PAKISTAN'S SPACE CAPABILITIES

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INTRODUCTION

Military parity with India has been an obsession of many Pakistani rulers in the past. Because of its strategic intimacy with global powers like the USA and China, to an extent, Pakistan has succeeded in at least procuring a few state-of-the-art technologies in military hardware to match India. Today, Pakistan has, to a certain degree, achieved missile prowess and, most importantly, a nuclear status. Such achievements were possible only because it could, either overtly or covertly, borrow these technologies from other states. But, at the same time, the strategic vision shown by the Pakistani leadership for 'managing' these technologies should be commended.

Based on current trends in acquisition of new weapon technologies by Pakistan, it could be safely concluded that it is investing in the revolution in military affairs (RMA). But one sector in which Pakistan is far behind India is that of space technologies. Compared to India's space programme, Pakistan's space programme seems diminutive. In this RMA era, when space is regarded as the fourth dimension of war, what is the Pakistan's standing in the field of space technologies and other related technologies? This article attempts to address these questions. The article also argues that Pakistan may not go all out for the development of indigenous space technologies and may depend more on joint collaborations with countries like China and commercially available space technologies.

PAKISTAN'S DUAL PURPOSE SPACE PROGRAMME

Developing countries normally do not have dedicated space programmes for military purposes. Their military space programmes are mostly the

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offshoots of their overall space programmes which are essentially driven by civilian requirements. In Pakistan, for the purpose of space science research and development, the Space and Upper Atmosphere Research Commission (SUPARCO) was established in 1961, and it started functioning in 1964. This national organisation with a high degree of autonomy, which implements the space policy of Pakistan, was established by the Space Research Council (SRC), whose president is the prime minister. The commission comprises the chairman and four members for space technology, space research, space electronics and finance, respectively.[1]

SUPARCO is headquartered at the Arabian Sea port of Karachi in southern Pakistan, with additional facilities at the University of the Punjab at Lahore. SUPARCO defines its primary mission as *earth imaging and upper atmosphere research*. Its programmes include the development and launch of sounding rockets, and identification of satellite technology necessities for remote sensing and communications. Pakistan claims that the main motive behind SUPARCO is building of an infrastructure for both aeronautics and space research, with the means at hand.[2]

SUPARCO had a very low profile existence for the first 30 to 35 years since its inception. Its progress in the research field also was not very significant. The commission started publishing its research achievements and other works of significance in the field of space technology through its quarterly journal, *Space Horizon*, in 1983, but ceased the publication in June 1991. The other quarterly journal, *Suparco Times*, published since 1982, met with the same fate and ceased publication in March 1994.[3] However, in the recent past, the organisation has started maintaining its website (www.suparco.gov.pk), giving detailed inputs about its research activities and achievements.

SUPARCO began launching imported sounding rockets in 1962, and has fired small sounding rockets on sub-orbital science flights from launch pads

1. http://www.suparco.gov.pk/about.html
2. http://www.suparco.gov.pk/about.html
3. http://www.fas.org/spp/guide/pakistan/agency/index.html

at its Sonmiani Beach (Maini Beach) flight-range, 58 km west of Karachi. By the 1970s, SUPARCO had developed the ability to fabricate rocket motors from raw materials at a solid-propellant manufacturing plant. By the early 1980s, SUPARCO announced plans for the development of the Hatf-1 and Hatf-2 surface-to-surface ballistic missiles. The organisation's solid propellant production facilities were enlarged by 1987 to support this effort. Tests of the Hatf-1 and Hatf-2 were announced in April 1989, and the Hatf-2 was displayed publicly during a Pakistan Day Joint Services Parade later that year.[4]

Pakistan had imported ballistic missiles from China since the late 1980s. Pakistan's then Foreign Minister, Abdul Sattar, with reference to Chinese M-11 missiles, in a statement to the Pakistani Senate on August 26, 1993, stated, "These missiles were bought keeping in mind Pakistan's security needs" which he went on to justify in relation to missiles across the borders from Afghanistan.[5] Chinese help in providing missile assistance to Pakistan was further extended towards developing a rocket factory. For five years, the American intelligence agency CIA (Central Intelligence Agency) had carefully tracked the flow of Chinese M-11 missile components into Pakistan. At the end of 1995, they discovered that "China was not only selling missiles to Pakistan but was also helping to build a factory to manufacture them."[6]

In 1989, Hatf-1 and Hatf-2 missiles were fired to ranges of 80 and 300 km respectively. According to Pakistani sources,[7] during the same period Pakistan and China had signed a ten-year cooperation agreement in defence science, technology and industry, including joint procurement, research and development, production and technology transfer. SUPARCO oversees the production and testing of sounding rockets, with an average of three or four launches per year and carrying high altitude and ionosphere research

4. Ibid.
5. Jasjit Singh, ed., *Nuclear India* (New Delhi: Knowledge World, 1998), p.180.
6. Douglas Waller, "The Secret Missile Deal," *Time*, June 30, 1997, available at http://edition.cnn.com/ALLPOLITICS/1997/06/23/time/missiles.html
7. http://www.wisconsinproject.org/countries/pakistan/miss-miles.htm

payloads. Pakistan's development of locally made sounding rockets continues with a long-term goal of launching small satellites[8].

