

The logo of the Indian Space Research Organisation (ISRO) is located in the top left corner. It features a stylized orange and blue flag above the text 'इसरो ISRO' in Hindi and 'Indian Space Research Organisation' in English.

Indian Space Research Organisation

The background of the slide is a collage of space-related images. It includes a satellite with purple solar panels, a rocket launch, a satellite dish, a globe with a rocket, and a view of Earth from space. The text is centered on a white, curved shape that resembles a satellite or a piece of space equipment.

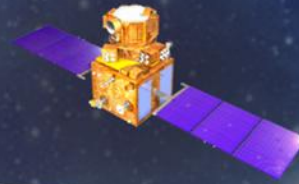
Overview of Indian Satellite Navigation Programme

N. Neelakantan
Director

Satellite Communication and Navigation Programme
Indian Space research Organization
India

The logo of the Indian Space Research Organisation (ISRO) is located in the top left corner. It features a stylized orange and blue arrow pointing upwards, with the text 'इसरो ISRO' in Hindi and English.

Indian Space Research Organisation



GAGAN

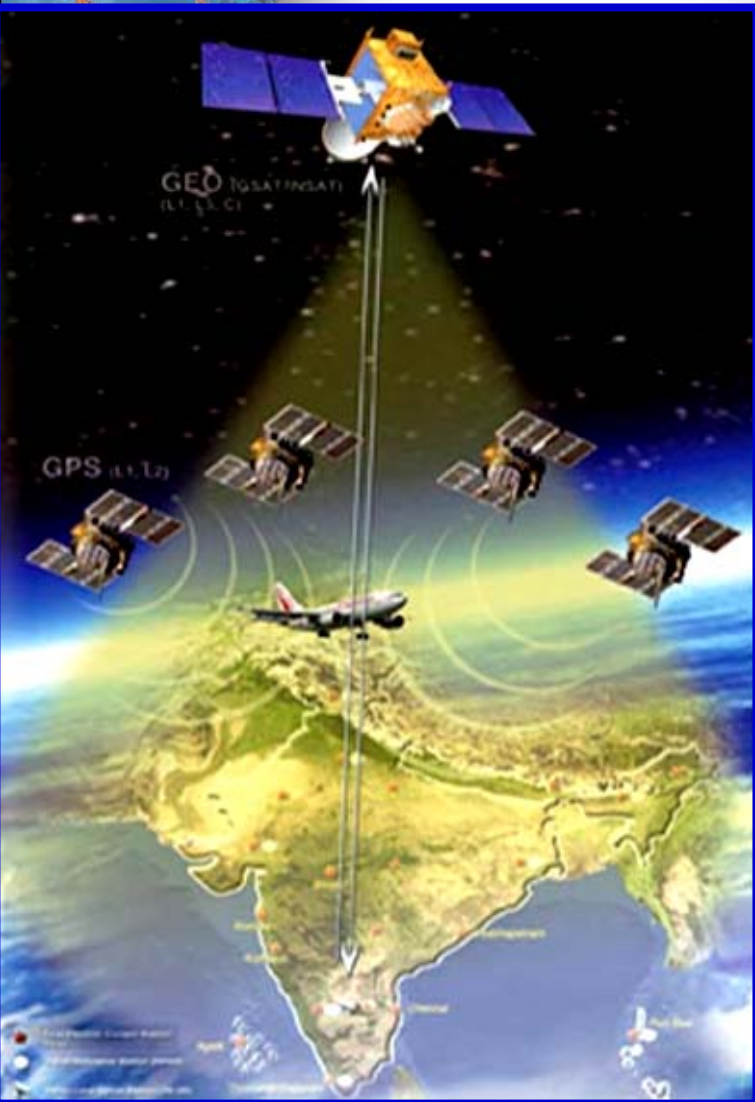
(GPS Aided Geo Augmented Navigation)

GAGAN

GPS Aided GEO Augmented Navigation

इसरो ISRO

Indian Space Research Organisation



1. GAGAN is a Satellite Based Augmentation System being implemented by India based on GPS
2. GAGAN jointly implemented by ISRO and Airports Authority of India (AAI)
3. GAGAN implementation in two phases
 - GAGAN – TDS (Tech. Demo System)
 - GAGAN – FOP (Final Operation Phase)

