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IAFI[1]

PROPOSAL FOR DEVELOPMENT OF AN APT STRATEGIC SPECTRUM PLAN TO BRIDGE THE DIGITAL CONNECTIVITY NEEDS IN APT COUNTRIES

1. Introduction

Access to High-speed internet is no longer a luxury, it is the fundamental building block of economic competitiveness, social inclusion, and national resilience. The powerful combination of 4G/5G, community Wi-Fi, and NGSO satellites, gives policy makers now the tools to provide meaningful and ubiquitous connectivity to every citizen. But the opportunity must be seized with urgency. Strategic policy, forward-thinking regulation, and inclusive investment are critical to ensuring no community is left behind in the digital age.

A connected population is an empowered one and connectivity should be treated as the infrastructure of opportunity. Ubiquitous connectivity is within reach, but it requires concerted action. Governments, Industries, and global and regional institutions must work together to overcome regulatory, financial, and technological barriers. By making strategic investment, smart policy, and collaborative models, we can ensure that digital access becomes a global right, not a privilege.

To achieve such connectivity, spectrum is the key ingredient. It is therefore essential for APT countries to develop a strategic spectrum plan to bridge the digital connectivity needs in APT countries to provide guidance to the regulators, industries and other stakeholders. This strategic spectrum plan will serve as a comprehensive blueprint for bridging the digital connectivity gap across the region.

2. Proposal

IAFI through this contribution proposes that AWG develop a new Report on a strategic roadmap for spectrum management to meet the digital connectivity needs within APT countries. The proposed roadmap will facilitate collaboration among governments, industries,

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and regional institutions, fostering a shared vision for a connected APT region. An outline working document and a workplan is attached for consideration of the AWG

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PROPOSED WORKING DOCUMENT TOWARDS A NEW APT REPORT ON

APT STRATEGIC SPECTRUM PLAN TO BRIDGE THE DIGITAL CONNECTIVITY NEEDS IN APT COUNTRIES

1.0 Introduction

In today's digitally driven world, internet connectivity is no longer a luxury — it's a necessity for economic growth, social inclusion, and access to critical services. Yet, nearly 3.8 billion people still lack reliable broadband access, particularly in rural and remote regions. This global digital divide creates significant disparities, leaving millions excluded from education, healthcare, and modern economic participation.

As technology evolves, several key innovations are helping bridge this gap. Among the most impactful are 4G, 5G and (6G) mobile networks, WiFi and industrial technologies, and Non-Geostationary Orbit (NGSO) satellites. Together, these technologies offer hope for universal, high-speed connectivity — even in the world's hardest-to-reach corners.

To achieve such connectivity, spectrum is the key ingredient. It is therefore essential for APT countries to develop a strategic spectrum plan to bridge the digital connectivity needs in APT countries to provide guidance to the regulators, industries and other stakeholders.

2.0 Importance of Spectrum for 4G, 5G and 6G:

2.1 4G: Affordable Access for the Masses - 4G networks have already brought transformative change to developing regions. With speeds up to 100 Mbps and low latency, 4G allows users to stream video, attend virtual classes, and use telemedicine services. Countries like India, Kenya, and Indonesia have harnessed 4G to connect millions. For instance, India's Reliance Jio used low-cost 4G plans to extend digital services to vast rural populations, while in Africa, mobile money services built on 4G networks have empowered unbanked communities. Moreover, 4G can operate in shared or unlicensed spectrum, helping reduce deployment costs in sparsely populated areas. However, it still requires towers, fiber infrastructure, and stable power supplies making extremely remote deployment costly.

2.2 Spectrum aspects of 4G (IMT-Advanced)

4G or IMT-Advanced is core of connectivity in APT countries. Provision of 4G services require access to core spectrum bands: 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2.3 GHz, 2.6 GHz. For this purpose, the target spectrum per operator is at least 2 × 20 MHz contiguous in low-band + 2 × 20 MHz in mid-band for urban capacity. Total national spectrum needed for a reasonably good service is about ~600–800 MHz across all licensees for today's traffic, but refarming of 2G/3G spectrum needs to continue to keep pace with data growth.

