Missile developments in Southern Asia: a perspective from India

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Credible nuclear deterrence presupposes the availability and integration of certain essential components that collectively constitute a nuclear arsenal. Delivery systems, deployable across a variety of platforms and of requisite range and reliability, are one such critical element. Accordingly, in the last decade the three nuclear-weapon states in Southern Asia[1] – China, India and Pakistan – have been engaged in developing missiles that they consider necessary to support their respective deterrent needs.

This paper identifies recent trends in missile development in the region, focusing on the above-mentioned states. It captures capability trends, considers the differing capability emphasis among the three countries depending on their approach to nuclear deterrence and assesses the impact of missile developments on strategic stability.

Increases in missile type and quantity

The first regional trend is the movement towards greater variety of missile types and increased inventory size. This pattern can be seen in China, India and Pakistan, although their individual reasoning and the pace of addition differ according to their disparate threat perceptions, technological capabilities and resource availability.

China's pursuit of missiles has been notable over the last decade. In 2016, the United States Defense Intelligence Agency (DIA) described China's missile forces – the People's Liberation Army Rocket Force (PLARF) – as 'the world's largest and most comprehensive'.[2] In 2019, then DIA director Lt-Gen. Robert Ashley, Jr stated that in 2018 'China launched more ballistic missiles for testing and training than the rest of the world combined'.[3] The US Department of Defense's (DoD) 2020 Annual Report to Congress on China's military capabilities corroborated this, documenting an increase in all PLARF missiles with the exception of short-range ballistic missiles (SRBMs). The report emphasised the PLARF's improvement to systems planned for nuclear-weapons delivery.[4] No official figures are available from China on its missiles or nuclear holdings. However, estimates are available in publications such as the International Institute for Strategic Studies's (IISS) *The Military Balance*, tHe Stockholm International Peace Research Institute's (SIPRI) *SIPRI Yearbook,* the *Nuclear Notebook* of the Bulletin of Atomic Scientists and periodic US DoD reports. The 2020 DoD report highlighted an increase in Chinese intercontinental ballistic missile (ICBM) launchers from roughly 60 in 2010 to 100 in 2020.[5] The 2021 edition of *The Military Balance* places the number of ICBM launchers at 104.[6] In 2020, SIPRI reported that China had 188 launchers for land-based nuclear missiles, having increased from 130 in 2011.[7] This figure includes ICBMs, excluding the DF-41 (CH-SS-20), for which no numbers are available; medium-range missiles, such as the DF-21 (CH-SS-5), with a range of 1,750–2,150 kilometres; and the DF-26 (CH-SS-18), an intermediate-range ballistic missile (IRBM) with an estimated range of 3,000–4,000 km.

The growth of China's IRBM inventory is significant, having increased from a likely maximum of 30 missiles in 2018 to around 200 in 2020.[8] While not all these missiles are thought to be for nuclear delivery given that the DF-26 is dual-capable, Washington is concerned by the rapid increase in the number of these systems that Beijing can field. Although the reason for the US withdrawal from the Intermediate-Range Nuclear Forces

