ITU Workshop on international telecommunication/ICT economic and policy issues

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Session 2: Economic and policy aspects of the provision of high-speed Internet connectivity by retail satellite operators

Key technical aspects of the provision of broadband services by non-geostationnary satellite systems

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Outline

- Context
- Applications and use cases
- Innovation and business drivers for new and emerging satellite broadband technologies
- Impact of NGSO development on public terrestrial networks
- Technical issues
- Recommendations

Context

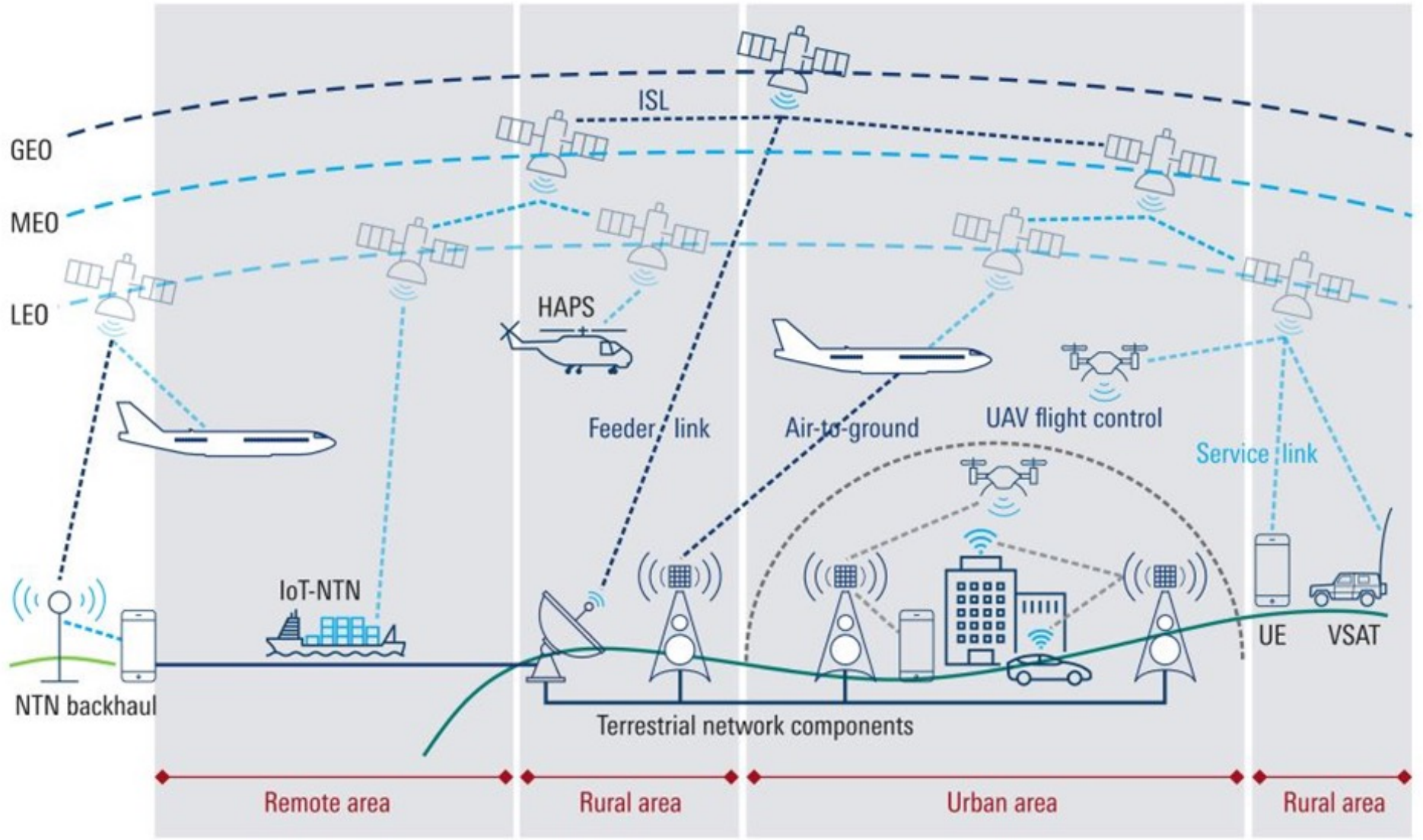
1 Role of satellites in the communications landscape

