# CLOSE-UP WITH SES

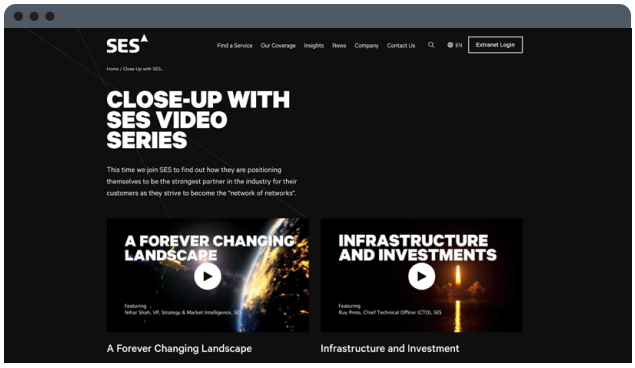
SES

# CONTENTS

# ABOUT THIS HANDBOOK

This handbook is a supplement to the Close-Up with SES video series. In each section, you'll find a brief overview of the topics discussed, descriptions and visual representations of key concepts, and an opportunity to dive deeper into the subject.

## WATCH THE VIDEOS




**Close-Up with SES** >

## KEY TERMS

**GEO**
Geostationary Earth orbit

**MEO**
Medium Earth orbit

**LEO**
Low Earth orbit

**Latency**
The delay in data transmission from one communication endpoint to another

**NGSO**
Non-geostationary Earth orbit

**HTS**
High-throughput satellite

**SD-WAN**
Software-defined wide area network

**ARC**
Adaptive Resource Control—a dynamic software solution that automates load balancing, traffic prioritisation, and switching between orbits

**SLA**
Service level agreement, covering throughput, latency, and availability

**MEF**
MEF, originally known as the Metro Ethernet Forum, is an industry forum leading the development of a global federation of network, cloud, and technology providers

**ONAP**
ONAP or the Open Network Automation Platform, is a comprehensive platform for orchestration, management, and automation of network and edge computing services for network operators, cloud providers, and enterprises

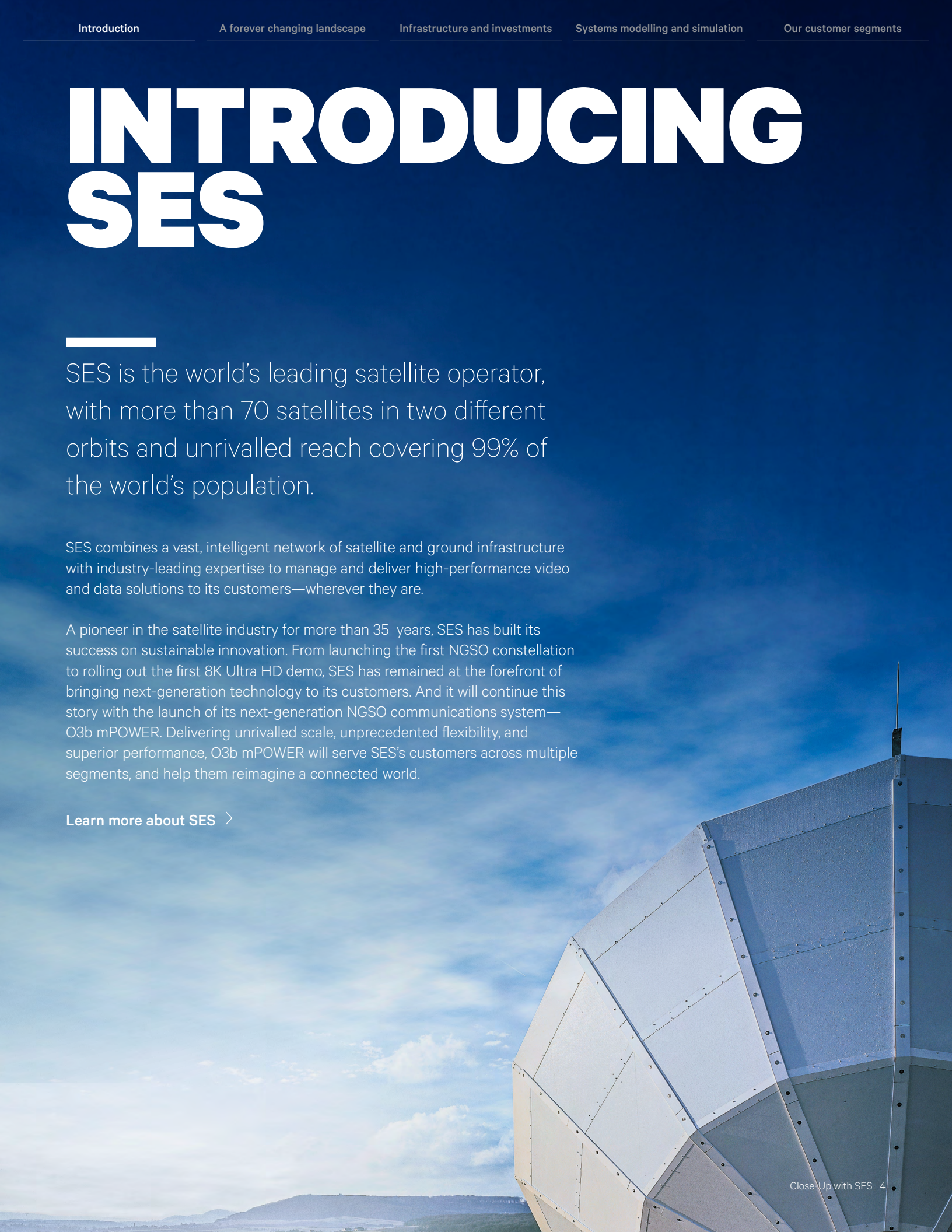
# INTRODUCING SES

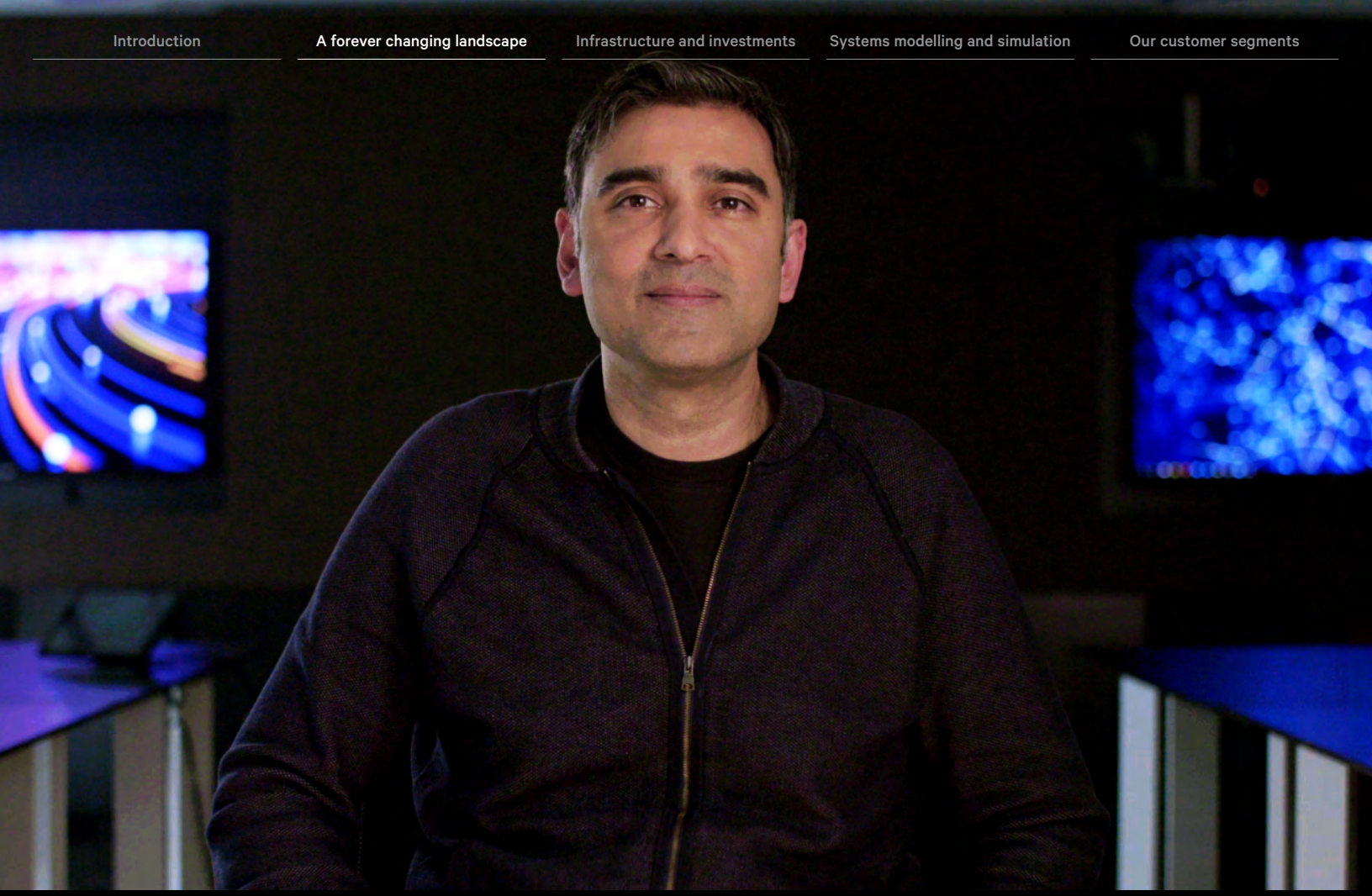
SES is the world's leading satellite operator, with more than 70 satellites in two different orbits and unrivalled reach covering 99% of the world's population.

SES combines a vast, intelligent network of satellite and ground infrastructure with industry-leading expertise to manage and deliver high-performance video and data solutions to its customers—wherever they are.

A pioneer in the satellite industry for more than 35 years, SES has built its success on sustainable innovation. From launching the first NGSO constellation to rolling out the first 8K Ultra HD demo, SES has remained at the forefront of bringing next-generation technology to its customers. And it will continue this story with the launch of its next-generation NGSO communications system—O3b mPOWER. Delivering unrivalled scale, unprecedented flexibility, and superior performance, O3b mPOWER will serve SES's customers across multiple segments, and help them reimagine a connected world.

**Learn more about SES** >





## A forever changing landscape

# MEET NIHAR SHAH

Nihar Shah heads Strategy and Market Intelligence at SES. His team analyses trends in the market, gains insights into our competitors' business strategies, and evaluates our customers' future needs to make strategic decisions that drive SES forward in a rapidly evolving industry.

In this video, Nihar discusses key drivers of change in the satellite industry—including orbital constellations, technology, and end-user demand.

**Watch the video** >

# THE SATELLITE INDUSTRY—A FOREVER CHANGING LANDSCAPE

## A brief overview

In the last decade, the satellite industry has seen massive change—from the satellite technology itself to the end-user applications that rely on satellite communication.

