Fostering Connectivity: The LEO Satellite Opportunities in APEC

APEC Telecommunications and Information Working Group

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Acronyms

ACMA	Australian Communications and Media Authority
APEC	Asia-Pacific Economic Cooperation
APEC TEL 69	69th Telecommunications and Information Working Group Meeting
DICT	Department of Information and Communications Technology
EAP	East Asian and Pacific Affairs
FCC	Federal Communications Commission
FSS	Fixed Satellite Services
GDP	gross domestic product
GEO	geosynchronous equatorial orbit
GSO	Geostationary Orbit
HTS	High Throughput Satellites
IFT	Federal Telecommunications Institute
IMDA	Infocomm Media Development Authority
IoT	Internet of Things
ISAM	in-space servicing, assembly, and manufacturing
ISED	Innovation, Science and Economic Development Canada
ITU	International Telecommunication Union
LEO	low earth orbit
MNO	Mobile Network Operators
NASA	National Aeronautics and Space Agency
NBTC	National Broadcasting and Telecommunications Commission
NGSO	Non-Geostationary Orbit
NICTA	National ICT Authority of Papua New Guinea
NTC	National Telecommunications Commission

USD	United States dollar
U.S.	United States
VPN	virtual private network
WRC	ITU World Radio Conferences

EXECUTIVE SUMMARY

Due to high cost and high latency capabilities, the first commercially available satellite communication systems were only accessible to large entities, such as enterprises (e.g., oil and mining companies, banking institutions) or governmental institutions. However, technological advancements and increased competition have substantially reduced costs, making satellite communication more accessible to all.

The growth in Low Earth Orbit (LEO) satellites has been particularly impactful, offering high-speed, low-latency, and high-capacity connectivity. Nevertheless, LEO broadband satellite deployment introduces complex regulatory challenges, including orbital resource management, frequency coordination, and a variety of other licensing issues. The need for appropriate regulatory oversight to prevent interference and ensure competitive markets remains at the forefront of policy-making concerns. Fostering competition in the LEO satellite market is pivotal for driving innovation, reducing costs, and improving service quality for consumers.

This document analyzes the transformative potential of LEO broadband connectivity and the numerous opportunities it offers, such as enhancing connectivity in remote areas, increasing connectivity offerings, enabling improved public safety and domestic security, and augmenting the quality of available services. It presents research and background assessing the legal and regulatory landscape for the provision of LEO satellite services across the APEC (Asia-Pacific Economic Cooperation) region. Possible best practices in regulatory frameworks are also discussed, highlighting recent regulatory developments in the APEC economies.

The following sections outline both the foreseen and estimated benefits, as well as the challenges presented by the emergence of LEO satellite broadband connectivity. They discuss the required licensing conditions for LEO services and highlight some emerging best practices. Section three provides a brief overview of regulatory developments in APEC economies related to LEO satellite broadband connectivity. The conclusion offers specific considerations to stimulate the discussion on the potential elements that should be advanced to harness the benefits of LEO satellite connectivity for APEC economies to navigate the described challenges effectively.

This document is one part of the APEC project with the objective of equipping policymakers, regulators, and civil society stakeholders with a framework for proposing and implementing needed regulatory or other changes in an

economy to allow LEO satellite services to offer broadband internet access to underserved areas and communities. The associated workshop was held in September 2024 on the margins of the 69th Telecommunications and Information Working Group Meeting (APEC TEL 69). The workshop agenda and the workshop summary report can be found in the annex of this report.

1. Introduction

The advent of commercial satellites marked a transformative moment in the history of telecommunications and space technology. The first commercial communications satellite in geosynchronous orbit, also known as "Early Bird" and established by Intelsat, was launched on 6 April 1965 by the United States' National Aeronautics and Space Agency (NASA) (NASA, 2010). This satellite was meant to overcome the challenges faced by the era's available technologies and relay signals across the Atlantic Ocean for stable real-time communication.

In its early years, satellite communication was an international connection tool that only large corporations and government entities could access. This was mainly because the infrastructure required for satellite communication, including ground stations, large antennas, and sophisticated receiving equipment, was run primarily via state-operated enterprises not focused on direct connectivity for smaller businesses and consumers or households. In the 2010s, the emergence of geosynchronous equatorial orbit (GEO) satellites capable of providing broadband Internet services marked a turning point, as they started to play a crucial role in addressing the digital divide and bringing connectivity across the globe.

Over the decades, advancements in technology for ground and space networks, increased competition, the decreasing costs of launch, and economies of scale have significantly reduced the cost of satellite communication. In recent years, the advent of the LEO Non-Geostationary Orbit (NGSO) satellites has changed the market landscape, meaning smaller and less costly satellites can now offer many services, including connectivity at high speed with low latencies and high capacity direct to consumers.

For instance, the market opportunity for High Throughput Satellites (HTS) including both Geostationary Orbit (GSO) and NGSO is estimated at USD 136 billion between 2024 and 2032, with 97% of the supply for such connectivity expected to be provided by NGSO systems (Euroconsult, 2024). LEO satellites are used for several applications and services, including Internet of

Things (IoT) connectivity, direct-to-cell communications, Earth observation, navigation, maritime communications, research, backhaul, and broadband.

LEO satellite constellations for broadband connectivity have been among the most promising segments. The cost reduction of manufacturing and launching satellites and the reduced costs of ground equipment, as well as the increased competition among satellite service providers have led to more affordable subscription plans for consumers. Many end-users are now aware of the possibilities of satellite connectivity for personal use precisely because of these recent developments. Moreover, the increased availability of broadband connectivity solutions – such as satellite services that can reach areas where terrestrial connectivity cannot be deployed or because the implementation costs are so prohibitive – presents an opportunity to bridge the digital divide and enhance connectivity in remote and underserved regions.

The advent of LEO satellite constellations brings with it many new regulatory challenges at the international and the domestic level. Firstly, at the international level, it is important to ensure the rational, efficient, and economical use of radio frequencies and associated orbits. At the domestic regulatory level, regulatory bodies must navigate frequency coordination to prevent interference and ensure competition. The increased availability and uptake of LEO satellite broadband connectivity has motivated regulators to reconsider traditional schemes for licensing, including elements such as the definition of technical parameters, whether to allow network or blanket licenses, the availability of spectrum, the movement of user equipment, and recognizing the potential of LEO systems in bridging digital divides.

