*Australia's Contribution to Alliance Strategy for the Western Pacific, 2025-2030**

Missile Defence and Operations in the Western Pacific

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Missile defence and operations in the western Pacific

Advanced missiles of different types will be a certain feature of any future major conflict in the western Pacific (see also Issue Brief 9). The importance of missiles to modern combat has been demonstrated again most recently in Ukraine. Types of missiles in operation include short-range anti-tank weapons, through guided rocket artillery, to ballistic and cruise missiles for attacking land targets or surface ships launched from land, sea or air, ballistic missile-launched hypersonic glide vehicles, which are manoeuvrable vehicles that travel at Mach 5+ and generally have much lower flight paths than ballistic missiles, multiple classes of anti-aircraft missiles from man-portable, to ground or sea-launched, to air-to-air, and anti-missile systems.

For missile defences, it is the tactically offensive land-attack and anti-surface ship varieties which are the focus. Although the majority of weapons most commonly targeted by missile defences are conventionally armed, there is no in-principle technical difference for defensive capabilities whether the target missiles are conventionally armed or armed with nuclear or other types of weapons of mass destruction payloads.

It is important to note, however, that the evolution of the different categories of ballistic, cruise and hypersonic glide vehicles, together with their flight characteristics, has tended to merge. This increasingly makes easy discrimination between categories less obvious, and poses difficulties for defences that may have been developed only to deal with one type of threat profile.[1] Thus, modern missile defences have needed to adapt to these changes, with different systems developed or evolved to deal with the gamut of offensive missile threats depending on their range, flight profile, speed and manoeuvrability.

Threat overview

Missile defences have become increasingly important as tactically offensive missile systems have proliferated, and as sensor and interceptor technologies have matured, allowing for greater effectiveness. Missile weapons are a favoured instrument of the two main threats in the western Pacific, China and North Korea.[2] Russia also maintains a large and diverse missile arsenal, but it is likely that much of its conventional land-attack missile inventory in the Far East has been redirected for use in the Ukraine war as its stocks of weapons have been expended.

China has by far the most significant tactically offensive missile force, with large numbers of ground and air-launched ballistic and cruise missiles designed for land attack, incorporating both nuclear and conventional warheads. In addition, it has created a large arsenal of anti-surface weapons to target US and allied warships, including ground-launched anti-ship cruise missiles (ASCMs) and anti-ship ballistic missiles (ASBMs), ground and sea-based aircraft-launched ASCMs, and both surface ship and submarine-launched ASCMs. China's People's Liberation Army (PLA) Navy is expected to field both ship and submarine-launched land-attack cruise missiles (LACMs) and possibly also surface ship-launched ASBM in the near future. In addition, it has developed a hypersonic glide vehicle payload launched from the DF-17 medium-range ballistic missile.[3]

Chinese missiles thus are a leading threat to Western forces operating in the western Pacific, including its medium and intermediate-range ASBMs, the DF-21D and DF-26B, respectively, designed to target US Navy carrier battle groups and the aircraft carriers, in particular. They form leading parts of China's anti-access/area denial (A2/AD) strategy.

The Democratic People's Republic of Korea (DPRK) has developed a ballistic missile force, albeit with a more limited ambition than China. Its ballistic missile force comprises an unknown number of nuclear and conventional weapons from short to intercontinental ranges.[4] Prior to the demands of the Ukraine conflict, at least, four brigades of Russian SS-26 Iskander-M short-range ballistic missiles (SRBMs) were located in its Eastern Military District. Furthermore, three of Russia's eleven nuclear ballistic missile submarines (SSBNs) are believed to be based with the Pacific Fleet.[5]

Coalition assets likely to be targeted in a conflict with China include military bases and facilities. Land targets could include US bases in Japan such as the air base at Kadena and US Marine corps facilities on Okinawa, as well as the naval base at Yokosuka, and possibly US bases in South Korea. Similarly, the concentration of military facilities on the American island of Guam presents attractive targets to a regional aggressor.[6] Logistics trains and facilities are also believed likely to be targeted. If nearby US allies such as Japan were actively participating in the coalition their own assets would also be targets. Obviously, in a conflict over Taiwan, the island itself would be heavily targeted.

