



Company Updates

Consequent upon retirement on superannuation of Dr. V S Hegde, Shri Rakesh Sasibhushan has taken over as CMD, ANTRIX with effect from 1st June 2016.

Consequent upon transfer of Shri V Raghu Venkataraman, Smt. T.S. Shoba, Director (T&S), ANTRIX has taken over as Executive Director (Operations) with effect from 12th September 2016, in addition to her present responsibilities as Director (T&S).

Shri A. Arunachalam has taken over as Director (RSDS) with effect from 2nd August 2016. Shri K. Parthasarathy has been appointed as Director (IT) with effect from 1st October 2016.

Changes in ANTRIX Board

The Board of Directors of ANTRIX consists of reputed professionals with long-standing experience in space programme, administration, academia and industry verticals. The present composition of the Board of Directors of the company is as under:

Functional Director (full-time)

Shri Rakesh Sasibhushan, CMD

Government Nominee Directors

Shri S. Kumaraswamy, Joint Secretary, DOS

Shri C.M. Sane, Joint Secretary (Finance), DOS

ISRO Nominee Directors

Dr. Y.V.N. Krishnamurthy, Director, National Remote Sensing Centre (NRSC)

Dr. M. Annadurai, Director, ISRO Satellite Centre

Dr. P.G. Diwakar, Scientific Secretary, ISRO

Independent Director

Prof. S.K. Jain, Director, IIT, Gandhinagar

CESSATIONS

Dr. V.S. Hegde, CMD of ANTRIX ceased to be a Director on the ANTRIX Board, consequent upon his retirement on superannuation.

From the CMD's Desk

Dear Reader

Though Indian Space programme has been more or less insulated from commercial pressures, it is time to take note of the developing commercial scenario which will help us to plan our activities to better serve the country in future. Dissemination of commercial information related to space business, especially in the Indian context, is essential for helping our colleagues to plan their activities.

Towards this ANTRIX is bringing out a quarterly news digest, commencing with this issue. Hope readers will find it informative and helpful.

We are living in a world increasingly driven by technology, and space assets are becoming a necessity for providing state-of-the-art services. Many businesses like DTH & Broadband are poised for a huge growth, both in terms of technology and volume. Remote sensing area also is seeing technological breakthroughs and companies are working to provide near real time actionable products. Indian scenario is also not very different. Though Indian Satellite services revenues are estimated at less than 5% of the global scenario, it is growing at a faster pace which is evident from the data on subscription base & financials. The proliferation of mobile devices are redefining the way people use data and this is going to have a significant say in the way applications are developed. Several start-ups have come up in the field of satellite manufacturing and services, which is promising. More and more application areas will be revealed as technology grows enabling space based services to reach the common man and make his life easier and more efficient.

In short, as far as space is concerned, sky is not the limit.



Rakesh Sasibhushan
Chairman cum Managing Director

Shri A. Vijay Anand, Government Director ceased to be a Director on the ANTRIX Board, consequent upon his retirement on superannuation. Dr. V.K. Dadhwal, ISRO Nominee Director ceased to be a Director on the ANTRIX Board, consequent upon his transfer from NRSC to IIST. Shri V. Raghu Venkataraman, Executive Director of the company ceased to be a Director on the ANTRIX Board, consequent upon his transfer to NRSC. Shri Arun Balakrishnan, Shri Y.S. Mayya and Prof. Devang Khakar, Independent Directors ceased to be Directors on the ANTRIX Board, consequent to ending of their term. ANTRIX places on record its appreciation of the valuable services rendered by them as Directors on the Board of ANTRIX.



Events

Bengaluru Space Expo 2016

Antrix Corporation Limited and Indian Space Research Organisation (ISRO) in coordination with Confederation of Indian Industry (CII) organised the fifth edition of Bengaluru Space Expo (BSX) 2016 and a concurrent International Conference on space business, “World Space Biz 2016” during September 1 – 3, 2016 at Bengaluru International Exhibition Centre (BIEC), Bengaluru. Large number of delegates from industry, from India and abroad, ISRO and Foreign space agencies had participated in the event. Delegates and visitors from 15 countries including USA, Japan, France, Australia, Switzerland, Taiwan, Russia and Ukraine attended BSX 2016.