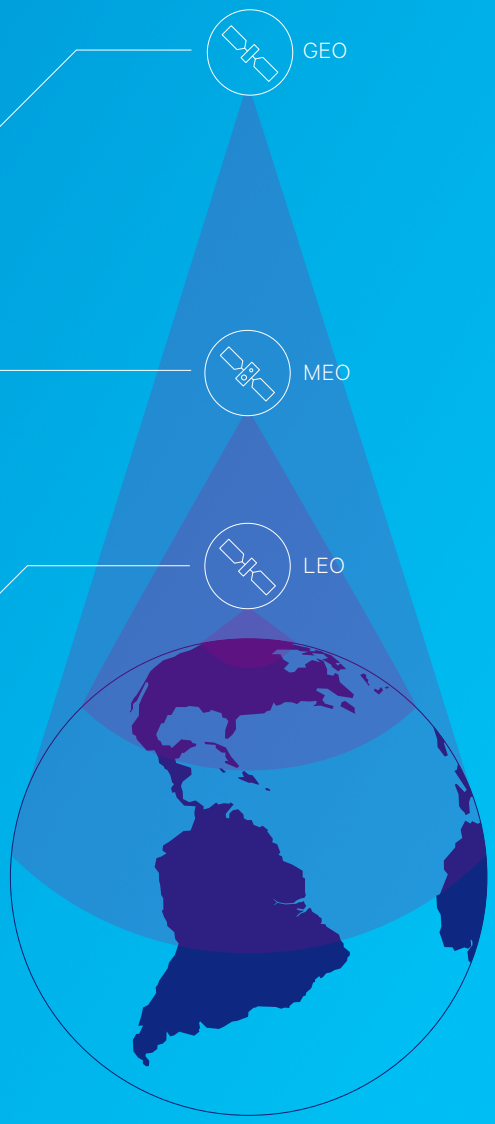
## ORBITAL CONSTELLATIONS

How we deliver satellite networks today is one of the biggest changes in the industry. The need to deliver low-latency performance is driving the shift towards orbital constellations in NGSO.

**GEO**
At 36,000km, GEO satellites provide very broad coverage, yet also introduce latency.

**MEO**
At 5,000 to 20,000km, MEO satellites provide broad coverage with low-latency performance.

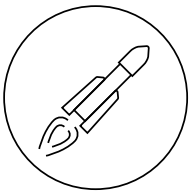
**LEO**
At 500 to 1,200km, LEO satellites provide very low latency with very narrow coverage.




**Orbital altitude determines latency performance**

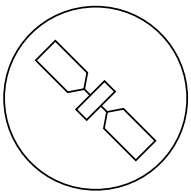
# INNOVATIONS IN TECHNOLOGY

Over time, multiple aspects of the technology used in satellite communications have seen quantum improvements.



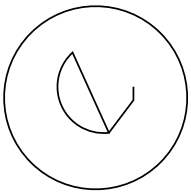
## LAUNCH SYSTEMS

SpaceX has completely revolutionised satellite launch systems, making reusability a central tenet—the same vehicle is used multiple times, massively lowering the cost to deliver payloads into space.



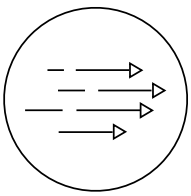
## SATELLITES

Today, satellites can deliver higher throughputs, allocated intelligently based on usage patterns on Earth. Additionally, more efficient batteries and solar panels increase the longevity of satellites in space.



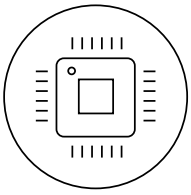
## GROUND TERMINAL TECHNOLOGY

The miniaturisation of antennas allows for quicker and easier installation processes, while increasing flexibility and reliability. Antennas with digital components can access different bands and orbits, and work well in high mobility use cases.



## MODEM TECHNOLOGIES

Innovation in the cellular industry has allowed us to learn how to increase efficiency in transmission.



## SOFTWARE

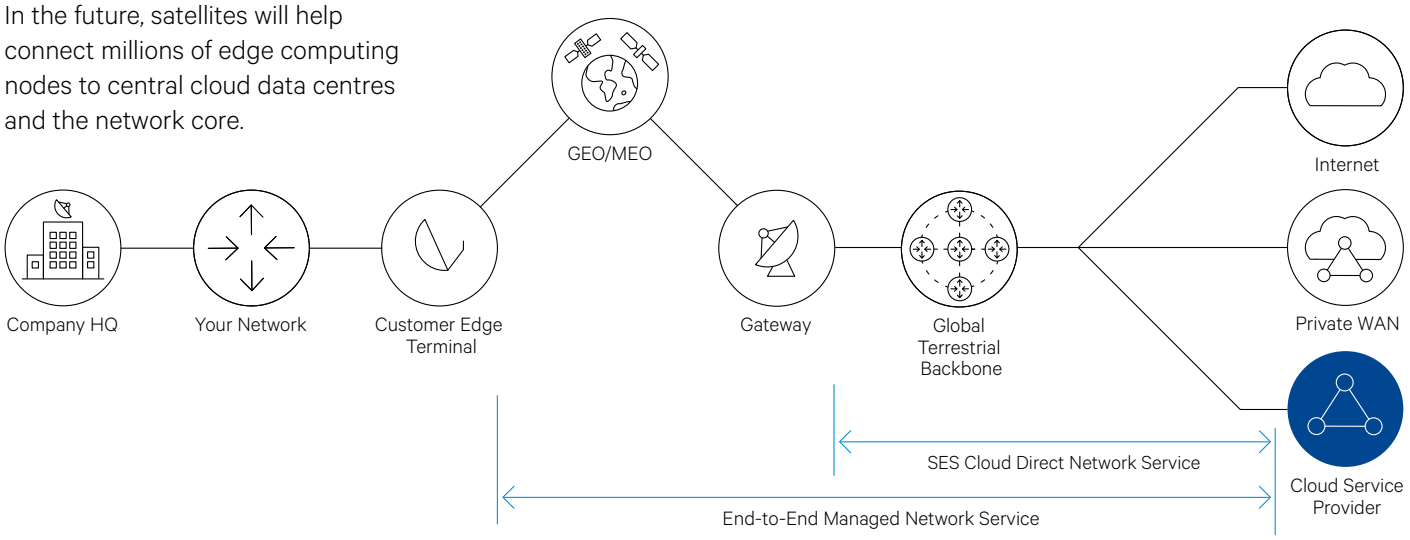
Intelligence gained from software used to control, orchestrate, and optimise telecommunication networks has been funnelled into the satellite industry to make satellite networks more efficient, intelligent, and adaptive.

# END USER DEMAND

One of the most profound changes in the satellite industry has been the evolution of end-user applications in the last decade.

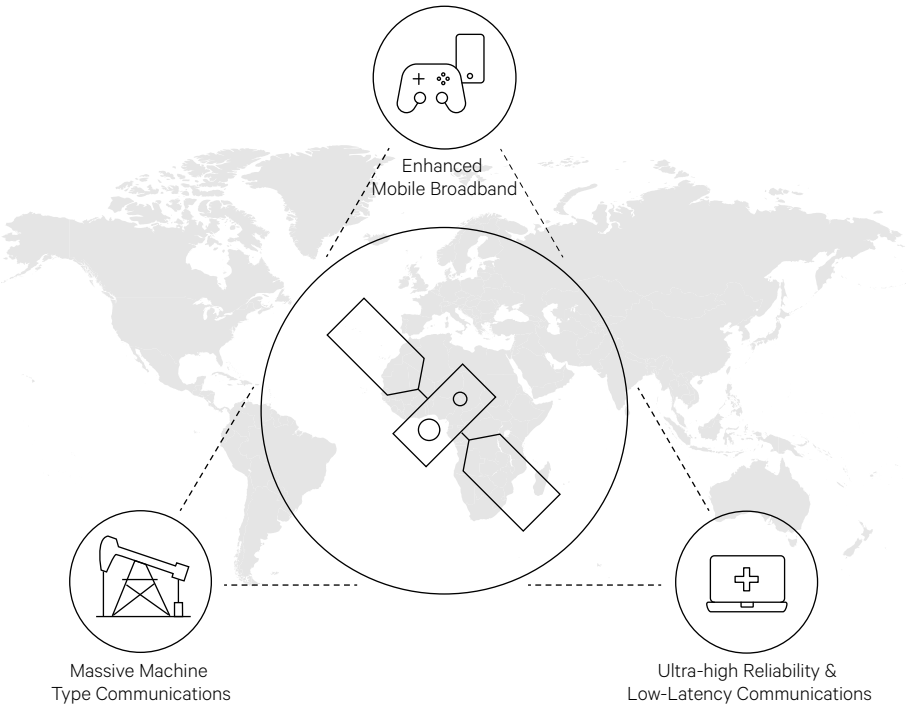
## CLOUD AND EDGE COMPUTING

In the future, satellites will help connect millions of edge computing nodes to central cloud data centres and the network core.




## 5G

Satellites will play a key role in ensuring the successful roll out of 5G services—especially in regions that lack access to terrestrial connectivity.

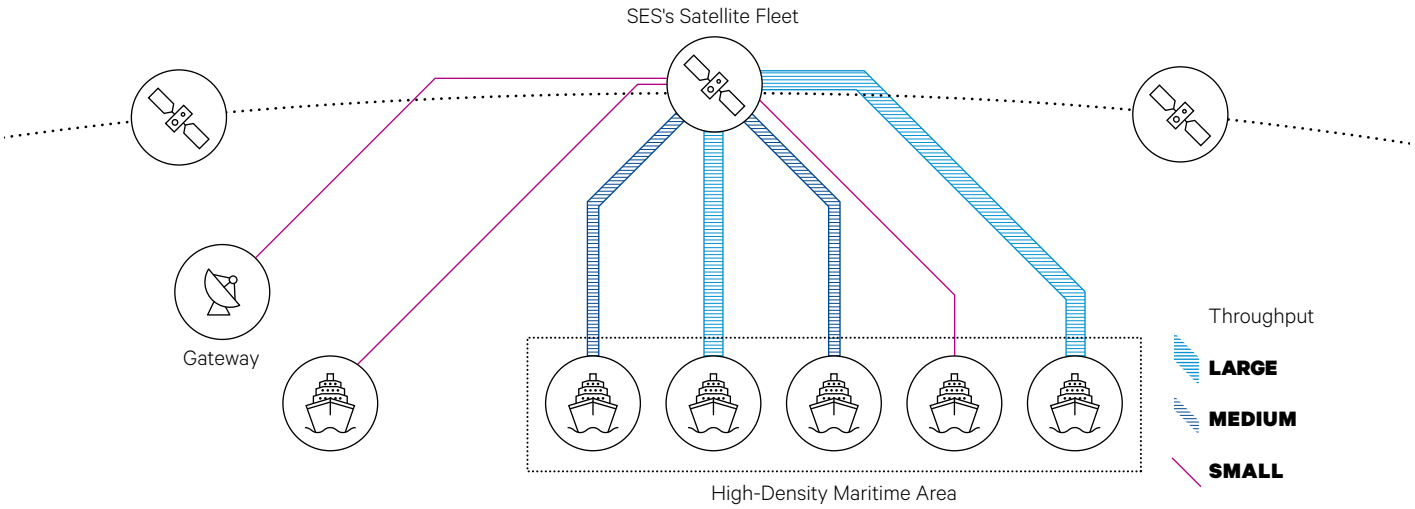


# MOBILITY MARKETS

Satellite connectivity is a game-changer in creating an exceptional passenger experience in the cruise and aero markets.