2.2 5G: A Leap Forward in Speed and Capacity

2.2.1 5G technology brings exponential improvements: ultra-fast speeds (up to 10 Gbps), ultra-low latency (under 1 millisecond), and the capacity to support millions of connected devices in one area. While often associated with urban innovations like smart cities or autonomous vehicles, 5G holds transformative potential for rural development too.

- **Education**: Virtual classrooms and real-time interaction can finally reach isolated students. In pilot projects, 5G has connected remote schools to top-tier teaching resources.
- **Healthcare**: From high-definition remote diagnostics to robotic surgery, 5G enables quality medical services to reach underserved populations.
- **Farming**: Smart agriculture using IoT devices can help farmers monitor soil, automate irrigation, and increase crop yields.
- **Small Business**: Entrepreneurs in rural areas can tap into global markets using 5G-powered e-commerce and cloud services.

Still, 5G isn't without obstacles. The technology requires extensive infrastructure and consumes considerable energy. High costs and regulatory challenges can hinder its deployment in low-income, low-density areas. Yet, innovative solutions like solar-powered towers, shared infrastructure, and public-private partnerships are helping bring 5G to rural regions.

2.2.2 Spectrum Aspects of 5G (IMT-2020)

Provision of 5G services require access to multi-layered spectrum strategy to balance coverage, capacity, and speed.:

a) the coverage layer utilizes 5G in bands below 1 GHz, including 600 MHz, 700 MHz, and 800 MHz 3GPP bands. At least 2 × 10-20 MHz per operator is required for rural reach and deep-indoor penetration.

b) For meeting the Capacity layer needs, spectrum from 1 to 7 GHz in 3.3–3.8 GHz, 4.4–5.0 GHz and 6.425-7.125 GHz (C-Band) is critical. At least, a minimum of 100 MHz contiguous per operator is required at launch; regulators should plan for 2 GHz total mid-band spectrum by 2030 to sustain 100 Mbps everywhere

c) Hot-spot layer (> 24 GHz): 26 GHz, 28 GHz, 39 GHz – at least 800 MHz contiguous spectrum is required per operator for multi-Gb/s eMBB and low-latency verticals in dense urban area.

2.3 6G (IMT-2030) – emerging requirement

2.3.1 In future, 6G services will require access to 400 to 500 MHz **additional** contiguous spectrum **per operator** of wide-area new spectrum in the **7–15 GHz range**. 7GHz band (7.125–8.5 GHz) is a prime candidate for this need and is viewed as the sweet spot for re-using existing macro grid while delivering 10–20× capacity gain. National planning assumption for 6G with 3–4 operators, suggests total need of **1.5–2 GHz new wide-area spectrum per country**.

In addition, 14.75–15.35 GHz would be ideal for denser urban scenarios will be needed for extreme localized XR/holographic links (study phase). Even with aggressive spectrum re-farming, a **shortfall of 1.5–2.2 GHz** is projected under optimistic 2030 spectrum-release scenarios.

2.4 Summary of spectrum needs of Mobile services

While 4G is largely catered for by legacy spectrum allocations; 5G needs immediate expansion of mid- and high-band holdings a nd 6G cannot be realized without **early identification and**

global harmonisation of 1.5–2 GHz of new contiguous spectrum between 7 GHz and 15 GHz, complemented by targeted sub-THz allocations for niche ultra-high-rate services.

3. Spectrum needs for WiFi and Industries

3.1 WiFi, though often overlooked, plays a vital supporting role. It allows users to share connectivity from mobile networks or satellite links within homes, schools, and villages. Community WiFi setups, where one broadband link powers many users, are especially useful in places were laying fiber or building towers is impractical. Combined with affordable routers and local tech support, WiFi can stretch the reach of mobile and satellite networks at a fraction of the cost.

