

Ballistic missile defence

How soon, how significant, and what should Australia's policy be?

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Executive summary

The issue of ballistic missile defence (BMD) was a controversial one when US President Reagan first advocated a strategic-level system in the early 1980s. It remains so today—defences against theatre- and tactical-range missiles are gradually improving, but no effective strategic-level system is in sight. Consequently, mutual deterrence will continue to define great-power nuclear relations for many years to come.

What's Australia's interest? We live a long way away from most current ballistic missile arsenals. But the ADF frequently deploys within range of ballistic missile systems, especially in Northeast Asia or the Middle East, and those systems might proliferate more widely in the future.

We have two questions to decide. The first is the priority for enhancing the ADF's own BMD capabilities. The second is whether it makes sense for us to participate in a cooperative arrangement with the US or other partners.



A Standard Missile Three (SM-3) is launched from the guided missile cruiser *USS Shiloh* (CG 67) during a joint Missile Defense Agency, U.S. Navy ballistic missile flight test. Two minutes later, the SM-3 intercepted a separating ballistic missile threat target. The test was the seventh intercept, in eight program flight tests, by the Aegis Ballistic Missile Defense. The maritime capability is designed to intercept short to medium-range ballistic missile threats in the midcourse phase of flight. 22 June 2006. Photo courtesy US Navy.

In evaluating the effectiveness of BMD systems, there are three main factors to consider: the range of the ballistic missiles, the sophistication of countermeasures that the missiles employ, and the number of missiles employed in an attack. BMD systems have a good chance of working against a small number of short-range missiles with simple (or no) countermeasures. But the defensive task gets rapidly harder against more complicated attacks, and even defences that are effective against small attacks can easily be overwhelmed by larger ones. In the most challenging case—an attack that involves a large number of long-range missiles with sophisticated countermeasures—the defence has no chance of protecting the target. Those factors mean ballistic missiles will retain strategic potency for years to come—and could prove to be an especially disruptive technology in a maritime area-denial role.

At the moment, defences lag behind the capabilities of offensive missile systems. Whether the gap can eventually be bridged is an open question (although potential saturation of the defences will always be a problem). But a system of only limited capability can still have important effects. As well as providing a measure of defence against forces with limited missile numbers or capability, it can take the 'cheap shots' off the table in a crisis and it can complicate the decision-making of adversaries.

For Washington, even a limited missile defence can better assure allies and partners, as well as Americans, that they're not hostage to every missile-equipped rogue. And it can make the US more willing to deploy its principal conventional weapons—such as aircraft carriers—in harm's way (although probably only where threat capabilities and numbers are limited).

For Australia today, the strongest argument for committing to greater efforts in the BMD field lies in our possible alliance role in the broader western Pacific. The US is grappling with the problems posed by a growing Chinese anti-access capability that includes ballistic missiles, and it makes sense for us to be aware of our ally's priorities. But that doesn't mean a big investment is required in this specialist area. Other parts of the ADF force structure (not least, submarines) also represent valuable alliance contributions, and a sizeable expenditure on BMD would have opportunity costs for the ADF and for the US as well.

With a continued modest investment in BMD research and development efforts, and a watchful eye on defensive technologies as they mature, Australia will be well placed to adopt them in the future, should externalities make that desirable.

Introduction

Those coming to the subject of ballistic missile defence (BMD) for the first time, and attempting—like good graduate students—to begin their research with a review of the existing literature, typically find that they have a daunting assignment in front of them. The topic is one where the literature tends to fall into two distinct camps: it's either strongly supportive of BMD or strongly dismissive. This bimodal distribution makes it hard to arrive at a reasoned assessment. The task is complicated by the fact that detailed data (on interceptor testing, for example) tends to be unavailable to the general public. The consoling news—and it's not especially consoling—is that it was ever thus.

In March 1983, President Reagan propounded the notion of the Strategic Defence Initiative, a grand strategic-level BMD shield that would use a range of weapons, including space-based X-ray lasers, to shoot down attacking missiles. Reagan's science adviser, George Keyworth, suggested that the system would have to be able to shoot down 100,000 warheads in flight in order to deter a strategy of swamping the defence. Critics suggested, with varying degrees of rudeness, that the president's video graphics of what the system might look like represented a triumph of cinematic imagination over physics—part of the reason the system was dubbed 'Star Wars', in homage to the science fiction movie series of the era. Critics believed that real BMD systems, if they could be built at all, were still 30 years away.

Well, 30 years have passed, and a lot of money has been thrown at the BMD problem over that time. So, are workable BMD systems on the horizon? And, if so, what difference will they make to current global and regional power balances?

Part of the challenge in answering those questions is a mere definitional one: what counts as 'a workable BMD'? Would a system that reliably intercepts attacking missiles in ones or twos qualify for the label? If not, how many missiles must it be able to counter before it does? Reagan's vision—of a system that could destroy thousands of warheads concurrently in flight—represents the

extreme threshold, but it certainly isn't the only variant of a missile shield that could have a useful strategic role. A system that saves New York City from a single-missile nuclear attack, for example, might be a useful capacity to have. Similarly, a system that protects US aircraft carriers from Chinese anti-ship ballistic missiles, and so makes Washington more willing to deploy its naval forces in harm's way, could easily be counted as a useful strategic asset.

