CHINA'S MILITARY SPACE PROGRAMME

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Antiquity and modernity are generally perceived to be partners in opposing camps; apparently antithetical, but enormously potent when fused together. China's military space programme is a classical example of the above blend; it mixes traditional military wisdom with the advantages of modern science, enabling it to forge way ahead of regional rivals and also bridge the technology divide vis-à-vis superpowers like the US. China, as of now, fully comprehends the enormous advantage space capabilities confer onto traditional military missions and hence earnestly pursues the acquisition of space based capabilities for military prowess and national development. It harnesses space for both the afore-mentioned purposes, but the accent apparently is on military space capabilities as evidenced by the number of satellites it has launched for military purposes in the new millennium. Its Anti Satellite (ASAT) endeavours (established and speculated), its opacity regarding its space programme and a host of other factors discussed in detail later in the paper. Its military space programme is modest compared to those of the US and Russia, nonetheless, within Asia it is the undisputed leader.

Overall, it attempts to harness space not in isolation but as an essential appendage to its lager aim of enabling a modern military transformation; a *"Revolution in Military Affairs (RMA) with Chinese characteristics*". The above

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is an essential component of its national strategy of beefing up its Comprehensive National Power (CNP). Efficacious wielding of CNP for national advancement would demand a modern military apparatus in addition to economic power. The above rationale drives the quest for acquisition of long range air, space and maritime capabilities which would enable containment of trans-continental super-powers and also consolidation of continental military prowess.

China is in the process of fulfilling its aim in a very studied, systematic and deliberate manner and has already forged way ahead of India. The above scenario is perhaps not ominously or immediately threatening; cooperation rather than conflict is the mantra of the new millennium. Nevertheless, it surely is enough cause for concern. Even after divesting oneself of the historical baggage of China's wanton aggression in 1962, and dismissing such a possibility as paranoia in the new millennium; it goes without saying that the impact of China's military modernisation needs to be studied and understood in our national context, the strategic challenges, needs and future strategies require to be dwelt and deliberated upon so as to prepare ourselves and prevent the possibilities of worst-case scenarios. Prevention is always better than cure, by extension, deterrence is always better than war, and hence a semblance of deterrence would be essential to maintain peace and. This paper attempts to comprehensively assess the extent of malaise so as to enable measures for containing the malaise well in time rather than expending disproportionate efforts later for curing or preventing the malaise.

MILITARY ORIGINS OF CHINA'S SPACE PROGRAMME

As in the case of India, the seeds of China's national space competencies were sown by expatriates returning from scientifically advanced Western nations in the late 50s, thus international assistance was critical to initial development. However, the similarity ends there. The Indian government

isolated space and placed it under the aegis of the Indian National Committee for Space Research (INCOSPAR) with the aim of targeting economic, social welfare and other civil needs. Four decades hence, the targets and aims continue largely unchanged. The military, then and now, has no role in the national space programme.

By contrast, the Chinese space programme was initiated at the behest of the Central Military Commission (CMC) for fulfilling national defence needs. The potential military utility of space was the central reason for China embarking on its national space programme since 1956. The programme was aimed at developing China's aviation, guided missiles, rockets and missile defence needs. Accordingly, the highly classified Fifth Research Academy, under the Ministry of National Defence was established to develop the space effort.[1] The Chinese perceived the initial utility of space for military ordnance delivery by Ballistic Missiles (BM) followed by high level observation. Hence, though Earth observation satellites were on the agenda since 1958, offensive military needs took priority and concentration was devoted on development of BMs rather than application satellites. The next priority was accorded to missile defences, and passive application satellites took last priority.

In keeping with its unique military priorities, within the first decade of the launch of a Chinese R-2 in November 1960, Chinese rocketry evolved to produce missiles like the *DongFeng*-1 (DF-1)[2], DF-2, and DF-3 etc. This formed its conventional missile strike force followed by missiles like the DF-4 and DF-5 which developed as its nuclear strike force. Thus, from its very beginning, the conceptualisation, design, and evolution of China's space programme has always had a pronouncedly military orientation and consequently its overall control has always rested with the CMC.

1. For details, ref Brian Harvey, "China's Space Programme – From Conception to Manned Spaceflight", (Chichester, UK: Praxis Publishing, 2004), Ch. 2, p. 22.
2. The organisational set-up has been sourced from the US *DOD Annual Report-2011*, "Military and Security developments involving the PRC", p. 21.

DUAL-USE PROGRAMME

The common nature of technology enabled adaptation of BMs into Satellite Launch Vehicles (SLVs). Thus, China's medium range DF-4 missile was adapted into its first SLV-the *Chang Zheng*-1 (CZ-1) or Long March-1. Similarly, the DF-5 Inter Continental Ballistic Missile (ICBM) became the CZ-2. By the late 60s, efforts had been put in for a national space tracking and control system. Thereafter, while China's first satellite; the *Dong Fang Hong* (DFH) launched in April 1970 and experimental *Shi Jian*-1 (SJ-1) had no military overtones, its next endeavour, the *Ji Shu Shiyan Weixing* (JSSW) were highly classified and for declared military purposes.[3]The recoverable satellite programme, *Fanhui Shi Weixing* (FSW) which followed thereafter was also for military observation. Many more launches like these followed.

China's civil and military space programmes are strongly intertwined. China's space programme continues to have a military bias; apart from dedicated military satellites, it also derives military capabilities from existing civil satellites. The overwhelmingly 'dual-use' character of the programme ensures that opinion on the Chinese space programme is strongly divided; some see it as an increasingly threatening enterprise and others dismiss it as militarily inconsequential. However, most such perceptions and mis-perceptions on the subject are largely American or Western in character and do not necessarily apply in a regional or continental context.

In a regional context, the fact prevails that the Chinese space programme especially in military terms, is evolving at an extremely rapid pace. Apart from out-racing every other worth-while space power in the Asian region, it has now out-distanced them to the extent that it has decisively altered the "balance of power" overwhelmingly in its favour and is likely to tilt the scales further in the next few years. Secondly, owing to its common origins and common industrial infrastructure, its aviation, space and BM

3. The official announcement stated that the satellite was part of "preparations for war". See op.cit., Brian Harvey, ch.4, p.70.

('*aerospace*') development programmes are also intertwined[4], overlapping each other and also evolving and driving each other at an equally rapid pace. It is known to be making earnest attempts to operationally integrate the above into its conventional military and nuclear apparatus. The homogenous origins and nature of its aerospace, nuclear and mammoth conventional military apparatus would endow it enormous military dividends. Lastly, China's growing ambition, economy and populace would ensure that the imbalance only accentuates further until the scales touch the earth. In view of the foregoing, an examination of the Chinese military space programme is undertaken as below.

Very little information is made public by the Chinese; information when made public is subjected to deliberate obfuscation or at times downright misinformation.

The Secrecy, Opacity, Chaos and Confusion of China's Space Effort

Before comprehensively examining China's space programme, it would be essential to appreciate the fact that the Chinese space programme has always been enormously secretive, complicated and opaque. Apart from the fact that China's space programme is one of the least publicised in the world. This is one aspect because of which it has largely succeeded in shrouding its military space programmes under a cloak of secrecy and multiple civilian nomenclatures.

Most of the afore-mentioned situation is apparently brought about by design and the rest by accident. Very little information is made public by the Chinese; information when made public is subjected to deliberate obfuscation or at times downright misinformation. For example, a variety of

4. China apparently interprets 'aerospace' to include aircrafts, space and BMs as evidenced by the common origin of the programme and the common defence industrial base for developing aerospace capabilities. For example, the Fifth academy, which pioneered China's early space programme was largely a product of China's attempt to establish a national defence aeronautics industry, as a consequence, it was staffed largely by aviation and rocket engineers. China further reorganised its military industrial complexes in the late eighties and combined the Ministry of Aviation Industry and Ministry of Space Industry (BM and Space) to form the Ministry of Aerospace, thereby putting all three under a common development umbrella. By the mid-nineties, it again reorganised to focus individual attention onto aviation and space development, nevertheless, enormous overlap continues and developments in one generally affect the other and as a consequence operational integration is easier.

designations and names are attributed to the same satellite, a particular name is registered with the UN registry of space objects while another is publicly declared, a separate Western nomenclature is also made public at times and these names are further revised, changed and applied retrospectively. Further, the inherently dual nature of space technology complicates matters. China's military and civil programmes are deeply intertwined and disentangling them is an enormously complicated exercise. The accidental factor of linguistic complications and inconsistent translations serves to add on to the chaos. Numerous examples of the chaos prevailing due to the above causes exist; nevertheless, the lead indicators of military satellite programmes - satellites, BMs and budgetary allocations are examined below to validate the above contention.

