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Introduction

1. India and China have been pursuing essentially a two pronged strategy in Asia, particularly in the Indian Ocean region. On the one hand, they are engaged in a growing economic partnership with a moderating influence on the strategic competition. On the other hand, they have been relentless in their pursuit of a militarily advantageous position in the region. The equation, however, is not comparable, with India having to account for Pakistan, while China has to contend with a US-Taiwan partnership.

2. So far as PLA's modernization plans are concerned they stem from its doctrine of of fighting and winning "local wars under conditions of informatization". This in essence means building up PLA's capabilities in the field of C4ISR i.e. command and control, computers, communications, information, surveillance and reconnaissance. Long range precision strikes, space support to the military and acquisition of potent cyber warfare capabilities are the other enablers on which PLA has been focusing. Over the years, roles and missions of PLA have been expanding and particular attention has been paid in providing budgetary support for development of capabilities in the field of advanced cruise missiles, short and medium range conventional ballistic missiles, anti-ship ballistic missiles, ballistic missile defence, counterpace weapons, and military cyberspace capabilities[1]. Though, all these efforts, according to the Pentagon's Report on China's military power, appear to be designed to enable anti-access/ area-denial (A2/AD) missions, or what PLA strategists refer to as "counter intervention operations" with a Taiwan focus, yet these capabilities can be easily switched to fight a local or regional war elsewhere.

3. PLA Second Artillery Corps has been a special area of attention of both political and PLA leadership. After having taken over as Chairman of the Central Military Commission in November2012, Xi Jinping during his visit to Second Artillery Corps observed that "the artillery force is the core strength of China's strategic deterrence, the strategic support for the country's status as a major power, and an important cornerstone safeguarding national security". Thus, the new leadership in China would continue to underscore the importance it

[1] Pentagon's Annual Report to Congress, "Military and Security Developments involving the People's Republic of China 2012" May, 2012

attaches to upgrade its missile forces[2]. PLA has been modernizing its short range ballistic missile force by consistently fielding advanced variants with improved ranges and payloads. China's capabilities in both short and medium range ballistic missiles have improved both in qualitative and quantitative terms.

Development of China's Ballistic Missiles

4. For a long period since the 1960s, the Chinese nuclear doctrine was based on a minimum credible nuclear deterrent, comprising of about 25-40 DF-4 and DF-5 ICBMs, of which 15-20 DF-5s were reportedly targeted at US targets. These ballistic missiles were static, based either on silos or deployed in caves to be rolled out for launch. In the late 1980s and 1990s, China pursued a vigorous programme of missile development designed to increase the mobility of its ballistic missile force without any significant efforts to increase its size. According to the US National Air and Space Intelligence Centre[3], at present, "China has the most active and diverse ballistic missile development programme in the world. It is developing and testing offensive missiles, forming additional missile units, qualitatively upgrading certain missile systems, and developing methods to counter ballistic missile defences. China's ballistic missile force is expanding in both size and types of missiles. New theatre missiles continue to be deployed in the vicinity of Taiwan, while the ICBM force is adding the CSS-10 Mod 1 (DF-31) and CSS-10 Mod 2 (DF-31A) ICBMs. The new JL-2 submarine-launched ballistic missile (SLBM) is also under development. Future ICBMs probably will include some with multiple independently-targetable re-entry vehicles, and the number of ICBM nuclear warheads capable of reaching the United States could expand to well over 100 within the next 15 years".

5. While pursuing determined efforts to improve the survivability of its land based ballistic missile deterrence, China continued to actively oppose all US attempts at developing theatre and national BMD. In a 2000 interview, China's chief arms negotiator Sha Zhukang described the projected US missile defence system as "threatening to China" and warned that China would resort to producing more nuclear warheads and developing more effective evasion methods for their missiles if the US went ahead with the deployment of theatre missile defences.[4] The trend of strong public opposition to the development of BMD continued. By the time President Bush announced his intention to withdraw from the Anti

[2] Yuan Yue, "Leaders of 2nd Artillery Corps Pledge their loyalty to party", *Sina English*, 13 December, 2012 available at http://english.sina.com/china/2012/1212/537222.html

[3] Ballistic and Cruise Missile Threat, National Air and Space Intelligence Centre, Wright-Patterson Air Force Base, Ohio, 2009, downloaded from http://www.fas.org/programs/ssp/nukes/NASIC2009.pdf.

[4] Jane Perlez, "China Likely to Modernize Nuclear Arms, US Believes," *The New York Times*, 12 May 2000, http://www.nytimes.com/2000/05/12/world/china-likely-to-modernize-nuclear-arms-us-believes.html?pagewanted=1

Ballistic Missile (ABM) Treaty and called for the deployment of a missile defence system "to protect the United States and its allies from rogue nuclear nation" in 2001[5], the Chinese position had become more nuanced. Sun Yuxi, a spokesman for the Chinese Foreign Ministry, was reported as saying that though China was opposed to the development of a missile defence system, it was willing to engage in negotiations with the US. He stated that "the ABM treaty is the cornerstone of global strategic balance and stability. If such a treaty is undermined, the global strategic balance will be undermined, the international disarmament process will end, non-proliferation efforts will be obstructed and a new military arms race will commence. China hopes the United States will continue to abide by the ABM treaty and other existing international treaties on disarmament and arms control. If the United States decides to send a special envoy here, we are willing to have consultations on the issue".[6]

