MARITIME AFFAIRS Copyright © National Maritime Foundation
Vol. 11 No. 2 Winter 2015, pp. 146–154
Print ISSN: 0973-3159, Online ISSN: 1946-6609, http://dx.doi.org/10.1080/09733159.2015.1105489

Routledge
Taylor & Francis Group

National
Maritime
Foundation

Maritime Aspects of Space Technology

Ajey Lele*

For any nation-state, multiple agencies are drawn in to guard their maritime interests, and technology plays a crucial role towards guarding such interests. This paper debates the significance of space technologies for the maritime domain in general and navies in particular. It identifies specific space technologies of relevance for improving ship movement and weapons delivery performance. Lastly, the paper also takes a macro view about investments made by India in space technologies for the purposes of their maritime requirements.

The expanse of sea power is enormous both in terms of physical area and in terms of the actors involved. Navies, coast guard, marine police and non-military agencies such as merchant, shipping, shipbuilding and other related industries are the main actors having stakes in the maritime domain. In strategic parlance, the effectiveness of sea power depends mainly on the strengths and weaknesses of those against whom it is exercised. In a broader sense, to paraphrase the words of Sir Julian Corbett: the real point of sea power is not so much what happens at sea, but how that influences the outcome of events on land.[1]

*Gp Capt Ajey Lele (Retd), is assistant director with the Institute for Defence Studies and Analyses (IDSA), New Delhi. He works on issues related to strategic technologies. He can be reached at ajey.lele@gmail.com

Captain Alfred Thayer Mahan's conceptualisation of sea power and its influence on yesteryears' and modern-day military thinking is eminent. He could be credited with creating awareness about the importance of naval power as a factor in the rise and fall of a state. Sea power is viewed by some as a country's naval strength, especially as a weapon of war, while there is also an opinion that the expanse of sea power is not limited to military power alone and has a larger geoeconomic and geostrategic purpose. Oceans are the medium for carrying out a major portion of international trade and commerce and transportation of energy. The success of such trade depends on seamless access to operations on the high seas. There are multiple hazards (pollution, accidents/incidents, piracy, illegal fishing, terror attacks and natural disasters) which could hinder the safe movement of traffic during peacetime, and navies are often the only rescuers under such circumstances. Even maritime infrastructure could become a potential target for adversaries to inflict damage.

Over centuries, sea power has been perceived differently by many; however, the process of gaining power at sea is dynamic and always leads to the domination of the sea waters, and states evolve various strategies and tactics depending on their interests and policies. This domination significantly depends on the nature of assets available at sea and in port. In general, navies that have both hard power and soft power are more effective in the modern day. The strength of any navy is primarily identified by the technological superiority of the hardware at its disposal. Presently, various modern-day maritime platforms and infrastructure at ports (and adjoining areas) significantly depend on satellites. This paper debates the significance of space technologies for the maritime domain in general and navies in particular.

Global shipping accounts for 90% of international trade. In recent times, using maritime transport as platform for leisure travel is also showing an increase essentially owing to the arrival of luxury shipping. Further, there has been an increase in exploitation of maritime resources. Over the years, revolutions in maritime technologies have essentially taken place in arenas related to shipbuilding, hull technology, submarines, sonar, etc. At the same time, there are some technologies which have been supported by the maritime industry and which have helped navies to increase their efficiency. Space technology is one such technology which has helped various maritime agencies with advanced communication, accurate navigation, real-time data transfer, weather assessment, etc.

The first satellite in the world, called Sputnik, was launched by the erstwhile USSR in 1957. During last five decades, satellite technology has evolved significantly and now

has become an indispensable part of human survival. Space technologies are finding increasing utility in various arenas of life. Essentially, various democratic setups have been found to use these technologies for socioeconomic development. Commercial utility of this technology has increased significantly over a period of time, and militaries too are finding this technology extremely relevant.

Theoretically, a satellite is just an electronic unit with specific sensors, and there is nothing exclusively civil or military about it. Inherently, by nature, satellite technology is a dual-use technology, and hence they offer benefits for both civil and military purposes. Satellites provide real-time information, and that information can be used by users depending on their need, which could be military or civil. In some cases, specific detailed and real-time information and/or connectivity is required for military purposes, and the payload onboard satellites is designed accordingly. The importance of satellite technologies for militaries is manifold. Satellites are mainly used by them for meteorology, communication, navigation, surveillance and reconnaissance purposes. Also, some states launch spy satellites based on their strategic needs.