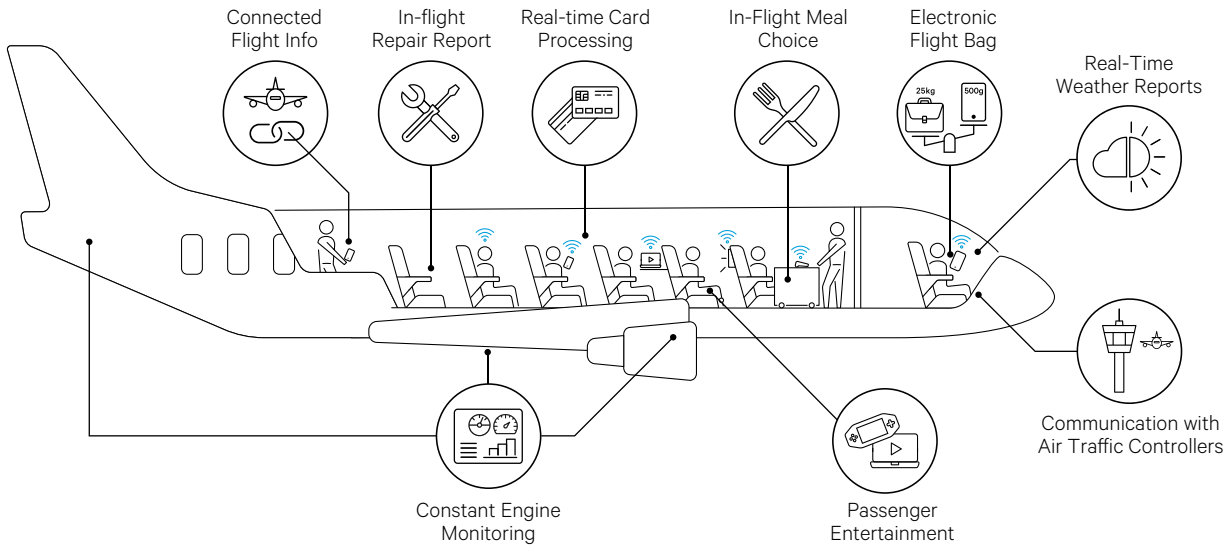
## ENHANCING THE GUEST EXPERIENCE ON CRUISE SHIPS

Satellite-enabled connectivity is crucial to ensuring guests aboard a cruise can stream, share, and stay connected on any itinerary.




## DELIVERING SUPERIOR IN-FLIGHT CONNECTIVITY

Satellite enables commercial and private aviation companies to meet customer demand for high-speed, always-on connectivity.



"The thing I'm most excited about is what you can do with the combination of connectivity and content."

—Nihar Shah, VP, Strategy & Market Intelligence Intelligence, SES

# DIVE DEEPER INTO THE TOPICS DISCUSSED

**Cloud and edge computing**

- Connecting the edge in partnership with Microsoft Azure
- Transforming the oil and gas industry with satellite-enabled cloud connectivity
- Connecting underserved regions

**5G**

- Connecting Greenland's East Cost

**Mobility markets**

- Enhancing in-flight connectivity for the elite traveller
- Helping transform the guest experience on cruise ships
- Enhancing crew experience


**SES's infrastructure and investments**

# MEET RUY PINTO

Ruy Pinto is the Chief Technology Officer at SES. Together with his team, Ruy is focused on delivering the network of networks to SES's customers, and, ultimately, making a difference in the world.

In this video, Ruy discusses multiple SES innovations that contribute to building the network of the future.

**Watch the video** >

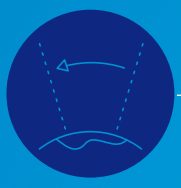
# SES's INFRASTRUCTURE AND INVESTMENTS

## A brief overview

The pace of innovation in the satellite industry has increased. A decade ago, the industry was focused on GEO satellites. The emergence of NGSO constellations in MEO or LEO are key aspects of this evolving industry, as well as digital processing onboard both GEO and NGSO satellites to focus bandwidth and spectrum.

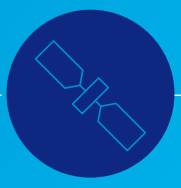
| GEO | MEO | LEO |
|---|---|---|
| 36,000km from Earth | 5,000 to 20,000km from Earth | 500 to 1,200km from Earth |
| Very high coverage | High coverage | Low coverage |
| Requires 3 satellites for global coverage | Requires 6 satellites for global coverage | Requires thousands of satellites for global coverage |
| High latency | Low latency | Very low latency |
| Enables basic broadband internet applications and video broadcasting | Offers fibre-equivalent performance | Supports high-performance computing applications |

## SES—A PIONEER IN THE SATELLITE SPACE



**2013**
First to launch a commercial NGSO constellation in MEO at 8,000km from Earth

**2017**
First to launch a geostationary satellite on a reusable rocket with our partners, SpaceX



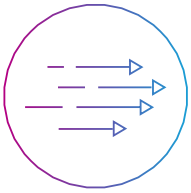
**2021**
Launch of SES-17, first in a series of next-generation GEO VHTS satellites in late 2021

**2021**
Launch of O3b mPOWER, a MEO satellite communications system that builds on the proven commercial success of O3b MEO in late 2021

# O3b mPOWER

O3b mPOWER is the key to bringing our multi-orbit strategy to life. The system will deliver unrivalled scale, unprecedented flexibility, and superior performance to customers everywhere.

## REIMAGINING A CONNECTED WORLD WITH O3b mPOWER



### UNRIVALED SCALE

Fibre-equivalent managed network services ranging from 50Mbps to multiple gigabits per second per connection

### UNPRECEDENTED FLEXIBILITY

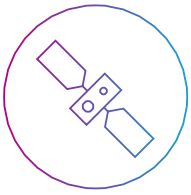
Flexibility in routing and bandwidth allocation to maximise network performance

### SUPERIOR PERFORMANCE

Ironclad SLAs covering throughput, latency, and availability to ensure an exceptional quality of experience (QoE)

### CLOUD-READY

Superior performance in critical cloud and edge applications

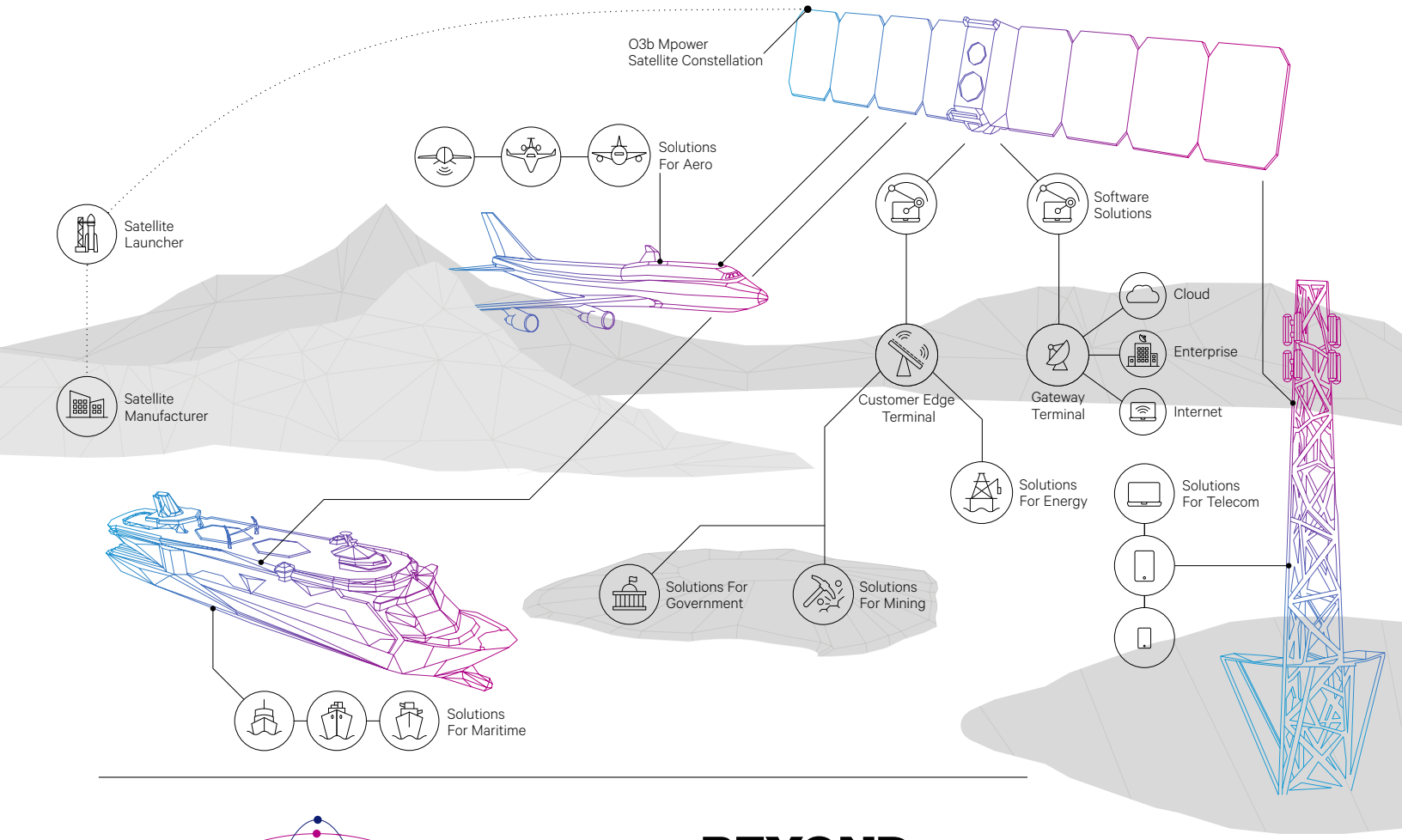


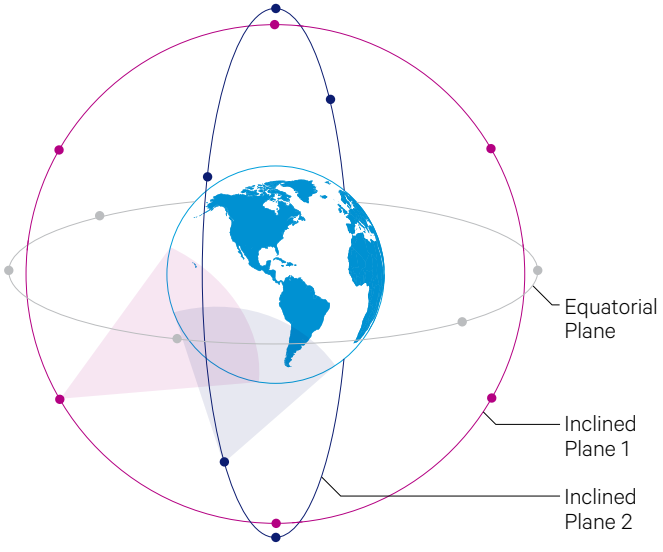
### PROVEN TECHNOLOGY

The industry's only NGSO solution built on commercially-proven technology and a market-proven business case

# REIMAGINING OUR CUSTOMER SEGMENTS WITH O3b mPOWER

O3b mPOWER will deliver unparalleled capabilities to our customers across segments—including telecom, mining, energy, cruise, commercial maritime, aero, and government.




## BEYOND O3b mPOWER

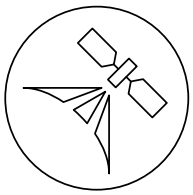
O3b mPOWER is the first generation of satellites to utilise fully digital payloads. In addition to digital signal processing onboard, the O3b mPOWER constellation of satellites will have phased arrays, making it easier to concentrate power and bandwidth wherever it's required. In the future, our strategy is to increase the capabilities of O3b mPOWER to serve customers at latitudes above 60°N and 60°S. Using a small number of satellites, we will be able to cover two or three inclined planes, which will allow us to reach the whole Earth—including the Poles.

*This diagram serves as an example and is not a fixed design.

# SES-17

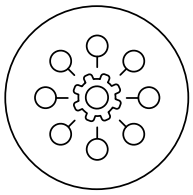
SES-17 is our newest GEO HTS satellite that will cover the Americas, delivering ground-breaking high capacity via flexible payloads to enable the service requirements of the future.