Further afield, the Australia-US joint facilities, such as Pine Gap near Alice Springs, are potential targets; Pine Gap not least for its role in detecting the launch of ballistic missiles.[7] However, mainland China-based conventional missiles currently lack the range to hit Australia and would need to be postured closer to Australian territory or at sea in order to do so. Coalition naval forces are also likely to be targeted with salvos of anti-ship missiles in waters within the first, and probably also the second island chains, particularly if those forces were concentrated.

In a North Korean attack, South Korea, Japan, and US bases would be likely targets.

Missile defence

Missile defence is a technologically and tactically complex mission. Although allied defensive capabilities continue to improve, so too do potential adversary capabilities, including delivery characteristics and flight profiles. Depending upon the specific threat circumstances, missile defences thus must potentially be able to cope with different classes of ballistic missile, cruise missiles or other air-breathing threats, hypersonic glide vehicles or, in some cases, even unguided rocketry. Israel's Iron Dome system was developed to deal with the latter type of threat. Defence against missiles thus requires several systems depending on the characteristics of the threat, including range, speed, size and other performance characteristics.

Ballistic missile flight paths are important features for defence. Ballistic missiles have three stages of flight:

1. The boost phase begins at launch and lasts until the rocket engine(s) stops firing and the missile begins unpowered flight. Boost phase can last one to five minutes and occurs mostly in the atmosphere. This is the phase of flight during which the missile is travelling at its slowest and its exhaust is at its brightest and hottest, making it easier to identify and track. But it is also the phase nearest to the launch point and thus enemy forces, and the temporal window for engagement is small.

2. The midcourse phase begins after the rocket(s) stops firing. The missile continues to ascend toward the highest point in its trajectory, before descending toward Earth. This is the longest phase of a missile's flight and, for ICBMs, it can last around 20 minutes. During the midcourse phase, longer range ICBMs can be travelling up to 28,000 kilometres per hour (Mach 23+) on re-entry into the atmosphere.

3. The terminal phase begins when the detached warhead(s) re-enter the Earth's atmosphere and ends upon impact or detonation. During this phase, which can last for less than a minute, some warheads can be travelling at speeds greater than 3,200 kilometres per hour. This is the least preferred phase for intercept due to the tiny margins for error, limited time, and the location of intercept is likely to be close to the intended target.[8]

Two characteristics of some ballistic missiles which complicate the task of defending forces are the potential for missiles to carry multiple independently targetable re-entry vehicles (MIRV), or manoeuvrable re-entry vehicles (MaRV).

In contrast to a missile carrying only one warhead, MIRVed missiles carry multiple warheads. For instance, a Russian MIRVed missile under development may be able to carry up to 16 warheads, each in a separate re-entry vehicle. Warheads on MIRVed missiles can be released from the missile at different speeds and in different directions. Some MIRVed missiles can hit targets as far as 1,500 kilometres apart.[9]

Manoeuvrable re-entry vehicles are warheads capable of autonomously tracking ground targets. This often requires some terminal active homing guidance to make sure the missile warhead does not miss the target, because of the frequent trajectory shifts.

US missile defence system

The US missile defence system is an integrated endeavour comprising networked ground, sea and space-based sensors, and ground and sea-based interceptors which use either a kinetic hit-to-kill or explosive blast fragmentation method of killing the incoming missile. Future developments are likely to include both further refinements to existing capabilities, plus new technologies such as sea-based directed energy (laser) weapons to counter ASCMs.

