Space-Based Strike Weapons

Indicator Description

This indicator assesses trends and developments related to the research, development, testing, and deployment of space-based strike weapons (SBSW). SBSW are s*ystem operating from Earth orbit with the capability to damage or destroy either terrestrial targets or terrestrially launched objects* passing through space such as ballistic missiles.

Key Trends

TREND 8.1.: While no space-based strike weapons (SBSW) have yet been tested or deployed in space, the US continues to develop a space-based interceptor for its missile defense system – Although the US and USSR developed and tested ground-based and airborne ASAT systems between the 1960s and 1990s, there has not yet been any deployment of space-to-Earth or space-to-missile SBSW systems. Under the Strategic Defense Initiative in the 1980s, the US invested several billion dollars in the development of a space-based interceptor (SBI) concept called Brilliant Pebbles, and tested targeting and propulsion components for such a system. The US and USSR were both developing directed energy SBSW systems in the 1980s, although today these programs have largely been halted.

TREND 8.2.: A growing number of actors are developing SBSW precursor technologies outside of SBSW programs – The majority of SBSW prerequisite technologies are dual-use. They are not related to dedicated SBSW programs, but are sought through other civil, commercial, or military space programs. While there is no evidence to suggest that states pursuing these enabling technologies intend to use them for SBSW systems, their development does bring these actors technologically closer to such a capability.

Both the number of such technologies being pursued in non-SBSW programs and the number of actors doing so are increasing. For example, China, India, and Israel are developing precision attitude control and large deployable optics for civil space telescope missions – a precursor technology to some SBSW. Thirty-two states have developed or are involved in developing independent high-precision satellite navigation capabilities. In the last 12 years, nine states have deployed a first small or microsatellite — a key SBI precursor technology. China and the EU are developing re-entry technologies which are also required for the delivery of mass-to-target weapons from space to Earth.

2006 Developments

TREND 8.1.: While no space-based strike weapons have yet been tested or deployed in space, the US continues to develop a space-based interceptor for its missile defense system

2006: Advances in US SBI programs but funding for tests temporarily blocked

The US Missile Defense Agency (MDA) has created a new Space Applications Center of Excellence which "leads a multi-agency, DoD, and industry team in developing, testing, and deploying space systems for the Missile Defense Agency."[1] Its major programs include the Space Tracking and Surveillance System, Near Field Infrared Experiment (NFIRE), the Missile Defense Space Experimentation Center, and MDA space technology development including an eventual space-based test-beds.[2] In the FY 2007 Defense Budget Request released in March 2006, MDA requested funding a new series of experiments under a project called Micro Sat – in a joint pot with NFIRE for a total of $207 million (although no more specific budget or schedule information is provided) that are possibly pre-cursor programs to the Space Test Bed. The three experiments based on maneuverable microsatellites will involve: 1) distributed sensing by two or three microsatellites; 2) a propulsion experiment believed to be the classified Microsatellite Propulsion Experiment (MPX) designed to test space-based interception technologies; and 3) a Target Risk-Reduction Experiment using a microsatellite as a target for ballistic missile interceptors. The latter experiment could be a de-facto anti-satellite (ASAT) test.[3]

The missile defense interceptor, or "kill vehicle" originally planned for the 2007 NFIRE test has been replaced by a German laser communications terminal.[4] The main purpose of the NFIRE satellite, scheduled for launch in the spring of 2007, is to distinguish between a missile body and its exhaust plume. This means that the sensors are those of a final homing stage nature, not sensors for missile tracking from afar, thus they are designed for testing of space-based missile defense interceptors and not space-based tracking sensors for ground based missiles. Revival of the kill vehicle is listed as justification for a second NFIRE mission in the FY 2007 budget request "in response to congressional encouragement in the FY 06 Defense Appropriations bill to complete development of the Kill Vehicle."[5] MDA requested $10.8 million for overall NFIRE spending in FY 2007.[6] It is understood that a fly-by missile test will still be conducted during the mission to verify the capability of the sensors.