This document provides an initial overview of some of the domestic regulatory and licensing developments for LEO broadband satellites across APEC economies. It outlines the potential socioeconomic benefits of LEO satellite connectivity and emphasizes the importance of light touch, effective regulatory frameworks in unlocking new opportunities for economic development and digital access. By fostering competition and ensuring fair access to spectrum resources, these frameworks can drive innovation, reduce costs, and improve service quality.

The following section details both the foreseen and estimated benefits, as well as the challenges presented by the emergence of LEO satellite broadband connectivity. It discusses the required licensing conditions for LEO services and highlights some emerging best practices. Section three offers a brief overview of regulatory developments in APEC economies related to LEO satellite broadband connectivity. The conclusion provides an initial set of

recommendations for APEC economies to effectively harness the potential of LEO satellite connectivity, focusing on enhancing competition, ensuring spectrum availability, and promoting digital access.

2. Challenges and Opportunities

What are the main challenges and opportunities that LEO broadband connectivity poses for APEC economies? This section provides an overview of some of those challenges and the action items that could be considered by APEC economies to maximize the benefits of the technology.

2.1 Regulatory Challenges from LEO Broadband Satellite Connectivity and Best Practices

The emerging LEO satellite constellations challenge traditional and legacy regulatory frameworks due to the increase in number of satellite operators, their innovative deployment, the large number of space stations and earth stations, technical requirements, and overall expansion of satellite services availability. These constellations are straining existing regulatory frameworks that were drafted primarily for a small number of telecommunications operators primarily focused on government, enterprises, and large-scale broadcast users, sited at fixed locations. Today's satellite innovations place a greater emphasis on services to consumers, mobility, and smaller scale enterprises. The main challenges and opportunities for improvement, based on international best practices regarding satellite services, are summarized as follows:

- **Landing rights:** Originally considered as protection for domestic satellites in the 1980s, the requirement for an authorization to allow foreign satellites to transmit and receive over a specific economy can limit or delay deployment of beneficial services, and, unless modernized, imposes barriers to service availability. While landing rights remain necessary, modernizing these requirements to reflect the changing technological and competitive landscape is crucial to promote the efficient deployment of LEO connectivity. *As frequency coordination procedures are conducted at both the domestic and the international level, a simple light-touch administrative registration, where required, could address domestic administration needs without compromising service availability.*

- **Spectrum availability:** LEO satellite broadband services primarily operate in the traditionally identified **Ka band** (17.8-18.6 GHz and 18.8-19.3 GHz (downlink) and 27.5-30.0 GHz (uplink)) and **Ku band** (10.7-12.7 GHz

(downlink) and 14.0-14.5 GHz (uplink)). The allocation of these frequencies is harmonized at the international level for Fixed Satellite Services (FSS), and technical parameters have been defined at the International Telecommunications Union (ITU) to allow satellite services to operate in these frequency ranges.

Nevertheless, at the domestic level, some economies make smaller portions of the Ku and Ka bands available (for example, 27-29 GHz in the Ka-band or 14-14.25 in the Ku-band) or only allow fewer applications within those ranges (for instance, not assigning spectrum for Earth Stations in Motion or transportable Earth stations). Reduced spectrum availability could result in lower quality of services provided to end-users because satellite providers have less capacity to plan and design networks for the data demands, or are competing with other operators for the same resources, which can also constrain innovation.

There is an increasing urgency to address these limitations and differences across the APEC region. Considerations regarding the coexistence between multiple LEO constellations and actions to ensure market entry for new entrants are also beginning to become an issue of interest to regulatory authorities. For instance, some regulatory frameworks allow for the full assignment of spectrum to new entrants, provided they meet certain legal and technical qualifications and can coordinate with existing systems, such as broadcasting-satellite service and fixed satellite service plans, both domestically and internationally. Default mechanisms may be employed if coordination efforts fail. *Once technical parameters are defined, if there are no interference risks, spectrum availability should be considered for the full Ku- and Ka-bands.*

- **Domestic gateways:** From both a technical and economic perspective, gateways are not required in every jurisdiction where services are provided in order to operate a system. Establishing unnecessary satellite gateways requirements greatly impacts the network's design and operation and represents high operational costs for satellite providers. It also places regulators in the role of designing the actual constellation. Nevertheless, many economies still impose this requirement to authorize an operator to provide broadband satellite connectivity domestically. Often, this is based on concerns about guaranteeing government controls or access. Alternative regulatory measures exist that obviate unnecessary physical gateway infrastructure.

For instance, allowing providers to use the local infrastructure of Mobile Network Operators (MNO) to pass traffic through their network or implementing virtual private network (VPN) connections to route the traffic to lawful domestic government entities could meet requirements for access. *In sum, alternatives exist to unnecessary gateway requirements.*

- **Network or blanket licensing:** The efficient operation of a LEO satellite broadband constellation to provide connectivity to broad areas requires licensing regimes that allow low-cost deployment of Earth stations to expand coverage and efficient distribution of end-user terminals. Legacy licensing conditions that require one authorization for each Earth station or end-user terminal to deploy or require information on their deployment (e.g., geographic locations) do not match the modern-day configurations of LEO systems, represent high costs for the satellite providers, and increase administrative burdens for the domestic authorities. Historical regulatory regimes were based on the assumption that there would only be a handful of earth stations, not the hundreds or thousands made possible with today's LEO systems.

  When such regulations are implemented, the deployment of services is delayed and the costs faced by the providers are often passed on to consumers, meaning service is offered at higher prices. A licensing scheme allowing for a large number of anticipated Earth stations (also known as blanket or network licensing) is helpful for the efficient deployment of broadband satellite connectivity.

