



EMERGING TRENDS IN BALLISTIC MISSILE DEFENCE (BMD) SYSTEM DEVELOPMENT

Introduction

BMD system is gaining prominence in the defence calculus of various potential adversaries across the globe. Old competitors are looking for more effective ways of negating missile arsenals of their opponents. Technology is enabling implementation of many concepts hitherto considered not feasible. The technological developments are touching new frontiers in enabling new trends to emerge in BMD system development. Nano technology is helping in miniaturisation of sensors, interceptors and command and control systems. New sensors mounted on mobile platforms like UAVs are finding wide acceptance. Japan has recently embarked upon the development of UAVs which will act as early warning sensors for their BMD system. Standard Missile-3 block IIA being developed by the US and Japan will be highly manoeuvrable and lethal enough to intercept ICBMs which are considered invincible weapons so far. The programme is scheduled to begin flight testing in 2014. The development

of new customised software along with artificial intelligence and automation systems is increasing the effectiveness of the systems as never before.

New models of development are also emerging in different parts of the Globe. Japan and USA in the Asia-Pacific on the one hand and Israel and USA in the Middle East on the other are jointly developing sensors, interceptors and command and control systems. The outcomes are expected to be impressive by providing more effective BMD systems at lesser cost. South Korea and China are sharing cost with Russia for joint development of the BMD system (S-400) with an eye for indigenisation. Besides acquiring state of the art system at lower cost, long term interests of these countries are likely to be well served. Phased Adaptive Approach (PAA) of BMD system deployment in the Europe is another concept which adds to flexibility and effectiveness at lower cost. Indian Defence Planners appear to have taken note of most of these global developments.

India's Ballistic Missile Threat Perception

There is a rapid missiles inventory build-up both by China and Pakistan. China has biggest arsenal after US and Russia. DF 21s (2500-3000 km) alone have been increased from 19-23 in 2005 to 85-100 in 2011. Pakistan is likely to become the fifth largest missiles inventory holder soon. All Pakistanis missiles of varied ranges are meant to be used against India. There is a marked improvement in range, accuracy and reliability of these missiles. All

later versions are solid fuel and mobile systems. Extensive training of mobile missile units has been conducted periodically to improve operational effectiveness. China's JL-2 (7300 km) SLBMs aboard three Jin class submarines give them a credible second strike capability. Major improvements such as adoption of countermeasure, MIRVing and MARVing have been incorporated in new generation missiles. Characteristics of Pakistanis and Chinese missiles are tabulated below.

Pakistan Ballistic Missile Characteristics

Missile	Length M	Diameter M	Warhead Kg	Range Km	CEP M	Status
Hatf-2/ Abadali	6.5	0.56	250-450	180- 200	150	Deployed
Hatf-3/ Ghaznavi	8.5	0.8	700	290	250	Deployed
Hatf-4/ Shaheen-1	12	1.0	700	750	600	Deployed
Hatf-5/ Ghauri 1	15.9	1.35	1200	1300- 1800	200	Deployed
Hatf-6/ Shaheen-2	17.2	1.4	700	2500	350	Development

China Ballistic Missile Characteristics

Missile	Stage	Diameter	Length	Payload	Range
DF-II/M-11	Single	0.88 m	10.6 m	1000 kg	384 km
DF-15/M-9	Single	1.0 m	9.0 m	700 kg	280 km
DF-21/JL-1	2 stage	1.4 m	10.4 m	700 kg	3000 km
DF-31/JL-2	3 stage	2.0 m	11 m	1400	7200 km
DF-41	3 stage	2.0-2.4 m	24 m	MIRV	12000 km

Indian BMD System

India has demonstrated its exo and endo atmosphere interception capability with a view to achieve a layered interception during mid course or terminal phase. Two interception missiles will work in tandem to ensure a hit probability of 99.8 percent. The stated goal is to achieve two tiers BMD in two phases. Interception of missiles up to 2000 km range has been achieved in 2012. Delhi (NCR) and Mumbai, have been selected for the ballistic missile defence shield. After successful implementation in Delhi and Mumbai, the system will be used to cover other major cities in the country. Interception of missiles up to 5000 km range is planned to be achieved by 2016. Also a Laser based interception is planned to be achieved in 2020-25 timeframe. This Indian system is claimed to be superior to PAC 3 system of the US in interception range and operation altitude.

India is making progress in developing a BMD system but its effectiveness in operational environment is yet to be proved. India cannot allow the strategic gap between it and China to grow. Therefore, it must remain abreast of vital strategic technologies. India has to consider developing ASAT technologies also before any international regime bans such tests like the non-proliferation treaty banning nuclear tests. India is not a member of any alliance and must rely on itself for development of crucial systems like the BMD with long term perspectives.

Response of Adversaries

Indian BMD system development is of vital interest to both China and Pakistan as it could reduce the effectiveness of their ballistic missiles against India. Chinese and the Pakistanis reaction to India's BMD system would be akin to the Russian response to the

proposed US BMD shield developing new missiles with more sophisticated countermeasures.