As compared to launch technology, SUPARCO's journey in the field of satellite technology started very late. SUPARCO first built a small amateur radio satellite in the late 1980s with the help of the Pakistan Amateur Radio Society. But, due to the explosion of the Challenger space shuttle, the launch of Pakistan's first satellite was delayed. The satellite was finally launched in orbit (low earth orbit—LEO) by a Chinese Long March LM-2E rocket in July 1990. This satellite was formally called the Badr-1 satellite, after the Urdu language word for "new moon." Badr-1 provided Pakistani scientists valuable experience in telemetry, uplink/downlink, and other satellite related technologies. Badr-1 provided the platform for Pakistan to develop satellite technology further.[9] The satellite successfully completed its designed life (it weighed 52 kg and had an orbital lifetime of six months). The design for this micro-satellite was apparently based on the University of Surrey platform[10]. For this mission, Pakistan had very limited objectives like testing the performance of satellite sub-systems in space environment and performing experiments in real-time voice and data communications between two user ground stations[11].

The success of Badr-1 is largely recognised as a success of the combined efforts of a few Islamic countries. The Inter-Islamic Network on Space Sciences and Technology (ISNET) was founded in 1986, in order to promote the advancement of space sciences and technology in the countries of the Islamic world. The member countries include Pakistan, Malaysia, Indonesia, Jordan, Syria, Bangladesh, Bahrain, Brunei, Kuwait, Senegal and Cameroon. It is headed by the chairman of SUPARCO. Headquartered in SUPARCO headquarters, Karachi, it has been responsible directly and indirectly for the

8. P. Proctor, "Pakistan's Space Agency Building Second Experimental Satellite," *Aviation Week and Space Technology*, August 10, 1992, Vol 137, No 6, p.45.
9. http://www.paksef.org/suparco.htm
10. Gerald M. Steinberg, "Satellite Capabilities of Emerging Space-Competent States," http://faculty.biu.ac.il/~steing/military/sat.htm
11. http://www.suparco.gov.pk/sat_badr1.html

fabrication, processing and launch of the Muslim *Ummah's* first experimental satellite, Badr-1.[12] It was a historical event not only for the people of Pakistan, but also for the entire Muslim *Ummah* as it was the first satellite built by any Islamic country based on indigenous resources and manpower.[13]

However, SUPARCO could not maintain the pace for further developments because of the sanctions regime. In June 1991, the Bush Administration imposed sanctions on China and SUPARCO for what Washington described as "significant transfers of M-11 missile technology and components." The sanctions were waived in March 1992, when China promised to abide by Missile Technology Control Regime (MTCR) guidelines. In August 1993, the US again imposed two-year sanctions on Pakistani and Chinese entities for violations of MTCR guidelines. The sanctions on Pakistan ended with the expiry of the fixed two-year term.

But SUPRACO continued with its clandestine activities. In 1996, shipments of ammonium perchlorate (an oxidiser for solid rocket propellant) destined for SUPARCO were seized in two separate incidents. In March 1996, 200 barrels of ammonium perchlorate shipped from North Korea's Lyongaksan General Trade Corporation were detained in Taiwan en route to SUPARCO. On April 29, 1996, customs officials in Hong Kong seized enough ammonium perchlorate to fuel about 25 missiles, originating in Xian, China. In September 1996, Pakistan acknowledged that SUPARCO had imported a small quantity of rocket fuel for scientific research but denied reports about the seizure of massive amounts of fuel. A Foreign Office spokesman claimed that SUPARCO had imported rocket fuel for research and study. All these activities forced the US Commerce Department to implement the sanctions on Pakistan (June 1998). The sanctions included a licensing policy of denial for export and import of items controlled for nuclear non-proliferation and missile technology. Such developments, directly or indirectly, affected the growth of development of satellite technology in Pakistan.

