MEO RELAY & REALTIME TASKING

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Agenda

1. **Intro to SES & O3b mPOWER**
2. **MEO Relay Concept**
   - A. Potential benefits with O3b mPOWER
   - B. On LEO terminals
3. **Opportunity to Unlock Value**
4. **Discussion**

Leader in Global Content Connectivity Solutions

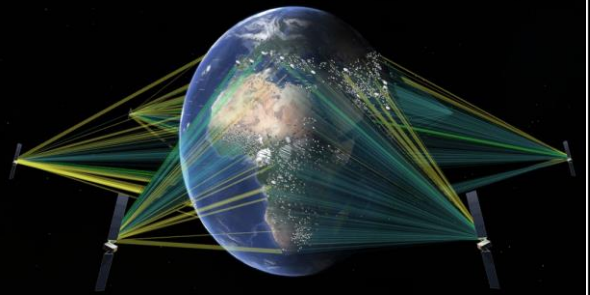
SES

O3b mPOWER

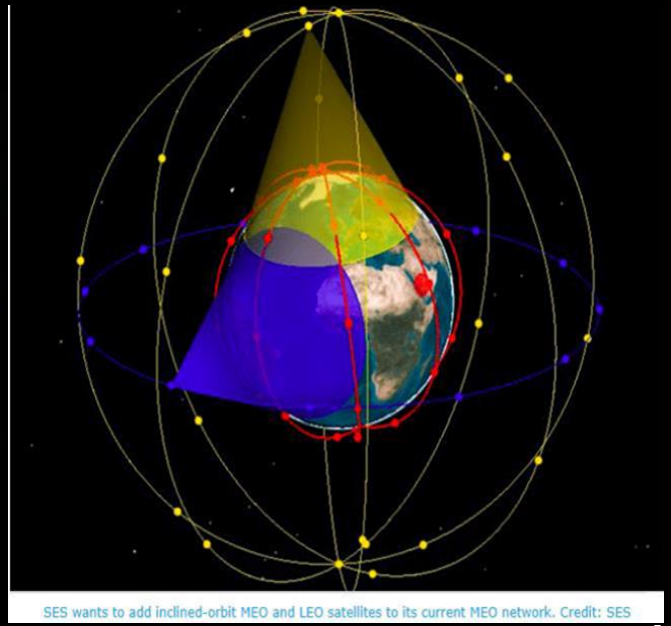
ENGINEERING FREEDOM

Our journey with high-throughput, low-latency MEO satellite communication systems

2014	2016	2018	2020	2023	Next?
O3b MEO start of service at 12 satellites	Mobility, Telco, Energy Government success	Scale O3b MEO to 20 total satellites	O3b mPOWER development	O3b mPOWER start of service	Go Polar, Gen. 3 MEO



