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History of Indian National Satellite Programme (INSAT)

Dr. T. ASOKAN[a]

[a]*Associate Professor, Department of History, Bharathidasan University, Tiruchirappalli- 620 024. Email id:* asokan.t@bdu.ac.in

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Abstract

INSAT stands for Indian National Satellite. INSAT system has the first multipurpose Indian satellite launched into geosynchronous orbit in 1980s. INSAT was the most advanced non-military satellite ever launched anywhere. Though the INSAT programme was executed in 1980s, the core idea was conceived by Indian scientist Homi Jahangir Bhaba and Vikram Sarabhai much earlier. In the early days particularly in the 1960s Bhaba and his successor Sarabhai faced several difficulties. Homi Bhaba had begun scouting for a satellite for India as early as 1965. He was unwilling to purchase readymade satellite, because India would not learn anything about making satellites. Instead, he sought technical assistance in building a satellite and met Arnold Frutkin several times to discuss US assistance. Frutkin was the NASA's pragmatic director of international programmes. He, however, found it would not benefit NASA if Indians are to build satellites. Vikram Sarabhai encountered even greater obstacles by way of not only more resistance to technology transfer, but also systematic pressures from the United Sates and its allies, especially from Britain, aimed at discouraging India's space program. Hesitantly, Sarabhai initiated the plan for an Indian national satellite to be called INSAT, in 1967.

Keywords: INSAT, NASA, International Programme

1. Introduction

Systematic thinking about INSAT began in mid-1968. A seventeen-member committee of engineers and scientists based at the Space Science and Technology Centre in Thumba conducted a preliminary feasibility study. Ironically, their preliminary report did not consider the development of the payload or satellite. They concluded that the first satellite had to be built in collaboration with other countries. They had not anticipated Western resistance to the transfer of space technology.

In the meantime, in terms of space-based communications, the Satellite Instructional Television Experiment (SITE), signed with NASA in September of 1969, was the world's first large-scale TV broadcasting experiment. The SITE project, with the reposition and use for one year of NASA's ATS-6 satellite, spearheaded a revolution in broadcasting. At the time, about 2400 villages spread across India could access TV broadcast either through direct reception or by All India Radio –TV transmitters linked via an earth station facility. Based on the initiative of Sarabhai, a joint study was conducted in the 1970s with the Massachusetts Institute of Technology for the design of the INSAT system. A group of scientists including Pramod Kale was involved in SITE programme. This laid the groundwork for future INSATs. Subsequently Kale became the project manager of INSAT programme. In the same year, Vikram Sarabhai announced plans for an Indian national satellite at the Bombay National Electronics conference on Electronics.

However, the sudden demise of Vikram Sarabhai in 1971 put the future of Indian space programme in the turmoil. The Indian government announced Dr. Satish Dhawan as Sarabhai's successor. However, it was not until 1977, Dhawan had received any favourable response relating to the INSAT programme.

2. First Generation of INSAT Series

INSAT 1A was a box shaped body weighing 1152 kg and was lofted into geosynchronous orbit by a Delta 3910 on 10 April 1982 from Cape Canaveral, Florida, U.S.A. INSAT-2 was built with twelve television transponders, two T.V direct broadcasting antennas and a very high resolution radiometer image that pictures the Earth every 30 minutes. But in a few months it failed in orbit and hence this satellite was abandoned. In the next year ISRO launched INSAT-1B on 30th August 1983, by Challenger shuttle from the same launchpad. Unlike INSAT-1A, INSAT-1B completed its full time and functioned until 1993. INSAT-1B provided television coverage to more than 70 percent of India's population. INSAT-1C was the third satellite of this series and launched in 1988. Shortly after its launch, INSAT-1C experienced a shot-circuit in one of its power systems and had to be content with about half of its capacity for 16 months, when it lost its Earth lock following a system failure. INSAT-1D was scheduled for launch in June 1989 to serve the transition period between the INSAT-1 and 2 series. INSAT-1D could be launched only in June 1990, following an accident in the launchpad which damaged the spacecraft. INSAT-1D sent weather images data and helped television relay. All the four satellites of the first generation of INSAT were launched by foreign launches during the period 1982-90. Except INSAT 1A and 1C, INSAT-IB and 1D were in active service for eight years or more compared with the expected life of only seven years.