Ground-based Midcourse Defense

Ground-based Midcourse Defense (GMD) is a modest homeland defence system with interceptors based in Alaska and California, primarily to counter the limited but growing threat from North Korea's nuclear ICBMs. The interceptors use an Exo-atmospheric Kill Vehicle (EKV), a hit-to-kill technology to destroy incoming target vehicles using kinetic energy.[10]

Sea-based Aegis

Aegis Ballistic Missile Defense (Aegis BMD) is currently deployed on 44 US Navy cruisers and destroyers, as well as Japanese and Korean destroyers. Aegis BMD is able to counter SRBMs, medium-range ballistic missiles (MRBMs) and intermediate-range ballistic missiles (IRBMs), although the ships are able to track all classes of ballistic missile and feed that information into the US Missile Defense System. In 2020 an Aegis BMD ship demonstrated the ability to defeat an ICBM target. [11]

Currently, Aegis BMD ships can defeat threats in either the midcourse or terminal phases of flight. The SM-3 Block IB is used for SRBM interception, and the newer SM-3 Block IIA missile co-developed with Japan, for kinetic (hit-to-kill) midcourse interception of MRBMs and IRBMs.[12]

Terminal phase interception can be conducted with explosive warhead-fitted SM-6 missiles. The AN/SPY-1 radar on which Aegis BMD is based is being replaced by the more formidable SPY-6, which is claimed to be able to detect 30 times as many targets that are half the size and at twice the range.[13] The SM-6 missile also has anti-cruise missile and anti-ship functions, with a range of 370 kilometres and an operational ceiling of 34 kilometres.[14]

In the early stages of development, the demands of the BMD function on the Aegis system meant that ships could not conduct other tasks while undertaking BMD. The recent Baseline 9 upgrade of Aegis enables the system to undertake both BMD and air defence simultaneously.[15] Baseline 9-equipped ships are capable of detecting and tracking space objects for the related space domain awareness mission.[16] The Baseline 10 upgrade for America's Flight IIA Aegis destroyers will incorporate further improvements, including for electronic warfare.[17]

Sea-based terminal (SBT) defence is being developed to counter manoeuvring and hypersonic warheads in the terminal phase of flight using the SM-6 interceptor, the only missile currently with such a capability.[18] Also under development is an improved integrated air and missile defence (IAMD) system, incorporating US Army and US Navy capabilities. For the western Pacific, an IAMD architecture is being developed to protect US bases on Guam from adversary ballistic, hypersonic and cruise missiles. For example, a test is planned involving both SM-2 air defence and SM-3 Block IB BMD interceptors.[19]

Aegis Ashore

Aegis ashore is the land-based version of the shipborne Aegis system which uses the same radar and SM-3 interceptors. It is in service in Europe to guard against SRBM, MRBM and IRBM threats.[20] However, it is not currently in use in the western Pacific.

THAAD

The Terminal High Altitude Area Defense (THAAD), deployed in batteries comprising six to nine launchers, each with eight interceptor missiles, is designed to intercept short to intermediate-range ballistic missiles during their terminal phase both within and beyond the atmosphere.[21] The THAAD interceptor missile has a single stage rocket motor and a liquid-fuelled kinetic hit-to-kill vehicle, which uses an infrared seeker for final target homing. THAAD can defend at ranges of 150-200 kilometres.[22]

Central to the THAAD system is the AN/TPY-2 radar, which can detect and track enemy missiles at from 870-3,000 kilometres and support BMD systems focused on either the boost or terminal phases of missile flight. The TPY-2 radar can be used in two modes, forward-deployed in which it detects missiles in the ascent phases (and can cue other BMD systems), including one based in Japan, and in the terminal mode when it is used for THAAD engagements, including with US Indo-Pacific Command.[23] An Emirati system scored THAAD's first combat kills against ballistic missiles in January 2022.

Patriot PAC-3

Patriot Advanced Capability (PAC)-3 is a more mature, lower-tier complement to THAAD, capable of intercepting incoming missiles later in their terminal phase. Like THAAD, it uses a manoeuvrable hit-to-kill interceptor. A typical launch station comprises four launch canisters each containing four missiles, while a typical battery can have six to eight launch stations.[24] The PAC-3 missile has a range of 70 kilometres and can reach an altitude of 24 kilometres. The AN/MPQ-53 radar system has a range of up to 100 kilometres, the capacity to track up to 100 targets and can provide missile guidance data for up to nine missiles.[25]

The Patriot Guidance Enhanced Missile (GEM-T) has improved performance against high-speed SRBMs.[26] Both PAC-3 and GEM-T are capable of defending against SRBMs, large-calibre rockets, cruise missiles and aircraft.[27] Patriot PAC-3, GEM-T and earlier versions have a long-standing operational record; with the system in service with a numerous countries, including Japan, South Korea and Taiwan.