- **Multiple Designations of Satellites**: The China Brazil Earth Resources Satellite (CBERS) was a joint project developed a 70:30 China and Brazil ratio. The Chinese accorded it a public designation of *ZiYuan* (ZY) or resource. The following year, in September 2000, China launched its own domestic version of CBERS, named *Zhangguo ZiYuan* or China resource, but largely referred to by the Chinese media only by the common suffix of ZiYuan thereby obfuscating matters. The orbital path of this ZY was different; it was manoeuvred extensively, had a much better resolution of 12 mtrs unlike the 20 mtrs of CBERS and was accused by Taiwan of obtaining military Imagery Intelligence (IMINT) over it. *The Washington Times* also corroborated the above.[5]China then renamed the CBERS as ZY-1 and the new domestic ZY as ZY-2. ZY-2 was joined by another satellite in a similar orbit in October 02. The designations of the domestic ZYs were now changed to ZY-2A and ZY-2B. By 2003, the companion of the original CBERS was launched and media reports completed the obfuscation by referring to it alternately as ZY-1B, ZY-2, ZY-2B, etc.
  Similarly, China's indigenous navigation satellites known variously as *BeiDou* (BD), Twin Star, Big Dipper, Plough etc appeared without any forewarning in October 2000. Following the third BD in May 03, China

5. Estimated numbers contained in Indian military publications like SP's and Indian Defence Year Book for the year 2005 are identical to Military Balance (2003-04) and hence are not mentioned separately.

obfuscated matters by referring to the new satellite alternately as BD 1-3 or BD 1C. The fact that BD-1 had been registered as ChinaSat 32 and BD-2 as ChinaSat 31 and BD-3 as BD1/03 at the UN certainly did not help matters.[6] The situation has now been exacerbated because China since 2004 has apparently given up the practice of officially communicating launch of its space objects with the UN[7].

- **Numerical confusion**: Apart from designations, no common agreement exists on China's numerical capabilities in terms of BMs as apparent from the chart below. Not only are the numerical statistics different, the periodical fluctuation in numbers within a span of two years is also quite large. The above is compounded by the fact that no official declaration of China's BM inventory has been made.

Fig. 1

Ballistic Missile		**Type**	**Estimated Numbers**[8]			
Chinese Designation	Western Desig		SIPRI (2004)	Mil Balance (2003-04)	SIPRI (2006)	Mil Balance (2005-06)
DF-31	CSS-9	ICBM	00	08	00	06
DF-4	CSS-3	ICBM	12	20	22	20
DF-5/5A	CSS-4	ICBM	20	24	20	20
DF-21A	CSS-5	IRBM	48	60	21	33
DF-3A	CSS-2	IRBM	40	32	16	02

l **Obscure Space Budget:** Space budgets are generally a reliable indicator of a nation's commitment to its endeavours and also roughly suggest its future road map. However, Chinese opacity on the subject prevails and at times appears as a deliberate effort to promote ambiguity to obfuscate inferences based on observable and quantifiable data. Secrecy and dissimulation are the defining characteristics of Chinese space

6. Ref Richard Fisher Jr, "China's Scary Space Ambitions", *Wall Street Journal*, January 20, 2010.
7. As revealed by Xu Guanhua, the Chinese Minister of Science and Technology at the 18th plenary session of the International Committee on earth observation satellites. See website of Ministry of Science and Technology's Newsletter No.385, November 20, 2004 at http://www.most.gov.cn/eng/newsletters/2004/t20050202_19006.htm.
8. Richard Fisher, Jr., "China's Manned Military Space Ambitions", *International Assessment and Strategy Centre*, October 10, 2005, p.10.

efforts. China's space budget was a secret until 1994 and even now it is not publicly revealed in any detailed fashion. Estimates in 2003 place it variously between $ one Billion and $ three billion per year, for both military and civil space programmes. For example, while the Chinese themselves estimate that government support for space activities is at ¥ 1.45 billion annually[9], the Western European Union (WEU) is known to have estimated it in the region of $ 3 billion and American estimates place it at $ 1.35 billion a year, of which $ 0.5 billion is directed towards civilian Research & Development (R&D) and $ 0.8 billion to military space activities. Several authoritative Western estimates have also been made. These range from€ 1.5 billion (Aviation Week and Space Technology) (AW&ST) to € 1.68 billion (Britain's Flight International) to $ 2 billion (Teal Group) and $2.2 billion (Beijing Review).

However, it must be borne in mind that the above are only estimates. Even considering China's low labour costs, it is doubtful whether its self proclaimed budgetary figure of $ 1 billion (mentioned during speeches) could sustain the great diversity of its programmes in areas of launch vehicles, manned space flights, space systems, applications etc. Considering China's planned historic high of ten launches in 2004 and the planned expansion of the Chinese space programme in the 10th five-year plan (2001-2005), it could be safely inferred that budgets much in excess of even $ 3 billion have been presently dedicated to its space programme.

BROAD STRATEGIC & DOCTRINAL DRIVERS OF SPACE EFFORT

Fundamental Doctrine & Strategy : While the potential military utility of space systems was at the heart of China's decision to undertake its own space programme, the centrality of space technology in bolstering the RMA and by extension overall military force capabilities was comprehended significantly only after Gulf War-1. Driven largely by the Chinese Academy of Military Sciences (CAMS/AMS), the Chinese meticulously studied the tremendous force-multiplication "effects" enabled by space during the 1991 Gulf War and the recent conflicts in Kosovo, Afghanistan and Iraq and reached upon

9. Eric Hagt "Vulnerabilities in Space", *China Security 2006*, Issue no.2, p. 91.

the conclusion that space power is an essential element of effective military action. In particular, the tremendous contribution of space to RMA[10] and hence modern high-technology warfare was well understood by Chinese analysts and thereby a strategic re-think of military concepts and doctrines was carried out leading to traditional concepts being replaced with modern warfare strategies and space-enabled techniques. It was such comprehension that led to the modification of the guiding principles for People's Liberation Army (PLA) modernisation from "*local, limited war*" to "*limited war under high-tech conditions*". Most Western analysts are of the opinion that China understands its break chances against technologically superior opponents like the US, and hence the desire to have some chances of success against a technologically superior opponent drives China to investigate inherently riskier asymmetrical advantages. Notwithstanding Chinese and Western perspectives on the subject, the bottom line is that, China doctrinally comprehends the tremendous impact of space on conventional capabilities and has earnestly begun the pursuit of 'operationalising' space enabled capabilities.[11]

The physical environment of space unlike that of land, sea and air continues to be daunting; largely unknown and technologically challenging.

Doctrines at Environmental Levels: The physical environment of space unlike that of land, sea and air continues to be daunting; largely unknown and technologically challenging. Hence, no clear cut space doctrine exists as in case of land, maritime and air power doctrines which evolved with significant inputs of experience, technology and geographical characteristics. The existing globally accepted operational space doctrine is that of '*Aerospace*' which builds on the premise that air and space are a

10. The above contention is validated when considering the fact that until the first three-year long duration FH-1 dedicated military communications satellite débuted in Jan 2000, China's military endeavours were largely confined to crude, primitive Electronic Intelligence (ELINT) payloads like the short duration JSSW of the seventies or recoverable satellite programs like the FSW-0 series for Imagery Intelligence (IMINT) which had enormously limited military advantage and duration. Its duration of flight was barely five days in the 1980s and gradually advanced to 16 days duration by the late 1990s. Since its transmission was not real time and subject to its recovery on earth and subsequent analysis its military utility was limited.
11. Numbers sourced from Air Commodore Jasjit Singh "Modernising the IAF, Why and How?" *India Strategic*, February 2006.

unitary entity for the conduct of military operations. As a natural corollary, typical airpower missions like counter air operations are extended to space to become counter space operations, air-borne force application is converted to space-borne force application, force multiplication by air (air-borne combat support) gets converted to space-based force enhancement and support operations for sustaining air power is transformed into space support operations. The Chinese apparently do not expend enormous time and effort in contesting the above as evidenced by their ready acceptance, adaptation and organisation of their operational space doctrines on similar lines. Their characterisations include[12]:

Space Safeguard Operations: This mission area is roughly equivalent to space support operations but only includes the launching and recovery of space vehicles and does not include operations involving satellite control.