In the FY 2007 budget request the US Missile Defense Agency (MDA) requested $45-million to begin in FY 2008 to develop a space-based ballistic missile interceptors that would attack ballistic missiles in boost phase.[7] However, in May 2006 the Subcommittee on Strategic Forces banned the Pentagon from using certain funds for the development of anti-satellite capabilities and space-based interceptors due to concerns that enemy assets could be targeted and that such targeting would arouse international response.[8] The Pentagon must submit to Congress a detailed report on the project before funding can proceed, providing, *inter alia*, the following information: 1) a description of the system's essential components, and of its interaction with other missile defense systems; 2) acquisition and life-cycle cost estimates; 3) an analysis of its vulnerability to counter-measures such as other interceptors and nuclear detonations in space; and 4) an analysis of implication on foreign policy and national security, as well as probable responses from other countries.[9]

Technical capabilities for space-based interceptors advanced in 2006, however, with the successful demonstration of a prototype rocket for MDA's Multiple Kill Vehicle (MKV) Payload system.[10] The MKV has previously been mentioned as being the preferred space-based interceptor for an integrated missile defense system.[11] It was tested on the Ground-based Midcourse Defence (GMD) interceptor on 1 September 2006 when the GMD successfully intercepted a missile launched from Alaska.[12]

Net assessment:
The ongoing absence of space-based strike weapons testing or deployment continued to bode well for space security in 2006. The plan to test a kill vehicle on an NFIRE follow-up mission, however, may demonstrate advanced SBSW capabilities. Restraint exercised by US policy makers with regards to testing of such capabilities are positive and indicate concern for space security and the challenge of balancing terrestrial missile defense requirements with the need to maintain freedom from space-based threats. However, recent developments in direct energy interceptor technology may lead to the de-facto presence of strike weapons in space in the near future, endangering security from space-based threats.

TREND 8.2.: A growing number of countries developing an increasing number of SBSW precursor technologies, which could be used for SBSW systems

2006: Upgrades in US and Russian global missile tracking and warning
Missile tracking and warning capabilities are key components for some SBSW systems. A number of countries are working towards establishing or improving these capabilities, primarily in the context of missile defence. USAF's missile early warning Space Based Infrared System (SBIRS) project underwent significant technological advances in 2006 (see Space Support for Terrestrial Military Operations). The new system will provide significant improvements to the current Defense Support Program (DSP), such as allowing it to scan a specific area for infrared activity while simultaneously staring at another.[13] The first HEO payload was launched in 2006 to detect northern polar region missile launches and is reportedly working successfully.[14] Nonetheless the project is behind schedule and continues to face cost overruns,[15] which prompted the Air Force to obtained congressional approval to begin work on a new missile warning satellite to follow the endangered SBIRS program. Work began in 2006 on an Alternative Infra-Red Satellite System (AIRSS), which would also use high-resolution infrared sensors to detect missile interceptor sites and missile launches, but would be simpler and cheaper to build than the SBIRS. The USAF hopes to test these new sensors some time after 2008 and to have them operational by 2015.[16] In addition, Two Space Tracking and Surveillance System (STSS) satellites were delivered to prime contractor Northrop Grumman in 2006. The satellites are expected to launch in late 2007, in the context of a missile tracking experiment (see Space Environment and Space Protection).[17] The STSS, formerly known as SBIRS-Low, is designed to track missiles through space, differentiate missile warheads from decoys and debris, and provide targeting data for a missile defense interceptor.[18] In 2006 Northrop Grumman received a $126.2-million contract modification to extend the STSS program timetable and perform additional testing requested by the government.[19] Two STSS satellites are expected to be launched into orbit aboard a single Delta-II rocket in late 2007.[20]

Russia announced plans in 2006 to restore the space-based component of its missile attack warning system (MAWS), and has recently increased MAWS funding, however no further details are currently available.[21] In December 2006 Russia's new early warning radar near St. Petersburg became operational and was put on combat duty, closing a coverage gap that had existed for seven years.[22] Russian analysts claim that its capabilities substantially exceed those of the US and other Western states.[23] Russia also has plans to build a new early warning missile defense base in the south of the country to reduce its dependence on radar systems in former Soviet states such as Azerbaijan and Ukraine.[24]

