Indian Space Programme

- Update on activities (Feb 2015)

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52nd Science & Technology Sub-Committee, UNCOPUOS
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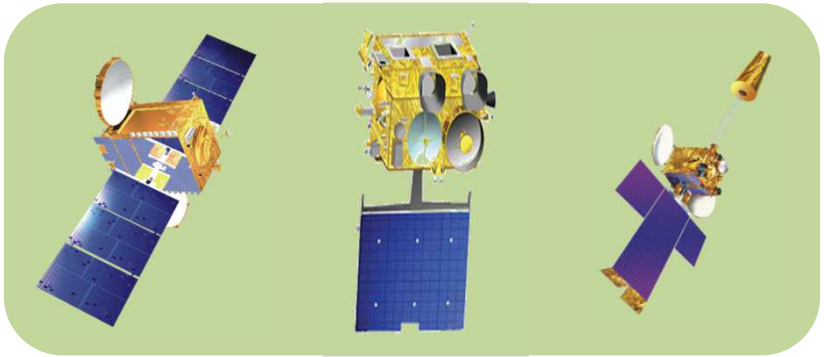
India's current Space Assets

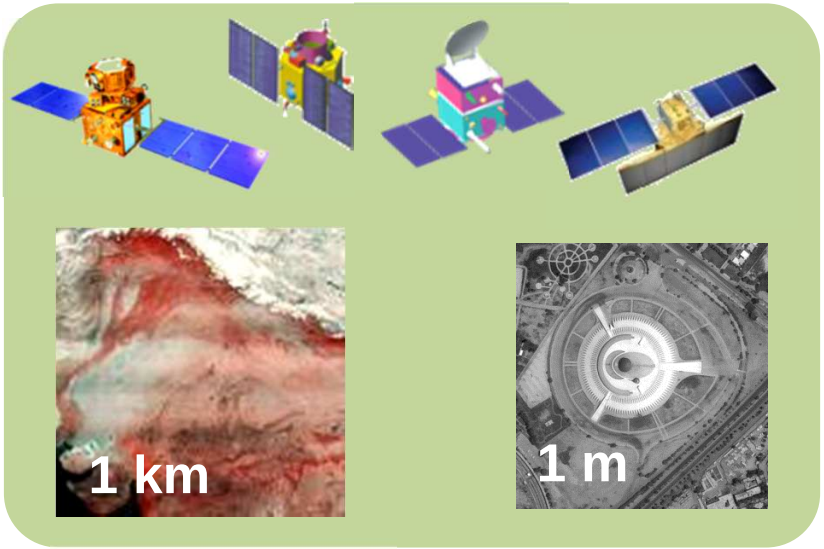
Communication Satellites

- 11 Operational (INSAT-3A, 3C, 4A, 4B, 4CR and GSAT-7, 8, 10, 12, 14, 16)
- 236 Transponders in C, Ext C & Ku bands

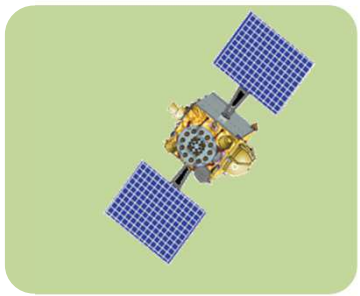


Remote sensing Satellites

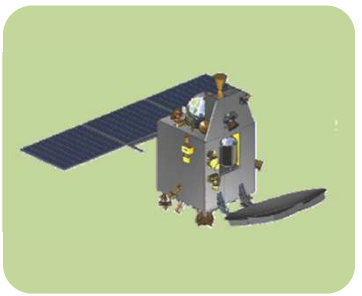
- Three in Geostationary orbit (INSAT 3D, Kalpana & INSAT 3A)
- 10 in Sun-synchronous orbit (RESOURCESAT- 2; CARTOSAT-1, 2, 2A & 2B; RISAT-1 & 2; OCEANSAT 2; MEGHA-TROPIQUES; SARAL)
- Both Optical & Microwave Sensors providing wide range of spatial, spectral, radiometric & temporal resolutions



Navigational Satellites : IRNSS 1A, IB & 1C



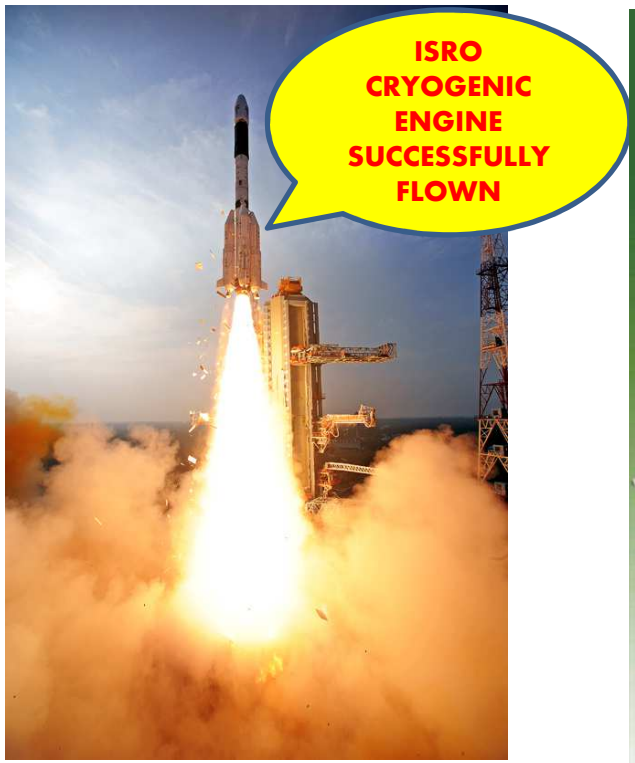
Inter Planetary Probe: Mars Orbiter Mission



