Memorandum, the government is investing heavily in Defence in the coming years, including in the space domain. The funding made available for investment will be used for the necessary build-up of space capabilities and for ongoing research and technology developments. These include a constellation of nanosatellites, a space situational awareness network (to know what is happening in space) and laser satellite communications.

1 Parliamentary letter, reference 24 446, no. 74 of 5 March 2021.



Importantly, our capabilities must be interoperable with partner countries' armed forces. Capabilities must also be robust to prevent interference by adversaries.

The space agenda is the starting point for Defence to further implement the space domain within our organisation. Defence is formalising and expanding the Defence Space Security Centre and, with the resources committed for a longer term, can enter into long-term partnerships as a reliable partner. With national knowledge institutes, industry (including industry organisations NIDV and SpaceNed) and international partners, Defence is building a solid operational base in the space domain and making a relevant contribution to ensure that the necessary capabilities are also available for the execution of the military mission in times of crisis and conflict.

Because the Netherlands cannot do everything alone in the space domain, we will use this agenda to select which capabilities we want to develop ourselves and with whom (nationally with industry and knowledge institutes, internationally in the EU, NATO or bilaterally with strategic partners) we will fulfil our needs for the space domain in the coming years. Given its modest budget (when compared internationally), Defence has decided to develop niche capabilities, which will deliver national and international value, and, where possible, to avoid duplicating capabilities that partners or commercial parties already have available. In the coming years, Defence will focus more explicitly on cooperation within the EU and intensify already existing NATO and bilateral cooperation with strategic partners such as Belgium, Germany, France, Luxembourg, Norway, the UK and the US. This will not only increase the Netherlands' strategic autonomy but will also contribute to NATO and EU joint combat power.

Achieving our ambitions as described in this agenda will provide the Netherlands armed forces with the necessary operational capabilities and knowledge building within the space domain and contribute to the information-driven operations of our armed forces. At the same time, the funding made available for space will give a major boost to the high-quality Dutch space industry (public and private) and will promote the economic security and strategic autonomy of the Netherlands and Europe. Defence thus contributes to protecting what we hold dear, including in space.

1. Relevant developments in the space domain

1.1 Dependence on space (we can no longer do without it)

Our society in the Netherlands has become significantly dependent on technology and applications in space for its functioning on Earth. For example, we find our way using satellite navigation systems, we rely on satellite communications for the internet and telephony, and we act on data obtained through observations from space. Important functions in our society such as trade, traffic control, the banking system, security and agriculture all depend on space. Loss or disruption of satellite signals, whether intentional or not, have an immediate disruptive effect on society.

This dependence also applies to Defence. Space applications for precise positioning, navigation and timing (PNT), communications, observation and intelligence, surveillance and reconnaissance (ISR) have become indispensable for the proper functioning of our armed forces (such as, for example, the use of satellites in the deployment of precision weapons to prevent collateral damage). For the deployment of our armed forces, we depend on others in obtaining the necessary information from space-based capabilities.

1.2 Threats in and from space

Defence recognises state-specific developments, technological developments and space debris as (potential) threats from space and in space.

1.2.1 State-specific developments

Besides the US, Russia and China are particularly active in military space programmes. These countries have numerous space satellites for military purposes. The space domain is an integral part of their military strategies and doctrines. The ambition to be able to exert influence in the space domain and thus on the capabilities of potential adversaries in space is part of those strategies and doctrine. Over the past 20 years, this has led to an acceleration in the development of counterspace capabilities, especially in Russia and China. With such counterspace capabilities, Russia and China have the ability to disable or even destroy other countries' satellites.

Russia

Russia has a long tradition in the field of space exploration. Although economic crises have affected the space programme, Russia has nevertheless developed significant military capabilities in counterspace in recent decades. A recent example is Russia's destruction of one of its own satellites in November 2021 with a direct ascent anti-satellite weapon.[2] With this action, Russia demonstrated its anti-satellite (ASAT) capability. Russia believes the Western method of waging war depends on the use of the electromagnetic spectrum and space capabilities. Russia is therefore developing systems that are specifically aimed against the Western (NATO) way of waging war, and these include counterspace weapons and electronic warfare weapons. Russia's ASAT capabilities cover a broad spectrum, including systems to disrupt navigation and communications (electronic warfare), among others, and laser weapons that blind optical payloads in space.

2 Russia destroyed its own obsolete spy satellite using a rocket, resulting, among other things, in the (deliberate) creation of so-called "space debris" (debris, rubbish, fragments of materials that all go into their own orbit and then pose a risk of another collision, etc.). The image on the next page illustrates the extent of space debris.

Russia is also developing inspector satellites [3], other types[4] of satellites and ASAT weapons, such as air- and ground-launched missile systems capable of destroying satellites of potential adversaries (as demonstrated in November 2021). It is essential to keep track of potential Russian threats in the space domain.

China

For China, space is part of their drive to conduct 'informatized' warfare. China, like the US, has housed its military space capabilities in its own armed forces element, the People's Liberation Army Strategic Support Force, where cyber and electronic warfare units are also concentrated. Beyond a multitude of satellite systems, China also has counterspace capabilities and is developing a wide range of ASAT weapons including a number of ground-launched missile systems, inspector satellites, laser weapons and jamming systems. As with Russia, it is essential for Defence to remain focused on potential Chinese threats in the space domain.

1.2.2 Technological developments

Hypersonic weapons

In addition to the increased threat of anti-satellite capabilities, the development and deployment of hypersonic weapons by some states is also a concern. Due to their high speed and complex flight profiles, hypersonic weapons are difficult to detect by existing sensors, which include radar and optical systems.

Cyber

Another threat originates from the cyber domain, as also recognised by the Dutch House of Representatives in the Bruins Slot (CDA) motion.[5] Cyber-attacks can have a destructive effect on satellite signals or on the ground stations where these signals are processed. The disruptive potential of cyber-attacks for society is therefore high. To cope with this, it is important that satellites and associated infrastructure are resilient to such attacks.

1.2.3 Space debris

Space debris also poses a hazard. This includes parts of old rockets, discarded satellites and millions of fragments of debris (varying in size) originating from satellite collisions (intentional or unintentional) or by the deployment of anti-satellite weapons. Given the staggering speed (8 km/s) of space debris, even small objects pose a serious threat to operational satellites. The amount of space debris is expected to continue to increase rapidly in the coming years (partly because of an increasing number of commercial satellites). The table and image on the next page[6] provide an insight into the extent of space debris orbiting Earth.