Even at its most basic level, a BMD system is a complex enterprise, a system of systems that attempts to knit together intelligence, early warning of ballistic-missile launches, sensors for detecting and tracking missiles and their re-entry vehicles, interceptors capable of intercepting those warheads in flight, and an advanced battle-management system to keep track of potential targets, available interceptors and debris. At the core of the enterprise lies the difficult task of discrimination: identifying the warhead(s) released by a missile and being able to distinguish between them, their associated decoys and penetration aids, and nearby pieces of the missile.

A ballistic missile primer

Let's start at the beginning, by explaining what a ballistic missile is and what differentiates the different missile ranges and warhead types. In brief, a ballistic missile is a missile that is powered through only a brief period of its flight. That phase, called the 'boost' phase, lifts the rocket and its payload into a ballistic trajectory. Once the boost phase ceases, the rocket and its warhead(s) fall back—perhaps with some steering adjustments—towards the earth. Some missiles are unitary, which means the warhead doesn't separate from the body of the missile when the boost phase is complete. Other missiles feature separating warheads, which typically makes the target a smaller one for BMD systems. Sophisticated multiple-warhead missiles have a separate post-boost-phase 'bus', which manoeuvres to deploy the warheads along different trajectories.

Once the boost phase ceases, the missile/warhead enters the mid-course phase of its journey. This typically occurs in space, and is also the time when the missile deploys decoys or other countermeasures to help conceal the true warhead from the defender. The terminal phase of flight commences when the missile/warhead re-enters the atmosphere. Re-entry helps the defence by stripping away many of the lightweight decoys, but now only a short time remains before the warhead hits its target.

Missiles with a range of greater than 5,500 km are typically called intercontinental ballistic missiles (ICBMs). The distance threshold derives from the first strategic arms control agreements between the US and the USSR during the Cold War. It's somewhat arbitrary, since not all potential adversaries enjoy continental separation, and they can do serious damage to each other's homelands with missiles of much shorter range. ICBMs are exo-atmospheric missiles, reaching heights of over 1,000 km.

Below the level of ICBMs are intermediate-range ballistic missiles (IRBMs). The definition of an IRBM has changed over the years, since the Intermediate-Range Nuclear Forces Treaty of 1987 defined an IRBM as a missile having a range of between 1,000 km and 5,500 km. The treaty also applied to shorter-range missiles with ranges between 500 km and 1,000 km.

The treaty definition notwithstanding, the US Missile Defense Agency currently defines a short-range missile as one having a maximum range up to 1,000 km; a medium-range missile as one having a range between 1,000 km and 3,000 km, and an intermediate-range missile as one having a range between 3,000 km and 5,500 km. IRBMs are also exo-atmospheric; for example, the Indian Agni-IV reaches a height of 900 km.

Tactical ballistic missiles have ranges of up to 300 km and remain within the atmosphere over their trajectory. For example, the American MGM-40 ATACMS has a range of 300 km and reaches a height of 48 km.

In their simplest form, short- and medium-range ballistic missiles can be thought of as extra-long-range artillery, allowing precision bombardment of fixed targets up to hundreds of kilometres distant. As one example of their applicability as weapons, it's believed that there are well over 1,000 ballistic missiles deployed along the Chinese coast opposite Taiwan—including from mobile launchers. A RAND study of a hypothetical cross-strait conflict showed that a combination of ballistic missile bombardment and air strikes had the potential to severely limit air operations from Taiwan.

A potentially disruptive technological development is that of terminally manoeuvring ballistic missiles able to hit a moving target. China, India and Iran have all demonstrated some capability in this area, but China's DF-21 is probably the most advanced. The motivation for the development of anti-ship ballistic missiles is the naval superiority of the US and its ability to project power via carrier battle groups. Opinions vary greatly about the robustness of the end-to-end sensor, launch and guidance chain required for the system to be effective, but there's little doubt that an effective weapon of this type would greatly complicate the planning of surface naval operations within its range.



Mobile nuclear intercontinental ballistic missile RT-2UTTKh «Topol-M» (NATO name SS-27 Sickle B) in the Red Square on Moscow Victory Parade of 2010. © Iexan/iStock.

Ballistic missile defence

Ballistic missile defences vary enormously. Against simple, short-range missiles, they might well include only those capabilities that help to achieve interception in the terminal phase of a ballistic missile's flight. Alternatively, and especially against longer-range missiles, they may comprise a layered set of capabilities that attempt to destroy a ballistic missile or its warheads at several points along its flight. Interceptions in the boost phase are especially appealing, because they catch both the missile and its payload before discriminating warheads from decoys becomes a major problem. Moreover, interception at this point, while the missile is still in the initial stage of its flight, provides the maximum defensive 'footprint', since it protects all possible targets. But intercepting a missile in its boost phase is difficult. Mid-course interception is plausible, but might well require a strategy of 'look-shoot-look' to check that the real warhead has been destroyed. Interception in the terminal phase is also plausible, assuming the warhead is not travelling too fast, but terminal defences protect the smallest footprint.