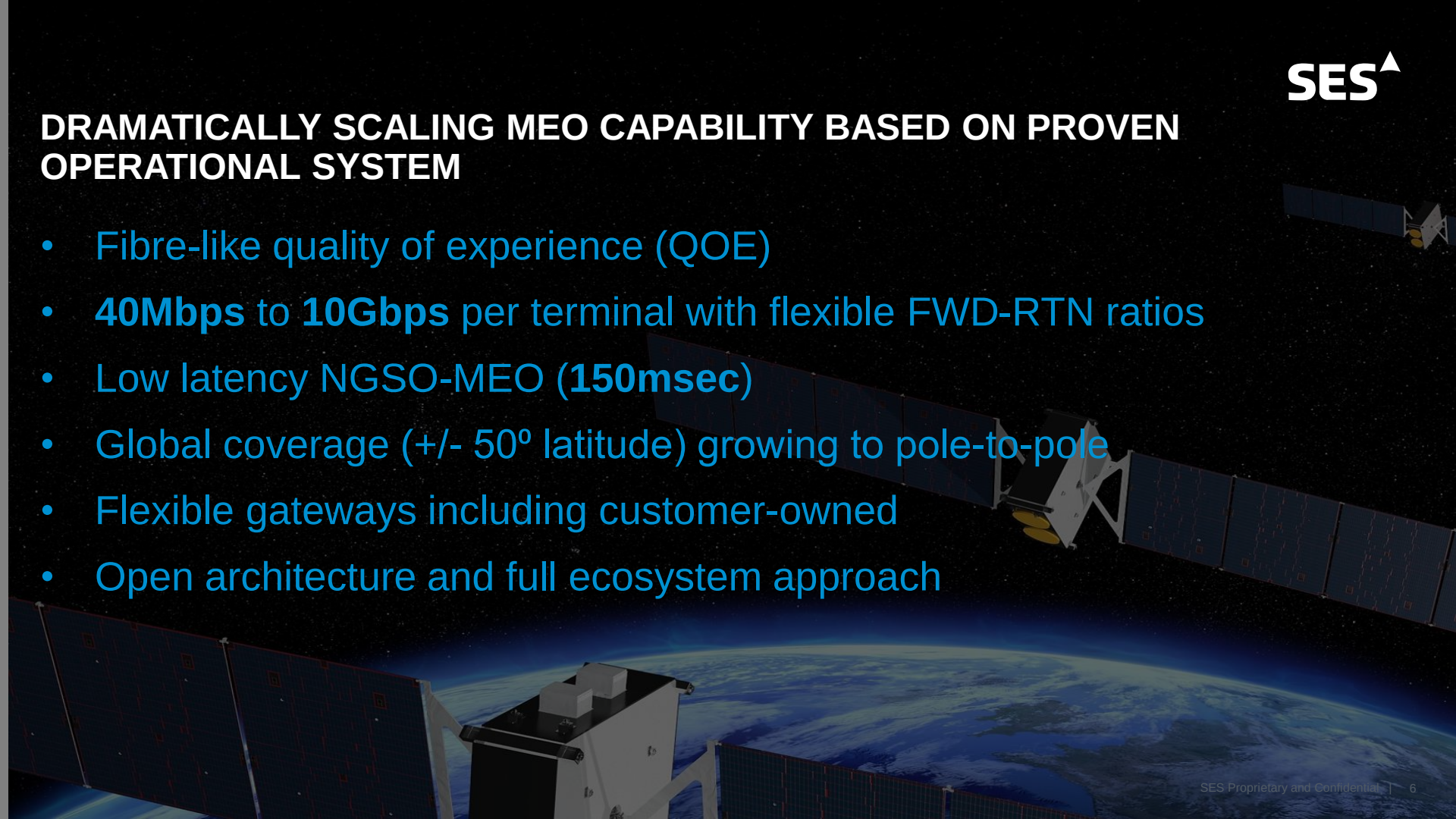
MEO Evolution
Unparalleled throughput, flexibility & scale



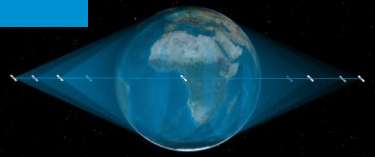
SES wants to add inclined-orbit MEO and LEO satellites to its current MEO network. Credit: SES

DRAMATICALLY SCALING MEO CAPABILITY BASED ON PROVEN OPERATIONAL SYSTEM

- Fibre-like quality of experience (QOE)
- **40Mbps** to **10Gbps** per terminal with flexible FWD-RTN ratios
- Low latency NGSO-MEO (**150msec**)
- Global coverage (+/- 50º latitude) growing to pole-to-pole
- Flexible gateways including customer-owned
- Open architecture and full ecosystem approach