1.3 Increase in number of commercial operators launching small satellites

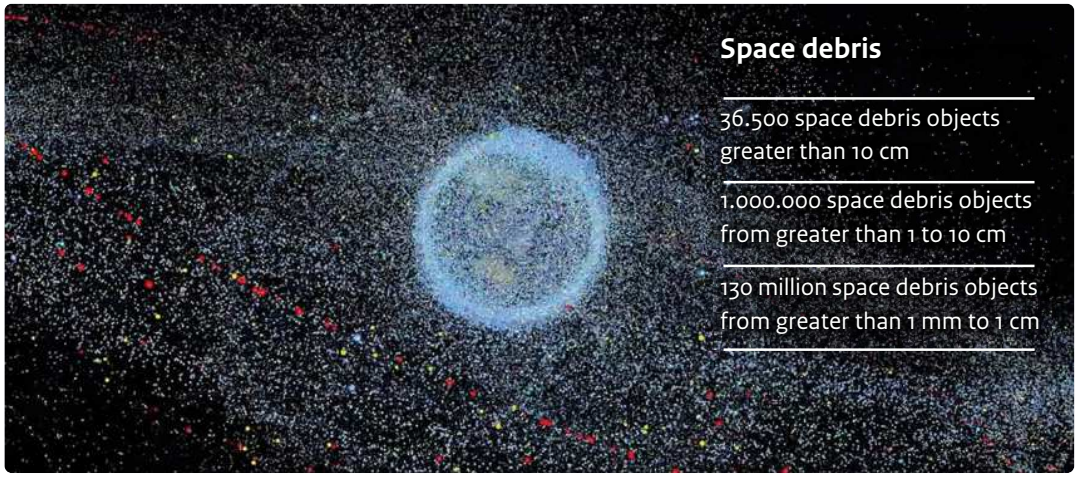
There is a tendency, wherever possible, to put many smaller and cheaper satellites into orbit instead of relatively large and costly ones. This is made possible by advancing technological developments and miniaturisation of satellites (nano- or microsatellites). Due to the limited size and weight of these satellites, launch costs are lower. At the same time, besides satellite launches by states, commercial space activities have also increased significantly.

3 Such satellites can position themselves near other satellites to inspect them, eavesdrop on them, take them out of orbit or disable them.

4 An example is the launch of the Kosmos 2519 satellite from which came first a smaller Kosmos 2521 satellite and subsequently the Kosmos 2523 satellite. These satellites can manoeuvre close to satellites of other states.

5 Bruins Slot motion, House of Representatives reference 35 000 X no 52.

6 As per 1 September 2022. Information taken from ESA - Space debris by the numbers. Data are updated monthly.



Foreign companies such as SpaceX, Blue Origin and Virgin Orbit but also the Dutch company ISISPACE offer the possibility of putting satellites into orbit. Lower launch costs and an increased number of launch providers make it easier and more attractive for countries (and possibly non-state actors) to launch satellites. On 30 June 2021, the first Dutch military satellite, BRIK-II, a partnership between the Ministry of Defence, NLR, Delft University of Technology and Dutch industry (ISISPACE), was successfully put into orbit.

In the light of these developments (states having the ability to deny other states free and secure access to space, the greater amount of space debris and number of satellites, and the increased number of commercial providers), space has become increasingly contested, congested and competitive.

1.4 Developments in Europe

The Netherlands is a member of the European Space Agency (ESA), which carries out 'joint' European space missions and technology programmes. Thanks to ESA, Europe has autonomous access to space and high-quality space infrastructure, such as ESTEC, located in Noordwijk, the Netherlands. ESA conducts civilian programmes in astronomy, Earth observation, exploration and satellite communications. Since the 1990s, the European Union (EU), in cooperation with ESA, has launched a number of civilian space programmes including Galileo for navigation, Copernicus for Earth observation, GOVSATCOM for satellite communications, EGNOS (European Geostationary Navigation Overlay Service) for accurate positioning in the approach and landing phase for aircraft and SST (Space Surveillance and Tracking) for detecting, logging and predicting the movements of space objects in orbit.

In the EU, (political) interest in the military use of space has increased. In 2020, the EU expanded its defence and industry cooperation to include space and created the Directorate-General for Defence Industry and Space (DG DEFIS). Furthermore, in late December 2020, a political agreement was reached on an EU space programme with a budget of €14.8 billion, following the European multi-annual budget 2021-2027.[7] Among other things, this budget is to be used for investment in space activities and the search and development of new technologies in the field of space. Several military cooperation projects are being implemented for the benefit of the space domain through the European Defence Fund (EDF) and Permanent Structured Cooperation (PESCO).

On 24-25 March 2022, EU government leaders agreed on the Strategic Compass. Among other things, it emphasises ensuring free and secure access of the EU and member states to space. In April, the Dutch House of Representatives was informed through BNC sheets about two space-related proposals by the European Commission, namely a Secure Connectivity Programme (SCP)

7 This amount is divided into €9 billion for Galileo and EGNOS, €5.4 billion for Copernicus and €0.4 billion for GOVSATCOM.

and a Space Traffic Management (STM) proposal.[8] In short, the Commission wants the SCP programme to establish European secure satellite connections for (data) communications with public and private users. Due to the strong global growth of space activities (contested, congested and competitive) and increased concerns about safe and sustainable space activities, the European Commission is endeavouring to work on establishing an international regulatory framework to improve Space Traffic Management (STM), in conjunction with the EU SST (Space Surveillance & Tracking) Partnership. Finally, the Commission is working on developing an EU Strategy for Security and Defence.

Defence sees these developments as an opportunity to focus more explicitly on EU cooperation in the coming years. This will be done in close cooperation with the Ministry of Economic Affairs and Climate Policy, as the coordinating ministry for (civil) space, with other ministries (incl. Foreign Affairs, Infrastructure and Water Management and Education, Culture and Science) and the Netherlands Space Office.

1.5 Developments within NATO

In November 2019, NATO declared space the fifth operational domain, alongside land, sea, air and cyber. The main goal is to recognise space as a unique environment for conducting and supporting military operations, but also an environment with its own physical characteristics, threats, treaties and specific systems. The recognition of space as an operational domain facilitates the integration of space capabilities into the NATO defence planning process (NDPP), which contributes to the effectiveness of operations. The Netherlands has also been given a number of space-related capability targets under the NDPP that we are trying to meet.

NATO has developed an overarching policy on the military use of space, the Overarching NATO Space Policy, and is currently working on its implementation. In its space policy, NATO endorses the importance of space in support of allied operations. NATO does not aim to become an independent actor with stand-alone capabilities in the space domain, but will work to integrate the space domain into NATO's collective defence, crisis management and shared security objectives. NATO has no space assets of its own and will rely on member states to provide these. The alliance currently relies heavily on US satellite capabilities. However, as part of its space policy, NATO added a Space Centre to the NATO Allied Air Command in Ramstein, Germany and a NATO Space Centre of Excellence will become operational in Toulouse as of 2023. Due to the increased importance of the space domain, NATO has identified space technology as one of the eight emerging and disruptive technologies (EDT). Through the NATO Science and Technology Organisation, the alliance is devoting more attention to research, development and innovation in the space domain in the coming years.