6. While taking such strong positions on the ABM treaty and attempts to develop BMD systems, China was never lax on the potential of and requirement for BMD systems. The earliest Chinese effort to indigenously develop a BMD system was the Project 640. The Academy of Anti-Ballistic Missile & Anti-Satellite was established in 1969 to develop Project 640. Despite the development of FJ-1 and FJ-2 intercepting missiles, the project was terminated during the 1980s under Deng Xiao Peng after the 1972 ABM treaty between the US and erstwhile USSR. However, China's interest in continuing development of BMD systems was rekindled after US withdrawal from the ABM Treaty in 2002 and developments in Taiwan. Chinese theatre and national BMD development in the intervening years till 2007 remained largely an enigma. On 11 January 2007, China surprised the entire world by successfully testing a direct ascent Anti-Satellite (ASAT) weapon. It was assessed that the ASAT system employed a KT-1 space launch vehicle (SLV), itself a modified DF-21 medium range ballistic missile (MRBM). The missile destroyed an ageing Feng Yun 1C (FY-1C) polar orbit satellite at approximately 865 kms above the earth's surface through kinetic impact. The test drew widespread condemnation, both for the manner in which it was carried out (resulting in a large amount of space debris, a major threat to low earth orbit (LEO) satellites) and the major shift in China's position concerning weaponization of space.

7. Having successfully changed course on its theatre and national BMD posture, China's determination to continue on the same course was driven home when on 11 January 2010, it tested its ground based midcourse missile interception technology. While the test apparently achieved its expected results, the exact missile used was not confirmed. Some analysts think that the missile used in the test was a HQ-9, HQ-12, or DF-21 variant. The Chinese Foreign Ministry emphasized the test was defensive, conducted over Chinese

[5] Bill Sammon, "Bush Scraps '72 Treaty for a Shield; Targets Pacts on ABMs as an Obstacle," *The Washington Times*, 2 May 2001, www.nti.org/e_research/profiles/China/.../chronology_2000-2004.html

[6] China Criticises US Missile Defence Plan, http://china.org.cn/english/2001/May/12533.htm

territory, and not targeted at any country. In an article in Liao Wang, a weekly news magazine published by Xinhua, Second Artillery Corps Senior Colonel Wu Tianfu, a professor at the Second Artillery Corps Command College, stated that if certain Western nations "had not frequently conducted anti-missile tests and space war drills, and extended their defensive strategies into a large swathe of territories in developing countries, it's unnecessary for China to have conducted an anti-missile interception test." Col. Wu continued to state that if continuously pressured and threatened, China would pursue this technology to ensure their defence, and indicated that further tests could be carried out.[7] In the article, Wu emphasized that the success of China's ground-based mid-course missile defence (GMD) test demonstrated significant progress by China in the development of "hit-to-kill," rapid precision-strike, guided and missile identification technologies.

8. It can be reasonably concluded that a major reason for the Chinese to move proactively into theatre BMD capability development, was the continuing deployment of US theatre and tactical BMD systems into East Asia (particularly Taiwan) and the clear edge both Russia and the US had achieved with respect to China in BMD capability. US attempts to deploy BMD systems in Eastern Europe and the Pacific Ocean, ostensibly to address the threat from Iran and North Korea, has clear implications for both Russia and China. However, development of advanced BMD capabilities by other countries has implications for the effectiveness of China's strategic deterrence and an expansion of its strategic forces is more clearly understood than a rapid expansion of its BMD capabilities. Since US and Russian strategic forces have neither gained in size or reach over the years, the expansion of the BMD capability has to be logically explained by other changes in the missile threat to China or by a well considered shift of its nuclear doctrine from minimum deterrence to war-fighting scenarios involving the use of IRBMs/MRBMs, possibly using conventional warheads.

9. After the March 2010 Ground-based Midcourse missile defence (GMD) test, some analysts suggested that it could also be a message to India in response to India's continued testing of the Agni-III and an eagerness to develop the Agni-V ICBM (at that point of time-Agni V was finally tested in April 2012), whose logical targets could only be in China. However, as Lora Salmaan suggests this was also a demonstration of the very same technology that it once denounced—much like China's nuclear test in 1964 and its anti-satellite test in 2007. As is their wont, prominent Chinese officials have publicly downplayed or discounted any credible strategic missile threat from India in the immediate future. Further, in the U.S. strategic calculus China, due to its GMD test of January 2010, became an important factor in addition to Russia for US Nuclear Posture Review of 2010[8].

[7] http://www.jamestown.org/single/?no_cache=1&tx_ttnews[tt_news]=35943

[8] Lora Salman, "Evolution of China's Ballistic missile Defense", August 23, 2012 available at http://carnegieendowment.org/2012/08/23/china-s-evolution-on-ballistic-missile-defense/dkpj

10. While developing the new BMD capabilities, China is continuing to rapidly expand its ballistic missile capability. The DF-31 and DF-31A road mobile missiles and the naval leg of the triad comprising of the JL-2 SLBM are now credible platforms. The reported deployment of the DF-21s in Tibet, and the assessed plans for deployment of the JL-1 and JL-2 SLBMs in the Indian Ocean region, point to an increased readiness of China to move from a minimal deterrent posture to a more aggressive one. Whether this capability development is directed at sending the appropriate messages to the US or is the precursor of a robust operational capability, is a moot point as far as Taiwan and India are concerned because China already has a sophisticated offensive capability against them using SRBMs (mainly against Taiwan but can also be shifted and used against India in certain contingencies), IRBMs and MRBMs. Still, the typical Chinese silence on the possible employment of emerging capabilities leads to significant uncertainties in modelling them.