- **Spectrum resources:** The allocation and management of spectrum resources are fundamental for the effective deployment of LEO satellite broadband services. Spectrum use and licensing charges need to be updated to reflect any new blanket/network developments targeting a broader population. Regulatory frameworks should ensure that spectrum resources are made available in a manner that encourages competition among providers, facilitating the rapid deployment of broadband consumer internet services at competitive prices.

  Spectrum use for the provision of satellite broadband internet brings social and economic benefits that should be considered when defining the fees charged by regulatory authorities, particularly to incentivize service deployment in underserved and unserved communities (Frontier Economics, 2022). While spectrum pricing remains an important consideration, it is essential that fees are cost-based and reflect the actual use of spectrum resources, rather than serving as a barrier to entry.

Revising spectrum fees and the conditions for charging them, with an approach that is proportionate to and promotes the economic benefits derived from increased connectivity and provision of services to more communities, could yield substantially greater gains than high fees collected from licensees.

- **Cost of end-user terminals:** Due to technological innovations, the prices of satellite end-user terminals have decreased substantially over the last five years. Nevertheless, they remain costly for mid and low-income households. Mass production of terminals and a reduction of the associated cost of entry into the market will aid in making end-user terminals affordable. Volume will drive down costs and increase availability.

  Typically, the costs associated with fulfilling type approval or homologation of equipment, such as importing procedures, are passed on to consumers via higher prices for the services (ADB, 2021). Simplifying type approval conditions, revising import controls of end-user terminal equipment, and streamlining import procedures including recognizing reciprocity will *reduce regulatory burdens and costs, allowing for lower prices to be offered to consumers as an effect of mass production and fewer costs to bring terminals to the market.*

- **Reevaluating local entity and foreign ownership restrictions:** Setting up a legal presence (local branch or an entity) is time-consuming and costly, posing a potential barrier to market entry. Furthermore, local entity limitations may deter operators from entering the market. *Regulatory bodies should assess the necessity of requiring local establishments or foreign ownership limits as a prerequisite for providing satellite broadband connectivity.* While some regulations do not explicitly mandate a local presence, practical considerations often necessitate it to meet various regulatory requirements. *A license document itself establishes regulatory control and can serve as the basis to enforce conditions of the license via suspension or revocation.*

Currently, the main providers of LEO broadband connectivity services include Starlink (a SpaceX company), OneWeb (currently Eutelsat/OneWeb part of the Eutelsat Group), and the forthcoming Kuiper (an Amazon company), Infrastructure for Resilience, Interconnectivity and Security by Satellite (or IRIS² via the European Union Secure Connectivity Programme), Telesat, Guowang, and Qianfan/G60. One development worth noting is that traditional satellite providers and owners of GSO systems are beginning to cooperate with LEO providers to offer services under their name but leveraging the

connectivity from the NGSO constellations (through a resale model). This is an area of convergence in satellite connectivity and creating competition among carriers and services.

As such, the supply of LEO connectivity goes beyond the operators identified above and has enabled multi-orbit resilient and seamless connectivity solutions to emerge. These are now offered by traditional satellite industry providers, such as Intelsat, Viasat/Inmarsat, EchoStar/Hughes, SES, and Eutelsat with OneWeb as part of the Eutelsat Group (Kratos, 2023). The emergence of multiple LEO satellite operators presents an opportunity to enhance competition in the market. Regulatory frameworks should be designed to lower entry barriers for new entrants, encourage innovation, and ensure a level playing field for all providers.

These technological and business advancements and convergence with other networks can bring significant opportunities for increased connectivity and innovative services. To fully enable this development, the need for concomitant regulatory adjustments is pressing as systems become more complex. Addressing these opportunities will unlock large social and economic opportunities, as described below.

2.2 Economic Opportunities

Increasing internet access by 10% generates a 2.5-2.8% increase in Gross Domestic Product (GDP) per capita for mobile broadband and a 2.0-2.3% increase in GDP per capita for fixed broadband (ITU, 2019). The impact is more significant in low-income economies than higher-income economies – precisely where the need is greater. Moreover, LEO broadband connectivity can also be used to provide backhaul for terrestrial (mobile) services to further expand connectivity options, thereby doubling – or more – the economic impact.

Notably, among the benefits of satellite broadband connectivity is its capacity to operate in hard-to-reach locations, including rural areas, with less infrastructure deployment than other solutions. This is particularly important for bridging the digital divide. In 2018, an estimated 90% of the world's population was covered by mobile broadband. As of 2024, this has only moved up four points, illustrating the pervasive difficulty in addressing the costly last mile in many parts of the world. Moreover, almost all urban areas and 98% of rural areas of high-income economies are covered. Therefore, the existing coverage gap corresponds almost entirely to people in rural regions of developing economies (ITU, 2023).

Compared to high-income economies, the mobile broadband basket is also 5.5 times less affordable in lower-middle-income economies and more than 20 times less affordable in low-income economies. A fixed broadband subscription, if available at all, costs the equivalent of a third of the average monthly income in low-income economies (ITU, 2023).

This is where LEO broadband connectivity solutions may provide end-users with direct Internet access or enable the expansion of other technologies at increasingly cost-competitive prices and quality of service. For instance, it is estimated that by 2030, at least 500 million people will use satellite broadband connectivity. The associated benefits for households are calculated at USD 52 billion by the same year, representing double the impact calculated in 2022. This figure represents the total value of benefits derived from improved connectivity, such as increased access to information, online services, education, healthcare, and other essential services. (Valdani Vicari & Associati; LS Telecom, 2023).

To materialize the estimated benefits and impacts of increased internet access and the potential unlocked by the particularities of LEO broadband connectivity, the regulatory challenges described in the previous sections must be addressed. Remarkably, LEO broadband service providers have been operational for around five years, and many economic benefits and growth are already estimated to be obtained in the short term.

Many APEC economies are in the process of reforming their regulatory landscape to enable access to a multiplicity of operators. Furthermore, some economies have already implemented regulatory updates to accommodate the existing challenges, as described in the following section.

3. Regulatory Developments and Licensing Requirements

This section looks at recent LEO broadband regulatory developments in some of the APEC economies to highlight the evolution of several regulatory frameworks, as well as the foreseeable actions and priorities set out by the APEC economies. The aim of this research is to provide input for further analysis and discussion.