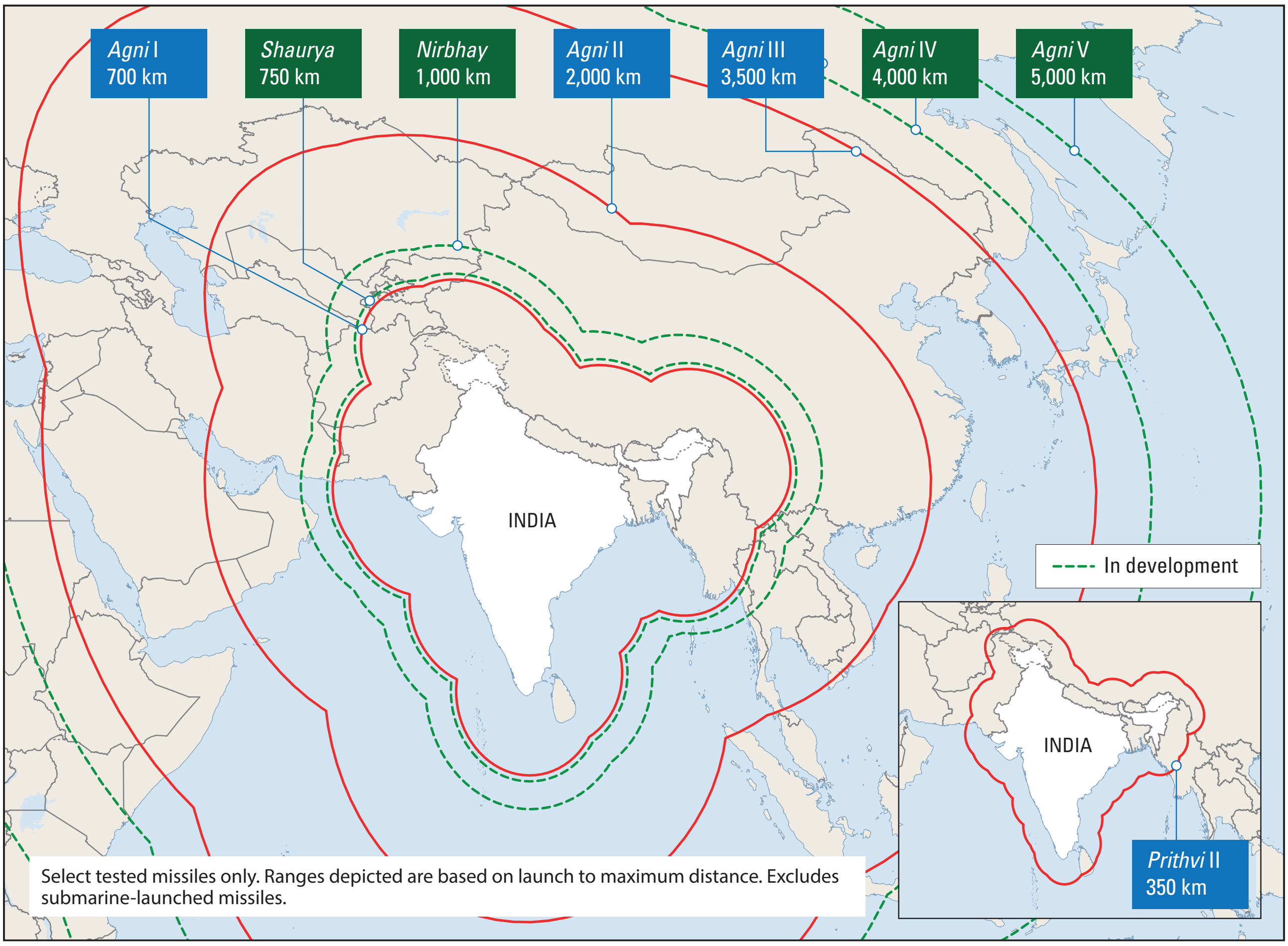

Figure 1. **India's notional missile ranges** **Source:** IISS

(INF) Treaty was Russia's violation of the agreement due to its development of the 9M729 (SSC-8 *Screwdriver*) cruise missile, US officials had noted when the treaty was in force that its restrictions meant the US lacked comparable capabilities to those of China.[9] Washington's decision to withdraw from the treaty has also been mentioned by analysts in the context of the 'rising US–China strategic competition and the rapid modernisation of Chinese military capabilities'.[10] Meanwhile, from China's perspective, the perceived threat from the US – particularly in the Taiwan contingency – accounts for its focus on intermediate- and intercontinental-range missiles.

