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Issue Brief

China's 2016 Space White Paper: An Appraisal

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S*ummary*

The underlying theme of China's 2016 White Paper on space is that it considers space industry as an important part of its overall national development strategy. The latest white paper is not a mere factsheet or list of proposed agendas for future. It actually sets out to project China as a space power. However, it is the dubious nature of its space programme and its questionable track record that makes many suspicious about the Chinese intent.

On December 27, 2016, China's State Council published a White Paper on "China's Space Activities in 2016". This is the fourth white paper on issues concerning China's activities in the outer space. Earlier, similar such white papers were issued in 2000, 2006 and 2011. The recent white paper indicates China's keenness to inform the outside world about their achievements and future plans in the space arena. It also means the continuation of the Chinese practice of auditing their activities every five years.

The format of the latest white paper on its space activities is largely similar to that of earlier white papers. It presents China's vision on space exploration, explains their past achievements and the role of industry towards building space architecture. It also identifies proposals for the future, highlights international collaborations and debate policies. The first Chinese white paper on space (2000), primarily describing China's achievements in the space sector since 1956, provides a wonderful insight into the evolution of Chinese 'thought' in the space arena over a period of about four to five decades. The second white paper on space (2006) had limited scope compared to the first one as it had to discuss activities of only the last five years. Interestingly, those five years were also one of the most 'happening' phases in China's space programme. It witnessed the visit of the first Chinese man into space and that too in a Chinese spacecraft.

The October 2015 *Shenzhou 5* mission later forced the rest of the world to take note of the technological progress made by China within a short span of time. The third white paper (2011) spoke about the Chinese desire to undertake a moon landing mission. In addition, the paper highlighted China's effort at developing a space station. This paper further underlined China's keenness to develop Beidou system, a space based global navigational system. It is important to note that China greatly values investments towards developing its global navigation system. They had even issued a separate white paper in June 2015, titled, "China's BeiDou Navigation Satellite System".

As seen with the 2006 and 2011 white papers, the December 2016 White Paper too provides an overview of the space activities undertaken last five years. However, it is important to view China's interests and investments in space in a much wider backdrop. During the last two decades, China has made a definitive progress in the space arena and has emerged as a major space power, globally. The latest white paper is not a mere factsheet or list of proposed agendas for future. It actually sets out to project China as a space power for it views space as an important instrument in its ongoing effort "to provide strong support for the realization of the Chinese Dream of the Chinese nation." It is about China demonstrating its emergence as one of the global science and technology leaders. For many years, particularly in regard to China's achievements in space domain, there were talks about an invisible "Russian shadow", but not anymore. In almost every aspects of space, from launch vehicles to ground equipment to all weather sensors, China has made a remarkable progress.

Launch Vehicles

The December 2016 White Paper presents development of space activities as “an important strategic choice” in its national overall development strategy. Normally, the capability of a state as a major player in the space arena is judged by its ability to launch various categories of satellites into different orbits. For Chinese launch vehicle programmes, 2015 and 2016 were very significant years. In these two years, China successfully tested four launch vehicles, namely Long March (LM) 5, LM 6 and LM 7 and LM11. These vehicles are designed for different categories of payloads. LM 6 and LM 11 are for approximately 1000kg category payloads while the other two are for higher payloads. LM 7 is a medium heavy launch vehicle. The LM 5 has a payload capacity of around 25 tons for low earth orbit missions and about 14 tons for geostationary transfer orbit missions. LM 5 competes with the best in the world including the United Launch Alliance’s Delta 4-Heavy Rocket and is considered better than Europe’s Ariane 5 and Russia’s Proton Launcher. The success of LM 5 is crucial for China’s proposed space station (a 60 ton module) programme and robotic sample-return mission to the moon.

China also has major plans to develop a heavy-lift launch vehicle project in the next five years indicating its desire to expand the space station project and undertake more interplanetary missions. Unfortunately, China remains shy of acknowledging its failures in the space arena. For instance, it has not disclosed any details regarding the failed launch of LM 4C rocket on August 31, 2016. This rocket had carried *Gaofen 10* satellite, part of China High-Resolution Earth Observation System (CHEOS) initiated in 2010. Probably, one of the reasons for China’s silence about LM 4C mission failure is due to the fact that this system is supposed to provide 24-hour intelligence gathering capabilities for both military and civilian users.