- **Space Support Operations.** This mission area corresponds entirely to force enhancement missions or what China interprets as '*power enhancement and support capabilities*'.
- **Attack Operations.** This mission area is very expansive and includes all elements of the mission areas of space control and force application. It includes the use of space-based weapons against terrestrial targets, the use of terrestrial weapons against space-based targets and the use of space based weapons against other space-based assets.

China's Operational Space War Theory: At the operational level, the primary missions are:

- Control of the environment of space.
- Integration of air and space operations.

Achievement of space control by China is considered as a fundamental condition for achieving air, sea and electromagnetic control; hence space control assumes greater significance than air, sea and electromagnetic

12. For details, see Nandita Vijay, "*Narayana Hrudyalaya moves out of ISRO satellite for telemedicine, switches to Skype*", PharmaBiz.Com July 13, 2012.

control. It considers space and air operations to be mutually supporting and hence aims at operationally integrating both for successful conduct of military operations. It holds the perception that air and space is linked by information, they are mutually supporting and are essential for coordination of C4I systems etc. Hence, it needs to be properly synchronised and integrated for successful conduct of overall military operations[13].

China certainly appears to be putting its theories into practice as witnessed by its burgeoning military space apparatus and the fast pace at which its air and space capabilities are growing in the new millennium. A broad examination of China's prevailing military space apparatus and forecast military capabilities are also indicative of the same.

CHINA'S PREVAILING MILITARY SPACE APPARATUS

As in most cases the information on China's precise military capabilities, intent and future course of action would neither be available for public knowledge nor open to scrutiny. Nevertheless, a judicious review of what China builds; launches and other quantifiable and observable data would be indicative of its prevailing capabilities and suggestive of its likely course of action. The same would form the bedrock on which implications in our context would rest and hence are discussed below in some detail. As of date, China trails the US and Russia in terms of national space capabilities. Nevertheless, Russian space capability is severely degraded and is only likely to degrade further without the requisite economic wherewithal to match. China's economy on the contrary is on an upswing and while it would be some time before it matched Russian capabilities, the possibility no longer seems remote or impossible. The European Space Agency (ESA) is a multi-nation conglomerate, has enormously limited interest in military space affairs and hence it would be fair to assume that China's continental stewardship is set to expand to global levels.

LAUNCH CAPABILITIES

China has developed two families of launchers, the *Chang Zheng* (CZ) or Long

13. For details, see ibid, pp. 334-336 , p.338.

China's 11th Five Year Plan 2006-2010 also reinforces the importance the government accords to space.

March and the *Feng Bao* (FB) or storm. The FB is no longer in service and the CZ looks after China's launch requirements. China already possesses an impressive inventory of launch vehicles and earnestly pursues the quest for acquisition of better capabilities. It has carried out 93 orbital insertions up to December 05 and ever since its last failure in 1996, has recorded 47 successful launches in a row. Nevertheless, historically, China's launch rates were miniscule, had never crossed unitary figures and rarely came close to even four or five until 1996. Post-1996, China's launch rates increased dramatically and touched an all time high of 10 in 2004. It plans to launch up to nine satellites in 2006 and aspires for an average launch rate of 25-30 satellites per year for the next five years[14]. *Sun Laiyan,* president of the China National Space Agency (CNSA) and Deputy Minister of Commission of Science, Technology and Industry for National Defence (COSTIND), states that, China's goal through 2010 is to triple the number of satellites it will launch[15]. At the executive level, statements by Deputy Director *Zhang Wei* of the System Engineering Department under COSTIND are also on similar lines and assert that during the 11th Five-Year Plan Period, China intends to launch 50-60 satellites into space.[16] China's 11th Five Year Plan 2006-2010 also reinforces the importance the government accords to space[17]. The previous Five Year Plan-10 (2000-05) pioneered the above trend and the future Five Year Plans are expected to be no different.

As a matter of fact, since its ninth Five Year Plan of 1996, China's launch rates have been growing as never before. While the launch rates of

14. "China Launches nine Satellites in 2006," *Sat News Daily*, March 13-19, 2006, available at http://www.satnews.com/frames.html
15. "Seize Opportunities and Promote the Development of Space," speech by Sun Laiyan, Deputy Minister of COSTIND and President of the CNSA, at the ceremony for the 35th anniversary of China's first satellite launch on April 29, 2005. Sourced from Eric Hagt "Vulnerabilities in Space", *China Security* -2006, Issue no.2, p. 88.
16. "China to launch 50 satellites in next 5 years" web site of CSSA, available at http://www.newcssa.net/read.php?tid=27246
17. See Communist Party of China (CPC) Central Committee's Proposal on the Formulation of the 11th Five-Year Plan (2006-2010) for National Economic and Social Development, approved by the Central Committee of CPC on October 11, 2005 at http://theory.people.com.cn/GB/40746/3781965.html.

the Americans and Russians have fallen, China has registered a dramatic upturn. At present, it registers the fastest growth in launch rates in the world as evidenced from the chart below.

Fig. 2: China's Growing Launch Rate

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005
USA	37	34	27	28	21	17	27	17	19
Russia	26	24	26	20	25	25	24	15	15
China	06	06	04	06	02	08	09	10	06
India	01	00	01	00	02	01	02	01	02

As China's 11th Five Year Plan progresses, the upswing would register higher growth rates, considering that it plans to blast off 100 more satellites into space by 2020.[18] It pursues the development of new generations of launchers and modifies existing vehicles to fulfill its foreseen needs by adopting the strategy of "making the big, bigger and the small, smaller."[19]Thus, the prevailing inventory by the year 2008 would be augmented by the development of heavy lift vehicles like CZ-5 capable of putting up to 25 tons in Low Earth Orbit (LEO) and 13 tons in Group on Earth Observations (GEO) as well as modification of the diminutive 1970s CZ-1 into small, powerful solid fuelled truck based launchers called *Kaitouzhe*-1 (KT-1) or Pioneer. The KT is aimed at placing 40 kg to 100 kg into 300 km high polar orbit from mobile launchers and because it is solid fuelled it can be prepared for launch quickly. Time and terrain limitations are hence effectively contained. Certain reports claim that the KT on commissioning would be capable of launch within 20 hrs from fixed or mobile launch pads. In addition to the above, it also plans to develop "*airborne carrier rockets*" to

18. As revealed by Xu Guanhua, the Chinese Minister of Science and Technology at the 18th plenary session of the International Committee on earth observation satellites. See website of Ministry of Science and Technology's *Newsletter No.385*, November 20, 2004 at http://www.most.gov.cn/eng/newsletters/2004/t20050202_19006.htm
19. Guo Linli, Shen Lin, Yang Yong and Hu Defeng, "Study on the Development Stratagem of China's Space Transportation System," *Missile and Space Vehicles*, Issue no.1, 2006.

enable mobile, flexible and fast launch of mini-satellites.[20]

Launch site limitations are a critical payload restricting factor for China, nevertheless, by 2010; China's new launch site at *Hainan* Island is expected to be functional and would more than double the payload launch capability for putting satellites into the geosynchronous and polar orbits, a capability it critically lacks.[21]Overall, its prevailing capabilities are potent as evidenced from the chart below and the potency is only set to increase by 2010.

Fig. 3: Prevailing Chinese Launch Vehicle Capabilities

SLV	Capability	Reliability	Remarks
CZ-1	300 kgs to 440 kms	100%	Derivative of DF-4 ICBM
CZ-2C	2.5 – 2.8 Tons to 170 – 300 kms	100%	Derivative of DF-5 ICBM
CZ-2D	3.4 Tons to 200 kms	100%	Used for FSW spacecraft.
CZ-2E	8.8 Tons to LEO,3.4 Tons to GEO	71%	
CZ-2EA	14-16 Tons to LEO	-	Design frozen.
CZ-2F	7.6 Tons to LEO	100%	Used for ShenZhou.
CZ-3	1.4 Tons to GEO	77%	
CZ-3A	2.3 Tons to GEO	100%	
CZ-3B	4.8 Tons to GEO	80%	Equal to Russia's Proton & Europe's Ariane-4.
CZ-4	3.8 Tons to LEO, 2.8 to SSO.	100%	Used for Feng Yun metsats.