Pakistan has also increased the number and variety of missiles in its arsenal. Islamabad's ballistic-missile inventory is dual-capable; it is specifically structured to be able to both deter and counter India's conventional superiority. Pakistan currently deploys six types of ballistic missile, which may be variously classified as close, short and medium range. These include the only Pakistani liquid-fuelled system – the *Ghauri* (*Hatf*-5, 1,250–1,500 km) – and solid-fuelled missiles, namely, *Abdali* (*Hatf*-2, 180 km), *Ghaznavi* (*Hatf*-3, 290 km), *Shaheen*-1 (*Hatf*-4, 600–750 km) and *Shaheen*-2 (*Hatf*-6, 1,500–2,000 km). The *Nasr* (*Hatf*-9, 60–70 km) is projected for battlefield use as a 'quick response system' to carry nuclear warheads 'of appropriate yield with high accuracy' and is considered a 'shoot and scoot' system.[11] The stated purpose of this capability is to offset India's superior conventional forces in limited conflict scenarios. However, the medium-range *Shaheen*-2 and the intermediate-range *Shaheen*-3 (2,750 km, currently in development), are likely intended to be the mainstay of Islamabad's strategic deterrent with a counter-value role, as compared to the close-range missiles deployed for battlefield use.[12] The total number of Pakistan's missile launchers in 2019 was estimated to be 156 for 160 nuclear warheads, which is nearly double the 2009 estimates.[13]

India has four types of land-based ballistic missile in service for nuclear-weapons delivery. These are the short-range *Prithvi* II (350 km) and *Agni* I (700 km), medium-range *Agni* II (2,000 km) and intermediate-range *Agni* III (3,500 km). Both the *Agni* IV (3,500–4,000 km) and *Agni* V (5,000 km) remain in development. In October 2020, India tested the *Shaurya* missile, which has an estimated range of 700–1,000 km.[14] Fielding plans are not known but it has been described as a canisterised missile for rapid deployment.[15] India's missile capabilities are steadily increasing to address the potential threat posed by two nuclear-armed adversaries, one on each side of its unresolved borders. While there have been no official statements on the development of missiles with ranges of over 5,000 km as New Delhi's current threat perceptions do not justify such a requirement, speculation on research and development (R&D) of longer-range missiles has periodically surfaced. This is the result of statements to this effect by the leadership of the Defence Research and Development Organisation (DRDO), which is responsible for developing India's missiles systems, among other equipment. Such statements could be driven by organisational interests and the desire for technological progression, or it could reflect some thinking within India's defence and security community. India is estimated to have 86 missile launchers and around 150 nuclear warheads. The number of India's warheads has roughly doubled from 60–80 in 2010, a similar quantitative trend to Pakistan.[16]

Mobility of ballistic missiles

In order to improve survivability, China, India and Pakistan have moved from liquid-fuelled to solid-propellant missiles over the last decade. Liquid-fuelled missiles are more vulnerable because of the time needed to fuel them before launch, which also curtails mobility. Missiles utilising solid propellants can also be canisterised and hence provide users with the advantages of speed, mobility and launch concealment.

Mobile systems, however, also require better infrastructure, such as adequate load-bearing roads, bridges and, in the case of India, railways (since India has opted for rail-mobile missiles). Additionally, mobile units require sufficient fuel reserves for the transporter erector launcher (TEL) vehicles to ensure suitable freedom of movement for large and heavy missiles. The capacities of the three countries to cater for these requirements varies. While each possesses the relevant technologies, they likely face different challenges in building the necessary infrastructure, overcoming issues related to land acquisition and ensuring suitable funding.

China, India and Pakistan see missile mobility as increasingly necessary due to improvements in potential adversaries' intelligence, surveillance and reconnaissance (ISR) capabilities and developments across all three states in conventional precision-strike capabilities. China has concentrated on at least four road-mobile missiles of different ranges, especially the DF-26 and DF-31AG, over the last three years. Pakistan has made all its land-based missiles road mobile, and India has also sought to exploit its road and rail networks for this purpose. India's extensive and robust rail network offers a credible means to enhance missile mobility, providing the advantage of quick dispersal and the possibility of deception through the use of dummy missiles.

Deployment at sea

Conventional wisdom dictates that placing nuclear missiles on stealthy, underwater platforms in the ocean best ensures their survivability, and the three countries have focused also on introducing sea-based deterrents. While China and India have identified nuclear-powered ballistic-missile submarines (SSBNs) for this purpose, Pakistan has opted so far for conventional diesel-electric submarines with submarine-launched cruise missiles (SLCMs).[17]

