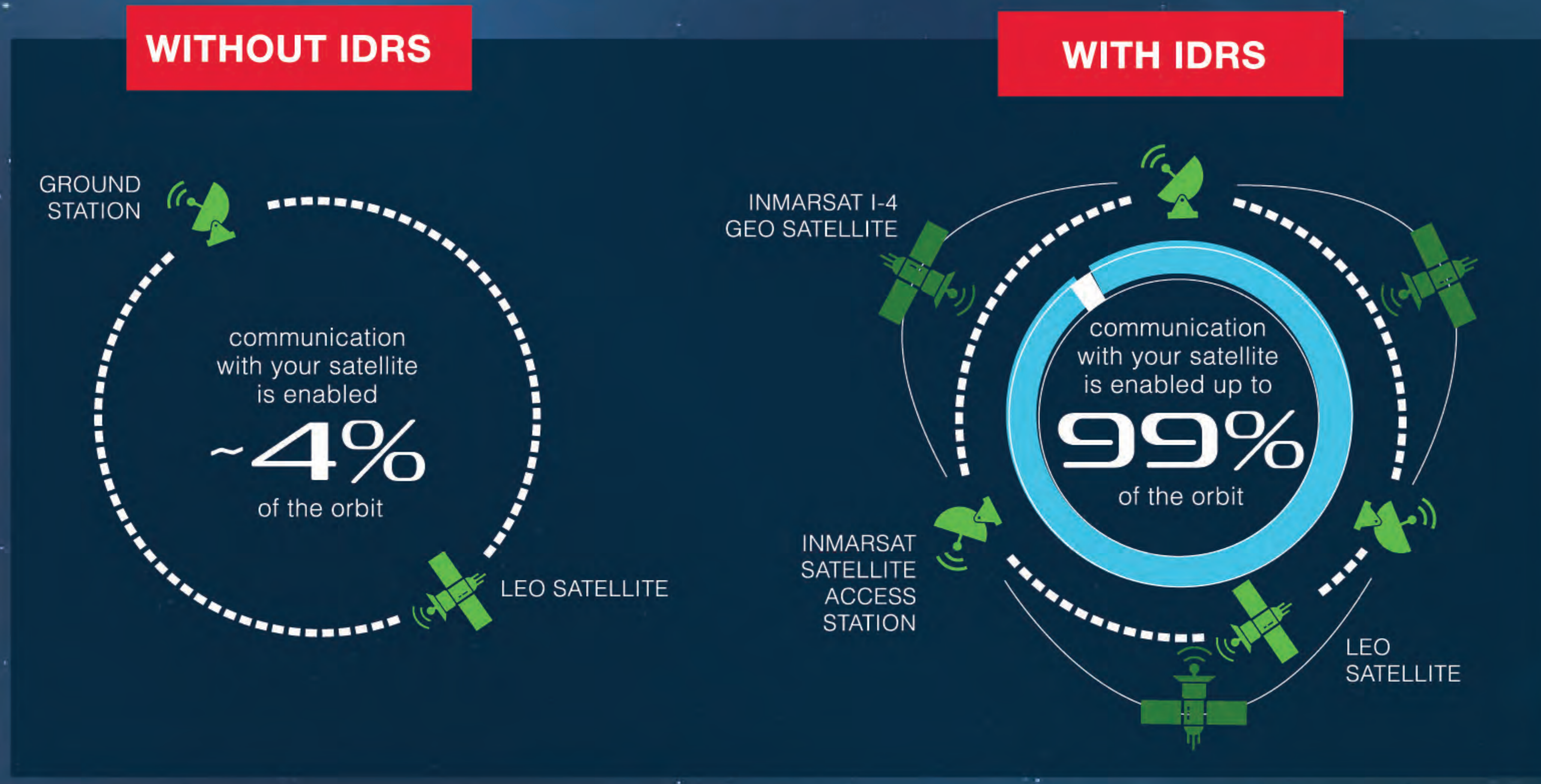


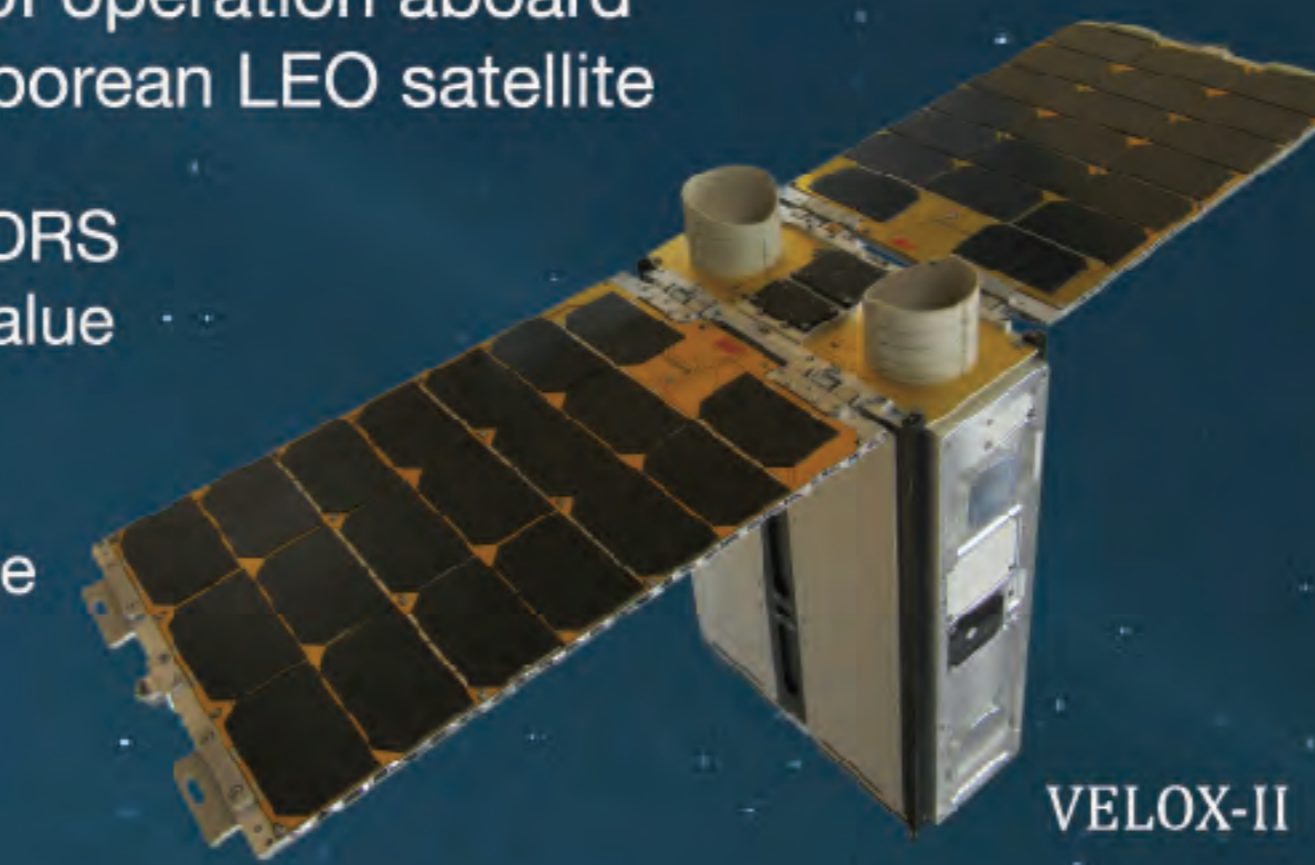
# Inter-Satellite Data Relay System (IDRS) for LEO Satellites Using a Commercially Available GEO Satellite System