## TRANSFORMING THE FUTURE OF SATELLITE NETWORKS



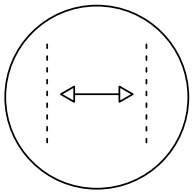
### INCREASED NETWORK AGILITY

Digital processing with the ability to concentrate power and bandwidth on a smaller spot beam



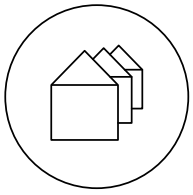
### ENHANCED RELIABILITY

Cost-efficient access to services from both low-density areas and high-traffic sites



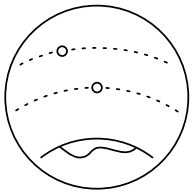
### SUPERIOR FLEXIBILITY

Highly flexible payloads that enable dynamic bandwidth allocation and volume-based billing



### UNMATCHED CAPACITY

Smart gateway switching to guarantee high uptimes, improved network security, and robust SLAs

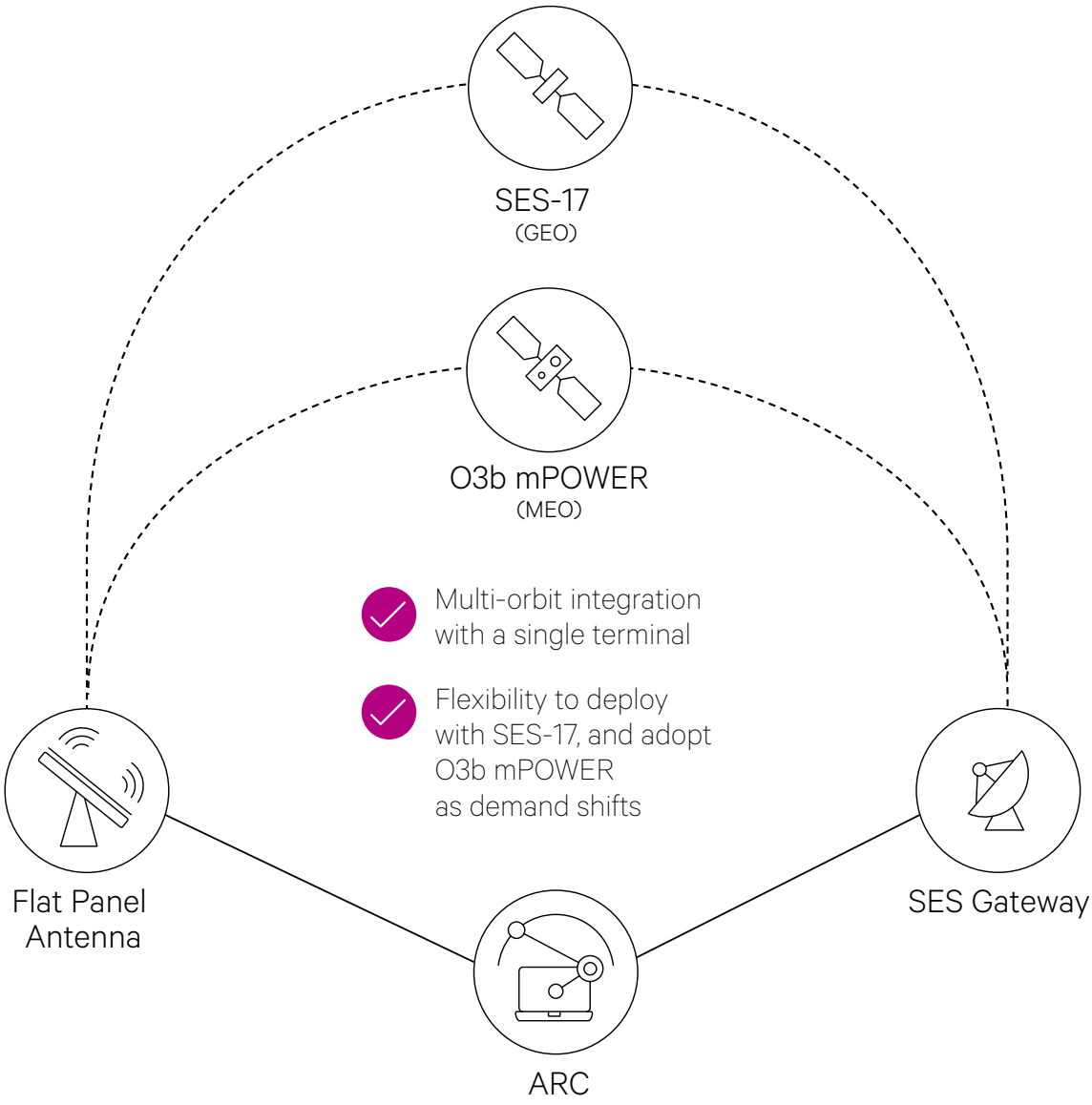


### FUTURE-PROOF TECHNOLOGY

Multi-orbit integration and traffic prioritisation via ARC

# ENABLING THE NETWORK OF THE FUTURE

SES-17, together with ARC and our next-generation MEO communications system, O3b mPOWER, will enable the network of the future. Our advanced Ka-band flat panel antennas will interoperate with SES-17 and O3b mPOWER simultaneously—enabling the world's first complete multi-orbit solution that will unlock unlimited possibilities for our customers.




**50+**

GEO satellites including 4 HTS satellites

**20**

MEO satellites

**11**

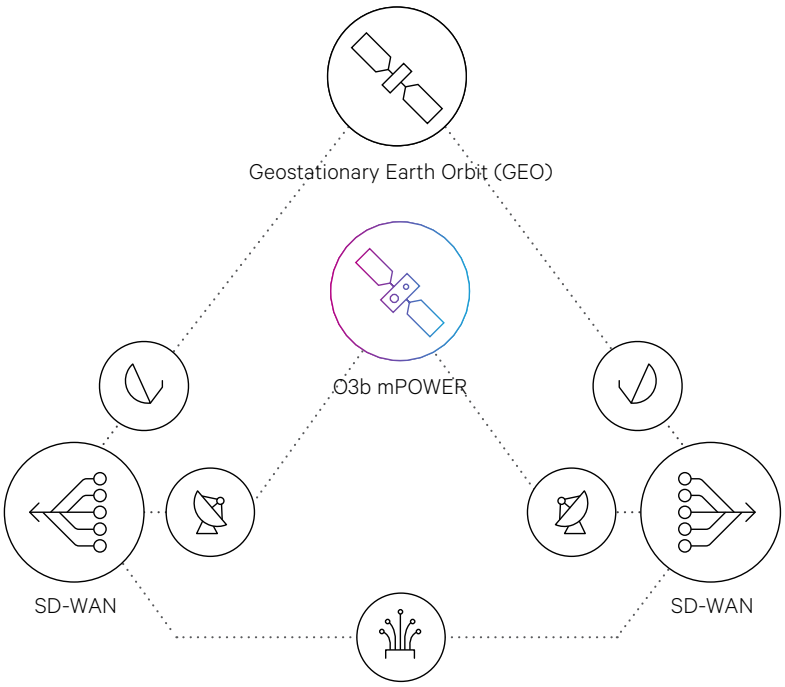
O3b mPOWER satellites to be launched in the future

# GROUND TECHNOLOGY

At SES, we're building an end-to-end ecosystem to provide exceptional services to our customers. This means investing in the ground segment to match the capabilities we have in space.

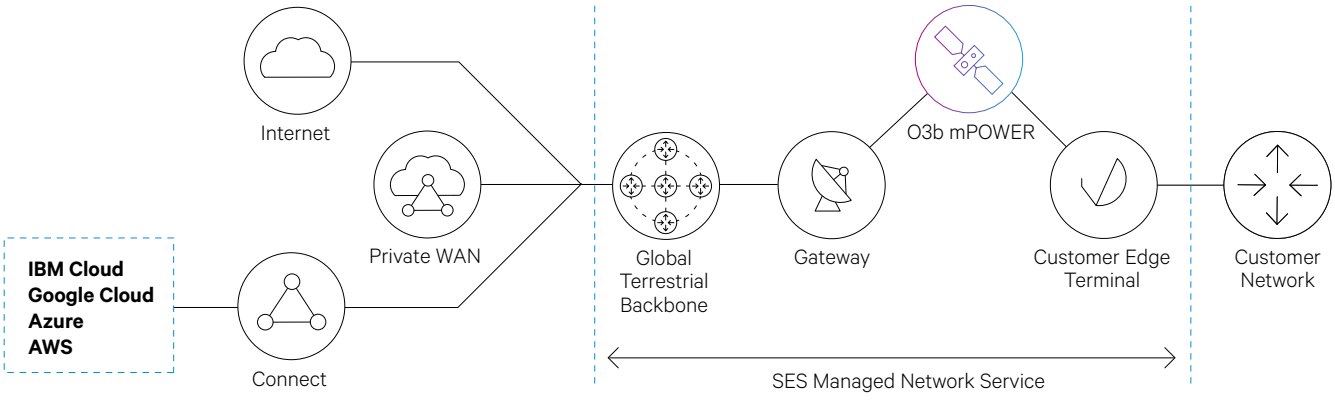
## SD-WAN

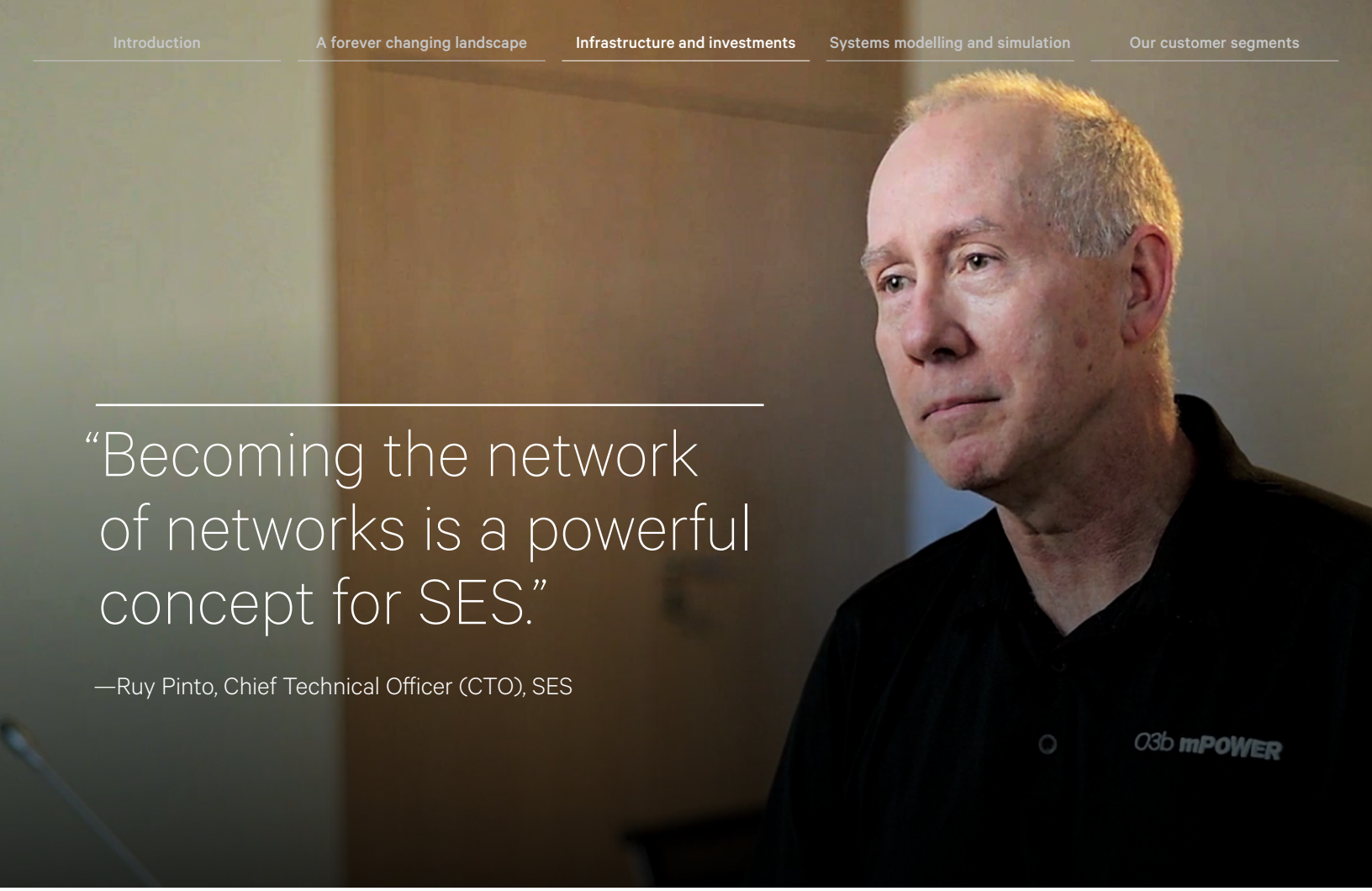
Our SD-WAN-driven service is the first of its kind, providing intent-based, policy-driven, application-aware routing to steer traffic over the optimal link. Our customers can optimally utilise their available WAN access connections via SES's GEO satellites and MEO constellation, as well as fibre and other terrestrial links.




