

Advances in Satellite Technologies- ISRO Initiatives

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Migration from Broadcast/VSAT centric to Data-centric Payload design - HTS

- Multi-beam coverage in Ku and Ka-band ensuring Frequency Reuse and enhanced Payload performance .
- Increased Payload Hardware – need for miniaturization
- Addressing new applications like Mobile backhauling, In-Flight Connectivity etc.
- Special focus on unserved/underserved regions within India

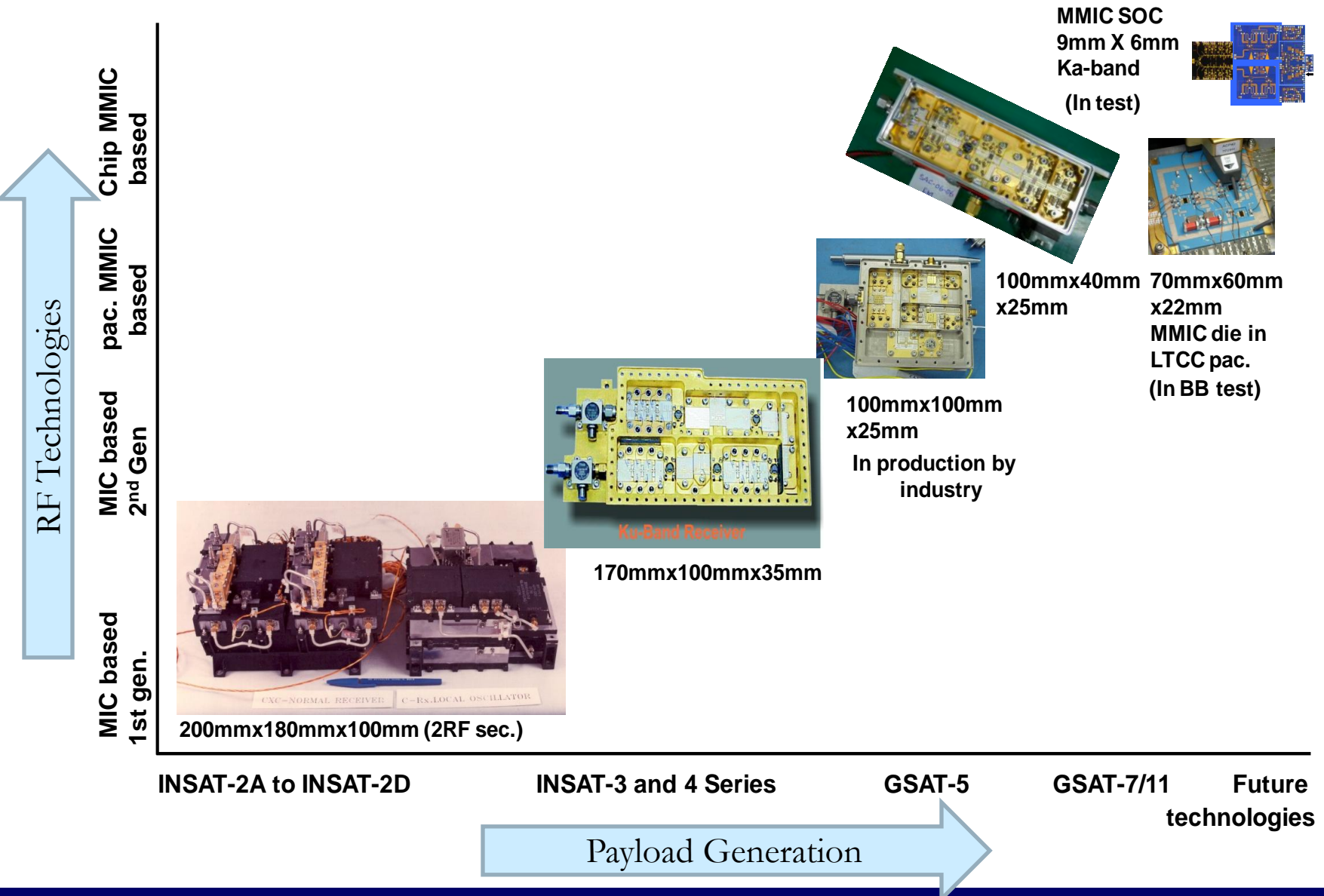
Use of Higher frequency bands – Ku to Ka to Q/V band