## 1. Inter-Satellite Data Relay Service Overview IDRS Concept Explained



## 2. Addvalue IDRS Proof of Concept - Heritage Flight SPACE PROVEN

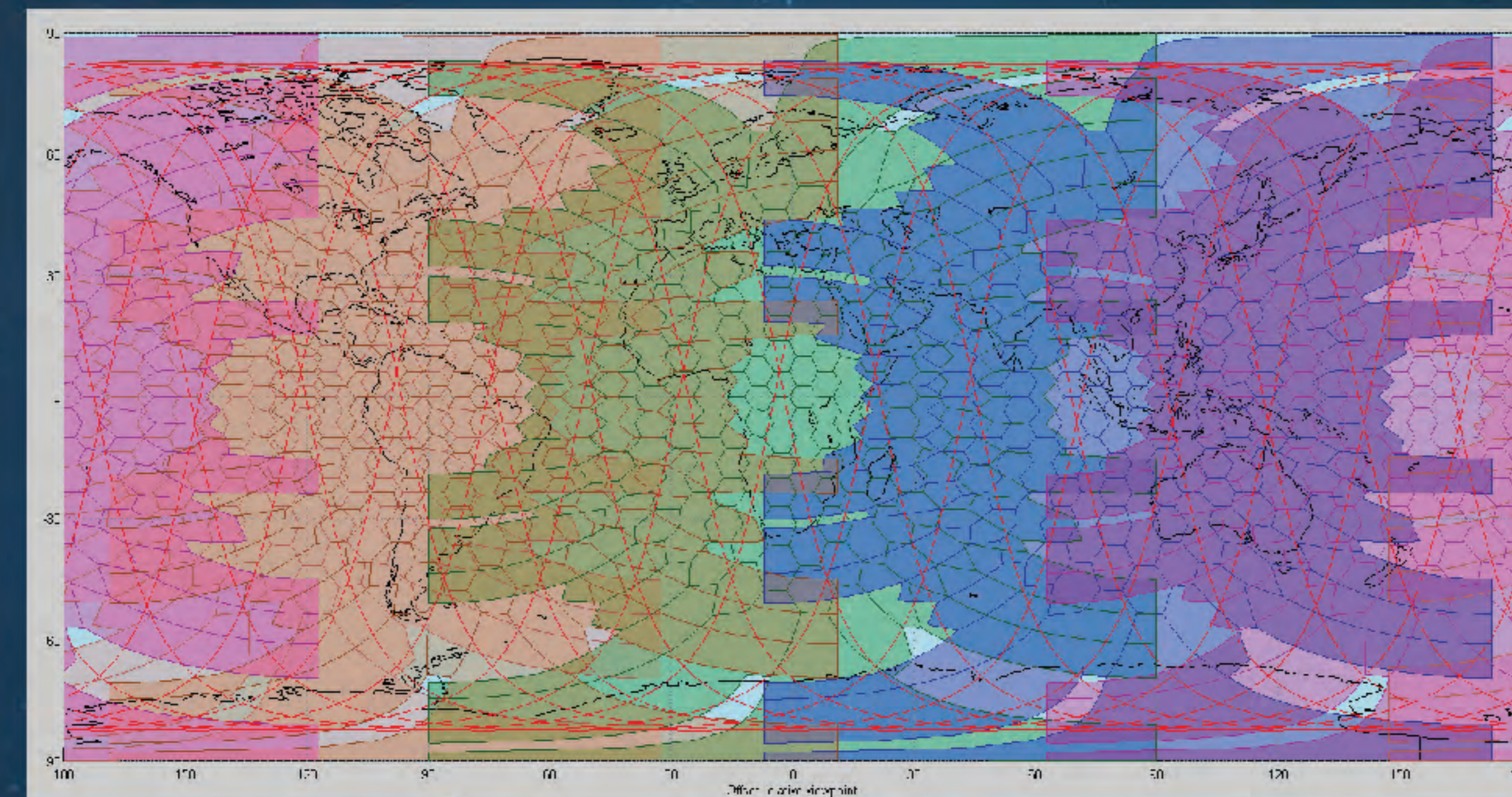
With over 14 months of operation aboard the VELOX-II, a Singaporean LEO satellite