GAGAN

इसरो ISRO

Indian Space Research Organisation

OBJECTIVE

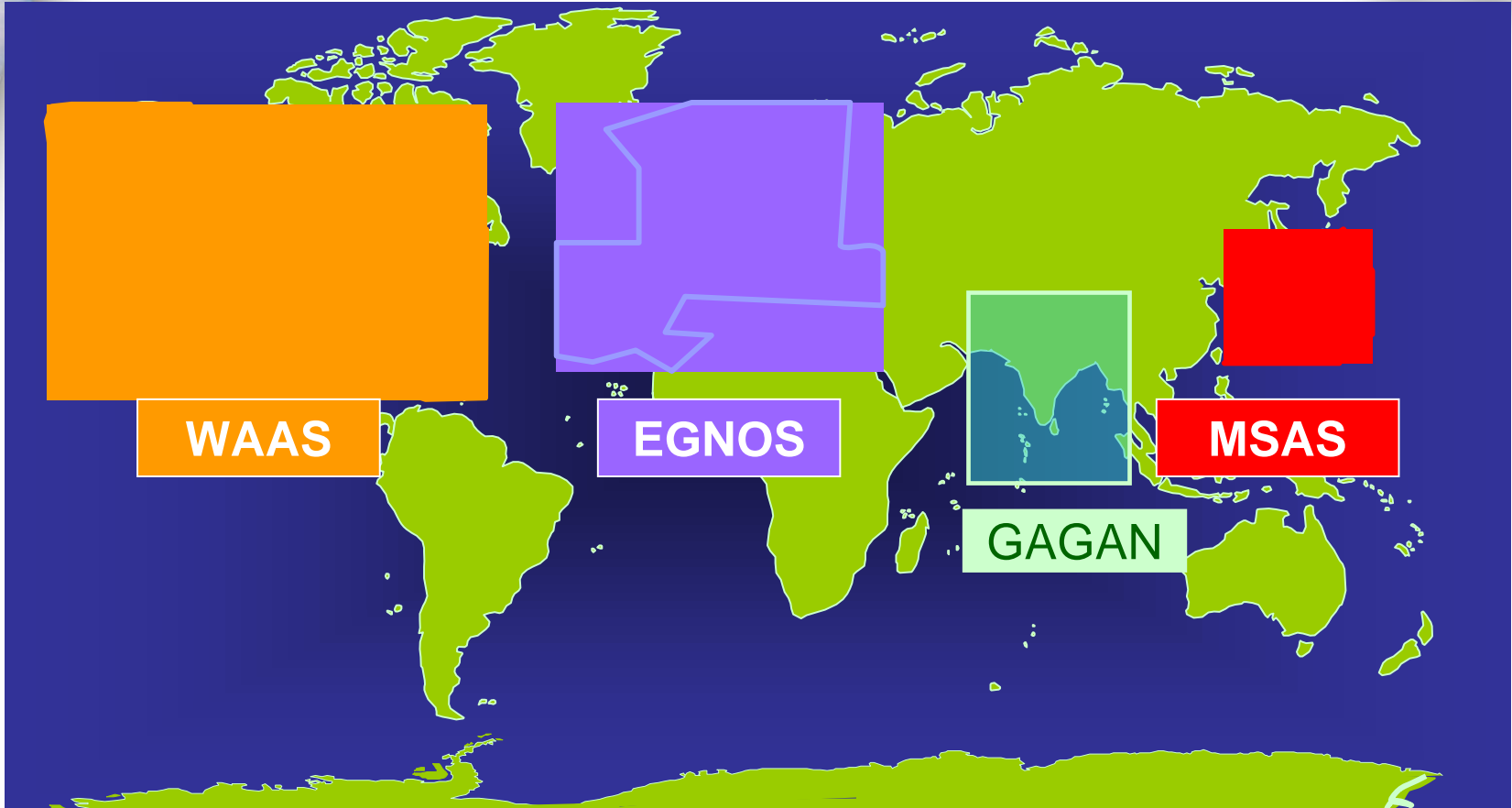
To provide Satellite-based Navigation services with accuracy and integrity required for civilian and aviation applications over Indian Air Space.

Better Air Traffic Management over Indian Airspace.

GPS Augmentation systems

इसरो ISRO

Indian Space Research Organisation



GAGAN CONFIGURATION

इसरो ISRO

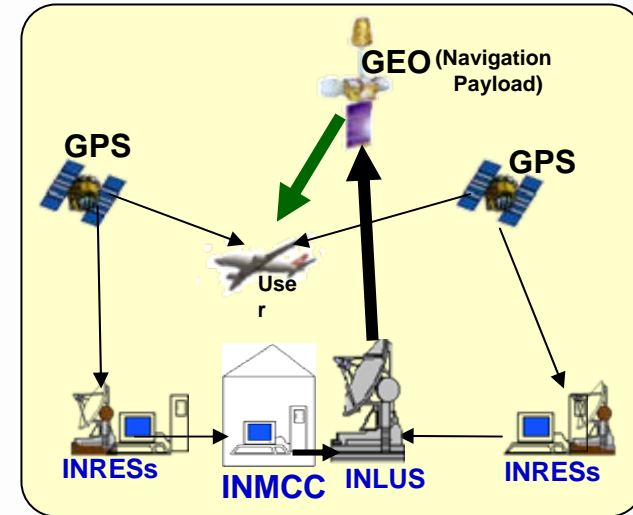
Indian Space Research Organisation

SPACE SEGMENT Three GEO Satellites

- Two operational Navigation Payloads
- One in-orbit spare Navigation Payload

GROUND SEGMENT

- Indian Master Control Centre (INMCC)
- Indian Navigation Land Uplink Station (INLUS)
- Indian Reference Stations (INRES)
- Communication links



GAGAN NAVIGATION SIGNALS



Indian Space Research Organisation



GAGAN Space Segment uses SBAS PRN codes 127 and 128 to transmit corrections and integrity parameters to SBAS receiver.

Signals Received by GAGAN Receiver

Signals	Frequency Band
1 MHz BPSK	L1 (1575.42 MHz)
10 MHz BPSK *	L5 (1176.45 MHz)

