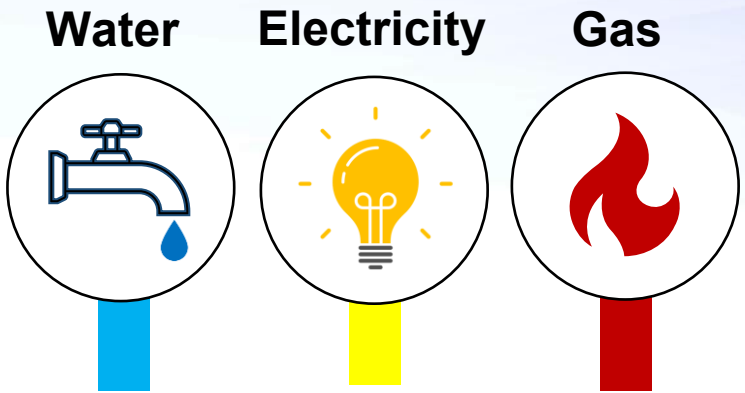
NTN and HAPS
towards 6G Era

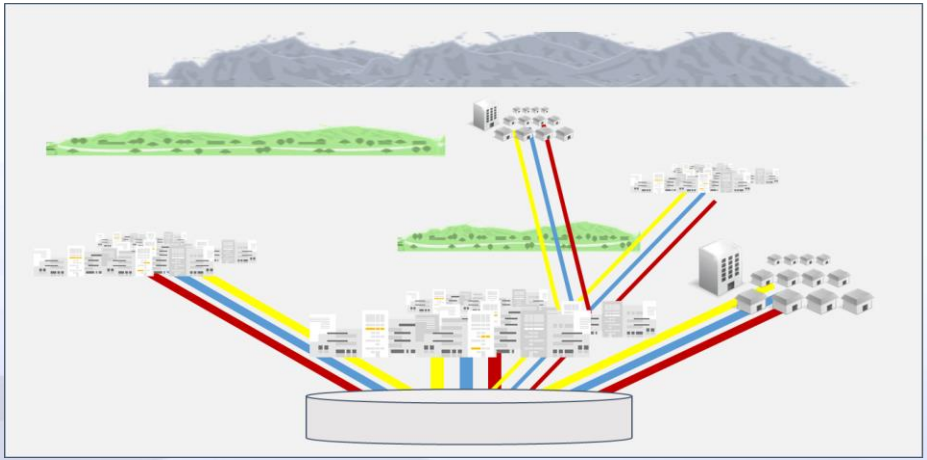
July 2026

SoftBank Corp.

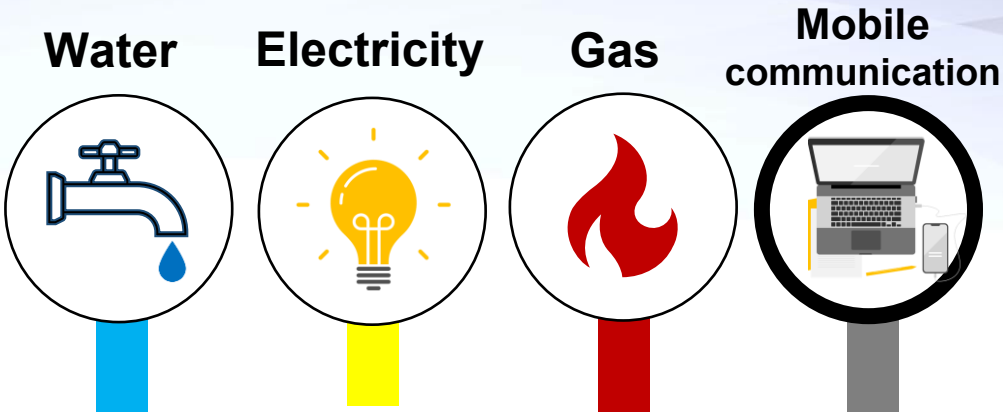
Image Credit: Sceye, Inc - LTA HAPS Developer in New Mexico, USA