- Telecommunications services rely on the complementary capabilities of different types of networks, be they terrestrial fixed and mobile networks, or satellite networks.
- Satellite networks occupy a special niche due to their technical capabilities to broadcast signals over large geographical areas.
- Their ability to provide ubiquitous coverage ensures that even the most isolated areas remain connected, helping to bridge the digital divide.
- Satellite network operators have traditionally divided their business into fixed satellite services (i.e. leasing capacity for video, voice and data traffic) and mobile satellite services (i.e. targeting users in maritime and aeronautical markets in particular).
- However, this dividing line, based on different technological solutions and international spectrum sharing allocations, is becoming blurred as all satellite network operators diversify their activities, invest in different types of satellites to complement their fleets and increasingly compete in existing markets.

2 Recent changes in the satellite communications landscape

- General developments in the markets for communications networks and services around the world, with the expansion of terrestrial networks.
- With the opening up of the space sector in recent years and the introduction of the private sector into all areas of space activities, including commercial satellite communications, the space sector is bursting with new energy and enthusiasm.
- Introduction of innovative space technologies in telecommunications (such as the new generation of high throughput satellites (HTS), broadband non geostationary satellite systems, reprogrammable satellites that can adapt to changes in bandwidth demand from different regions and customers, new ground segment equipment) with significant increases in the total amount of capacity in orbit, leading to declining prices for satellite services.
- Evolving customer needs and requirements, particularly for access to high-speed internet, television services and connectivity on the move.
- New entrants' business models and potential impact of large satellite constellations, particularly for future satellite broadband services.

Overview of space-based infrastructure



4 Overview of GEO, MEO and LEO orbital characteristics

Characteristics	GEO	MEO	LEO
Altitude	35 800 km	8 000-20 000 km	400-2 000 km
Orbital period	24 hours	4-12 hours	1-2 hours
Footprint	Large	Medium	Small
Satellite cost	High	Medium	Low
Satellite lifetime	Long	Long	Short
Latency	Medium (~700 m/s)	Low (~150 m/s)	Very low (~50 m/s)
Earth coverage	Very large	Large	Small
Satellites required for simultaneous global coverage	3	6	Hundreds
Gateways	Few and fixed	Regional and flexible	Local and numerous
Antenna	Stationary	1-hour slow tracking	10-minute fast tracking

Non geostationary satellite constellations

- Reshape the satellite communications landscape and play an increasingly important role bringing connectivity to all.
- Offer low-latency, high-speed internet connectivity, which is particularly critical for real-time applications such as emergency alerts and autonomous vehicles.
- Improve access to broadband by reaching remote or rural areas where traditional infrastructure is difficult or costly to deploy.
- Central to global scientific endeavours, including Earth observation and climate monitoring.
- Play a critical role in improving global navigation and emergency response capabilities.
- One of the key enablers for achieving the United Nations Sustainable Development Goals (SDG) for a more sustainable and globally inclusive society.

Applications and use cases for NGSO systems

Main components of a NGSO system

- Satellite constellation: the hundreds or thousands of satellites that are launched into orbit and typically arranged in different “shells” at different altitudes.
- Ground stations: also called gateways, these are the large antennas and facilities that connect the satellites to the rest of the Internet.
- User terminals: also called a ground terminals or simply antennas or dishes, these are the means by which users receive and transmit data to and from the satellites. NGSO companies selling directly to consumers may also package additional equipment with the terminal such as a Wi-Fi router.