*** When GPS L5Civil is available**

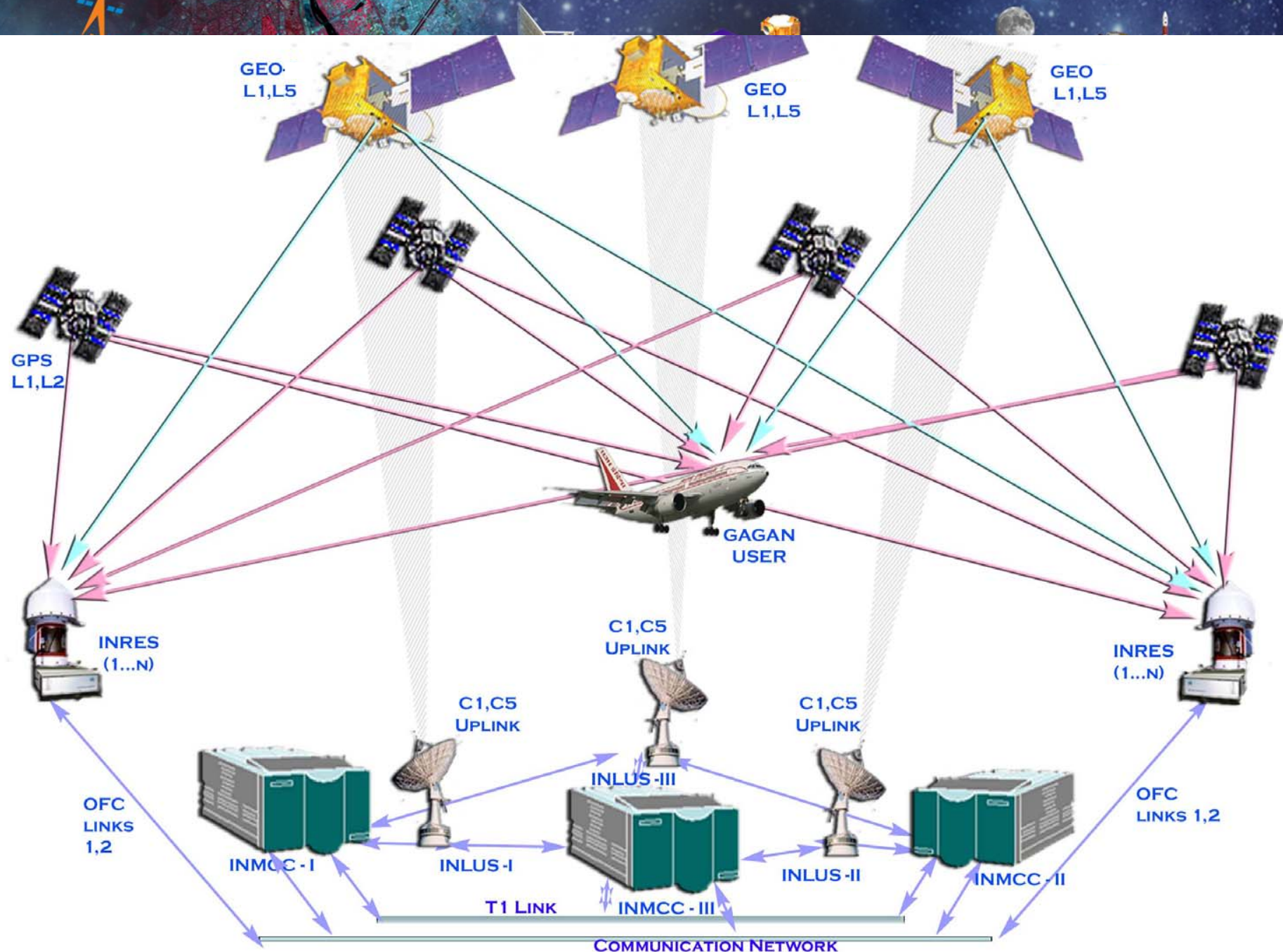
GAGAN PAYLOAD CHARACTERISTICS

इसरो ISRO

Indian Space Research Organisation

Sl. No.	System characteristics	L1 Freq. (1575.42 MHz)	L5 Freq. (1176.45 MHz)
1.	Transmit EIRP (EOC)	30.2 dBW	29.2 dBW
2.	Receive G/T	-2 dB/deg.K	-2 dB/deg.K
3.	Bandwidth	20 MHz	24 MHz
4.	Footprint	Global	Global
5.	Feeder Link frequency	C-band	C-band
6.	Transmit polarisation	RHCP	RHCP
7.	Type of Antenna	Helix	Helix
8.	Antenna Gain	15.8 dB	15.8 dB
9.	RF Power rating	40W	40W
10.	Total Payload weight	50 Kg	
11.	Power D C	240W	