Capability Evaluation

11. Apart from the GMD system in development (explained earlier), China has placed considerable reliance on BMD of critical target systems that cover not only the Second Artillery force structure but also value targets like Beijing and Shanghai. It is producing under license the Russian S-300PMU-2/S-300PMU-1 series of SAMs that have an ABM capability. It also produces the indigenous HQ-9 SAM system and the HQ-19 system that has been jointly developed with Russia. Both these systems possess some ABM capabilities. A new generation of anti-ballistic and anti-satellite missiles called the KT-1, KT-409, KT-2, KT-2A, KT-3, and other KT versions are in development. The PLA Navy has modern air-defence destroyers in the Type 052C Destroyer and Type 051C Destroyer.

12. As compared to the deceptive and secretive development of theatre BMD capability, Chinese ballistic missile capability has been extremely vigorous and declaratory. A large portion of China's strategic missile force is land based. On 1 October 2009, five missile systems - the DF-11, DF-15, CJ-10, DF-21C, and the DF-31A were displayed as part of the National Day Parade in Beijing. The DF-31 and DF-31A which are already in deployment phase are road-mobile, solid-fuelled missiles and have shortened launch preparation times. BMD countermeasures, to include manoeuvring re-entry vehicles (MaRV), multiple independently targeted re-entry vehicles (MIRV), decoys, chaff, jamming and thermal shielding are all under active development. The DF-31 and JL-2 will also probably be equipped with terminal satellite based navigation technology in order to improve their accuracy.

13. The most notable feature of China’s strategic missile force development in recent years has been its emphasis on developing an effective undersea deterrent. According to the 2008 Chinese Defense White Paper: "Since the beginning of the new century, in view of the characteristics and laws of local maritime wars in conditions of informationization, the Navy has been striving to improve in an all round way its capabilities of integrated offshore operations, strategic deterrence and strategic counterattacks, and to gradually develop its

capabilities of conducting cooperation in distant waters and countering non-traditional security threats, so as to push forward the overall transformation of the service. Through nearly six decades of development, a modern force for maritime operations has taken shape, consisting of combined arms with both nuclear and conventional means of operations." China's first ballistic missile submarine (SSBN) the Xia-class, or Type 092, has not been actively deployed. The Federation of American Scientists (FAS) reported in 2008 that China's single Xia-class SSBN left dry dock at the Jianggezhuang Naval Base near Qingdao, on China's eastern coast, where it had undergone a multi-year overhaul. The Xia-class submarine can deploy 12 JL-1 missiles, which are China's first generation of operational SLBMs. On 3 May 2007, satellite images available on Google Earth showed two Jin-class or Type- 094 SSBNs docked at the Bohai shipyard at Huludao. China is reported to have five Type-094 SSBNs under construction. These submarines will be equipped with the JL-2 which is the sea-based version of the DF-31.

14. China's ballistic missiles both deployed and under development along with their estimated numbers are listed at Appendix 'A' at the end of this paper. It is to be noted that the older missiles have single warheads with yield of 1-5 megatons (nominally 3.3 megatons). The upgraded versions have improved mobility and their yields range from 50-500 kilotons. A trend towards reducing the yield in favour of smaller size and greater accuracy is a natural progression. When compared with the Indian systems listed later, the higher yield stands out as Indian systems have a lower yield of the order of 20 kilotons.

India's Response

15. In response to Chinese moves, India too has initiated demonstrable capability development in theatre BMD. India's BMD programme is a spin-off from the missiles developed under the Integrated Guided Missile Development Programme (IGMDP) and on-going improvements in its radar capabilities. The Indian programme consists of the development of a two tiered system consisting of the Prithvi Air Defence (PAD) missile for high altitude interception and the Advanced Air Defence (AAD) Missile for lower altitude interception. India first tested the PAD in November 2006 followed by AAD in December 2007. On March 6, 2009, India again successfully tested the PAD system. The two tier system is intended to be in the class of the PAC-3 system to intercept IRBMs at distances of over 600 km. A new missile named the PDV was also reported in 2009. The PDV is intended to replace the existing PAD in the PAD/AAD combination. The induction of the PDV will complete the Phase 1 of the BMD system, allowing it to be operational by 2013. India is also developing two new anti ballistic missiles (AD-1 and AD-2) that can intercept IRBM/ICBMs as Phase 2 of its BMD system. Phase 2 is intended to give India capabilities in the class of the US Terminal High Altitude Area Defence (THAAD).

16. In addition to the indigenous efforts, India has launched an extensive technology cooperation programme with Israel to develop air defence systems. The Barak-NG programme was started in 2006; it has been upgraded in 2009 to develop an MR-SAM under

the designation Barak-8. The Barak-8 is primarily for the Indian Navy but there will be land version that will have an ABM capability, in the class of the US Patriot Advanced Capability (PAC-3). For several years India has also been in talks with the US for possible purchase of the PAC-3 and the USSR for import of the S-300V systems. Apparently, due to progress in its own efforts and possible very high costs besides many other complications India has not as yet gone in for cooperation with the U.S. India has also benefitted from cooperation with Israel to build in the capabilities of the EL/M-2080 Green Pine radar[9] part of the Israeli Arrow-2 system, in building its Swordfish Long range Tracking Radar (LRTR). The LRTR has a reported range of over 600 kilometres which the DRDO plans to raise to 1400 kilometres. As far as a Battle Management/Command, Control and Communications (BM/C3) system is concerned, there are no credible reports of such a system being in development.