Key use cases for NGSO systems

- Individual consumers: People in rural or remote areas can have reliable and fast internet access.
- Connectivity on the move: Recent advances in in-vehicle connectivity mean that any vehicle within a coverage area can be connected.
- Community development: NGSO systems would be useful for community networks to backhaul to the rest of the Internet.
- Disaster Response: The ability to rapidly deploy NGSO access is a "game changer" by organisations responding to natural disasters.
- High availability and network resilience: NGSO systems can provide additional or alternative capacity and the ability to provide even greater resilience.
- Complementing and extending the reach of terrestrial 5G networks: backhaul and trunking, edge computing and caching, mobility support.
- Internet of Things (IoT) connectivity: The global coverage and low latency of NGSO systems make them well suited to support IoT applications, particularly in industries such as agriculture, maritime and logistics.
- Direct-to-device (D2D) satellite technology: connectivity is provided directly to a person's mobile phone or any standard mobile device.
- Other potential use cases: Internet access for remote monitoring (sensors for earthquakes, bush fires and floods), agricultural machinery, and medical centres in remote locations

Innovation and business drivers for new and emerging satellite broadband technologies

Space segment

- Smaller satellites
- In-orbit services
- Software defined satellites
- Inter-satellite links

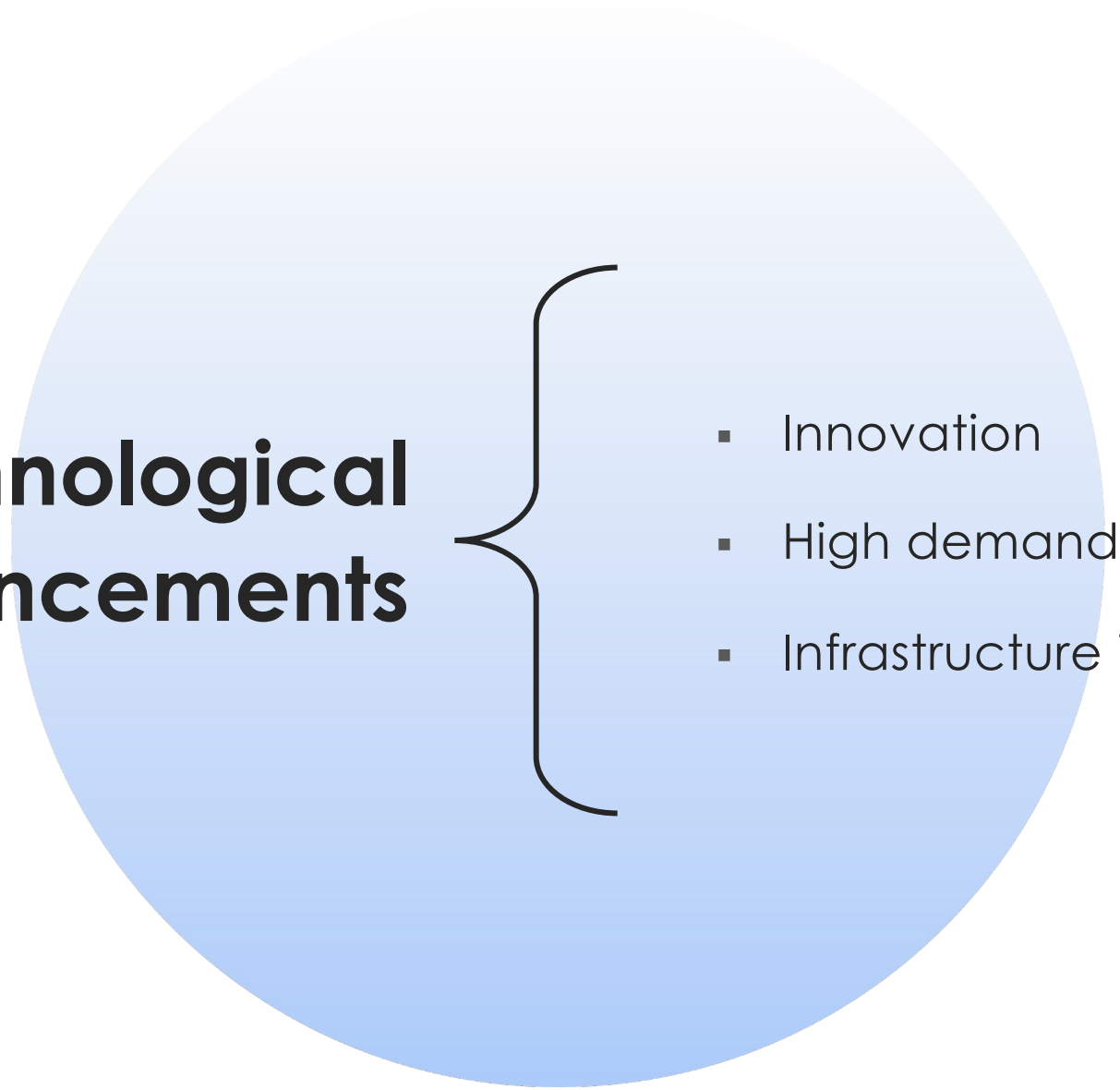
Ground segment

- Advanced ground systems
- Artificial intelligence and cloud services
- 5G networks leading to standardization
- Direct-to-device connectivity

Impact of NGSO development on public terrestrial communication systems

Market dynamics

- Competition
- Market segmentation
- Pricing mechanisms
- Pricing pressure
- Pricing strategies
- Service bundling