NavIC applications and Enabling Technologies to Eco System for Space Start Ups in India. The conference was well attended with active participation from the audience.

More than 70 exhibitors had their stalls at BSX 2016 including Airbus, JAXA, ECIL, Centum, Ananth Technologies, Data Patterns, Astra Microwave Products, Viasat, CNES, Swissnex, Asiasat, Measat etc. A large number of visitors from industry and academia apart from general public visited the exhibition.

Two new initiatives, a B2B meeting on “Small Satellites Development and Solar Panels” and “Satcom Services User Consultations” were organised during BSX 2016. The B2B sessions and user consultations with INSAT/GSAT Users of space segment capacity had a combined participation of more than 200 delegates from industry. Both these interactive sessions were well appreciated, with representatives actively engaging in discussions on the way forward and future plans for a mutually inclusive growth.

The trade exhibition conducted alongside the Expo saw participation by various space industries from India and abroad as well as space agencies. Overall, the Expo conveyed the technology scenarios, challenges and opportunities in Space Business and was well received by the participants.



Opening Ceremony of World Space-biz - CII President addressing the gathering

There were seven sessions during the conference which focussed on topics like Turnkey Satellite System Realisation, Tapping New Market for Satellite Sub-Systems, Launch Vehicle Productionisation through Industry, Connecting the Unconnected: Unlocking potential through High Throughput Satellites (HTS), NavIC and GAGAN: The Opportunities Ahead, GIS and Navigation: Enabling and Trends, Space Start Ups: The New Face of Industry. In addition, there were highlight addresses and lightning talks on futuristic communication by eminent industry professionals. The conference sessions were very fruitful with interactive discussions on many key topics of relevance to space. These topics of current interest ranged from Internet from Space, Connecting the Unconnected: HTS perspective, Marine Navigation: Find your Road in Sea,

Transponder services

Through INSAT/GSAT fleet of satellites, ANTRIX, the commercial front end of ISRO, provides satellite based communication services for a multitude of applications like TV broadcasting (Television), DTH (Direct to Home), DSNG (Digital Satellite News Gathering) and VSAT (Very Small Aperture Terminal) services. The satellite based services are enabled through a large number of transponders from INSAT/ GSAT fleet in C, Ext C and Ku bands and complemented through satellites from foreign satellite operators. ANTRIX is servicing more than 100 users, across a wide cross section of Private, Public and Government Users.

Recent Agreements

Automatic Identification System Data feed

During December 2016, Antrix Corporation Limited executed a service contract with M/s exactEarth Ltd., Canada for the supply of global space based Automatic Identification System (AIS) Data to the Indian users. With more than 7,500 km of coastline and significant off-shore resources, keeping track of maritime activity is paramount to maintaining India's security and economic activity. M/s exactEarth's Satellite-AIS technology will help the Indian Users to identify, detect and track vessels of interest and to secure the country's maritime borders. Through M/s exactEarth, ANTRIX shall provide end to end turnkey solution which includes AIS raw data feed from space vehicles and associated systems for viewing and monitoring of Space based AIS data feed. The agreement is based on a competitive bid and has resulted in the first AIS data services agreement for the Indian Users. This contract is valid for a period of three years, renewable annually.



Ms. TS Shoba, Executive Director (Operations), ANTRIX handing over the agreement to Mr. David Martin, Vice President, Global Sales & Marketing, M/s exactEarth

Data reception & processing facilities for Oceansat-2 at University of Dundee

The University of Dundee has entered into an agreement with ANTRIX to receive data from Oceansat-2 for use in environmental research. The Dundee Satellite Receiving Station (DSRS) is one of the main facilities in the UK acquiring data from space and will now directly receive data from the ISRO-built Oceansat-2 Earth Observation (EO) satellite. The primary purpose of this collaboration is to collect and distribute these data to UK environmental scientists to support marine science research. More broadly, DSRS data are also used in areas such as meteorology, vegetation, snow/ice, volcano and earthquake research.