2006: France, Germany and China continue to develop missile tracking and warning systems

Breaking the trend of US and Russian dominance in missile early warning capabilities, France, Germany and China are moving forward with construction of such systems. In France an experimental ballistic missile warning constellation named Spirale is under development[25] with two satellites scheduled for launch in 2007 or 2008 to HEO. Both China and Germany launched new Synthetic Aperture Radar satellites in 2006 (see Space Support for Terrestrial Military Operations). The Chinese JianBin 5 and the German SAR-Lupe satellites provide high resolution, all weather, day and night imaging capabilities of the Earth's surface.[26] US Space Based Radar (SBR) provides Surface Moving Target Indication (SMTI): it can locate, monitor and track ballistic missile locations and mobile systems for missile defense.[27] The German SAR-Lupe will share information with other European space partners, but it is not currently clear whether or not French and German capabilities will lead to a European-wide ballistic missile defense system.

In 2006 Chinese researchers continued to work on target tracking technologies that may be used as key components for an advanced tracking system. Present basic research revolves around obtaining greater tracking precision and real-time accuracy. [28]

2006: India demonstrates key SBSW precursor technology capabilities

A 2006 test of India's new anti-missile system, known as the Atmospheric Intercept System (AXO), demonstrated several key precursor technologies for SBSW. Indian scientists claim that the "missile had its own mobile launcher, secure data link for interception, independent tracking and homing capability and its own radar" as well as high manoeuvrability.[29] In addition, India sought Israeli help to complete its Defence Research and Development Organisation's (DRDO) surveillance project, designed to provide early missile warning. The project was to become operational in 2006 but costs are overrun and it is far behind schedule.[30] A revised timeline for operations has not been released. India also planned to test its new reusable launch vehicle in January 2007. The re-entry technology developed for the vehicle will be tested upon the vehicle's return to Earth approximately 12 to 90 days after launch.[31] The vehicle is an important precursor to the planned human space program announced by India in 2006 (see Civil Space Programs and Global Utilities).

2006: The US, Europe, China, Russia, and India continue research and development of global positioning systems

A number of countries continued to develop, upgrade, or acquire access to global positioning systems in 2006 (see Civil Space Programs and Global Utilities). Global positioning capabilities are required for all SBSW concepts. In 2006, the US continued its program of modernizing its GPS.[32] Russia made plans to cooperate with China and India on GLONASS.[33] Russia is still working on improving its GLONASS system, and currently has 17 satellites in orbit, 15 of which are emitting signals. An 18th satellite was scheduled for launch in December 2006. While India will cooperate with Russia on GLONASS, it is also developing a separate GAGAN civilian satellite navigation system, which passed preliminary ground test in 2006.[34] China continued work on its independent navigation system, the Beidou satellite series, which is to be used specifically for military purposes.[35] The first signals from European Space Agency's satellite navigation system, Galileo, were received in January 2006.[36]

2006: More resources for US Global Strike Program?

The US Bush Administration announced plans to spend $2-billion in 2007[37] on the promo global strike program to develop a global strike weapon system with rapid response to time-sensitive targets. Such a system will develop many technologies necessary for a space-based global strike system. Though the project has been criticized as lacking purposeful applications, the Pentagon is pursuing a two-year cost and feasibility analysis of various ideas offered by its main contractors, such as Boeing and Lockheed Martin. The project envisions among other things a military space plane type bomber, which would require advanced SBSW technology capabilities such as precision manoeuvrability and launch on demand abilities.[38] "Supersonic aircraft, missile, satellite and even other vehicles are on the table;" the total project over two decades is estimated at $493.3-billion.[39] However, Congress cut funding for part of the program, outfitting submarine-launched ballistic missiles with conventional weapons rather than nuclear warheads, to $30-million from the requested $127-million.[40]