In terms of current capabilities, the US Ground-Based Interceptor (deployed in Alaska and California) is intended to intercept long-range ballistic missiles in the mid-course phase. The Aegis sea-based system includes an SM-3 interceptor, designed to intercept missiles in the mid-course phase, and an SM-2 interceptor, designed to intercept in the terminal phase. Among the ground-based theatre and tactical systems, the Terminal High Altitude Area Defence (THAAD) system and the Patriot PAC-3 system are meant to be complementary terminal systems, THAAD providing interception in the higher altitudes and Patriot at lower altitudes.

Why does it matter to Australia?

Why should Australia be interested in BMD? There are two possibilities: national defence and theatre defence for deployed ADF elements. The former isn't a pressing need, at least at the moment. Australia's a long way from the bulk of the world's ballistic missiles, and can only currently be attacked with intercontinental-range missiles. So there's little need for an Australia-based system, but many of our friends and partners in Asia and elsewhere are relatively close to burgeoning missile capabilities. And our ally, the US, has long laboured to develop workable BMD systems and has already deployed a small number of missiles dedicated to the protection of the continental US against long-range ballistic missile attack. On balance, though, there's no need for our partner's priorities to become ours. Watching developments in both offensive missiles with the range to reach Australia and the effectiveness of defences against them is adequate for now.

US allies elsewhere are already beginning to buy in to US sea- and land-based BMD systems aimed at countering short-range ballistic missiles. As tactical/theatre ballistic missiles become more widespread—and become more effective against moving targets, such as ships—their potential applicability in the ADF's force structure will increase commensurately. Almost as importantly, with NATO, Japan and South Korea already committed to closer BMD cooperation, Australia runs the risk of being increasingly marginalised in US eyes by its reluctance to buy into the cause of BMD.

Strategic attraction

Proponents of BMD say that it responds to a growing strategic need. They point to an environment in which ballistic missiles are increasing in quantity, quality and range. That's true, although the trend might not yet be as widespread as some suggest. In particular, short-range missiles are increasingly common, and even the world's most exclusive missile 'club', the ICBM club, is gradually becoming less exclusive as countries such as North Korea knock on the door. As the number of ballistic missiles continues to grow in the arsenals of risk-tolerant states—and there are arguments about which states are risk-tolerant and which aren't—one of the most compelling strategic reasons to invest in some level of BMD is to take the 'cheap shots' off the table.

What's a cheap shot? Well, in the first Gulf War (1990–91), when Saddam Hussein was firing ballistic missiles at his neighbours, a common judgement was that constraints on BMD were never intended to allow people like Saddam to have a free shot at others. Saddam eventually fired 88 Scud missiles at Israel and Saudi Arabia. The Patriot missile system was credited at the time with defeating many of those missiles, although reputable critics insisted later that the system had probably intercepted fewer than 10% of missiles, and might have intercepted none. Still, during the conflict the international coalition had compelling reasons for suggesting that the intercept rate was higher—the more it could sell to Saddam the idea that his missiles were ineffective, the less incentive he had to fire them; and the more it could sell the same idea to the Israelis, the less incentive Israel had to enter the war (an action that might well have broken the multinational coalition engaged in ousting Iraqi forces from Kuwait).

The broad rule about the value of taking cheap shots off the table applies to most cities, but to a range of other targets as well. One or two nuclear warheads can destroy a modern city. The destructive capacity of conventionally armed warheads is much more limited, although of course all lives saved matter. And it might be worth keeping in mind the reconstruction costs after 9/11. The Institute for the Analysis of Global Security, counting merely the direct costs of building replacement for the World Trade Center and at the Pentagon, the clean-up costs, and the broader damage to property and infrastructure, estimated financial costs of between US\$15.5 billion and US\$19.8 billion.

BMD systems—effective ones, anyway—would bring one central strategic gain: they would devalue the currency of ballistic missiles. They're unlikely to devalue them to the point where ballistic missiles become obsolete—after all, air defences haven't made aircraft obsolete, and counter-rocket-artillery-and-mortar systems haven't made rockets, artillery and mortars obsolete—but better BMD would complicate the decision-making of an adversary. At the moment, ballistic missiles are a fast and relatively inexpensive means of conducting offensive warfare. Their flight-times are short and they have a high chance of penetrating to their targets. Better BMD systems wouldn't stop prompt-strike warfare per se. Where a strategic need for prompt strike exists, such defences might only push arms competitions into other forms of prompt strike—manoeuvring hypersonic delivery vehicles, for example. But, like most arms competitions, it would drive up the complexity and cost for the adversary—a hypersonic strike system will require a greater investment of resources than a simple ballistic missile.

The US has so far led the move towards BMD, both in its declaratory policy and in its practical deployments. In a declaratory sense, it has seen BMD as an opportunity to deny an aggressor the success of its attack rather than merely allowing the US to punish the aggressor afterwards, although that option's always available. Washington's ambition has been to allow deterrence by denial to play a larger role in strategic calculations, as a supplement to rather than a replacement of deterrence by punishment. In policy settings, Washington walked away from the Anti-Ballistic Missile Treaty of 1972 some years back, freeing its hands to explore and exploit technological improvements as they came along. And, in hardware terms, the US has built and deployed a wider range of anti-ballistic missile systems than any other country.