Historically, data received at Dundee have been provided by US and European satellites. The agreement with ANTRIX provides an opportunity to broaden the range of satellite data available to users at UK and develop a new partnership with ISRO. DSRS will be the second ground station outside India to receive Oceansat-2 data directly.

URL: <http://www.dundee.ac.uk/scienceengineering/news/2016/article/university-to-provide-data-reception-and-processing-facilities-for-indian-satellite-.php>

PSLV Launch Services for TeamIndus Spacecraft

ANTRIX has entered into a Launch Service Agreement with M/s Axiom Research Labs Private Limited, an aerospace start-up based in Bengaluru, for providing Polar Satellite Launch Vehicle (PSLV-XL) launch services for the TeamIndus Spacecraft. The scope of PSLV Launch Services Agreement is limited to launching of TeamIndus spacecraft on-board PSLV-XL. Launch of TeamIndus Spacecraft is envisaged during fourth quarter of 2017.



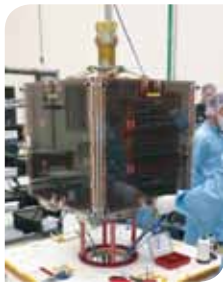

Launch Services



PSLV-C35 with 5 International Customer Satellites

India's Polar Satellite Launch Vehicle, in its thirty-seventh flight (PSLV-C35), that took place on 26th September 2016, from SDSC, SHAR launched SCATSAT-1 for weather related studies, two Indian Student Satellites (PRATHAM, PISAT) and five International Customer Satellites namely ALSAT-1B, ALSAT-2B, ALSAT-1N, Pathfinder-1 and NLS-19.

PSLV-C35 mission was very significant as it was for the first time, a primary satellite and co-passenger satellites were placed in two different orbits. This was made possible by re-starting the upper stage of PSLV (PS4 liquid stage). All the customer satellites have been successfully placed in their designated orbits.

Details on the international customer satellites from Algeria, USA and Canada :

- i) ALSAT-2B Micro satellite: It's a high resolution remote sensing satellite (weighing 117 kg) with panchromatic and multi spectral imaging capability. It is a follow-on satellite to ALSAT-2A which was launched earlier on-board PSLV-C15 during 2010. The satellite belongs to Algerian Space Agency (ASAL), Algeria.
 
- ii) ALSAT-1B Micro satellite: It's a earth observation satellite (weighing 103 kg) based on the SSTL-100 platform. The main objectives of the satellite include monitoring of agriculture, environment and disasters. The satellite belongs to Algerian Space Agency (ASAL), Algeria.
 
- iii) ALSAT-1N Nano satellite: It's a technology demonstrator nano satellite (weighing 7 kg) built by Algerian students. The satellite belongs to Algerian Space Agency (ASAL), Algeria.
 

- iv) Pathfinder-1 Micro satellite: It is a high resolution earth imaging micro satellite (weighing 44 kg). The satellite is built by Spaceflight Industries, USA.
 
- v) NLS-19 Nano satellite: It is a technology demonstration nano satellite weighing 8 kg. The main objective of NLS-19 is to perform experiments related to reducing the space debris. The satellite is built by Space Flight Laboratories (SFL), UTIAS, Canada.
 

As on date, 79 international customer satellites from 21 countries have been successfully launched on-board PSLV, under commercial arrangements between ANTRIX and International customers.



PSLV-C35 lift off

Mission Support Services

ANTRIX provided Transfer Orbit Support Services (TOSS) for NBN Co-1B satellite from MCF Hassan to M/s Intelsat, USA during October 2016.

ANTRIX provided TTC support for a prestigious satellite's orbital relocation to M/s Swedish Space Corporation from ISTRAC during August-November 2016.