As part of the prompt global strike program, the first vehicle of the US Defense Advanced Research Projects (DARPA) Falcon hypersonic test vehicle was abandoned in 2006 following technical difficulties. Instead, plans have shifted to build a more easily produced design as part of a series of "rocket-boosted, gliding test vehicles with increasing hypersonic lift-to-drag ratio and flight duration."[41]

2006: EU makes progress on re-entry technology in the US and Europe

While India made plans to test its re-usable launch vehicle in 2007, other countries made progress on reusable vehicles in 2006. A number of experimental re-entry vehicles have been studied in recent years by France, Germany, Italy and the European Space Agency (ESA), which have culminated with the development of the Intermediate eXperimental Vehicle (IXV) by 2010.[42] The project, first announced in 2005, is a partnership between the ESA, the Agenzia Spaziale Italiana (ASI), and the Cenre National d'Etudes spaciales (CNES), the German Aerospace Centre (DLR). In 2006 contractors worked on Phase-B1, the preliminary design definition, with a system requirements review planned for mid-2007. The primary goals of the project are "reentry system demonstration, technology experimentation and technology validation."[43]

2006: Advances in global launch on demand

In 2006 research and tests progressed on hypersonic aircraft in Australia and the US (see Space Systems Protection), which have the potential to offer cheap and rapid access to space. The Australian Hyshot project underwent three successful tests with international partners in Japan and Britain, as well as the Australian Defense Science and technology Organization (DSTO).[44] The US Air Force Research Lab and the Australian (DSTO) also sined an agreement to collaborate on hypersonic technology development project called HiFIRE.[45]

Kazakhstan's Kazcomos is developing a rapid air launch capability with Russia named Ishim, which is based on a Soviet era ASAT system (see Space Systems Protection).[46]

2006: Significant advances in air-based laser technology

Significant advances in laser technology were made in 2006. Weapons using laser technology are rapidly becoming even cheaper and more powerful. The laser industry passed many key milestones in 2006, several of which were specifically related to airborne technology.[47]

The Airborne Laser (ABL) made a surprising come-back late in 2006 after reports earlier in the year of technical problems related to its weight, beam strength and optics that raised questions about the future of the project.[48] Increasing costs and delays also jeopardized the future of the project. The ABL is a high-powered chemical laser mounted on a modified Boeing 747 jet aircraft to be used as a direct energy interceptor for ballistic missiles. It uses related technology to any Space Based Laser concepts. Infrared sensors onboard the craft detect missiles launches, prompting the laser to destroy the missile upon its assent. Successful ground tests carried out by Lockheed Martin and Boeing this year were successful have sustained the project. Boeing is now preparing for installation of the ABL on the aircraft in 2007, and a demonstration of its ability to shoot down missiles in their boost phase will take place in 2008, more than six years after the initially planned delivery date.[49]

Boeing Missile Defense Systems is also developing a less powerful solid-state laser called the "Advanced Tactical Laser" (ATL), which is intended to be fired at ground targets from the air with high precision. Reports indicate that the technology development is outpacing the Pentagon's plans to use it. US decision makers attempted to slow this process down by cutting the allocated budget in 2006 by $12 million. Nonetheless, Boeing successfully tested a lower power version of the ATC during flight tests conducted last fall, and is preparing for full power demonstrations in 2007.[50]

Finally, Northrop Grumman announced that it has successfully developed and tested the highest power, brightest laser ever created, the Strategic Illuminator Laser (SILL), for technical performance. The SILL is a solid-state laser designed for air and space applications, to withstand temperatures ranging from -50 to +50 degrees Celsius.[51] Solid State laser technology is seen many as the technology that will enable the ABL.

Net Assessment

Space-based weapons designed to strike terrestrial targets will require sophisticated technological developments that, at present, few space-faring states seem able to exploit. The development of dual-use capabilities which also provide enabling technologies for SBSW systems continued in 2006 although there was no evidence that states were developing such capabilities for SBSW purposes. Research and development into re-entry technologies as well as missile tracking could eventually facilitate the development of orbital bombardment systems and SBI. While the integration of such technologies into an SBSW capability could be very difficult and take many years, their development does bring states closer to an SBSW capability, should a future decision be made to pursue it.

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