- Migration to higher frequency bands – ‘User ‘ as well as ‘Feeder’ links
- More interference free Spectrum
- Constraints of available technologies

Redefining MSS with enhanced capabilities

- Multi-beam High power transponders in S-band - enabling SDMB services

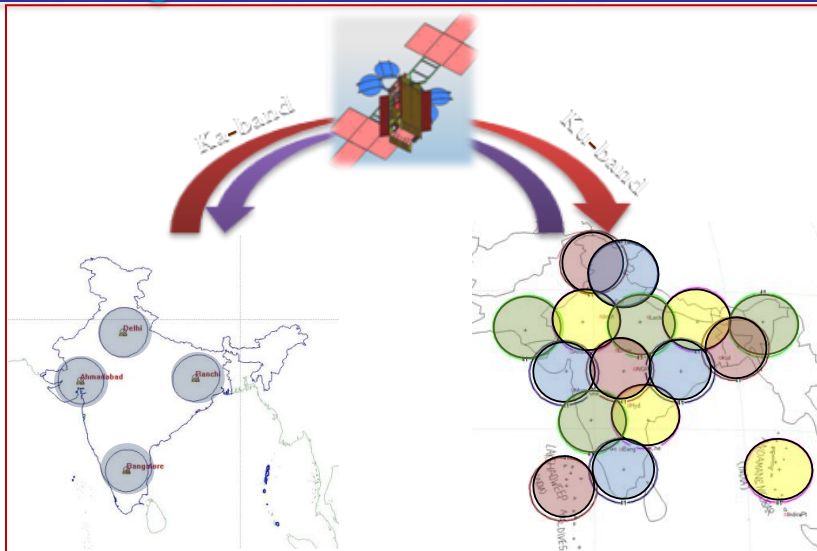
Technology Trends – Active Low power RF Circuits



High Throughput Satellite : GSAT-11

Features:

- First full fledged Indian HTS payload based on I-6K Bus of ISRO
- Average Throughput : 16 Gbps
- 32 Spot Beams (16 in each Polarization)
- 8 Hub beams (4 in each Polarization)
- Use of Ka-band Spectrum in Hub beams
- Frequency as well as Polarization reuse : 8 GHz of effective spectrum in user links using 500 MHz Ku-band Raw spectrum
- Site Diversity with Uplink Power Control for hubs and DVB-S2X for fade mitigation in Ku and Ka-bands



Spectrum

User Link:

U/L : 12.75 – 13.25 GHz

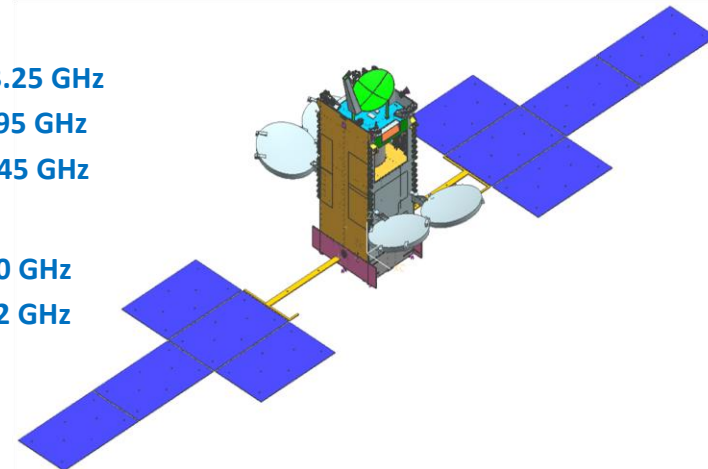
D/L : 10.7 – 10.95 GHz

11.2 – 11.45 GHz

Hub Link:

