Regulatory Best Practices to Bridge the Digital Divide and Make Internet Access Available and Affordable for Everyone Using Non-Geostationary Satellite Constellations

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Abstract

The majority of the world still does not have access to the internet, and this "digital divide" is not only an issue in developing countries. Unconnected populations exist in every country, and regulators must find ways to provide universal access to the internet. Furthermore, the demand for connectivity (internet and data) is growing exponentially, and existing terrestrial solutions likely will be insufficient. Regulators must foster new technologies such as the newest non-geostationary satellite constellations, which have almost no delay for two-way voice and data connections and can provide broadband to the most remote and unconnected populations and industries. To ensure the fast deployment of these solutions, regulators should support technology-neutral regulations (such as blanket licensing) that encourage speedy roll-out of innovative services, as well as have transparent "open skies" policies that promote competition (which has been proven to boost economies).

Keywords: satellite, broadband; regulatory; "open skies"; innovation

Acronyms/Abbreviations

Compound Annual Growth Rate (CAGR)
Geostationary Satellite Orbit (GSO)
Geostationary Satellite Operator (GSO)
Geostationary Satellite System (GSO)
Gigabits per second (Gbps, or Gb/s)
High-Throughput Satellites (HTS)

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International Telecommunication Union (ITU)
Internet Service Providers (ISPs)
Low Earth Orbit (LEO)
Medium Earth Orbit (MEO)
Megabits per second (Mbps, or Mb/s)
Non-Geostationary Satellite Orbit (NGSO)
Non-Geostationary Satellite Operator (NGSO)
Non-Geostationary Satellite System (NGSO)

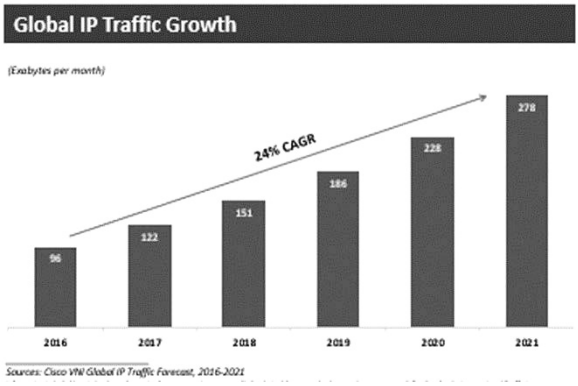
1. Introduction

Most of the world does not have access to the internet: the ITU estimates that 52% of the world still does not have access to the internet,[1] and this is a problem in both developing and developed countries. At the same time, the global demand for data, especially mobile data, is growing exponentially,[2] and terrestrial solutions alone cannot keep up.

1.1 Global IP Traffic Growth is increasing

Global IP traffic is estimated to have a 24% compound annual growth rate (CAGR) over the next five years, growing from 96 exabytes/month in 2016 to 278 exabyte/month by 2021.[3]

Table 1. Global IP Traffic Growth to 2021



1.2 Most fixed broadband connections are still too slow

Twenty percent of fixed broadband connections are under 10 Mbps.[4]

1 *ITU – ICT Facts & Figures 2015; FCC 2015 Broadband Progress Report.*
2 Cisco VNi Global IP Traffic Forecast, 2016-2021.
3 *Cisco VNi Global IP Traffic Forecast, 2016-2021.*
4 Cisco VNi Global IP Traffic Forecast, 2016-2021.

2. New satellite technology can meet the increasing data demand

Only space-based infrastructure can ever provide true geographic ubiquitous coverage of the world. The satellite industry has gone through game-changing transformation in the last decade, not only creating high-throughput satellites for use at the traditional geostationary orbits, but more importantly, developing non-geostationary satellite systems (NGSOs) that are much closer to earth, thus cutting the latency (delay) in communication to a tenth of what it used to be. With latencies of under 150 ms, these NGSOs are revolutionizing wireless broadband coverage for the entire world.