17. While the PAD-AAD programme had been classified as a technology demonstrator till 2011, the DRDO Chief Saraswat, in an April 2012 declared it to be fully developed against IRBMs with a range of 2,000 kilometres. The DRDO has also stated that the second phase will be completed by 2016, giving India the technical capability to ICBMs with ranges of over 5,000 kilometres. According to the DRDO, "The Ballistic Missile Defence (BMD) shield is now mature. We are ready to put phase one in place and it can be put in very short time. ..... The shield.....can be put in place in two cities in the country, where the infrastructure is available. However, the two places have not yet been identified and the selection will be made at the political level." Of course, many analysts have treated this claim with a great degree of scepticism. Saraswat also observed that India has all the building blocks for an ASAT system in place.

18. The Indian offensive portfolio is also evolving gradually with continuing testing of the Agni III missile. Agni V with an estimated range of 5000 km was tested in April 2012 thus adding to India's deterrent capabilities. This was designed to place India in the ICBM class as far as strike capabilities are concerned. Appendix 'B' to this paper at the end lists India's ballistic missiles, both deployed and under development along with their estimated numbers.

9. The Green Pine is Active Electronically Scanned Array (AESA) solid state radar. It operates at L band - in the range 500 MHz to 1,000 MHz, or 1,000 MHz to 2,000 MHz. It reportedly operates in search, detection, tracking, and missile guidance modes simultaneously, capable of detecting targets at ranges of up to about 500 km and is able to track up to 30 targets at speeds over 3,000 m/s. It discriminates targets from natural clutter and countermeasures, illuminates the true target and guides the missile to within 4 m of the target. The effective radiated power (ERP) of the Green Pine also makes it a possible candidate for conversion into a directed-energy weapon, by focusing pulses of radar energy on target missiles. The energy spikes are tailored to enter missiles through antennas or sensor apertures where they can fool guidance systems, scramble computer memories or even burn out sensitive electronic components.

Projected Capabilities till 2017

19. Projecting ballistic missile capabilities over the long term is subject to great risks given the complexity of the technology and the interplay with an equally complex international environment. However, it is possible to project five years hence till 2017, with confidence pertaining to the qualitative profile and with lesser confidence as far as the quantitative profile is concerned. Table 1 compares the projected Chinese and Indian ballistic missile (nuclear capable) capabilities and Table 2 compares the projected BMD capabilities.

Table 1: Chinese and Indian Ballistic Missile Capability 2017

Capability		China	India	Remarks
Main Capability	Attributes			
Ground Based	ICBMs	140	(?)	Longer range (strategic)
	MRBMs/IRBMs	150	20	Medium range (theatre)
	SRBMs	1500	100	Short range (operational)
	Propulsion (Solid/Liquid Fuel)	Both	Both	Affects time to prepare and mobility
	Launch platform (cave/silo/TEL)	All	TEL	Affects vulnerability and mobility
	Guidance (Inertial/GPS/Homing)	All	Inertial/GPS	Affects accuracy and hence lethality
	Multiple Warheads	Yes	No	Affects vulnerability to Exo-atmospheric ABM measures
	Manoeuvring warheads	Limited	None	Affects vulnerability to Endo-atmospheric ABM measures
	Countermeasures (decoys/anti-simulation)	Yes	Perhaps	Affects vulnerability to ABM measures
Sea Based	ICBMs	24-36	None	Longer range (strategic)
	MRBMs/IRBMs	?	10 (?)	Medium range (theatre)
	Launch platform (surface/sub-surface)	Sub-surface	Surface	Affects vulnerability and mobility
	Guidance (Inertial/GPS/Homing)	All	Inertial/GPS	Affects accuracy and hence lethality
	Multiple Warheads	Yes	No	Affects vulnerability to Exo-atmospheric ABM measures
	Manoeuvring warheads	None	None	Affects vulnerability to Endo-atmospheric ABM measures
	Countermeasures (decoys/anti-simulation)	Yes	No	Affects vulnerability to ABM measures

Table 2: Chinese and Indian BMD Capability 2017

Capability		China	India	Remarks
Main Capability	Attributes			
Terminal BMD	Systems	S-300 PMU-1, HQ-9, S-300 PMU-2, S400	Barak-8, S-300 PMU-2	Barak-8 jointly developed with Israel
	Range (nautical miles)	S-300 PMU-1 – 80 HQ-9 – 50 to 100 S-300 PMU-2 – 105 S-400 - 215	40	
	Numbers (batteries)	S300 PMU – 8 HQ-9 – 20 S-300 PMU-1 - 16 S-300 PMU-2 – 8 S-400 -8	S-300 PMU-2/S-300V/Arrow - 6 Barak -8 - 18 (54 launchers, 432 missiles)	S-400 jointly developed with Russia
Theatre BMD	Systems	KT-1, KT-2, KT-2A, KT-III, GMD (KT-1?)	PAD/AAD combination AD-1/AD-2 (Under development) PDV (development)	KT series based on DF-21(?)
	Range	Mid-course, hit-to-kill	PAD – Exo atmospheric (50-80 km altitude) AAD – Endo atmospheric (up to 30 km altitude) AD-1/2 > 600 km	

Capability Application Scenarios

20. Strategic and operational scenarios for the use of ballistic missiles, especially those armed with nuclear warheads, have been evolving over time. The Mutual Assured Destruction (MAD) scenarios of the cold war are now history. Even during the cold war period, MAD scale scenarios were not envisaged in the US-China context (and hence the Chinese reliance on a minimum nuclear deterrent). In the international context, the scenarios have moved to the use of one or a few missiles by 'rogue' nations like North Korea and Iran. The India-Pakistan contest has also never escalated to MAD like scenarios, although the operational planning, especially in Pakistan, caters to war-fighting in a nuclear overhang. The China-Taiwan context involves Chinese use of a preponderance of conventionally armed SRBMs; operational employment of nuclear SRBMs/IRBMs is, however, envisaged in the context of Chinese anti-access strategy. The development of a Chinese ASBM could be viewed through this prism.