Notably, this section only covers connectivity and regulatory regimes at the ground segment level, comprising the regulations and requirements to install and operate Earth stations and provide connectivity services to consumers. It does not relate to the domestic rules in APEC economies that govern the

space segment, which corresponds to the launch of satellites and the notification and coordination procedures that Administrations must conduct with the International Telecommunication Union (ITU) to enable efficient use of the spectrum and associated orbital resources and the operation of the constellations in space without causing harmful interference to other services.

3.1 Spectrum Resources

In terms of the spectrum requirements for operating a constellation of LEO satellites providing broadband services, all major operators[1] use the **Ka-band** (17.8-18.6 GHz and 18.8-19.3 GHz (downlink) and 27.5-30.0 GHz (uplink)) and the **Ku-band** (10.7-12.7 GHz (downlink) and 14.0-14.5 GHz (uplink)). As mentioned, these fall within the internationally harmonized spectrum bands for FSS, developed through negotiations at ITU World Radio Conferences (WRC), and contained in the ITU Radio Regulations.

Additionally, some operators have started to test the provision of services on the **V-band** (37.5-42.0 GHz (downlink) and 47.2–50.2 GHz and 50.4–52.4 GHz (uplink))**,** which helps increase data capacity because higher spectrum frequencies can carry more information per second. However, the use of portions of the **V-band** for satellite services is still under discussion at the international level.

Within the telecommunications frequency allocation frameworks of different APEC economies, FSS systems continue to be placed within the aforementioned bands and most economies follow international ITU allocations. However, the assignment of these bands for satellite services and the complexity of obtaining such assignments varies significantly across the APEC economies.

For example, some economies, such as New Zealand, have defined “class licenses” or “general use licenses” authorizing the use of spectrum only subject to compliance with technical requirements. Therefore, no application for a license, nor payment of a fee, is required. Meanwhile, economies like Canada; Chile; Japan; and Mexico have streamlined licensing procedures for the assignment of spectrum and procedures are typically completed within six months or less. In other economies like Australia and the United States, LEO systems are licensed in keeping with their respective ITU space segment conditions and the ground stations are licensed separately sometimes via

1 Starlink, OneWeb, Telesat, Kuiper.

class or group licensing, or individually for gateways. In contrast, obtaining a spectrum frequency assignment to provide satellite services in other APEC economies, such as Brunei Darussalam; Indonesia; Papua New Guinea; or the Philippines, effectively requires longer timeframes and the completion of several more requirements; in some cases, licensing requires forging business relationships with local operators.

3.2 Licensing Conditions

Rules for providing LEO broadband Internet services reflect a different set of licensing conditions in each APEC economy. Typically required authorizations include:

- **Landing rights:** Allowing a foreign satellite to transmit to and from the market and provide capacity over an economy.
- **Telecommunications license or Network Service Provider License:** Authorization that allows providers to operate the network and sell services to third parties or the public. These can be a single type or include subclassifications differentiating the operation of networks and the provisioning of services.
- **Spectrum permit:** The assignment of frequencies that allows providers to use the frequencies and operate Earth stations in the economy over a set of frequencies.
- **Radio equipment license:** An additional authorization to operate Earth stations that, in some instances, are not covered by the spectrum permit.
- **Type approval:** Also known as homologation, this refers to the verification of the equipment to be used to ensure it complies with technical requirements, is safe for human health, and does not cause harmful interferences. In some economies this is handled via the earth station license process.

The specific requirements vary by economy, often reflecting the complexity of the local regulatory environment, the level of involvement in telecommunications and space services, the difficulty of market entry for providers, and overall market maturity. For instance, economies such as Australia: Chile; Japan; New Zealand; and Chinese Taipei, in order to promote competition and broadband access, have opted for simplified licensing frameworks and conditions representing fewer barriers to market entry for new providers.

Other economies require additional, defined reporting requirements, such as, Canada; Mexico; Peru; and the United States. While these requirements may seem more complex, they are designed to ensure transparency and regulatory compliance, which can provide a clear and predictable framework for market participants.

As described in the previous sections, the emergence of LEO satellite connectivity services has disrupted markets and challenged regulatory frameworks in less than five years of effective operations and market availability.[2] Such rapid changes highlight the necessity for regulatory evolution. However, regulators and policymakers in APEC economies are responding to the opportunity and evolving and developing new policies.

3.3 Relevant Developments

Recent examples of regulatory developments in some APEC economies concerning LEO broadband are highlighted below.

- **Australia:** The Australian Communications and Media Authority (ACMA) has issued several updates to the licensing regime to acknowledge and accommodate LEO satellite services, including harmonization with decisions adopted at the ITU level, such as the operation of Earth Stations in Motion and guidance on International Mobile Telecommunications (IMT) Satellite direct to mobile service. Furthermore, in October 2022, a Low Earth Orbit Satellite Working Group was established. The first report was published on 24 April 2024 (Low Earth Orbit Satellite Working Group, 2024) with recommendations across five issues: digital inclusion, universal services, direct to device services, resilience and redundancy in emergencies, business and economic benefit.
- **Canada:** Several regulations have been updated by Innovation, Science and Economic Development Canada (ISED) recently to accommodate for the licensing particularities of NGSO satellite services, including considerations on spectrum fees and technical parameters, among others (ISED, 2023). Furthermore, the Spectrum Outlook 2023 to 2027 (ISED, 2023) addresses LEO satellite services as follows:

2 NGSO constellations were conceptualized more than three decades ago and started to be offered to the market in the 1990s; however, the technology available at the time was too costly, and the terrestrial services (mobile telephony) made greater breakthroughs offering cheaper and more convenient solutions (Butash, Garland, & Evans, 2021).