Apart from the above, China also pursues the development of Expendable Launch Vehicles (ELVs) etc. and the Shenyang Aircraft Company has reportedly undertaken the task of developing a single stage to orbit space plane[22].

20. Ministry of Science and Technology of the Peoples Republic of China, *Science and Technology Newsletter No. 366* ,May 10, 2004 at http://www.most.gov.cn/eng/newsletters/2004/t20041130_17766.htm
21. Hainan to Build a Space Harbor in 2010," *Hainan Economic Daily (Hainan Jingji Bao)*, October 12, 2005.
22. Richard Fisher, Jr. "China's Manned Military Space Ambitions" *International Assessment and Strategy Centre* , October 10, 2005. p.10.

SPACE SYSTEMS

Of these 50 satellites in orbit, up to 26 have been launched since the year 2000

China had 72 satellites in orbit as of December 05 and even excluding commercial ventures like Iridium, joint ventures like the CBERS, second-hand satellites like Asiasat, Apstar etc. It still notches an impressive array of up to 50 satellites which is set to grow rapidly as indicated by Chinese governmental pronouncements, budgetary allocations of its 10th and 11th Five Year Plans, and trends since beginning of the new millennium. While the above number appears miniscule as compared to that of the US, certain analysts from the West aver that, when measured in terms of national GDP, the significance of China's satellite base increases dramatically and when compared in terms of GDP per capita it actually rises to levels on par to that of the US[23]. The above indicates that in the context of China's overall development, its current interests in space are already substantial and rising dramatically.

Of these 50 satellites in orbit, up to 26 have been launched since the year 2000, of which up to eight are for dedicated military uses; while the balance like the *FengYun, HaiYang, Tsinghua*, etc are capable of dual military and civil uses and are known to provide the same. As a matter of fact, while the major military space system efforts prior to the millennium were sporadic and largely in terms of primitive recoverable observation satellites like the FSW or JSSW, post-2000, the efforts are apparently systematic, studied and deliberate, as a consequence, availability of on-station military satellites have registered a dramatic upswing[24]. The above ostensibly is in keeping with its maturing military space doctrines of '*power enhancement and support capabilities*' or 'force enhancement' in Western parlance, which essentially conotates acquisition of information capabilities in terms of space based observation, communication,

23. Eric Hagt "Vulnerabilities in Space", *China Security* -2006, no.2, p. 91.
24. The above contention is validated when considering the fact that until the first three-year long duration FH-1 dedicated military communications satellite débuted in January 2000, China's military endeavours were largely confined to crude, primitive Electronic Intelligence (ELINT) payloads like the short duration JSSW of the 70s or recoverable satellite programmes like the FSW-0 series for Imagery Intelligence (IMINT) which had enormously limited military advantage and duration. Its duration of flight was barely five days in the 1980s and gradually advanced to 16 days duration by the late 1990s. Since its transmission was not real time and subject to its recovery on earth and subsequent analysis , its military utility was limited.

meteorology, navigation, positioning etc. Development and deployment of a viable architecture of space-based sensors, communications and weather systems is a fundamental requirement for expanding battle-space awareness as also is the need of navigational systems for Positioning Navigation and Targeting (PNT) etc. Thus, the PLA's efforts have expanded beyond episodic 14 day photo-reconnaissance missions of the FSW to permanent positional presence of dedicated IMINT, navigational and military communication satellite constellations etc. for enabling comprehensive information dominance at least in an initial regional context. Accordingly, during the period of the 10th Five Year Plan (2000-05), a BD constellation of three military satellites for PNT is in place, three ZY-2 series satellites for military observation are in orbit, two Frequency Hopping (FH) military communication satellites which are part of a five satellite constellation are also in place. The above capabilities are also augmented by intermittent launches of the FSW as well as dual-use satellites like the Feng Yung (FY) weather satellite constellation, the HY for ocean reconnaissance, manned missions like the *ShenZou* and microsatellites like the *Tsinghua* etc. Considering that China opened its account in 2006 with the launch of a fourth dedicated military IMINT satellite, its capabilities can only be expected to increase further as it marches into its 11th Five Year Plan which has allocated greater resources to developing air and space capabilities. In order to comprehend the full impact of China's quest for space enabled informationalisation and consequent RMA, its existing capabilities are dwelt upon as below.[25] As they span the entire spectrum of force-enhancement missions like observation (ISR), navigation (PNT), communications, weather etc. they are categorised and described accordingly.

OBSERVATION (ISR) SATELLITES:

Until the period of the ninth Five Year Plan, earth observation in China was largely the mainstay of airborne remote sensing platforms. The system is world class and comprises of 80 airplanes, 25 airborne sensors and variety of instruments ranging from airborne Pushbroom Hyperspectral Imagers

25. For a more complete and detailed account of China's historical evolution of its launchers, military space sytems etc., ref Sqn Ldr KK Nair, "Space: the Frontiers of Modern Defence", ch.6: The Great Asian Space Militarisation Race. pp. 117-133.

(PHI), airborne Synthetic Aperture Radar (SAR) systems to high resolution Charge Couple Device (CCD) cameras etc.[26]Nevertheless, permanent on-orbit presence of military satellites is crucial for information-based military operations, China lacks the same and hence by the period of the 10th Five Year Plan, Chinese investments in military IMINT systems have registered an upswing and are likely to continue. Consequent to it, space based observation has become an important element of Chinese space systems, several systems have been developed and launched and as a result it constitutes the largest category of satellites launched by China. Nevertheless, amongst observation missions, the Chinese display a clear bias for IMINT systems rather than Signals Intelligence (SIGINT).

SIGINT systems: China's space programme does not accord a very high priority to SIGINT and its important components of ELINT and Communications Intelligence (COMINT). This could be partly attributed to the fact that it has a massive terrestrial SIGINT network which has been widely described as being the most extensive in the entire Asian region. Secondly, its dual-use satellites like the SZ and Shi Jian (SJ) also intermittently supplement its SIGINT needs as also do the occasional piggy-back payloads strapped on other satellites. Thirdly, its attempt to obtain domestic and regional SIGINT through off-the-shelf purchase of two Asia Pacific Mobile Telecommunications (APMT) satellites resulted in enormous avoidable controversy and national embarrassment[27]. Lastly, it has not given up attempts for acquisition of the same and perhaps waits for a more opportune moment. From the foregoing, it could be safely surmised that it has no pressing need for space based permanent SIGINT systems and has a high degree of proficiency in covertly deploying additional SIGINT payloads. Hence, its present focus is on building up its on-orbit IMINT capabilities, which it seriously lacks.

IMINT Satellites: China's early IMINT endeavours like the Fanhui Shi Weixing (FSW) had definite limits. It was not real time, the IMINT films were sent back from space in recoverable cabins (some recovered,

26. Quoting from presentation by Cao Xuejun of MOST, "Earth Observation in China", *Dragon Symposium*, Santorinin Greece, June 27 – July 01 2005.
27. For details, see Airpower journal

others not) and military analysts had to wait until the film was developed before they could analyse points of interest. The above scenario changed with China's launch of its indigenous ZY-2A in September 2000. ZY-2A was highly manoeuvrable, could transmit images in real time and had better resolution capabilities; some reports placed it at 12 mtrs[28], some at 05 mtrs[29]. This was followed by a second IMINT satellite, the ZY-2B in October 2002. Both satellites operate in tandem and between them cover the same ground path every five days enabling the capacity to cover any ground location every two and a half days. By November 2004, a third ZY-2C also joined them and all three satellites are positioned equidistant in the sun synchronous orbit, giving a full coverage of the earth at all times[30]. As of April 2006, a fourth military remote sensing satellite has been launched. In keeping with Chinese proclivities at assigning multiple nomenclatures, this satellite has been named "Remote Sensing Satellite-1".