## CLOUD

Another area SES is investing heavily in is the cloud. More and more businesses are deploying cloud applications to accelerate digital transformation and increase operational efficiency in their organisations. By partnering with Microsoft Azure, and co-locating our teleports with their data centres, we're able to deliver one-hop connectivity to the cloud anywhere our customers operate—whether on land, in the air, or at sea.






"Becoming the network of networks is a powerful concept for SES."

—Ruy Pinto, Chief Technical Officer (CTO), SES

# DIVE DEEPER INTO THE TOPICS DISCUSSED

**O3b mPOWER**

- Reimagining a connected world with O3b mPOWER

**SD-WAN**

- Delivering resilient network services with multi-access SD-WAN
- Powering cloud-scale networks through software innovation

**Cloud**

- Enabling one-hop connectivity to the cloud
- Delivering high-performance cloud-connect services

## Systems modelling and simulation

# MEET WARREN GEBBETT

Warren Gebbet leads the Systems Modelling and Simulation team at SES. Warren is an aerospace engineer whose love for technology brought him to SES. He's increasingly motivated by how satellite technology can bring the value of telecommunication to everyone on Earth.

In this video, Warren discusses how SES leverages insights on customer behaviour and technology adoption in various market segments to deliver successful services and solutions.

**Watch the video** >

# SYSTEMS MODELLING AND SIMULATION
## A brief overview

At SES, we take a customer-centric approach to building our network and solutions—we understand customer and end user needs first, and then build solutions to serve those needs.

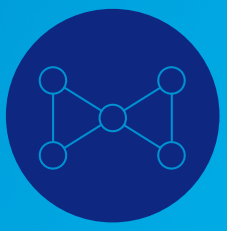
Through modelling and simulation, we tune into customer behaviour and study technological advances to capture trends within each market segment we serve. This informs multiple decisions at SES—including how we build our satellites and gateways, how we integrate them, and the type of payloads used in each orbit.

This way of working allows us to optimise services and deliver experiences that serve our customers within multiple market segments—now and in the future.

**5G**
Adoption of 5G will accelerate. Forecasts predict close to 3.5 billion 5G subscriptions worldwide by 2026.[1]

**Edge computing**
Enterprises will increasingly leverage the cloud at the edge of their networks. The global size for edge computing is expected to grow to USD 6.72 billion by 2022.[2]

**Artificial intelligence (AI)**
Businesses will increase the adoption of AI technology. AI is expected to enhance productivity by up to 40%.[3]



**Internet of things (IoT)**
IoT is a top strategic objective for multiple businesses. Data generated by IoT devices worldwide is expected to grow to 73.1ZB by 2025.[4]

**Aero**
By 2026, 68% of aircrafts are expected to be connected.

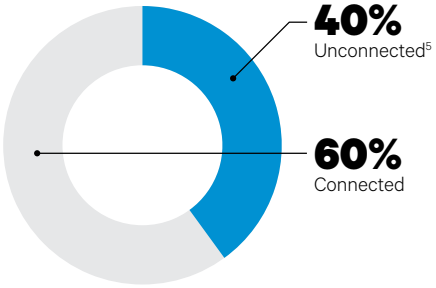
**Maritime**
The average seafarer spends between 2–4 hours online per day.

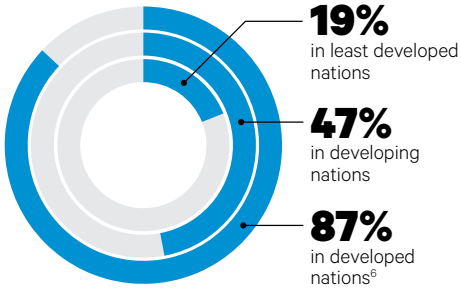
1 "Ericsson mobility report," Ericsson. November, 2020.
2 "Edge Computing Market Worth 6.72 Billion USD by 2022," Marketsandmarkets. November, 2017
3 "Artificial intelligence is the future of growth," Accenture. 2016
4 "IoT Growth Demands Rethink of Long-Term Storage Strategies, says IDC," International Data Corporation. July 2020.

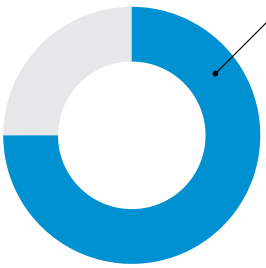
# DIGITAL INCLUSION

A trend that has prevailed over the last decade, and will continue into the future, is that customers expect to receive enhanced connectivity services at lower costs. While the technology to connect the world is available, making services available to every part of the world is largely an economic issue. However, this may change soon. Today, large companies are investing billions in building satellite communication constellations, which could turn a previously niche industry into a more mainstream one.

## KEY INSIGHTS



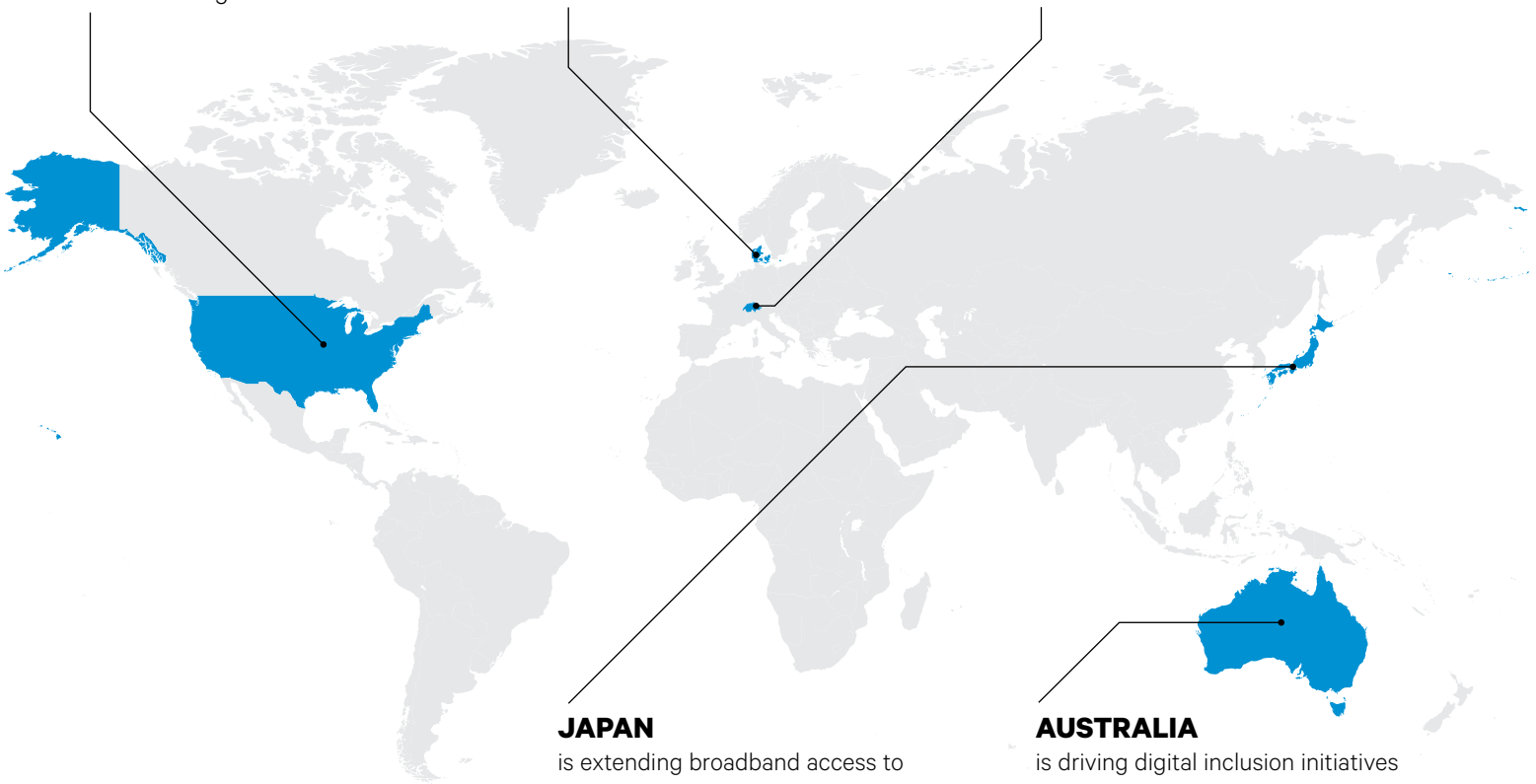




**USA**
is in the midst of upgrading its cellular networks to LTE in Alaska and rural regions.

**DENMARK**
is enabling critical communications in villages situated in the frozen hills of Greenland.

**SWITZERLAND**
is working to deliver connectivity to remote hamlets in high altitude locations.



**JAPAN**
is extending broadband access to settlements in mountainous areas and remote islands.

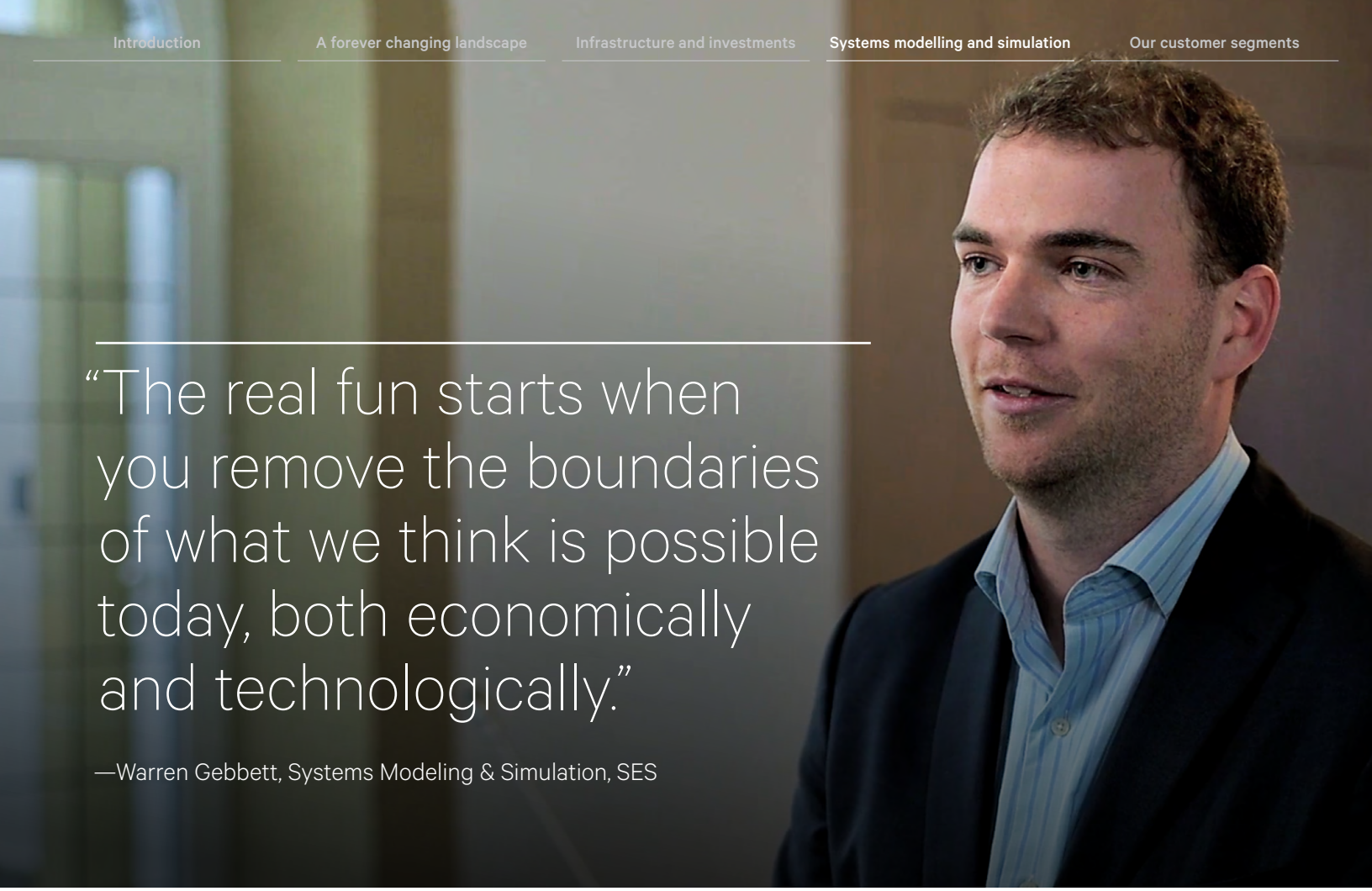
**AUSTRALIA**
is driving digital inclusion initiatives to narrow the 'Capital-Country gap' across states.