Satellite Systems

The communication and broadcasting satellites have both socio-economic and strategic relevance. China has invested in various categories of satellites including the fixed, mobile and data relay satellite systems. Presently China is in a position to provide communication services in all its territories and also in many other parts of the world. Satellites in the category of fixed communications systems called *Yatai* and *Zhongxing* (also known as ChinaSat) provide broadband and multimedia services. On August 05, 2016, China launched its first mobile communications satellite *Tiantong-1* to provide mobile communication services not only across China but also regions outside including Indian Ocean, West Asia and Africa. Owing to geographical limitations, it becomes difficult for communication satellites to have a clear view of all the ground stations and hence they are unable to pass all the information gathered to the user. To address this challenge, China has developed its first-generation data relay satellite system composed of three *Tianlian-1* satellites.

In addition, China has established *Dong Fang Hong* (DFH) geostationary telecommunications satellite bus (a broad model on which multiple-production satellite is based) for TV broadcasts, voice and data communications, data relay, and mobile communications satellites. They could also be used for navigation and deep space exploration missions. The first *Dong Fang Hong-1* (DFH-1/China-1) satellite was launched way back in 1970. The idea of developing high-capacity and long-endurance communications satellites both for civilian and military missions first appeared in China's 10th Five-Year Plan (2001-2005). However, China's progress in this field has been a mixed bag of success and failure. Projects like DFH-4 did suffer initial failures, with the first two satellites (SinoSat 2 and NigComSat 1) failing to deploy their solar panel wings (two-stage solar wing deployment method). This forced China to opt for a less complex single-stage deployment method (at the expense of lower power output) and the subsequent missions have been successful.

China is successfully using the DFH model commercially too. They have marketed the DFH-4 as a single package that includes custom-made satellite design and manufacturing, launch services, and even launch insurance. With this they have attracted many developing countries and today states like Nigeria, Pakistan, Venezuela, Bolivia, Laos, Sri Lanka, Bolivia, the Democratic Republic of Congo and Nicaragua have either taken the delivery of DFH buses or are in the process of getting one. China is continually upgrading its spacecraft bus and developing satellites with performance and price requirements based on the customers' need and capacity. Presently, it is working on an all-new DFH-5 platform and expects a boost in its commercial (and military?) sales.

In addition to communication satellites, China is also making huge investments in space science and earth observation satellites for remote sensing, space mapping and meteorological purposes including constellation of small satellites for environment and disaster monitoring and forecasting. The 2016 White Paper in fact discusses in detail China's investments and future plans in all these sectors. Satellites developed under High-resolution Earth Observation System come with sub-metric resolution and have Synthetic Aperture Radar (SAR) imaging instruments on-board. During 2015-16, China launched its first commercial remote sensing satellites, the *Jilin-1* series. The manufactures of these satellites aim to provide customers with new concept products, which though technologically advanced would still be available at low costs. In the last few years, China has launched dozens of satellites under *Yaogan Weixing* series. These remote sensing satellites are dual-use and are believed to provide reconnaissance support to the People's Liberation Army (PLA).

The 2016 White Paper also provides various inputs about the progress made towards developing ground facilities such as Telemetry, Tracking and Command (TT&C) infrastructure, up linking stations, data-sharing and data-processing facilities, new launch sites for rockets and techniques and processes evolved towards monitoring and providing early warning on the movement of space debris. Also, various details have been provided about the investments made for developing

innovative technologies and proposals for future experimentation in space and methods for gathering data in the field of space science.

Core Areas of Interest

All the four white papers on space and a separate one issued on BeiDou Navigation Satellite System indicates that presently China has three core areas of interest in the space domain: space based navigation, space station and inter planetary missions.