21. **Conflict Scenarios**. In the China-India strategic equation, all out conventional war and the concomitant risk of a nuclear conflagration is usually discounted by the strategic community. However, the Chinese War Zone Campaign doctrine does account for a limited

war with a nuclear overhang. The limited conflict in this case could emerge from the conflicting territorial claims or the Chinese reactions to a perceived political threat against Tibet. Other conflict triggers in the medium term could come from aggressive contests along the Sea Lanes of Communication (SLOCs) in the Indian Ocean, aggressive Chinese involvement with groups inimical to India in countries like Nepal, Bangladesh, Sri Lanka and Myanmar. Aggressive defensive and patrolling activities along the undemarcated Line of Actual Control (LAC) could also result in extremely localised escalation. Therefore, for the purpose of the instant analysis, possible ballistic missile warfare scenarios in the China-India context have been listed hereafter.

(a) An '**accidental launch**' scenario. The accidental launch would be from China since India is not known to deploy any systems in full operational readiness.

(b) An '**escalatory scenario**' emerging from extremely localised conflict triggers. Such a scenario would involve at best one or two ballistic missiles being exchanged by either side. The targets are likely to be counterforce targets. Given that it is difficult to find isolated counterforce targets, particularly in India, the choice may deliberately involve value components in a target system, while maintaining the position that only nuclear forces are being attacked.

(c) A '**limited scenario**' emerging from 'Limited War under conditions of Informationization' as the Chinese use with reference to the War Zone Campaign doctrine. Such a scenario could involve the employment of SRBMs by either side during the conduct stage and employment of a few IRBMs/MRBMs/ICBMs as part of conflict termination.

(d) A '**major scenario**' involving all out military conflict. Being an extremely remote possibility in the coming decade, this scenario need not be developed in detail for analysis.

22. While Ballistic Missile Defence (BMD) and Theatre Missile Defence (TMD) have the complexity, lower tier terminal defences are much less expensive and can be produced in large numbers to provide effective protection for counterforce targets and some protection for value targets. In particular, TMD benefits greatly by operating low level BMD assets in conjunction with upper tier assets.

BMD's Effectiveness

23. It is well known that for either for BMD or TMD, a large number of interceptors are required if the attack size goes beyond a few attackers. Thus the introduction of Multiple Independently Targetable Re-entry Vehicle (MIRV) technology can tilt the balance distinctly in favour of the attacker. The use of multiple decoys with a single warhead can also achieve similar effects. This shows that development of an NMD or TMD against unitary attackers may be possible for defenders with an adequate technological and resource base. The

Chinese GMD demonstration and more mature terminal ABM capabilities indicate that it is well on the way to overcome the technological challenges; addressing the quantitative and integration requirements does not appear a challenge of the same order. In case the Chinese plans gain greater momentum, it may be possible for China to neutralise the extremely limited Indian strategic deterrent as early as 2015-2020.

24. As compared to India, China has the capability to launch a large number of SRBMs/IRBMs against targets of its choice. However, in the present geo-political environment there are not many operational scenarios that envisage a large scale attack. But given China's recent assertive policies an attack with preponderance of SRBMs a la Taiwan should not be ruled out. On the other hand, India has to reasonably contend with the Accidental and Escalatory scenarios. A limited BMD or thin TMD could plausibly protect against limited missile attacks as envisaged in the Accidental and Escalatory scenarios.

25. Simulation exercises have shown that the BMD performance degrades severely as the attack size (i.e. number of missiles being fire by the attacker) increases beyond a threshold. The attacker with a limited arsenal always has the option of concentrating his attack systems against one or a limited number of targets. The apparent attack size can also be increased out of proportion to the number of launchers and missiles by using MIRV and decoy technologies in warheads. This approach has high value for India to achieve strategic deterrence against China.

26. Given the terrain configuration along India's border with Tibet, the desired probabilities of detection and tracking may also not be achievable in the medium term. Similarly, a 0.80 probability (for ballistic missile defence systems) that no attacking missile will reach the target may be very useful for counter force targets being defended but a 20 percent probability that at least one attacking missile could get through may render such BMD of no practical use for civilian value targets.

27. While BMD and TMD have much complexity, as mentioned earlier, lower tier terminal defences are much less expensive and can be produced in large numbers to provide effective protection for counterforce targets and some protection for value targets. In particular, TMD benefits greatly by operating low level BMD assets in conjunction with upper tier assets.

Impact of Related Factors

28. The preceding analysis and deductions examine the interplay of ballistic attack and BMD only from the perspective of weapon characteristics. However, there are a host of other factors that will impact the balance in the coming years. Some of these issues are discussed in the subsequent paragraphs.

