



## **GLONASS FAILURE: IMPLICATIONS FOR INDIA**

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The first operational satellite based navigation system to become operational was the USA's Global Positioning System (GPS) "Navstar". This was followed soon by the erstwhile Soviet and now Russian Global Navigation system (GLONASS). All GLONASS satellites were in orbit by 1995 but the economic troubles of Russia at the time led to the system being ignored and decaying in performance till in 2001 President V. Putin of Russia gave a fillip to its up gradation. This effort saw new upgraded satellites being launched as well as partnering with India to support the system. Performance guidelines for GLONASS included a fully on orbit constellation of satellites by 2011 by when its accuracy was expected to be equal to that of the US "Navstar" GPS. GLONASS uses Frequency Division Multiple Access (FDMA) techniques unlike the US GPS' Code Division Multiple Access (CDMA) techniques. This makes development of GPS receivers able to work with both GLONASS and GPS more complicated.<sup>1</sup> The European Union is developing its Galileo GPS system independently while China is in the process of putting its Bediou system up. All these systems work in a similar manner in that a constellation of more than 20 satellites is placed in polar orbit. Thus a large number of satellites are required for at least three to five being in view at any given time for accurate position determination and to obtain global coverage. India is known to be putting two different systems up. These are the GPS Aided Geo Augmented Navigation (GAGAN) and Indian Regional Navigation Satellite system (IRNSS) into place.

### **Applications, Reliability and Vulnerability of Current GPS Systems**

GPS “Navstar” has demonstrated a good record of robustness. While there have been many individual satellite failures affecting limited regions as a time, there has to date been no global GPS “Navstar” system failure. The GLONASS has suffered a global failure on 02 April 2014, which lasted 10 to 12 hours, in which the information from almost all its satellites was affected.<sup>ii</sup> It has been reported that positioning accuracy was incorrect by as much as 55 kilometres during this failure.<sup>iii</sup> It is important to keep in mind that India is a user of both the “Navstar” GPS as well as GLONASS for military as well as civil applications. Thus the GLONASS is quite alarming in the context that since the advent of GPS systems these have found application in many areas of military and civil endeavour. Military applications range from navigation, target detection and position marking as well as accurate weapon delivery with accuracies of 3 to 10 meters. Civil applications include navigation by surface vehicles as well as ships, tracking of cargo and mapping and survey applications. In case of inaccurate GPS data being received even for a short while the consequences could be very serious. In the military realm, forces could be incorrectly positioned for the task as hand and could even engage incorrect targets resulting in collateral damage and / or the failure of the planned operation. In the civil realm logistics systems could be disrupted and ships and

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land vehicles could suffer catastrophic damage due to incorrect position determination. Results of surveys etc. could be very inaccurate with severe economic and administrative consequences.

**F**urther while the recent GLONASS failure has been attributed to faulty software it is quite feasible for a hostile power to interfere with the functioning of a GPS system. Observe the Stuxnet and Flame malware attacks on the Iranian nuclear program.<sup>iv</sup> GPS systems perform rely upon wireless signals to and from ground stations for their operation due to the extreme unlikelihood of secure cables ever being feasible to link satellites and ground based control stations. Wireless links provide an opportunity for a malign signal to enter the satellite control system where it could potentially cause immeasurable havoc. This cyber attack on illustrates the vulnerability of GPS systems and the requirement of hardening them against cyber attack. In addition there is need to build in ability to use multiple GPS systems simultaneously. Ideally one should be able to utilise the GPS system owned and operated by hostile countries as their degrading coverage of their own systems in battle zones is less likely due to the needs of their own forces.

### **GLONASS Failure; Implications and Lessons for India**

**T**he failure of GLONASS should be seen in this context of the possible consequences of failure. The recent failure in April 2014, fortunately, did not result in any major damage. While the GLONASS suffered a technical failure attributed by Russia to faulty software which has since been corrected, the US GPS comes with the rider that the US can elect to degrade or deny its signals to any geographical region at the whims of the US establishment. Despite the complexity of combining CDMA and FDMA into a single receiver many customers have opted to enable use of both GPS “Navstar” and GLONASS to give redundancy and protection from intentional degradation or denial by the US. This strategy of dual receivers is vindicated by the apparently unintentional failure of GLONASS. It should be borne in mind that GPS systems are vulnerable to cyber attacks and a failure such as the one suffered by GLONASS recently could also be engineered by an external hostile agency. Hence the introduction of receivers with capability of using signals of

multiple systems is a good step but not the entire solution. We are likely to see soon GPS receivers able to use GPS “Navstar”, GLONASS, Galileo and Bediou. Such as receiver should be able to provide some fail safe options to operators.

**T**he Indian GAGAN would do well by introducing ability to use signals from “Navstar”, GLONASS, Galileo as well as Bediou for its differential GPS error correction broadcasts to deliver safety from inadvertent or wilful GPS failure. This is where the importance of IRNSS, which is an independent satellite navigation system covering the Indian mainland and up to 1500 km beyond India’s borders/ coastlines, comes in. IRNSS, unlike GAGAN, does not require inputs from any other navigation system and uses its own signals. With an indigenous system the country can suitably modify it to strengthen it against hostile acts aimed at degrading it while retaining control over its availability and reliability. While in the process of getting IRNSS up and running Indian Space Research Organisation (ISRO) should consider that in jamming electronic systems it is the receiver that is attacked and not the transmitter. Hence IRNSS may require development of difficult to disrupt waveforms of satellite transmissions and suitable hardening of IRNSS receivers to protect against intentional jamming by hostile forces. GAGAN meanwhile may be expanded to enable it to use signals of all other GPS systems. The small domestic lobby that is against development of an indigenous satellite navigation system requires to examine these issues in more detail to understand the imperatives for establishing an Indian owned satellite navigation system free from dependence upon foreign systems.

## Conclusion

**S**ince their introduction GPS systems have found myriad applications in military and civil fields. These applications make these essential for modern warfare as well as for efficient functioning of modern economies. The recent failure of the GLONASS system illustrates the dangers of this dependence. Further while the GLONASS failure is reportedly due to internal issues similar failures could be affected by hostile countries through cyber attacks. This leads to need for ability to simultaneously use multiple GPS systems as well as for development of a domestic satellite navigation system that can be suitably hardened to

meet

local

requirements.

*(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)*

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<sup>i</sup> "Global Navigation Satellite System (GLONASS) Overview", [http://www.positim.com/lonass\\_overview.html](http://www.positim.com/lonass_overview.html), accessed on 06 May 2014.

<sup>ii</sup> "GLONASS Suffers Temporary System wide Outage; Multi-GNSS Receiver Overcomes Problem (updated)", <http://www.insidegnss.com/node/3979>, accessed on 06 May 2014.

<sup>iii</sup> "New data shows extent of UK disruption during failure of Russian GPS satellite navigation system", <http://www.directionsmag.com/pressreleases/new-data-shows-extent-of-uk-disruption-during-failure-of-russian-gps-satell/394067>, accessed on 06 May 2014.

<sup>iv</sup> "Flame and Stuxnet: Two cyber weapons unleashed by same master", <http://rt.com/news/flame-stuxnet-kaspersky-iran-607/>, accessed on 06 May 2014.