Some reports have indicated a military designation code of JianBing-5, the military codes have been applied retrospectively (since 2003) with ZY-2A being designated as JB-1, ZY-2B as JB-2, ZY-2C as JB-3 and to confuse matters, FSW3-1 has also been designated as JB-4. Irrespective of the precise nomenclatures, it goes without saying that Chinese imaging systems and capabilities have improved substantially over the five-year period of the 10th Five Year Plan and while precise resolution details have not been made public, the fact that JB-5 or Remote Sensing Satellite-1 carrying its first SAR system would endow it with tremendous military advantage. Unlike conventional passive optical imagery satellites, space based SAR systems can see through clouds, rain, fog and dust to detect targets on the ground, underground, on oceans and even under ocean, enabling tracking of surface as well as sub-surface vessels like submarines in shallow waters etc. They can also track moving targets and enable military mapping.[31]

Dual-Use Observation Systems: In addition to the above, China's

28. Brian Harvey, "China's Space Programme", Ch.6, p 156.
29. Bill Gertz, "Chinese civilian satellite a spy tool", *Washington Times*, August 1, 2001.
30. Chinese Defence Today, "Jianbing-3 (ZY-2) Earth Remote Sensing Satellite" at http://www.sinodefence.com/strategic/spacecraft/ziyuan2.asp -->
31. Chinese Defence Today, "Jianbing-5/Remote Sensing Satellite-1 Synthetic Aperture Radar" at http://www.sinodefence.com/strategic/spacecraft/jianbing5.asp

Information, Surveillance, Reconnaissance (ISR) needs are also augmented by dual-use satellites. For example, the *ShiJian* (SJ) scientific experimental satellites have been known to carry payloads with SIGINT characteristics[32], as also the atmospheric research DaQui-1 (DQ-1) satellites and the manned as well as unmanned SZ versions. All *ShenZhou* (SZ) missions since November 1999, inclusive of the four unmanned test missions and the manned test mission of October 2003 were known to have performed military missions. SZ-1 and SZ-2 carried an Electronic Intelligence (ELINT) payload to monitor communication signals in the Ultra High Frequency (UHF) band as well as radar transmissions. SZ-3 and SZ-4 were known to carry an IMINT payload of CCD cameras with a resolution of as much as 1.6 mtrs.[33] Enormous realms of literature in the West have been written on the SZs carrying out military IMINT and ELINT missions in addition to their civilian tasks and the Chinese have gone to great lengths to refute or justify the same[34]; nevertheless, the overwhelming evidence points to military missions having been conducted and finally, the entire manned SZ mission is a PLA endeavour and all the data collected has gone into military rather than civil scientific research.[35] China's microsatellite endeavours like *Tsinghua* are also known to be capable of performing ISR missions. Thus, even after discounting civilian Earth observation missions like the CBERS capable of dual-use imagery, China has a formidable capability for space enabled military specific observation.

As mentioned previously, the Chinese had already achieved proficiency in obtaining real time imagery from airborne systems. Nevertheless, the PLA has gone in for space based systems also since it views space based imagery as vital for consistent information gathering and information-

32. Thompson, David J. & Morris, William R., "China in Space: Civilian and Military Developments", *Maxwell Paper no.24,* August 2001, Air War College,.
33. For details, see Sqn Ldr KK Nair, "China's Space Programme: An Overview", *Airpower Journal*, vol.1 no.1, Monsoon 2004, p.154. Also ref Richard Fisher Jr., "China's Manned Military Space Ambitions" *International Assessment and Strategy Centre* , October 10, 2005.
34. For the Chinese version on the SZ's military missions, see ChangXianqi and SuiJunqin, "China's Space Mission" as well as Sun Dangen, "ShenZhou and dreams of Space", *China Security*, Issue no. 2, 2006.
35. Liu Cheng and Chai Yongzhong, "CAST group donates SZ databases to military scientific research institutes", *PLA Daily*, December 26 at http://english.chinamil.com.cn/site2/columns/2005-12/26/content_373517.htm -->

dominance. Thus, since the new millennium, China's on orbit presence of military observation satellites has increased as never before. While on-orbit military IMINT presence prior to the new millennium was as good as nil, it has burgeoned to as much as five satellites by 2006 and going by prevailing trends, the presence is set to increase further.

NAVIGATIONAL SATELLITES (NAVSATS):

China's first navigational satellite BD-1A appeared without any forewarning in October 2000, taking the entire world by surprise. It was in response to declared defence requirements[36]and was part of a three satellite first generation navigational system. The system works at 2491.75 Mhz and covers the region between Longitude 70°~140° E and Latitude 5°~55° N. Two satellites are positioned in geosynchronous orbit at 80° E and 140° E and the third satellite is positioned at 110.5° E[37]. It enables both limited PNT services within China and its contiguous areas and also enables reasonably accurate targeting of certain US targets by Intercontinental Ballistic Missiles (ICBMs). It provides positioning data accurate up to 100 mtrs, which Western sources claim by using ground correction stations which can be increased to 20mtrs[38] whereas the Chinese claim the system coupled with their wide area augmentation system can enable an increased accuracy of up to 12 mtrs[39].

Going by available accounts, the original plan was to follow it up with an improved second generation system[40] and also go in for international endeavours with NavSat providers like the European Galileo and Russian Glonass. Nevertheless, apparently neither options now appeal to the Chinese, given that Glonass capabilities are severely degraded and with regards to Galileo; not only is China denied the military specific Premium Regulated Service (PRS), but also many commercial applications available to other European partners. As a matter of fact, Chinese cash deposits of $ five million

36. Zhu Yilin, "Fast track development of space technology in China", *Space Policy*, May 1996. pg.139.
37. Chinese Defence Today, "Beidou-1 Satellite Navigation System" at http://www.sinodefence.com/strategic/spacecraft/beidou1.asp -->
38. Ibid.
39. Most, NLS-382 October 20, 2004.
40. See MOST, Newsletter No.499.

in the Galileo project are likely to be refunded and chances of China being pushed out of Galileo are high.[41] The Chinese have hence reportedly decided to go in for an indigenous full-fledged 24 satellite navigational constellation in Medium Earth Orbit (MEO), akin to NAVSTAR and Galileo which would enable unencumbered global utility. It has for the above purpose registered 32 slots in the International Telecommunication Union (ITU) and also placed orders for Rubidium atomic clocks which are the heart of navigational satellites and enable highly accurate timing that is the basis of satellite-based position location and navigation. Akin to Galileo, whose frequency is close to and overlaps that of the US NAVSTAR GPS, thereby enabling interoperability and also securing Galileo against possible jamming[42], China also proposes to place Compass in frequency bands close to Galileo, so as to guard against deliberate jamming by the US. The above has caused considerable consternation amongst the Europeans and the Americans.

Chinese cash deposits of $ five million in the Galileo project are likely to be refunded and chances of China being pushed out of Galileo are high.

MILITARY COMMUNICATION SATELLITES:

With regard to military communications, China's military forces are already connected extensively within China by fibre-optic communication networks. Nevertheless, these are apparently inadequate to complement the extended reach enabled by its recently acquired long range fighters like the SU-30's, its Air-to-Air refuellers and its maritime elements. Since the PLA was allotted only limited channels amongst China's eleven DFH communication satellites, it attempted to rectify the situation and proposed a network of defence communication satellites. Its FH-1 (*Feng Huo*-1) military communication satellite (first of the series) was launched

41. Peter B. de Selding, "Europeans Raise Red Flags over Chinese Satellite Navigation Plans", *Space News,* June 12, 2006.
42. Deliberate jamming by the US of Galileo would in turn lead to US's NAVSTAR also experiencing interference and degradation. For a more detailed discussion, see Taylor Dinerman, "Will China compel the development of GPS-4", *The Space Review*, June 19, 2006 and Ryan Caron, "Letter: Galileo and Compass", *The Space Review*, August 7, 2006.

in January 2000, which consists of the *Qu Dian* C[4]I (Command, Control, Communications, Computers and Intelligence) system.The network as per its registration with the ITU would consist of up to five satellites, China Sat 21-25. This network would enable PLA commanders to communicate with their in-theatre forces in near real time,[43] and also enable data transfer with all units under joint command in addition to providing the Chinese military with a high speed and real-time view of the battlefield thereby enabling effective command and control. The Chinese military describes the new tactical information system component of the *Qu Dian* system as being analogous to the American Joint Tactical Information Distribution System (JTIDS). The satellites would reportedly provide the military with both 'C' and UHF band communications. Thus, once fully deployed, the FH series constellation would establish space-based military tactical communication networks to support Chinese military operations.