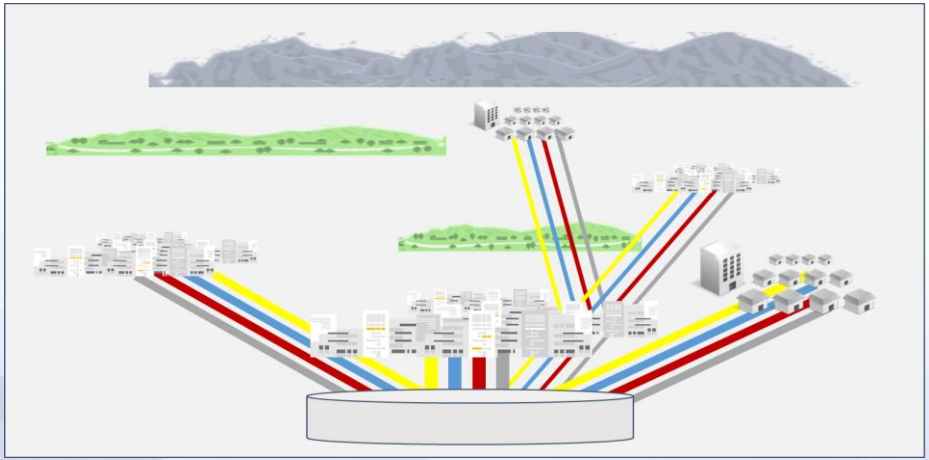
Critical lifelines in our modern society





Critical lifelines in our modern society





What we have for Mobile Network Coverage

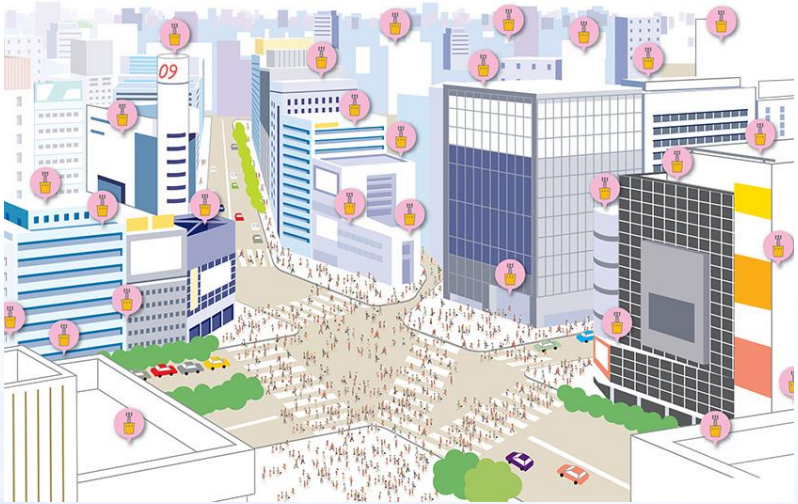
In order to deal with different deployment situations,
we need to take varied measures to design and create service areas

Tower type

Most wide area coverage

Concrete Pole Type

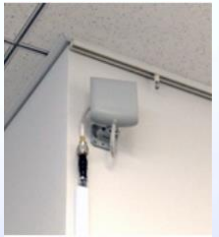
Space-saving
Suitable for either urban or rural



Building Rooftop Type

Good in densely built-up areas

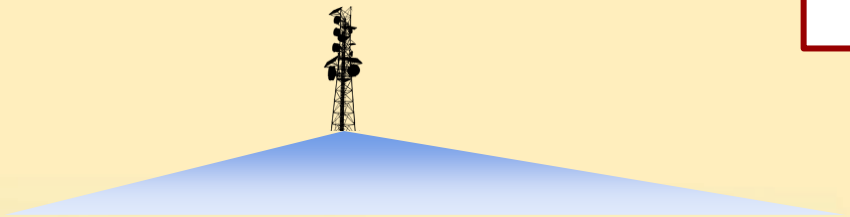
Indoor Type



Thorough coverage of indoor areas

The limitations of the ground coverage method

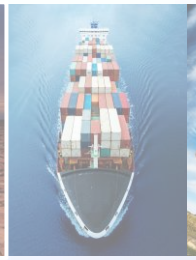
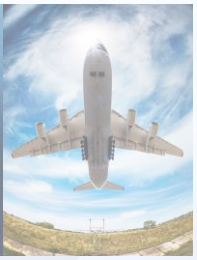
Coverage for rural and remote areas, like islands or mountainous areas, is however remained unsolved