3.2 Wi-Fi consumer, enterprise & industrial LAN are met by need both the legacy spectrum bands and new Capacity bands

- **Legacy bands**
  – 2.4 GHz (ISM 2400–2483.5 MHz): 3 non-overlapping 20 MHz channels – now **highly congested** in factories and offices.
  – 5 GHz (5150–5925 MHz): 500 MHz total → max. 2 × 160 MHz or 6 × 80 MHz channels – **approaching saturation** in dense venues.
- **New capacity band**s for Wi-Fi 6e, the **500 MHz** newly opened for license-exempt use spectrum in 6 GHz band within 5925–6425 MHz should be made available urgently in all APT countries. In future, Wi-Fi 7 can provide a **10 ms latency** for AR/VR, AGV/robot control and 8K video but will require **at least two contiguous 320 MHz channels**. However, in the available **500 MHz in 5925–6425 MHz,** only a single 320 MHz channel would be available and thus the available 160 MHz channels have to be used for this purpose. Further action to open unlicensed WiFi in 60 GHz V band is therefore necessary.

3.3 Industrial verticals – Public safety, manufacturing, energy, logistics

- **Locally licensed / on-site 5G**
    - Preferred Low bands are 450-470 MHz and 700/800 MHz
    - Preferred mid-band spectrum frequencies are: **3.8 – 4.2 GHz** (400 MHz), 49950-4990 MHz (50 MHz). 3.8 GHz band has been harmonized by CEPT by 2026 for factory-floor 5G NR cells .
    - **Sub-GHz ISM / short-range device (SRD) bands**
      – 433 MHz, 868/915 MHz, 2.4 GHz, 5.8 GHz for low-rate sensors and legacy telemetry

3.4 Key take-away

Wi-Fi is moving from “best-effort” to deterministic real-time traffic; ensuring **6 GHz license-exempt access** is now a **prerequisite** for Industry 4.0. Parallel to this, regulators must **reserve 3.8 – 4.2 GHz for local, lightly-licensed industrial 5G** and provide clear spectrum-sharing frameworks for legacy ISM/SRD bands to avoid interference with safety systems.

4.0 NGSO Satellites and their spectrum needs:

One of the most promising solutions to universal connectivity lies above us — in space. NGSO satellites orbit the Earth at altitudes of 500 to 2,000 kilometers, far lower than traditional geostationary satellites. This enables faster data transfer and lower latency, which are crucial for applications like video calls and online learning.

4.1 Key Advantages of NGSO Systems:

- **Speed and Latency**: NGSO satellites offer near-fiber speeds with latency low enough for real-time services, including telehealth and online education.
- **Cost Efficiency**: These constellations avoid the need for widespread ground infrastructure, making them ideal for rugged or remote areas.
- **Global Reach**: NGSO systems can blanket the globe, ensuring no region is left behind.
- **Network Resilience**: Their distributed design adds redundancy, improving service continuity even during disasters.

4.2 Major Projects Leading the Way:

- **Starlink (SpaceX)**: With plans for over 40000 satellites, Starlink has already connected thousands of rural users globally with high-speed, low-latency internet.
- **OneWeb**: Targeting underserved communities, OneWeb is building a 648-satellite constellation for global broadband access.
- **Project Kuiper (Amazon)**: Approved to deploy over 3000 satellites, Kuiper will further expand access to those currently offline.
- **Telesat Lightspeed:** An advanced global broadband network initially comprising 198 to 298 satellites and ultimately expanding to 1671 satellites

4.3 Real-World Impact in Rural Communities

When remote areas gain internet access, the effects are profound:

- **Education**: Students gain access to digital resources, remote tutoring, and global learning platforms, helping close education gaps.
- **Healthcare**: Virtual consultations, diagnostics, and even surgeries become possible — eliminating long travel times for basic care.
- **Economic Opportunities**: Residents can start online businesses, access financial tools, and tap into new job markets.
- **Digital Inclusion**: By connecting the unconnected, these technologies help integrate marginalized groups into the digital economy.

4.4 Challenges Ahead

Despite their promise, NGSO satellites and other connectivity solutions face significant hurdles:

- **Regulation**: With thousands of satellites being launched, space traffic, spectrum allocation, and orbital sustainability are pressing issues that demand international cooperation.

- **Affordability**: Equipment and service fees can still be too high for low-income households. Tiered pricing, subsidies, or community access models may be needed.
- **Technical Complexity**: Building and maintaining massive satellite constellations, managing ground stations, and integrating with terrestrial networks require major coordination and innovation.