Launch Missions 2014

- GSLV D-5/ GSAT-14 - 5 January 2014
- PSLV C24/ IRNSS-1B - 4 April 2014
- PSLV C23/ SPOT (+4) - 30 Jun 2014 +
- PSLV C26/ IRNSS-1C - 16 October 2014
- LVM3-X / CARE - 18 December 2014

Co-Passerngers (PSLV C23)
AISAT – (DLR,Germany)
NLS7.1,NLS7.2 (UTIAS/SFL Canada)
VELOX-1 (NTU Singapore)



GSLV D5 Jan 05,2014

- 2xS200 + L110 + Passive C25
- Lift-off mass : 630t
- LN2 in LOX tank and GN2 in LH2 tank

PSLV-C23 launched France's SPOT-7 & 4 smaller satellites

Plus…

- AISAT, Germany (14 kg)
- NLS 7.1, Canada (15 kg)
- NLS 7.2, Canada (15 kg)
- VELOX-1, Singapore (7 kg)

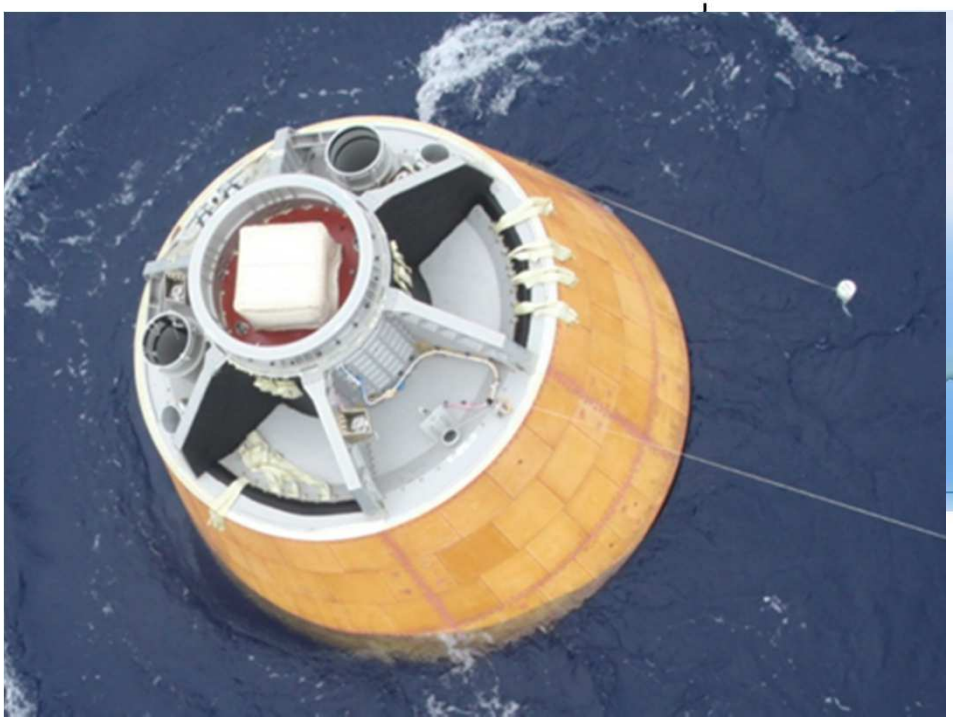
- On June 30, 2014, PSLV in its 26th consecutively successful flight placed French EO Satellite 'SPOT-7' and 4 piggy-back satellites in their intended orbits
- Earlier, an identical satellite 'SPOT-6' was launched by PSLV in September 2012.
- With this, PSLV launched 40 satellites from 19 countries