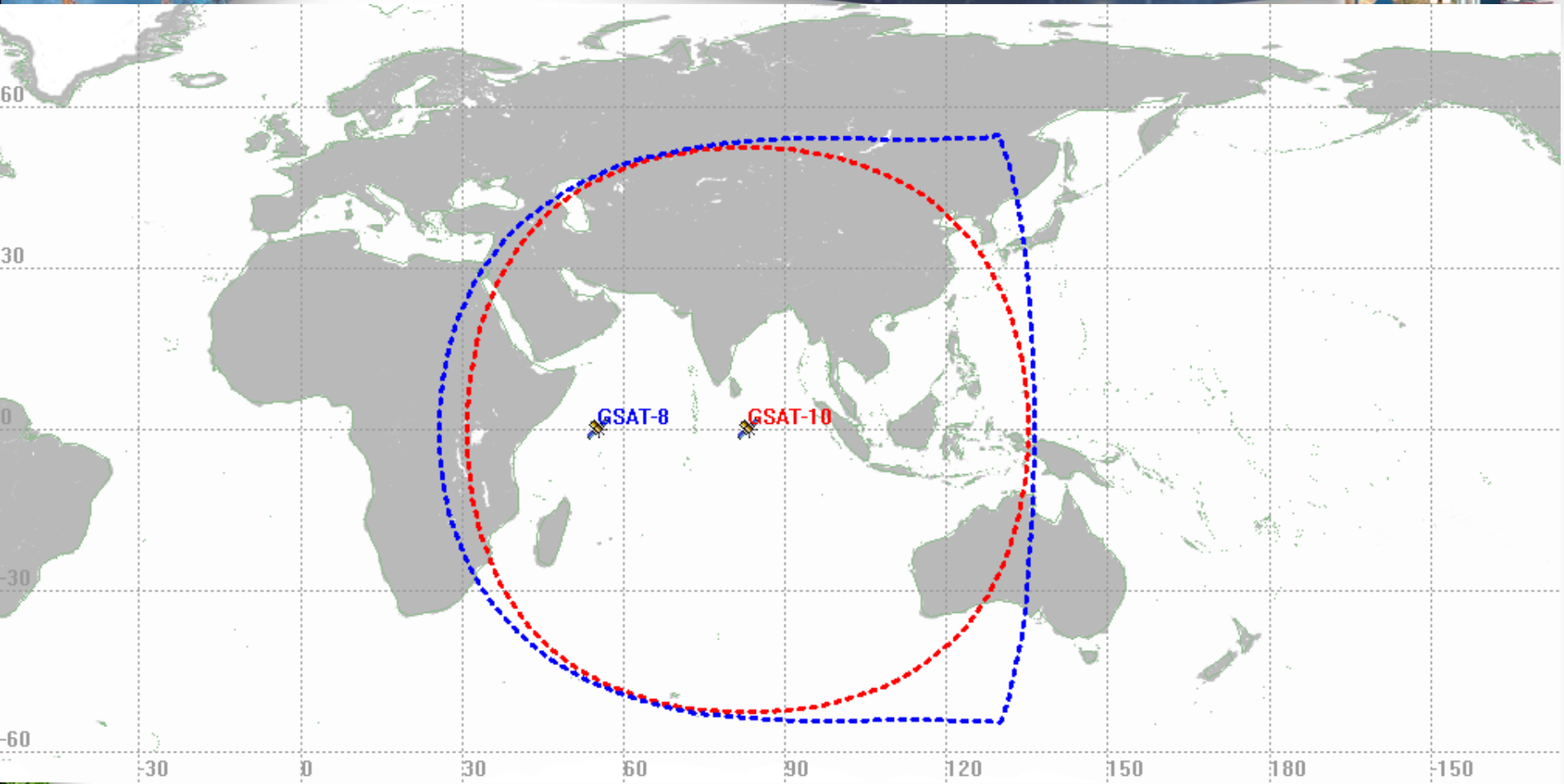
GAGAN CONFIGURATION



GAGAN COVERAGE FROM 55 & 83 Deg.E

इसरो ISRO

Indian Space Research Organisation



GAGAN INTENDED SERVICES

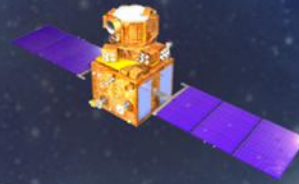
इसरो ISRO

Indian Space Research Organisation

- High position accuracies with integrity (APV-1.5 or better) over Indian geographical area.
- These position accuracies to be simultaneously made available to all airports and air fields in Indian FIR, enabling satellite based landing of aircraft fitted with SBAS receivers.

The logo of the Indian Space Research Organisation (ISRO) is located in the top left corner. It features a stylized orange and blue arrow pointing upwards, with the text 'इसरो ISRO' in Hindi and English.

Indian Space Research Organisation



IRNSS

(Indian Regional Navigation Satellite System)

IRNSS

Indian Regional Navigation Satellite System

इसरो ISRO

Indian Space Research Organisation



- ✚ IRNSS is an independent regional navigation system
- ✚ 7 satellite constellation and corresponding ground segment.
- ✚ Coverage area is about 1500 km beyond Indian territory.