China is ahead of others in the region and has graduated to second-generation SSBNs with the deployment of Type-094 or *Jin*-class submarines. Six are believed to be in service, having partially overcome problems of high noise levels and radiation leaks that plagued the earlier Type-092 or *Xia*-class SSBN.[18] Each *Jin*-class submarine is reportedly armed with 12 single-warhead submarine-launched ballistic missiles (SLBMs), the *Julang*-2 (JL-2)/(CH-SS-N-14), with an estimated range of 7,000 km or more.[19] The People's Liberation Army Navy (PLAN) is reported to have started development on the successor Type-096 SSBNs, which would be even quieter and carry the JL-3, which has a range of at least 10,000 km.[20] The PLAN's new SSBN is expected to begin construction in the early 2020s.[21]

Pakistan established a Naval Strategic Forces Command (NSFC) in 2004 as part of its nuclear command-and-control architecture. In 2012, the country

Figure 2. **Test launch of an Indian K-15 *Sagarika* SLBM in the Bay of Bengal, January 2013. With a range of 700 km, the K-15 is designated for service on *Arihant*-class submarines, the second of which – the INS *Arighat* – is expected to be commissioned in 2022. The K-15 SLBM is expected to be replaced with the longer range K-4 SLBM at some point by the mid-2020s.** **Source:** Getty

moved further on its intention to develop a sea-based nuclear capability with the inauguration of the NSFC headquarters.[22] In 2014, it was reportedly considering deploying nuclear-armed cruise missiles on the frigate PNS *Zulfiqar*. In January 2017, Islamabad conducted its first test of an SLCM, the *Babur* III, from an underwater mobile platform.[23] Further tests followed. The missile – armed with nuclear warheads – is assumed to be intended for deployment aboard some of the *Agosta*-class diesel-electric submarines.[24] Pakistan is also buying Type-039A *Yuan*-class submarines from China, which may serve as an additional SLCM platform.

INS *Arihant*, India's first SSBN, began sea trials in 2014 and was commissioned into the navy in 2016. In November 2018, Prime Minister Narendra Modi announced the completion of its first deterrent patrol.[25] The *Arihant* is equipped with 12 700 km-range *Sagarika*, or K-15, SLBMs. In the future, *Arihant* and boats in its class – of which INS *Arighat* is expected to be commissioned in 2021 – are expected to be armed with the longer-range K-4 SLBM, which has been tested up to 3,500 km.[26] It is expected that there will be further missile-range extensions to allow SSBN patrols to be conducted at greater distances.

China, India and Pakistan consider taking their nuclear weapons out to sea as a logical step to enhance deterrence through dispersal. For China and India, this assumes greater relevance as a way of ensuring a second strike given their no first use (NFU) policies. Although all three countries' current seagoing platforms and missiles may suffer from technical and operational constraints,[27] Beijing, Islamabad and New Delhi consider them critical for credible deterrence.

Introduction of MIRV and MaRV technologies

China has been miniaturising warheads to allow for the deployment of multiple independently targetable re-entry vehicles (MIRVs) since the late 1990s.[28] In the past decade, it has reportedly deployed MIRVs on a small number of its silo-based, liquid-fuelled ICBM, the DF-5B (CH-SS-4 Mod 3).[29] At a military parade in Beijing in October 2019, China showcased its new solid-fuelled MIRVed missile, the DF-41, estimated to be capable of carrying at least three, and up to ten, warheads.[30]

Given the large amount of nuclear ordnance that a single MIRVed missile can carry, they are viewed as first-strike weapons. A state could use such a capability for a first strike to maximise attrition of enemy forces. For this reason, MIRVed missiles may pose problems for China's declared NFU policy. However, China seems to perceive them as necessary to improve its penetration capabilities with regard to US ballistic-missile defence (BMD).[31] With the same goal in mind, China has also been developing and testing manoeuvrable re-entry vehicles (MaRV) to evade interception by missile defences during a warhead's terminal stage of flight by performing mid-course manoeuvres while still accurately guiding the payload to the target with the help of terminal guidance.