ANTRIX provided Transfer Orbit Support Services (TOSS) for EchoStar-19 satellite from MCF, Hassan for M/s Intelsat, USA during December 2016.

Customer Story

GAF AG looks back at 20 years of handling Indian Earth Observation (EO) satellite data in Neustrelitz



Team of GAF branch office Neustrelitz in front of one of DLR's 7.3 m X-band antennas. The site has 4 antennas of that size or larger

This year marks the 20th anniversary of the German Company GAF AG signing an agreement with ANTRIX to receive and distribute Indian EO satellite data on an exclusive basis for European customers. In the field of EO data distribution, GAF can be regarded as only continuously active international partner of ANTRIX for the last 20 years. So far, the partnership includes six satellite missions, and thanks to both the ambitious Indian EO programme and the common understanding reached between ANTRIX and GAF, the partnership is set to be expanded further. During the last 20 years, GAF has acquired and archived more than 1.4 million image scenes covering almost 40 billion square kilometres with medium, high or very-high resolution

raw IRS optical satellite data. GAF has provided data products and related services to, for example, the Joint Research Center (JRC) of the European Commission and the European Space Agency (ESA) for the Copernicus programme. It has also developed the Euro-Maps 3D Digital Surface Model (DSM) product with 5 m post spacing.

“The access to Indian data is a core element in GAF’s and the Telespazio Group’s policy of securing preferential access to EO data sources that enable the development of innovative value added products, while still acting as a truly independent data broker for all the important data providers in the market,” says Peter Volk, CEO of GAF.

URL: <https://www.gaf.de/content/gaf-ag-looks-back-20-years-handling-indian-earth-observation-satellite-data-neustrelitz>

Euro-Maps 3D - a Transnational, High-Resolution Digital Surface Model using Cartosat-1 data

Euro-Maps 3D is a homogeneous 5 m spaced Digital Surface Model (DSM) semi-automatically derived by GAF AG from 2.5 m in-flight stereo data provided by the Indian Cartosat-1 satellite. This product has been developed in close co-operation with the Remote Sensing Technology Institute (IMF) of the German Aerospace Center (DLR) and with the outstanding support of ISRO (ANTRIX & NRSC) within a very good and longstanding partnership. As the Cartosat-1 mission is in orbit since 2005 and still operating, there is a very good and steadily improving archive data situation in many parts of the world. In the last 7 years, a multitude of DSMs for very large areas (~2.0 Million sq.km) has been produced for commercial applications with the specialized and highly automated multi-source capable production line of GAF. The DSM perfectly fits the demand for larger regions and transnational areas. The very detailed and accurate representation of the surface is achieved by using a sophisticated and well adapted algorithm implemented on the basis of the Semi-Global Matching approach. In addition, the final product includes detailed flanking information, consisting of several pixel-based quality and traceability layers also including an ortho layer. The product provides a vertical accuracy of 5-10 m LE90 and a horizontal accuracy of 5-10 m CE90.

URL: <https://www.gaf.de/content/elevation-bathymetry-3d-data>



Special Feature

High Throughput satellites: The dawn of a new era in Satellite Communication Technology