12. n. 3.
13. http://www.angelfire.com/stars/whippee/badranv.htm

Rising above the difficulties faced due to the sanctions, by the late Nineties, Pakistan undertook a number of steps for consolidating and focussing its space programme in response to national priorities. In late 1999, Dr Abdul Majid, the then chairman of SUPARCO, announced that Pakistan would develop its own satellite launching vehicle within a period of about three years, although no details of this previously undisclosed programme were revealed.[14] However, in reality, Pakistan was found depending more on international commercially available space systems for satellite derived inputs. For this purpose, the existing satellite ground station for reception of NOAA, LANDSAT and SPOT data was upgraded in the late 1990s. A national Geographic Information System (GIS) Committee was constituted to bring about GIS standardisation. Only indigenous activity undertaken was related to the development of the Badr-B multi-mission satellite.

Since the early Nineties, Pakistan has made significant investments towards training and educating space application experts.

Since the early Nineties, Pakistan has made significant investments towards training and educating space application experts. The scientists and technicians are trained in areas like application of satellite remote sensing data for resource and environmental surveying, meteorological and related environmental studies; determination of vertical profiles of atmospheric parameters through satellite radiance; study of the earth's atmosphere through balloon and rocket soundings; air pollution monitoring; and collection of environmental data from unmanned data collection platforms. Also, full-fledged research activity started during the same period in areas including ionospheric physics and radio wave propagation, satellite tracking by optical and radio techniques, geomagnetism; observational astronomy, communication satellite system design; and small ground terminals / receivers.

Pakistan's Remote Sensing Applications Centre (RESACENT) at Karachi has well-equipped laboratory facilities for visual as well as digital

14. n.3.

interpretation and analysis of remotely sensed data. SUPARCO has established a satellite ground receiving station at Islamabad to acquire LANDSAT, SPOT, and NOAA data in real-time. This station is one of the most advanced and sophisticated stations in the Asia-Pacific region. It covers, in addition to the whole of Pakistan, a large number of neighbouring countries, wholly or partially. The station has the most modern facilities for processing. SUPARCO has established a sophisticated ground receiving station for acquisition of NOAA APT pictures and facilities for reception of TOVS/HRPT data. Micro computer based systems are available for the processing of NOAA and TOVS/HRPT data.[15]

SUPARCO had planned the launch of Badr-II satellite during 1993. However, the target could not be achieved. Subsequently, the launch was planned during 1995/96. The anticipated launch date subsequently slipped to early 2000. Finally, Pakistan's second satellite, Badr-B/Badr-II, was launched on December 10, 2001, from the Baikonour Cosmodrome, Kazakhstan, on a Zenit-2 rocket. It was launched in a sun-synchronous orbit of 1,050 km altitude. The satellite is tracked from the TT&C Station at Lahore and has an expected life period of two to three years.

Badr-II has been launched with the following mission objectives:

- Indigenous development of low cost satellites and creation of necessary infrastructure for future development in this field.
- Acquisition of knowhow and technology for earth imaging by the use of CCD sensors.
- Acquisition of knowhow and capability in the field of satellite altitude control and stabilisation.
- Encouraging and stimulating the interest of the country's academic and scientific community in the peaceful uses of space[16].

SUPARCO established the Satellite Ground Station (SGS) near Islamabad in the year 1989 to ensure regular and timely availability of satellite remote sensing (SRS) data to user agencies for their natural resources and

15. Ibid.
16. Details of Badr-II are from http://www.suparco.gov.pk/sat_badr1.html and http://www.fas.org/spp/guide/pakistan/earth/

environmental surveying activities. The station has the capability to acquire and process LANDSAT MSS and TM data, SPOT HRV data in both the multispectral (XS) and panchromatic (Pan) modes (under agreements with EOSAT and SPOT IMAGE, the operators of the LANDSAT and SPOT satellite systems, respectively) as well as NOAA AVHRR data in the HRPT mode. This data processing sub-system equipment was upgraded around the year 2000. SUPARCO has modernised the processing systems by installing the latest hardware. This has helped them immensely to enhance the processing speeds.[17] Along with NOAA, which essentially caters for Pakistan's routine meteorological requirements, they also depend on METEOSAT-5 satellite images for tracing tropical cyclones in the Arabian Sea region.[18]

During December 2002, Pakistan deployed a communication satellite, PAKSAT-1 (geostationary orbit), as an interim solution to cater for communication needs. In order to implement a fully operational communication satellite programme, Pakistan's SUPARCO is presently conducting a detailed study towards the launch of a national communication satellite, PAKSAT-1R. The organisation is taking the help of a number of telecom users from both the public and private sectors. With their help, the organisation is expected to identify the current and future requirements of satellite transponder capacity to assist in the design of PAKSAT-1R.[19]