Pakistan is also developing MIRVed missiles. This became evident in January 2017 with the announced test firing of *Ababeel*, which Pakistani officials claimed has a range of 2,200 km and the capability to deploy multiple warheads at different targets.[32] Although the missile will need more testing before it is ready for deployment, Pakistan's intent is clear, and Islamabad justifies its developments in this area as a countermeasure against possible Indian BMD. India has conducted R&D on BMD technologies and the DRDO has claimed that it has successfully intercepted targets during tests.[33] As yet, no decision has been made on deployment. In any case, India's BMD is expected to be of limited coverage and capability and is unlikely to undermine the current nuclear-deterrence equation with Pakistan.[34] This is the predominant view of the strategic community within the country too.

India has not officially declared any interest in MIRVed missiles. Again, while some senior DRDO scientists have discussed the potential for developing such a capability, there is no evidence as yet that the Indian government has approved a MIRV programme.[35] India's priorities are to bring the *Agni* V into service as a deterrent against China; build and deploy better and more multiple re-entry vehicles (MRVs), which can hit the same target with several warheads, to ensure 'massive retaliation' as promised by India's nuclear doctrine; and develop MaRVs, in order to defeat potential BMD. The decision to move towards MIRVed missiles, if taken, is likely to be influenced by perceived threats from China and Pakistan in light of changes in their respective force structures and postures. Having demonstrated a MIRV capability of sorts through successful launch of multiple satellites into distinct orbits with one rocket, India does not appear in a rush to operationalise the capability and finds it prudent to wait and watch.

Payload ambiguity

India has maintained a distinction between nuclear and conventional missiles that sees the separation of command and control over missile units. It has avoided integrating its nuclear capabilities with conventional forces – the Strategic Forces Command administers and manages India's nuclear arsenal. One analyst has noted that in the case of India, 'nuclear weapons … are developed, maintained, and deployed through parallel systems to conventional forces, rather than being integrated with them'.[36]

By contrast, China and Pakistan have not only claimed dual-capability roles for some of their delivery systems but also commingled them. In the case of China, both nuclear and conventional versions of the DF-26 missile are available within the same brigade and are also under the command and control of the PLARF.[37] Such commingling is intended to enhance nuclear deterrence through ambiguity. Given the threat that China perceives from US BMD and its superior long-range precision-strike capabilities launched from air and sea platforms, Beijing appears to find the risk of nuclear entanglement worthwhile.[38] In doing so, China seeks to deter by signalling that the US could inadvertently target sites where nuclear and conventional assets are located, thereby increasing the potential for escalation. Pakistan follows the same logic to deter India's superior conventional capabilities. Such a strategy is arguably fraught with risks of misperception and miscalculation that could lead to inadvertent escalation and potentially nuclear use.[39]

Growing sophistication of cruise missiles

At present, China is not believed to have assigned nuclear roles to its cruise missiles. The most recent US DoD reports have not attributed nuclear delivery for Chinese ground- or air-launched cruise missiles,[40] although US reports have previously mentioned Chinese cruise missiles as having nuclear capabilities.[41] Beijing, however, has introduced updated variants of cruise missiles over the last decade, including the CJ-10A.[42]

Unlike China's cruise missiles, Pakistan's are dual-capable. Islamabad has emphasised the nuclear role of its land-attack cruise missiles (LACM) to increase diversity in targeting options and provide it with greater flexibility in operational deployments.[43] Pakistan first tested a ground-launched cruise missile (GLCM), the *Babur*, in 2005. The system is believed to have entered service in 2010 and has a range of 350–700 km.[44] It is road mobile and capable of carrying either a conventional or nuclear warhead.[45] According to Inter-Services Public Relations (ISPR), the media and public-relations organisation of Pakistan's armed forces, the missile utilises a turbofan engine enabling it to travel at high subsonic speeds. The ISPR also claims that it can fly low-level, terrain-hugging flight paths to hamper detection and penetrate air defences. The *Babur* is also declared to have a high degree of manoeuvrability and an advanced navigation and guidance system.[46] While it is difficult to ascertain if Pakistan has been able to indigenously build all the complex technologies the *Babur* requires, including the high level of miniaturisation and computing capability, the possibility of help from China cannot be discounted. (Pakistan has received Chinese assistance while developing other technologies.[47]) The *Babur* II, a subsonic extended-range variant of the *Babur* I, is under development with a purported increased range of 1,000 km. Pakistan claimed the system was successfully tested in April 2018,[48] although a later test in March 2020 was reportedly unsuccessful.[49]