In few cases, even some civil commercial satellites are being used for several military tasks, including command assistance and military logistics support. Military satellites are also used for geodesy, the study of Earth's shape and size. Data from geodesic surveys is important to the military, as it is used for map making, positioning, navigation and a variety of other missions.[2] The use of space technology could also significantly contribute towards the enforcement of international rules and legislation, and facilitates policy making.

From a military perspective, the desirable inputs required from satellites are in the arena of reconnaissance, navigation and communication. Satellites built for these purposes could provide inputs to all defence services, namely army, air force and navy. Also, there are specific satellites developed essentially to cater for maritime needs. The usability of the satellites in the maritime domain would depend on the interests of the user. The agencies which are required to manage/monitor/coordinate a significant amount of maritime traffic mostly depend on communications and navigational satellites. A few states would be interested in using satellites for the purposes of information gathering and would depend on remote sensing/earth observational satellites. Also, satellite systems are used towards cargo tracking, identification and security.

Satellite systems capable of providing extensive coverage of all of the world's ocean regions are available. This is a dynamic process and various new satellites/replacement satellites are continually getting added depending on requirements, and most of them

are designed specifically to serve the maritime industry. They facilitate voice, video and data services to a variety of maritime platforms, including merchant, cruise and government vessels. Providing real-time data communication links for safety and efficiency for the conduct of maritime businesses is vital. Satellites allow real-time communication essential for ship and cargo surveillance, or vessel monitoring. It also assists ship-to-ship, ship-to-rig and ship-to-shore communication, and that amongst crews and passengers. Videoconferencing facilities and video data downloading facilities are required for the purposes of professional work, interacting with family back at home and for entertainment.[3] All this eventually directly or indirectly helps to improve ship performance and efficiency.

In recent years, various coastlines have seen a number of disastrous accidents involving oil tankers. These have had catastrophic economic and environmental consequences. Because of the volume of traffic and the resultant high risk to shipping in sea waters, various maritime agencies have introduced ship routing systems, approved by the International Maritime Organization (IMO). This helps to reduce the risk of collision. However, the existing systems have limited geographical scope and concentrate on the main zones of traffic convergence, without properly covering events that could occur outside the range of radar or shore-based automatic identification systems (AIS).[4] Such navigational limitations are overcome by space-based navigational constellations like the global positioning system (GPS), which is the most common navigational system. However, the performance of the system at times degrades owing to technical limitations or the impact of the land/sea terrain. Hence, these signals are augmented further using a mechanism called the differential GPS, with an accuracy of 1 to 5 m. In the maritime context, greater navigational accuracy is required, especially in congested and confined waters. GPS/differential GPS presents the best option in this context. Space-based navigation attracts larger international focus and a few agencies are developing their own satellite constellations. The European constellation GALILEO and the Global Monitoring for Environment and Security (GMES) systems are likely to give accurate and timely services with sub-metric precision, while the Russian system, GLObal NAvigation Satellite System (GLONASS), is fully operational. In particular, the Chinese investments in this area are monitored closely. China has an ambitious plan of launching a 30-satellite constellation called COMPASS (BeiDou-2). More than half of these satellites have already been launched. Also, states such as Japan and India are developing their own regional systems for providing accurate navigational assistance.

GPS is not only useful for ship identification and navigation but can also help towards cargo tracking, identification and security. GPS can pinpoint the location of a body within 100 m. Coupled with wireless communications systems, terrestrial and satellite based, valuable location and intrusion information can be transmitted to the appropriate authorities. Small transceivers that can send and receive signals from packetised data cellular systems when available or toggle over to low Earth orbit (LEO) satellites are attached to intermodal shipping containers.[5] Sensors are installed to record information regarding numerous parameters such as temperature, shock, weight and motion, combined with GPS receiver information and container-door intrusion devices. Such techniques help to keep a constant watch on the status of the shipment until it reaches its destination.