5 Kemp, Simon. "Digital 2020: October Global Statshot," Dataportal. Hootsuite. Retrieved March 17, 2021.
6 "Measuring Digital Development: Facts and Figures," International Telecommunications Union. 2019.

# At SES, our goal is to create a connected world—delivering uninterrupted connectivity and expanding the reach of our services. That's why thinking out of the box is important to us.

In 2009, SES made the bold move to invest in O3b Networks, and it became the first successful satellite constellation to operate outside of the geostationary arc, offering high throughput solutions. This proves that by combining the right technology and the right price point, it's possible to find a solution that disrupts the market.

The development of cloud, for instance, is a game-changer for SES. Our partnership with Microsoft Azure allows us to scale bandwidth from zero to multiple gigabits per second using computational resources available in the cloud—with a click of a button. By adopting a cloud-first strategy at SES, we're already starting to see a huge difference in what we can enable for our customers. Ultimately, our goal is to provide seamless, reliable connectivity services so our customers can focus on expanding and growing their businesses.



"The real fun starts when you remove the boundaries of what we think is possible today, both economically and technologically."

—Warren Gebbett, Systems Modeling & Simulation, SES

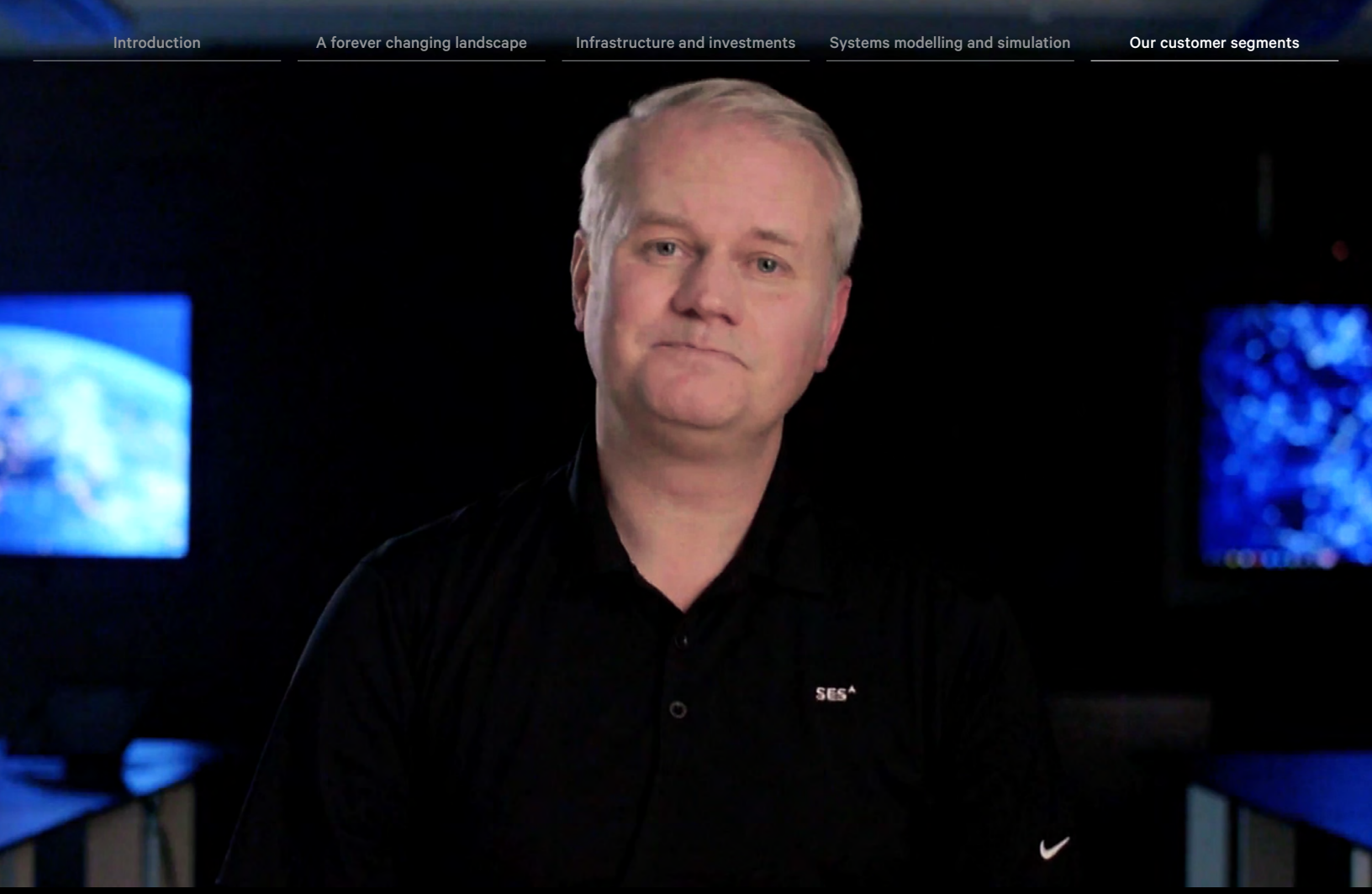
# DIVE DEEPER INTO THE TOPICS DISCUSSED

**Digital inclusion**

- Bridging the digital divide in Colombia with INRED

**Cloud**

- Building cloud-based partnerships




## Our customer segments

# MEET JP HEMINGWAY

JP Hemingway is the CEO of SES Networks, and heads a team that looks after the data communications segment at SES. Throughout his time at SES, he's been passionate about what satellites can do to make an incredible difference in people's lives.

In this video, JP Hemingway discusses multiple customer segments, and the role satellites play in each.

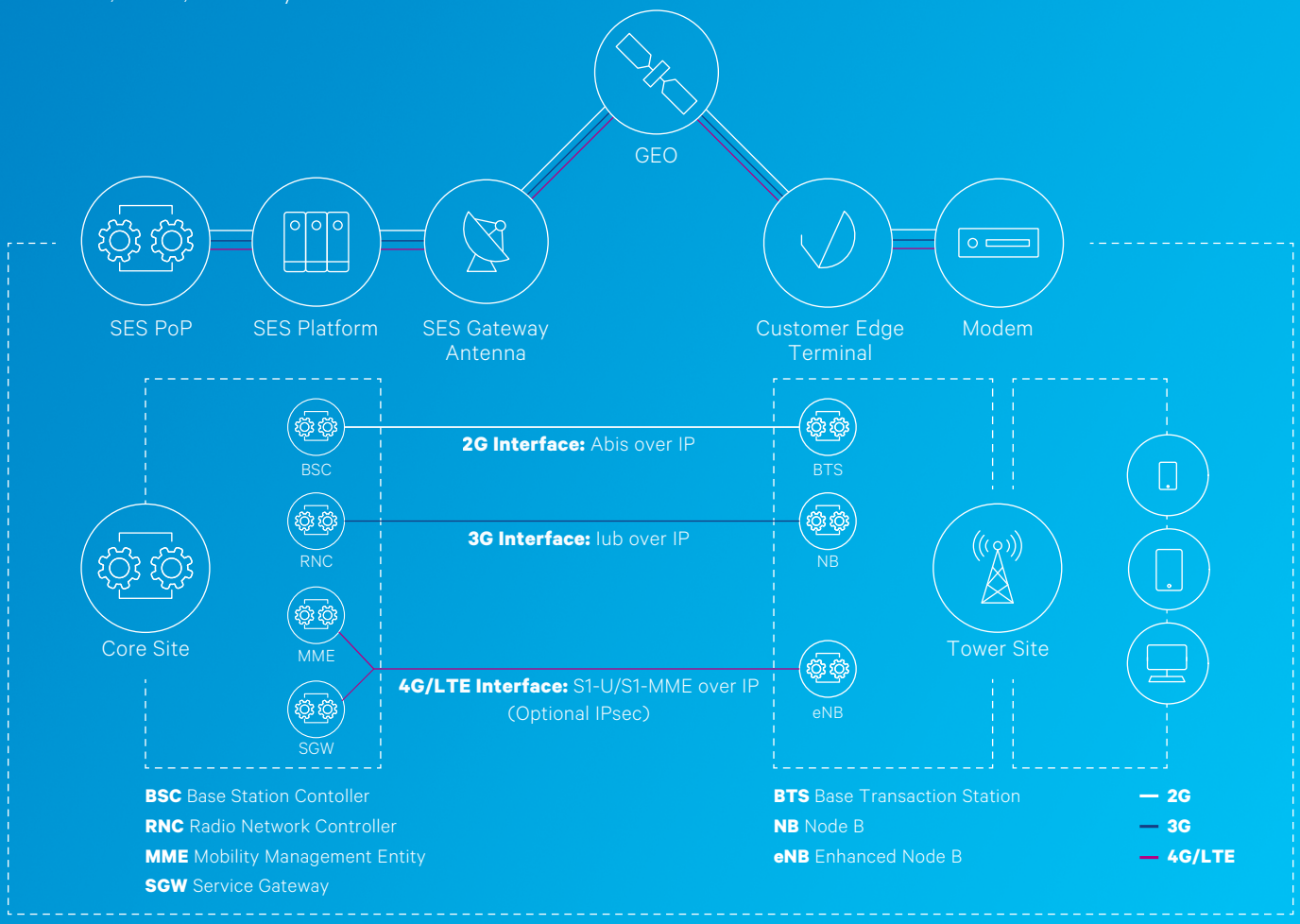
**Watch the video** >

# OUR CUSTOMER SEGMENTS
## A brief overview

SES offers distinct services tailored to the needs of each of our customer segments—fixed data, maritime, aero, government, and video.