The existing PAKSAT-1 satellite is a third-hand satellite bought from Turkey at an initial cost of $ 4.5 million. This satellite was originally developed for Indonesia by Boeing. It was later bought by Turkey, and finally Pakistan purchased it and launched it. The decision to acquire this satellite was taken after Pakistan realised that the orbital slot allocated to it by the International Telecommunications Union (ITU) along 38 degrees East would lapse in April 2003 unless it had a satellite in place with transponders switched on, and the ownership of the slot was approved internationally.[20]

17. http://www.suparco.gov.pk/sgs.html
18. http://www.suparco.gov.pk/cyclon_99.html
19. http://www.suparco.gov.pk/news.html
20. http://www.apnic.net/mailing-lists/s-asia-it/archive/2003/01/msg00031.html and www.pakistaniaviation.com/ and http://www.paksef.org/suparco.htm

The Pakistani government had earlier sold one of its GEO (geostationary equatorial orbit) slots to Alcatel Escape for a commercial telecommunications satellite. As per some estimates, approximately 70 per cent of Pakistan's rural and remotely located population lacks good communication services. Pakistan's TV and telecommunication capacity is leased on ASIASAT-1.[21]

SUPARCO has various multilateral /bilateral collaborations in the field of space technology and its applications with the countries of the Asia-Pacific region. By virtue of an agreement signed between SUPARCO and the Earth Observation Satellite (EOSAT) Company, the latter is SUPARCO's sales agent outside Pakistan for the sale of LANDSAT data (except data pertaining to Pakistani territory) generated at the Satellite Ground Station, Islamabad.[22]

There are reports that Pakistan is preparing to launch its own satellite launching system. Pakistan's first space launch vehicle (SLV) is expected to be available in the near future. However, this news has not been widely reported, and further details are yet awaited. In the IDEAS 2002 exhibition (the second International Defence Exhibition and Seminar, IDEAS 2002, held at Karachi during August/September 2002), a model of Pakistan's first SLV, was displayed.[23]

TECHNOLOGY REVOLUTION

Post-industrial revolution, the multi-disciplinary technology revolution is changing the thinking of the militaries all over the world and Pakistan is no exception. In the near future, Pakistan is expected to incorporate many technological advancements into its military hardware. It has already started the incorporation of information technology (IT) into its military systems. The question is, to what extent is this influencing the structure and use of military power?

High-performance computing, satellite imagery, crypto technologies, and other forms of militarily useful IT-based techniques are in use all over the

21. *Jane's Space Directory* (2000–2001), Surrey, 2000, p.19.
22. http://www.suparco.gov.pk/international.html
23. n. 3

world. Pakistan is importing a majority of its military equipment from the developed nations. Naturally, most of the recent procurements are state-of-the-art machinery. Pakistan already has large conventional armed forces based overwhelmingly on mechanical and electrical industrial age technologies.[24] In future, it is expected that Pakistan's existing military hardware will be increasingly augmented by IT-based systems. In South Asia, India has marched ahead in the IT revolution which, in turn, has made a major impact on Indian defence policy. Today, India is in possession of many technologies which seek decisive IT-based battlefield advantages. This, in turn, is going to intensify regional arms races as potential combatants are likely to seek decisive IT-based battlefield advantages.

Currently, militarily aware countries like India and Pakistan are in the midst of an RMA. RMA proponents contend that victory in future conflicts will go to those forces that most aggressively apply it to military uses. Pakistan understands that the astonishing proliferation of precision-guided munitions (PGMs), sophisticated intelligence-gathering capabilities, advanced command and control systems, and ingenious information warfare processes are evidence of the RMA's impact. The RMA's technological focus is apparent in today's Pakistani military thinking.[25] The RMA, however, is about more than simply grafting the latest technologies onto existing forces. Most analysts insist that for a true RMA to occur, doctrinal and organisational change must accompany the new warfighting technologies. However, this article limits itself to looking at space-based and other related technological advancements linked with the RMA.

The total strength of the Pakistan Army is approximately 550,000 personnel. Pakistan is planning to downsize the army[26] with a view to enhancing the combat potential of the army by qualitative upgradation. This appears to be an attempt to re-muster non-combatant personnel for new

24. S.E. Goodman, "Information Technologies, and International Asymmetries," *Communications of the ACM*, vol. 9, no. 12, December 1996, et passium.