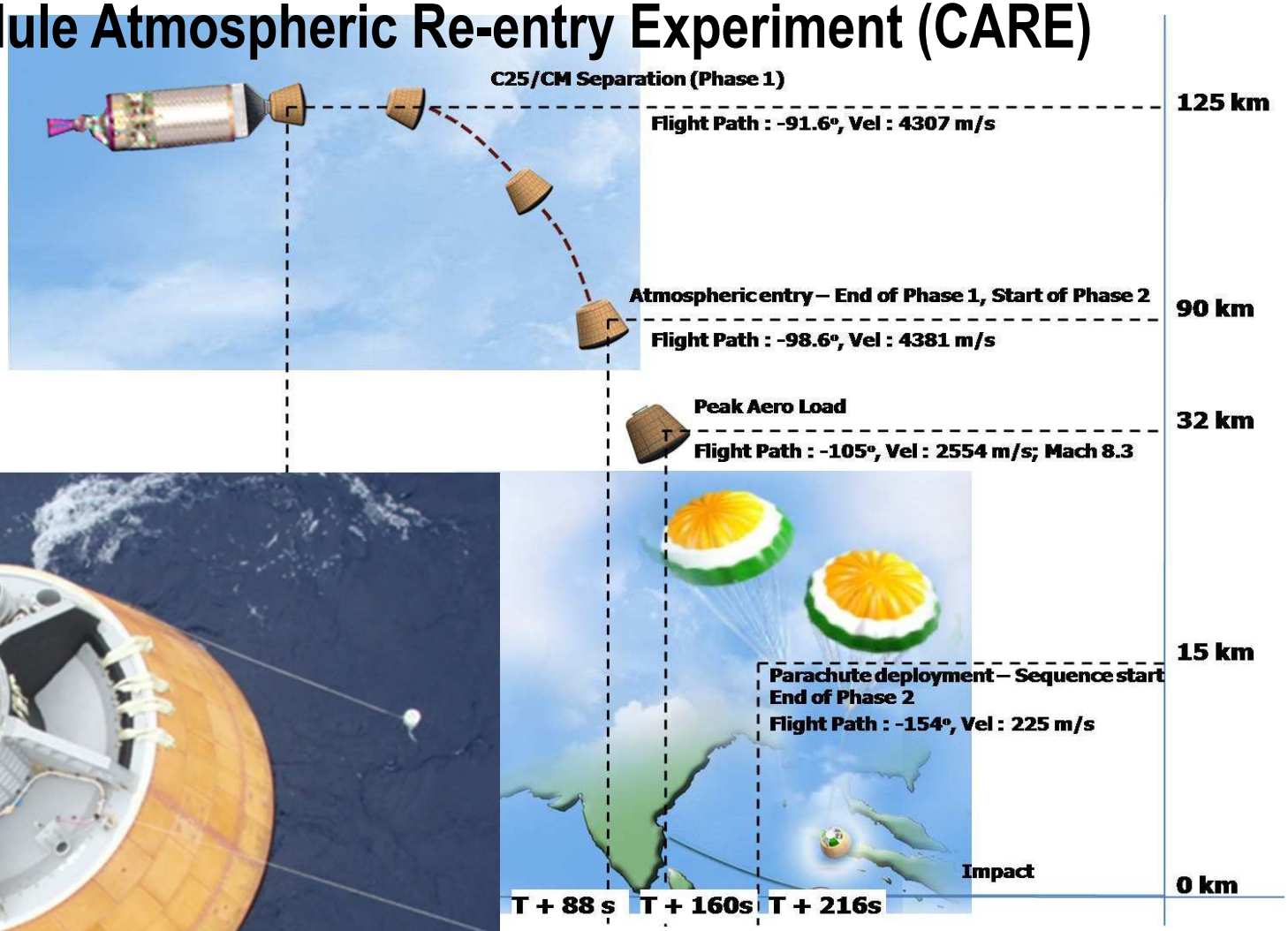
GSLV MK III – The heavy-lifting launch vehicle of ISRO

- First experimental suborbital flight of India's new generation launch vehicle GSLV Mk III on Dec 18, 2014
- Successfully conducted Crew Module Atmospheric Re-entry Experiment (CARE)
- Module was recovered about 20minutes after lift off (reached altitude of 126 km)

CARE – Re-entry Mission

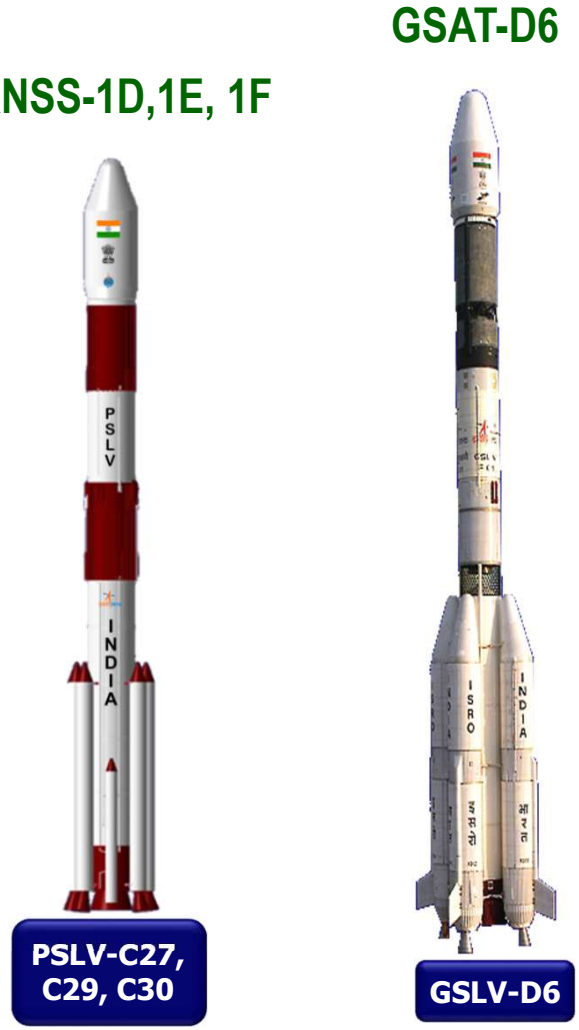
- Crew module Atmospheric Re-entry Experiment (CARE)