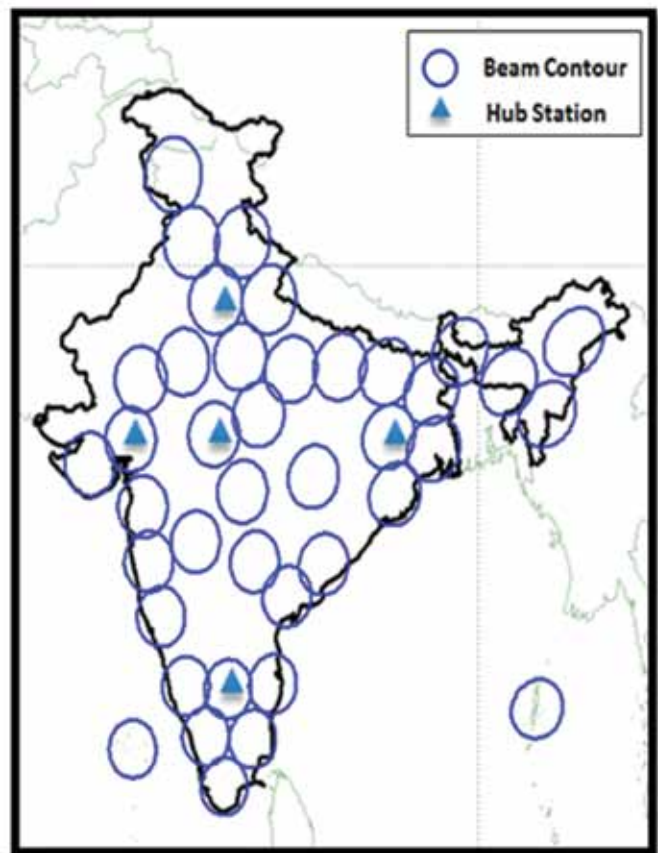
It all began with Arthur C. Clarke's article published in October 1945 issue of *Wireless World*, which had theoretically proposed the feasibility of establishing a communication satellite in a geostationary orbit. He discussed how a GEO satellite would look static to observer on Earth within the satellite coverage and suggested that three satellites would provide uninterrupted communication services across the globe. This marked the beginning of FSS era and scientists started to look seriously at such possibility and the revolution it was likely to bring along with it.

High throughput satellite is a new generation satellite that provides many times the throughput as compared to conventional fixed, broadcast and mobile satellites (FSS, BSS and MSS) for the same amount of allocated frequency on orbit. This has become a reality due to one fundamental difference in the architecture of an HTS system - use of multiple 'spot beams' to cover a desired service area, rather than a wide beam. This brings a two-fold benefit:

- a) Higher Tx/Rx gain due of its higher directivity and thus higher gain. A narrow spot beam means increased power and smaller user terminals, thus achieving a higher rate of data transmission per unit of orbital spectrum.
- b) As the desired service area is covered by multiple spot beams - resulting into several beams can reuse the same frequency band and polarization and thus boost satellite capacity for a given amount of frequency band allocated to the system. This process is frequency reuse.

HTS take advantage of frequency reuse and multiple spot beams to increase throughput and reduce the cost per bit delivered, regardless of spectrum choice.

Various HTS systems have been placed into orbit and already supply many Gbps of capacity since the 1990s and deployment was done in Ku and Ka spectrum bands. Over the years, Ka band has emerged as the most preferred option



as it enables narrower beams, thus higher satellite antenna gain, improved link budget (thus possibility to operate with a higher level of interference) and therefore higher throughputs. It facilitates smaller user terminal antenna, higher spectral efficiency, more cost-effective in terms of Mbit/s and more reuse of frequency. Rain attenuation and other atmospheric perturbations can be mitigated using Fade Mitigation Techniques.

This new bird in sky shall address the growth in demand for broadband connectivity, connect the unconnected and shall expand addressable geographic markets by delivering broadband everywhere. ISRO's first Ku-Ka band high throughput satellite - GSAT 11 has 32 user beams in

Ku band and 8 hub beams in Ka band is planned for launch in 2017. The satellite with mission life of 15 years shall provide throughput of 10 GBPS.

The Ka-band frequencies have multiple advantages over the Ku-band for high-capacity systems. Satellite communications

being the most technically advanced industry, leverages on the latest technology to continually increase the capabilities, capacity and performance delivered to its customers, wherever and whenever they need it. After all, Customer is the King!!!

Resourcesat-2A: Satellite with a Unique 3-Tier Imaging System

ISRO's Polar Satellite Launch Vehicle, in its thirty eighth flight (PSLV-C36), successfully launched the 1235 kg RESOURCESAT-2A Satellite on December 07, 2016 from Satish Dhawan Space Centre (SDSC-SHAR), Sriharikota. This is the thirty seventh consecutive successful mission of PSLV.

