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The Long-range Weapon Threat

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Long-range weapons for use against targets on the ground, in the air or at sea have been gaining a great deal of attention on the world stage, most notably the Russian and US cruise missile strikes against targets in Syria, the North Korean missile tests and the deployment of US missile defence to South Korea. Long-range weapons have the potential to radically alter national security, but their impact has to some extent been exaggerated. There is a tendency to assess long-range weapons just by looking at their nominal range from a geographical point of view, but this is not always a valid assessment of their effectiveness – especially against moving or mobile targets. Security and defence policy has to be founded on realistic assessments of threats and capabilities. Accurate threat analyses based on technical facts are therefore of vital importance.

Long-range weapons can provide both tactical and strategic advantages in a conflict. They allow a threat to be projected while out of range of an opponent's weapons. In addition, the opponent will need to implement various tactical and technical means of protection. The term long-range weapon often refers to missiles. Missiles can be launched from the ground, the air or the sea against fixed or mobile targets. Missiles are classified according to their construction, their launch platform and their intended targets. Cruise missiles and ballistic missiles are used against targets on the ground. Ballistic missiles are propelled at high speeds and high altitudes, from where they fall towards the target in a ballistic trajectory. Ballistic missiles have traditionally been designed for far away targets on the ground, often on other continents. A cruise missile flies much slower than a ballistic missile and often at low altitudes. A cruise missile is propelled by an engine throughout its flight and navigates to reach its target.

Anti-ship missiles and surface-to-air missiles (SAMs) are examples of missiles for use against moving targets. To be able to hit a moving target, the missile needs a seeker, some sort of sensor that can be used to steer the missile to the target. Anti-ship missiles are basically cruise missiles fitted with a seeker that can detect ships. Surface-to-air missiles are launched from the ground or from vessels against aerial targets such as aircraft or missiles.

In the past decade, long-range missiles have become increasingly common in the Swedish neighbourhood. Russia has deployed the *Iskander* surface-to-surface missile and the *S-400* surface-to-air missile in the Baltic Sea region. In addition, the *Kalibr* cruise missile has been deployed on ships in the Baltic Sea. Finland and Poland recently acquired long-range weapons in the form of the stealthy cruise missile *JASSM*, while Germany has had the *Taurus KEPD 350* cruise missile for more than a decade. Sweden is currently upgrading its anti-ship missile inventory.

There is also intense activity in other parts of the world. Both Russia and the United States have used cruise missiles against targets in Syria while in North Korea there has been a steady stream of more or less successful launches of increasingly advanced ballistic missiles.

Realistic threats against moving targets

There are fundamental differences in the threat long-range missiles pose to fixed and moving targets. A moving target that follows a dynamic trajectory must be continuously tracked. Mobility therefore constitutes a form of protection and the target enjoys an advantage. For stationary targets, however, modern technology has shifted the balance in favour of the attacking cruise or ballistic missiles.

One long-range weapon that has attracted considerable attention in Sweden is Russia's S-400 SAM system. Its nominal range of 400 km means that the S-400 could theoretically reach Swedish territory. However, the actual range of a SAM is limited by a number of factors. An obvious factor is the curvature of the earth. Figure 11.1 shows that at a distance of 400 km, an aircraft needs to be at an altitude of 12 000 metres to be visible from the ground. Conversely, an

observer needs to be at an altitude of 12 000 meters to be able to detect an object on the ground from this distance.

Another limiting factor is the flight time of the SAM. It takes about ten minutes for a SAM to travel 400 km, which is enough time for a fighter aircraft to fly more than 100 km in any direction. Consequently, a long-range SAM would need to receive real-time updates of the target's position and velocity in order to adjust its trajectory. This would require airborne or surface-based sensors to track the target and transmit data to the missile via a data link. All of this requires line of sight between the target and the sensors, as well as between the data-link transmitters and the missile. Terrain masking poses an obvious challenge for detecting and tracking targets at low altitude. Furthermore, the missile has a limited supply of velocity, which would be quickly drained as the target manoeuvres.

All of this means that while a long-range SAM system such as the S-400 would certainly be a threat at a very long range to an airliner cruising at 36 000 feet, the actual effective range against a fighter at low altitude could well be under 20 km, depending on the terrain.

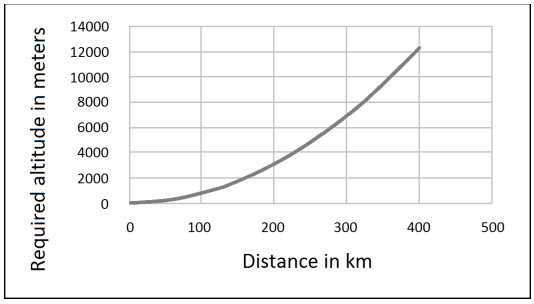

Figure 1. Required altitude for visibility of objects at a distance.

Hence, long-range SAMs constitute only a limited and to some extent manageable threat to fighter aircraft. For a SAM system to reach its full potential, it needs to be an integrated part of a network of sensors, command and control functions, and weapons. To be effective at long range, airborne sensors are required. Thus, the threat posed by a long-range SAM system in Kaliningrad or on Gotland, for example, cannot be described as a circle on the map with the nominal range as the radius. An aircraft taking off from an airbase in Sweden could not be shot down by SAMs based on the other side of the Baltic shortly after it left the runway.

