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ISRO TAKES GREATER STRIDES TO BOOST INDIAN SPACE CAPABILITY

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Introduction

One of the most important and useful space applications developed in the space era is that of satellite assisted navigation systems. The 1980s saw operationalisation of the US Navstar Global Positioning System (GPS). GPS has since found myriad uses in both the military and civil fields of operation. Militaries all over the world utilise GPS for navigation, weapon guidance, and to improve the accuracy of earlier munitions launched from land, sea or airborne platforms. In the civil arena GPS has found utilisation for navigation in all three environments of land, sea and air. Logistics has been simplified to a large extent by integration of GPS devices in tracking of shipments. New applications of GPS technology continue to be found on a regular basis. Apart from bringing efficiencies that were unimaginable in earlier years to military and civil operations, GPS has also generated considerable revenue for its owner, operator, and suppliers of GPS receiver systems. Desire to have an independent and fully controlled satellite navigation system has led to development of similar systems in Western Europe, the Galileo, Russia, the Global Navigation Satellite System (GLONASS), China, the Beidou, and India, the Indian Regional Navigation Satellite System (IRNSS).

Background and Developments

Earlier articles on this website have covered the configuration of the satellite navigation systems from different countries in detail and have examined the relative merits and demerits of each. IRNSS is a major departure from other satellite navigation systems in that it reduces costs and complexity through limiting its coverage to a swath of 40 degrees by 40 degrees in latitude and longitude. This coverage can be further extended by adding more satellites along further longitudes, east and west of the initial configuration. By adopting a more limited initial coverage area IRNSS has reduced the satellite requirements from 24 in orbit, for the America Navstar system, to a mere seven. This reduces

costs of satellite building as well as launch costs, making IRNSS more affordable, while still delivering needed capability. The initial IRNSS satellite constellation was completed with the launch of IRNSS-1G, the seventh and last planned satellite of its initial configuration. IRNSS-1G was placed in its desired orbit by the thirty fifth successful flight or the thirty third commercial flight of the Polar Satellite Launch Vehicle (PSLV) rocket (PSLV-C33), which was launched as planned at 1250h on April 28, 2016. With this the IRNSS is much closer to commencing providing useful services to its users. Being a totally Indian owned and controlled satellite navigation system, it should give Indian users a degree of protection from the changing priorities and decisions of foreign satellite navigation system operators. For instance, the US has always reserved the right to degrade or deny its GPS signals in specific geographical areas in pursuit of its own national interests[1]. The reluctance of non-US users to rely on GPS for critical requirements such as using GPS as a landing aid for commercial aircraft has led to the US stating that it will not degrade or deny GPS services at any time[2]. However, the damage appears to have been done in the faith non-US users have in the GPS.

Getting the complete IRNSS constellation into the air is one step in operationalising the system. The next step must involve the owner and operator of IRNSS demonstrating the system's accuracy and reliability. Such a step will imbibe confidence in potential users of the utility and safety of switching to IRNSS. Further, the design and ready availability of satellite navigation receivers able to work with IRNSS signals will be required. It may be prudent to push the design of satellite navigation signal receivers that are able to function with GPS, GLONASS and IRNSS. Such a situation may give users a method of incorporating safety from system failures or denial / degradation of any one system. The probability of all three satellite navigation systems failing simultaneously is lower than any one becoming less reliable at any one time. Readers will recall the earlier articles on this website on failures of the GLONASS and GPS at various times in the past. Such multi-system receivers could also be programmed to compare signal and navigation accuracy and quality of all three systems and utilise the best at any given time.

While the IRNSS has made considerable progress in the past few months, this is not the end of the road for its effective exploitation. Till such time as IRNSS accuracy and reliability is established, and suitable receivers are made readily available to potential users, the IRNSS system could be reasonably regarded as a work in progress.