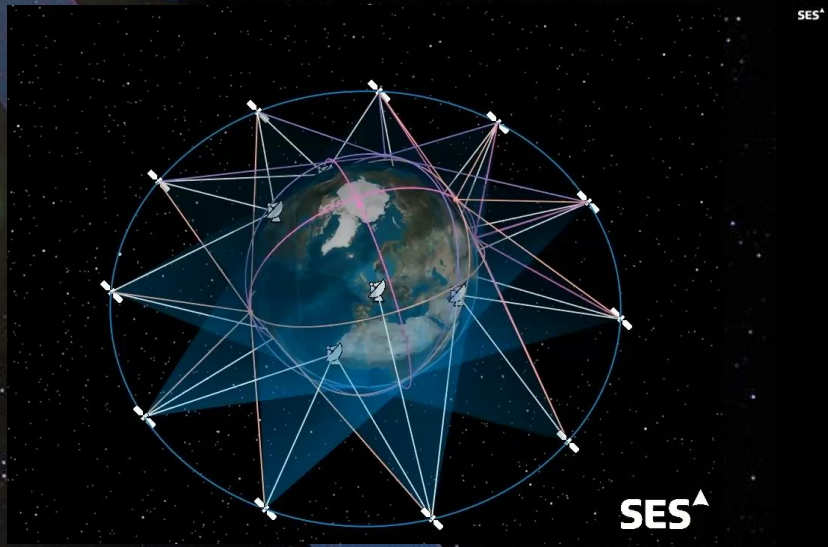
mPOWER Equatorial



Earth Observation / Data Relay Connectivity
O3b mPOWER equatorial RF Relay Service Overview

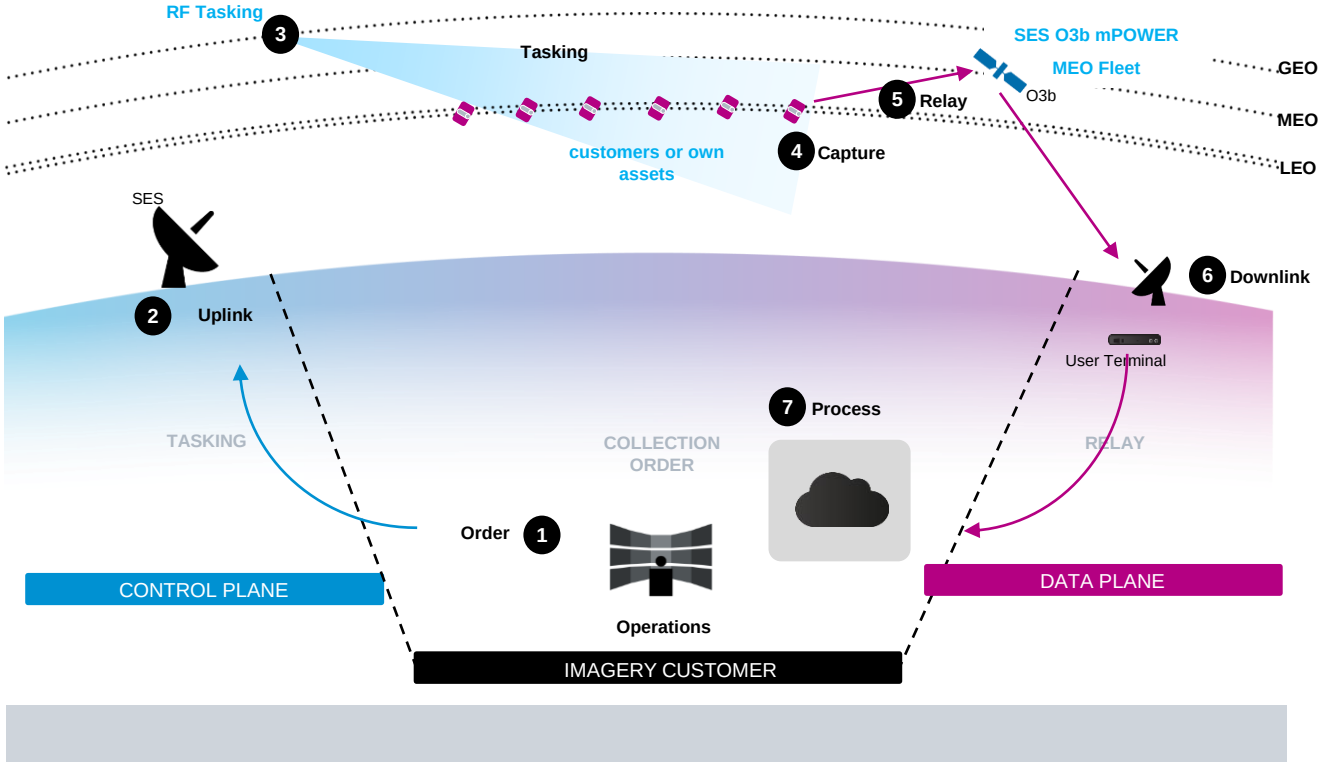
- **Equatorial mPOWER field of view** – MEO orbit allows continuous tracking of LEO spacecraft at almost any latitude
- **Space relay to ground from anywhere** – With its ability to dynamically generate and commission beams, mPOWER can relay LEO data to ground from anywhere along the LEO's track.
- **High downlink flexibility** – Downlink to virtually anywhere in +/-50 latitude. Through SES Managed Gateways or Directly to a customer ground terminal or both
- **Real-time - Downlink just after acquisition** and even real time video.
- Up to 1Gbps data rates achievable depending on terminal size