Attacking moving targets at long range requires a chain of sensors, command and control, weapon platforms and weapons that is both accurate and fast. The United States is probably the only country that currently has the capacity to use long-range weapons against mobile ground targets or time-critical targets.

Severe threat to stationary objects

Because the target's position is known in advance, long-range attacks can be made against stationary targets without any sophisticated system of sensors. Consequently, cruise missiles and ballistic missiles are highly realistic threats to stationary objects and need to be taken into account by Swedish defence planning.

As long as the position of a target has been identified with a high degree of accuracy prior to the attack, a cruise missile or ballistic missile strike can be made with a high level of precision. Fixed targets such as buildings, runways or parts of the power grid can be targeted well in advance, based on satellite imagery.

The ballistic missiles that pose a potential threat to Sweden are primarily those based in Russia. The *Iskander* has a range that most sources put at 400–500 km, which means that it could reach parts of Sweden. Furthermore, the *Iskander* has a short flight of less than 10 minutes from the other side of the Baltic – and a high level of precision. The *Iskander* cannot be used against moving targets, but its short flight time means that it could be used against targets of a temporary nature such as command and control sites or forward arming and refuelling sites.

Trends

The development of high-tech long-range weapons is likely to continue at pace. Developments in guidance and navigation coupled with a general proliferation of technology will make long-range cruise missiles increasingly available and affordable. Cruise missiles, which used to be the trademark of a superpower, are about to become available to many countries or even non-state actors, and possibly also to individual terrorists.

There is a trend among the advanced countries for cooperative engagement based on networking sensors, command and control functions, weapon platforms and

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weapons. Such cooperation aims to quickly establish situational awareness when carrying out a mission. The purpose is to provide missiles with real-time target data to enable the target to be hit in a coordinated salvo. For long-range cooperative engagement to work, high-performance sensors and secure datalinks are of paramount importance. The United States is leading in the development of cooperative engagement, especially for strikes against ground targets.

High-speed missiles are another trend. High-speed in this context means speeds in excess of 3000 km/h. This reduces a missile's flight time, which gives the intended target less time to react by manoeuvring, deploying countermeasures or returning fire. High speeds are also important to reduce a missile's vulnerability to air defences, for example when an anti-ship missile is attacking a combat ship. The Russian-Indian *BRAHMOS* anti-ship missile can reach speeds of about 3000 km/h and the *BRAHMOS II* is being designed to reach 5000 km/h.

Countermeasures against long-range missiles

During the Cold War, the main threats to fixed objects were enemy bomber aircraft and sabotage by special forces. The identity and location of many installations could be concealed using physical perimeters, camouflage and the control of information. Enemy bombers would have to get close to their targets, which would expose them to air defences. Today, however, the ability to conceal the location of installations is much more limited. High-resolution satellite or aerial imagery is currently available even to actors that lack their own reconnaissance systems.

Ground-based air defences can be effective against both cruise missiles and ballistic missiles. However, there is a striking imbalance in the fact that many defensive SAMs are more expensive than the offensive cruise missiles they are defending against. Furthermore, the defended area is small, as cruise missiles can exploit the terrain to avoid detection and the high velocity of ballistic missiles limits the effective range of SAMs. In reality, this means that the area that can be protected by an advanced ground-based air defence system with a nominal long range corresponds to a single airbase or a medium-sized city. Advanced sensors, in particular air-borne sensors, integrated with the SAM system can significantly increase the area that can be protected, but such sensor systems come at a high cost.

Thus, technology has given an advantage to the attacking side, at least for stationary ground-based targets, and there is an imbalance between threats and protective measures. An illustration of this is Israel's recent launch of two Patriot missiles, which cost around US$ 3 million each, to shoot down a drone over Syria. If inexpensive drones and cruise missiles proliferate to an increasing number of actors, including non-state actors, the cost of using advanced air defence systems as protection will become unattainable.

One way to defend against long-range weapons is to strike first to prevent their launch. This requires your own long-range weapons and very good intelligence about the location of enemy assets, especially if the enemy is using mobile launchers. A method that works against the cheaper weapons employed by non-state actors is to jam satellite navigation systems in the vicinity of the target. In addition, traditional methods of protection such as underground fortifications, decoys and camouflage remain highly relevant.

Moving or mobile targets still represent a challenge for long-range weapons. Attacking a moving target requires a fully functioning chain of sensors to provide target data, command and control functions and the right weapons, all of which can be vulnerable to both weapons and electronic warfare.

Correct technical analysis is essential for the right type of protection

Long-range weapons are very powerful and play an increasingly important role in battle. Technological developments have given long-range missiles, including ballistic missiles, a high degree of accuracy. However, against moving targets the difference between the nominal effect of a long-range weapon and its actual effect is highly significant.

Protective measures and countermeasures will differ for stationary and moving targets. As most types of countermeasure and protection are extremely expensive, it is of paramount importance to analyse the threat against each type of target and to find the most appropriate way to protect against them. Taking measures to protect against a threat that has been overestimated can be just as costly as underestimating a threat and neglecting to take countermeasures.

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