China. China is monitoring India's BMD system development since 2006. It is believed that 25 - 30% of total Chinese discourse on BMD is on India's system leaving the rest for the US BMD system. Their major focus is on indigenous nature of Indian BMD system. They are particularly known to be monitoring all early warning capabilities. China is also concerned over possible Indo-US cooperation in this field.

Pakistan. Pakistan is using every opportunity to lament impact on strategic stability in South Asia and justify own stance on FMCT in CD. Pakistan is also justifying own increase in arsenal and development of 'new' capabilities due to Indian BMD system progress.

Emerging Global Trends in BMD System Development

Space Based Early Warning Systems. There is a clear emphasis on detecting the hostile missile as early as possible so that sufficient reaction time is available to the BMD system for interception. Space Based Infra Red System (SBIRS) of USA is being developed for this purpose. A constellation of satellites will be monitoring the entire globe with the help of carefully generated algorithm to pin point the launch of the hostile missiles during boost phase itself. In a smaller theatre UAVs equipped with multiple sensors will

provide an early warning of missile launch. Both Japan and Israel are actively pursuing this approach. Both the options are relevant for the early detection requirement in the Indian context too due to proximity of the possible missile launcher sites. Missile Defence Agency of USA is developing the Precision Tracking Space System (PTSS) to provide space-based tracking of ballistic missiles, enabling simultaneous homeland, regional, and theatre missile defence. This trend is likely to continue for a long time and would eventually facilitate an effective boost phase detection and subsequent interception.

Phased Array Early Warning System (PAWS) Radar. The new generation surface based early warning radars are increasing the detection range through technological innovations. Two Pave (PAWS) category of radars (Surveillance Range 3,800 km against 1 square meter target) suitably sited could scan most of the Indian aerospace and that over Pakistan & China. The new generation Voronezh-DM class Russian radar is reported to have a range of 5900 km. In November 2011, a Voronezh-DM radar became operational in Russia's westernmost exclave of Kaliningrad. Technological breakthrough in miniaturized microwave power generation and amplification; ultra sensitive receivers with a very effective noise suppression system managed by state of the art softwares are beginning to deliver results beyond imagination. The trend is likely to continue and will be useful for the Indian context too.

Multiple Sensors Homing Head Interceptor Missiles.

The new generations of homing heads are capable of colour detection and possess ability to distinguish a real warhead from decoys. Standard Missile-3 blocks IB, II A and II B are planned to have this capability. Indian BMD System will be required to develop this capability for ensuring effective interception in the presence of decoys during terminal phase.

Higher Velocity Interceptor Missiles.

ICBMs continue to be invincible weapons as they cannot be effectively intercepted by the existing BMD system due to very high approach velocity. A very high speed and agility interceptor could provide a solution. SM3-Blocks II A & B are being developed for ensuring an effective interception of the ICBMs. An intelligently deployed early warning, command and control system and interception system could make it possible to intercept a multiple ICBMs strike. Phase IV & V of the European Phased Adaptive Approach of the US aims to achieve this goal by 2020-22. This trend of development is likely to continue and is of particular interest for the Indian theatre against China's SLBM & ICBM capability.

Multiple Kill Vehicles (MKVs). The MIRVed and MARVed missiles are a reality in our neighbourhood too. These potent survival technological feats of the modern missiles pose a real challenge for the BMD system. Interceptors equipped with the MKVs could provide an effective interception to the

MIRVed and MARVed missiles. The MKV technology was being developed on a dual-path basis by Lockheed Martin Space Systems Company, designated MKV-L, and the Raytheon Company (MKV-R). Missile Defense Agency announced that a test of the MKV-L was conducted on 2 December 2008, at the National Hover Test Facility at Edwards Air Force Base, California. Preliminary indications were that planned test objectives were achieved. Objectives of the test included having the MKV-L hover under its own power and prove its capability to recognize and track a surrogate target in a flight environment. During the test, the MKV-L's propulsion system demonstrated maneuverability while tracking a target. On 06 April 2009, US Secretary of Defence Robert M. Gates announced that the Pentagon's budget would be reshaped. Under this proposal the MKV programme has been terminated. The requirement of the MKVs is likely to resurface in view of the countermeasures being incorporated in the new generation of ballistic missiles and is of particular interest in the India-China scenario also.

Sea Based BMD Capability. A sea based BMD capability is far more potent as it offers flexibility for deployment according to the emerging Threat. Aegis BMD of the US is finding acceptance not only in European theatre but in Asia Pacific as well. Aegis Ashore is the land-based component of the Aegis Ballistic Missile Defence (BMD) System. Aegis Ashore leverages the present and future Aegis BMD capabilities to adapt to the evolving ballistic missile security environment. India is

finding it difficult even to undertake BMD system testing against greater range missiles and will be required to develop a sea based BMD system for this purpose.

Seamless Integration. ICT technologies are making it possible for a seamless integration of early warning system; command and control system and interception launch controls as never before. Indivisibility of the

aerospace also demands a unified approach. Russia and China prominently continental powers are already known to have an integrated aerospace defence system unlike maritime powers such as US and UK who have a different integrative model. The trends of seamless integration will grow due mainly to emerging challenges and available technological solutions. India will be required to develop its own integration model mainly due to geo strategic constraints.

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Inputs from Round Table Discussion on 08 Jan 13 at Cenjows

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