Bringing it all into view

QoS and QoE aspects of satellite-based Internet services

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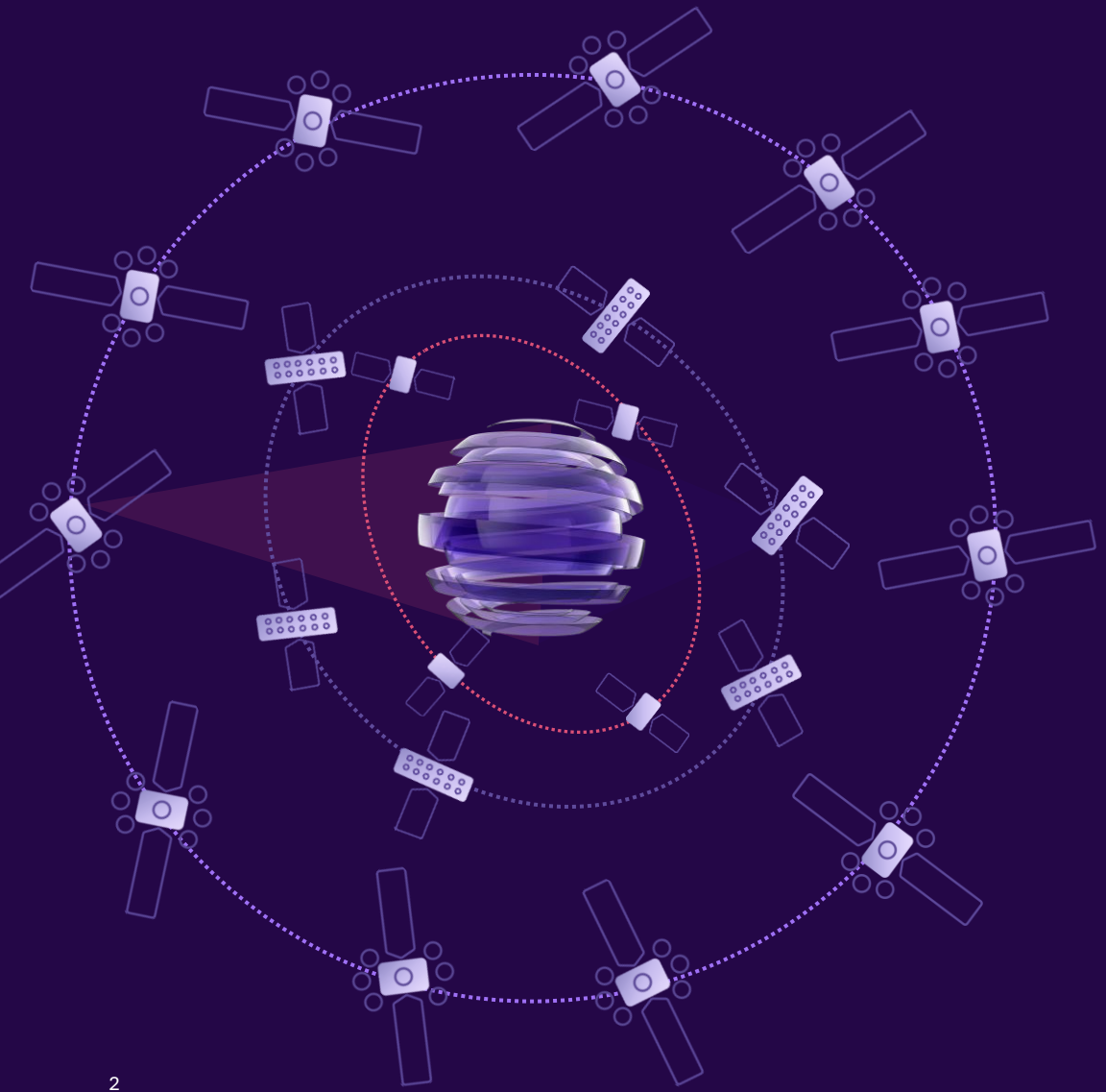
8th June 2026