- o Conducted in-orbit IDRS testing with an Addvalue designed and built BGAN terminal aboard a LEO satellite operating over the Inmarsat I4 satellite network
- o Demonstrated good quality IDRS functionality in orbit
  - o Established and maintained two-way, real time data sessions
  - o Confirmed Inmarsat BGAN network compatibility
- o Gathered useful data for the development of its commercial version
  - o Link margins and sustained data throughput over the orbit
  - o Antenna pointing regime, GPS receiver operation, and anomaly detection/ recovery methods
- o Hardware resilience

## 4. IDRS Service Capabilities

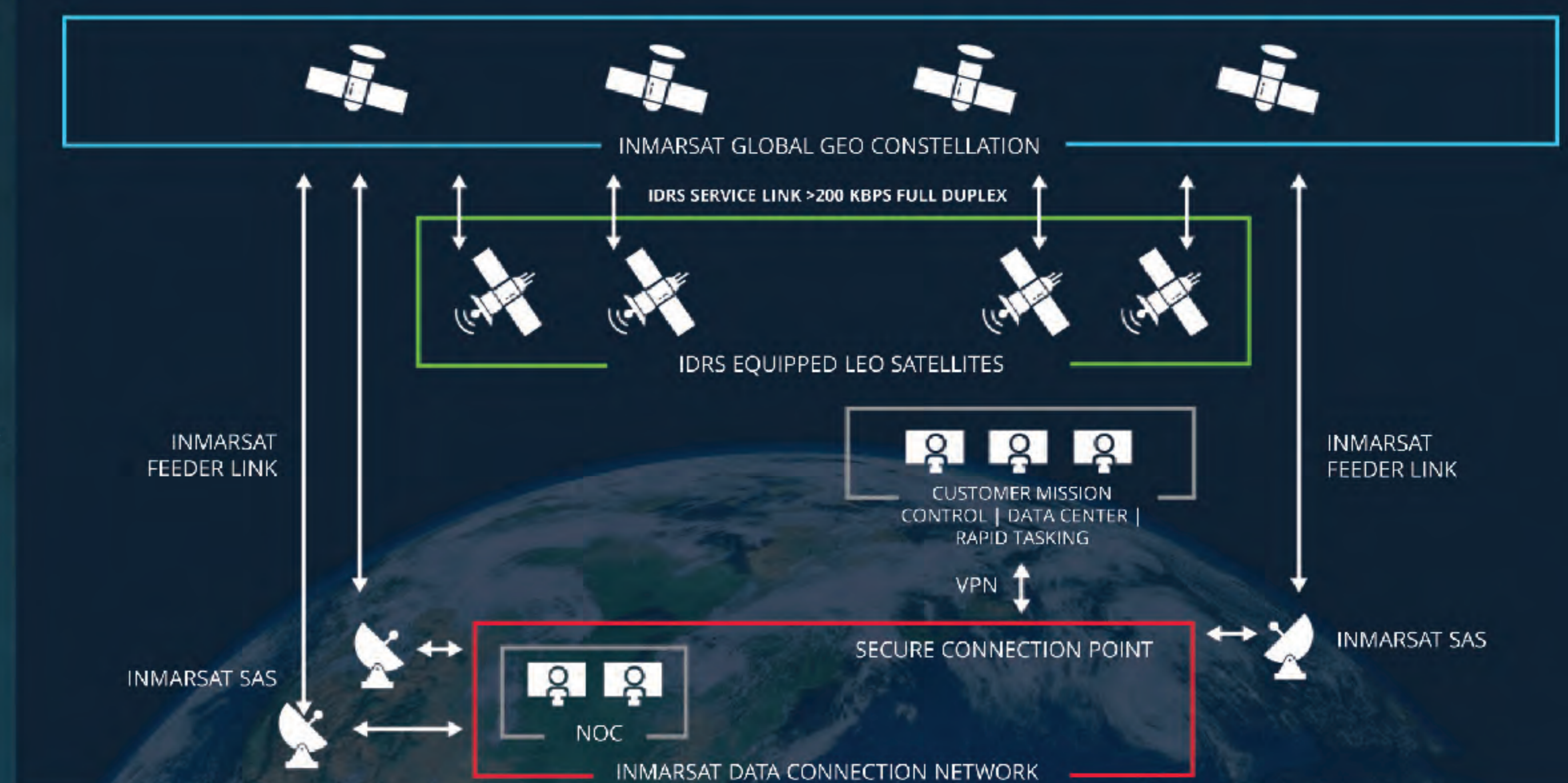
- o Uninterrupted IP -sessions while within Inmarsat GEO satellite coverage
- o A few seconds interruption only in satellite to satellite handovers