Beyond GLCMs, Pakistan has also developed a dual-capable air-launched cruise missile (ALCM). The *Ra'ad* ALCM was first tested in August 2007 from a Pakistan Air Force (PAF) *Mirage* IIIE or *Mirage* 5 and is declared to have a range of 350 km.[50] It is possible that it could be integrated onto the JF-17 – a multi-role combat aircraft of Chinese origin – in the future, of which more than 120 are in service. Additional upgraded variants of the aircraft are being co-produced by Pakistan and China.[51] The ISPR describes *Ra'ad* as a 'state-of-the-art' cruise missile 'with stealth capabilities … a low altitude, terrain hugging missile with high manoeuvrability' able to deliver nuclear and conventional warheads with 'pinpoint accuracy'.[52] Its role is to target fixed installations such as radar sites, command-and-communications installations, and infrastructure, such as ports and refineries.

Figure 3. **A *Nirbhay* cruise missile at a military parade in New Delhi, 2018. The conventionally armed LACM is India's first indigenously produced cruise missile. The terrain-hugging subsonic missile will have a range of 1,000 km and improve India's counterforce options.**

Source: Getty

India has not built any cruise missiles for nuclear delivery. Although it has the supersonic *Brahmos* GLCM that it co-developed with Russia, the system is not intended for nuclear delivery. Instead, its role is to undertake precision attacks on counterforce targets. *Brahmos* currently has a range of 290 km, with variants in operation with all three branches of the armed forces. It has recently been tested with an augmented range of 400 km and there are reports that this could be enhanced further.[53] Additionally, New Delhi is also developing *Nirbhay*, a subsonic LACM with an intended range of 1,000 km. Like *Brahmos*, *Nirbhay* is also being developed for precision strikes against long-range targets, although there is not any publicly available information to suggest it will have a nuclear role. As stated earlier, India has refrained from mixing conventional and nuclear missiles. This serves to minimise the possibility of entanglement caused by designating missiles for multi-role functionality.

Hypersonic missiles: new kids on the block

Hypersonic delivery systems, such as boost-glide vehicles or hypersonic cruise missiles (HCMs), travel at speeds faster than Mach 5 through the upper atmosphere. While existing ICBMs attain and sustain hypersonic speeds for most of their exo-atmospheric flight, in the case of a hypersonic glide vehicle (HGV), most of its flight is within the upper atmosphere. For an HCM, notionally at least, the flight path is all within the atmosphere. Both systems provide users with significant levels of manoeuvrability compared to traditional ballistic missiles, which creates challenges for missile-defence systems.

With an eye to US BMD capabilities, China has invested in endo-atmospheric hypersonic delivery systems to buttress regional deterrence by making defence against such weapons more difficult. If equipped with suitable guidance systems, these can be used for precision strikes against high-value fixed targets, such as command-and-control installations or hardened bunkers, and potentially time-sensitive mobile targets, such as maritime vessels. China is assessed to have the world's largest and most well-funded hypersonic-missile research programme.[54] Its DF-17 HGV was unveiled in October 2019; it is believed to have a range of roughly 2,000 km and may well be dual-capable. China is also developing an air-launched ballistic missile, the CH-AS-X-13, which will be carried by a variant of the H-6 bomber. Some analysts have suggested that this might be capable of travelling at hypersonic speeds.[55]

India's hypersonic-weapons programmes, of which there are few details in the public domain, include the HGV and the HCM. India conducted two tests of its Hypersonic Technology Demonstrator Vehicle (HSTDV) – a scramjet demonstrator for the HCM – in 2020.[56] Given that the first test of the HSTDV in June was unsuccessful, the second successful attempt in September was important to validate the technologies.[57] India's programmes remain in early experimental stages. New Delhi's motivation to remain engaged with these technologies is perhaps influenced by its experience of being on the wrong side of technology-denial groups in the case of nuclear technology. While there are no efforts as yet to restrict hypersonic technologies specifically – beyond Russia and the United States' bilateral New Strategic Arms Reduction Treaty (New START) obligations, which restrict their deployed and non-deployed nuclear warheads and delivery platforms – India would want to be at the table as a rule-making country that already possesses hypersonic technology, in the event of future restrictions. Moreover, if China's BMD was to grow in scope and increase the speed of its deployment, it could push the pace of India's decision-making on hypersonics.