2.1 High-Throughput Satellite (HTS)

HTS is the term used to describe the newest generation of geostationary satellites (GSOs), and the newest of these will provide throughputs approaching 3000 Gbps.[5]

2.2 Satellite costs are decreasing

Launch costs, manufacturing costs, and time to market are all decreasing, making satellite solutions more affordable. At the same time, improvements in technology such as faster processing power and smaller antennas are increasing capacity and throughputs.[6]

2.3 Higher needs and lower costs are driving demand for satellite solutions

Demand for mobile broadband is driving telco's and mobile network operators to find additional technology solutions, such as satellite, to augment their infrastructure so they can meet the exponential demand.
OneWeb's high speed, low latency, and global solution are well-positioned to win in these markets.

3. OneWeb's mission is to provide global satellite internet coverage

3.1 OneWeb hopes to bring affordable access to all

OneWeb will have global availability, high performance, and low latency (under 50 ms). To provide this, we have partnerships to provide low-cost, easily manufactured satellites (with Airbus), and strong partners who are leaders in their respective fields (such as Qualcomm, Softbank, Coca-Cola, Hughes, Grupo Salinas, and Intelsat.)

3.2 NGSOs will be able to support high-throughput broadband

NGSOs will be able to support high-throughput broadband for fully interactive two-way communications to mobility users such as planes and ships in addition to remote locations. NGSOs will be able to provide full

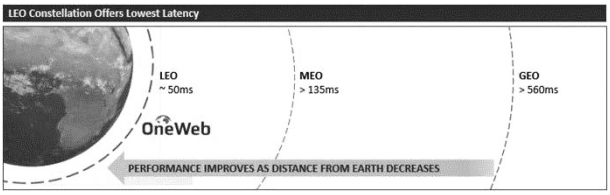
5 Euroconsult.
6 Euroconsult

connectivity in times of emergency, not just for the first responders but for the entire community.

3.3 LEOs provide the lowest latency

The low Earth orbit (LEO) NGSOs, such as OneWeb, provide the lowest latency to date, and will revolutionize the infrastructure used to provide 4G and in turn 5G.

Figure 1 Why LEO Constellations Offer Lowest Latency



3.4 NGSOs have innovative technology

NGSOs use constellations of satellites, often with multiple planes or even multiple altitudes to encircle the globe, providing capacity everywhere. OneWeb will use the Ka band for its major gateway earth stations, and the Ku band for its user terminal communications. OneWeb expects its user terminals to be affordable, compact, and easily installable.

4. Regulatory best practices will encourage the deployment of innovative satellite technologies

4.1 Benefits of encouraging new technology

Every country in the world is working toward connected communities and universal access. Rapid innovation allows new technologies to efficiently reach unserved areas with flexibility. NGSOs can overcome economic or geographic challenges so as to provide connectivity immediately following emergencies and disasters; services to end users; data capacity to ISPs and enterprise customers; and backhaul capacity to oversaturated mobile systems. Real-time applications need the low latency of the newest satellite configurations.

4.2 Certainty and fairness regarding spectrum access is essential

The ITU plays a vital role in the global management of this scarce resource, and its centralized management is the ideal way to provide predictability and protection for all spectrum users. Most countries follow the regional allocations made by the ITU, as well as the internationally-accepted ITU processes.

"Open Skies" policies allow domestic licensees to choose the best backbone infrastructure to serve their users. A simple registration is often sufficient. "Landing rights" or other domestic service licenses result in diminished choices, insufficient capacity, and high prices to end users.
The requirement of service licensing for satellite connectivity will only raise costs to end users.

4.3 Licensing regimes should facilitate efficient rollout and coexistence

Technology neutrality is essential: competitive prices for end users result from policies that allow deployment of the most efficient and affordable services, regardless of architecture model.
Domestic and cross-border competition ensures thriving economies and markets in every country. Protecting domestic operators from competition is detrimental to innovation and speedy deployment of new services.
Blanket licensing and exemptions from licensing are valuable tools for regulators and allow for scaled solutions.