29. **Multilateral Linkages**. Other than their bilateral balance, both India and China have to contend with Pakistan, US, East Asia and Taiwan while dealing with the larger question of

developing ballistic missile attack and BMD capabilities. In the last few years the US has made conscious efforts to project its BMD capability development against a 'rogue' threat and avoid linkages to the Russian and Chinese ballistic missile arsenals. In general, the Chinese do not appear to have bought this line. Given the major asymmetry in their mutual strategic deterrence, even marginal improvements in US BMD would appear threatening to the Chinese perception of their minimal deterrence against the US. Thus, Chinese ballistic missile and BMD capability development is likely to be guided overwhelmingly by US actions within the continental US, Europe and East Asia, including Taiwan. In the Indian case, mutual strategic deterrence exists in the absence of comprehensive BMD capability with either India or Pakistan. If India were to make rapid progress on BMD and TMD, Pakistan would feel the same pressure that India now feels from China.

30. **BMD Technology**.

(a) BMD technologies have moved from a nuclear tipped interceptor of the 60s to kinetic kill technologies. Kinetic kill is challenging at the very high speeds of attacking missiles. The situation becomes more complex when we are dealing with manoeuvring re-entry vehicles (RVs) and MIRV warheads. Any country capable of launching a satellite into low earth orbit can attempt to produce an interceptor of the technological ability required to reach in the vicinity of attacking ballistic missiles for GMD. However, the ability to make the final kinetic kill is much more difficult to acquire. Considering that a country like the US with a much more mature TMD capability is having difficulties convincing critics of the efficacy of the SM-3 platform, time lines projected for deployable Chinese GMD capabilities are optimistic and the time lines being mentioned by India's DRDO speculative at best.

(b) Similarly, a deployable BMD and TMD capability requires massive investments in satellite networks. It is notable that the cost estimates of BMD programmes often exclude many costs; most prominently the use of a sophisticated satellite network.

(c) It is, therefore, clear that the technological risks in developing a BMD capability are extremely high.

31. **Nuclear Doctrine**. China has a No First Use (NFU) nuclear doctrine that does not apply to India. Therefore, it is necessary for India to retain a credible counter strike force. Unlike the US, Russia and China, India is not known to maintain nuclear forces in readiness in silos/caves or in road mobile condition (often referred to as a recessed deterrent). Therefore, there is a strong case to provide a very high level of BMD to key storage locations and command and control components.

32. **Command and Control and BMD Organization**. Unlike the great powers like the US, Russia and China, India is yet to graduate to a robust National Military Command required for responding to emerging strategic and operational scenarios involving ballistic missile

attack and defence. To have a genuine BMD capability, India will need significant advances in doctrine and organizations to deal with the complexities of ballistic missile warfare.

Deductions for Capability Development

33. **National Security and Military Strategies**. The preceding analysis shows that there is a wide gap in the Chinese and Indian capabilities in ballistic missile warfare. The incipient Indian nuclear deterrent is at risk in case the Chinese TMD and BMD capabilities expand at a faster pace than the potential of the Indian ballistic missile attack capability. Therefore, Indian national security strategy will have to be drawn in a manner to control in any escalation with China in the medium term. At the same time, the military strategy will have to be formulated in a manner that it optimally exploits its emerging SRBM capabilities in order to ensure operational deterrence at potential conflict locations.

34. **Ballistic Missile Capability**.

(a) The two main deductions from the preceding analysis are that India's ballistic missile attack capability at long ranges needs an urgent upgrade. While India does not have too many options in terms of the yield and lethality of its missiles, numbers above a certain threshold will ensure that India always has the ability to pierce a thin BMD or a TMD deployed by China. In this context, MIRV technology can be developed with much lower political risks and greater payoffs. Apparently, DRDO is working on MIRV technologies and possibly will acquire and demonstrate the capability for MIRVs by 2014-15[10].

(b) The 'window of vulnerability' before the recessed deterrent is made operationally ready can be closed either through a limited silo based posture or through a deployed but unarmed SLBM capability.

35. **BMD Capability**.

(a) It is generally accepted that BMD has extremely high costs which can escalate more than linearly if the attacker adopts effective countermeasures. Nevertheless, there are certain key assets that need to be protected with a degree of confidence if even a limited deterrent has to have enough credibility. In case of an opponent like China, known to have repeatedly taken unusual risks in escalatory settings, the credibility of such a reactive deterrent needs to be even higher. This implies that a high confidence lower tier terminal TMD is required for key counter-force targets.

(b) Although politically incorrect, there do not seem to be cost-effective options to provide for a reasonable degree of protection for more than one or two value targets.

[10] Ajay Shukla, "DRDO: Intercontinental ballistic missile within reach", Business Standard, September, 2012 available at http://business-standard.com/india/news/drdo-intercontinental-ballistic-missiles-well-within-reach/485519/

However, over a period of time with additional budgetary resources becoming available, it may be possible to provide protection to more value targets. A graduated/phased approach could be adopted for this purpose.

(c) Despite the hype and media excitement over the attacking missiles and interceptors, the most critical components of BMD are countermeasures resistant detection, tracking and fire control radars and satellite based detection and communication systems. Investments in developing these technologies have payoffs not only for ballistic missile warfare but also conventional air defence.

Prognosis

36. It is widely accepted that BMD capabilities are destabilising and have the potential for setting off an arms race. For years China was comfortable with a credible minimum nuclear deterrent against the US. The appearance of 'rogue' states like North Korea and Iran, and the politically sensitive war on terror, leads one to the conclusion that the expansion of US BMD capabilities is not going to be reversed, although it may be controlled for some time. Pakistan is a surprise omission from the 'rogues' gallery', but perhaps not for long. Accordingly, the ongoing momentum in the expansion of the Chinese ballistic missile capability, right up to the blue waters of the Indian Ocean, will proceed relentlessly. It appears that the only stumbling blocks in an escalation of ballistic missile competition in the region are technological.