1.6 Developments with strategic bilateral partners

The Netherlands and Norway are working closely together in the MilSpace2 project, which is part of an MoU between these countries. In this project, the Dutch and Norwegian Ministries of Defence, together with knowledge institutes, the Dutch NLR and TNO and the Norwegian FFI, are developing a demonstration mission for a space-based observation system to detect and identify specific radar systems. This system consists of two identical microsatellites that will orbit in tandem formation at an altitude of about 550 km, with a distance of 15 to 25 km between them, allowing the satellites to record signals simultaneously. The launch of the two satellites (through a commercial party) is scheduled for December 2022. Because of the good cooperation, the Netherlands and Norway are identifying topics for a subsequent MilSpace programme that will also link R&D to operational capabilities.

Following on from the excellent current bilateral cooperation with Germany, specifically for cooperation in the space domain, a representative of the Netherlands Defence Space Security Centre will again fulfil a liaison function in the German Space Situational Awareness Centre. This offers the prospect of further shaping cooperation with

8 Letter from the Minister of Foreign Affairs 8 April 2022, Parliamentary reference 22 112, nos. 3412 and 3413.

Germany in the space domain. Furthermore, we are expanding the ongoing cooperation with Belgium in the area of space weather and see opportunities to develop military SATCOM capabilities together with Belgium and Luxembourg. There are also opportunities to cooperate with France and the UK, two countries that previously developed a military space strategy and Space Command respectively. The Netherlands works closely with the United States, through among other things the Responsive Space Capabilities (RSC) Memorandum of Understanding (MoU)[9], while we are also partners in the US-led Advanced Extremely High Frequency (AEHF) MILSATCOM programme, in GPS and in the field of Space Situational Awareness. Finally, the DSSC will collaborate with the Air Force Research Laboratory (AFRL) from 2023.

Due to the various cooperation opportunities, bilateral cooperation with our strategic partners Belgium, Germany, France, Luxembourg, Norway, the UK and the US in the space domain will be further shaped and intensified over the coming years. For the Netherlands, far-reaching cooperation, especially in Europe, is the starting point in order to strengthen Europe's strategic autonomy. European cooperation acts as a lever, with countries sharing knowledge and capabilities on the basis of reciprocity and thus gaining access to (international) knowledge and capabilities that could not have been obtained by their own means. Consequently, opportunities to implement cooperation programmes similar to MilSpace with other European countries are also being explored. With shared, lower costs, the participating countries will acquire a greater (joint) available capability that can also be offered as a contribution to the EU and NATO.

9 The Responsive Space Capabilities MoU is an agreement between 11 countries: Australia, Canada, Germany, Italy, the Netherlands, New Zealand, Norway, Spain, the United Kingdom, the United States and Sweden) exploring cooperation opportunities in the field of small satellites, communication technologies and responsive launch options.

2. Defence's interests in the use of space

As described in the previous chapter, space is critical to the operational performance of our armed forces. The interests for Defence in the space domain are first and foremost those arising from national security. But there are also interests related to NATO and EU commitments. And finally, there are those related to technological and industrial interests. Those interests and the resulting needs are detailed below. Chapter 3 explains the investments Defence is making on the basis of these interests.

2.1 National security

It is crucial that our armed forces have satellite capabilities in their operations. That satellite capability, for example, will structurally strengthen our national intelligence position. Future operations and missions in conflict situations will require information dominance and situational awareness, both on the ground and in space (multi-domain), to be carried out in a targeted and as safe as possible manner. By developing satellites and sensors ourselves and putting them into space, we are less dependent on strategic partners and commercial parties for capabilities that are essential for communications, navigation, observation and ISR in the information-driven operations of our armed forces. This promotes our strategic autonomy. Own capabilities also provide an international 'seat at the table', ensuring more partners' capabilities available to the Netherlands.

We think it is important to be better informed about what exactly is happening above us in space (Space Situational Awareness) and to map these activities (Space Surveillance and Tracking). We can identify some of the many millions of artificial objects in space, because they have been officially reported to or registered with the UN space object registry by states or commercial entities. For other objects, this is not possible and sometimes these objects are systems that were put into space by hostile states for the purpose of deliberately disabling or disrupting other satellites or satellite links (spoofing or jamming[10]). It is also important to have an overview of hazards or natural threats from space such as, for example, space debris, an eruption on the sun or other consequences of "space weather"[11]. Space weather can lead to disruptions in navigation, communication and detection assets (e.g. radios and radars on the ground) and thus the availability and reliability of systems such as GPS and SATCOM that are essential in the conduct of military operations.

Space is also important for Defence because of the 'early warning' function that some satellites can perform for Integrated Air and Missile Defence (IAMD). Besides the recently increased threat in space from anti-satellite and hypersonic weapons, ballistic missiles also continue to pose a threat. Through the EDF, the EU is developing such Shared Early Warning (SEW) capability, but currently relies

10 Spoofing involves a real satellite signal that is replaced by a manipulated and more powerful signal that deviates or gradually starts to deliberately deviate from the real position or time, causing the receivers to calculate an incorrect position and time. Jamming is the deliberate broadcasting of radio frequencies or signals with the intention of interfering with the reception of satellite signals from space.

11 The term 'space weather' refers to environmental conditions in the Earth's magnetosphere, ionosphere and thermosphere due to the sun and solar wind that can affect the operation and reliability of ground-based and space-based systems and services (such as satellites).

on information from the US. By having early warning satellites in space that are interoperable with ground-based radar systems, Defence can contribute to an IAMD capability.

When performing its tasks, especially during operations or (humanitarian) missions, it is essential for the armed forces to be able to share information in a secure way within Defence and with its military partners, but also with other relevant government organisations. It is expected that this will largely take place via so-called "secure space-based laser communication". Thanks to new forms of encryption and use of quantum technology, this form of communication will be highly secure and much faster, and will be able to send significantly more data than hitherto.

2.2 NATO and EU commitments

We will offer our operational space capabilities to NATO and the EU. In doing so, we will contribute to promoting and strengthening the security interests of both organisations. Another reason why the use of space is important to us stems from a NATO request. As part of the NATO Defence Planning Process (NDPP), the Netherlands has committed to the target for Space Based Surface Surveillance and Situational Awareness, which contributes to the intelligence process using space-based assets. With information obtained via Dutch space capabilities, for example in the field of SSA or early warning, we will show ourselves to be a reliable partner within NATO and the EU.