  - The Spectrum Outlook acknowledges the increased demand for satellite connectivity, particularly NGSO and innovative uses requiring additional spectrum availability, and defines the need to keep working on the issue and monitoring developments as the market consolidates.
  - The Spectrum Outlook also envisages a rethinking of the regulatory environment around facilitating the growth of LEO and NGSO operators.
- **Chile:** Historically, the Chilean regulatory framework has been one of the simplest in South America. There are no landing rights requirements, a technologically neutral licensing regime with authorizations granted for up to 30 years, and on a renewable basis (Subtel, 2019).
  - The economy was one of the first in South America to grant licenses for LEO satellite providers in 2022 and 2023, and providers have chosen Chile to set up operations to offer services in the region due to the overall ease of doing business and the simplified licensing conditions compared with other South American economies.
  - The Digital Transformation Blueprint 2035 (CEPAL, 2024) highlights the role of LEO satellite connectivity in providing internet access to rural and dispersed populations. The Blueprint acknowledges the need to favor technologically neutral strategies to promote infrastructure deployment and incentivize innovation in using spectrum resources to cover the underserved areas, particularly areas with low population density and challenging business cases.
- **Mexico:** In 2023, the Federal Telecommunications Institute (IFT) revised the rules for the provision of satellite services (IFT, 2023), looking, among others, to incorporate recent technological developments, allow for innovations, and facilitate access to domestic and foreign providers. Overall, the Mexican licensing regime is technologically neutral. Although licensing conditions include the need for landing rights and only domestic entities are eligible to apply for licenses, several satellite providers offer their services in Mexico, and LEO satellite providers are already licensed or have announced their investment plans in Mexico. Additionally, there is a requirement for satellite operators to pay a percentage of their revenue to the government, which may impact the attractiveness of the market for some providers.
- **Papua New Guinea:** In 2023-2024, the National ICT Authority of Papua New Guinea (NICTA) held a public consultation to seek the views of the

industry and stakeholders on appropriate arrangements for licensing the provision of LEO satellite services (NICTA, 2024). The consultation acknowledged the need to update some licensing conditions to this technology and, following technological neutrality best practices, also recognized that LEO solutions should be eligible for implementation of universal access and services projects.

- **The Philippines:** Recognizing the need to improve connectivity and the role of satellite services in closing the gap, especially given its geography, in 2021, the Department of Information and Communications Technology (DICT) issued Circular 002 (DICT, 2021) to significantly expand internet services through satellite technology by modifying their landing rights requirements and access to spectrum from broadband connectivity. Under the new rules, satellite providers are allowed to sell their capacity to domestic licensees directly. To offer broadband Internet services, domestic licensees are subjected to a simpler and faster licensing regime, facilitating their access to spectrum frequencies. Moreover, the National Telecommunications Commission (NTC) is tasked with ensuring that sufficient spectrum resources are available for the provision of broadband satellite connectivity.

- **Singapore:** Due to the extensive deployment of fixed broadband, internet access is highly affordable in Singapore (ITU, 2024). Nevertheless, the benefits of LEO broadband connectivity are acknowledged by domestic policies and have been identified and incorporated into the domestic framework, as evidenced by the following developments.

  - LEO satellite broadband service companies are covered under the Facilities Based Operations and Services-based Operations Licensing Framework. In particular, their service is within the scope of “Satellite Mobile Telephone or Data Services” in the Guidelines (IMDA, 2023). The 2023 Singapore Digital Connectivity Blueprint (Ministry of Communications and Information; IMDA, 2023) identifies enabling the growth of LEO satellite services, including from a regulatory perspective, as a key area for further developing Singapore’s digital infrastructure. The expansion of seaport and airport capacities is identified as one of the areas with the greatest potential for LEO satellite technologies in Singapore. The Blueprint also announces that work will be undertaken to ensure sufficient spectrum resources and to increase clarity in the existing licensing framework.

- **Thailand:** The National Broadcasting and Telecommunications Commission (NBTC) revised its licensing framework in 2023 to better align with the complexities of foreign satellite operators (NBTC, 2024). Under the new regime, operators wishing to offer services using foreign satellites must apply for three separate licenses: gateway station facilities, landing rights for uplink and downlink satellite signals, and commercial services. This replaces the previous single-license system, making the process more rigorous. While these changes aim to provide a more structured and comprehensive regulatory approach, they also introduce additional steps that may increase the complexity and duration of the licensing process. Despite the regulatory changes, implementation challenges persist.
- **The United States:** The United States was among the first economies to introduce changes to the regulatory framework to allow LEO satellite services, including frequency allocation, interference concerns, availability of services, and licensing conditions. The Federal Communications Commission (FCC) issued the first rules acknowledging the complementarity of satellite and terrestrial technologies, particularly in areas lacking coverage (FCC, 2024). Moreover, the FCC introduced measures to streamline satellite licensing rules and procedures to among other things, expedite licensing of satellite space and earth stations including NGSO FSS systems. (FCC, 2023). Additional specific actions include:
  - In 2023, as part of the Space Innovation Agenda to meet the needs of a new space age, the FCC created a dedicated Space Bureau to handle policy and licensing matters related to satellite communications and other in-space activities (FCC, 2023), to facilitate the deployment of commercial space services, streamline regulatory processes, and support the increase in new entrants and technologies into the marketplace.
  - In April 2023, the FCC released new rules for spectrum sharing between NGSO FSS systems (FCC, 2023). The rules establish that NGSO FSS operators licensed or granted market access in the United States in the same processing round must coordinate with each other in good faith and set forth a sunset period for the protection granted to earlier licensed providers, looking to allow new entrants to share spectrum on an equal basis once the sunset period expires. The rules are predicated on the understanding that promoting coordination between satellite providers and defining technical parameters will allow the coexistence of NGSO systems and contribute to the development and competition in broadband NGSO satellite services.