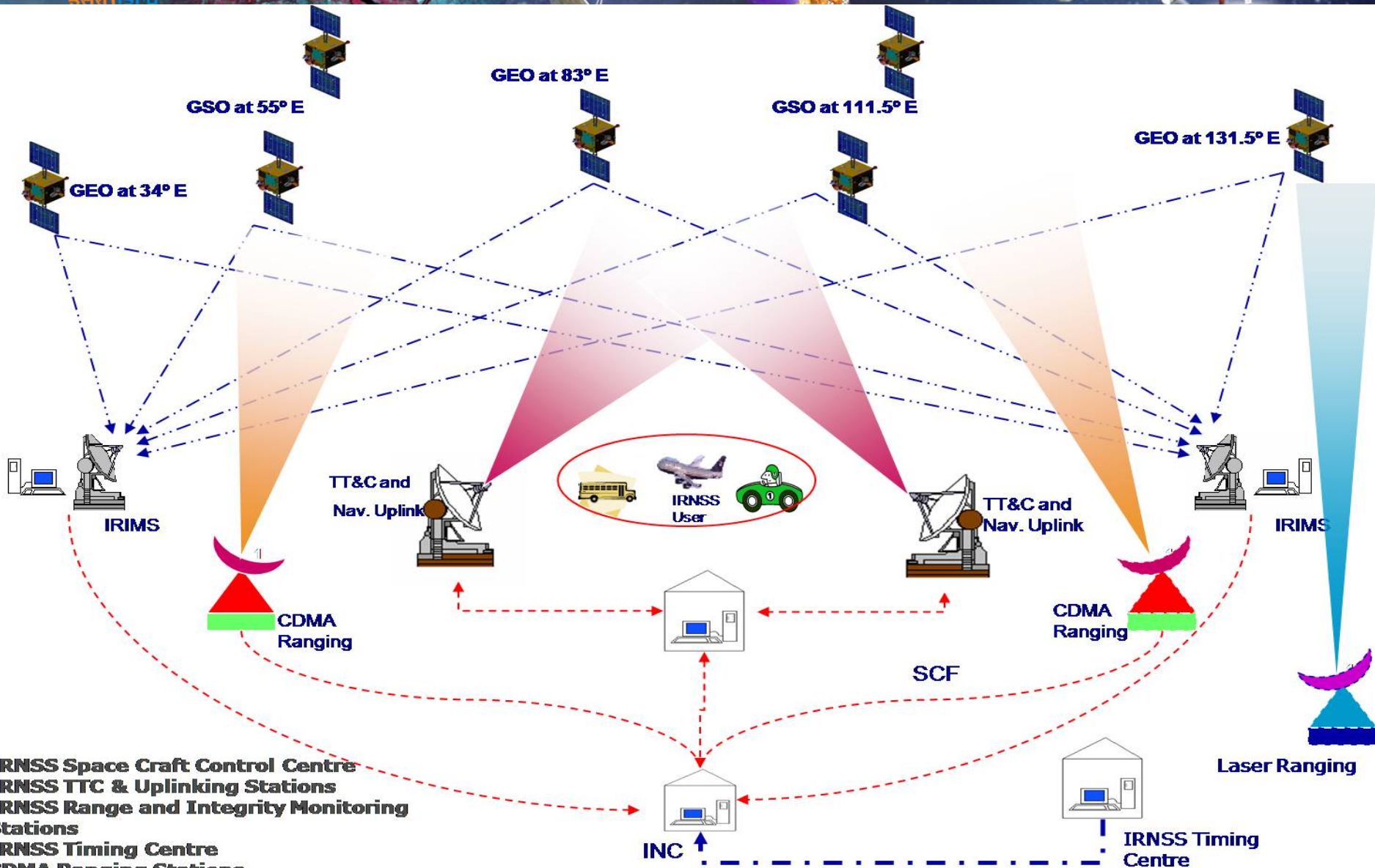
IRNSS

Indian Regional Navigation Satellite System

OBJECTIVES

- Reliable Position, Navigation and Timing services over India and its immediate neighborhood.
- To provide fairly good accuracy to the user.
- The constellation is seen by user all the time.
- Integrity and ionospheric correction messages to user.

IRNSS CONFIGURATION



- IRNSS Space Craft Control Centre
- IRNSS TTC & Uplinking Stations
- IRNSS Range and Integrity Monitoring Stations
- IRNSS Timing Centre
- CDMA Ranging Stations
- Laser Ranging Station
- IRNSS Navigation Centre
- Data Communication Links

