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A STEP CLOSER TO OPERATIONALISING IRNSS

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Introduction

Since the advent of the space age in the 1950s and 1960s mankind has progressively found an ever increasing range of practical applications of space technology and space assets. One of the more significant of these has been the advent of satellite based navigation systems. Maritime and Aviation navigation requirements initially drove attempts to design and implement accurate navigation systems to assist safe conduct of the activities of global maritime and aviation users. This resulted in systems such as Long Range Navigation (LORAN) and Omega. These systems comprised an extensive network of ground based transmitters. Receivers on board ships and aircraft received these ground station transmissions and through their analysis obtained a reasonably accurate fix of their position. These systems were expensive to implement and despite the costs involved were unable to provide very accurate fixes of position.

Modern Developments

The advent of the space age saw military forces turning their attention towards utilising the new field of space technology to address the earlier problems of the ability to accurately fix a receiver's position anywhere on earth. Given the global coverage possible through use of earth orbiting artificial satellites,. It soon became apparent that a viable solution was now possible. The US "Navstar" Global Positioning System (GPS) was the first such system to be developed. Inevitably it was followed by other nations designing and implementing their own similar systems. The erstwhile Soviet Union, later Russia

implemented the Global Navigation Satellite System (GLONASS) as their equivalent GPS while the European Union (EU) commenced putting in place their equivalent similar system called Galileo. The Peoples Republic of China (PRC) designed and implemented their system called Beidou.

These satellite based navigation systems have one common characteristic of requiring global coverage. Satellite dynamics and the need for at least three satellites to be visible at any point on the planet at any given time dictated a large number of in orbit satellites in these navigation systems. The fact that most of these satellites are placed in low or medium earth orbit and go progressively around the entire planet placed a need for satellite monitoring and control stations at several locations on the planet. The geographical limits of nations' borders forced the GPS operating nations to seek satellite monitoring and control facilities to be located in other nations' territories for the required monitoring and control purposes. In absence of this being available the option was o arrange such facilities on large ships which could then maintain station at various points in international waters. This latter path was followed by the erstwhile Soviet Union and later by the PRC. The large numbers of satellites as well as the offshore satellite monitoring and control facilities are dictated by the need for global coverage. Global coverage was a specific requirement of the US and the EU due to their political and military global interests. The erstwhile Soviet Union and now Russia required this coverage due to the vast land mass occupied by that country. The PRC sought the same capabilities as the American 'Navstar' due to its global ambitions to compete with the US also went in for a GPS system with global coverage.

Indian Scenario

Since the late 1980s India's armed forces have been purchasing and utilising satellite navigation systems using the US 'Navstar' GPS signals and later receivers utilising

both 'Navstar' and GLONASS in the hope that at any given time both should not face a denial of service or failure situation, thus enabling GPS dependent operations to be executed. It is not a good situation to be dependent upon foreign controlled facilities for such vital needs as accurate navigation as well as position and time fixing. GPS has myriad applications in civil fields of endeavour as well. These civil uses contribute to more efficient functioning of the economy. A certain royalty could be expected to be paid for utilisation of foreign owned and operated GPS systems. Hence a need was felt for development of a totally India owned and operated satellite navigation system.

India has been very pragmatic and has kept its needs confined to immediate requirements and its political posture. India's Indian space Research Organisation (ISRO) designed a satellite based navigation system, called Indian Regional Navigation Satellite System (IRNSS), that requires a mere seven satellites and can provide accurate navigation signals over the Indian landmass and extending to a distance of approximately 1500 kilometres beyond the national borders and coastlines. This area roughly comes to be a swath of about 40 degrees by 40 degrees in latitude and longitude centered on India. This operational requirement meshes with India's non expansionist and non threatening political and military posture while also addressing India's legitimate security needs. Through this less than global coverage requirement ISRO designed a navigation system architecture that could provide the required accuracy and coverage with four satellites in geo-synchronous orbit and three satellites in geo-stationary orbit. The reduced number f satellites helps reduce the cost while coverage centered on India itself eliminates the requirement for offshore satellite monitoring and control stations as all IRNSS satellites remain in line of sight of such stations located in India itself.

The complete IRNSS system requires all seven satellites to be operational. However, signals from four satellites can in theory be adequate to commence use if the system. ISRO launched the first three IRNSS satellites by the end of year 2014. On 28 March 2015, ISRO's

Polar satellite Launch Vehicle (PSLV) on its 28th successive successful flight placed the fourth IRNSS satellite in the required orbit. With this successful launch more than half of the IRNSS satellite components are already in place. ISRO could now be expected to commence testing of the initial system. The remaining three satellites are expected to be launched over the next nine months. In year 2016 IRNSS should be fully in place and well on the way to being declared fully operational. This will be a landmark achievement. The Indian government's organs will then be free from dependence on foreign navigation systems. Such a situation could be expected to enhance national security. Civil applications of the IRNSS could be expected to provide a fillip to efficient functioning of the economy. The architecture of IRNSS permits later augmentation of the system towards wider coverage if need through addition of more satellites spaced out in longitude. The IRNSS itself was discussed in depth on this website in years 2014.

Another spin off from the IRNSS launch mission on 28 March 2015 is the fact that ISRO's PSLV rocket has established a track record in reliability and efficiency. This was the 28th successive successful launch of the rocket with another demonstration of its quality inferred from the fact that it has consistently placed its payloads into the desired and planned orbits at the precise velocity of insertion. The accuracy becomes important as it reduces costly satellite orbit adjustment manoeuvres necessitated by inaccurate orbit insertions. Thus the satellite life in orbit is enhanced as more residual fuel remains on board.

The PSLV launch on 28 March 2015 has brought India a step closer to operationaslising IRNSS and also proven once again the maturity and reliability of PSLV. This opens the door to greater commercial exploitation of the PSLV rocket by ISRO.

Conclusion

Satellite based navigation systems through their greater accuracy as well as coverage replaced the earlier LORAN and Omega global navigation systems. While designed primarily for military use these satellite based navigation systems have found a plethora of civil uses as well. India has been depending upon use of the American 'Navstar' GPS and the Russian GLONASS. Both these foreign systems could potentially face denial of use or degradation in India's context. Hence India planned the IRNSS as a wholly India owned and operated navigation system. On Saturday 28 March 2015 this system came a step closer to operationalisation when the fourth of the planned seven IRNSS satellites was placed in orbit by the 28th successful launch of the PSLV rocket. The mission on 28 March 2015 also once again demonstrated the maturity and reliability of the PSLV rocket system.

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