Western Pacific operations

The extensive missile threats posed in the western Pacific will complicate alliance and coalition operations to defend victims of aggression by making access difficult and extremely hazardous. Coalition forces will be operating well within China's weapons engagement zone. Therefore, to deny the PLA its objectives, defeating those missile threats must play a large role in coalition planning. That will encompass the entire spectrum of missile defence operations, from the short-range organic systems operated by ground forces to long-range systems for defeating IRBMs, hypersonic glide vehicles and even ICBMs.

It should be noted that shooting down adversary missiles is only one part of the missile defence enterprise. Equally important will be the ability to operate in a dispersed fashion, using deception to present small or confused target profiles, and countering enemy C5ISRT systems through counter-reconnaissance missions, offensive cyber and electronic warfare.[28] If an adversary cannot find, track or target coalition forces, their offensive missiles become far less potent, reducing the burden upon missile defence systems.

Missile defence and Australia

The combination of the China threat across the western Pacific, the strategically important joint facilities, including those at Pine Gap and Exmouth, and increased US military presence under the US Force Posture Initiatives, have led to growing ADF interest in missile defences. The *Hobart*-class destroyers and future *Hunter*-class frigates both employ the Aegis combat system, and could be made missile defence-capable. The combination of Aegis, and the recent commitment to upgrade to Baseline 9, plus SM-6 missiles, may be the ultimate BMD fit for the destroyers.[29] Defence had previously intimated an interest in both sea-based missile defence, and directed energy weapons for close-range ship defences.[30]

A BMD capability would provide some ability for terminal defence against ballistic missile attack, or cruise missile attack, of naval or deployed joint or combined (coalition) maritime forces, or perhaps to defend selected near-coastal Australian targets, but in the latter case only at the expense of other tasking for the ships. Even for deployed forces, missile defence will be limited by the small number of interceptors able to be carried in too few vertical launch cells. Availability of the multi-function SM-6 for the destroyers plus SM-2 Block IIIC may alleviate this problem somewhat, but the limited missile-carrying capacity of both classes of ship remains an operational weakness.

Defence has also indicated an interest in RAAF high-speed missile defence capability for its fighter fleet,[31] to fulfil part of the high-end of joint IAMD for deployed forces, together with Aegis at sea, comprising Advanced High Speed Missile Defence (AHSMD). The IAMD programme will be integrated through a Joint Air Battle Management System (JABMS). The Medium Range Ground Based Air Defence (MRGBAD) Project will function as a deployable "middle-layer" capability to defeat both air and missile threats.[32]

The Army has also selected the National Advanced Surface to Air Missile System (NASAMS) integrated with a CEA Active Electronically Scanned Array (AESA) radar for the short-range element of the joint IAMD.[33] The US Secretary of Defense has claimed that NASAMS had achieved "a 100 percent success rate in interrupting Russian missiles" in Ukraine. [34]

The 2023 *Defence Strategic Review* was critical of a perceived lack of prioritization in deploying an operational layered IAMD capability, and stressed the need to adopt urgent off-the-shelf solutions prior to developing a "mature" integrated missile defence force.[35]

Australia's Jindalee Operational Radar Network, its joint facilities with the United States for space domain awareness, sea-based radars and other surveillance technologies can assist to detect and track ballistic missile threats throughout the wider region. Thus, while starting from a low base, existing ADF capabilities and planned enhancements can contribute meaningfully to both homeland and deployed, independent and combined, missile defences.

A question remains, however, whether Australia will require a ground-based system to defend homeland bases and facilities against longer range missiles, particularly IRBMs, if they are regionally postured close enough to target the northern or eastern parts of the continent.

Endnotes

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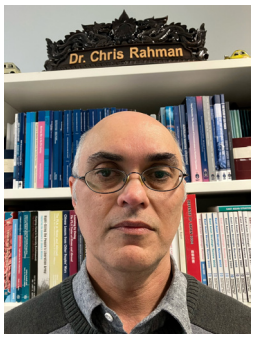

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