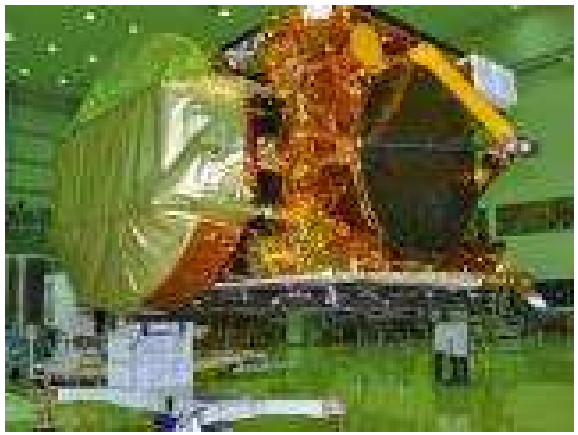


LAUNCH PLANS *for* 2015

- PSLV for GTO launch to realize IRNSS program
  - PSLV-C27 (IRNSS-1D), PSLV-C29 (IRNSS-1E), PSLV-C30 (IRNSS-1F)
- PSLV for polar EO launch
  - PSLV-C28*
- PSLV for equatorial launch
  - PSLC-C34 (ASTROSAT) +1
- GSLV for GTO communication satellite
  - GSLV-D6 (GSAT-6)



GSAT 16: Advanced Communication Satellite



Launch Mass:	3181.6 kg
Dimension:	2.0 m x 1.77 m x 3.1 m cuboid
Power:	Solar array providing 6000 Watts and two 180 AH Lithium Ion batteries
Launched on:	December 7, 2014
Launched by:	Ariane-5 VA-221
Mission Life:	12 Years
Orbital Slot:	55°E

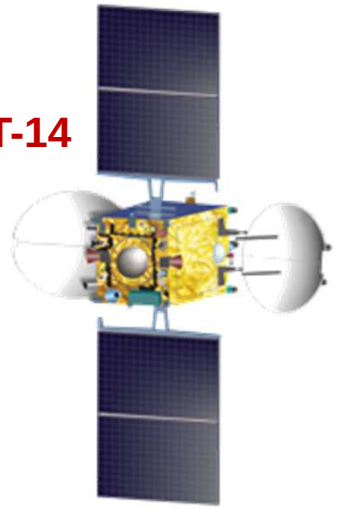
Payloads

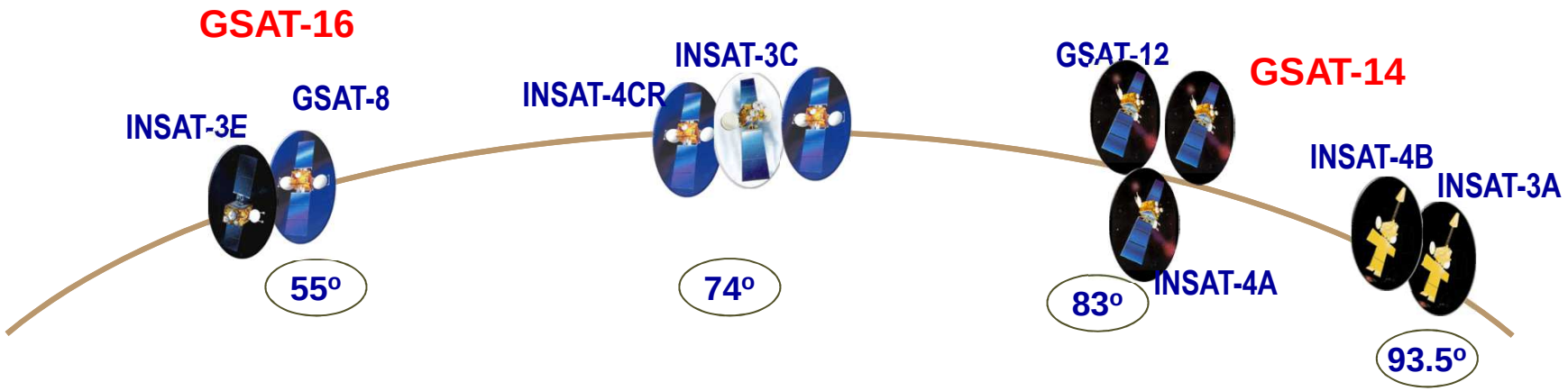
- 12 Ku-band transponders
- 24 C-band transponders
- 12 Upper Extended C-band transponders

In-orbit Testing (IOT) of payload under progress

Satellite Communication

- **GSAT-14** *(Launch Jan 5, 2014)*
  - *6 Ext C, 6 Ku, 2 Ka beacons; 1982 kg, 2600W*
  - *Launch by GSLV D05*
- **GSAT-16** *(Launch Dec 7, 2014)*
  - *24 C, 12 Ext C, 12 Ku, 3100 kg*
  - *Launch by Ariane 5A*