Recommendations

37. The deductions in the preceding paragraphs are clear enough for strategic planners to be able to derive lessons and recommendations. Some concluding recommendations are in order:-

(a) To cover the impending gap in the strategic missile balance with China, India must retain a posture of strategic **dissuasion** vis-à-vis China and progressively acquire strategic deterrent capabilities, possibly in next three to five years.

(b) Enhancement of the range, numbers and survivability of the **Indian nuclear ballistic missile force must get precedence over populist or politically correct postures on development of BMD capability**. In any case, India must not pursue a BMD capability simply because it has been able to develop IRBMs with a degree of sophistication.

(c) One reason for India's predicament over the degradation of its extremely limited nuclear deterrent vis-a-vis China is its NFU nuclear doctrine. This places a tremendous strain over its defensive posture and the pursuit of even a minimal BMD cover for its own counter-force targets is likely to impose heavy costs. Therefore, a review of the NFU doctrine against nuclear armed adversaries is urgently called for.

(d) A thin BMD and well developed TMD capability has justification for a power like the US with an entrenched overwhelming advantage in ballistic missile attack over all potential adversaries and self-assumed responsibilities of extended deterrence in East Asia. India's circumstances being distinctly different it should not blindly adopt the same BMD doctrine as the US.

(e) Although India was one of the leading countries to come out actively in support of President Bush's BMD plans, the analysis reveals that India has been negatively impacted by the collapse of the ABM Treaty framework. Even at this stage, it is in India's interest to join any efforts to slow the proliferation of ABM systems and the weaponization of space.

Conclusion

38. Sophisticated BMD technology has been uncorked like a genie from the closed bottle of the ABM Treaty framework. This has created waves in the ocean of geo-strategic relationships and the stable equilibrium of mutual nuclear deterrence has been severely perturbed. In a volatile strategic environment, Indian strategic planners have to weigh their options carefully to ensure that scarce resources are used in the most optimal manner to secure national interests on an on-going basis. The paper has provided a comprehensive evaluation of ballistic missile attack and defence capabilities in the China-India context. Ballistic missile warfare has extremely high resonance in media and there are a number of vested interests in military-industrial-political complexes all over the world. Fortunately, ballistic missile warfare lends itself to sophisticated analytical methods. It has been shown that the BMD and ballistic missile trends in the region require India to pay urgent attention to maintaining a credible minimal nuclear deterrent vis-à-vis China. The asymmetries between India and China in missile warfare capabilities are huge. India needs to develop its strike capabilities on a fast track mode. Meanwhile, it can ill afford to neglect development of its missile defence capacities, if India wants to be counted as a power of consequence. There is also a need to diversify in the field of missile defence by providing adequate capabilities to air craft carrier fleet to protect itself against the Chinese ASBM threat.

The preceding analysis has provided recommendations regarding India's national security and military strategy, technology direction, nuclear doctrine and international posture which could be implemented after further debate and discussion.

Appendix A

China's Ballistic Missile Capability

Designation [given by NATO]	#	Range & Payload	Warhead and Yield	Propulsion and Guidance	Est. CEP	Remarks
DF-3/3A [CSS-2]	15-20	3,000 km 2,150 kg	Single nuclear warhead, 1-5 MT (3.3 MT) -Single conventional warhead	Single-stage; storable liquid propellant; Fully inertial strap-down guidance system	2.5-4.0 km	120-150 minute launch prep. time; road-mobile
DF-4 [CSS-3]	15-20	5,400+ km 2,200 kg	Single nuclear warhead, 1-5 MT (3.3 MT)	Two-stage, non-storable liquid propellant (LOX/kerosene)	3.0-3.5 km	60-120 minute launch prep. time; cave-based and rolled out to launch
DF-5/5A [CSS-4]	20	13,000+ km 4000-5000 kg	Single nuclear warhead, 1-5 MT (4-5 MT)	Two-stage; storable liquid propellant (N_2O_4/UDMH); gyro-platform with onboard computer	0.5-3.0 km	30-60 minute launch prep. time; deployed at silos at 3 locations; DF-5A (CSS-4 Mod 2), longer range and more mobile, continues to replace the DF-5 (CSS-4 Mod 1), which is silo-based
DF-21/21A [CSS-5] [Mod 1&2]	50-80	2,100 km 200-300 kg	Single nuclear warhead, 200-300 kT -Single conventional warhead	Two-stage; solid propellant; gyro-platform inertial guidance with onboard computer; working on terminal guidance system	0.3-0.4 km	10-15 minute launch prep. time; land-mobile; reportedly replacing DF-3 in some areas; same missile as JL-1 SLBM; longer range Mod 2 continues to replace Mod 1
DF-21C [CSS-5] [Mod 3]		1,700km 2,000kg	Single or multiple conventional warheads	Two-stage; solid propellant; combined inertial/GPS, coupled with terminal guidance		Road-mobile MRBM. Increased accuracy due to the combined guidance system.
DF-21D [CSS-5] [Mod 4]*		1,500+ km	Single or multiple conventional warheads	Two-stages; Solid propellant and a re-entry vehicle with a seeker, control fins and a warhead		Road-mobile delivered from a transporter-erector-launcher (TEL).
DF-15/M-9 [CSS-6/ CSST-600]	350-400	600 km 950 kg	Single nuclear warhead, 50-350 kT -Single or cluster conventional warhead	Single-stage; solid propellant; strap-down inertial computer-digitized guidance system with terminal control	600 m	30 minute launch prep. time; M-9 version designed explicitly for export; enhancing accuracy with GPS technology