The Launch of IRNSS-1G has also once again demonstrated the precision and reliability of the PSLV which executed its thirty fifth consecutive and thirty third commercial flight on

April 28, 2016. This success makes India one of the lowest cost suppliers of precise satellite launch capability in the world market. In the coming years this could translate into revenue for India through commercial satellite launches for other countries. The Prime Minister of India, Mr Narendra Modi named the IRNSS system as 'Navic' or (Navigation with Indian Satellite Constellation)[3], in his address immediately after the successful insertion of IRNSS-1G into its planned geosynchronous transfer orbit.

The Navic or IRNSS constellation comprises seven satellites. Of these IRNSS-1A, IRNSS-1B, IRNSS-1C, and IRNSS-1G are in geosynchronous orbit (GSO), while IRNSS-1D, IRNSS-1E, and IRNSS-1F are in geostationary orbit (GSO)[4]. The first satellite was launched on July 01, 2013. Each satellite has a life of 12 years on station[5].

However, it needs to be kept in mind that one use rockets which have been the most common vehicles for space access take a long time to manufacture and prepare for launch, thus limiting the possibility of rapid on demand access to space. Indian Space Research Organisation (ISRO) is reportedly at an advanced stage of developing a reusable launch vehicle (RLV) and hopes to test a scaled down prototype in June or July 2016[6]. This project is aimed at testing several separate technologies that could in future lead to ISRO stepping up from a Two Stage to Orbit (TSTO) in the initial RLV to a Single Stage to Orbit (SSTO) vehicle in later years[7]. This program, if it achieves success, could reduce launch costs by several orders of magnitude while also making available the ability to access space on demand at short notice[8].

Conclusion

India has worked over several years to develop its own satellite navigation system. Unlike similar systems from the US, Europe, Russia, and China the Indian plan was for a regional satellite navigation system that reduced costs and complexity by not aspiring for global coverage. Once fully operational such a system will give India all the benefits of a satellite navigation system over the Indian landmass and extending to up to 1500 km from India's shores and borders. The initial constellation of seven satellites on the IRNSS was completed on April 28, 2016 with successful insertion in orbit of the IRNSS-1G satellite by the PSLV rocket. The next steps are likely to involve demonstration of the accuracy and reliability of the system along with ensuring easy availability of IRNSS receivers to increase its popularity and utilisation. Once these remaining steps are successfully achieved, IRNSS could be ready to take its place alongside the GPS, GLONASS and Beidou. In addition, the efforts by ISRO towards RLV technology should further enhance India's space capability.

(Disclaimer: The views and opinions expressed in this article are those of the author and do not necessarily reflect the position of the Centre for Air Power Studies [CAPS])

Notes

[1] Declan McCullagh, "U.S. Could Deny GPS to Taliban", http://www.wired.com/2001/10/u-s-could-deny-gps-to-taliban/, accessed on April 28, 2016

[2] James S. Brady Briefing Room, "Press Briefing by Neal Lane, Director of the Office of Science and Technology, Arthur L. Money, Assistant Secretary of Defense for Command, Control, Communications and Intelligence, James Baker, Administrator of N.O.A.A. and Gene Conti, Assistant Secretary of D.O.T.", http://www.presidency.ucsb.edu/ws/?pid=48120, accessed on April 28, 2016.

[3] Pathri Rajasekhar, "Satellite launch gives India own GPS system", http://www.asianage.com/india/satellite-launch-gives-india-own-gps-system-044 accessed on April 29, 2016.

[4] "List of Navigation Satellites", http://www.isro.gov.in/spacecraft/list-of-navigation-satellites.

[5] Ibid.

[6] http://everything.explained.today, "Avatar (spacecraft) explained", http://everything.explained.today/Avatar_%28spacecraft%29/, accessed on April 28, 2016.

[7] Ibid.

[8] Arya Bhatta, "ISRO:: Guiding the World into the next era of Space Technology", http://www.defencenews.in/article/ISRO--Guiding-the-World-into-the-next-era-of-Space-Technology-4619, accessed on April 28, 2016.