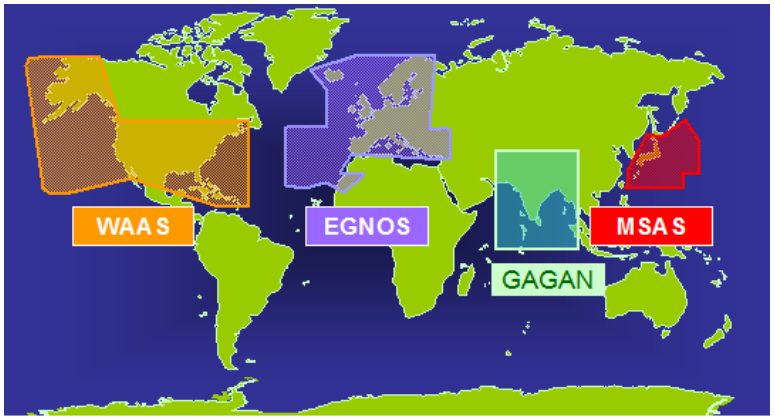


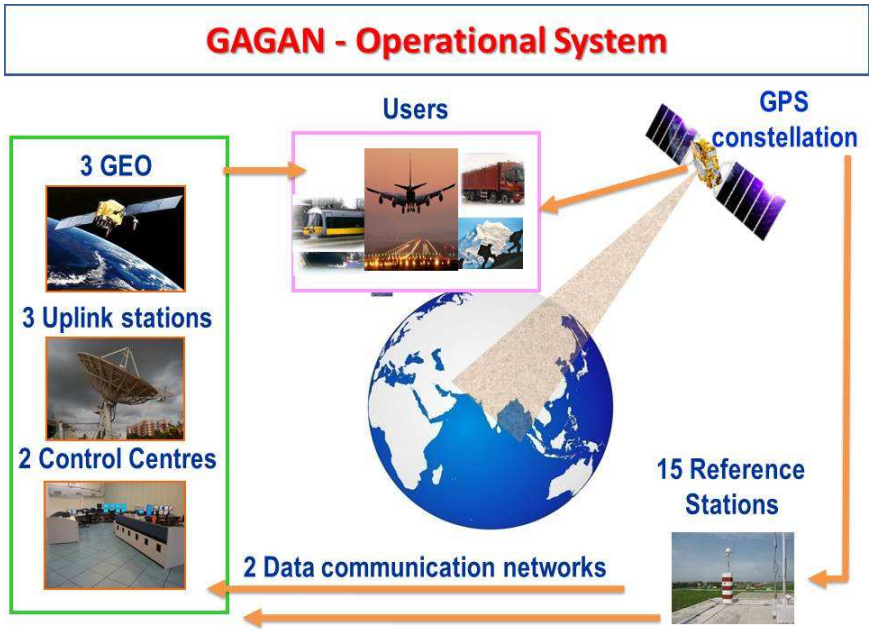


236 Transponders in C, Ext C & Ku bands

GAGAN : Augmented Navigation

- **GAGAN : GPS Aided GEO Augmented Navigation**
  - Jointly implemented by ISRO & Airports Authority of India
- **Configuration**
  - Ground Component (15 ref st; 3 uplink stn, 2 control stn)
  - Space Segment : Payloads on GSAT8 & GSAT10
- **Certification**
- Indian aviation regulator DGCA issued certification for RNP0.1 (Required Navigation Performance, 0.1 Nautical Mile) service level on December 30, 2013.
- **Interoperable global system**