Urgency trumps effectiveness

In Washington, perceived strategic need has been a powerful driver of missile defence even when the technologies haven't been available to address the need. President Reagan needed a strategic policy that repositioned the US in relation to the USSR in 1983. President George HW Bush needed something to offset Saddam Hussein's missile attacks during the Gulf War—something that could be presented as a counter to Saddam's single most effective offensive capability (at least in public perception) against his neighbours. President George W Bush needed something to suggest that the US had a capacity to counter the single-missile threat potentially posed by a rogue state or an ambitious terrorist group. In all cases, the driver was essentially the same—discomfiture with the technological fact of vulnerability.

For people trying to follow the US Missile Defense Agency (MDA) program, it's well worth reading a succession of US Government Accountability Office (GAO) reports on the topic. Since 2002, the MDA has essentially been driven by presidential fiat into a series of initiatives characterised by high concurrency in development, testing, production and deployment. Concurrency is a risky strategy—just ask the Joint Strike Fighter development team—but one deemed acceptable in the US after 9/11. George W Bush's mandate to develop and deploy a national missile defence for the continental US drove the deployment of unready systems requiring major retrofitting.

The Ballistic Missile Defense Review Report, published by the Obama administration in early 2010, attempted to draw a line under a decade of sometimes overexcited development and deployment. The review tried to steady the ship by drawing clearer priorities for future development. And the report claimed that in 2010 the US already had a capacity to protect the US homeland from a 'limited ICBM attack', even though test results don't justify confidence in that claim. The claim seems to have been 'limited' to North Korean and Iranian ICBMs—a capability that neither state possessed either then or now—but established a precedent that the US should work to keep (or get) its national missile defences at a point where they could offset the steadily improving capabilities of rogue states.

A good investment?

But that still leaves open the question of whether BMD systems are actually a good investment of defence monies. The answer seems to be a heavily qualified 'sometimes'. There are three main factors: the range of the ballistic missiles, the level of countermeasures the missiles employ, and the number of missiles. If the missile is a short-range one, if its countermeasures are

simple and if the attack is small, BMD systems have a good chance of working. But if any of those three factors (short, simple and small) don't apply, the defensive task gets harder. If none of them applies—the attack involves long-range missiles with sophisticated countermeasures and a large number of missiles—the defence has no chance of protecting the target.

Range is important because the quick rule is that the longer the range of the ballistic missile the harder it will be to intercept. For ballistic missiles of intercontinental range, when the warhead is moving at about 7 km/second and much of the trajectory is above the atmosphere where lightweight decoys are not inhibited by aerodynamic drag, interception is exceptionally challenging. At the opposite end of the scale, for ballistic missiles of short range, when the warhead might be moving at 1 km/second (around three times the speed of sound—Mach 3—the same speed as the fastest cruise missiles) and within the atmosphere, interception is still a non-trivial task, but plausible. Speed increases with range. Scuds capable of flying 600 km are usually travelling at over 2 km/second (Mach 6, the speed of hypersonic systems now under development).

Recent experience with Israel's 'Iron Dome' system—a system intended to counter rockets, artillery rounds and mortar shells—suggests that Hamas' short-range rockets, which usually fly over ranges of 15–25 km and with speeds of around 500 m/second (supersonic, at around Mach 1.5), can often be intercepted in flight. So some progress is being made at the shorter-range end of the spectrum, but just how much is uncertain. Even Iron Dome has its critics, some of whom argue that in a significant proportion of its 'intercepts' the system merely succeeds in deflecting the incoming warhead rather than destroying it.

The level of countermeasures is important because it plays to one of the principal weaknesses in any attempt to intercept the missile or its payload—the problem of discrimination. Unless the sensors of the BMD system have the capacity to sort real warheads from decoys, the system is simply going to run out of interceptors by firing at everything that might be a warhead.

And the size of an attack is important because the simplest way to get through a defence that has proven itself able to counter one or two missiles/warheads is to 'saturate' or 'swamp' the system. This is especially relevant to ship-borne defences. If they rely on large missiles for effectiveness, a task group can't rearm its defensive systems at sea and is susceptible to swamping. That's why work on laser and electromagnetic rail gun defences is underway—those systems (assuming they can be made to work effectively) are more capable of firing multiple rapid shots. (But see the comments in the following section.)

The three factors—range, countermeasures and attack size—lie at the heart of how such defences might be defeated. First, where it has the choice to do so, an aggressor might simply choose to fire a longer-range missile against the target, trusting to the warhead's speed to get through. Second, it might increase the prospects for successful penetration by deploying decoys and penetration aids on its missiles—things designed to show up easily on radar screens and confuse the defence about which signal represents the real warhead, for example. Third, it might swamp the defence, firing a salvo of missiles simultaneously at a target, increasing the possibility that at least one will get through.

The aggressor also has other options: it might directly attack the defence before launching its real offensive, attempting to 'blind' or otherwise degrade the defensive network, in order to lessen its efficacy against subsequent ballistic missile attacks. Alternatively, it might attempt to 'go around' the BMD system by choosing another delivery route (such as hypersonic missiles, which don't have the predictable trajectories of ballistic missiles). And these approaches aren't mutually exclusive. Some targets—an aircraft carrier battle group, for example—might have to be defended against all of the possible delivery vectors simultaneously: tactical-range ballistic missile attack, hypersonic missile attack, plus a range of conventional-force options.

The range of delivery options would clearly vary in relation to the specific aggressor. Although some of the recent interest in BMD has been motivated by the possibility that a terrorist group might launch such a missile, in reality terrorists are more likely to build a weapon of mass destruction *in situ*, sail it into a harbour, or deliver it by truck.