China is fast completing its BeiDou Navigation Satellite System as 23 of the proposed 35 satellites have already been put in the orbit and the constellation has been made operational for the Asia-Pacific region. It is expected to be fully operational at the global level by 2020, proving positioning accuracy of less than 10 meters and a timing accuracy of 20 nanoseconds. As per some estimates, almost two-third of the smartphone users in China depend on BeiDou System for searching required locations and using other applications like booking taxis, etc. China has already established partnership agreements with Russian and the European space based navigation agencies for interoperability with their navigational constellations (GLONASS and Galileo). BeiDou System is of great significance to its Belt and Road initiative as well. China also proposes to jointly develop space-related infrastructure with relevant nations involved in this project.

China's first manned space flight in 2003 could be considered as the first major step towards developing a space station. Post-2003, various initiatives taken towards ensuring long-duration human stay in space were directly or indirectly part of its continuing effort at building a space station. During last five (or more) years, China has got breakthroughs in conducting space-walk, extravehicular activity, long-term human stay in space, development of robotic space arm, spacecraft rendezvous and docking technology and operation of a manned space transportation system. Now, China plans to launch a cargo spacecraft to dock with the earth-orbiting space laboratory. It is also keen to master key technologies for cargo transport and replenishment. Overall, the various technologies developed and experience gained would help China in building and operationalising its space station in the coming years.

For deep space exploration (deep space region is an expanse beyond 100,000 km from the earth), China proposes to focus on two specific areas: First, to continue with its lunar exploration project and get soil/rock samples back from the Moon by undertaking robotic missions. Also, achieve mankind's first soft landing on the far side of the Moon (around 2018). Second, a mission to Mars in 2020 probably on the same lines as that of India, putting a satellite close to Mars and undertaking various observations for planning future missions.

ASAT Silence

In the 2016 White Paper, China claims that it always adheres to the principles of exploration and utilisation of outer space for peaceful purposes. It also reiterates China's opposition to any weaponisation or possible arms race in the outer space. However, China's track record in this field had been a subject of concern. In 2007, it had undertaken an anti-satellite test (ASAT) which had generated a significant amount of space debris.

The following table compiled by one of the US-based think tanks working on space issues (Secure World Foundation) provides a summary of known or suspected Chinese ASATs in space:

Date	ASAT System	Target	Altitude Reached	Result
July 02, 2005	SC-19	Not known	Unknown (likely LEO)	Likely rocket test
February 06, 2006	SC-19	Unknown satellite	Unknown (likely LEO)	Likely flyby of orbital target
January 11, 2007	SC-19	FY-1C satellite	865 km	Destruction of satellite and debris creation
January 11, 2010	SC-19	CSS-X-11 ballistic missile	250 km	Destruction of target, no debris creation
Jan 27, 2013	Possibly SC-19	Unknown ballistic missile	Unknown	Destruction of target, no debris creation
May 13, 2013	Possibly DN-2	Not known	10,000 to 30,000 km	Likely rocket test
Jul 23, 2014	SC-19	Not known	Unknown (likely LEO)	Non-destructive test

Apart from the above missions, some other missions have also raised questions about China's intentions. For example:

- Three Chinese satellites - *Chuang Xin-3*, *Shiyan Weixing-7* and *Shijian-15* - launched together on July 19, 2013, had made a sudden manoeuvre on August 19, 2013.

- The satellite *Shiyan 7* (SY-7, Experiment 7) had already completed a series of orbital changes, putting it close to one of the companion satellites with which it was launched – *Chuang Xin 3* (CX-3). However, it made a surprise rendezvous with a completely different satellite, *Shijian 7* (SJ-7, Practice 7), launched in 2005.

Such separation, approach and grapple exercises/simulations undertaken by bringing two satellites in close vicinity (say two satellites separated by a distance of about five kilometres) raises concerns about China's actual intentions behind undertaking such missions. A space debris clean-up satellite (Aolong-1/The Roaming Dragon) launched on the inaugural LM 7 flight in June 2016 also raises concerns about China's intentions. The broad concept behind such mission is to demonstrate the space debris mitigation technology by using a small robotic arm to grab debris pieces and launch them towards the atmosphere so that they would burn upon entering the earth's atmosphere. There is a possibility that such technology could also be used for ASAT purposes. The recent White Paper is conspicuously silent about such activities and it is but obvious that China would not disclose their future plans (if any) in similar directions.