2.3 Interdepartmental, industrial and scientific-technological interests

The Ministry of Economic Affairs and Climate Policy coordinates national space policy to ensure coherence between the politico-strategic, economic, societal and scientific functions of space. On behalf of the cabinet, this ministry informed the House of Representatives on the matter.[12] Space technology is often dual-use in nature (it has both civilian and military applications) and developments can be mutually reinforcing. Investment in the military use of space is therefore also of civilian interest (and vice versa) and thus relevant to other ministries in determining national and international space policy. The same as my colleague, the Minister for Economic Affairs and Climate Policy[13], I endorse the importance of achieving synergy between military and civilian applications in the space domain to avoid duplication and strengthen our space ecosystem. Owing to the growing social relevance, the vulnerabilities in the use of space and the military, civilian, technological and legal developments in the space domain, it is important for the Ministry of Economic Affairs and Climate Policy, together with the Ministry of Defence, the Netherlands Space Office and other ministries involved in the space domain, to develop an integrated space policy and long-term space agenda by 2023; an agenda that will address issues such as ensuring synergy between the military and civilian space domains, the governance of the interdepartmental space policy and how the Netherlands can contribute to Europe's strategic autonomy.

In November 2022, the State Secretary for Defence sent his *Uitvoeringsagenda Innovatie en Onderzoek* [Innovation and Research Implementation Agenda] to the House of Representatives, with space as one of the priorities.[14] Defence will invest in research and technology development for the military use of space in the coming years. After all, the space domain is vital for Defence, as this agenda sets out. With the additional funds, Defence intends to co-operate with its knowledge and innovation partners to strengthen existing and develop new knowledge and innovation ecosystems, at national and European level. In terms of the space domain, this is an obvious step,

12 Parliamentary letters, reference 24 446, no. 64 of 19 June 2019, no. 74 of 5 March 2021, no. 77 of 15 July 2022 and 33 009, no. 81 of 17 October 2019.

13 Parliamentary letters, reference 24 446, no 78 of 20 October 2022.

14 Parliamentary letter, reference 31 112, no 122 of 2 November 2022. This is also described in the parliamentary letter sent that day by the Ministries of Economic Affairs and Climate Policy and Defence "Defence Industry Strategy in a new geopolitical context".

because the Netherlands has a high-quality space industry and internationally renowned knowledge institutes (such as TNO and NLR). Together with industry and knowledge institutes (Golden Triangle), we will then also capitalise on the opportunities offered by the KIA Mission 'Security in and from Space' resulting from the Ministry of Economic Affairs and Climate's Mission-driven Top Sectors and Innovation Policy and by European cooperation (in particular the EDF and PESCO). In the coming years, Research and Technology (R&T) activities focusing on the space domain will continue. R&T provides the basis to develop and acquire capabilities that enable a technologically advanced and operationally relevant armed forces.

At the same time, in the coming years, the necessary capabilities for the space domain to protect our security will have to be (further) developed with the available resources. In cooperation with the knowledge institutes TNO and NLR and Dutch industry (including the NIDV), investments are being made in, among other things, knowledge building in the field of space situational awareness (SSA), data use and microsatellites for ISR and in the field of space weather, in which the Royal Netherlands Meteorological Institute (KNMI) has a major role. There is collaboration with the Netherlands Space Office to leverage networks and technology from civilian R&T programmes for military purposes. Not only because these capabilities are important for military action, but also because these capabilities are an international niche. A niche through which the Netherlands positions itself as an allied and technologically interesting partner and can make a relevant contribution to EU and NATO policy and capability plans. With the development and application of high-tech knowledge, systems and components in the space domain, Defence directly invests in high-quality capabilities and, in doing so, also makes a concrete contribution to the economic security, strategic autonomy and long-term earning capacity of the Netherlands (2022 Defence White Paper and the Defence Industry Strategy, 2018).

3. Required Defence capabilities in the space domain

Military use of space requires investment.[15] This chapter describes how Defence will use investments in the coming years to develop the capabilities needed for the space domain. The focus here is on the years 2023 - 2027. In short, Defence is using the investments to make the Defence Space Security Centre the operational unit and knowledge authority within Defence for the space domain; to ensure that the domain is organised more broadly and robustly within Defence; to build several small satellites to strengthen our information/intelligence position; to strengthen our capabilities in space situational awareness, space weather, shared early warning, (laser) satellite communication, positioning, navigation and timing (PNT), observation (ISR) and, finally, to intensify research and technology development for the space domain. We will achieve this in close cooperation with our national knowledge institutes, industry, other departments, the Netherlands Space Office (NSO), the EU, NATO and strategic partner countries.

3.1 Defence Space Security Centre

To implement space as the fifth operational domain and in line with the 2022 Defence White Paper, temporary positions at the Defence Space Security Centre (DSSC) will be converted into permanent positions and the total number of positions will be gradually increased to 25 positions by 2030. The staff members of DSSC are tasked with building expertise and competence in the various relevant areas of the space domain and some will also hold positions of strategic importance abroad. With this increase in staff numbers, the DSSC is developing into Defence's knowledge authority on the military use of space, lending support to operational commanders by advising on the efficient use of available space capabilities in day-to-day operations and in the event of threats, and is involved in the development of national and international space capabilities. The DSSC is thus the single service manager to the other defence elements and is supported by the DMO. The DSSC thus focuses in particular on the six defined functional areas of the NATO Overarching Space Policy: Positioning, Navigation and Timing (PNT), Satellite Communications (SATCOM), Intelligence, Surveillance and Reconnaissance (ISR), Meteorology and Oceanography (METOC), Space Domain Awareness (SDA) and Shared Early Warning (SEW). DSSC is a Defence-wide organisation that includes representatives of all the armed forces services and is part of the Royal Netherlands Air Force. DSSC will explore whether it can fulfil a role for the Netherlands coast guard and other ministries involved in implementing the national space policy in the future.

With an operational and fully manned DSSC, Defence will have an organisation that will develop into the centre of expertise on the military space domain for the benefit of the entire armed forces and will ensure knowledge building, development and maintenance of operational space capabilities in the NATO's six functional areas.

3.2 Building satellite capability

The Netherlands does not have its own operational satellite capability and depends on coalition partners or possibly a commercial party for the information that we require to carry out future operations and missions. However, the Netherlands does lead the way in the development of small satellites (micro- or nano-satellites) and high-tech, miniaturised sensors. Because of its industrial and scientific position, the Netherlands is quite capable of further developing small satellites for Defence (and also for other government bodies), thus giving us our own

15 An indicative outlook on the investments required to set up space as an operational domain is given in Annex 3 of the 2022 Defence White Paper (p. 65, Procurement of operational space capability, financial volume €25 - 100 million)

(partly) independent capability in the space domain to strengthen our information position. This allows faster and better political and military decision-making. The Militaire Inlichtingen- en Veiligheidsdienst (MIVD) [Defence Intelligence and Security Service (DISS)] will be one of the main users of ISR capabilities and therefore plays a key role in determining the required capabilities. At the same time, the development of these small satellites and sensors represents a niche market and can further distinguish Dutch industry and knowledge institutes from others worldwide.