The New SES: Our Multi-Orbit Fleet



Multi-orbit, multi-band satellite network of GEO, MEO, with strategic access to LEO satellites

GEO Geostationary Earth Orbit
~90 GEO
Unparalleled reach

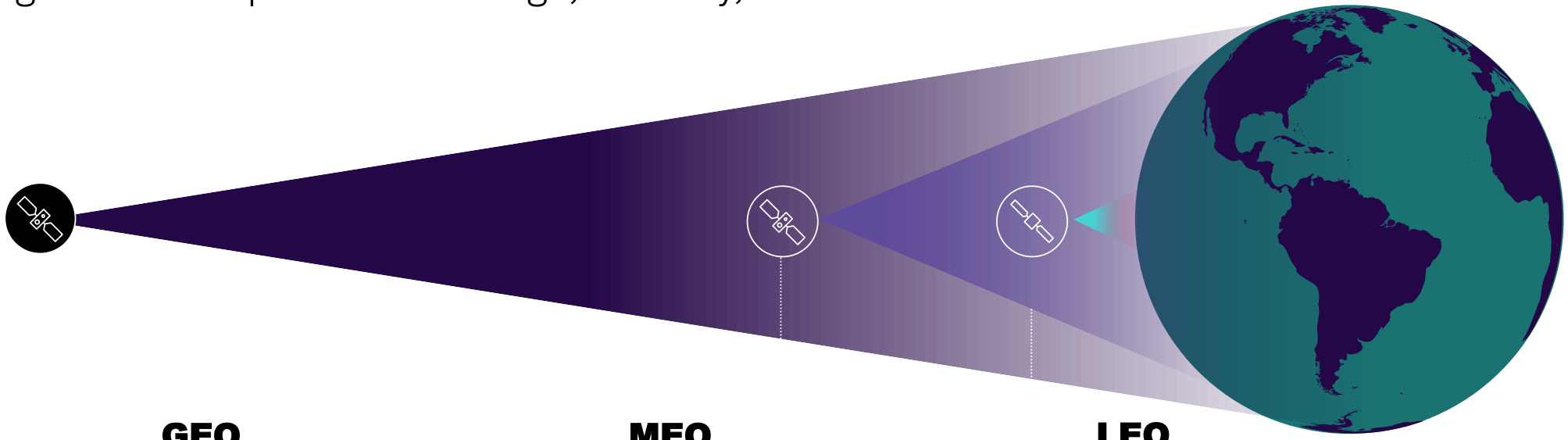
MEO Medium Earth Orbit
~30 MEO HTS (O3b & O3b mPOWER
Fiber-equivalent data connectivity

LEO Low Earth Orbit
100s Through strategic partner constellations
Lower-latency coverage

Seamless integration and orchestration between orbits based on application

SES Multi-Orbit Architecture: Use Cases per Application

Combining Orbits to Optimise Coverage, Latency, and Performance



GEO	MEO	LEO
~40,000Km, High Latency, 1-50 Mbit	~8,000Km Low Latency, 100Mbit-10Gbit	<1,000Km Lowest Latency ~150Mbit
Well known – Highest reliability	Enterprise Reliability	Adequate Reliability

SCADA
Asset Mgmt
Cloud Workloads
Autonomous Vehicles
Worker Welfare
Email/Messaging
Realtime Surveillance
Remote Ops
Video Conf.
Enterprise Apps
Emergency Comms
Remote Experts
Machine Sight
Non-Crit Comms
Public Internet

Quality of Service vs. **Quality of Experience**

Elevating the SLA through focusing on customer experience

Quality of **SERVICE**	
Latency	Responsive to internet requests of the network
Jitter	Reduce the variation in Latency
Capacity	Accommodate the needs of all passengers onboard
Availability	The network is reliable and present throughout the flight
Packet Loss	The connection is stable and consistent throughout the flight