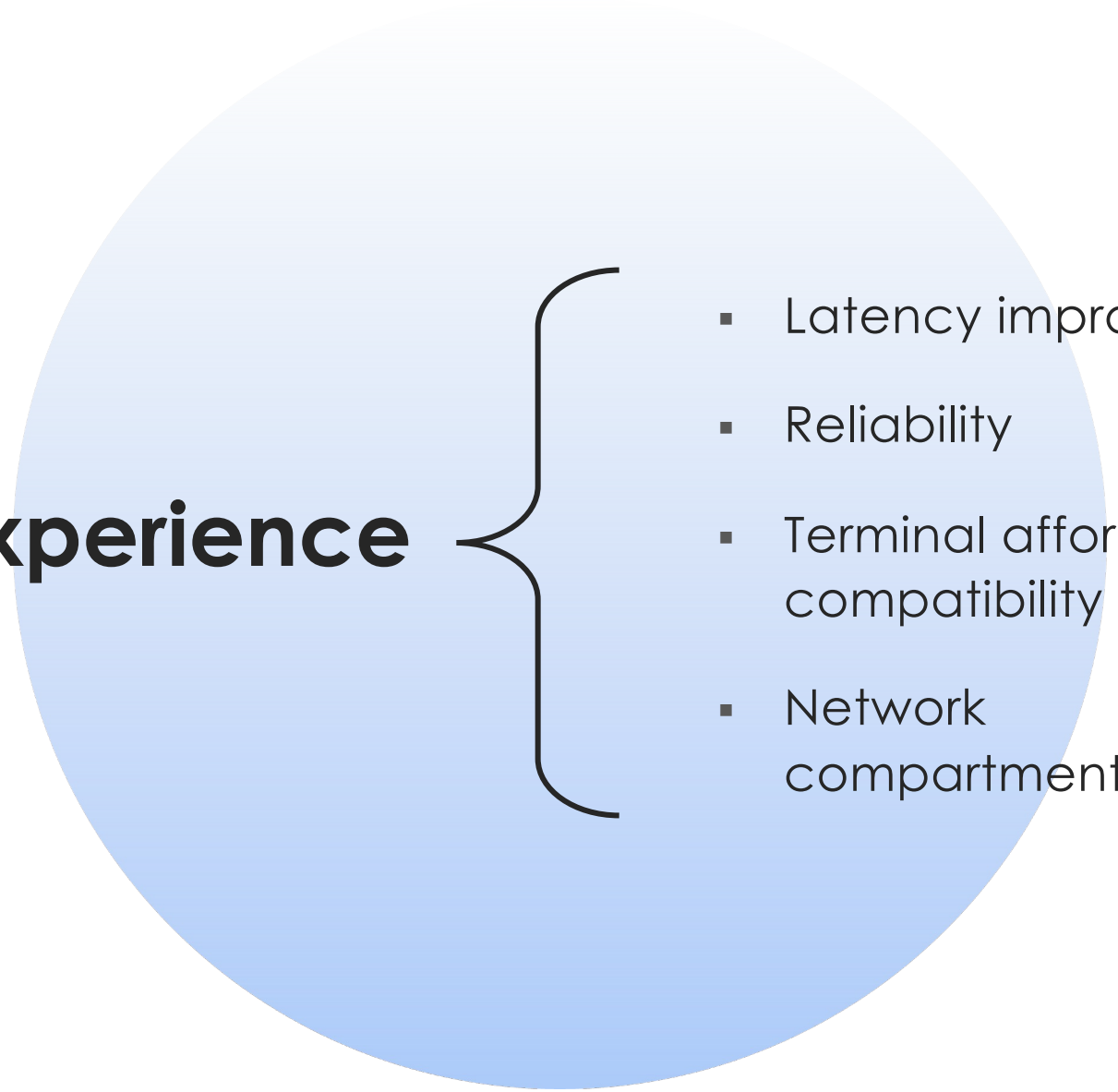

Technological advancements
Innovation
High demand for capacity
Infrastructure improvements