Appraisal

The December 2016 White Paper not only highlights the various activities conducted by China in the space domain during the last five years, it also enumerates its strategic future plans. China has proved the competence of its technology in the space arena. Between 2011 and November 2016, the Long March carrier rocket series had completed 86 launch missions, sending over 100 spacecraft into target orbits with a success rate of 97.67 per cent. On an average, China has undertaken 14 to 15 missions per year. China has been able to broadly meet various deadlines (one to two years delay is viewed as normal in space domain) and made rapid progress on various projects identified in the 2011 White Paper.

Developing and successfully testing four different categories of launch vehicles is much commendable. The development of liquid oxygen and kerosene engines has helped China launch LM 6 and LM 7 vehicles. The new kerosene-burning engine used for LM 7 vehicle also generates more thrust and is more fuel-efficient. China is proposing to develop more heavy-lift launch vehicles in future. It is important to note that China has not given any details/deadlines about their impending launch vehicle proposals. Probably, all their plans would depend on further developments in the high-thrust liquid oxygen and kerosene engines, and oxygen and hydrogen engines. It is important to monitor the nature of investments and the progress made by China in the field of rocket engines in particular for assessing the future trajectory of its space programme.

It is often argued that Chinese investments in space sector have a military bias. However, the progress made by China in many fields, from disaster management to

environmental monitoring, apart from typical fields like remote sensing and communications, does give an indication that China is looking at space technologies as a tool for infrastructure development, education, medicine, internet access, and for assisting various other social sectors. China's BeiDou Navigational System is expected to play a major role towards implementation of their Belt and Road initiative.

Presently, China is increasingly seeking international engagement and cooperation. As per the 2016 White Paper, it has signed 43 cooperative agreements or memoranda of understanding with 29 countries in the last five to six years. China is using its space expertise as a foreign policy tool. It has been engaging various developing and smaller states, providing them with the required assistance in realising their objectives in the space domain. China's present focus is mainly towards countries in South & Southeast Asia and also in South America & Africa.

The underlying theme of the 2016 White Paper is that China considers space industry as an important part of the nation's overall development strategy. However, the latest white paper is totally silent on commercial gains made from the navigational market. It neither discloses any details on the number of satellites launched on commercial basis, nor about countries to which remote-sensing data/satellite imageries, etc. are being sold. As per some Chinese sources, the Beidou satellite generates about \$31.5 billion for online clients such as the China Aerospace Science and Industry Corp, AutoNavi Holdings Ltd, and China North Industries Group Corp. In fact, none of the white papers till date have given any space-related budget figures. Though the latest white paper lauds the industrial progress achieved, there is no mention of any specific investment made in the space industry by any internal and/or external agency.

While it is understandable that China would not comment about their counter-space capabilities programme, but their silence about their capabilities which are significant from the point of view of maritime security, management ocean traffic, etc. is worrisome. A case in point is the recent launch of *Zhongxing 15A* satellite, which essentially could play a major role in maritime communications. Also, no information has been provided about present and future small satellites though China is using many such satellites for experimentation purposes. It may be noted that micro/nano/pico satellites have significant strategic relevance too.

China is keen to highlight its proposed space station and Moon and Mars missions. China fully understands that probably post-2024, theirs could be the only operational space station. This would not only enhance their prestige but also make them the only agency capable of undertaking micro-gravity experimentation. Probably, China is working towards 'manned Moon landing', say by 2030, in its quest for technological supremacy.

Overall, the 2016 White Paper sheds light on China's growing ambitions in the space sector though it only reveals what China wants the rest of the world to know. So far, China has made remarkable progress in the space arena. The white paper mentions that China is keen to explore the vast cosmos and build itself into a

Space Power. China has been successfully exploiting the space environment in pursuit of its national goals at social, economic and strategic levels. It is also discretely using its capabilities in space to influence smaller powers. However, the dubious nature of its space programme and its questionable track record makes many suspicious about their intent, although the preamble of the 2016 White Paper states that China looks at space technology as an instrument for improving the well-being of the mankind. However, to emerge as a respectable Space Power, China needs to practice what it preaches.

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