In June 2021, the BRIK-II satellite was successfully put into orbit. This is the Netherlands Ministry of Defence's first military satellite. BRIK-II is a demonstration mission with capabilities in communications and it is able to detect ground emissions and measure electron density in space. According to the current schedule, the next step is to put two Dutch-Norwegian microsatellites into orbit together in December of this year. That is also a demonstration mission. By putting more satellites into space in the coming years, Defence is improving its information and intelligence position and creating more opportunities to work with partners.

Furthermore, under the KIA Mission 'Security in and from space', Defence is developing payloads for future satellite launches together with our knowledge institutes. In addition to developing and operating more national satellites, we will also work together with one or more European EU or NATO member states (following the Dutch-Norwegian MilSpace cooperation). The cost of developing, delivering into space and using a small satellite (with admittedly limited capabilities) for several years amounts to several million annually. That is a relatively small amount when compared to the cost of launching the large satellites that were launched recently (often hundreds of millions of euros or more).

By developing and deploying microsatellites in space, Defence will improve its information and intelligence position for the information-driven operations of its armed forces and will reduce its dependence on strategic partners or commercial parties. This allows faster and better political and military decision-making. Having our own capabilities will also improve our position in partnerships.

3.3 National Space Situational Awareness (SSA) capability

Given an increase in threats in and from space, it is necessary to invest in SSA capability so that hazards and threats are detected in a timely manner. Adequate and timely intelligence from the MIVD on the capabilities of satellites, e.g. who they belong to and what they are used for is essential to determine the threat level of the objects and the impact on military operations. Knowledge related to satellite positioning is important for the security of both Defence and our society. In addition, SSA provides information on the risks of space objects returning to Earth (intentionally or unintentionally) and possibly falling on to our territory. Having an operational

SSA capability nationwide with its own sensors will create a better information position, which is vital to our armed forces for conducting operations and missions.

Defence does not yet have its own SSA capabilities and relies on information received from others. However, the Netherlands does have the industrial and knowledge infrastructure required to play a leading role in developing its own SSA capacity. For example, together with Thales, the SMART-L Multi-Mission radar is being developed into an SSA capability. Besides detecting air targets and ballistic missiles, after further development, our SMART-L Multi-Mission radars will also be able to see satellites, other objects and debris in space. The information received by the radars will be processed into a national SSA database that can be used to work with other countries towards an EU or NATO-wide comprehensive SSA network. These (upgraded) radars form a niche capability internationally and can contribute to the EU's Space Surveillance Network[16], NATO and, for example, the US, which in turn can provide Defence with relevant information. Together with Germany, France and Italy, the Netherlands (in the shape of the Ministry of Defence) is a member of the EU PESCO programme European Military Space Surveillance Awareness Network (EU-SSA-N) and is exploring opportunities for cooperation in an SSA network. Part of Space Situational Awareness is Space Surveillance and Tracking (SST). Under the leadership of the Ministry of Economic Affairs and Climate Policy, the Netherlands is currently taking part in discussions on a possible Dutch contribution to the EU SST Partnership that will start during 2022. The envisaged Dutch contribution to this service will consist of SSA data, for example from the SMART-L Multi-Mission radar systems, which will be shared through the Defence Space Security Centre. Finally, a national SSA capability fits into the Netherlands' broader international commitment to space security: through SSA, compliance with agreements on the responsible use of space can be monitored.

16 Together with Germany, France and Italy, the Netherlands (Defence) is a member of the EU PESCO programme European Military Space Surveillance Awareness network (EU-SSA-N) and is exploring options for jointly developing an autonomous EU military SSA capability.

With its own SSA capability, Defence has the data to operate safely and efficiently in the space domain. Several sensors are being considered, but in international terms radars that can detect satellites and other objects (space debris) are scarce. This capability therefore provides an opportunity to cooperate internationally with the EU, NATO and strategic partners and detect threats in and from space in a timely manner. Therefore, initial priority is given to developing the SSA capability of the SMART-L Multi-Mission radar.

3.4 Space weather

The term 'space weather' refers to ambient conditions in the Earth's magnetosphere, ionosphere and thermosphere due to solar activities that can affect the operation and reliability of ground-based and space-based systems and services (such as satellites). Space weather can cause disruptions to communications and navigation assets and thus can have a major impact on the performance of tasks, operations and missions by our armed forces. It is vital to our armed forces' operations to have a degree of expertise in space weather in order to recognise whether any occurring effects (such as communication breakdown) are caused by natural phenomena or by deliberate disruption of systems (by jamming, for example). Within Defence, the Joint Meteorological Group (JMG), part of the Royal Netherlands Air Force, has set up a very limited capacity to provide space weather information to Defence operations. Defence does not yet have its own sensors for observing solar activity, but uses information from a network of international partners. Investments in building space weather capabilities contribute to making our armed forces better informed. Also, as part of strengthening knowledge building, KNMI (which is responsible for space weather predictions for civilian purposes), the Netherlands Institute for Radio Astronomy (ASTRON) and knowledge institutes will conduct additional space weather research, using, among other things, the solar eruption warning system DISTURB.

Investment in the further development of a proprietary space weather service and warning capability contributes to improving the information and intelligence position for the benefit of the information-driven operations of the armed forces and reduces dependence on other strategic partners or commercial parties.

3.5 Satellite communications

The importance of fast and reliable network connections to modern society can hardly be underestimated. Satellite communication (SATCOM) is now a critical part of this global infrastructure. Modern warfare also depends on direct global links between sensors, weapons systems and command and control. This requires the broad deployment of commercial and military SATCOM technology within Defence. Geopolitical developments increase the need for timely and adequate military action around the world. One example is the war in Ukraine. Another example is the melting of ice caps at the North Pole; in the next decade, this will create important new shipping routes and allow for the extraction of resources in the Arctic. These new economic and political interests may also make the Arctic an area of operations for Defence.

Highly secure and robust Military SATCOM (MILSATCOM) is crucial for our armed forces' global information-driven operations. The 2022 Defence Paper therefore provides a budget for developing MilSATCOM as one of the key enablers for this. Moreover, the budget involved is separate from the budget for investments in the space domain, as described in the 2022 Defence White Paper (page 65, annex 3).

Developing and managing MILSATCOM capability requires huge investments. This is why the Ministry of Defence relies on international partnerships for MILSATCOM. The Netherlands is a partner in the US-led Advanced Extremely High Frequency (AEHF) programme. This gives Defence access to the most robust form of strategic satellite communication for both independent and coalition operations.[17] In addition, the Netherlands is a partner in the Wideband Global SATCOM (WGS) programme. With WGS, Defence has high-bandwidth global SATCOM for all operational domains. In the field of narrowband communications for the tactical domain, there has been a rapidly increasing structural shortage of satellite capability worldwide in recent years. This issue also requires intensive international coordination and cooperation. By investing proactively, the Netherlands will have tactical satellite capability over Europe from 2024.[18] As a result, we will be well-prepared to fulfil our

17 AEHF SATCOM communication is the only form of communication that can resist an electromagnetic pulse (EMP) and many forms of jamming and has a very high resistance to interception and detection.