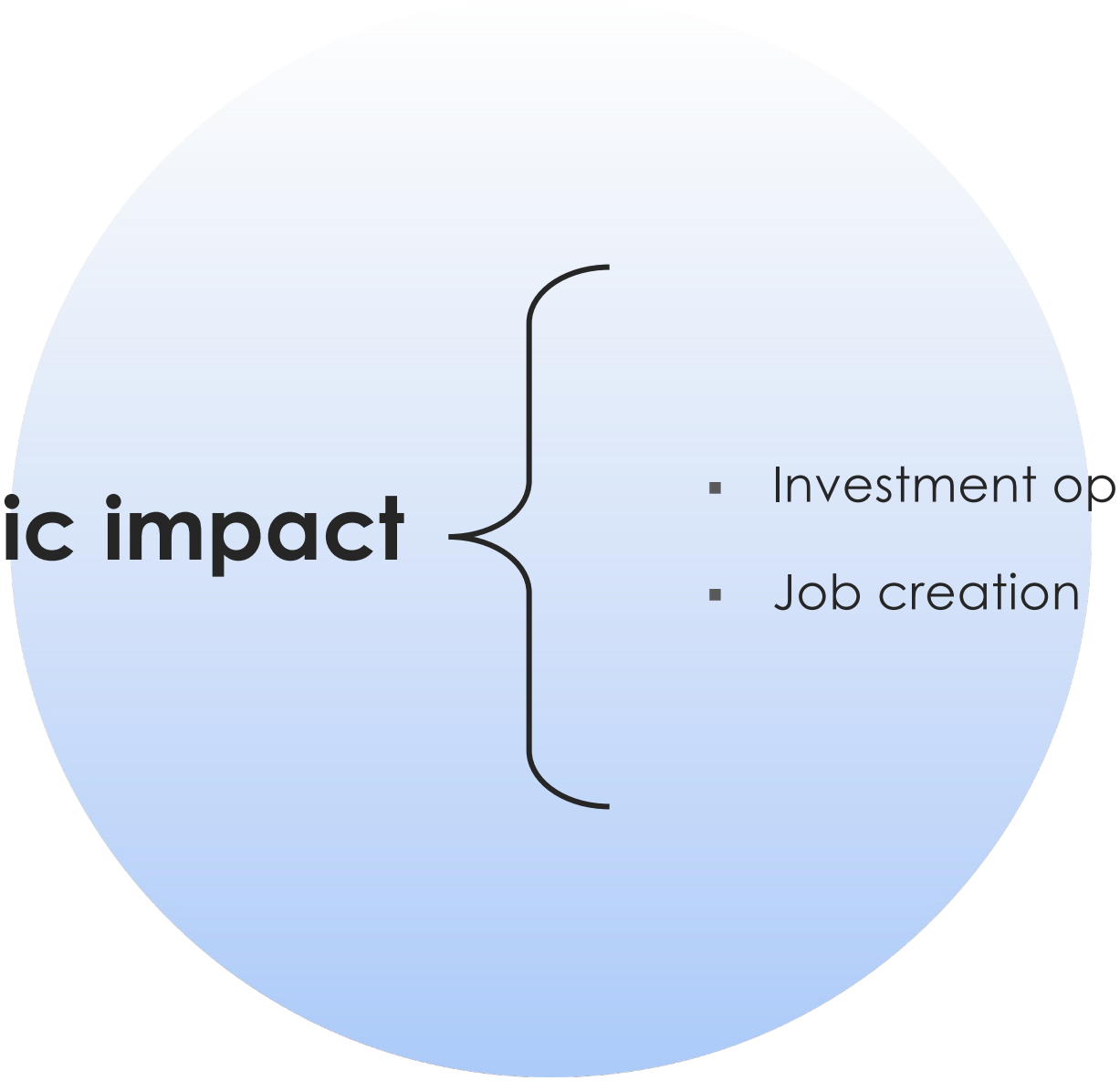
Regulatory changes

- Regulatory intervention
- Level playing field
- Spectrum management
- Compliance and standards
- Universal service
- Local presence requirement
- Regional cooperation

Service coverage and accessibility

- Global reach
- Urban vs rural dynamics


User experience
Latency improvements
Reliability
Terminal affordability and compatibility
Network compartmentalization



