Impact Factor (SJIF): 4.542

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444
Volume 4, Issue 4, April-2017

Review Paper on Indian Regional Satellite System

Vruti S Joshi[1], Balvant J Makwana[2], Dr. Ashish M Kothari[3]

[1]*ME student, EC Department, Atmiya Institute of tech. & Sci, Rajkot, Gujarat, India*
[2]*Asst Prof , EC Department, Government Engineering College, Rajkot, Gujarat, India*
[2] *H.O.D , EC Department Atmiya Institute of tech. & Sci, Rajkot, Gujarat, India*

Abstract — *The Indian Regional Navigation Satellite System (IRNSS) is an autonomous regional satellite navigation system being developed by the Indian Space Research Organization (ISRO). Which would be under complete control of Indian Government. The requirement of such a navigation system is driven by the fact that access to Global Navigation Satellite Systems, GPS, is not guaranteed in hostile situations. The main objective is to provide reliable position, navigation and timing services over India and its neighborhood.*
Keywords-IRNSS, Navigation, Application, GPS, Global Navigation Satellite Systems

I. INTRODUCTION

Today navigation system is important because the system helps a layman person to locate himself/herself precisely anywhere on the earth within few seconds/meters. Satellite based navigation services are an emerging technology with commercial and surgical applications. There are many satellite navigation services like GPS (developed by U.S), GLONASS (developing by Russia), Galileo (developing by European Union), BieDou (developing by China), IRNSS (developing by India), etc[1].IRNSS is an Indian regional satellite based positioning system for critical national applications and user navigating purpose. The main objective is to provide reliable position, navigation and timing services over India and its neighborhood[2].

India developed a satellite based navigation system called Indian Regional Navigation Satellite System (IRNSS) with a constellation of 7 satellites and complementary round infrastructure. Two spare satellites are also planned. Government has approved the IRNSS project at a total cost of Rs. 1420.00 crores in May 2006 for both space and ground infrastructure. The IRNSS is expected to provide positional accuracies similar to the Global Positioning System (10 meters over Indian landmass and 20 meters over the Indian Ocean) in a region centered around the country with a coverage extending up to 1,500 km from India between longitude 40° E to 140° E and between latitude ± 40°[3].

IRNSS was featured with highly accurate position, velocity and time information in real time for authorized users on a variety of vehicles. This system provides Data with good accuracy for a single frequency user with the help of Ionospheric corrections and also provides all environmental operation on a 24 hour basis. Polar Satellite Launch Vehicle (PSLV) in its twenty fourth flight (PSLV-C22) have launched India's first dedicated navigational satellite system IRNSS-1A. Each IRNSS satellite weights about 1,380 kg and their solar panels generate 1,400 Watt of power. The satellites will be configured with an optimized I-1K bus (compatible for launch onboard PSLV) with a power handling capability of around 1600W. The IRNSS mainly consists of three segments: space segment, ground segment and user segment.

II. IRNSS SPACE SEGMENT

The space segment consists of seven satellites with three satellites in GSO orbit and four satellites in GSO orbit. The 3 GSOs is located at 32.5º E, 83º E and 131.5º E and the 4 GSOs have their equatorial longitude crossings at 55º E and 111.75º E (two in each plane). IRNSS satellites have two types of payloads, navigation and ranging payload. The navigation payload will transmit the ranging codes being generated onboard along with the navigation data uplink from the ground stations. A separate C-band transponder for precise CDMA ranging is included in the payload configuration. The important functions of the IRNSS payload are: Transmission of the navigational timing information in the L5 band; transmission of navigation, timing information in S band.[1]

Details of space segments are shown in table 1.

Table -1: Space Segment Details

IRNSS space craft	Longitude (Degree) (E)	Inclination (Degree)	Launch Date
1A	55	29	July 1,2013
1B	55	29	April 4,2014
1C	83	29	October 15, 2014
1D	111.75	29	March 27, 2015
1E	111.75	29	January 20, 2016
1F	32.5	+5 or -5	March 10, 2016
1G	129.5	+5 or -5	April 28, 2016

III. IRNSS GROUND SEGMENT

The ground segment of the IRNSS constellation would consist of a Master Control Centre (MCC) (stationed at Karnataka) and ground stations to track and control the satellites. The MCC would predict the position of all satellites, integrity, make necessary ionospheric and clock corrections and run the navigation software. The navigation software has been indigenously developed at ISRO Satellite Centre. The software modules interface with various subsystems of the ground segment and generate navigation parameters required for broadcast from the spacecraft[5].

IRNSS Ground Segment Elements:

- IRSCF(IRNSS Satellite Control Facility)
- IRTTC(IRNSS TTC and Land Uplink Stations)
- IRSCC(IRNSS Satellite Control Station)
- IRIMS(IRNSS Range and Integrity Monitoring Stations)
- IRNCF(IRNSS Navigation Control Facility)
- IRDCN(IRNSS Data communication Network)

IRNSS ground segment architecture is shown in Figure 1.