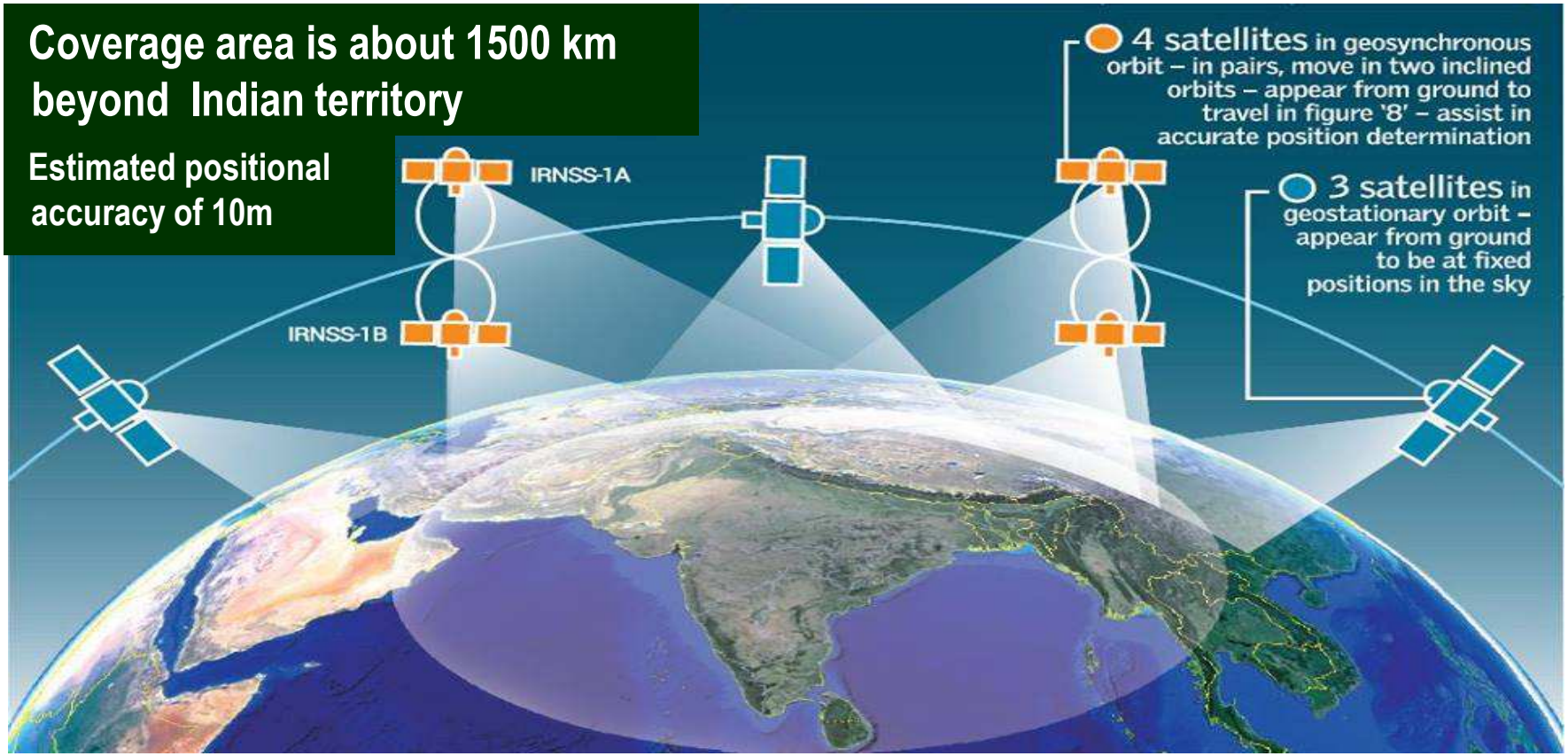




Satellite Navigation - IRNSS

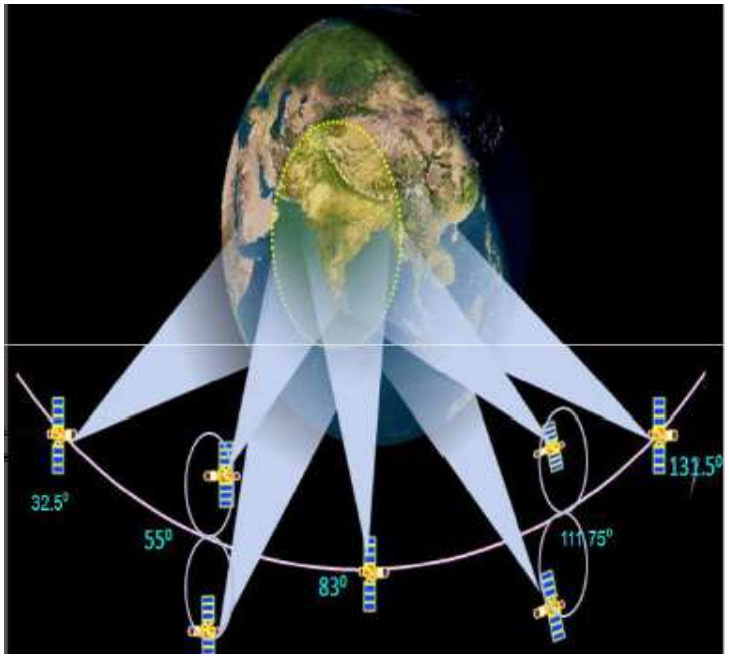
Indian Regional Navigation Satellite System

- An Indigenous navigation system of seven-satellite constellation designed for providing position, navigation and timing services over Indian region
- Three satellites are already in orbit; 4th Satellite to be launched in March 2015
- Constellation is planned to be completed by 2015



Navigation Program : IRNSS

- **IRNSS**
  - 7 satellite configuration (3 geostationary; 4 geo-synchronous)
  - IRNSS-1A was launched on Jul 1, 2013
  - Two satellites IRNSS-1B (Apr 4) and IRSNSS-1C (Oct 16) launched in 2014
  - IRNSS Signal-in-Space Interface Control Document (ICD) for Standard Positioing Service (SPS) released



April 04,2014

IRNSS-1B

2nd in the IRNSS Series launched onboard PSLV C-24

October 16,2014

IRNSS-1C

3rd in the IRNSS Series launched onboard PSLV C-26

Currently operational EO missions

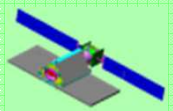
- Provides remote sensing data in a variety of spatial, spectral and temporal resolutions
- Both Optical and Microwave

Land & Water

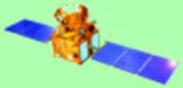
Cartographic

Ocean & Atmosphere

2012
RISAT-1
C-SAR



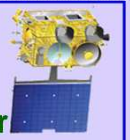
2011
RESOURCESAT-2
LISS 3; LISS 4; AWiFS