- In January 2024, the FCC adopted an Order on Reconsideration that which provides clarity and guidance to satellite operators on satellite maneuverability disclosure requirements and the use of “free-flying” deployment devices, methods for conducting a re-contact risk analysis, and clarifies the applicability of the 0.99 disposal reliability goal for large satellite systems. The Commission also clarifies requirements for assessing and limiting the release of persistent liquids in space, that the Commission’s orbital debris rules apply to non-U.S.-licensed space stations, and by shortening from 25 years to 5 years the period of time that FCC-authorized LEO satellites can remain in orbit following the completion of their missions.
- In September 2024, the FCC adopted new rules to open 1300 megahertz of contiguous spectrum for non-geostationary orbit (NGSO) fixed-satellite service operations in the 17.3-17.8 GHz band. This action promotes spectrum efficiency, fosters competition and expands the ability of satellite operators to deploy advanced services, including high-speed Internet access to unserved and underserved areas.
- In February 2024, the Commission proposed a framework for licensing frequencies used for stations engaged in in-space servicing, assembly, and manufacturing (ISAM) activities. ISAM activities are an area of rapidly accelerating innovation and economic opportunity. As part of its Space Innovation Agenda, the FCC is proposing changes to its part 25 rules to support the development of these novel space activities.

The measures described above demonstrate a clear recognition of the transformative potential of LEO satellite technology to enhance connectivity, foster innovation and competition, and bridge the digital divide. There are key steps, facilitated by light-touch and smart regulatory environments, that facilitate the deployment of LEO satellite services and serve as a foundation for future growth in APEC economies. These steps include:

- Implementing technologically neutral licensing frameworks to allow current and future innovations to be easily deployed and expedite access to the benefits of newer technologies in all segments of the economy.
- Addressing spectrum allocation issues and continuously monitoring technology developments to efficiently manage this natural resource, the prime material for all wireless communications.

- Simplifying market entry regulations to impact on the costs and variety of services available to all sectors of the economy.
- Addressing the new regulatory evolution realm needed to enable the role of LEO constellations to boost 5G connectivity and other applications in a timely manner.
- Incorporating ITU decisions, recommendations, technical standards, and best practices while reducing domestic regulatory burdens to increase competition.

The incorporation of modern regulatory frameworks in satellite technology can help ensure that all APEC economies, at a pace that aligns with their unique domestic needs and capacities, contribute to and benefit from the collective progress in digital connectivity. The following section further elaborates on these recommendations.

4. Recommendations

Building on good practices and success stories in the APEC economies to support LEO satellite connectivity, as well as acknowledging the need to balance the market entry conditions with public policy priorities, this section elaborates potential elements that should be advanced to harness the benefits of LEO satellite connectivity.

Share knowledge and capabilities regarding spectrum use.

Noting the differences in the implementation of international best practices and incorporation of rules for newer technologies across APEC economies, regulators should share spectrum and licensing expertise and expand capacity-building mechanisms. Among the topics that would benefit from this collaboration are regulatory best practices and use cases for coordinating frequency usage to avoid harmful interference and ensure coexistence with other satellite and terrestrial services.

Ensuring sufficient spectrum availability for LEO services is another significant topic; therefore, APEC economies should consider sharing insights into spectrum sharing and dynamic spectrum access techniques that maximize the efficient use of available spectrum, actions to accommodate the growing demand for satellite connectivity, and learning from the implementation of rules in different economies. Regulatory authorities should prioritize the efficient allocation and management of spectrum resources to support the growth of LEO satellite services. This includes:

- Setting spectrum fees at a level that is cost-based and aligned with the actual use of spectrum resources, avoiding fees that do not serve a practical purpose.
- Considering the economic benefits of increased connectivity when setting spectrum fees, to incentivize service deployment in rural and less connected areas.
- Streamlining the licensing process for licensing and spectrum use to reduce barriers to entry and promote competition among providers.
- Recognizing the different types of fees (earth station, landing rights, and spectrum) and helping ensure they are structured to support the economically sustainable development of satellite broadband services.

Consider Security and Technology Choices

Sharing and testing practices for securing satellite communications, protecting user data, and ensuring compliance may be beneficial, including considering the various approaches by APEC economies. Sharing examples may help to identify options that could affect costs and deployment speed to achieve these important goals. Additionally, discussing technology choices that enhance security, and privacy can provide further insights into effective practices.

Prioritize opportunities for standard or streamlined market entry elements between APEC economies to increase competitiveness and build out incentives to LEO broadband to aid in the bridging of the digital divide

Reconsidering some of the complexities associated with acquiring landing rights, such as evaluating the requirement for a local entity or presence as requisite to apply for the license or revising the possibility of accepting legal entities established within the APEC economies, would also ease entry barriers and reduce the cost-of-service provision, increasing competitiveness.

Incentivizing LEO providers to extend their coverage to unserved areas is an important milestone for bridging the digital divide in APEC economies. Lowering financial barriers can include implementing programs that encourage providers to ensure coverage to underserved or unserved areas, connecting households and communities, and offering Wi-Fi solutions to schools, hospitals, community centers, and similar institutions.

Several regulatory bodies have explored and implemented these programs, and they could be explored within APEC economies to build best practices and use cases. Likewise, drawing from the geographical diversity among APEC economies, solutions and best practices on policy solutions and incentives for service provision to rural and hard-to-reach areas could be explored. Economies can support growth of regional connectivity and economic development by proactively sharing these lessons learned and practices with proven effectiveness among APEC economies.

Overall, the concerted efforts of APEC economies to enhance LEO satellite connectivity can significantly bridge the digital divide, increase competition, and foster broad-based growth. Collaborating on regulatory frameworks, technical standards, and security measures can boost connectivity in rural areas and drive innovation and economic development. By leveraging collective knowledge and adopting best practices, member economies can help ensure that the transformative benefits of LEO services are fully realized.