Testing controversies

It's because of such countermeasures that US BMD testing is increasingly turning to slightly more complex interception scenarios, such as attempting to intercept two warheads in flight at the same time. And here we come to a further controversy: the relative

success of the BMD testing program in the US. The MDA provides a range of figures about BMD testing. At its heart is a statistic that says 80% of tests result in successful interceptions of their targets. The data on the MDA website claims that 64 tests out of 80 across all classes of interceptors have been successful.

If we take these figures at face value, there would seem to be a case for arguing that BMD is finally beginning to show its potential. But critics have argued that the testing program looks good only on the basis of a selective definition of 'success'. Some say the 'targets' aren't fully representative of the threats. That's partly true: Director, Operational Testing and Evaluation (DOT&E) reports suggest a range of low-velocity targets fired on predictable trajectories, sometimes with beacons deployed on the target to assist guidance. Moreover, some critics allege that success is typically measured by interception, not by whether the target's warhead was destroyed. That's also partly true: we know from congressional testimony that a 'hit' isn't the same as a 'kill'. In testimony in 2012, DOT&E Michael Gilmore cited the case of FTG-02, a test of the Ground-Based Interceptor that hit its target a 'glancing blow', but that wouldn't have killed the target. After due allowance for those factors, it's still possible to conclude that progress is being made—albeit at a slower pace than missile defence advocates argue and, more importantly, slower than the development and proliferation of long-range missiles.

One recent assessment by the US National Academy of Sciences (NAS) suggests that progress is definitely being made but that there's still some way to go. In both the report and a letter of recommendations to congressional leaders, the NAS laid out a series of practical recommendations for the future of BMD effort. In particular, it was critical of the concept of boost-phase interception, for the simple reason that BMD systems can rarely be placed close enough to a ballistic missile launch point to intercept the missile successfully when it's still in its boost phase. Even laser intercepts are devalued by the degradation of the beam as it travels through the atmosphere. For all practical purposes, the report concluded, the defensive system, whether missile or laser, would have to be placed within a few tens of kilometres of the ballistic missile's launch point.

The Airborne Laser program has since been terminated; a senior Pentagon official told a congressional subcommittee in 2013 that the program 'had proved to be technically more challenging than initially thought'. So, too, have the Kinetic Energy Interceptor and the SM-3 Block IIB missile, both originally intended to provide options for attacking a missile during its boost phase. As Admiral James Syring told Congress in 2013, the SM-3 IIB was predicated on achieving a very high velocity with the missile, which proved to be simply too technologically challenging and too costly.

The NAS report accepted that North Korean missiles might be vulnerable in their boost phase to US seaborne or airborne defence assets deployed east of the peninsula. And it conceded that sometimes the US might well have air superiority over an adversary's territory, allowing for the deployment of air assets, for example. But the general point is true: interception of a ballistic missile in its launch phase is an exceedingly demanding task. And that's the single biggest problem with BMD—because once the missile deploys its warheads and decoys into the mid-course phase of flight, defeating the attack becomes much harder.

The report also accepted that effective capability is emerging against short- to intermediate-range ballistic missile attack, based on the current Aegis, THAAD and Patriot (PAC-3) systems and potential interceptor improvements. Again, the relative rate of improvement is probably open to dispute, and the interception rate would probably be better against missiles with simpler countermeasures rather than more advanced ones. The NAS, in its letter to key congressmen, specifically stated that it was assessing BMD capabilities only in relation to the limited mission of countering threats from rogue states for the next decade or two. It noted that it had made no assessment of effectiveness in countering a Russian or Chinese strike; nor had it made a specific judgement about an ability to counter an accidental or unauthorised launch emanating from any one of the current nuclear powers.

In a recent report, the GAO summarised testing progress, as well as critiquing the acquisition program for BMD systems. The GAO's findings support the generally pessimistic assessment in this paper. It found that, while the MDA has 'made tangible progress in increasing the complexity and sophistication of missile defense tests', those tests still continue 'to provide less knowledge than initially planned'. In turn, that 'forces decision makers to make key decisions without adequate information about the weapon's demonstrated operational effectiveness, reliability, and readiness for production'.

The critics

Critics of the current US BMD architecture and its components are typically somewhat harsher in their judgements. Perhaps the best known are George Lewis and Theodore Postol, and readers might want to read their 2010 article in the May issue of *Arms Control Today* to get a clearer sense of their argument. In brief, they argue that nothing important in the field of BMD has changed over recent years. They're scathing about the Ground-Based Interceptor—the missiles deployed in Alaska and California meant to defend the US against a limited ICBM attack. But they're almost as rude about the capabilities of the shipborne SM-3 (the supposed darling of the Obama administration), and dismissive of the capacities of ship-based Aegis radars (originally designed for relatively short-range air defence).

Central to the critics' case is the need to destroy the warhead itself. Once a ballistic missile ceases its boost phase, the (unpowered) warheads are essentially in a state of freefall towards the earth. Unless they're destroyed, they'll keep falling, arriving at an eventual impact point in the vicinity of their target—and the closer the intercept occurs, the nearer to the target the impact point will be.