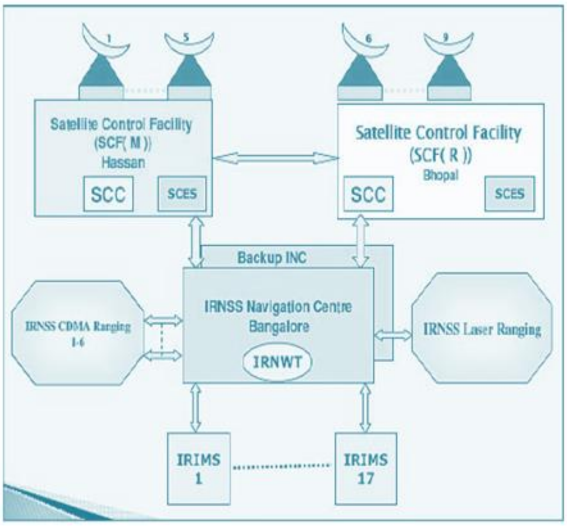

Figure 1 Ground segment architecture

IRNSS will have a network of 21 ranging stations geographically distributed primarily across India. They provide data for the orbit determination of IRNSS satellites and monitoring of the navigation signals. The data from the ranging/monitoring stations is sent to the data processing facility at INC where it is processed to generate the navigation messages. The navigation messages are then transmitted from INC to the IRNSS satellites through the spacecraft control facility at Hassan/Bhopal. The state of the art data processing and storage facilities at INC enable swift processing of data and support its systematic storage[3].

Seventeen IRIMS sites will be distributed across the country for orbit determination and ionospheric modeling. Four ranging stations, separated by wide and long baselines, will provide two-way CDMA (Code Division Multiple Access) ranging. The IRNSS timing center will consist of highly stable clocks. The navigation center will receive all this data through communication links, then process and transmit the information to the satellites[1].

IV. IRNSS USER SEGMENT

The user segment consists of IRNSS receivers operating in: · Single frequency (L5 at 1176.45 MHz or S-band at 2492.028 MHz) · Dual frequency (L5 and S-band) The single frequency and dual frequency receivers shall receive both SPS (Special Positioning System), which is provided to all users, and RS (Restricted/Authorized Service) signals, which is an encrypted service provided only to authorized users[6].

The IRNSS user receiver calculates its position using the timing information embedded in the navigation signal, transmitted from the IRNSS satellites. The timing information being broadcast in the navigation signal is derived from the atomic clock onboard the IRNSS satellite[7].

The IRNWT (IRNSS Network Time) is determined from a clock ensemble composed of the cesium and hydrogen maser atomic clocks at the INC (Indian Navigation Centre) ground stations. As with UTC, IRNWT is also a weighted mean average time, but with two substantial differences. IRNWT will be made available in real time and is a continuous time without leap seconds. The IRNSS satellites carry a rubidium atomic frequency standard onboard. At INC through navigation software, these onboard clocks are monitored and controlled. The deviation between each of the satellite and IRNWT is modeled with a quadratic function of time, and the parameters of this model are calculated and transmitted as a part of the IRNSS broadcast navigation messages[4].

IRNSS Services:

The satellite system will provide two basic services

1. Standard Positioning Service (SPS):
   It is use for civil users.
2. Restricted Service (RS):
   Restricted service with encryption for special authorized users like the army forces.

V. IRNSS APPLICATIONS

- IRNSS provides fairly good accuracy and the whole constellation is seen all the time. There are plans to send integrity and ionospheric correction messages to the user.
- A variety of applications taking the benefit of above will be catered by IRNSS.
- In view of the independent nature of the constellation it is planned to cater to specialized users.
- Surveying and town/construction planning: precision pinpoint of geographical location can be used to set markers.
- Disaster management: rescue operation can be aided by the IRNSS. Also techniques are available to detect fault movement and land deformation.
- Agriculture: Precision agriculture taken into account the soil type, weather and crop and helps in increasing the output.
- Vehicle tracking and fleet management.

VI. CONCLUSION

The objective of the IRNSS is to implement an independent and indigenous regional space born navigation system for national applications. The IRNSS design requirements call for a position accuracy of < 20 m throughout India and within the region of coverage extending about 1500 km beyond. The system is expected to provide accurate real-time position, velocity and time observables for users on a variety of platforms with 24 hour x 7 day service availability under all weather conditions.

REFERENCES

[1] Byroju Saikiran, Vippula Vikram"IRNSS architecture and applications" , Vol. No.1, Sept-Dec 2013.

[2] Parimal Majihiya, J.K.Hota."Indian Regional Navigational System "

[3] Wg Cdr Kiran Krishnan Nair, " The indian regional navigation satellite system 1e: another keystone for make in india ", 21 Jan, 2016.

[4] Analysis of IRNSS over Indian Subcontinent by Vyasaraj Guru Rao1, Gerard Lachapelle1, Vijay Kumar S B2 ION ITM 2011, Session B5, San Diego, CA, 24-26 January 2011.

[5] Leick, A. (1995), GPS Satellite Surveying Second Edition, John Wiley & Sons, Inc.

[6] Bhaskaranarayana, A. (July 15th 2008) Indian IRNSS &GAGAN, Presentation to COSPAR Meeting, Montreal.

[7] G. X. Gao (2007), "DME/TACAN Interference and its Mitigation in L5/E5 Bands" in ION Institute of Navigation Global Navigation Satellite Systems, Conference, 2007.

[8] IRNSS-Satellite Mission-eo Portal Directory –Earth online directory.eoportal.org.

[9] www.inside Gnss.com