IRNSS SPACE SEGMENT

इसरो ISRO

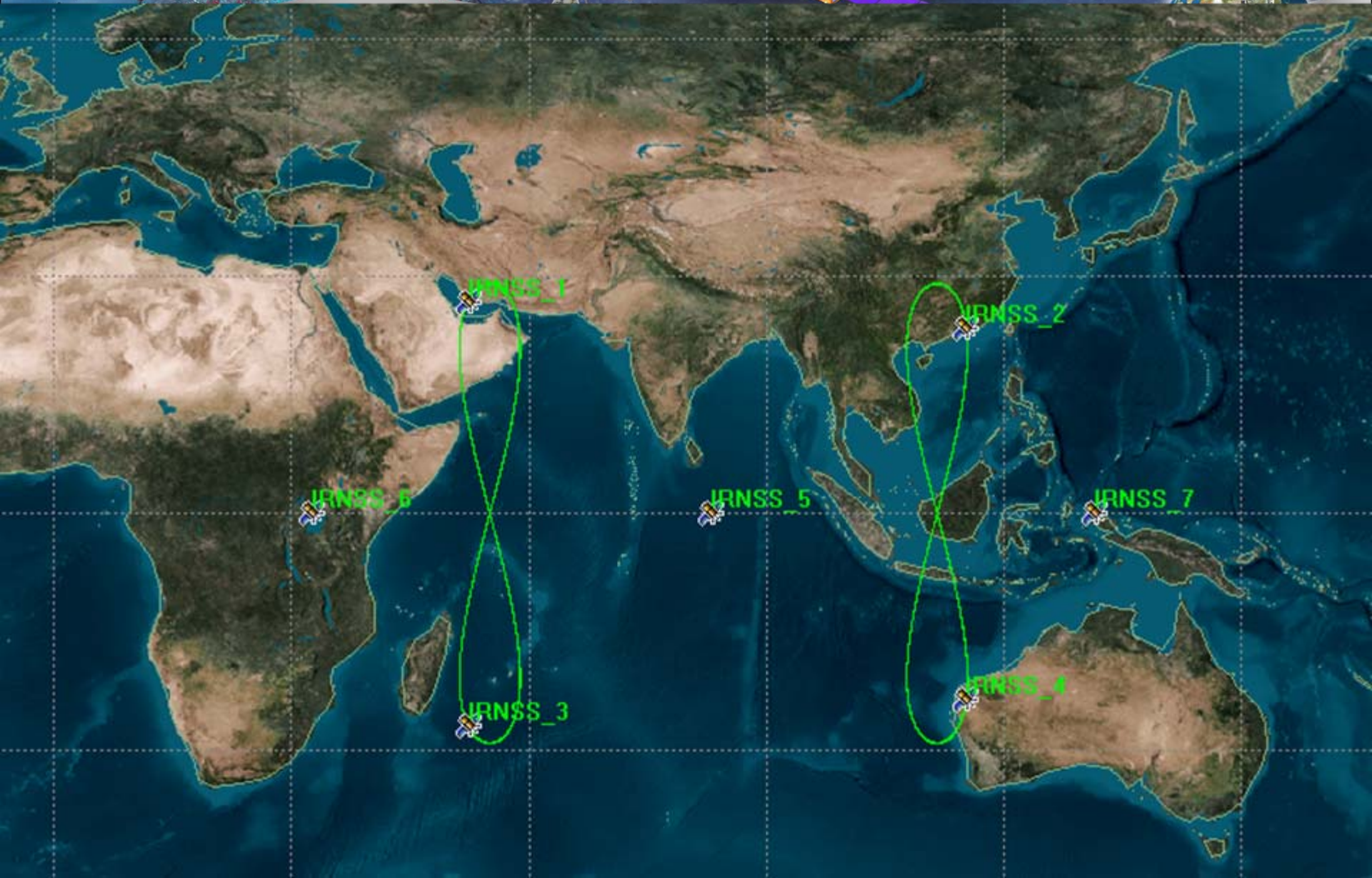
Indian Space Research Organisation

- ✚ 3 GSO satellites at 34° , 83° , and 131.5° East.
- ✚ 4 Inclined GSO satellites at 29° inclination with Longitude crossing at 55° and 111.5° .
- ✚ To be launched indigenously on the proven Indian PSLV.
- ✚ First satellite launch by second half of 2011.
- ✚ Full constellation completion by mid 2014.
- ✚ In Phase#2, the space segment is proposed to be augmented with 4 more satellites to make 11 satellite constellation with better coverage and accuracy.