U/L : 29.5 – 30.0 GHz

D/L : 19.7 – 20.2 GHz

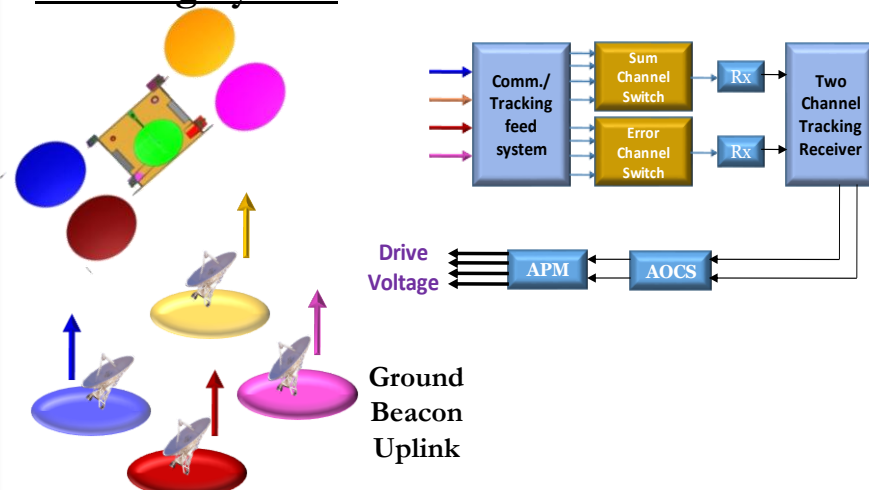


High Throughput Satellite : GSAT-11

On-board Technologies:

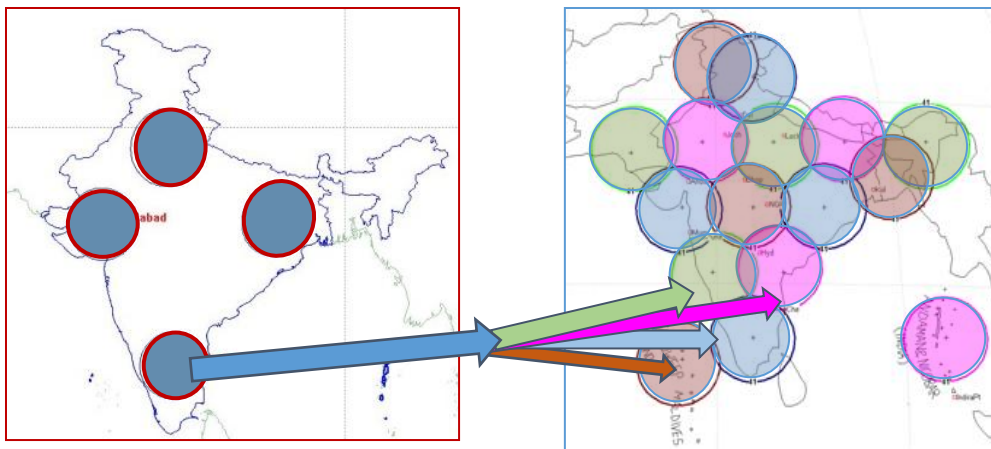
- Multi-beam antenna system in Ku-band
- Precise Antenna pointing mechanism using Ground-beacons
- High power transponders in each beam
- Highly sensitive on-board Receiver to cater to smaller terminals
- On-board Power management with Multiport Amplifier in 4 beams

Tracking System



- ❖ Beacons uplinked from four ground stations.
- ❖ Monopulse tracking used for precise pointing of all the four reflectors.
- ❖ Reflector pointing accuracy: ~ 0.05 degree.

User Beams with On-board Power Management

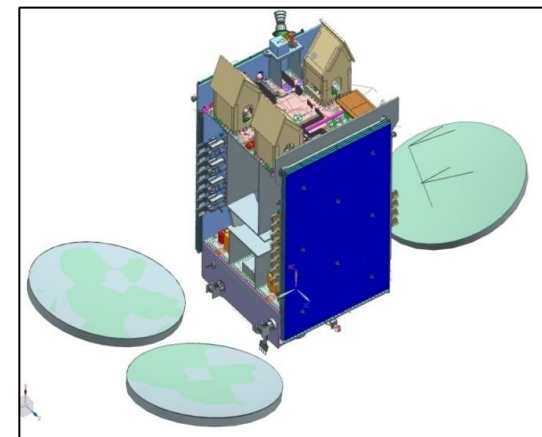
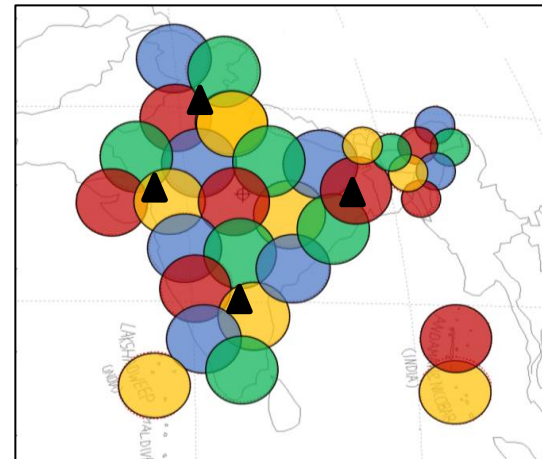