O3b mPOWER can relay your ISR/Earth Observation data
(from LEO or UAVs)
when and where you need it

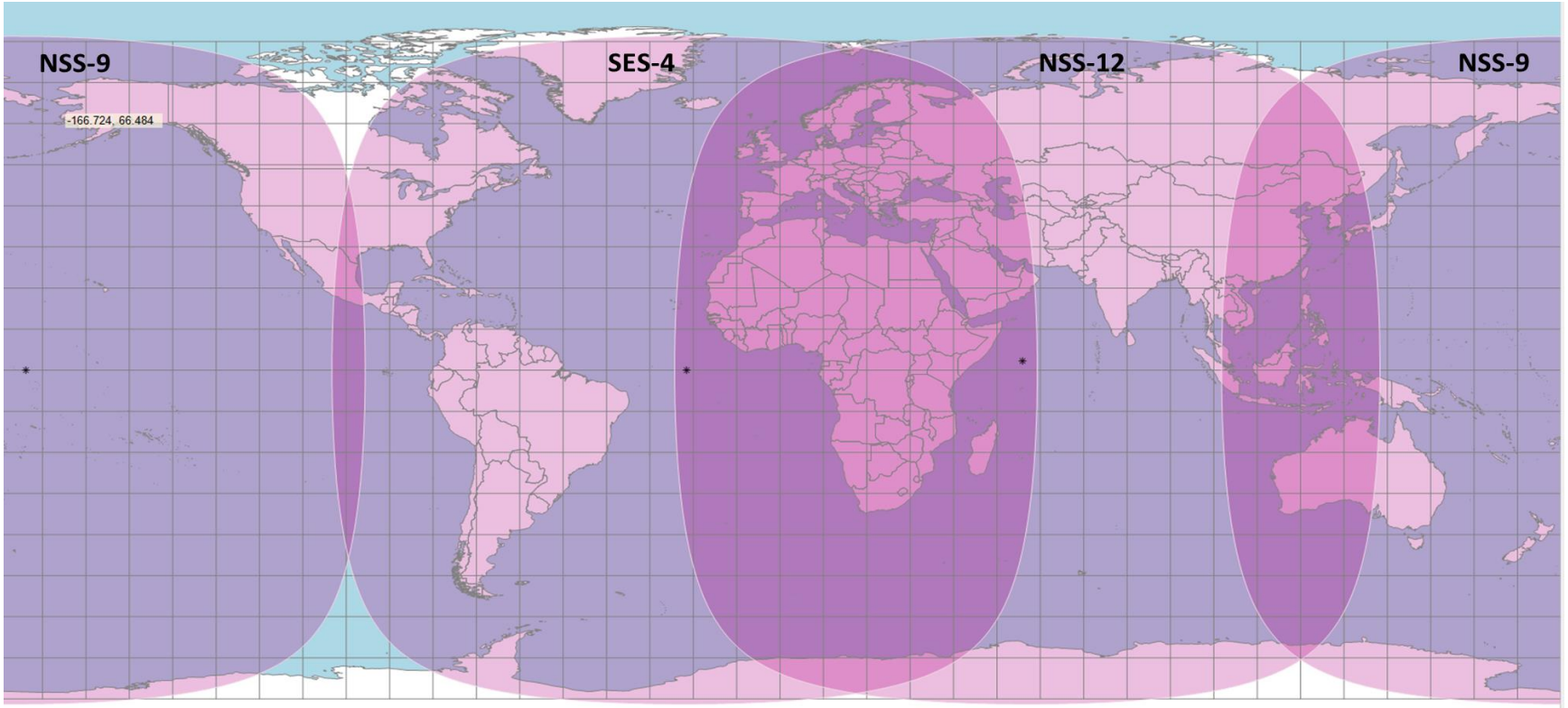


Animation of 11 O3b mPOWER providing data relay services to a 6 LEO satellites in 2xsun-synchronous + 2x 50degree + 2x 40 degree inclined planes.
All possible links over time are shown MEO-LEO.
An arbitrary selection of ground locations has been used.

SES O3b mPOWER Ka MEO Downlink Relay Concept



C-band Global Coverage Maps

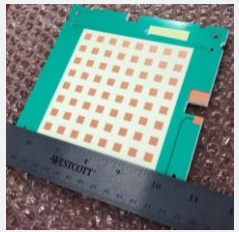


LEO data relay: Example of RF terminals

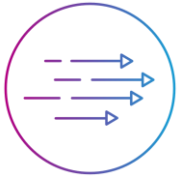
- Thinkom VICTS
  - https://www.thinkom.com/satellite-payload-antennas/
  - Possibly the best overall solution due to compactness, thus low drag (with respect to deployable or gimbal-based dishes), and better efficiency (wrt ESA/Flat panels)
  - But requires one aperture for Tx and another for Rx

- Steerable dish
  - https://www.tendeg.com/products
  - Key strengths being: 0dB scan loss, deployable (aperture size not limited to deck size) and Tx/Rx or even multiband in same aperture.
  - But will lead to larger drag and it is perceived as a high risk if it needs to deploy.

- Flat Panel Phase Array
  - Several LEO platform manufacturers could propose a flat panel.
  - Possibly the lower cost and most compact solution.
  - Poor aperture efficiency and limited scan range due to scan loss impact. Requires different Tx and Rx apertures.



Opportunity to Unlock Value



REAL TIME DELIVERY

- Continuous, virtual contact channels within each mPOWER MEO region
- Send imagery immediately any time
- No Gaps: no waiting for ground station pass

OCEAN COVERAGE

- 70% of globe is ocean
- Instantly downlink Ocean imagery
- Eliminate gaps due to ocean flyover
- Offer real-time naval/maritime value

NO CONTACT GAPS

- Always-available MEO-to-ground relay.
- Overcome contact gaps over ocean, huge inaccessible landmasses (regulatory)

SCALE GLOBALLY

- Virtual Downlink contact while imaging anywhere over inhabited earth – all with a single service
- Add regional or global real-time downlink capability
- Time-to-market: Bypass in-country delays & barriers

IN-THEATRE REAL-TIME

- Overcome lack of in-theatre/near-theatre downlinks
- SES MEO Relay extends real-time connectivity to LEO during In-Theatre fly over, without need to rely on nearby ground assets for downlink

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