3. Second Generation of INSAT Series

The second generation of the INSAT programme was approved in April 1985, which costed Rs. 20 billion (€ 425 million). The basic aim of INSAT-2 generation programme was to indigenously develop the satellite with the help of foreign launcher into geosynchronous orbit. The new satellites were 50 percent heavier than INSAT-1, carried eighteen transponders, and a beacon for an international maritime distress system. Each satellite weighed 1906 kg at launch, 911 kg once all its propellant had been depleted. Europe's Ariane was chosen as the launcher for the series. The INSAT satellites were built in India itself, with some limited assistance from abroad. Britain was involved in the INSAT-2 design, British Aerospace supplying titanium-made helium pressurisation tanks.

4. INSAT -2A

INSAT-2A was launched by Ariane 4 on its fifty-first flight, V51, on 10 July 1992 . INSAT-2A, though planned as a test satellite, has been put into operational service within a month after its launch and is providing regional TV distribution services since August 1992. Like INSAT -2A, the second satellite of this series was also indigenously built in India. It was launched on 23 July 1993, also by the Ariane launch vehicle. It is located at 93.5º east longitude. INSAT 2B weighed 1906 kg and the launch and successful commissioning of INSAT -2B has greatly enlarged and improved the INSAT space segment capabilities. The INSAT-2 satellites were designed and built in India, but they were launched by the European launcher, Ariane, during 1992–9. INSAT-2A and INSAT-2B were introduced as test satellites but due to their satisfactory performance they were pressed into operational service. These two satellites provided services for more than seven year. INSAT-2E is the heaviest in the INSAT-2 series and built with many technical innovations.

5. Other INSAT 2 Series

INSAT-2C, the third in the INSAT-2 series of satellites, designed and built by ISRO, was launched by Ariane rocket on 7 December 1995. The rocket injected INSAT-2C, 27 minutes after the lift-off into a geosynchronous transfer orbit (GTO). Two years later fourth satellite of the second INSAT generation INSAT-2D was launched by Ariane from Kourou on 4 June 1997. However, the fourth satellite, INSAT-2D, owing to problems with electrical supply lost its ability to lock on the earth and was lost . After the

failure of INSAT-2D, India purchased Arabsat-1C from an Arab consortium for Rs 1.77 billion in 1998. Subsequently it was renamed as INSAT-2DT and functioned in the similar veins of INSAT-2D. INSAT-26 the last satellite of the second generation was launched on 2 April 1999 by Ariane on its 117th mission. It weighed 2.55 tonnes and was positioned 83º over the Indian Ocean. For the first time on INSAT, a radiometer for assessing of water vapour was also included. This radiometer had 2-metre resolution in the visible land and 8-metre in infrared.

The configuration of the INSAT-2 series was based on four considerations: one, the need for continuity of service; two, increased capacity for telecommunications and broadcasting; three, improved resolution of meteorological payloads; and, four, introduction of new services such as mobile phone and improved facilities for business communications.

6. Third Generation of INSAT series

Third generation of INSAT series began with the launching of INSAT-3B. Originally the third generation consisted of five satellites but launched only four satellites except INSAT-3D. INSAT-3B was launched in 22 March 2000 by Ariane-5 vehicle of 128th flight of Arianespace from Kourou. It is a communication satellite launched of INSAT-3A and it has twelve extended C-band transponders, urgently needed to meet the demands following the failure of INSAT-2D. It has also a Ku-band payload providing three channels. For the first time, these frequencies will be used for VSAT services with smaller ground satellites. The satellite is primarily intended for business, developmental and mobile communication. The satellite is located at 83º-east longitude along with INSAT-2E. INSAT-3C, the second satellite of the third generation, was launched by an Ariane launch vehicle of Arianespace from Kourou, French Guyana on 24 January 2002 . INSAT-3C carries twenty-four C-band transponders, six extended C-band transponders, two S-band transponders and mobile satellite service transponder operating in S-band up-link and C-band down link. INSAT-3C augments the INSAT capacity for communication and broadcasting, besides providing continuity of the services of INSAT-2C . INSAT-3A, the third satellite of the third generation, was successfully launched on 10 April 2003 by Ariane-5 . The 160th flight of Ariane, carrying ISRO's heaviest satellite sofar, the 2950 kg INSAT 3A, lifted off at 4.22 IST from Kourou, French Guyana. About 30 minutes after the lift off it was injected into at 93.5º East longitude. INSAT-3A could augment the INSAT capacity for telecommunication and broadcasting, besides providing meteorological services along with INSAT-2E and KALPANA-1. INSAT-3E the third generation's fourth satellite was launched on 28 September 2003, by the 162nd flight of Ariane weighed 2750 kg. It was lifted off at 4.44 am from Kourou, French Guyana, into a GTO at a 55º East longitude.