WEATHER SATELLITES

Although not designed primarily for military uses, Chinese weather satellites do support military activities. Designed primarily for civil users, these satellites provide earth observation, weather and other related data that are vital to military forces when determining useable ground manoeuvre routes, aircraft flight paths and visible target areas, amongst other things. China's weather satellites are listed as the *Feng Yun* series, up to four series and a total of eight satellites have been launched till date. With every launch, capabilities and performance witness greater improvement. In addition to visible and infrared scanning radiometers, they now carry microwave sensors and imaging devices and are capable of identifying highways from a height of 870 kms.[44]

EARLY WARNING SATELLITES

It is surprising that China has not put in dedicated measures for the above mission, considering that it has developed the entire complement of BMs,

43. John Pike, "The military uses of outer space", *SIPRI Year book 2002: Armaments, Disarmaments and International Security.*
44. Most newletter no. 399.

possesses a triad of nuclear forces and is enormously concerned with the US's Ballistic Missile Defence (BMD) programme as well as the cover it might provide to Japan and Taiwan. As a matter of fact, China's greatest vulnerability is its lack of strategic reconnaissance platforms; neither does it possess a functioning Over-The-Horizon (OTH) radar network, nor high altitude strategic reconnaissance aircrafts, nor dedicated satellites to provide early warning. It could be speculated that some covert capability exists or that it plans to develop it in a phased manner.

MICRO-SATELLITES (MICROSATS)

Microsats have numerous civil and military applications. Their primary military appeal lies in the fact that they are expendable, cheap to produce and launch, are flexible and difficult to detect. They offer a cheaper alternative for fulfilling a range of both active and passive military space activities. For example, microsats can be offensively utilised in ASAT roles as well as for disrupting satellite reception signals. They can also provide a surge capability for crises besides providing a less expensive replacement platform for larger passive military platforms in space providing military communications, IMINT, SIGINT etc. As a matter of fact, the entire panoply of military missions ranging from 'force-enhancement' to 'counter space operations' **(SPACING BETWEEN WORDS)** can be effectively fulfilled by microsats. Nevertheless, its gainful military utility demands a high degree of technological sophistication, precise tracking and orbital manoeuvring accuracy as well as commensurate launch capabilities. As of 2006, the Chinese have apparently made significant advances in all the above three and are continuing investments for pursuit of better microsat related capabilities.[45] Evolving technological sophistication is

45. Chinese commitment and investment to microsatellites can be gauged from the fact that it established a 8,000 square metres site for a National Research Centre (NRC) for Small Satellites and Related Applications in April 2003 and followed it up with the world's largest "Microsat Industrial Park" in Beijing in December 2004. The park stretches over 16,000 square metres, and has an annual capacity to manufacture and test six to eight advanced small and micro-satellites as well as their application technologies. Other governmental efforts include the Small Satellite Research Institute of CAST and the Shanghai Institute of Microsystems and Information Technology. The above is in addition to prevailing collaborative efforts of *Tsinghua* university with SSTL, UK as well as *Haerbin* University's joint efforts with the European company Astrium.

a foregone conclusion and the ability to launch multiple payloads on a single launcher was successfully demonstrated in 1981. Ever since, the Chinese have made tremendous advances and the highly mobile KT-1, capable of mobile and fixed launch within 20 hours would enable it to fulfil it's much desired 'launch-on-demand'capability. This in turn would entail continuous on-orbit presence and gap-free coverage of its areas of interest as also significant ASAT capability. It has mature space detection, tracking and manoeuvring capabilities in place which would multiply the utility of microsats in ASAT roles.

China's microsat endeavours have increased substantially in the new millennium. A China and Surrey Satellite Technology Ltd (SSTL), UK partnership project enabled the June 2000 launch of a 50 kg *Tsinghua*-1 micro-satellite and companion Surrey Nanosatellite Application Platform (SNAP) nano-satellite weighing 6.45 kgs. On-orbit rendezvous capabilities of both were put to test and were reportedly successful[46]. The *Tsinghua-1* is a precursor to a larger 07 satellite *Tsinghua* constellation aimed at providing high resolution imagery. While the first *Tsinghua* has a resolution of 30 mtrs which is not of enormous military significance, later satellites display improved military grade resolution.

Microsatellite efforts were later formalised and financed under the aegis of the 10th Five Year Plan and a major project "high performance microsat ground observation technology and associated applications" was approved. Under it, Beijing-1 or *Tsinghua-2* was a product of the same project. The *Tsinghua-2* launched in October 2005 has a resolution of 4 mtrs and a swath of more than 600 mtrs which is of significant military value[47].

Additionally, as disclosed by the China National Space Administration (CNSA), during the period of the 11th Five Year Plan[48], China plans to put into orbit a *Huanjing* constellation of 11 microsats for environmental observation and disaster watch in two phases. The first phase would include 02 optical satellites and a third SAR satellite to be launched by 2007. The second phase

46. Brian Harvey, ch.6, p.161. *Tsinghua* is reffered to as *Qinghua*, nevertheless, the above is a matter of mixed nomenclatures and the subject microsatellite is the same.
47. MOST, NLS-441.
48. As quoted by the Ministry of Science and Technology, *Newsletter No.339*, August 10, 2003.

would include 04 small optical and 04 SAR satellites to be launched by 2010 enabling a 12 hourly revisit.[49] The project was apparently slated to begin in 2005 and has been delayed. Overall, China of date has the following microsats in orbit which are set to multiply as it progresses into its 11th Five Year Plan.

Fig. 4: Chinese Microsats in Orbit- December 2005

Micro-Satellite	Launch Date	Weight	Role	Remarks
Tsinghua-1[50]	20 Jun 2000	50 kgs	Imagery	Res: 30mtrs, 03 optical bands (NIR, green, blue) Swath: 600 kms
Tsinghua-2[51] (Also named as Beijing-1.)	27 Oct 05	150 kgs	Imagery	Res: 04mtrs panchromatic camera + 32 mtrs res 3-band multispectral
Tansuo-1	18 Apr 04	150 kgs	Imagery	camera. Swath: 600 kms. Carries 10 mtrs stereo resolution camera[52].
Tansuo-2	18 Nov 04	300 kgs	Imagery	Not Known (N/K)
Naxing-1	18 Apr 04	25 kgs	N/K	N/K
Chuangxin-1	21 Oct 03	100 kgs	Data relay	Launched piggy-back on CBERS-2

ASATS

The military mission area of counter space ops aims at controlling the realm of space for own use and denying it to the adversaries. The same in Chinese parlance is termed as *'Attack Ops'* and includes the pursuit of ASAT and other capabilities aimed at denying, degrading and destroying the space assets of the adversary. The essential precursor to any counter space capability is the ability to detect, identify and track objects in space which is referred to as

49. "China to set up world's first satellite constellation for disaster monitoring", *People's Daily Online*, June 25, 2004 at http://english.people.com.cn/200404/27/eng20040427_141719.shtml
50. Data on *Tsinghua* sourced from a variety of sources, weight sourced from site of SSTL, technical parameters from Stoney, W.E., "Guide to Land Imaging Satellites,' *The American Society for Photogrammetry and Remote Sensing*, Updated February 2, 2006, available at http://www.saniita.com/pdf/Guide%20to%20Land%20Imaging%20Satellites.pdf
51. For details, see "Beijing-1 (China-DMC + 4, Tsinghua-2)…." *Space News Feed*, October 30, 2005 at http://www.spacenewsfeed.co.uk/2005/30October2005_25.html
52. Brian Harvey, ch.6, p.162.

'aerospace surveillance' and the same is hence dwelt upon as below.

Aerospace Surveillance: The above in a military sense is aimed at obtaining space situational awareness which is the first step to denial, destruction or degradation by ASATs or any other means as also for protection of own assets (by evasive manoeuvres) in space. As of date China has a mature world-class space surveillance and TTC system and earnestly pursues the acquisition of better technologies related to spacecraft navigation, attitude control, simulation, integrated rocket measuring and launching control. The above are essential for any credible space faring nation and are not directly indicative of military aims but certainly endow enormous incidental military capabilities essential for counter space ops. For example, the ability to track objects is essential for keeping a track of own satellites as also for detecting and identifying foreign satellites to conduct ASAT ops like putting objects in the orbital path or aiming ground-based lasers for destroying sensors during overpass timings or taking deception, camouflage and concealment measures to deceive space based surveillance etc.