2007
CARTOSAT-2
PAN

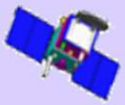
2005
CARTOSAT-1
Stereo PAN, F/A

2013
INSAT-3D
Imager, Sounder



2009
OCEANSAT-2
OCM , SCAT
ROSA

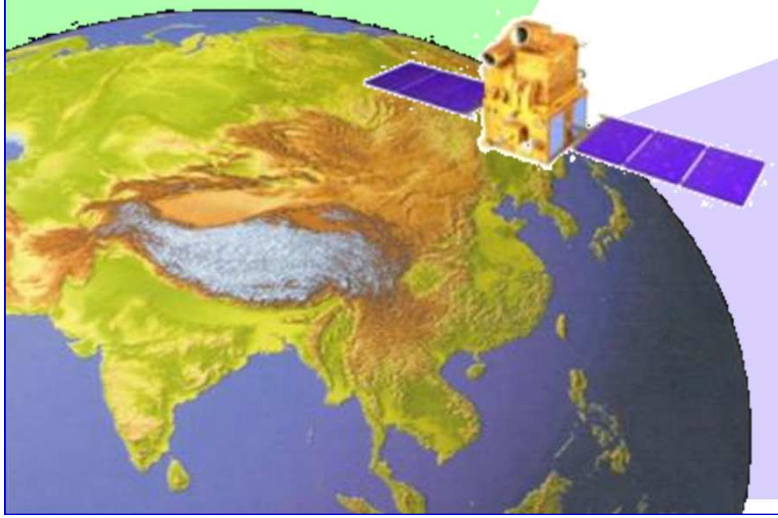
2013
SARAL
Altika, ARGOS



2003
INSAT- 3A
VHRR, CCD

2011
Megha Tropiques
MADRAS, SAPHIR
SCaRaB

2002
KALPANA-1
VHRR



Future EO Missions

CARTOSAT-2E

To provide continuity to Cartosat-2

PAN (0.65m) & 4B MX (2 m)
Swath : 10 km
Radiometric Resolution: 11 bit
Steering up to ±26°/±45
Altitude: 500 km
Solid State Recorder: 600 Gb
Local time: 0930 hrs
Revisit : 5 days

GISAT

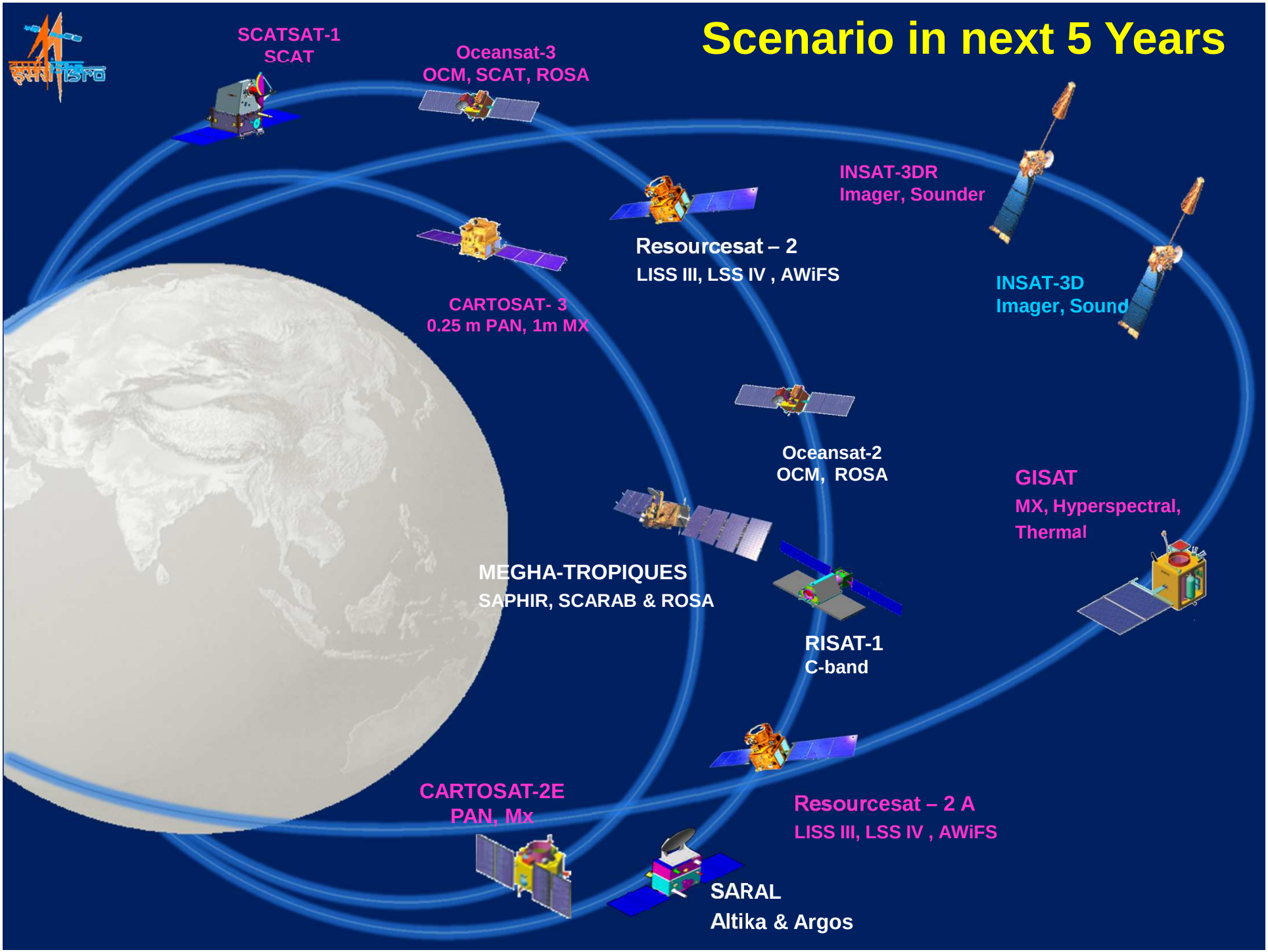
Multiple acquisition capability from a Geosynchronous Orbit