25. Colonel Charles J. Dunlap, "Organizational Change and the New Technologies of War," http://www.usafa.af.mil/jscope/JSCOPE98/Dunlap98.HTM

26. Raja Menon, "Follow Pakistan Example, Cut Down," *Indian Express*, June 12, 2004.

"force multiplier" units such as electronic warfare, information and cyber-warfare, reconnaissance, surveillance and target acquisition (RSTA) and air defence units, all of which Pakistan is known to be raising in its quest to catch up with the RMA.[27]

The existing assets of the Pakistan Army, Navy and Air Force which include main battle tanks, attack helicopters, F-16 Falcons, Mirage-III and Mirage-5 squadrons and naval combat aircraft and submarines[28] imply that first phase of the RMA itself would take time and effort. Upgradation of these assets and investments in new technologies is likely to make their RMA more contemporary. Already a debate is on in Pakistan's defence establishment regarding the need of investment in modern technologies. It is argued that new tools and processes of waging war like information warfare, network-centric warfare (NCW), integrated command and control (C^4ISR), system of systems, all powered by information technology, have led to the RMA and the Pakistani establishment should take serious note of it. This in turn, will also broaden the parameters of Pakistani thinking about national security. The countries of the world are now on the brink of a major revolution (read India). Also, the ramifications of the RMA need to be understood not only by Pakistani military officers but also by strategy planners, both military and civil. The Pakistani military has to contend with the fifth dimension of warfare—information—in addition to land, sea, air and space.[29]

Pakistan's direct and indirect dependence on space technologies and information technologies is expected to increase in the future. This becomes evident from its force modernisation plan. The Pakistan Navy is hopeful of getting P-3C Orions[30] long-range maritime surveillance aircraft from the US.

27. Gurmeet Kanwal, "Pakistan Army's Downsizing Effort", http://www.observerindia.com/strategic/st040503.htm and *Indian Express*, May 8, 2004
28. For more details on Pakistan's military equipment holdings, see http://www.rediff.com/news/2002/jan/23spec.htm
29. The argument is based on Sharjeel Rizwan, "Revolution in Military Affairs," *Defence Journal*, September 2000, http://www.defencejournal.com/2000/sept/military.htm
30. Refer Defence News Network by PakistaniDefence.com: August 2004 for more details available at http://www.pakistanidefence.com/news/MonthlyNewsArchive/2004/August2004.htm

It plans to acquire four F-22P frigates and anti-submarine helicopters from China in the immediate future.[31] It has taken a big leap to strengthen its fast depleting air power by securing a nod from Sweden to sell Islamabad an airborne early warning and control system (AEW&CS). This state-of-the-art system will also augment the Pakistan Navy's existing potential for maritime and tactical surveillance. Close to final approval is Pakistan's decision to acquire 14 SAAB 2000 aircraft from Sweden. Seven of these aircraft will be dedicated for the Pakistan Air Force's (PAF) AEW&CS while the remaining seven will be acquired by the Pakistan International Airlines (PIA) to replace its fleet of Fokker aircraft, which have already been grounded.[32]

There are also unconfirmed reports that Pakistan is planning to acquire unmanned aerial vehicles (UAV) from Turkey. The Pakistan Aeronautical Complex (PAC), an aircraft manufacturing factory at Kamra, manufactures PAC Ababeel which is a small arms air defence target. PAC had also exhibited a new aerial target called Nishan at the Dubai Air Show in November 1997.[33] Recently, the PAF had shot down an Israeli made UAV loitering in Pakistani air space. The remnants of this 'bird' could have given them some secrets of the UAV technology. Hence, it could be inferred that along with the existing technological base and borrowed knowledge, PAC may succeed in developing UAVs in the near future.

The Institute of Optronics (IOP) at Chaklala-Rawalpindi has established state-of-the-art military specifications production and testing facilities of night vision devices, based on image intensifier tubes.[34] The night vision systems have vastly improved the ability of the Pakistini armed forces to undertake a number of vital functions related to force effectiveness, command and control, and surveillance. These systems have also improved their tactical and logistical movements and have increased the accuracy of firepower. Such modern technologies depend largly on information and satellite technologies for purposes of communication and intelligence reporting.

31. http://www.pakistanidefence.com/
32. http://www.pakistanidefence.com/news/FullNews/2004/July2004/AWECS
33. n.21, pp. 13 & 331.
34. http://www.pakobserver.net/200408/18/view/?page=1&id=5

Space capabilities play an important role in network-centric warfare. This type of warfare offers a method to build information superiority, a key factor to success in the modern battlespace. The 21st century militaries are greatly dependent on network-centric warfare because it makes possible smooth and accurate information sharing and increases situational awareness amongst the troops and in turn enhances mission effectiveness. The Pakistani armed forces and defence industries are aware of these advantages. The future plans of the Institute of Optronics include the establishment of facilities for night vision devices based on thermal imaging techniques for all types of armoured vehicles and helicopters. The latest batch of Al-Khalid main battle tanks (developed at the Heavy Industries Taxila—HIT) assures greater survivability of the machine in the battle ground. The other vital feature of the upgraded Al-Khalid is a data-link system which allow the tanks to exchange data with each other and with the command centre.[35] These upgradations have been conducted by the HIT keeping in view the need of modern day network-centric war strategies. Pakistan's emphasis on network- centric warfare has made a real-time electronic map display system available to its tank commanders.