China claims that its space control network has reached an orbiting accuracy at the metre level, which makes the flawless control and management of 85 orbiting vehicles possible.[53] It also claims to have developed software to enable it to orbit multiple satellites at the same time, with an accuracy reaching centimetre level. Trial applications show that the system has centimetre-level positioning accuracy, with an advanced function to orbit multiple satellites in multiple arcs at the same time[54]. If the above claims are taken as accurate, then the possibility of China successfully undertaking satellite interception missions becomes enormously credible. It would have the requisite orbital data to calculate the proper path to the target, to launch the booster at the precise moment, the ability to track and plot the precise intercept course to the target and detonate, dock, rendezvous or inspect as need be. The above appear to be enormously credible considering that Chinese microsats like *Tsinghua*-1 have been known to carry out successful

53. Ministry of Science Technology, News Letter No. 370.
54. MOST, NLS-397.

rendezvous manoeuvres with other microsats[55].

ASAT capabilities: Western and Chinese writings on ASAT capabilities (both established and speculative) are profuse. Chinese R&D for ASAT weaponry has been going on since 1960 under the 640 programme of the space and missile industry's Second Academy. The programme was abandoned in the 1980s. Nevertheless, ASAT efforts were not given up altogether and funding continued under programme-863. Western reports on Chinese ASAT capabilities were profuse in the late 1990s. Since 1998, there were reports that China's Central Committee of Communist Party had been giving highest priority to the development of an anti-surveillance ASAT system. This system comprises of ground based lasers capable of damaging sensors of LEO imaging satellites[56]. America's Cox report of 1999 also judged that China had the technical capabilities to develop CSS-2 or DF-3/3A Intermediate Range Ballistic Missile (IRBM) into a direct ascent ASAT weapon. Some reports also mention the possible modification of China's solid fuelled missiles, the DF-21 or DF-31 as a direct ascent kinetic kill weapon[57]. Reports on Chinese ASAT capabilities reached a crescendo in the new millennium with the Department of Defence (DoD) Annual Report on the Military Power of the People's Republic of China for the Fiscal Year 2003 (FY 03) and FY 04 both containing references to Chinese "parasite" satellites for potential use as ASATs. The source of the report on parasitic ASATs was not credible and was traced to a self-proclaimed "military enthusiast" named *Hong Chaofei* from a small town in *Anhui* by

55. Brian Harvey, pg 161.
56. Paul Beaver, *Jane's defence weekly*, December 02, 1998, p.18.
57. Kinetic energy attacks that are launched from the earth and attempt to destroy the satellite without placing an object into orbit are referred to as direct-ascent attacks. Such an attack may use a homing interceptor. The ASAT would be launched on a missile that carries it above the atmosphere and releases it in the direction of the target satellite. The interceptor would then use its sensors to detect the target satellite and its thrusters to guide it to collide with the satellite. Shortly before intercept it might release a small cloud of pellets to increase the possibility of collision. Since the attack can be direct-ascent and does not require the interceptor to be placed in orbit, attacking satellites in low earth orbit requires only a relatively short-range missile to loft the interceptor to the satellite's altitude.

the American Union of Concerned Scientists.[58] DoD reports ever since are extra cautious and the FY 06 very guardedly state that "China can currently destroy or disable satellites only by launching a ballistic missile or space-launch vehicle armed with a nuclear weapon".

The fact of the matter is that, though China has not conducted ASAT tests like the Soviets or the US to conclusively establish ASAT capabilities, it undoubtedly possesses a range of enabling capabilities for prosecuting ASAT operations. For example, while the prospect of launching nuclear payloads would not appeal due to the inherent risks involved, it goes without saying that conventional kinetic-kill payloads could perform the same tasks effectively with lesser collateral damage[59]. Similarly, China's direct-ascent ASAT capabilities are a foregone conclusion in view of its prevailing potent launch capabilities which would only multiply in the near future.

Additionally, lasers, RF energy, High Powered Microwave (HPM) and such-like Diverted Energy Weapons (DEW) have potent ASAT applications. Lasers, in particular both solid-state and chemical have immense ASAT applications. Laser technology in China is mature, and a variety of laser materials and techniques have been developed with a range of power levels. Laser ASAT systems also require a tracking and pointing system. Movable mirrors are used both for directing the laser beam toward the satellite and to focus the beam. China earnestly pursues acquisition of all the above and has acquired world-class proficiency in these systems. To cite a case in point, China's first femtosecond high powered solid state laser device

58. The US Department of Defence, "Annual Report on the Military Power of the People's Republic of China" July 2003 p. 36 also claimed that China was developing killer microsatellites based largely on a January 2001 Hong Kong newspaper article. However, Gregory Kulacki and David Wright of the Union of Concerned Scientists traced the story to a web site run by a self-described 'military enthusiast' named Hang Chaofei who ran a Chinese language internet bulletin board filled with crude illustrations and "fanciful stories about secret Chinese weapons to be used against Americans in a future war over Taiwan". For details, see Greogory Kulacki and David Wright, "A Military Intelligence Failure? The Case of the Parasitic Satellite" (Cambridge: MA: Union of Concerned Scientists, August 2004), p. 3.

59. Attacks that attempt to damage or destroy a satellite through high-speed collisions with another object are called kinetic energy attacks. Since satellites move at high speeds, a collision with even a small object can seriously damage them. Even a collision that leaves the satellite largely intact could cause it to tumble. Prevailing Chinese launch capabilities enable potent capabilities.

with an output of 300TW (3×1014W) has been recently put into successful operation in *Mianyang, Sichuan.* It has also acquired proficiency in utilising lasers and mirrors for accurate ranging and positioning. SZ-4 reportedly carried a space mirror, laser reflector which enabled accurate ranging and positioning to the extent of 01 centimetre.

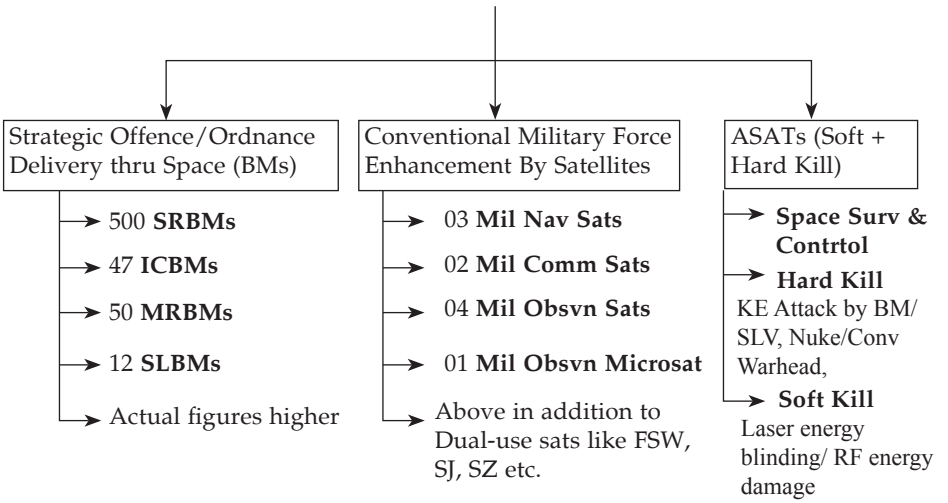
Speculation on China's build-up of ASAT capabilities is on the rise. Apart from proficiency in launch and surveillance, its increasing proficiency in microsats would also endow incidental ASAT capability. Microsats have immense applications as ASATs. Operationalisation of its highly mobile KT-1 for launching microsats would make its military counter space mission more potent as also its pursuit of airborne carrier rockets as well as ASAT aircrafts like the MiG-31.

China's launch abilities, its ability to rendezvous and inspect, accurate orbital control and multiple satellite navigation, accurate ranging by lasers and mirrors etc would make a credible ASAT capability possible. Following the demise of the Cold-War, the need for mutual chest-thumping braggadocio between equal partners is no longer necessary and considering that the above are part of China's quest for acquisition of 'asymmetric capabilities' vis-à-vis the lone super-power, the question of going in for declared ASAT tests just does not arise. A common-sense approach would demand the discrete build-up of capabilities, which is ostensibly what is being done.