IRNSS SPACE SEGMENT

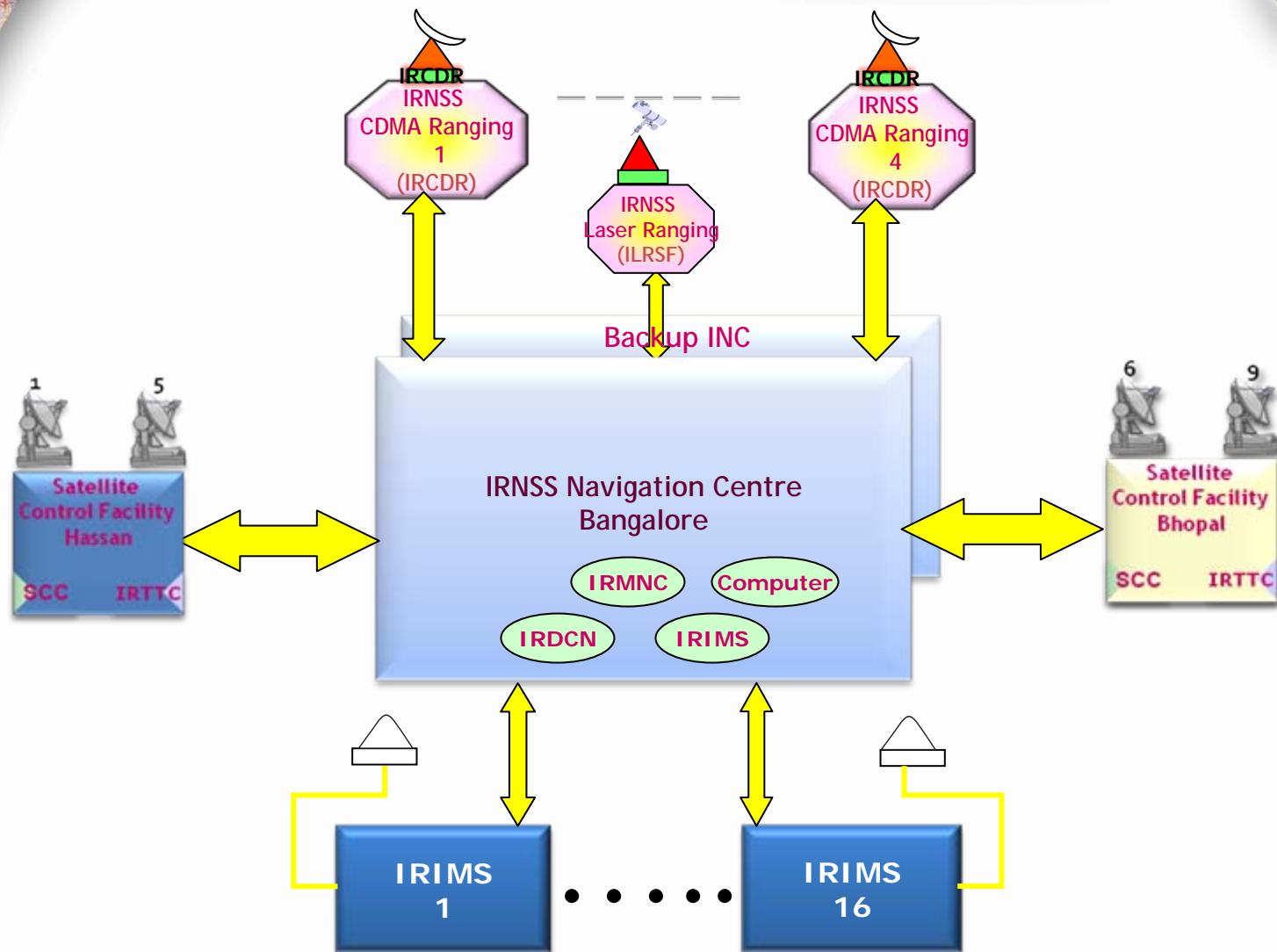
Indian Space Research Organisation



IRNSS- GROUND SEGMENT Architecture



Indian Space Research Organisation



IRNSS- GROUND SEGMENT Architecture

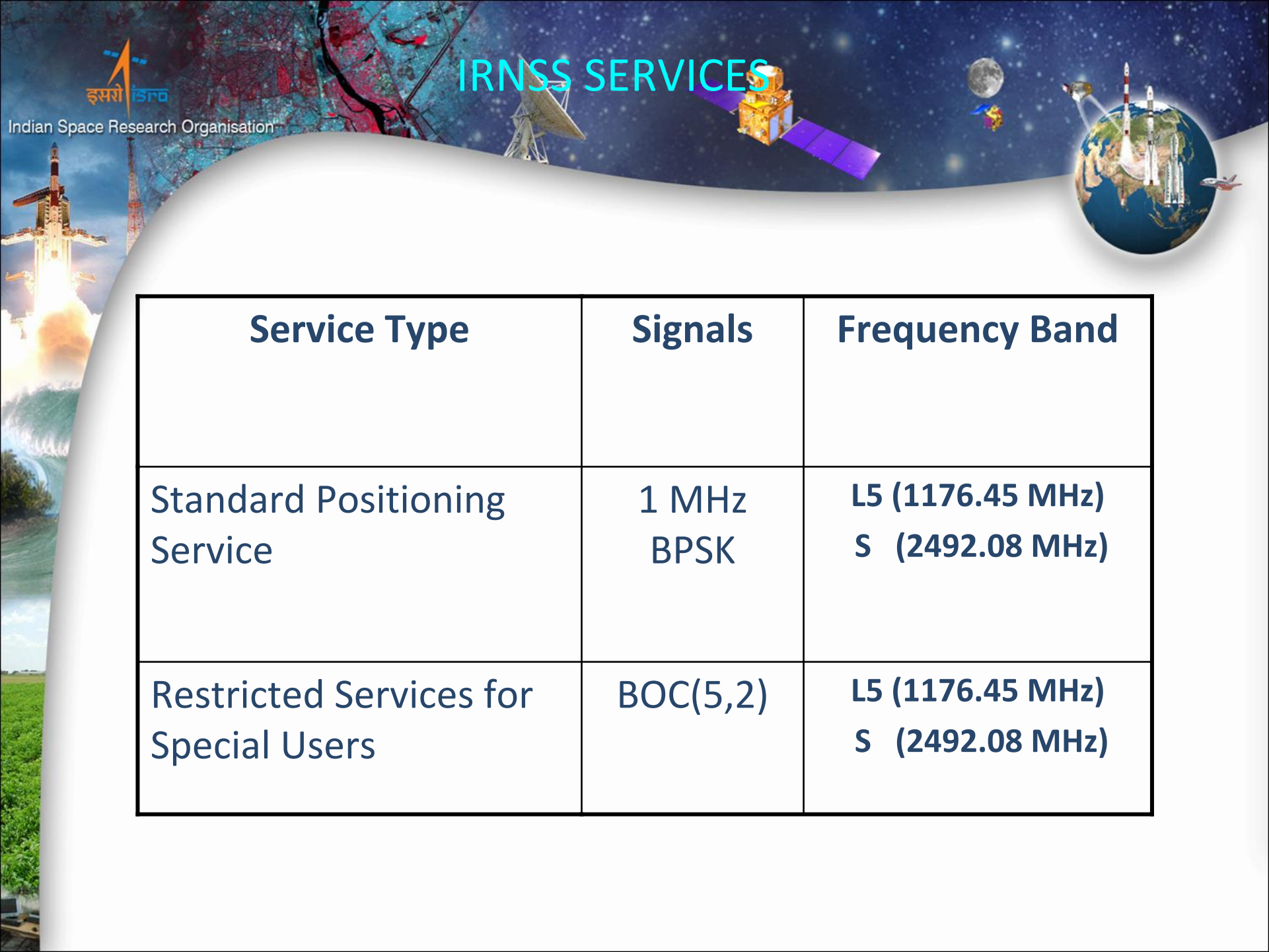
इसरो ISRO

Indian Space Research Organisation

- **IRNSS Navigation Control Facility (IRNCF)**
 - IRNSS Navigation Centre (INC) - 2 Nos**
 - IRNSS Network Time (IRNWT) - 2 Nos**
 - IRNSS CDMA Ranging Stations (IRCDR) - 4 Nos**
 - IRNSS Laser Ranging Service (ILRS)**
 - IRNSS Range and Integrity Monitoring Stations - 16 Nos**
 - IRNSS Data Communication Network (IRDCN)**

- **IRNSS Satellite Control Facility (IRSCF)**
 - IRNSS TTC & Land Uplink Stations (INLUS) - 9 Nos**
 - IRNSS Satellite Control Centre (IRSCC) - 2 Nos**

IRNSS SERVICES

The background of the slide is a vibrant space-themed collage. It includes a rocket launch on the left, a satellite in orbit in the center, a satellite dish on the ground, and a globe with a rocket and satellite on the right. The text 'IRNSS SERVICES' is overlaid in the upper center.

Service Type	Signals	Frequency Band
Standard Positioning Service	1 MHz BPSK	L5 (1176.45 MHz) S (2492.08 MHz)
Restricted Services for Special Users	BOC(5,2)	L5 (1176.45 MHz) S (2492.08 MHz)

IRNSS NAVIGATION SIGNALS

	SPS	RS
L5 (1176.45 MHz)	BPSK	BOC (5,2)
S band (2492.028 MHz)	BPSK	BOC(5,2)