4.4 Licensing timelines and processes require transparency and harmony

Online application processes ease burdens on operators, provide for easy tracking, and save time for the regulator.
Predictable timelines for application review help operators plan for deployment.
Regulators should consider adopting the concept of "default approval" if no response is provided within a certain timeframe: this allows regulators to focus on more important applications and policy issues.
International and regional harmonization is vital to the sustainability of satellite services. Satellite systems require substantial investment, as well as years of desig, and building before deployment. Spectrum access and certainty are essential for systems to be developed and launched.

4.5 Administrative requirements and fees should be reasonable

Self-certification of homologation is an acceptable practice, in conjunction with approval from a reputable institution.
Costs of licensing should be limited to recovery of the regulator's administrative costs to process the applications and maintain the license.
For NGSOs with multiple antennas at a "gateway" site, licensing should be administered on a "per site" basis and not on a "per antenna" basis.
Spectrum fees on a "per MHz" basis discourage innovation: the need to use large bandwidths for new high-capacity services should not be punished, given the strong benefits such services bring to end users.

5. Case Study: the European Authorization regime

CEPT,[7] or the European Conference of Post and Telecommunications Administrations (www.cept.org), encompasses 48 countries. Within CEPT, the ECC (Electronic Communications Committee) develops harmonized regulations on authorization and allocations of radio / electronic services across the CEPT member states. The instruments that the ECC develops are not mandatory.[8] However, these are developed to provide countries with harmonized view-points and regulatory references that countries can adopt nationally, with the objective of efficient use of the radio spectrum, satellite orbits, and numbering resources across Europe.

5.1 ECC and NGSO instruments in the Ku-band

Over the past two years, through the request of OneWeb, the ECC (participated by regulatory agencies and industry) has worked on the development of ECC Decisions and Reports for NGSO systems in the Ku FSS allocations (10.7-12.75 GHz and 14.0-14.5 GHz).

An ECC Decision, (ECC/DEC/(17)04, on "The harmonised use and exemption from individual licensing of fixed earth stations operating with NGSO FSS satellite systems in the frequency bands 10.7-12.75 GHz and 14.0-14.5 GHz") has been developed and adopted for Fixed terminals of NGSO FSS systems. This was based on the existing GSO regulatory framework in place in previous decisions of the CEPT.

Another ECC Decision (ECC/DEC/(18)05, on "The harmonised use, exemption from individual licensing and free circulation and use of Earth Stations In-Motion (ESIM) operating with NGSO FSS satellite systems in the frequency bands 10.7-12.75 GHz and 14.0-14.5 GHz") was adopted in 2018.

5.2 European NGSO Regulatory Regime in Ku-band – Fixed Earth Stations of NGSO systems

The ECC adopted ECC/DEC/(17)04 in 2017 to harmonize the regulations across the CEPT countries for Ku-band fixed satellite terminals of NGSO systems, to:

- Harmonize the frequency use in 10.7-12.75 GHz and 14.0-14.5 GHz FSS allocations for NGSO systems; and to
- Exempt from licensing individual satellite terminals.

Such results were adopted considering the existing regulatory regime in place for GSO systems (i.e., ECC/DEC/(03)04, ECC/DEC/(06)02, and ECC/DEC/(06)03).

7 https://www.cept.org
8 https://www.ecodocdb.dk

While the decision looks generic and does not reference OneWeb in accordance with the rules of the CEPT, it has been developed based on the compatibility studies carried out using the OneWeb system. Any other NGSO system would therefore need to demonstrate through studies that it meets the same conditions to be able to apply the decision.