From the navy's point of view, any victory at sea is dependent upon the relative strength of one's force and the exploitation of one's "positions". Naturally, developments in the field of communications, surveillance, reconnaissance and navigational systems, enabled by the usage of space assets, contribute substantially towards achieving this aim. Also, connectivity enabled by space systems can help in achieving information superiority, essential for the success of any naval operation.[6]

For most modern-day naval operations, space systems play a vital role even towards delivering payload from the ship to the target. These systems help in achieving information superiority essential for the success of naval operations. The simple case of the Tomahawk Land Attack Missile (TLAM) reveals that only the launching of TLAM is conventional, but otherwise the entire process of launching mainly depends on space systems. First, intelligence is gathered mostly by satellites. Second, the command and control of the strike mission and navigational assistance are satellite communication dependent. Third, the weather forecast issued for the mission is based on space inputs, and, fourth, the damage assessments after the strike are carried out by satellites.

Intelligence could be gathered by using various technical and nontechnical means. There are various disciplines for intelligence gathering which include human intelligence (HUMINT), signals intelligence (SIGINT), imagery intelligence (IMINT), measurement and signatures intelligence (MASINT) and open source intelligence (OSINT). These disciplines are important for maritime agencies to collect information. For the purpose of this information gathering, various technology-based means are used like the aircraft, unmanned aerial vehicles (UAVs), etc. Also, satellites offer accurate and reliable options for intelligence gathering. For example, the National

Reconnaissance Office (NRO) in the United States develops and operates space reconnaissance systems and conducts intelligence-related activities for their national security.

Investments in space technologies for the navy have been the core focus of major powers. In order to preserve and enhance a strong space technology base and to provide expert assistance in the development and acquisition of space systems for naval missions, the US administration has established the Naval Center for Space Technology (Code 8000), which was officially inaugurated on October 1, 1986. The activities of the Naval Centre for Space Technology extend from basic and applied research through advanced development in all areas of the navy's interest. These activities include developing spacecraft, systems using these spacecraft, and ground command and control stations. The centre also provides systems engineering and technical direction assistance to system acquisition managers of major space systems. In this role, technology transfer is a major goal that motivates a continuous search for new technologies and capabilities, and the development of prototypes that demonstrate the integration of such technologies.[7]

For the US government, their navy is a vital instrument to ensure that their ambition for global reach remains feasible. For this purpose, one of the important steps taken by them was to establish the Naval Space Command (NSC), a military command of the United States Navy which began operations on October 1, 1983. The NSC used the medium of space and its potential to provide essential information and capabilities to shore and afloat naval forces by a variety of means:

- Operating surveillance, navigation, communication, environmental and information systems;
- Advocating naval warfighting requirements in the joint arena; and
- Advising, supporting and assisting the naval services through training, and by developing space plans, programs, policies, concepts and doctrine.

This command was merged into the Naval Network and Space Operations Command, itself a part of the Naval Network Warfare Command, around July 2002.[8] There are various other states and their maritime establishments which depend significantly on the space technologies. However, the US is one of the few states which have evolved a detailed space architecture to cater for their maritime requirements.

For states like India, where the majority of investment in space technologies is from the point of view of socioeconomic development, some investments in strategic areas have also been undertaken. On August 27, 2015, India's Geosynchronous Satellite Launch Vehicle (GSLV) successfully placed in orbit the communication satellite GSAT-6. India has announced that the GSAT-7 (launched on August 30, 2013) and GSAT-6 satellites were developed for strategic purposes. Earlier, some remote-sensing (sub-metre resolution, matching with the best in the world) satellites were also launched by the Indian Space Research Organisation (ISRO) as dual-purpose satellites, like the technology experimental satellite (TES, 2000) and the four cartographic satellites (CARTOSAT-1, 2, 2A and 2B launched in 2005, 2007, 2008, 2010, respectively). India has also launched (with Israeli assistance) two synthetic aperture radar (SAR) satellites called RISAT II (2009) and RISAT I (2011), essentially to address terrorism-related threats. Satellite-based navigation is another important arena which has significant military utility. The ISRO is developing a programme called the Indian Regional Navigation Satellite System (IRNSS) to provide accurate position information services to civilian and military users. A position accuracy of better than 10 m is expected to be provided to military users. IRNSS will have seven satellites, of which four have already been placed in orbit, and the system is expected to become operational shortly. All these satellites together constitute India's military space investments.[9]