Annex I: Member Economies and their Relevant Authorities

MEMBER ECONOMY	RELEVANT AUTHORITY
Australia	Australian Communications and Media Authority (ACMA)
Brunei Darussalam	Authority for Info-communications Technology Industry (AITI)
Canada	Innovation, Science and Economic Development Canada (ISED)
Chile	Telecommunications Undersecretariat (SUBTEL)
People's Republic of China	Ministry of Industry and Information Technology (MIIT)
Hong Kong, China	Office of the Communications Authority (OFCA)
Indonesia	Ministry of Communication and Information Technology (Kominfo)
Japan	Ministry of Internal Affairs and Communications (MIC)
Republic of Korea	Korea Communications Commission (KCC)
Malaysia	Malaysian Communications and Multimedia Commission (MCMC)
Mexico	Federal Telecommunications Institute (IFT)
New Zealand	Ministry of Business, Innovation and Employment (MBIE)
Papua New Guinea	National Information and Communications Technology Authority (NICTA)
Peru	Ministry of Transport and Communications (MTC)
The Philippines	National Telecommunications Commission (NTC)
The Russian Federation	Federal Service for Supervision of Communications, Information Technology and Mass Media (Roskomnadzor)
Singapore	Info-communications Media Development Authority (IMDA)
Chinese Taipei	National Communications Commission (NCC)
Thailand	National Broadcasting and Telecommunications Commission (NBTC)
The United States	Federal Communications Commission (FCC)
Viet Nam	Viet Nam Telecommunications Authority (VNTA)

Annex II: Workshop Agenda

Asia-Pacific Economic Cooperation

USAID FROM THE AMERICAN PEOPLE

Agenda

Workshop on Expanding Broadband Access through Low-Earth Orbit (LEO) Satellite Communications Systems

September 12, 2024

Classico Room, Sheraton Maria Isabel Hotel

Mexico City, Mexico

SESSION	
8:30 – 9:00 am	**Registration and Arrival**
9:00 – 9:15 am	**Welcome and Opening Remarks** **Jai Nair**, U.S. TEL Working Group Head of Delegation, U.S. Department of State
Session 1 9:15 – 10:15 am	**The Impact of LEO Satellites on Bridging the Digital Divide** *LEO satellite technology is an alternative to traditional broadband services that has the potential to narrow the digital divide and increase broadband internet access in unserved and underserved areas and communities, ultimately providing sustained economic benefits to communities across many APEC economies. This session will share an economy's perspective in the implementation of LEO satellite technology, assessment of how these services can expand connectivity in underserved areas and populations, and the regulatory considerations required for authorization and launch of services.* **Dennis Morales**, Director, Infostructure Management Bureau, Department of Information and Communications Technology, The Philippines **Dr. Sayuri Adriana Koike Quintanar**, Researcher in Vertically Integrated Markets in Telecommunications and Broadcasting Networks, Federal Telecommunication Institute, Mexico
10:15 – 10:45 am	**Coffee Break**
Session 2 10:45 am – 12:15 pm	**Lessons Learned in LEO Deployment: Perspectives from Economy Regulatory Bodies** *In this session, economies in various stages of deployment or pre-deployment will share the legal and regulatory considerations necessary for implementing LEO satellite technology. Economies will detail licensing requirements, the role of domestic regulatory bodies, legislative and/or regulatory hurdles faced in implementation, and perspectives*

	on how to promote cooperation on regulatory approaches to expand broadband access. *Moderated by: Peter Lovelock, Chief Consulting & Innovation Officer, Access Partnership* **Clare Spring**, Department of Infrastructure, Transport, Regional Development, Communications and the Arts, Australia **Dr. Anna Christina Situmorang**, Head of Innovation and Working Program Intensification, Spectrum Policy and Planning, Ministry of Communication and Informatics, Indonesia **María Fernanda Sánchez Zavala**, Director of Technical Analysis and Orbital Resources, Spectrum Unit, Federal Telecommunication Institute, Mexico **Geoffrey Carr**, Foreign Affairs Officer, Office of Technology Security, Information & Communications Policy, U.S. Department of State
12:15 – 1:30 pm	**Lunch**
Session 3 1:30 – 2:30 pm	**Solutions for a Robust Regulatory Framework** *This session will offer a perspective on what regulatory changes are needed to realize the economic benefits of LEO and the benefits of a fair and competitive LEO market. This session will also explore how to address interests of different stakeholders ranging from customers, governments, and service providers.* *Moderated by: Jai Nair, U.S. TEL Working Group Head of Delegation, U.S. Department of State* **Zach Blackburn**, Lead, Licensing and Regulatory Affairs, Americas, Amazon Kuiper **Peter Lovelock**, Chief Consulting & Innovation Officer, Access Partnership **Juliana Ramirez Echeverry**, Senior Practice Manager, Global Government Advisory, Access Partnership
2:30 – 3:00 pm	**Coffee Break**
Session 4 3:00 – 3:30 pm	**The LEO Business Model** *This session will showcase the different use cases of LEO and offer a business perspective. This session will discuss customer base, points of entry, pricing, and which industries are turning to LEO, such as its use for emergency services.* **Israel Rosas**, Director, Partnerships and Internet Development, Internet Society
Session 5 3:30 – 4:15 pm	**Breakout Groups**

	This breakout session will delve into the legal and regulatory considerations for deploying LEO satellite technology and how cooperation on these regulatory approaches could expand broadband access.
4:15 – 4:30 pm	**Report Back and Closing Remarks**

Annex III: Workshop Summary Report

Summary of Workshop on Expanding Broadband Access through Low-Earth Orbit (LEO) Satellite Communications Systems
September 12, 2024
Mexico City, Mexico

On 12 September 2024, the United States held a workshop to build on the 2023 TEL workshop introducing Low-Earth Orbit (LEO) satellite technologies as an alternative to traditional broadband services for hard-to-reach and underserved areas. The September 2024 workshop focused on policy and regulatory frameworks that economies have adopted to introduce LEO satellite communications services into their telecommunications systems to narrow the digital divide and increase broadband internet access in unserved and underserved areas and communities, ultimately providing sustained economic benefits to communities across many Asia-Pacific Economic Cooperation (APEC) economies. The workshop provided a forum for economies to discuss approaches to developing an enabling regulatory environment for LEO, and the various ways in which governments can address regulatory landscape, and licensing requirements.