Resourcesat-2A is primarily intended for resource monitoring and a follow-on mission to Resourcesat-1 and Resourcesat-2 and it has a unique 3-Tier imaging system. The payload system comprises of three Optical remote sensing cameras, namely high resolution Linear Imaging Self Scanner (LISS-4) camera, Medium resolution LISS-III camera and Advanced Wide Field Sensor (AWiFS) camera. The specifications of these payloads are described hereunder:

Payload	LISS-IV	LISS-III	AWiFS
Spatial Resolution (m)	5.8	23.5	56
Swath (Km)	70	141	740
Spectral Bands (Microns)	Green : 0.52 – 0.59	Green : 0.52 – 0.59	Green : 0.52 – 0.59
	Red : 0.62 – 0.68	Red : 0.62 – 0.68	Red : 0.62 – 0.68
	NIR : 0.77 – 0.86	NIR : 0.77 – 0.86	NIR : 0.77 – 0.86
		SWIR : 1.55 – 1.70	SWIR : 1.55 – 1.70
Quantization (bits)	10	10	12 (VNIR); 14 (SWIR)
Revisit (days)	5	24	5

The data from this satellite will continue to address the needs of Agriculture, Soils, Bio-Resources and Environment, Water Resources, Geology and Mineral resources, Urban planning and Infrastructure development, as well as Rural Development. Interested International community may write to ANTRIX to establish/ augment their Ground Station to receive Resourcesat-2A data. ANTRIX also offers Remote Sensing imagery from other IRS satellites namely Cartosat-1, Cartosat-2, RISAT-1 and Resourcesat-2 as well as archived data from earlier IRS missions.

Annual General Meeting

The Twenty Fourth Annual General Meeting of ANTRIX was held on Friday, 23rd September 2016. Secretary, DOS and Additional Secretary, DOS, the shareholders of the Company, attended the meeting along with other Board of Directors of ANTRIX. A dividend of 30% on the post-tax profits amounting to ₹63 crores for the year 2015-16 was declared during the meeting.



CSR Activities



Shri Rakesh S, CMD, ANTRIX addressing the gathering during the Brahmasandra village adoption. Hon'ble Minister Sri T.B. Jayachandra is to his right.



Shri Rakesh S, CMD, ANTRIX inaugurating the sanitation facility at Dr.H N National High school, Gauribidanur, Chikkaballapur.

As part of its Corporate Social Responsibility (CSR) efforts, ANTRIX has adopted Brahmasandra Village, Sira Taluk, Tumkur district through Bharatiya Agro industries Foundation (BAIF), an NGO, for integrated and holistic development towards making it a model

village. Shri T.B. Jayachandra, the Honourable Minister for Law, Justice and Human Rights, Government of Karnataka and Shri Rakesh S, CMD of ANTRIX inaugurated the program on 8th November 2016 at the village.



Shri P. Kunhikrishnan, Director, SDSC, SHAR interacting with the officials and beneficiaries during the assessment camp.

ANTRIX under Swachh Vidyalaya Abhiyaan completed building of sanitation facility in 33 Government Schools located in Chikkaballapur District, Karnataka, through M/s. Sulabh International Social Service Organisation involving District authorities, Government of Karnataka. The Facilities were handed over to respective Principals/Head masters on 1st December 2016.

An assessment Camp was organized at Sulurpeta, Nellore District, Andhra Pradesh by ALIMCO with the support of District Authorities, SDSC SHAR, and ANTRIX on 23 – 24 November 2016, to identify persons with orthopedically, visually and hearing disabilities, for distribution of Appliances under CSR.

ANTRIX has been conferred “Outstanding CSR Project Award – 2016” by Delhi Management Association (DMA) and Indian Institute of Corporate Affairs.

Editorial Team: Arunachalam A, Rajiv R, Sonali Nanda, Sajith R C

For feedback and/or details, please write to us at mail@antrix.gov.in

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