India's first exclusive defence satellite GSAT-7 was successfully launched by Arianespace's Ariane 5 rocket from Kourou spaceport in French Guiana. This satellite is found to be giving a major push to the country's maritime security. Now, the Indian Navy has become a user of the multi-band home-built communication spacecraft. GSAT-7 is the country's first dedicated spacecraft for defence applications, and the India Navy is the exclusive user of this system. This demonstrates the importance of satellite technology (integrated platform) for maritime purposes.

The frequency bands of GSAT-7 assist space-based marine communications. It has coverage over the Indian landmass as well as the surrounding seas. This satellite helps to overcome the navy's limitations from line of sight and ionospheric effects, among other things, as far as space-based communications are concerned. GSAT-7 is an advanced communication satellite to provide a wide range of service from low-bit-rate voice to high-bit-rate data communication. Its payload is designed to provide communication capabilities to users over a wide oceanic region including the Indian land mass.[10]

Globally, maritime security has emerged as a multidisciplinary area of research that addresses various threats to maritime forces in ports, to international shipping and to energy security. At the same time, the conventional role of navies remains intact. Particularly for the naval forces from states which are nuclear capable, there is an additional responsibility to ensure that the deterrence potential of their nuclear architecture remains intact. For this purpose, space technologies could play a very vital role.

In general, it could be argued that from a military point of view, modern-day space technologies are being used to provide war fighters with near real-time integrated solutions. Space-supported warfare is here to stay and can be highly effective. Also, the 21st century is an era of multilateral forces fighting jointly with mostly rogue nations. So, modern navies do not fight in isolation and form a part of a larger fighting force. This creates a need for the linking of platforms (e.g. tanks, ships and aircraft) into a common shared-awareness network in order to obtain information superiority and enhance decision making. This is nothing but network-centric warfare (NCW). Modern navies on their own are trying to establish maritime NCW capabilities. At present, a few projects are in progress to develop the networked underwater warfare technology to evaluates warfare (ASW) as a focus.

All these areas depend heavily on space infrastructure and, in the future, it is expected that nation-states are likely to depend more on space assets to ensure maritime security.

Notes

1. Geoffrey Till, *Sea Power: A Guide for the 21st Century* (London, UK: Frank Cass, 2004), pp. 4–5.
2. Anurag Ghosh, "Military Satellites: Meaning and Purpose." http://www.brighthub.com/science/space/articles/26768.aspx (accessed August 24, 2015).
3. SES.com. "Maritime". http://www.ses.com/maritime#sthash.Co9ogD40.dpuf (accessed September 2, 2015).
4. CNES. "Nauplios: Galileo Pilot Project." http://www.transport-research.info/Upload/Documents/200607/20060727_153921_34691_NAUPLIOS_Final_Report.pdf (accessed September 10, 2015).
5. Seung-Bum Ahn, "Container Tracking and Tracing System to Enhance Global Visibility", *Proceedings of the Eastern Asia Society for Transportation Studies (2005)*, 5 (2005): 1719–1727.

6. Lieutenant Commander John J. Klein, "Corbett in Orbit", *Naval War College Review*, LVII, no. 1 (Winter 2004): 59–72.
7. Naval Center for Space Technology. "Code 8000". http://www.nrl.navy.mil/research/directorates-divisions/space-technology/#sthash.wNtsb0Kn.dpuf and http://www.nrl.navy.mil/ssdd/ncst (accessed July 28, 2015).
8. Gary R. Wagner, "Naval Network and Space Operations Command Established", http://www.navy.mil/submit/display.asp?story_id=2878 (accessed September 14, 2015).
9. Ajey Lele, "GSAT-6: India's Second Military Satellite Launched". http://www.idsa.in/idsacomments/GSAT6IndiasSecondMilitarySatelliteLaunched_alele_310815.html (accessed September 10, 2015).
10. "India's First Defence Satellite GSAT-7 Launched Successfully", *Times of India*, August 30, 2013.