7. The Fourth Generation of INSATs series

The fourth generation of the INSAT series began with the launch of INSAT-4A in 2005. This series consisted of seven satellites and three were launched so far. India's latest satellite INSAT-4A weighed 3086 kg was successfully launched from Kourou in French Guyana on 22 December 2005, by the Ariane-5 launch vehicle in to GTO. It has given further boost to the INSAT system capacity, especially for Direct To Home (DTH) services. INSAT-4A carries twelve high Ku-band transponders and twelve C-band transponders for television services. On the next year (July 10 2006) INSAT-4C was launched from SHAR in the vehicle of GSLV. This was the first attempt of an INSAT satellite launched from the Indian soil with the help of indigenously developed launching vehicle (GSLV). However, about 55 seconds into the flight GSLV-Fo2 started deviating significantly from its nominal flight path resulting in the vehicle breaking up at 62 seconds after lift-off. The debris fell into Bay of Bengal.

The most recent satellite INSAT-4B was launched on 12 March 2007 at 3.33 am by Arianespace's Ariane-5 vehicle from the Kourou Island in French Guiana . It was lifted off along with co-passenger Skynet-5A, a military communications satellite of the United Kingdom. The 3025 kg, satellite could boost the DTH and other communications services. G. Madhavan Nair, Chairman of ISRO said "It is a unique opportunity to have an additional twenty-four transponders to our fleet of 175

transponders [in other INSATs] serving the national developmental programmes" . ISRO paid around Rs. 210 crore to Ariane space for launching the satellite, which cost Rs. 215 crore to build.

INSAT system was established in 1982 and it has now become one of the largest domestic communication satellite systems in the Asia Pacific region with nine satellites in operation – INSAT-2E, INSAT-3A, INSAT-3B, INSAT-3C, INSAT-3E, GSAT-2, EDUSAT, INSAT-4A besides INSAT-4B – providing 175 transponders in various frequency bands like S-band, C-band, extended C-band and Ku-band for television, telecommunications, VSAT, tele-education and telemedicine as well as instruments for meteorological services.

8. Conclusion

Besides working on the INSAT programme, ISRO concentrated on a separate satellite for meteorological purpose. As the result METSAT was designed and fabricated by ISRO exclusively for meteorological purpose. On 12 September 2002, METSAT, later renamed as KALPANA-1, was launched by PSLV-C4, from Sriharikota into GTO. The 1060 kg METSAT was unique in two different aspects. One, it was the first ever meteorological satellite launched by ISRO. Two, PSLV for the first time was launching a satellite into GTO. The early missions launched its satellites only in polar orbit. Launching a satellite into GTO proved that PSLV is capable of launching the satellite into GTO. METSAT carries a Very High Resolution Radiometer (VHRR) capable of imaging the Earth in the visible, thermal infrared and water vapour bands. It also carries a Data Relay Transponder (DRT) for collecting data from unattended Meteorological platforms. METSAT relay data sent by these platforms to the Meteorological Data Utilization Centre at New Delhi. Such platforms have been installed all over the country. METSAT was injected into orbit with a perigee (nearest point to Earth) of 218 kilometre and an apogee (far the point to Earth) of 34,700 kilometre with an orbital inclination of 17.7º, with respect to the equator. The first pictures received at MCF, Hassan, indicate excellent functioning of VHRR. After six months on 5 Feb 2003 the METSAT was named after renamed Kalpana Chawla, KALPANA 1. Cherishing the memory of, the first Indian-born American astronaut killed in the US space shuttle Columbia disaster on 1 February 2003.

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