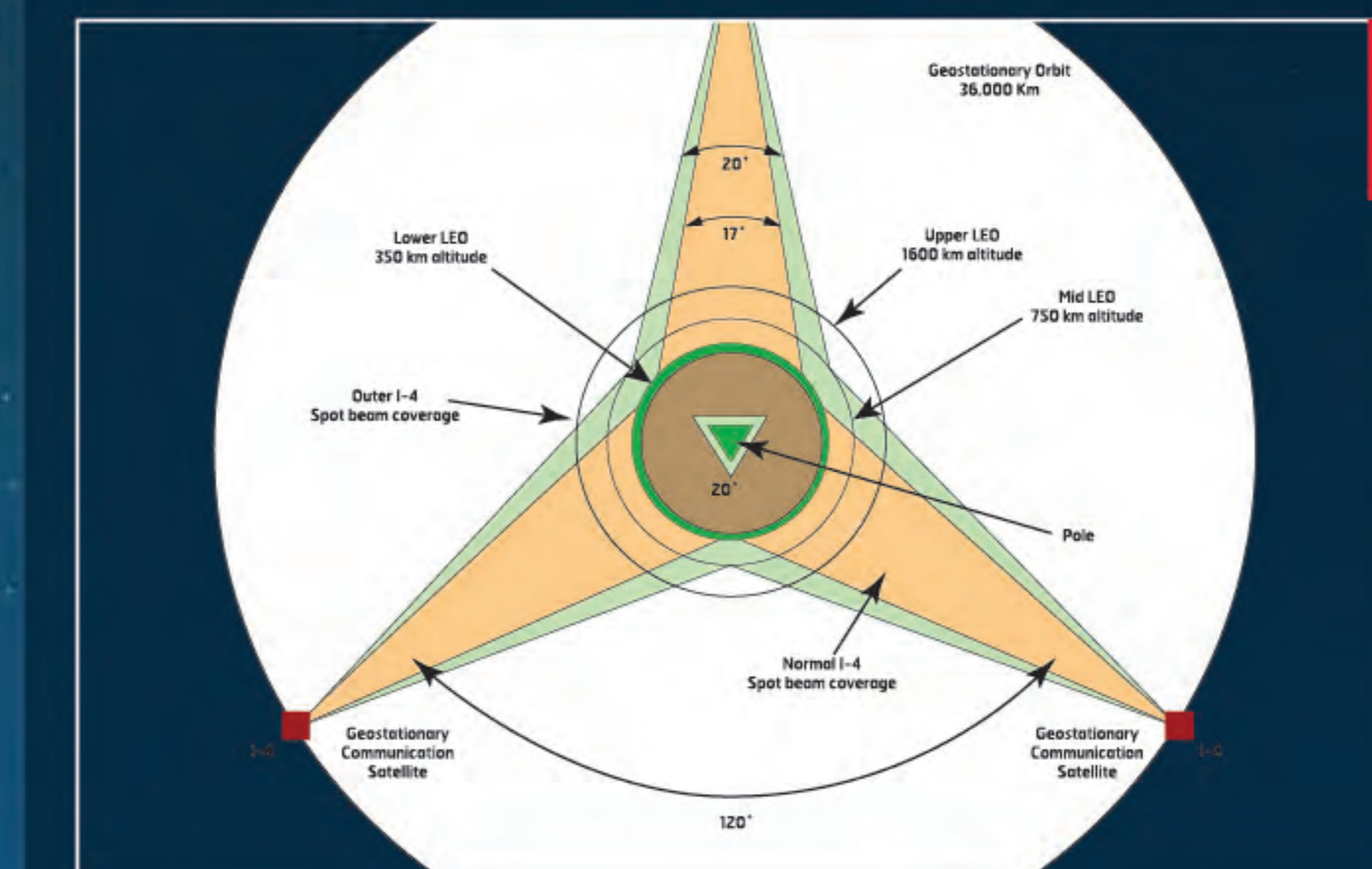
# THE WAIT IS OVER

## 3. The IDRS System

- The LEO spacecraft maintains real-time Full Duplex connectivity with the Inmarsat Data Connection Network via the IDRS Service Link to one of the visible Inmarsat-4 satellites and via the corresponding Feeder Link to one of the Inmarsat SAS's.
- The radio link between the IDRS terminal and the ground is secure and protected by a 3G-Cyphering protocol.
- The end-to-end IP data connection between the customer premises and LEO spacecraft is carried securely over the global and private Inmarsat Data Connection Network.



The final connection to the Customer Mission Control is carried securely either via VPN over open internet, or via a leased line. Each of the IDRS terminals is assigned a static IP address and its location is tracked by the mobility management function of the BGAN network. This allows instant connectivity to be initiated "On Demand" either by the LEO spacecraft or by Mission Control on the surface.



### GENERIC POLAR VIEW OF INMARSAT-4 CONSTELLATION

Illustrates the extended coverage provided by the Inmarsat-4 outer ring of spot beams (coloured in green). The coverage offered to the IDRS terminal depends on the LEO satellite altitude and inclination. Spacecraft below Mid-LEO altitudes would benefit from 80% and up to 100% coverage.

## 5. The IDRS Terminal

The IDRS terminal - a compact, low-mass, space-resilient and affordable communications terminal that would fit to LEO satellites of all sizes starting from 6-U Nano-satellites. The terminal is a core element in the IDRS data relay service for supporting LEO satellite operations.