- ❖ Flexibility of allocating power
- ❖ 4x4 Multiport Amplifier for On-board Power management.
- ❖ 4 beams are configured with MPA.
- ❖ Power can be unequally shared among the four beams in forward link.
- ❖ Beams controlled by Southern Hub

Future Ka-band HTS : GSAT-20

Features & Technologies:

- Based on I-4K Platform of ISRO
- Miniaturization in Payload RF elements using in-house designed MMICs
- > 50 Gbps overall throughput
- 32 Ka-band User Spot Beams, 4 Hub stations
- #3 Deployable Antenna Reflectors
- Four Colour Frequency Re-use
- Hub Spectrum: 2 GHz in both Polarizations
- User Spectrum: 1 GHz in both Polarizations
- Higher throughput over NE region
- To provide In-Flight Connectivity in specific band
- Site Diversity with Uplink Power Control for hubs and DVB-S2X for fade mitigation



Spectrum

User Link:

U/L : 29.5 – 30.5 GHz

D/L : 19.7 – 20.7 GHz

Hub Link:

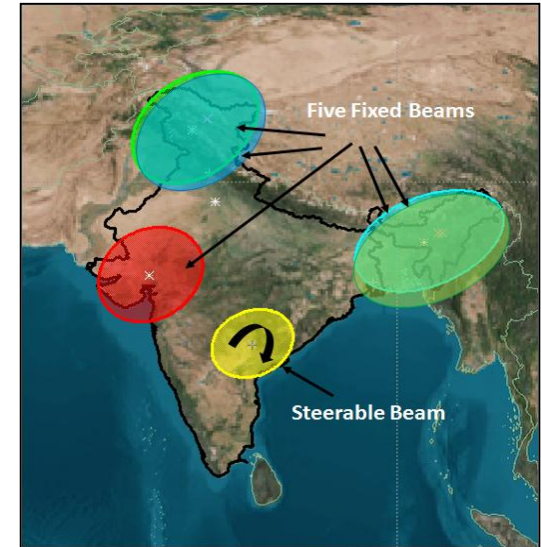
U/L : 27.5 – 29.5 GHz

D/L : 17.7 – 19.7 GHz

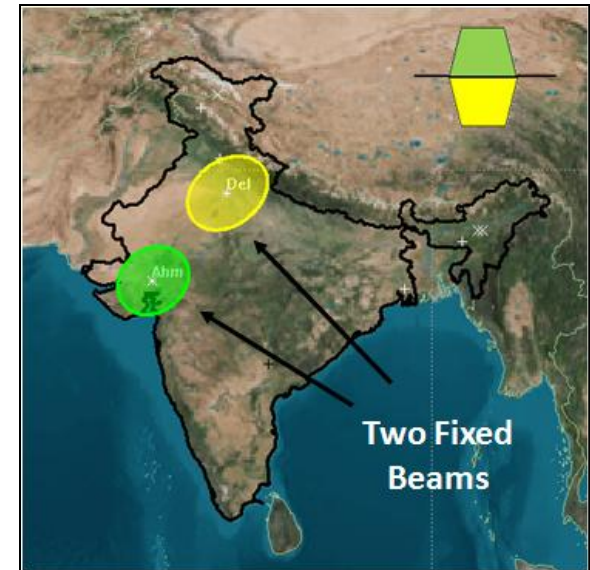
Multi-band Payload : GSAT-29

Payload Features:

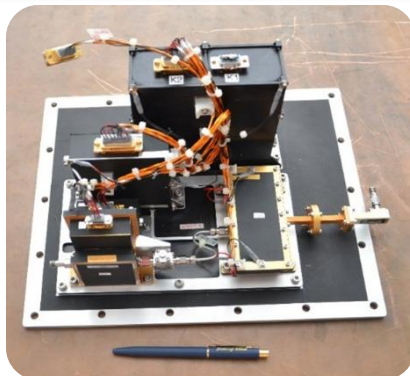
- Ku and Ka-band Spot beams over J&K and NE Regions
- Q/V-band Technology Demonstration Payload
 - Two beams each over Ahmedabad and Delhi
 - Two transponders of 125 MHz BW each
 - Inter-beam connectivity between the beams
 - Spectrum: U/L 43.1- 43.25 GHz, D/L 38.0 – 38.15 GHz
 - Optical Payloads: Geo High Resolution Camera with data downlink in Optical band.