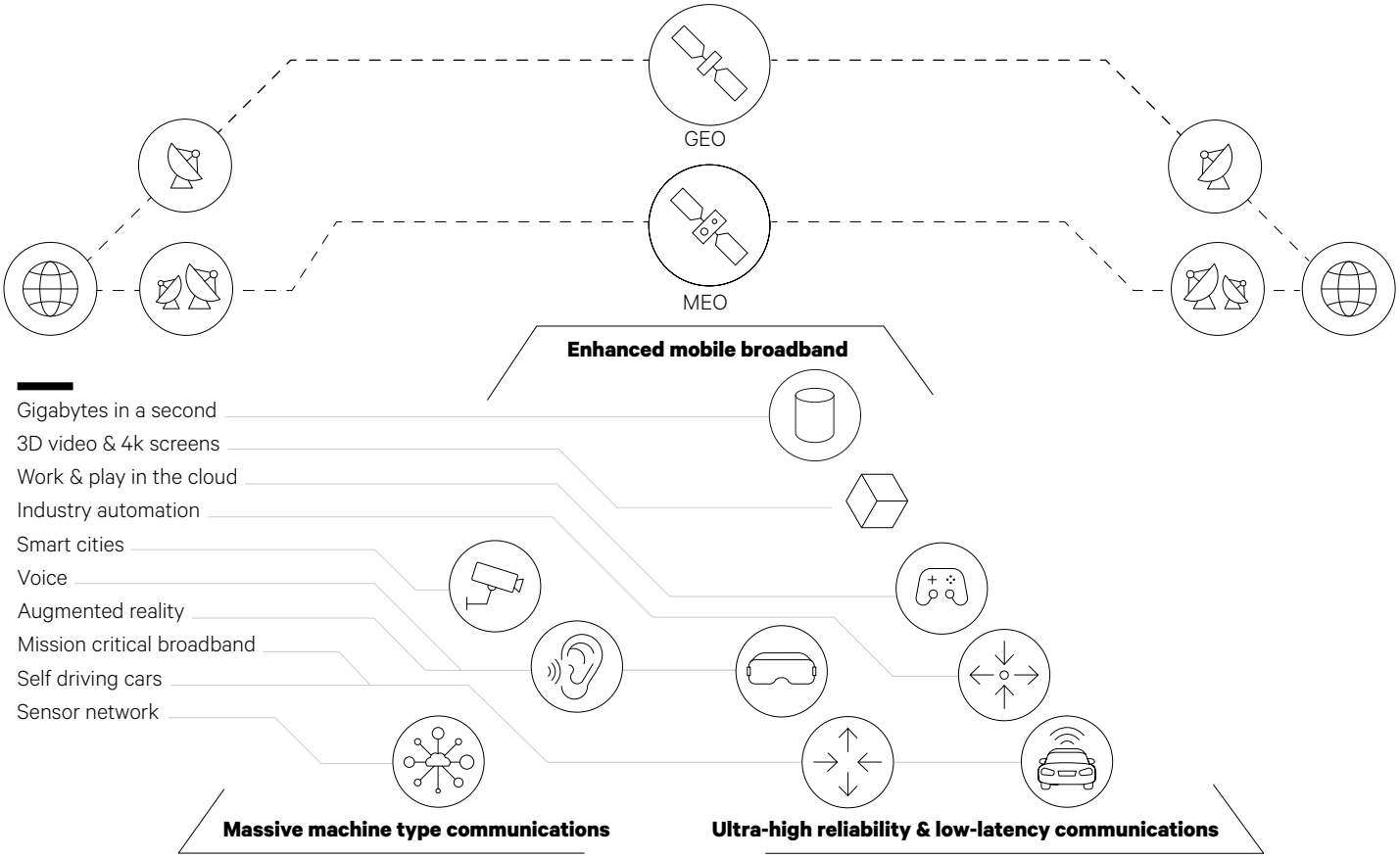
## 1. FIXED DATA

SES delivers solutions that enable telcos and MNOs to seamlessly extend their networks to areas that are difficult to reach via terrestrial networks. We meet customer expectations around standards and quality assurances with MEF certification, ONAP, and lifecycle services orchestration.



# OPTIMISING THE PATH TO 5G

SES will also play a key role in the rollout of 5G. We're already driving 4G LTE connectivity to the most remote locations in the world. And we've successfully completed tests for backhauling 5G over our O3b MEO constellation, proving that our customers can use satellite infrastructure to bring 5G services to areas beyond the urban landscape.




# REIMAGINING FIXED DATA WITH O3b mPOWER

- Seamless, reliable, carrier-grade network extension solutions
- Ability to manage network capacity to meet changing customer demand in real time
- Enables next-generation services and applications enabled by 5G, the Internet of Things (IoT), and the cloud

Read more about our services for
**FIXED DATA CUSTOMERS**

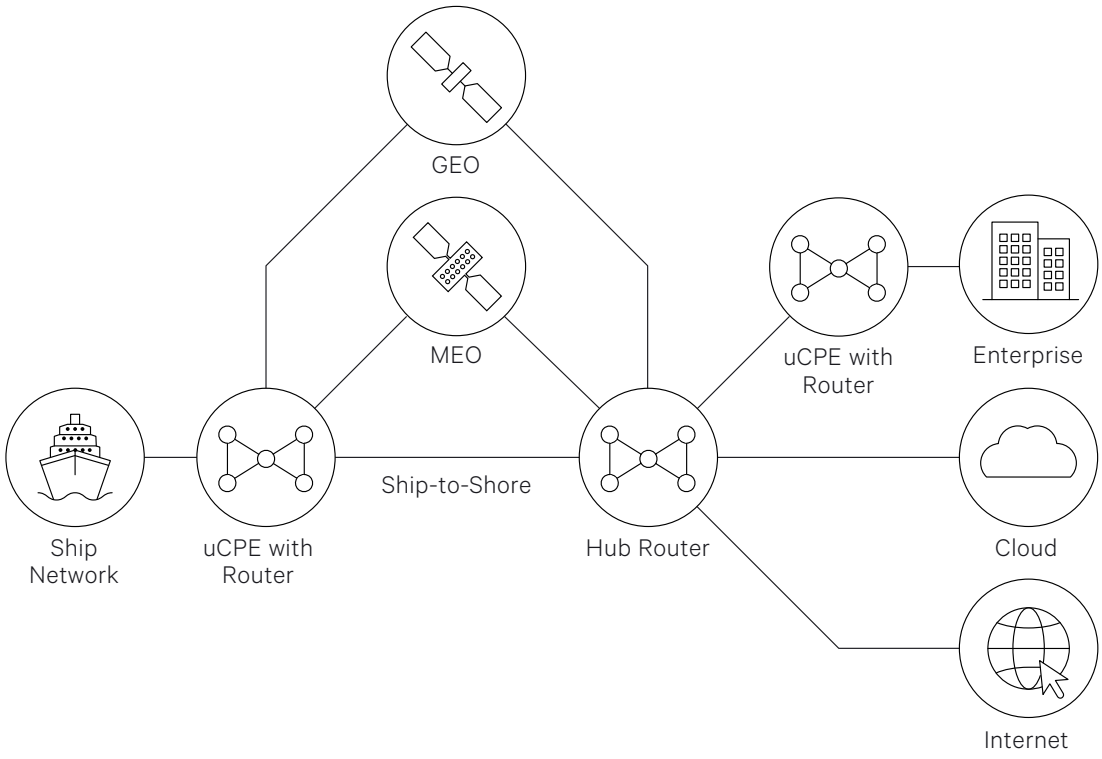
# 2. MARITIME

SES has completely changed the game for the cruise industry. Our fleet of GEO and MEO satellites provide the connectivity required to deliver extraordinary guest experiences aboard cruise ships. In the commercial shipping market, connectivity is required for thousands of ships to enable cloud applications and enhance crew welfare services. Using our highly flexible global platform, our partners can build services for commercial shipping companies—anywhere they operate.

**OPTIMAL UTILISATION**

**ULTRA-HIGH AVAILABILITY**

**ENHANCED USER EXPERIENCE**




## REIMAGINING CRUISE AND COMMERCIAL SHIPPING WITH O3b mPOWER

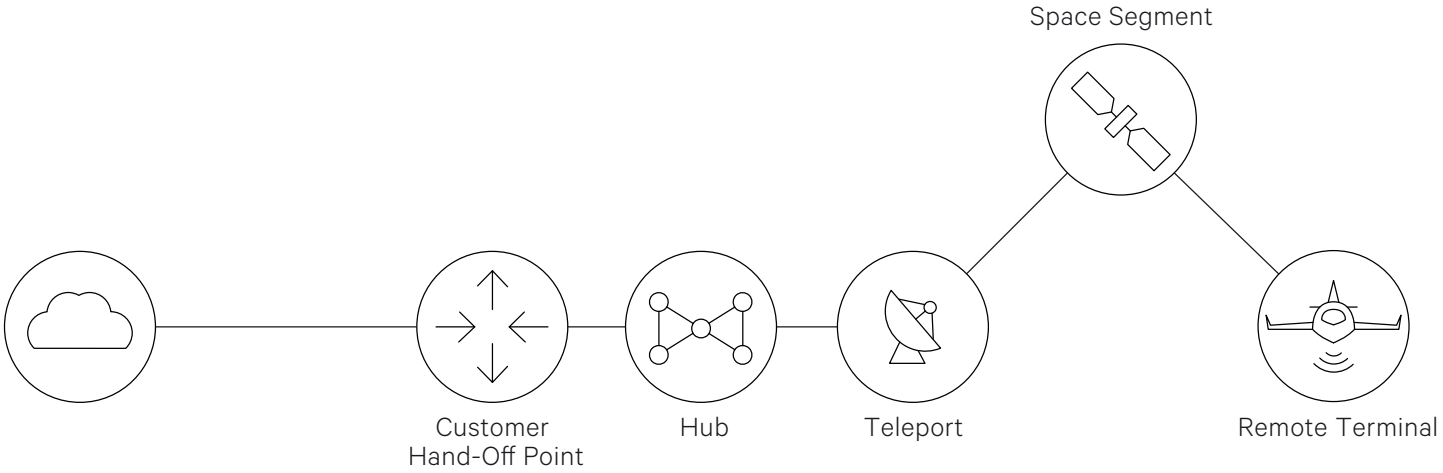
- High-throughput, low-latency network services and global end-to-end coverage
- Fibre-like connectivity scalable to multiple gigabits per second
- Flexibility in bandwidth allocation with intelligent application steering over the optimal link
- Interoperability with our geostationary Earth orbit (GEO) fleet for seamless coverage

Read more about our services for **CRUISE CUSTOMERS**

Read more about our services for **COMMERCIAL SHIPPING CUSTOMERS**

# 3. AERO

In the in-flight connectivity services (IFCS) market, SES serves all of the four big players. When partnering with Global Eagle, Gogo, Panasonic, and Thales, we work to understand their end consumer needs, so we can deliver an optimised connectivity service.