Designation [given by NATO]	**#**	**Range & Payload**	**Warhead and Yield**	**Propulsion and Guidance**	**Est. CEP**	**Remarks**
DF-11/M-11 [CSS-X-7]	700-750	300 km 800 kg	-Single nuclear warhead, 350 kT - Single or cluster conventional warhead	Two-stage; solid propellant; strap-down inertial computer-digitized guidance system with terminal control	150 m	30-45 minute launch prep. time; M-11 version designed explicitly for export
M-7/8610 [CSS-8]	?	180 km 500 kg	Conventional warhead	Two-stage; solid propellant booster and storable liquid propellant main engine		Modification of HQ-2 (SA-2) surface-to-air missile (SAM); mobile
DF-25	0	1,700 km 2,000 kg	Single conventional warhead	Two-stage; solid propellant		Development thought to be cancelled in mid-1990s but may have been restarted since then; based on first two stages of DF-31; land-mobile
DF-31 [CSS-X-10]*	<10	7,200+ km Payload unknown	Single nuclear warhead, 200-300 kT (100-200 kT) (500 kT). Possible future use with MRV/MIRV capability	Three-stage; solid propellant	0.5 km	10-15 minute launch prep. time; land-mobile; most likely cave-based; same missile as JL-2 SLBM; to replace the DF-4; could incorporate penetration aids such as decoys or chaff.
DF-31A	<10	11,200+ km Payload unknown	Single nuclear warhead, yield unknown. Potential for MRV/MIRV capability unknown	Three-stage; solid propellant	?	Launched from a road-mobile transporter-erector-launcher (TEL). Incorporates decoys and penetration aids to confuse missile defense systems.
JL-1 [CSS-N-4] SLBM	12	1,770+ km 200-300 kg	Nuclear warhead, 200-300 kT (500 kT)	Two-stage; solid propellant; gyro-platform inertial guidance with onboard computer	1.0 km	Sea-based version of the DF-21/21A
JL-2 [CSS-N-5] SLBM*	0	7,200 km 200-300 kg?	Nuclear warhead, 200-300 kT. Possibly will be equipped with MRV/MIRV capability	Three-stage; solid propellant	1.0 km	Sea-based version of the DF-21/21A

(Adapted from: http://www.nti.org/e_research/profiles/China/Missile/index.html)

Appendix 'B'

India's Ballistic Missiles

Name/ Alt.	Missile Type/ Prop- ulsion	Types of War- heads	Payload Weight	Range	Status/ Service	Est. Inven.
Prithvi-I/ SS-150	Ballistic/ Single-Stage/ Liquid-Engine	Conven-tional/ Nuclear	1,000 kg	150km/ Road- Mobile	Operational/ Army	75-90
Prithvi-II/ SS-250	Ballistic/ Single-Stage/ Liquid-Engine	Conven-tional/ Nuclear	500 kg	250km/ Road- Mobile	Undergoing User Trials; Operational Status Unclear/ Air Force	25
Dhanush/ Prithvi-III/ SS-350	Ballistic/ Single-Stage/ Liquid- Engine	Conven-tional/ Nuclear	Undis-closed	350km/ Ship & Submarine Based Fixed Launch Platform	Undergoing Flight Tests; Production Status Unknown; Navy has ordered missile for two ships.	
Agni-Tech-nology Demon-strator (TD)	Ballistic/ Two- Stage Hybrid/ Solid- Motor/ Liquid-Engine Stages	Nuclear	1,000 kg	1,200- 1,500 km/ Road-/ Rail-Mobile	Completed Flight- Tests; Limited Production; Small Number Available to Army; Operational Status Unclear	10-20
Agni-I	Ballistic/ Single- Stage/ Solid- Motor	Nuclear	1,000 kg	700- 800 km/ Road-/ Rail-Mobile	Undergoing Flight- Tests; Limited Production; Inducted, but Operational Status Unclear	Undis-closed
Agni-II	Ballistic/ Two- Stage/ Solid- Motor	Nuclear	1,000 kg	2,000- 2,500 km/ Road-/ Rail-Mobile	Completed Flight Tests; Limited Production; Small Number Probably Available to Army; Inducted, but Operational Status Unclear	Undis-closed
Agni-III	Ballistic	Nuclear	Undis-closed	3,500- 4,000 km	Tested Successfully in 2007 and 2008; to be Inducted into the Army in 2009.	
Agni-V	Ballistic	Nuclear	Undis-closed	5,000 km	Approved by Government in 2008; to be Tested by Dec. 2010, and Available to Armed Services by 2015.	
BrahMos/ PJ-10	Cruise/ Two- Stage/ Solid- Booster/ Liquid-Sustainer Engine	Conventional	200-300 kg	280- 300km/ Ship/ Sub-Surface/ Land/Air- Based Platforms	Development- Tests of Naval Variant Completed; Naval (ship-based) and Army Variants Inducted; in Serial Production; Air Force and Navy (Submarine) Versions under Development	
Nirbhay	Cruise/Multiple platforms	Conventional	Undis-closed	1,000 km	Under Development	
K-15 (Sagarika)	Sub marine- Launched Ballistic Missile/Two Stage	Conventional/ Nuclear	600 kg	700 km	Tested in February, November 2008, Expected To Become Operational By 2010-11	
Shourya	Ballistic/Solid Propellant/Canister-Based	Conventional/ Nuclear	Over 500 kg	600 km	Tested in November 2008.	

(Source: http://www.nti.org/e_research/profiles/India/Missile/table_india_ballistic_cruise_missiles.pdf)

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