18 The Netherlands has 3 UHF TacSat channels available on the EUTELSAT satellite.

international partner role in this domain, and to further build this capacity. Defence's SATCOM capabilities are supplemented by commercial contracts as required. With the huge growth in the commercial supply of high-quality SATCOM capability, it is becoming opportune to explore dual-use scenarios in collaboration with industry: deploying commercial SATCOM infrastructure for military applications. Through limited co-investment, Defence could have this commercial capability made suitable for military deployment, and also strengthen the business case for industry.

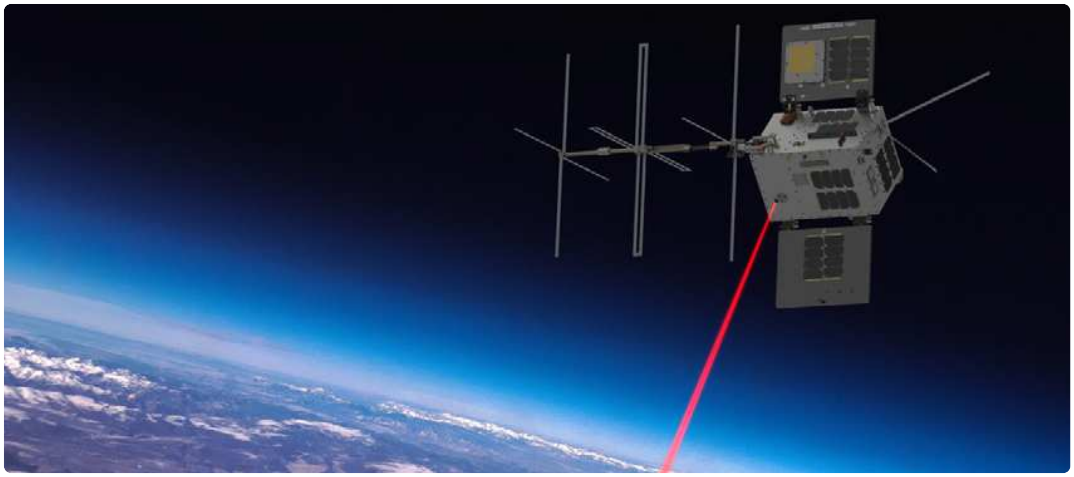
The war in Ukraine has structurally increased the demand in European countries for military satellite capabilities with sufficient resistance to attacks by state actors. The willingness in the EU to structurally increase defence budgets provides an opportunity to jointly develop military SATCOM capabilities through European cooperation, which includes the BENELUX. One example is acquiring capacity on the LUXGOVSAT1 satellite; a military satellite originating from the commercial company SES and the government of Luxembourg.

Today, the SATCOM domain is undergoing unprecedented development across the board. Technical developments in satellites, terminals and ground infrastructure are moving at lightning speed. New innovative launch capability providers, such as Space-X, are making satellite launches increasingly common. Today, we see huge investments in commercial low earth orbit (LEO) and medium earth orbit (MEO) constellations of satellites. Examples include OneWeb, Starlink and O3B. Because of the short distance between the satellite and Earth, these constellations provide connections that can compete with land-based fibre networks in terms of latency and bandwidth.

In addition, we have evidence that state actors are increasingly focusing on developing SATCOM-specific attacks. These attacks are also being developed across the spectrum: ranging from attacks in the electromagnetic domain (such as jamming, directed energy deposition and interception) to kinetic attacks and cyber-attacks on ground-based infrastructure, including management infrastructure. Technical, geopolitical and commercial developments in the SATCOM domain require a broad (re)orientation of Defence's need for more secure and robust high-capacity SATCOM links.

Because SATCOM is currently very much in flux due to new technological applications, because there is a need for safer, more robust and resilient SATCOM links; and because the development of a new satellite system takes about 8 years (and reaching full operational capability takes another few years) and the fact that Defence has to start preparing for the replacement of the SATCOM constellations currently in use, Defence is working on a roadmap (MIL)SATCOM for the period up to 2040. This roadmap provides direction with regard to the increasing demand for secure SATCOM capability and guides cooperation with the US in the replacement of SATCOM satellite constellations for AEHF and WGS.

Another important development is laser satellite communication technology. The need for a secure communication infrastructure is great. Large amounts of data coming from sensors on satellites, from unmanned and manned vessels and from vehicles and aircraft require ever-increasing bandwidth. There is also a strong interest in sharing this information securely. Demand for data transport and bandwidth for communications outstrips supply. Laser satellite communication offers the advantages of high bandwidth combined with a great deal of security. Moreover, this is a technology being developed in the Netherlands in which we have an edge over other countries. And laser satcom technology is seen as one of the priority technologies in the Defence Industry Strategy (2018). Defence is therefore working, in cooperation with the Ministry of Economic Affairs and Climate Policy, the Netherlands Space Office, research institutes and Dutch industry, to further develop laser-satellite communications for secure communication and increased transmission capability. Industry and knowledge institutes will be engaged to develop the required knowledge and capabilities.



Developing the future generation of MILSATCOM constellations is complex, costly and takes time. This requires coordinated research and cooperation - both with industry and international partners. Investing in a further build-up of a SATCOM capability will help ensure that Defence has greater bandwidth for future communication. To this end, Defence needs to implement new technologies such as laser communication. The (MIL)SATCOM Roadmap describes the long-term strategy to meet the increasing demand for secure SATCOM capabilities across the full spectrum and provides direction for cooperation with the US and within Europe.

3.6 Positioning, Navigation and Timing

To reduce EU member states' dependence on the US GPS, the European Commission and the European Space Agency (ESA) developed the Galileo satellite navigation system. This system provides Europe and the Netherlands with autonomous satellite navigation capability for civil and military applications. Current geopolitical developments have once again highlighted the importance of autonomous and secure satellite navigation, especially for military applications and national security. Galileo operates independently of GPS and offers the Public Regulated Service (PRS) as its functionality. Galileo PRS is Galileo's most secure and most advanced service, making it suitable for applications where robustness and continuity must be guaranteed.

Galileo and PRS were developed by the EU as a system for (in principle) civilian applications, and the management of the Galileo signal is therefore also in civilian hands. In 2007, the position of the Dutch government of the time was that Galileo was not intended for 'specific military use'. The Netherlands has always been cautious about so-called 'military use' of PRS. However, various geopolitical and strategic developments have meant that there is no longer a taboo on the military use of PRS[19]. France, for example, has placed the control and use of PRS entirely within Defence. The use of Galileo PRS for defence applications also contributes to Europe's strategic autonomy. In addition, the use of both PRS and GPS within Defence ensures redundancy and a robust satellite navigation capability. The EU will explicitly address the importance of space capabilities for defence applications, including Galileo PRS, in the yet-to-be-published EU Radio Navigation Plan 2023, and there is a strong commitment within the European Defence Fund to develop PNT technologies and equipment for military users. The Parliamentary letter on space policy sent by the Ministers of Economic Affairs and Climate Policy and Infrastructure and Water Management on 20 October also underscored the importance of Galileo for military applications and national security.