4.5 Spectrum Needs of satellite services

4.5.1 Core bands in use today

- L band 1.5 – 1.6 GHz (uplink) / 1.6 – 1.7 GHz(downlink) | MSS (Iridium, Globalstar) | Narrow-band voice/data; full global allocation already congested | |
- Ku-band 10.7 – 12.7 (down) / 14.0 – 14.5 (up) | Fixed-Satellite Service (FSS) | Shared with GSO; EPFD limits constrain power & coverage
- Ka-band | 17.3 – 18.6 (up) / 18.8– 20.2 (down) | FSS (Starlink, Kuiper, OneWeb, Telesat Lightspeed) | High-throughput broadband; EPFD limits apply in parts of the band|
- Ka Band -28 GHz - **27.5 – 30.0GHz** is globally assigned to **Fixed-Satellite Service (FSS)** for **Earth-to-space** links, i.e., **user-terminal uplinks** to NGSO and GSO satellites. The 28 GHz band is the **primary Ka-band uplink** for Starlink, Kuiper, OneWeb, Telesat Lightspeed and other NGSO broadband constellations.
- **Gateway Feeder Links**: Some operators also use **27.5 – 30 GHz** for gateways, there is increasing interest in the use of the **Q/V-band (37-51 GHz)**.
- Q/V-band | 37.5 – 42.5 (up) / 47.2 – 51.4 (down) | Gateway links | > 3 GHz required for multi-terabit aggregate capacity |

4.5.2 Capacity-driven spectrum needs by 20230

By 2030, industry leaders like SpaceX and possibly others are expected to operate constellations consisting of thousands of high-capacity satellites (e.g., 15,000–20,000 Starlink V3 units), potentially resulting in aggregate orbital shell capacities in the multi-terabit or even approaching 8 Tbps range per orbital shell, depending on deployment and throughput per satellite. This will create a need for **more than 3 GHz additional spectrum** above 50 GHz (E/W-bands 71-76 / 81-86 GHz).

5. Summary and way forward

TBD

Annexure-I

Detailed Workplan for

APT STRATEGIC SPECTRUM PLAN TO BRIDGE THE DIGITAL CONNECTIVITY NEEDS IN APT COUNTRIES

Title	APT Strategic Spectrum Plan to bridge the Digital Connectivity in APT Region
Document Type	APT/AWG Recommendation
Group/Chair	WG-HAR - Mr. John Lewis, Ericsson (Thailand) Ltd, Thailand SWG-SA&H - Ms. LYU Boya (China)
Editor(s)	To be determined by the AWG-35
Scope	The scope of this project is to develop an APT Recommendation, provides strategic guidance to regulators, industry, and stakeholders, to effectively manage and allocate radio frequency spectrum. The goal is to bridge the digital connectivity gap within the Asia-Pacific Telecommunity (APT) member countries using combination of technologies, including 4G/5G, community Wi-Fi, and Next-Generation Satellite Orbit (NGSO) systems.
Purpose	Considering high-speed internet is the foundation of economic competitiveness, social inclusion, and national resilience, combined power of 4G/5G, community Wi-Fi, and NGSO satellites, policy makers now have the tools to bring meaningful connectivity to every citizen. Governments, Industries, and global and regional institutions must work together to overcome regulatory, financial, and technological barriers. Strategic investment, smart policy, and collaborative models can ensure that digital access becomes a global right, not a privilege.
Related Document	
Related Forums and Organization	APG, ITU-R, SG5, and WP 5D
Timelines	**(AWG-35)** - Approval of the work item and work plan - Approval of the project and draft the initial report outline - Approval of initial document **(AWG-36)** - Discussing the inputs submitted by APT members

	- Study the current spectrum usage and regulatory framework of APT Countries - Prepare a questionnaire to collect data from member administrations. **(AWG-37)** - Compile and analyze the answers of questioner - Studies on various issues regarding spectrum sharing and impact on existing radiocommunication services - Review and update the Working Document and transforming to PDNR **(AWG-38)** - Discuss the inputs received from various APT members - Review and update the PDNR to DNR - **(AWG-39)** - Review and update DNR - Collect responses to the questionnaire and summarize regulatory status in APT member countries. - Develop final document for approval of APT members
Note	1. All member administrations are requested for continuous collaboration and active participation for timely completion of this work items. 2. The timeline is a guide and may be adjusted based on the progress of studies and the consensus-building process.