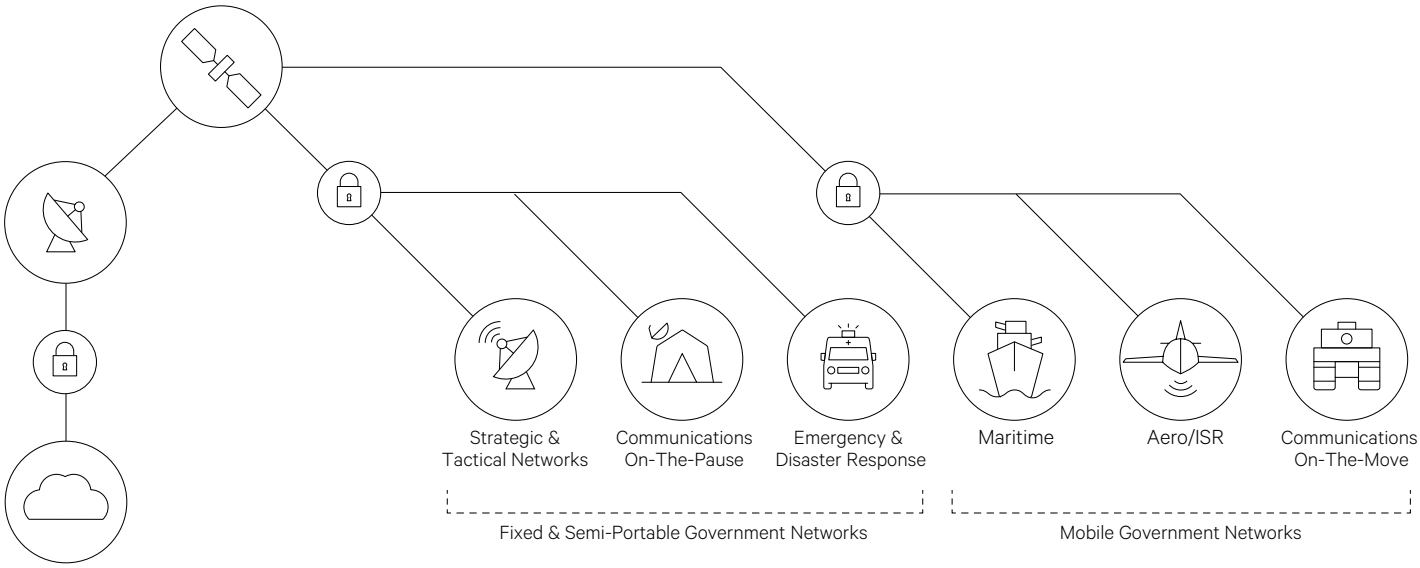

## REIMAGINING AERO WITH O3b mPOWER

- High-throughput, low-latency connectivity enables next-generation IFCS
- Intelligent, real-time switching between our GEO and MEO constellations
- Dynamic bandwidth allocation among aircraft, ensuring more efficient use of capacity

Read more about our services for **AERO CUSTOMERS**

# 4. GOVERNMENT

SES has two dedicated teams serving the government sector—US and Global. Our fleet of more than 80 GEO and MEO satellites cover the world's surface, allowing us to connect government operations taking place anywhere on Earth to their own secure locations.



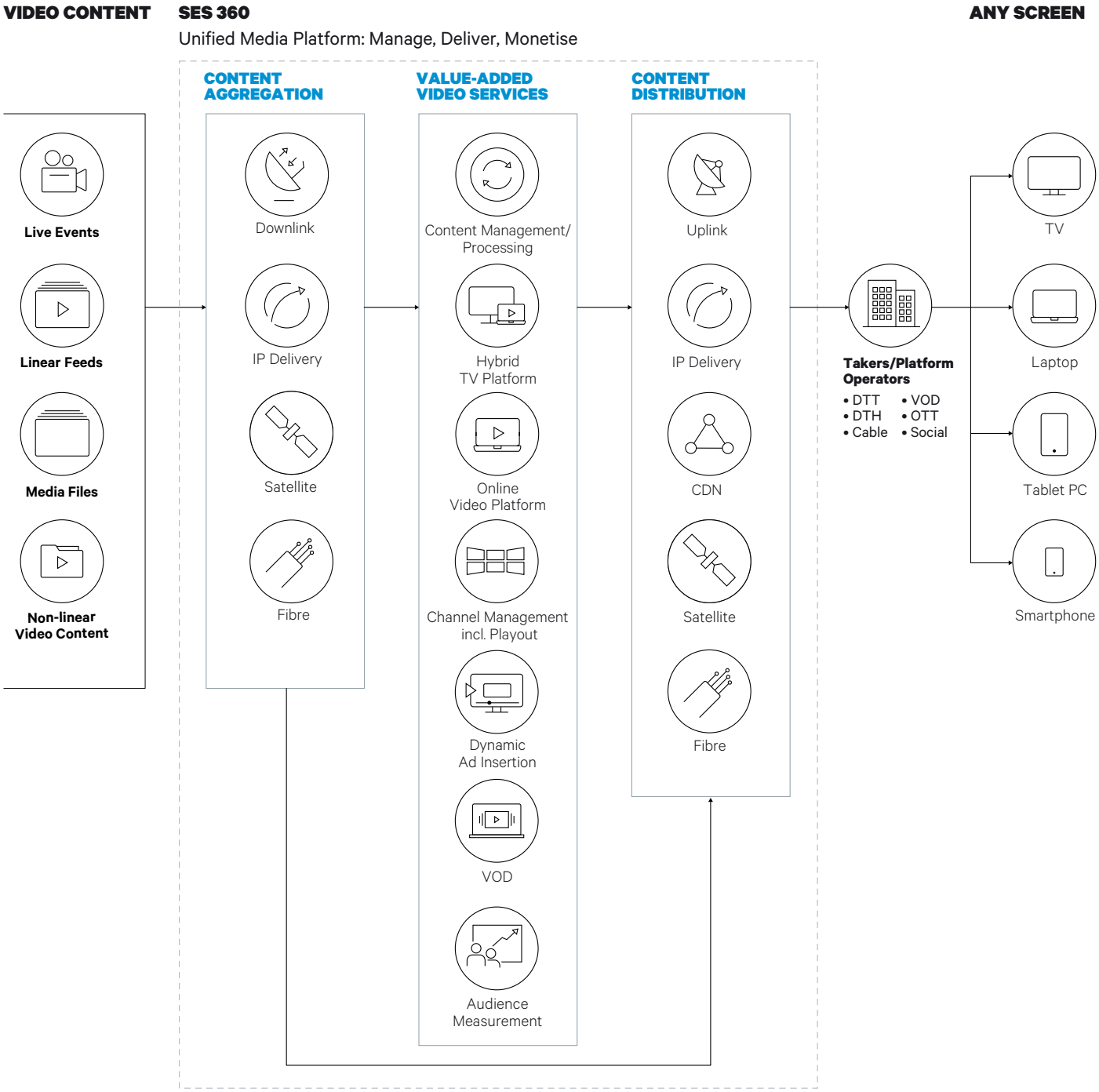

## REIMAGINING THE GOVERNMENT SECTOR WITH O3b mPOWER

- Fibre-equivalent, cloud-scale connectivity scalable to multiple gigabits per second per connection
- Unprecedented flexibility in routing, bandwidth provisioning, and service tailoring
- Inherent resistance to interception and jamming to increase access security and network resilience
- Data steering directly to sovereign government gateways and creation of independent subnetworks

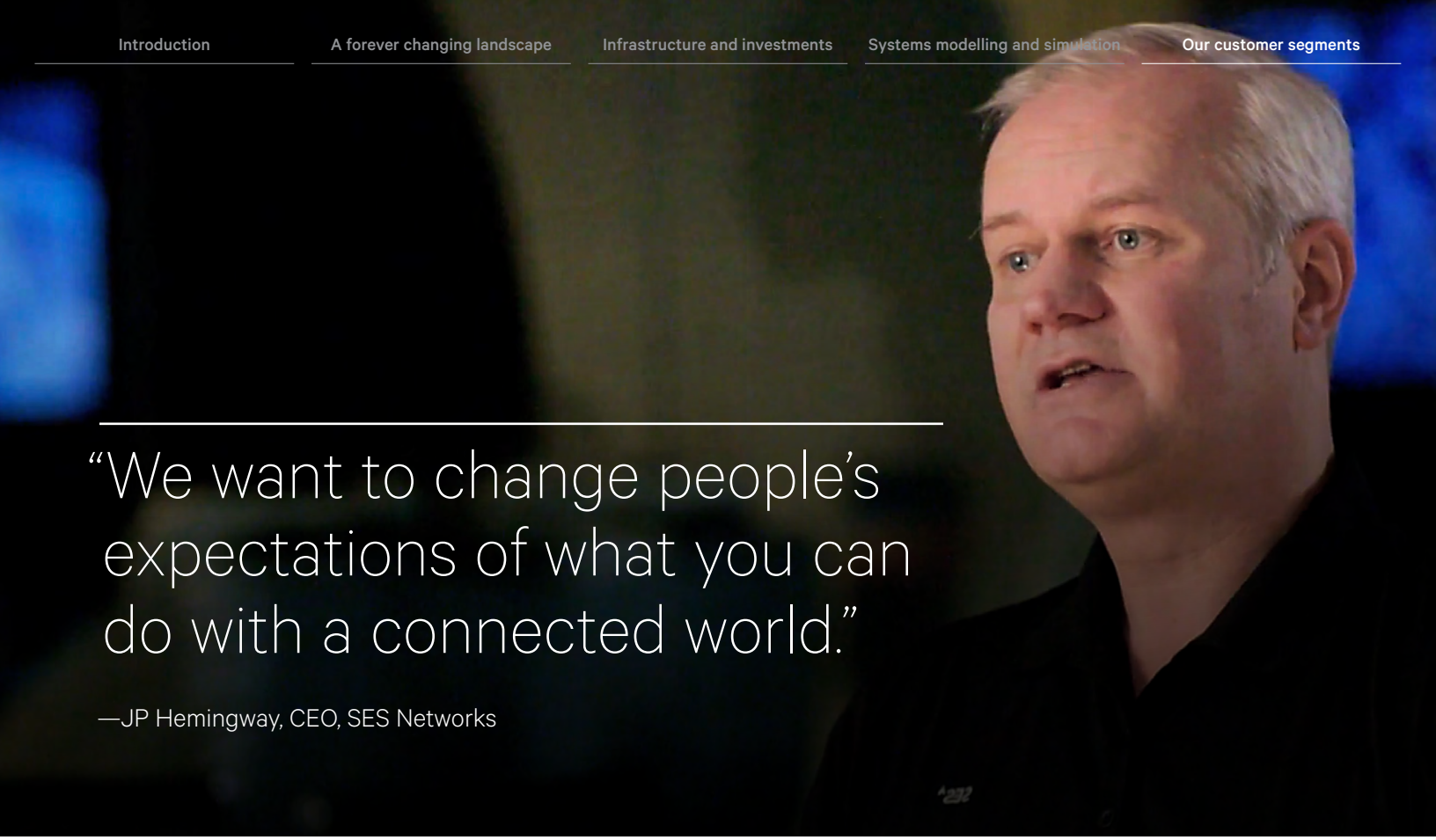
Read more about our services for **GOVERNMENT CUSTOMERS**

# 5. VIDEO

In the video segment, our customers face the challenge of remaining relevant in a highly disruptive industry. SES co-creates with customers to help them develop hybrid platforms by combining linear and live TV with on-demand streaming capabilities, and harness cloud applications to deliver content and playout services.




Read more about our services for
**VIDEO CUSTOMERS**



"We want to change people's expectations of what you can do with a connected world."

—JP Hemingway, CEO, SES Networks

# DIVE DEEPER INTO THE TOPICS DISCUSSED

**Digital inclusion**
- Reaching the unreachable
- Connecting businesses, everywhere
- Accelerating the 5G roll out
- Reimagining opportunities for Telcos, MNOs, and ISPs

**Maritime**
- Enhancing passenger experience with Royal Caribbean Cruises
- Enabling the fastest internet at sea
- Ensuring connectivity at sea with SatCom Global
- Delivering managed data to any maritime vessel
- Reimagining opportunities for the mobility sector

**Aero**
- Bringing IFC services to the commercial aviation market with Panasonic
- Raising the bar for in-flight connectivity

**Government**
- Supporting global government organisations
- Delivering near real-time connectivity for intelligence, surveillance and reconnaissance agencies
- Enabling secure and resilient network expansion

**Video**
- Enhancing broadcaster growth in Ethiopia
- Bringing live sports to audiences in the Americas with Casablanca

"Whether through supporting education, remote health, disaster response, connecting populations or simply delivering entertainment, we are driven to leverage the best innovation in space to make life better for people here on the ground."

**STEVE COLLAR**
CEO, SES

To learn more about SES and our services, please visit ses.com.

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Published in June 2021.


For more information about SES, visit www.ses.com

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