The offence–defence debate

Gradual improvements in BMD might not be wreaking a strategic revolution in the future of ballistic missiles, but they've certainly reawakened an old debate on the interface between offence and defence. That debate isn't merely one about the potential interaction between offensive nuclear forces and BMD systems, which was the focus of concern in the Cold War days. Then, several analysts observed that imperfect defences would cope better against a ragged retaliatory strike than they would against a first strike—meaning that it would be sensible for the side with the best defences to strike first. Striking first would allow that side to



DF-15B short range ballistic missiles are displayed in a parade of the celebrations for the 60th anniversary of the founding of the People's Republic of China, Beijing, 1 October 2009. © Ding Lin/Xinhua Press/Corbis.

add another layer of effectiveness to its proposed shield: to interceptions in the boost phase, mid-course phase and terminal phase, it could add what humourists called 'interceptions in the pre-boost phase' or, in blunter language, catching some portion of the enemy's arsenal in its silos.

Now the picture is more mixed. Ballistic missiles don't merely have a role in a final, strategic-level, ICBM exchange, but potentially in lower-level actions as well. The Chinese DF-21 is an important capability in Chinese anti-access planning, and the need for a defence against it is driving US Navy R&D efforts.

In turn, the Chinese have become more concerned about US BMD efforts, worried in part by the potential scalability of US capabilities developed for protection against rogue states. In his November 2013 presentation at the US–China dialogue on strategic nuclear dynamics, Brad Roberts identified the topic as one of the key areas of difference between the US and China. Many Chinese analysts, he observed, still believed that US missile defences were 'pointed' at China, and intended to negate China's missile capabilities as part of a broader policy of containment. The truth, said Roberts, is that US defences were pointed at North Korea, and would have little capacity to counter a Chinese missile strike. Still, the emerging architecture of US BMD in the Asia–Pacific probably can't help but reawaken some of the traditional concerns, especially given the growing interest in conventionally armed Prompt Global Strike program capabilities.

In recent congressional testimony, the director of the MDA assured a house subcommittee that the cancellation of the Airborne Laser program didn't mean that the US had entirely abandoned its ambitions for early ballistic missile interception. The agency, he told the congressmen, was 'looking at what technology is available, boost-phase and even left-of-launch', but he was unwilling to comment further in an open forum. The 'left-of-launch' remark—with its implication that something might be done about a missile before its launch—shows that the offence–defence debate is justifiably alive and kicking.

The question isn't a trivial one for the future of BMD systems. At the moment, a desire not to awaken an action–reaction dynamic between defences and offences is an important constraint for the US. Constraints on testing, for example, aren't merely technical (the extent to which readily available targets are actually 'threat-representative') and environmental (it would be counterproductive to US interests in space if the testing increased space debris). They're also political: the testing has to be a valid confirmation to the Chinese (for example, about sensor capabilities and interceptor speeds) that the US is not realistically attempting to counter the Chinese strategic nuclear arsenal.

Still, the extent to which capabilities are transferable from one—primitive—category of targets to another more sophisticated set is a question that becomes a little sharper at the shorter end of missile ranges. Here the Americans do have a strategic interest in countering the Chinese capability to direct ballistic missiles against US carrier groups operating in the littoral waters of East Asia. And some aspects of the AirSea Battle operational concept developed in response to China's maritime denial capabilities raise broader strategic questions. In particular, 'deep strikes' against Chinese command and control nodes, designed to blind Chinese defences—including their short range conventionally armed ballistic missiles—could be misconstrued as precursors to a nuclear first strike.

Ground-Based Interceptor

During the George W Bush administration, the Americans began to construct silos in Alaska and California to deploy a limited number of Ground-Based Interceptor missiles. But it would be too much to conclude that deployment reflected a mature system. Casting a retrospective eye over the previous decade, the DOT&E told a congressional subcommittee in 2012:

Due to urgent need, the Bush Administration decided to field the Ground-Based Missile Defense (GMD) system absent a successful flight test of the ground-based interceptor (GBI) and kill vehicle composing the deployed system, as well as absent a comprehensive program of ground-based component level testing for reliability and performance of those interceptors and kill vehicles. Thus the original decision to field GMD was made without data permitting statistical assessment at any meaningful level of confidence of the GBI's reliability or performance. The resulting concurrent fielding of the GMD system while it remains under development has complicated the challenge of testing the GMD system's reliability and overall operational effectiveness.

By the time of his FY2013 report, the DOT&E was concluding that:

GMD has demonstrated a partial capability to defend the US Homeland from small numbers of simple intermediate or intercontinental ballistic missile threats launched from North Korea or Iran.

The basis for even this judgement is far from clear, since the testing program has never demonstrated a single successful interception of an ICBM warhead, or a successful intercept of more than one warhead at a time, by the Ground-Based Interceptor. The DOT&E told Congress last May that the first interception of a true ICBM target was scheduled for the fourth quarter of FY2015, although that was before the latest failure of the Ground-Based Interceptor in July 2013 and the director's subsequent observation that the exo-atmospheric kill vehicle might need to be fundamentally redesigned.

Overall, what can we say about the Ground-Based Interceptor program? Although on bare figures it boasts a record of eight interceptions from 16 attempts, there seems to have been a high level of artificiality in several of those tests. Its recent test record has been less than spectacular: its last successful interception occurred in December 2008. The interceptor might have some chance of intercepting a simple long-range missile from North Korea or Iran, but the prospects for success would not be high. It would have almost no chance of intercepting an advanced long-range missile.