### IDRS i100

The IDRS i100 terminal is designed to match the requirements of small LEO satellites down to 6-U Nano-satellites. The terminal is designed with an operational lifetime of 3 years in space. The terminal consists of a transceiver module plus one of three optional antenna configurations to match different satellite constraints, orbital characteristics and mission requirements.



POWER CONSUMPTION	
Rx mode:	< 7 watts
Tx mode:	
• Omni Ant:	< 40 Watts Peak
• Switched Ant:	< 32 Watts Peak
• Directional Ant:	< 25 Watts Peak
Average (TT&C+Tasking → 10% duty cycle)	
• Omni Ant:	< 10.3 Watts
• Switched Ant:	< 9.5 Watts
• Directional Ant:	< 8.8 Watts

### OVERVIEW OF TERMINAL DIMENSIONING

Antenna Type	Directional Antenna	Switched Antenna	Omni Antenna
Antenna Dimensions	Patch Ant. 200mm x 100mm	7 Segment Ant. 150mm x 270mm Or attached to top and side panels	ISOFLUX Ant. element 200mm x 20mm (Height x Diameter)
Transceiver type	i100 (1U)		
Transceiver Dimensions	125 x 96 x 70 mm <sup>3</sup>		
Transceiver Weight	< 1 Kg		
Antenna Design			
Antenna Weight	<150g	<2.8kg (incl Switching Module)	<1.2kg (incl Front-end Module)

## 6. IDRS – Applications and Benefits



## 7. Conclusions

- o IDRS provides "always on" on demand connectivity to LEO satellite
- o Space proven
- o Secure
- o Available globally
- o Affordable
- o Product and service are commercially available now