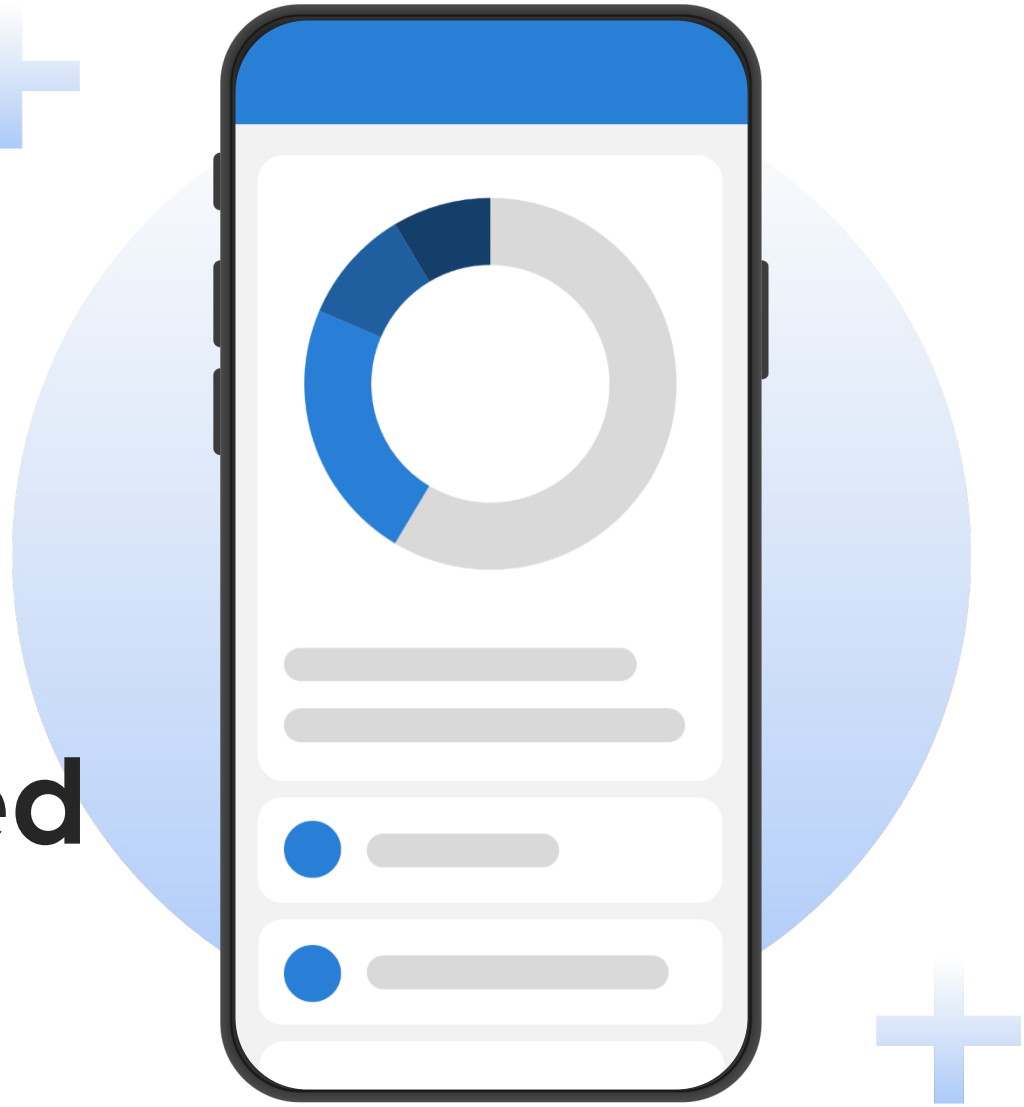
Economic impact

- Investment opportunities
- Job creation

Environmental considerations

- Space debris
- Energy consumption
- Waste electrical and electronic equipment
- Multi-stakeholder engagement

Technical issues related to NGSO broadband systems



Spectrum avalilability and allocation

- Efficient and effective spectrum management
- Timely availability of spectrum
- Globally harmonized spectrum allocation process
- Harmonized spectrum use accross countries and continents

Spectrum coordination, sharing and interference

- Spectrum sharing challenges
- Non excusivity in the use of satellite spectrum resources
- Protection of GSO satellite networks
- Implementation of frequency coordination and other mitigation techniques

Quality of service and capacity

- Tradeoff between density of users and throughput of the network
- Need for more research on the capacity limits of NGSO broadband systems

Standards and interoperability

- Separate and mutually incompatible standards for NGSO constellations
- Implementation of open standards for internet access

Peering and interconnection

- Interconnection with national internet exchange point (IXP)

Privacy

- Need to protect users or satellite terminals from interception, eavesdropping or unauthorised access to the information contained in their communications
- Level of protection of personal privacy and security against unauthorised disclosure of data similar to that provided by terrestrial mobile networks

Security

- Complex undertaking given the nature and scale of the satellite ecosystem
- Right security posture to protect users against the range of attacks that are prevalent in today's environment

Critical infrastructure and national security

- Should NGSO broadband systems be declared critical or not?
- Should NGSO systems be perceived as a potential future threat to national security?

Access to trafic data and lawful interception

- How to implement requirements to facilitate the physical and procedural means of interception?
- Innovative approaches to better meet lawful interception requirements for global NGSO constellations

Unauthorised satellite terminal uses and users

- Measures to be taken by NGSO operators to comply with the requirement to limit the operation of transmitting earth stations within a given territory only to those licensed or authorised by the competent administration, irrespective of their actual location