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Other network-centric force mutipliers like SQPS (squad personal positioning system[36]) systems are being made available to the Pakistani commando units. After a para-drop from an aircraft inside a hostile territory, Pakistani troops can locate their exact positions from the SQPS personnel electronic map positioning system. On a small portable colour screen, troops can view the map of the area, their objective, their own position and that of their entire squad. A miniature GPS (global positioning system) sensor on

35. Ibid.

36. For more details of the system, refer http://www.eastwestin.com/TAPS_milproducts.htm

their shoulder establishes the ground position, which is electronically transmitted to the commander and displayed on a hand computer via the squad radio. The entire mission is programmed in the map on the commander's hand computer overlaid on the geographic map of the area.[37]

Pakistan is likely to be in possession of ECOM WISPER WATCH unmanned airborne SIGINT system (it is being marketed by a Pakistani firm named East West Infiniti (EWI) (P) Ltd.,1–10, Industrial Area, Islamabad[38]) which is designed for armed forces like Pakistan's that cannot procure and maintain a high end manned SIGINT aircraft. It provides nearly the same capabilities at a fraction of the cost and is like an electronic ear in the sky to eavesdrop on RF signal emitters up to 250 km away. EWI has used the maturity of unmanned aerial platforms and software controlled radios to produce a new force-multiplier. The WISPER-WATCH unmanned airborne SIGINT system can be deployed in a small UAV or an AEROSTAT (a deal for the sale of six of these radars was cleared by the US Congress during July 2002 for the purposes of bolstering Islamabad's counter-terrorism capabilities[39]) which is operated as a remote controlled monitoring station. The receivers are positioned in the airborne platform whereas the workstations and operators are positioned in a ground mission control a few kilometres from the flying platform, out of harm's way.[40]

As per Air Chief Marshal Kaleem Saadat, head of the PAF, post-2004 US presidental elections, the new government may even go ahead with the sale of F-16s to Pakistan as a gift for its help in the "war against terror".[41] If this sale goes through, it will further enhance Pakistan's operational prepardness with RMA compatable aircraft. At the same time, Pakistan is also fully aware that technologies like satellite technology make the military establishments more transparent. The nuclear sites of Pakistan are on display

37. http://www.pakistanidefenceforum.com/lofiversion/index.php/t35353.html
38. http://www.eastwestin.com/PDF%20Files/ECOM%20Wisper-Watch.pdf
39. http://www.iwar.org.uk/news-archive/crs/20710.pdf and *Times of India*, August 02, 2002.
40. http://www.eastwestin.com/whisperwatch_mp.htm and www.pakistanidefenceforum.com/lofiversion/index.php/t35353.htm
41. "Pakistan: Buying U.S. Jets?" September 15, 2004**,** http://www.stratfor.com/. Also refer, "Pak to Acquire New Assets," *Vayu* IV/2004, New Delhi, p.38

on the web. The credit goes to IKONOS, Internet and Federation of American Scientists (FAS). The FAS' Public Eye project is acquiring imagery of nuclear and missile facilities around the world. The high-resolution images, acquired by the FAS from the Space Imaging IKONOS satellite, show details of Pakistan's weapons facilities previously known only to the secret intelligence world.

These imageries on the website (www.fas.org) cover two of Pakistan's most important special weapons facilities, the plutonium production reactor at Khushab, and the nearby medium range missile base at Sargodha. Plutonium from the Khushab reactor would probably be used in lightweight nuclear warheads for the M-11 missiles at Sargodha, which Pakistan acquired from China in the early 1990s. The satellite imagery indicates that construction of the Khushab reactor is essentially complete, and that Pakistan has built a dozen garages for mobile missile launchers and associated vehicles at Sargodha.[42] Pakistan should not look at these imageries as leakage of a secret, but should use them towards formulating confidence building measures (CBMs) with India in the nuclear arena. Such transparency in Pakistan's defence activities may help in bringing peace in the region.