Payloads

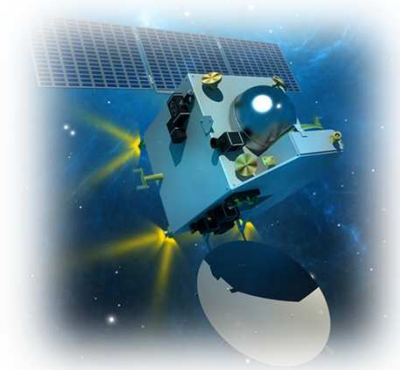
- **High resolution multi-spectral VNIR (HRMX-VNIR): 50m Res.**
- **Hyper spectral VNIR & SWIR: 320m and 192m Res.**
- **High resolution Multi-spectral (HRMX-TIR): 1.5km Res.**

Status

- **Launch by PSLV during 2016-17**


Scenario in next 5 Years
SCATSAT-1
SCAT
Oceansat-3
OCM, SCAT, ROSA
INSAT-3DR
Imager, Sounder
Resourcesat – 2
LISS III, LSS IV , AWiFS
INSAT-3D
Imager, Sound
CARTOSAT- 3
0.25 m PAN, 1m MX
Oceansat-2
OCM, ROSA
GISAT
MX, Hyperspectral,
Thermal
MEGHA-TROPIQUES
SAPHIR, SCARAB & ROSA
RISAT-1
C-band
CARTOSAT-2E
PAN, Mx
Resourcesat – 2 A
LISS III, LSS IV , AWiFS
SARAL
Altika & Argos

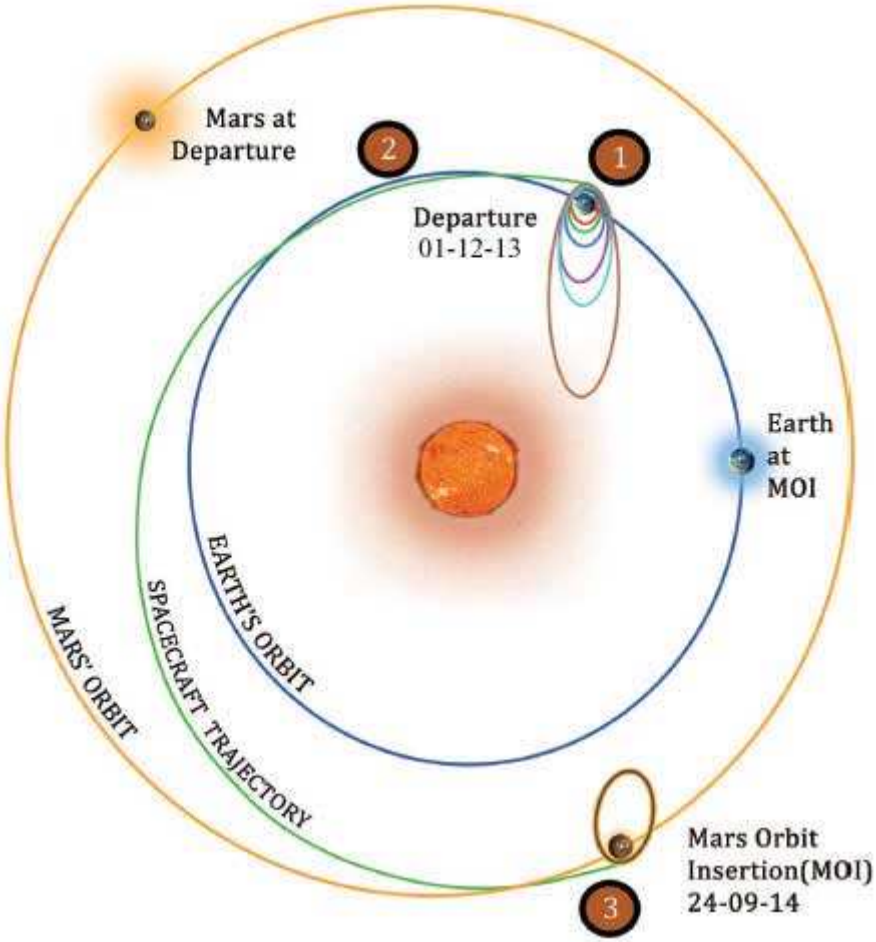
September 24, 2014– A Historic Day for India
India's first Inter-Planetary Probe reached Mars Orbit



Technological Achievements

- Realized a spacecraft to reach Mars and orbit around Mars
- Radiation shielding for prolonged exposure
- Built high level of onboard autonomy within the Orbiter
- Robustness and reliability of propulsion system
- Precisely inserted into Martian orbit after 300 days voyage
- Currently undertaking a few scientific studies using 5 instruments

HOW WE REACHED MARS



Phases of MOM's Journey

1. Earth-centric phase
2. Sun-centric phase
3. Martian phase

International Cooperation

- IRS Data support for International Charter, Sentinel Asia, UN-SPIDER &
  - Drought assessment for Sri Lanka under UNESCAP-DRR
- CEOS & GEO participation
- CSSTE-AP
- IRS Data Reception
  - Resourcesat-2 at Cuiaba (Brazil), RISAT-1 by KSAT (Norway)
- NASA ISRO SAR (NISAR) Agreement
  - Dual frequency (L&S) SAR Mission

Thank You

http://www.isro.gov.in