19 Such as the European PESCO project EU Radio Navigation Solution (EURAS), which aims to develop a military PNT capability within Europe using the knowledge and experience that already exists with Galileo PRS.

In the Mission 'Security in and from space', which stems from the Ministry of Economic Affairs and Climate Policy's Mission-driven Top Sectors and Innovation Policy, the Netherlands has set the ambition to have an operationally robust national PNT solution, capable of analysing and fusing navigation signals, by 2030 at the latest. On that basis, Defence accepted a NATO target under the NATO defence planning process to have such a system in place from 2030. Interdepartmental work is being carried out in this area as not only Defence, but also other ministries are dependent on PNT.

Developing robust PNT capabilities is vital from an operational point of view in order to be able to continue using our weapons systems, navigation systems, etc. in the future during the execution of tasks, operations and missions. Developments around the modernisation of the US GPS will be closely followed and Defence will actively contribute to the further development of the European Galileo-PRS system and a national PNT capability.

3.7 Shared Early Warning

The threat from ballistic missiles, anti-satellite weapons and recently hypersonic weapons has continued to grow in recent years. Countries such as Russia, China, Iran and North Korea are making steady progress in offensive missile system programmes. In addition, Russia and China are already well advanced in the development and deployment of hypersonic weapons. The overall chain of defence (disabling or destroying) against ballistic or hypersonic threats starts with the initial/early detection of the threat via space-based sensors: Shared Early Warning (SEW). These sensors play a crucial role in defence against ballistic missiles or hypersonic weapons, because they have the ability to detect a launch on the basis of the rocket engine's enormous heat signature and then track the object. Using data from the sensors, it is possible to track the trajectory and predict the target, allowing authorities to choose the most appropriate option. The Netherlands and Europe currently lack shared early warning capacity and rely on information from the US.

Recently, the European PESCO project Timely Warning and Interception with Space-based TheatER surveillance (TWISTER) was launched. Besides France (chair), Germany, Finland, Italy, the Netherlands and Spain participate in this project as members, and Belgium, Hungary and Sweden are observers. This project consists of two parts: the first part concerns the development of an interceptor against ballistic threats and the second part is the development of space-based sensors to detect and track launches. Defence uses the Golden Triangle principle with regard to TWISTER, and is looking to give Dutch industry and knowledge institutes a meaningful role in this project, especially as TWISTER, a PESCO project, is linked to the European Defence Fund (EDF).

By investing in developing European shared early warning capability, together with knowledge institutes and industry, the Netherlands is contributing to an important capability for Europe that strengthens our strategic autonomy.

3.8 Intelligence, Surveillance and Reconnaissance

Intelligence, Surveillance and Reconnaissance (ISR) is an integrated process in which intelligence and operations work together to synchronise (direct, collect, process, exploit and disseminate) collection capabilities in direct support of current and future operations. A satellite in space is one of the ways to provide ISR data to the armed forces, a major advantage being that satellites do not violate a country's sovereignty and can therefore gather information at all times. Defence does not have its own space-based ISR capabilities and relies on third parties for information. For example, Earth observation information can come from Sentinel satellites from the EU Copernicus constellation and is provided by the EU Satellite Centre. In addition, there are specific bilateral agreements with some partner countries and commercial parties provide footage. With the current emergence of large commercial satellite constellations, the Earth is being imaged with increasing accuracy and frequency. Also, the number of types of sensors (electro-optical/ infrared, synthetic aperture radar, multi-spectral) is increasing and major developments are taking

place in data analysis tools, especially in filtering operationally relevant information from the big data stream from all of these sensors. The degree of integration of these space-based (ISR) information sources and the resulting operational information can be decisive in achieving information dominance and in the information-driven operations of the armed forces. There are opportunities in the field of ISR for developing capabilities in this area, including better/different analysis and fusion of available commercial data and the development of a proprietary space-based ISR capability. The MIVD and operational commands are major consumers of information derived from such ISR capabilities.

Commercial high-resolution satellite data is increasingly available. The advantage of acquiring commercial data is that it is relatively cheap and easy to obtain. Linking up with a constellation of multiple satellites will ensure that Defence can have detailed and timely imagery of many places around the world for the purpose of planning processes. This information is essential to increase situational awareness for a (potential) mission area. But this option also has drawbacks. The use of commercial satellites places special requirements on operational security. It must be possible to order and disseminate this information confidentially (so that our area of interest is not made public) and the whole chain must be resilient to cyber threats. To mitigate these drawbacks, developing a proprietary space-based ISR capability offers a solution. It is also the solution for specific satellite data not available commercially or from partners. The miniaturisation of satellites and decreasing launch costs bring the possibility of putting national capabilities into space financially within reach, possibly in cooperation with other countries and programmes. From a research and development perspective, investments are already currently being made in experimental capabilities such as our own BRIK-II and the Dutch-Norwegian research programme MilSpace2. The goal is that these capabilities will evolve from research and development to an operational capability in the coming years. Here, the aim is to develop a constellation of small satellites that can provide military-relevant ISR information that is currently unavailable or limited. Using our own capabilities can increase the frequency of observation and communication capabilities and enhance situational awareness in order to reach situational understanding. Furthermore, the deployment of our own capabilities will prevent the Netherlands from being influenced to take actions on the basis of potentially incomplete, redacted or incorrect information from third parties. Opportunities offered by Dutch industry and knowledge institutes could be explored in the development of this capability, for example for the development of secure laser communication in networks of satellites and to ground stations.

Investing in the further development of our own ISR capabilities in niche areas contributes to improving the information and intelligence position for the benefit of the information-driven operations of our armed forces. At the same time, it reduces dependence on other strategic partners or commercial parties and allows ISR capabilities to be shared with NATO, EU and partners.

3.9 Intensification of research and technology development for the space domain

The Defence White Paper states that in the future, Defence must have a technologically advanced and operationally relevant armed forces. Defending against the new threats requires investment in building research and technology development (R&T) for the benefit of the space domain. With investments in the field of R&T, Defence will also be able to face new threats in the future and the armed forces will remain operationally relevant, including in the space domain. Investing in knowledge building and technology development enables participation in national and international development programmes and secures the knowledge gained. Nationally, this involves cooperation with knowledge institutes (NLR and TNO) and industry, and internationally with research and capacity development programmes (including cooperation programmes within EU PESCO, EDF and Responsive Space Capabilities). An example is the previously mentioned further development of SMART-L Multi-Mission radar systems to obtain an SSA capability. This can make an important

contribution to ongoing EU initiatives, such as the PESCO EU Military Space Situational Awareness Network (EU SSA-N) and the EU Space Surveillance and Tracking (EU SST) Partnership. In an international context, the Netherlands has to rely on knowledge contribution, particularly specific niche knowledge, in order to be considered a reliable and equal partner. For instance, the Netherlands has long-standing bilateral cooperation with Norway in the MilSpace programme. Continuation of this cooperation is crucial and will be secured for the coming years.