ASSESSMENT

Many universally recognised space-based and satellite systems are inherently dual-use technologies, with both civilian and military applications. Pakistan is yet to have a dedicated "military space system." Hence, Pakistan's military space capabilities may be inferred from its civilian space programme. Pakistan probably depends on civil communication satellites for military communication requirements, and may be using the information provided by navigation and meteorological satellites for planning military manoeuvres. While a detailed investigation of the impact of dual-use space systems on the military preparedness of Pakistan is beyond the scope of this paper, some broad implications can be discerned.

42. Bal Krishna, "Internet-IKONOS," www.GISdevelopment.net

Pakistan is not even a second-tier space power. (The first tier could be the US, European Union (EU) and Russia and the second tier could be China, India and Israel.). With non-affordable costs, limited domestic expertise availability, restrictions on technology transfer, and a spoiled international reputation, Pakistan is likely to remain a peripheral space power, at least in the near future.

With non-affordable costs, limited domestic expertise availability, restrictions on technology transfer, and a spoiled international reputation, Pakistan is likely to remain a peripheral space power, at least in the near future.

Despite all the efforts put in by SUPARCO, the process of conquering the upper atmosphere has been relatively slow. Pakistan is slowly progressing in this field, and will take some more time, probably a decade, to establish full capability of launching its own satellites into space. SUPARCO's success, to a large extent, will also depend on the financial backing received from the Pakistani government and the success of the collaborations with international space giants in the near future.

However, this will not entirely limit their access to space resources or operational capabilities. The easy accessibility of numerous and growing commercial launch services has increased the ability of many states to develop and operate satellite systems for various purposes or purchase 'reception rights' from existing commercial satellite constellations. Like many other nation-states, Pakistan also could be a beneficiary of this 'space reality'.

The capabilities of commercial satellites all over the world are getting dramatically improved on a regular basis. A few US licensed companies and Israeli firms plan to make 0.5 to 1 metre resolution satellite imagery commercially available in the near future.[43] Other developed nations may also join this business of the high resolution imagery market. Such images are good enough to detect and identify nuclear sites and production facilities, airfields, oil refineries, troop concentrations, etc. Pakistan is expected to derive benefits from such commercial ventures for its intelligence gathering.

43. http://bcsia.ksg.harvard.edu/BCSIA_content/documents/ViennaSATpaper.pdf

Currently, Pakistan is using LANDSAT and SPOT images overtly for civilian purposes. The military potential of such commercial satellites mainly depends on factors like optical resolution, spectrum, orbital features, sun-angle, and return time. For military reconnaissance purposes, satellite 'resolution' plays a major role towards providing quality input.

Satellites with resolutions of 10 to 15 metres can provide useful information for strategic planning. The SPOT system is the primary operational example in this category. Today, Pakistan receives SPOT images with a resolution of 10 metres or even less. History suggests that images obtained from SPOT have been used for many national security-related purposes by global powers. SPOT images have helped in the identification of the German industry sponsored Rabta chemical warfare plant in Libya. SPOT also played an important role in revealing details of the situation at the Chernobyl nuclear reactor complex. Most importantly, SPOT and LANDSAT images were embargoed during the 1990–1991 Gulf War, indicating that these images contained militarily useful information.[44]

At the same time, it should be appreciated that the military utility of systems with resolutions of between 15 to 30 metres is limited. Such images do not have much significance at the tactical level. Hence, Pakistan's dependence on SPOT and LANDSAT may not be of much use during the actual operations phase. This is mainly because very low resolution images may not be sold during the war period or they may even be totally be blocked by the company. Also, the Badr-II system does not have a good resolution (approximately 250 metres)[45]. Hence, it could be inferred that Pakistan's 'military dependence' on space technologies is *peace-time specific* and the satellite inputs could essentially be used only for military planning purposes.

NOAA satellite inputs may not have much military utility other than their use for predicting meteorological conditions on the battlefield. These satellite inputs will come handy, particularly for undertaking aerial operations

44. n.9

45. http://www.au.af.mil/au/awc/awcgate/grayspc/graysat/surv.htm

during the conflict phase. These satellites with a resolution of around 1.1 km[46] could in some way be helpful for topography and terrain analysis.

Interestingly, nuclear Pakistan does not have robust command, control, communications and intelligence systems (C^3I) in place. Given the economic and technological constraints, this is not likely to materialise for some time to come.[47] The proposed launch of PAKSAT-1R may help Pakistan to improve its military communication network.

Interestingly, nuclear Pakistan does not have robust command, control, communications and intelligence systems (C^3I) in place.