Aegis

Because the Aegis side of US BMD capabilities is the one most immediately relevant to Australia, it's worth exploring a little more deeply here. The Aegis system is both a naval asset and a land-based one in the form of the Aegis Ashore capability being deployed in Europe. Testing shows that the Aegis system is developing a capability against short-range (less than 1,000 km) and medium-range (less than 3,000 km) ballistic missiles. Its capacity to defend against intermediate-range missiles (less than 5,500 km) is less certain.

The latest DOT&E annual report (FY2013) observed that 'overall Aegis BMD 4.0 Weapon System reliability is adequate for the midcourse defence mission against short- and medium-range ballistic missiles'. We can supplement that judgement with a little 'first principles' analysis. Aegis was originally designed for wide-area air defence at sea, and fits into a model in which the carrier's aircraft provide combat air patrol at distances of up to a couple of hundred kilometres and missile-equipped destroyers provide fleet defence closer in. Supersonic sea skimmers, which have been in the inventory of the former Soviet Union and others since the mid-1980s, come in at Mach 3 and 10–50 metres height, so they'll appear above the horizon up to 30 km away. Higher flying threats with stand-off weapons might be 100+ km away. The continued investment by the US and other nations into Aegis-equipped ships suggests that they're assessed as having a robust level of capability against weapons that can be found in some numbers in the inventories of both Russia and China, and are now proliferating beyond. (In Australia's immediate region, Indonesia has acquired Russian Yakhont supersonic anti-ship missiles.) A short-range ballistic missile—even one that's manoeuvring—will typically travel at around the same speed, but on a higher trajectory. The version of Aegis optimised for ballistic missiles (which the Australian Navy's three ships won't have) has the ability to engage targets further away, and the 2008 shooting down of satellite USA193 (on a predictable trajectory) shows that it can engage targets at 250+ km.

So we can conclude that the Aegis combat system can support defence against at least short-range ballistic missiles, although, as noted above, the limited number of missile cells and lack of ability to reload at sea make it potentially vulnerable to saturation attacks, and place a premium on accurately discriminating between decoys and real targets.

For missiles incoming at substantially higher speeds, such as the Mach 6+ of intermediate or longer range ballistic missiles, the capability of the Aegis system and its integrated surface-to-air missiles is much less clear. The speed of the incoming projectile means that any mid-course corrections of the surface-launched interceptor need to be made earlier, or be small enough for the kinematic envelope to allow for successful interception. It's most likely that Aegis provides some residual capability against very high speed missiles, but with significantly lower kill probabilities—and the saturation attack problem remains.

Australian thinking about ballistic missile defence

Australia has been contributing to US monitoring of ballistic missile activity since we started hosting the US early-warning facility at Nurrungar decades ago. That facility was a ground station for the US Defense Support Program satellites that monitored a good chunk of Eurasia for the heat signatures typical of ballistic missile launches. In the Gulf War, the facility made a useful contribution to US attempts to counter Iraqi missile launches.

But there's long been something of a partisan divide within Australian politics about the merits of BMD. The Labor Party has typically been concerned about the effects of such defences on strategic stability, while the Coalition has focused rather more on practicalities and affordability. That attitude showed up in the 1980s debate after Reagan's 'Star Wars' speech, resonated in the report of the Joint Standing Committee on Foreign Affairs, Defence and Trade on Australia–US relations in 2004 (see paragraph 5.58), and could still be detected in certain sentences in the 2009 Defence White Paper (see paragraph 9.103) and the 2013 Defence White Paper (see paragraphs 8.42–8.43).

In December 2003, Defence Minister Robert Hill announced that the Australian Government had 'agreed in principle to greater participation in the US Missile Defence program', but that formulation covered a variety of possible activities, including enhanced cooperation on ballistic missile early warning, cooperation on ship-based or ground-based sensors, or more basic forms of research, development, testing and evaluation. The wording wasn't intended to suggest that Australia saw any near-term major commitment to a missile shield for the Australian continent. Rather, it was a framework agreement under which Australia would have the opportunity to explore areas of interest to itself.

The issue resurfaced at the AUSMIN talks in November 2013, where BMD was identified as an area for future cooperation. And the debate is bound to resurface, anyway, as our three Air Warfare Destroyers (AWDs) move from conception to reality, since they would offer us some possibility of deploying an Aegis-type BMD capacity—although our ships aren't being optimised to counter the ballistic missile threat. That capacity already exists in the US and Japanese navies (and a number of countries are building or planning to build Aegis combat systems into ships, including South Korea, Spain and Norway). As Ronald O'Rourke observed in a recent assessment of US naval capacities to contribute to the BMD mission, US ships that have such capabilities are among those in heaviest demand from US regional commanders.

Given our reliance upon US extended nuclear deterrence, we might well have concerns if BMD were to reach such a point of maturity that the efficacy of the US strategic nuclear arsenal were called into question. But such a point is distant and may never be reached. And, long before the US arsenal could be rendered obsolete by missile defences, all other nations' missile forces would have been made similarly redundant. Good defences, even imperfect ones, would raise the price of entry to the missile 'club' and might in some way reverse the trend of recent years, which has been towards a less exclusive WMD–ballistic missile ensemble, and might also curtail the proliferation of theatre weapons.