Pakistan is yet to demonstrate any capability in this domain. Some Pakistani strategic analysts have recommended 'a two-pronged approach' that would see Pakistan develop or acquire ramjet technology from a friendly country and indigenously develop its own scramjet technologies.[58] This ambition would likely grow if India showed a committed pursuit of hypersonic technologies. In that case, there is the possibility of Chinese assistance in technology, or even complete weapons systems being made available to Pakistan, given their 'iron brother' relationship.[59] Pakistan's ability to independently support the infrastructure required for scramjet development is questionable.

Implications of missile developments for strategic stability

It is evident that the offensive and defensive missile forces of China, India and Pakistan are more capable and varied than they were a decade ago. As each country's inventories evolve, they will inevitably impact the others' threat perceptions and potential responses. Based on how the developments across the borders are perceived, counteractions could be taken, leading to a chain of action and reaction.

Some missile developments may be more strategically destabilising than others. For instance, nuclear capabilities that ensure survivability enhance strategic stability by providing reassurance that an adversary's first strike cannot degrade retaliatory capability. The mobility of land-based missiles and their dispersal across different platforms can be beneficial in this context.

Of the various delivery platforms spread across nuclear triads, SSBNs and SLBMs provide states with second-strike assurances, which enhance deterrence stability. However, nuclear dispersal at sea also brings its own set of challenges, particularly of incidents at sea that could lead to inadvertent escalation. These are exacerbated when the areas of operation of geographically proximate neighbours overlap, or when their relations are particularly prone to crises. As China and India begin to operate SSBN patrols, these challenges will increase. Not much is currently known about their operating standards and procedures. However, a lack of public knowledge does not mean these protocols do not exist, or that China and India do not understand the risks. Both states can be expected to have closely observed other countries that have long operated SSBNs and would have drawn up their own procedures and processes accordingly.

Another factor that lends a measure of strategic stability to the region is the current force postures of the three countries. Information available in the public domain regarding their alert levels indicates that they maintain their respective arsenals in a low-alert state, with the majority of missiles de-mated: i.e., where the warheads are not routinely kept mounted on delivery systems. While availability of canisterised missiles will make future systems more ready than those that are recessed, the number of such systems is expected to be small.

It remains to be seen whether such postures can be sustained if political relations remain strained and technological advancements offer new options. For instance, reports have surfaced regarding China's desire for a strategic early warning system, possibly developed with assistance provided by Russia.[60] If this capability were deployed and Beijing perceived the threat from US missile capabilities to have grown, China could be tempted to abandon its low-alert posture in favour of 'launch on warning', a posture for which some Chinese analysts have advocated if certain conditions are met.[61] An upending of China's strategic alert posture would likely compel India to reassess its own deterrence requirements.

While such a development may or may not occur, a more urgent issue for those in the region is the commingling of dual-use missiles on land and sea and the risks this entails. Pakistan and China utilise ambiguity, ostensibly to enhance deterrence. However, it also heightens the potential for inadvertent escalation. For instance, if a storage site housing both conventional and nuclear missiles were to be struck by an adversary that mistakenly believed only conventional missiles were present, the targeted state might incorrectly conclude that its nuclear forces were at risk, increasing the potential for inadvertent nuclear escalation. It remains unclear whether states that commingle nuclear and conventional systems are overconfident in assessing their ability to manage the risks or whether they accept such risks as being an acceptable cost for their ambiguous deterrence posture.

The introduction of hypersonic-missile technology will also have an adverse impact on strategic stability. Glide vehicles in particular introduce ambiguity regarding warheads (especially where the possessor states have not clarified the missile's payload) and targets (due to the manoeuvrability of the glide body). If a targeted state's early warning radar detected an inbound HGV but was uncertain as to whether it was conventionally or nuclear armed and unable to ascertain its target, the tendency among military planners would be to assume the worst.