Following opening remarks by United States Telecommunication and Information (TEL) Working Group Head of Delegation, Jai Nair, the workshop began with an introduction on the impact of LEO satellites can have on bridging the digital divide. Two economies with recent experience in authorizing LEO satellite communications services, Mexico and The Philippines, shared lessons from their experiences. Dennis Morales, the Director of the Infrastructure Management Bureau in the Department of Information and Communications Technology (DICT) in the Philippines, discussed his department's efforts to connect every Filipino to free internet access through Wi-Fi sites in public places. DICT partners with the private sector to provide 2,192 free Wi-Fi LEO sites in health centers, local community centers, state universities and daycare centers. He emphasized that LEO satellite services have been particularly impactful during unexpected events, including emergency response and brown outs, due to the simpler setup and infrastructure requirements than other options. Following the Philippines overview, Dr. Sayuri Adriana Koike Quintanar, a Researcher in Vertically Integrated Markets in Telecommunications and Broadcasting Networks at the Federal Telecommunication Institute in Mexico, discussed her recent academic studies calculating the costs of extending broadband services. The study that she presented involved calculating the costs associated with extending broadband services to areas lacking guaranteed mobile coverage (3G, 4G, or 5G). This is done using two distinct models: one based on satellite technologies and another that uses a wireless network solution. The use of LEO satellites decreases connection costs, but the actual cost of connection depends on scale and number of users. She further presented an analysis of initial LEO investments and annualized costs to give participants an understanding of how they could conduct this analysis in their economies and pointed participants to the study link, which is included in her presentation.

The second session discussed lessons learned in LEO deployment from a regulatory perspective. Clare Spring from the Australian Government Department of Infrastructure, Transport, Regional Development, Communications and the Arts

presented on Australia's experience with LEO satellite services to close connectivity gaps in remote First Nations communities. She discussed Australia's Universal Service Obligation to ensure everyone in Australia has access to baseline fixed phone and broadband services regardless of where they live or work. She indicated that Australia's LEOSat Working Group, established in 2022, has been crucial to help inform on the role of LEOSats in future telecommunications policy. Then, Dr. Anna Christina Situmorang, the Head of Innovation and Working Program Intensification, Spectrum Policy and Planning in the Ministry of Communication and Informatics in Indonesia, shared the Digital Indonesia Vision 2045, which supports digital integration at the government, economy, and society level. She spoke about types of frequency licenses for satellite communications in Indonesia and described Indonesia's current range of service providers carrying out the Digital Indonesia Vision 2045. María Fernanda Sánchez Zavala, the Director of Technical Analysis and Orbital Resources, Spectrum Unit at the Federal Telecommunication Institute in Mexico, then discussed whether domestic frameworks need to be updated or made more flexible to address the most recent needs in satellite communications. She also discussed international provisions on the use of LEO for amateur satellite, science, meteorological, earth observation, academia, global navigation, end user communications, data relay, and the Internet of things (IoT). The discussion then turned to Geoffrey Carr, a Foreign Affairs Officer in the Office of Technology Security, Information & Communications Policy at the U.S. Department of State. He emphasized that his office understands that there is an evolution of technology and regulation change is always needed. Therefore, economies need to be part of the solution in sharing best practices, as well as forming partnerships with Internet service providers (ISPs) to create local presence for companies. He emphasized that international coordination and cooperation is vital across economies on topics such as spectrum harmonization and that there are several use cases for LEO, including emergency and last-mile service delivery which are particularly relevant to APEC economies.

The third session explored the regulatory changes are needed to realize the economic benefits of LEO and the benefits of a fair and competitive LEO market. The session emphasized that there is significant opportunity for LEO application across APEC economies and reinforced the need for industry partners to provide key input into the development of LEO policy framework to reflect the issues of today. Juliana Ramirez Echeverry, the Senior Practice Manager of Global Government Advisory at Access Partnership overviewed research on LEO satellite opportunities in APEC. She advised that there has only been a four percent increase in reaching new customers with connectivity in the last four years as the remaining unconnected consumers are those with the highest marginal costs for bridging that last mile, including lower-income communities and rural communities. She highlighted actions undertaken by APEC economies and stressed that knowledge sharing and capacity building is essential to addressing security and privacy concerns and allowing broadband providers to bridge the digital gap. Then, Zach Blackburn the Lead of Licensing and Regulatory Affairs for the Americas at Amazon Kuiper shared the Amazon LEO broadband service provider initiative with a latency of between 30 and 50 milliseconds, which is comparable to terrestrial options. This service offers connectivity on planes, trains and boats and Amazon can produce devices at scale. He discussed how good regulatory practices can be used to support LEO service providers, like Amazon Kuiper, when they are fit for purpose. Moderator Jai Nair

closed out the session with questions and answers on topics including various cases of backhaul and post mission compliance.

The fourth session focused on the LEO business model, where Israel Rosas, the Director of Partnerships and Internet Development at the Internet Society, discussed how the Internet is for everyone, and LEO satellite technologies can assist everyone in getting access to the internet. He discussed LEO challenges, including affordability, capacity, competition, and deployment. He outlined the interest in LEOs due to their ability to offer low-latency, high speed connections that support real-time communication as well as a significant reduction in costs for satellite development and rocket launches. Israel Rosas was joined by Peter Lovelock to answer questions from participants, including what additional barriers face last-mile communities in accessing broadband connection, how governments and society consider externalities, and how to ensure economy coordination.

The workshop's final session included an interactive activity, where participants discussed three key questions surrounding LEO satellite communications. When asked what were, or what would they expect to be the greatest challenges to enabling LEO satellite communications service in their economy, participants noted coordination and licenses, regulation and regulatory frameworks that need to be fit for services, device certification, and the need for economically sustainable use cases, dispersed populations, affordability and how competition can work in existing networks and with current service providers. When asked what gap does, or could, LEO satcom services fill in their economy and how does their economy view LEO satcom services in the context of its overall telecommunications network, participants shared a lengthy list of services. These included emergency response, e-services like e-health and education, security and environmental monitoring, cellular backhaul, industrial connectivity, and industrial applications for manufacturing and mining. When asked what other aspects of LEO satellite services they would like to see in TEL in the future, participants indicated that they would like to understand coordination on spectrum issues, how to manage administrative challenges, how to better understand business models, and the harmonization of standards and good practices for shared knowledge.

The workshop underscored the opportunity that APEC has in sharing best practices for LEO satellite service expansion to ensure connectivity for all. Panelists and participants highlighted current and future efforts to improve connectivity and harness the benefits of LEO satellite technology through good regulatory practices and increased economy coordination.

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