Serious players will still devote the time, money and effort needed to retain an offensive arsenal that will offer assured second-strike capability as a deterrent to other nuclear powers. A wave of ballistic missile modernisation is already underway in some nuclear weapon states (such as Russia and China), and the US is scheduled to modernise its own submarine-launched ballistic missile and ICBM force over coming decades. Such modernisation, current and planned, suggests that no-one with a serious, well-funded ballistic missile force is currently contemplating throwing it away because of some looming cross-over point from an offence-dominant world to a defence-dominant one.

But Australia isn't in the strategic missile business, or likely to become so. For us, it's a matter of working out where BMD might fit in with our own national priorities and how it might fit in relation to our alliance commitments.

In relation to our national priorities, there's no immediate reason to spend serious money on BMD systems of doubtful efficacy. The lack of an obvious threat and the technical difficulties being faced by continental BMD systems pretty much make homeland defence a non-starter.

But with a new Defence White Paper in development, force structure thinking on a timescale of two or three decades is appropriate. And, as noted above, North Asia is a theatre in which tactical ballistic missiles are already a *fait accompli*, and Iranian systems raise the stakes in the Persian Gulf. The priority given to operations in those regions will be determined as part of the white paper process, and that in turn will help to determine the priority of BMD for the ADF. If we did decide to increase the ADF's BMD capability for combat operations in those regions, one early step might be to arm one or more of our AWDs with an Aegis-based BMD capability. Even then, the capability would be more effective against a small number of North Korean or Iranian missiles than against a large number of Chinese ones. And we'd need to decide how often an Australian BMD-equipped warship would be likely to be deployed to relevant theatres.

The judgement comes down to a balance between the cost and capability of BMD systems, the potential operational gains, and the assessed likelihood of involvement in what, ultimately, previous white papers have seen as a discretionary task for Australia. If we were Japan or South Korea, for example, living permanently under the shadow of North Korean missiles, the calculus would be different. And we'd certainly have to reassess our priorities in the event of ballistic-missile proliferation emerging in Southeast Asia.

The other potential value of Australian BMD is its value to our alliance relationship with the US and our deepening security relationship with Asian partners—especially Japan. An Aegis BMD capability could deploy in tandem with American or Japanese forces, or potentially those of other Asian partners. On this question, the key consideration isn't so much whether we'd benefit directly from an investment in BMD, but whether or not other countries (especially the US) would, and the extent to which they'd value our contribution. This is a much more finely balanced consideration. If we were prepared to dedicate a particular AWD to such an alliance role, and perhaps even to homeport it in Guam, then the vessel might well be available to support alliance-related missions for 70% of its operational life. In short, it could make a broader contribution towards supporting a US presence in the western Pacific, without ever necessarily firing its interceptors against real targets. The capability would be more of a strategic enabler than an operational one.

Key judgements

We judge that an effective counter to long-range ballistic missiles is still many years away, so the prospect of defending continental Australia against ballistic missile attack lies well in the future. Meanwhile, BMD systems for use against short-, medium- and possibly intermediate-range ballistic missiles are improving, although they'll remain relatively easy to overwhelm for at least another decade and probably considerably longer. It will still be sensible for countries within range of such missiles to invest some portion of their defence budget in BMD, but that argument gets harder to sustain for countries that are more geographically remote.

In the absence of any ballistic missile threat in Southeast Asia, the near-term priority of BMD for Australian forces depends strongly on the emphasis given to operations in North Asia and other regions where ballistic missile systems might be encountered, such as the Persian Gulf. That's a call for the next Defence White Paper to make—but those areas haven't been recognised as force structure determinants in previous white papers.

For Australia today, the strongest argument for committing to greater efforts in the BMD field lies in our possible alliance role in the broader western Pacific. The US is grappling with the problems posed by a growing Chinese anti-access capability that includes ballistic missiles, and it makes sense for us to be aware of our ally's priorities. But that doesn't mean a big investment is required in this specialist area. Other parts of the ADF force structure (not least, submarines) also represent valuable alliance contributions, and a sizeable expenditure on BMD would have opportunity costs for the ADF and for the US as well.

With a continued modest investment in BMD research and development efforts, and a watchful eye on defensive technologies as they mature, Australia will be well placed to adopt them in the future, should externalities make that desirable.

Notes

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- 11 Michael Gilmore, Director, Operational Testing and Evaluation, in testimony to the House Armed Services Subcommittee on Strategic Forces, 8 May 2013.
- 12 See Joint Standing Committee on Foreign Affairs, Defence and Trade report, paragraphs 5.17–5.20.
- 13 Ronald O'Rourke 2013. *Navy Aegis Ballistic Missile Defence Program: background and issues for Congress*, Congressional Research Service, RL33745, 17 October, pp. 8–9.

Acronyms and abbreviations

ADF	Australian Defence Force
BMD	ballistic missile defence
DOT&E	Director, Operational Testing and Evaluation (US)
GAO	Government Accountability Office (US)
ICBM	intercontinental ballistic missile
IRBM	intermediate-range ballistic missile
MDA	Missile Defense Agency (US)
NAS	National Academy of Sciences (US)
THAAD	Terminal High Altitude Area Defence
WMD	weapon of mass destruction

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