TIPPING THE AEROSPACE BALANCE

In view of the foregoing, it is comprehensively apparent that China fully appreciates the impact of composite aerospace capabilities in furthering CNP and hence since its ninth Five Year Plan has put in enormous efforts and investments for modernising its antiquated military machinery. The process of modernisation spearheaded by its growing air and space capabilities would make it enormously powerful both in quantitative and qualitative terms. Its composite military space capabilities are the most powerful in Asia and evidently globally formidable considering its military space apparatus below.

Fig. 5: China's Present Military Space Apparatus



To complement the above, Chinese airpower is also rapidly expanding and modernising. China's comprehensive pursuit of air and space power is evidenced by the fact that as in case of space, China laid the foundations for building modern airpower capabilities during the ninth Five-Year Plan (1996-2000), made significant progress on both the civil and military elements during the 10th Five-Year Plan (2001-05) and going by trends will continue to build on all aspects of this foundation during the 11th Five-Year Plan (2006-10) also. Chinese airpower is growing rapidly and apart from People's Liberation Army Air Force (PLAAF) which enables it military force projection, China's civil aviation industry is also growing at an equally rapid pace.

With regards to PLAAF, in sheer quantitative (numerical) terms, it has for most of its history maintained its position as the largest Air Force in Asia and the third largest in the world. Nevertheless, in qualitative terms, it has lagged behind many nations. As a matter of fact, even within Asia, in qualitative terms it has at times lagged behind Taiwan and India also. Nevertheless, the Chinese fully comprehended the military dividends yielded by the extensive reach of modern airpower and began corrective actions around the period of the ninth Five Year Plan. Thus, as it progresses into the new millennium, its airpower capabilities are expected to shrink quantitatively and grow qualitatively. Its

antiquated tactical aircraft inventory is being replaced by modern third and fourth generation strategic fighter aircrafts like the SU-30, long range transport aircrafts like IL-76s, Air-to-Air refuellers, Airborne Warning and Control System (AWACS) etc which would enable it to complement its expanding global influence and interests. In 2005 China announced plans to buy approximately 30 IL-76 transport planes and eight Il-78 tanker planes from Russia, which would greatly increase its troop airlift capability and offer extended range to many aircraft.

Military fighter aircraft are the most visible manifestation of a nation's long range military force projection capability and strongly impact national power and security dynamics. Hence, a qualitative audit in numerical terms of modern fighter aircraft of the two leading Air forces of Asia; the PLAAF and IAF has been undertaken as below.

Fig. 6: Comparing Periodical Modern Fighters of PLAAF & IAF Inventory

	PLAAF			Indian Air Force		
Period	**2nd gen**	**3rd gen**	**4th gen**	**2nd gen**	**3rd gen**	**4th gen**
1979	80 J-7/ Mig-21.	Nil	Nil	200 Mig-21	Nil	Nil
1989	300J-7 + 200 J-8	Nil	Nil	320 Mig-21 +267 Others.	49 Mig-29 + 52 Mir-2000.	Nil
1999	700 J-7 +J-8.	48Su-27	Nil	632 Mig-21,etc.	99 M-29+ Mir	08 Su-30s.
2000	950 J-7 + J-8.	50 Su-27	10 Su-30	618Mig-21, etc.	99 M-29+ Mir	08 Su-30s.
2001	950 J-7 + J-8.	65 Su-27	38 Su-30.	618 Mig-21, etc.	99 M-29+ Mir	18 Su-30s.
2002	794 J-7 + J-8.	70 Su-27	57 Su-30.	557 Mig-21, etc.	103M-29+Mir	16 Su-30s.
2003	854 J-7 +J-8.	90 Su-27	58 Su-30.	534 Mig-21, etc.	103M-29+Mir	30 Su-30s
2004	858 J-7 + J-8.	100 Su-27	100 Su-30	533 Mig-21, etc.	103M-29+Mir	40 Su-30s
2005	858 J-7 + J-8.	116 Su-27	76 Su-30	466 Mig-21, etc.	105M-29+Mir	40 Su-30s

It is evident from the chart above that while the IAF was qualitatively superior to the PLAAF till the 1990s; the situation began changing since the period of China's ninth Five Year Plan. Ever since, PLAAF has not only closed in, it has actually overtaken the IAF in qualitative terms. It is evident that China is in the process of undertaking a phased retirement of its antiquated inventory and by 2010 would possess a diverse air force with hundreds of third and fourth generation modern fighter aircrafts. The above would be in addition to its vast inventory of improved second generation aircrafts. More alarmingly, PLAAF's modernisation pace as opposed to the IAF is enormously fast and by 2010, the qualitative balance also would be almost irrevocably in its favour. Most modern air forces aspire to a 'lean and mean' capability; PLAAF is evidently getting meaner though not necessarily leaner. By contrast, the IAF has depleted from its force levels of as much as 64 squadrons (50 combat and 14 transport) in 1961 to around 33 at present and is likely to stay at that or even lesser in the following years.[60]

Airpower is generally regarded as the total aviation capability of a nation, civil and military, existing as well as potential and hence any analysis of Chinese airpower would be incomplete without an exploration of its civil aviation sector. China's civil aviation industry is also booming and set to expand as never before. While global civil aviation industry plummeted post September 11, China's soared as never before. China's aviation industry has leaped from the 37th place in 1978 to the fifth in 2003. Its passenger traffic has also risen from 35th place to the 5th in the world and would continue to grow as evidenced by the fact that in the first half of 2006 itself, it has registered a 17.5 % growth with a passenger traffic volume of 73.99 million.

In view of the foregoing, it is conclusively evident that China's aerospace capabilities have transformed as never before and the transformation would only gather further momentum as it progresses further into the 11th and 12th Five Year Plan. The aerospace balance has conclusively in qualitative and quantitative terms shifted entirely in its favour. As a matter of fact, the scales have touched the earth!

60. Numbers sourced from Air Commodore Jasjit Singh "Modernising the IAF, Why and How?" *India Strategic*, February 2006.

PROGNOSTICATING THE FUTURE

In addition to a growing economy, the critical supporting factors of an indigenous aerospace industry along with suitable manpower for sustained development and efficacious application of aerospace power also exist and as they mature would yield greater dividends in the near future. It is common knowledge that China's economy is growing and set to peak in the period of its 12th Five Year Plan (2010-15). Going by prevailing trends, it would be safe to assume that economic support for developing aerospace capabilities would only be facilitated even more; by extension its capabilities would only expand even further. Secondly, although China's indigenous aerospace industry doesn't exactly inspire PLAAF's confidence (in view of the fact that it rejected the indigenous JH-7 after a two and a half decade wait and went in for Su-27s finally), four decades hence, its industry finally appears to be maturing and would soon begin delivering to its aerospace apparatus[61]. Thirdly, by 2010, China's pool of military draft age personnel would be the highest in the world at 61.73 million[62] and hence the critical mass essential to ensure efficacious development and application of aerospace power would also be available to it.

In view of the foregoing and China's declared emphasis on building up air and space capabilities, it would be safe to assume that the following 'Aerospace' capabilities would be available by 2010.

Fig. 7

Aerospace Elements	9th FYP (1996- 99)	10th FYP (2000- 05)	11th FYP (2006 -10)
4th Gen Ftrs	Nil	128 SU-30s	220 + 350 SU-30s
Mil Sats in Orbit	Nil	09	20+
ICBMs	20	47	61

In addition to the above, manpower is critical to consummation of vision and more so in case of military visions. Secondly, the critical supporting

61. China's aerospace industry
62. "Modernising China's military: Opportunities and constraints" p.38-39.

factors for military modernisation and force projection; of a robust economy and manpower would be entirely in China's favour by 2010. Therefore, it would be safe to assume that Chinese military superiority would tip the balance of power entirely in its favour.

CONCLUSION

From the foregoing it is apparent that China's development of aerospace capabilities is aimed at enabling its transition from antiquated military machinery focussed on territorial defence to a modern military focussed on long range strategic power projection. The above would be instrumental in complementing its growing political and economic might and interests. By 2010, the numbers, doctrines, strategy etc. would all be firmly in place and the homogenous nature of its air, space, BM & Nuclear programme would enable operational integration into its mammoth conventional military apparatus, making it a formidable power not only in Asia, but the entire world.