Ku and Ka-band coverage



Q/V-band Spot beams

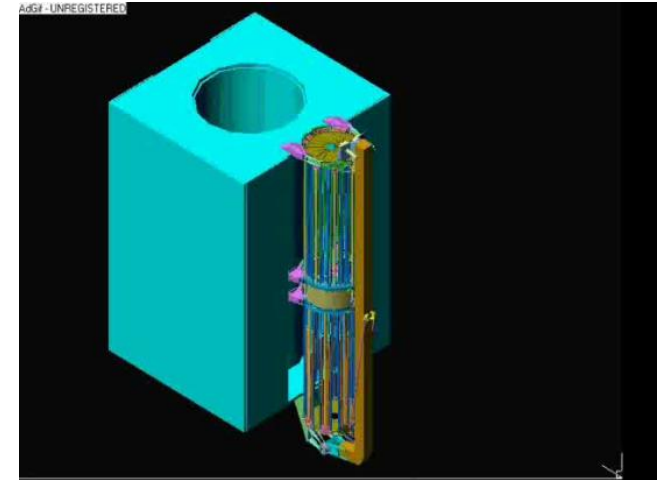
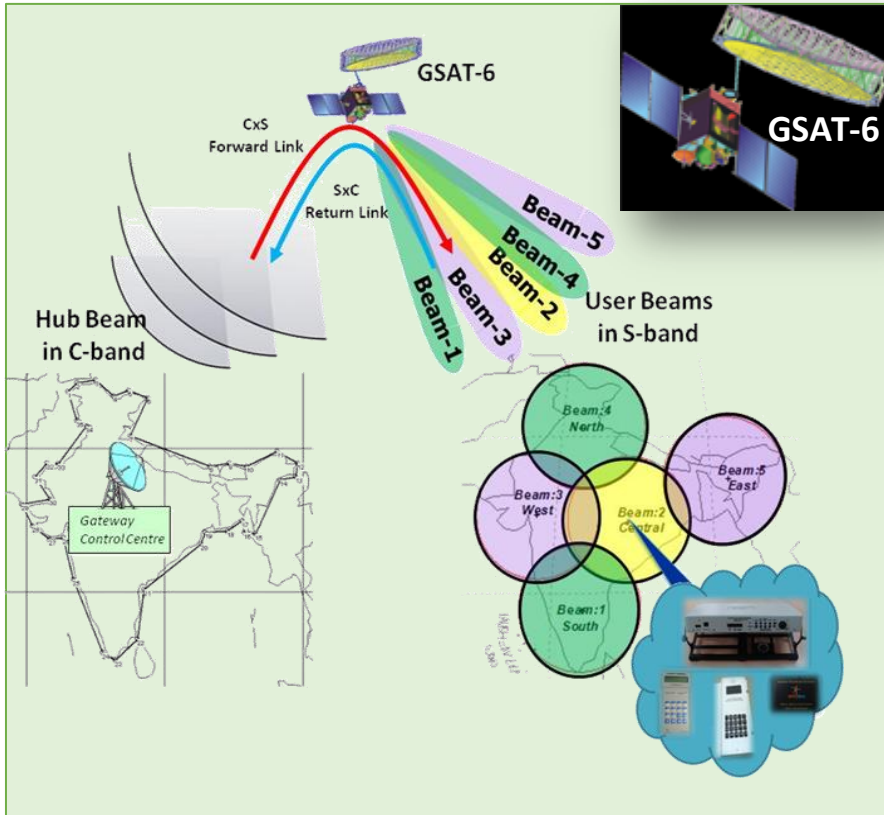


Q Band Solid State Power Amplifier



V Band Receiver

Payload for Mobile Satellite Service : GSAT-6



6m Unfurlable Antenna

Payload Features:

- On-board 6m Unfurlable Antenna
- Five High power S-band Spot Beams
- Hub link in C-band
- Voice/data/video to on-the-move Terminals

Thank You