Further strengthening knowledge building, technology development and innovation for the benefit of the space domain will allow us to continue to participate in national and international development programmes, maintain high-quality knowledge institutes and industry (in line with the Defence Industry Strategy), and contribute to a certain degree of strategic autonomy at the national level.

4. In summary

4.1 In summary

Our armed forces have become heavily dependent on space for their deployment in information-driven operations. Capabilities in communication, observation, PNT, ISR etc. have become indispensable. At the same time, threats in and from space have increased. The stakes of using space for Defence are high and will continue to grow in the coming years. The establishment of space as a separate operational domain for all Defence elements is a vital part of the realisation of the goals set in the 2022 Defence White Paper. With the aforementioned capabilities, we will be less dependent on others in the future, we will have good and clear awareness of what is happening above us in space, we will have satellites and sensors that can give us information at the time and geographical location we desire, we will be able to communicate securely and transmit a multitude of data, and we will have independent and robust navigation systems. We will offer these capabilities to NATO and the EU as a contribution to the promotion and defence of their security interests.

This will require investment over the coming years. For the period 2023 to 2027, the investment is in the €25 to €100 million range.[20] By allocating resources to the space domain in the coming years, we will strengthen capability, first in the Defence Space Security Centre in terms of personnel and then further in the Defence organisation, we will develop satellites and niche capabilities in the field of SSA (with the further development of the SMART-L Multi-Mission radar systems), space weather, shared early warning, ISR, PNT and laser satcom, and we will invest in intensifying research and technology development for the benefit of the space domain. A major point for consideration here is to avoid duplication and overlap, both nationally and internationally.

Further intensifying knowledge building, technology development and capacity building will be done nationally in close cooperation with our high-quality knowledge institutes TNO and NLR, as well as with industry. Defence will then continue to have high-quality capabilities in the long term and, in line with the Defence Industry Strategy, we will create a level playing field at European level for the Dutch space industry and knowledge institutes. Furthermore, by investing in the space domain, Defence is contributing to the long-term earning capacity of the Dutch defence sector. Defence is putting more emphasis on cooperation within the EU (the PESCO programmes EU-SSA-N and TWISTER; the European Defence Fund and the European Defence Agency) for international development of military capabilities in the space domain. Naturally, we will also continue and intensify our cooperation in the NATO context and with our strategic partners. For example, we are intensifying our cooperation with Belgium in the field of space weather, we will post a liaison at the German Space Situational Awareness Centre, we will continue our cooperation with Norway in a follow-up MilSpace programme, we will continue and intensify our cooperation with the US (including RSC, SSA and AFRL) and we are starting cooperation with France and the UK. Developing these capabilities nationally and internationally for the space domain promotes the Netherlands' strategic autonomy. Defence will then collectively develop an integral space policy and an integral long-term space agenda with the other ministries involved in the space domain and the Netherlands Space Office, to be completed by 2023.

20 The amount set aside for the investments required for the space domain is separate from already ongoing SATCOM investments realised through the Defence Materiel Organisation (DMO).

Abbreviations

AEHF ------- Advanced Extreme High Frequency
AIV --------- Advisory Council on International Affairs
ASAT ------- Anti-Satellite
COPUOS --- Committee on the Peaceful Uses of Outer Space
DIS --------- Defence Industry Strategy
DSSC ------- Defence Space Security Centre
EDA -------- European Defence Agency
EDF -------- European Defence Fund
EDT -------- Emerging Disruptive Technologies
ESTEC ------ European Space Research and Technology Center
EU ---------- European Union
EGNOS ----- European Geostationary Navigation Overlay Service
EURAS ----- EU Radio Navigation Solution
ESA -------- European Space Agency
GPS -------- Global Positioning System
ISR --------- Intelligence, Surveillance and Reconnaissance
JMG -------- Joint Meteorological Group
KIA Security Knowledge and Innovation Agenda Security
KNMI ------ Royal Netherlands Meteorological Institute
METOC ----- Meteorology and oceanography
MoU ------- Memorandum of Understanding
NATO ------ North Atlantic Treaty Organization
NDDP ------ NATO Defence Planning Process
NIDV ------- Dutch Industry for Defence and Security
NLR -------- Netherlands Aerospace Centre
NSO -------- Netherlands Space Office
PAROS ----- Prevention of an Arms Race in Outer Space
PESCO ----- Permanent Structured Cooperation
PNT -------- Position, Navigation and Timing
PRS -------- Public Regulated Service
RSC -------- Responsive Space Capabilities
SATCOM --- Satellite Communication
SCP -------- Secure Connectivity Programme
SEW -------- Shared Early Warning
SSA -------- Space Situational Awareness
SST --------- Space Surveillance and Tracking
STM -------- Space Traffic Management
TNO ------- Netherlands Organisation for Applied Scientific Research
UK --------- United Kingdom
US ---------- United States
WGS ------- Wideband Global SATCOM

References

- 2022 Defence White Paper, A Stronger Netherlands, A Safer Europe. Investing in a robust NATO and EU, June 2022 (Reference 36 124, no. 1)
- Strategische Kennis- en Innovatieagenda [Strategic Knowledge and Innovation Agenda], November 2020 (Reference 35 570-X, no 32)
- Kennis- en Innovatieagenda Veiligheid, Missie: Veiligheid in en vanuit de ruimte [Security, Knowledge and Innovation Agenda, Mission: Security in and from Space], October 2019 (Reference 33 009, no 81)
- Nota Ruimtevaart 2019 [2019 Space Policy Paper], June 2019 (Reference 24 446, no 64)
- Parliamentary letter on introduction of space security policy, March 2021 (Reference 24 446, no. 74)
- Nota voortgang ruimtevaartbeleid [Space policy progress note], July 2022 (Reference 24 446, no. 77)
- Nota Ruimtevaartbeleid 2022 [2022 Space Policy Paper], October 2022 (Reference 24 446, no 78)
- Uitvoeringsagenda innovatie en onderzoek [Innovation and research implementation agenda], November 2022 (Reference 31 125, no 122)

List of sources for the illustrations

The illustrations or photos below were taken from external sources:

p. 1 KNMI/Eumetsat
p. 3 European Parliament and EU Institute for Security Studies, 2020
p. 6 ESA – European Space Agency
p. 14 Bas Stijnen, Ministry of Defence (De Vliegende Hollander 01, 2017)
p. 15 Arjen de Boer, Ministry of Defence (De Vliegende Hollander 10, 2014)
p. 17 Courtesy of UTAS/SFL & TNO