Satellite terminal type approval and marking

- Harmonised/recognised standards
- Availability of a set of standardised measurements that can be used to verify the compliance of an earth station antenna model with the applicable performance requirements
- Entity that is qualified to obtain homologation certificates from the regulator

Recommendations

Example of good practices

- Develop and enforce a digital services licensing regime that ensures a level playing field for all forms of digital service provision.
- Ensure fair use of spectrum, clearly allocated and equitably shared between technologies and operators (avoiding spectrum interference)
- Promote international harmonisation of spectrum allocation, comply with the ITU Radio Regulations, and ensure timely and fair adaptation of policies to cope with technological and operational constraints of operators.
- Link licences to a commitment by satellite operators to provide remote access to information when requested by national law enforcement authorities.
- Be transparent about the capacity, latency, and reliability of services (and benchmark them against other forms of internet access).
- Support the latest open Internet standards and common, interoperable communication protocols.

Example of good practices

- Encourage the development of standards related to the non-radio aspects of NGSO through the ITU-T study groups.
- Implement current industry best practices for Internet security and resilience.
- Ensure that the information transmitted through their systems is kept private, confidential, and is not altered in transit (support end-to-end encryption where possible).
- Encourage the use of localised Internet infrastructure, such as internet exchange points, to connect ground stations and allow end users to access other networks at lower cost and latency (and explore other options for shared infrastructure.
- Implement the latest physical and network security practices, ensuring systems are secure by design and practising defence in depth.
- Promote international harmonisation of binding rules, such as those on debris management, to reinforce the responsibilities of space actors.
- Establish a consultative framework for the various regulatory associations in Africa to address the regulatory issues related to NGSO systems with global networks spanning multiple countries.

Merci

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