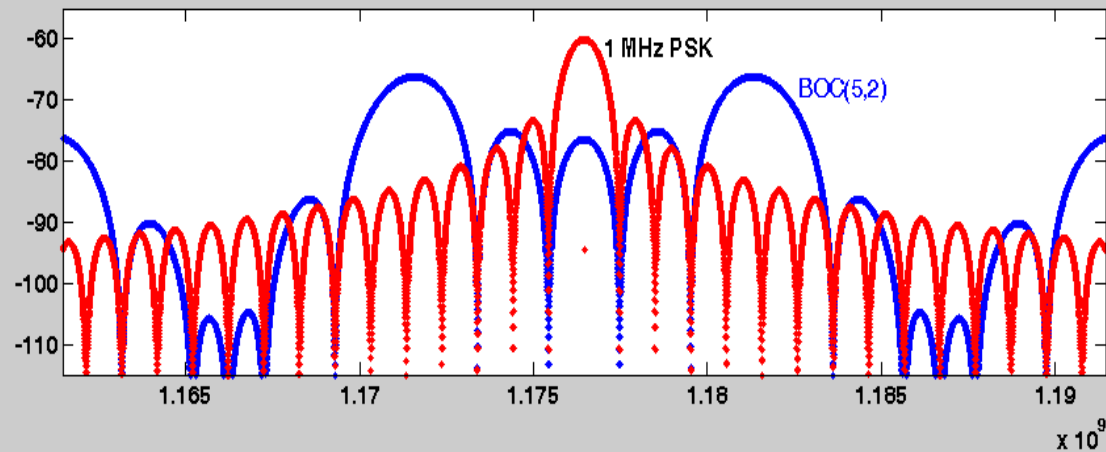
CDMA Ranging Frequencies

- Uplink : 6712 .0MHz (B.W 24MHz)
- Downlink : 3412 .0 MHz (B.W 24MHz)

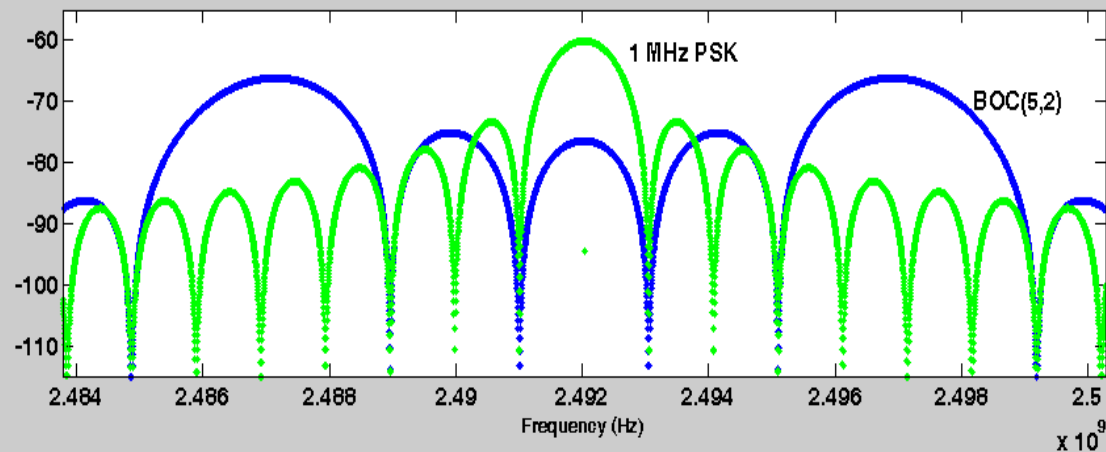
IRNSS NAVIGATION SIGNALS



IRNSS Signals (PSD in dBW) in L5 - Band: 1.023 PSK and BOC(5,2)



IRNSS Signals (PSD in dBW) in S - Band: 1.023 PSK and BOC(5,2)





Indian Space Research Organisation



THANK YOU

GNSS- Aviation Alert Limits



Service	HAL	VAL	Decision Ht.
RNP 0.1	0.2 nm	None	None
LP	40 m	Barometer	250 ft.
APV 1.5	40 m	50 m	250 ft.
LPV 200*	40 m	35 m	200 ft.
CAT-I	40 m	10-15 m	200 ft.

	<i>Accuracy</i>	<i>Integrity</i>	<i>Time-to-Alert</i>	<i>Continuity</i>	<i>Availability</i>
En route	3.7 km (H)	1-10⁻⁷ per hr	5 min	1-10⁻⁴/hr to 1-10⁻⁸/hr	0.99 to 0.99999
Terminal	0.74 km (H)	1-10⁻⁷ per hr	15 sec	1-10⁻⁴/hr to 1-10⁻⁸/hr	0.999 to 0.99999
Initial & Int Approach, NPA, Departure	220 m (H)	1-10⁻⁷ per hr	10 sec	1-10⁻⁴/hr to 1-10⁻⁸/hr	0.99 to 0.99999
APV-I	220 m (H) 20 m (V)	1-2x10⁻⁷ per approach	10 sec	1-8x10⁻⁶/hr in any 15 sec	0.99 to 0.99999
APV-II	16 m (H) 8 m (V)	1-2x10⁻⁷ per approach	6 sec	1-8x10⁻⁶/hr in any 15 sec	0.99 to 0.99999
CAT I	16 m (H) 6-4 m (V)	1-2x10⁻⁷ per approach	6 sec	1-8x10⁻⁶/hr in any 15 sec	0.99 to 0.99999

IRNSS NAVIGATION FRAME STRUCTURE



Indian Space Research Organisation

SUBFRAME 1	Fixed Format-- Ephemeris and clock parameters
SUBFRAME 2	Fixed Format-- Ephemeris parameters
SUBFRAME 3	Message Format-- Secondary parameters
SUBFRAME 4	Message Format-- Secondary parameters

Format
SUBFRAME 1 & 2

TLM	TOW	DATA	CRC	TAIL
8	22	232	24	6

Format
SUBFRAME 3 & 4

TLM	TOW	MSG ID	DATA	CRC	TAIL
8	22	6	226	24	6

FRAME STRUCTURE AFTER FEC

2400 bits @50bps

SUBFRAME 1	SUBFRAME 2	SUBFRAME 3	SUBFRAME 4
600 Symbols	600 Symbols	600 Symbols	600 Symbols

Structure for Master Frame

600 Symbols
Subframe

Sync Code
16 Bits

584 symbols

IRNSS Subframe Structure