This could prompt a shift towards more reactive postures, such as launch on warning or 'launch under attack', to ostensibly enhance deterrence. These shifts

Figure 4. **China's DF-17 at a military parade in Beijing, October 2019. China's pursuit of hypersonic weapons could spur similar developments in India, with associated problems such as warhead ambiguity and shortened reaction times having detrimental impacts for strategic stability** **Source:** Getty

would heighten the risk of misperception and miscalculation in moments of crisis, leading to a tendency towards pre-emption. Countermeasures envisaged to detect and potentially intercept hypersonic missiles include the placement of sensors in outer space in the more immediate time frame and interceptors more distantly. While the latter would require substantial developments in current technologies, the weaponisation of outer space could be further aggravated once the development of hypersonic missiles becomes the norm.

Several of China's missile-technology advances have come in response to perceived threats to its nuclear deterrent from US nuclear, conventional, cyber and space capabilities. The nuclear dynamic between China and the US transcends the nuclear domain and is affected by the nuclear relationship between the US and Russia. US–China bilateral developments also have downstream effects on India and Pakistan.[62] The resultant strategic chain that is formed is therefore influenced by global geopolitical equations, the presence or absence of arms control, and technological advancements. Southern Asia's regional nuclear dynamics, meanwhile, are also affected by individual state-specific drivers, such as technological obsolescence and organisational imperatives. In fact, the influence of the latter factor could grow in the coming years as China, India and Pakistan operationalise capabilities that fulfil their versions of credible deterrence. The military-industrial complexes created to fulfil these deterrence requirements will begin to look for new technologies to peddle to national leaderships.

Unless inter-state relationships improve through dialogue on strategic issues, hedging strategies will fuel offence–defence spirals. Missile developments in Southern Asia can therefore best be influenced by improvements in the overall security environment among China, Russia and the US. Strategic stability at the global level could similarly encourage cooperative approaches in the regional nuclear dynamics.

Notes

1 The prevalent term for the region is South Asia. However, the nuclear dynamic between India and Pakistan in a narrow South Asia frame that does not include China is not reflective of the reality of the regional situation. Hence the term Southern Asia.

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3 Lt-Gen. Robert P. Ashley, Jr, 'Russian and Chinese Nuclear Modernization Trends', US Defense Intelligence Agency, 29 May 2019, https://www.dia.mil/News/Speeches-and-Testimonies/Article-View/Article/1859890/russian-and-chinese-nuclear-modernization-trends/.

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6 See 'Chapter Six: Asia' in IISS, *The Military Balance 2021* (Abingdon: Routledge for the IISS, 2021), p. 249.

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8 US, Office of the Secretary of Defense, 'Military and Security Developments Involving the People's Republic of China 2018', Annual Report to Congress, 16 May 2018, https://media.defense.gov/2018/Aug/16/2001955282/-1/-1/1/2018-CHINA-MILITARY-POWER-REPORT.PDF; and US, Office of the Secretary of Defense, 'Military and Security Developments Involving the People's Republic of China 2020', p. 59.

9 See, for example, 'Statement of Admiral Harry B. Harris Jr., U.S. Navy Commander, U.S. Pacific Command Before the Senate Armed Services Committee on U.S. Pacific Command Posture', US, Senate Armed Services Committee, 27 April 2017, p. 7, https://www.armed-services.senate.gov/imo/media/doc/Harris_04-27-17.pdf.

10 ANI, 'China Features in US Withdrawal from INF Treaty', *Business Standard*, 11 December 2018, https://www.business-standard.com/article/news-ani/china-features-in-us-withdrawal-from-inf-treaty-118121100151_1.html.

11 'Shoot and scoot' refers to the ability to fire at a target and then rapidly redeploy to avoid counter-fire. See Press Release by Pakistan's Inter-Services Public Relations, PR 94/2011, 19 April 2011, https://www.ispr.gov.pk/press-release-detail.php?id=1721#:~:text=No%20PR%2D94%2F2011%2DISPR&text=The%20missile%20has%20been%20developed,accuracy%2C%20shoot%20and%20scoot%20attributes.

12 Press Release by Pakistan's Inter-Services Public Relations, PR-378/2015-ISPR, 11 December 2015, https://ispr.gov.pk/press-release-detail.php?id=3124.

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