5.3 European NGSO Regulatory Regime in Ku-band – Earth Stations in motion (ESIMs) of NGSO systems

The ECC adopted ECC/DEC/(18)05 in 2018 to harmonize the regulations across the CEPT countries for Ku-band ESIMs of NGSO systems.
This decision was made possible after thorough compatibility analyses of the operations in the FSS downlink allocation in the band 10.7-12.75 GHz with the radio astronomy service (RAS) and the EESS (earth exploration satellite service) (passive), and the compatibility of the earth stations using the FSS uplink allocation in the band 14-14.5 GHz with the fixed service (FS) and the RAS, on the model of the OneWeb system. The technical studies and results have been published in ECC/REPORT/271 and adopted after consultation with the 48 CEPT countries.
From the ECC/REPORT/271, Regulatory ECC/REPORT 279 "The Use of Earth Stations In-Motion operating to NGSO satellite systems in the 10.7-12.75 GHz and 14-14.5 GHz band" was adopted.
The report provides an analysis and recommendation of the regulatory regime for NGSO ESIMs. This ECC Decision, ECC/DEC/(18)05 adopted in 2018, allow the regulatory regime of ESIMs of NGSO systems to:

- Harmonize frequency use in 10.7-12.75 GHz and 14.0-14.5 GHz FSS allocations for NGSO systems;
- Exempt from licensing individual satellite terminals; and
- Allow free circulation and use of satellite terminals across CEPT countries.

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5.4 Equipment type approval: ETSI Harmonized Standard and System Reference document

In Europe, there is a requirement that the OneWeb user and business terminals must comply with essential requirement under the European Union (EU) Radio Equipment Directive (RED). This is a type approval requirement leading to CE marking necessary to market and use the equipment within the EU. The CE marking is also recognized in some non-EU countries. There

exist many laboratories around the world which are recognized by the European Commission to type approve radio equipment and then be CE marked. For this end, European Telecommunication Standards Institute (ETSI) standards are developed to describe the technical characteristics of the equipment, which comply with the RED Directive.
The ETSI is an international organization based in France. It has more than 800 members including 36 European Administrations, 6 Observer Administrations from Africa and Asia, and more than 600 companies from 60+ countries around the world. The European Union also officially recognizes ETSI as a European Standards Organization and uses its work to harmonize radio standards amongst the 28 EU countries.
ETSI produces globally-applicable standards for Information and Communications Technologies (ICT), including satellite communication systems, as ETSI standards are also recognized outside Europe. The ETSI Technical Committee of Satellite Earth Stations is responsible for developing equipment standards for satellite earth stations.

Technical standards are reference documents that provide:

- Technical radio or mechanical limits
- Equipment requirements
- Lab procedure scripts used to test the equipment

These can be used by manufacturers or test labs to test equipment against the radio limits specified by the document.
In the case of OneWeb's equipment, ETSI has developed the standard ETSI EN 303 980 "Satellite Earth Stations and Systems (SES); Harmonised Standard for fixed and in-motion Earth Stations communicating with non-geostationary satellite systems (NEST) in the 11 GHz to 14 GHz frequency bands covering essential requirements of article 3.2 of Directive 2014/53/EU", which addresses NGSO equipment in the Ku-band FSS allocations.
The document approved in October 2017 and published in December 2017 specifies the technical characteristics and methods of measurements for fixed and in-motion earth stations communicating with non-geostationary satellite systems in the 11 -14 GHz FSS frequency bands, which ensures that no harmful interference is caused by the equipment when in operation.
An ETSI "System Reference document" (SRdoc), developed under the remit of the Electromagnetic Compatibility and Radio Spectrum Matters (ERM) committee is usually produced in support of any new system, service or application. In particular, an SRDoc is developed when either a change of the present frequency designation / utilization within the EU or CEPT or a change in the present regulatory framework for the proposed band(s) regarding either wanted or unwanted emissions is needed. The document of

reference for OneWeb is TR 103 399, "Fixed and in-motion Earth stations communicating with satellites in the non-geostationary orbits in the 11-14 GHz frequency band (TR 103 399)".

6. Conclusion

Regulators can encourage innovative new technology to bridge the digital divide and connect the unconnected by applying the "best practices" described in this paper, and by considering the utility in their own region of the case study provided using the EU decisions on licensing ESIMs.