The Pakistani satellite programme has a clear bias towards remote sensing technologies for obvious reasons. It understands the value of remote sensing in the war effort. These techniques are very handy for identifying troop and tank movements as well as activities in underground bunkers. With Chinese help, Pakistan is trying to develop a network to acquire robust and versatile space reconnaissance capability. Pakistani interest (with Chinese help) in the development of a new small, solid-propellant space lifter would provide them an opportunity to hurl small satellites into orbit for broad military, civil, and commercial applications.

But, being a signatory to the Outer Space Treaty,[48] Pakistan cannot plan to place in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction or station such weapons in outer space in any other manner. Pakistan has signed this treaty on "Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies" (signed on December 9, 1967, and ratified on August 4, 1968). Hence, it is technically (overtly) bound to making use of outer space only for exploration, and in accordance with international law, including the Charter of the United Nations, in the interest

46. http://www.rrcap.unep.org/lc/cd/html/countryrep/pakistan/introduction.html
47. Admiral L. Ramdas, "Myths and Realities of Nuclear Command and Control in India and Pakistan," http://www.acronym.org.uk/dd/dd54/54ramda.htm
48. For full text of the treaty, refer http://www.state.gov/t/ac/trt/5181.htm

of maintaining international peace and security and promoting international cooperation and understanding.

Post-9/11, the US policy interests in Pakistan encompass a wide range of issues, including counter-terrorism, nuclear stability in South Asia, missile proliferation, growing Asian markets, and human rights. Today, the US considers Pakistan as its "vital ally" in its war against terrorism and has nominated it in the category of major Non-NATO Ally. Hence, in future, US-Pak technology collaboration is expected to be on an upswing. This may help Pakistan to make rapid progress in the areas of RMA and network-centric warfare.

Given Pakistan's lack of strategic depth, it is expected that in the event of an Indian missile strike, Pakistan would have just three minutes warning time. Clearly, this is much less time than the 15 minutes PADS (Pakistan Air Defence System) provides in case of an attack by enemy aircraft.[49] Hence, early warning for Pakistan is becoming more and more crucial. This is where Pakistan may be interested in bringing in network-centric capability. It would like to augment force multipliers like AWACS and other IT infrastructure in order to device a system for getting adequate early warning.

CONCLUSION

Pakistan may have succeeded in putting only two indigenously made satellites into orbit, riding on Chinese or Russian launches, but it has managed to form links with commercial ventures of the USA, France and the EU. The greatest short-term impact of such commercial understandings may be seen in the field of reconnaissance. The immediate impact of Pakistan's interests in space technologies on the overall security calculus of South Asia is likely to remain limited, and on its own, Pakistan is incapable of starting a space arms race in the subcontinent. However, Pakistan understands the importance of space technologies and if it plays 'space politics' well, then in the near future, it would be able to at least satisfy its strategic needs of satellite data by 'outsourcing' the space necessities.

49. http://defencejournal.com/may98/defendingpakistan1.htm

As the trend suggests, Pakistan is likely to get onto the Chinese space wagon in the near future. Pakistan may also explore the possibilities of engaging other Muslim countries since the Islamic network in the arena of 'space collaboration' already exists. It could look for collaboration with countries like Malaysia which have already started modest investments in these technologies. Malaysia has launched a few satellites and evolved a "National Blueprint for the Malaysian Aerospace Industry"[50] in 1996. No direct talks on 'space cooperation' between these countries have taken place yet but it is expected that they may develop military technology collaboration. This became evident during the speeches delivered by the heads of both countries during the recent UN General Assembly sessions.[51] Also, Pakistan is expected to try for accessing commercial technologies available in the market to get military imageries. With the exponentially increasing international satellite market, Pakistan may even hire or purchase transponders from various global commercial vendors in the near future.

Pakistan desires to acquire more RMA capabilities in order to match the Indian force structure. Its Afghanistan border is likely to remain in a state of flux in the near future. As an important American ally, Pakistan could even be asked to make a substantial contribution towards the US-led operations anywhere in the world. Hence, it needs to carry out a military transformation aimed at developing basic force projection and more advanced RMA capabilities. Accurate and timely information is the key for increasing battlespace awareness. Network-centric warfare translates this information superiority into combat power. Investments in the modern day enabling technologies like information technology, materials and nanotechnology will facilitate Pakistan to address these challenges of modern day warfare. ■

50. www.oosa.unvienna.org/COPUOS/ stsc/2004/presentations/sabirin.htm

51. Hashim Syed Mohammad Bin Qasim, "Chinese Space Program and Muslim World: A 'Divine Journey,' Chinese Manned Space Flight Program—Opportunities of Collaboration for the Muslim World - Justuju (The Quest)," October 8, 2003, http://www.paktribune.com/news/index.php?id=40789