Quality of **EXPERIENCE**	
Send & Receive Email	**“I want to be able to send and receive a 10MB file quickly”**
Responsive Web Pages	**“I want readable content on my favorite sites just like at home”**
Video Performance	**“I want Netflix to begin quickly and play without interruption (buffering)”**
Messaging & Social Media	**“I want acknowledgement of success for my posts and messages”**
Cloud Workloads	**“I need to remain connected to my Enterprise Applications everywhere”**

Case Study: The SES Service Level Agreement for In Flight Connectivity

Quality of Service

CIR Plan: Committed Information Rates to the aircraft.

Aircraft Availability: The percentage of time service is up and running for your passengers.

Network Availability: The percentage of time our network is up and running for your passengers.

Data Speed: The raw data speeds in Mbps delivered, measured at the device level; using an n+1 methodology.

Quality of Experience

Streaming Video: Number of Rebuffering Events
Does my video keep stopping to load?

Service: Service Availability
Am I able to get online and stay connected?

File Transfer: Time to Send or Receive Files
Can I send an attach and send a file over email?

Web Browsing: Web Page Load Times
Can I stay up to date with the content I care about?

Use Case: SES SLA Approach

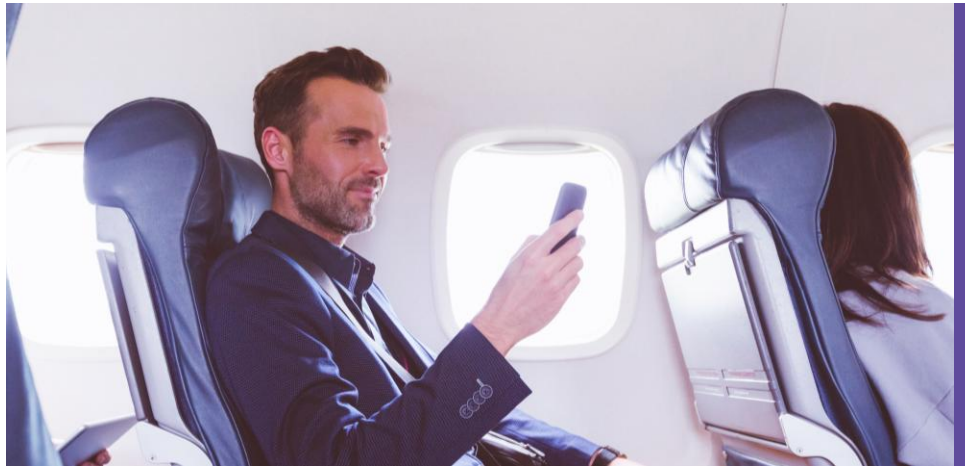
Deliver Excellent Service on all orbits

QoE	Success Criteria	NGSO	GEO
Video Streaming Start-up Delay	Measured once per hour of flight time, at least **90%** of videos will start on or under ___ **sec**		
Video Streaming Rebuffering Events	Measured once per hour of flight time, at least ___**%** of videos will present **zero** rebuffering events		
Webpage Load Time	Measured once per hour of flight time, at least **90%** of websites will render on or under ___ **sec**		

- In addition to these measurements SES offers SLAs for latency, speed and availability
- Measurements are taken at least once per hour but never less than once per flight

Understanding QoE In Flight

We support multiple, transparent, customer-centric measurement



Monitoring QoE allows us to **gauge passengers' satisfaction** with the service. We do this directly and indirectly.

SES-Driven Insights

- **N+1 QoE monitoring**
- **Flight-level QoS Scoring + Survey**
- **Application-level QoE (in developmet)**

Third-Party Monitoring

- **SES can also host applications from neutral 3rd parties that constantly probe the network**

Webpage Load ***Video Startup*** ***Video Playback*** ***Availability*** ***Speed***

Thank you