Dense Urban | Urban | Rural | Super Rural | Maritime / Sky

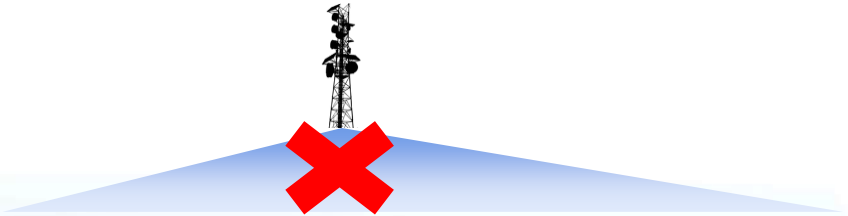




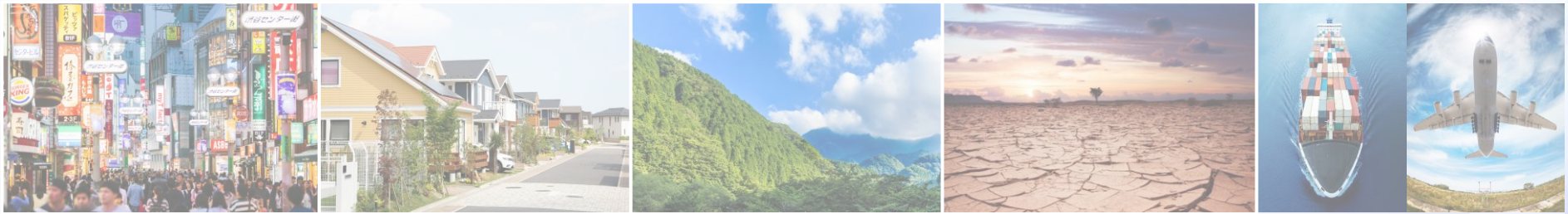



The limitations of the ground coverage method

In addition, amidst the growing scale of natural disasters, there have been several instances where communications have been disrupted. The issue is how to maintain resilience.



Dense Urban | Urban | Rural | Super Rural | Maritime / Sky



NTN (Non-Terrestrial Network)

Beyond the normal coverage on the ground,
an approach from the sky which provides “wide” and “resilient” network

Dense Urban | Urban | Rural | Super Rural | Maritime / Sky






The necessity of Non terrestrial network

Connectivity is Needed for Everything, Everywhere and at all Time

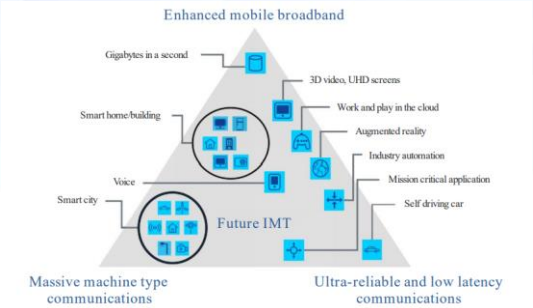
Bridging Digital Divide in Developing Countries and Rural Areas

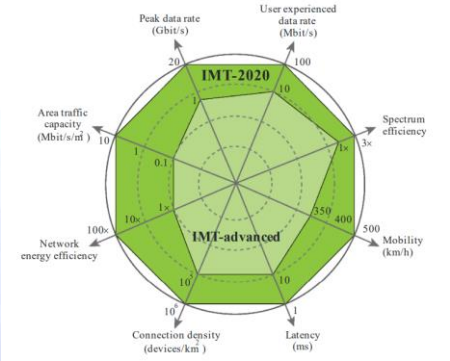
Seamless Connectivity Even During Disasters

3D Mobile Coverage including the Sky

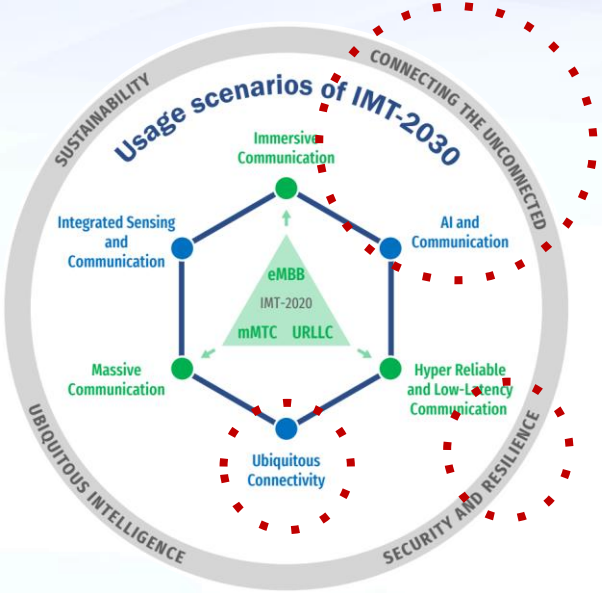
ITU-R Vision for 6G

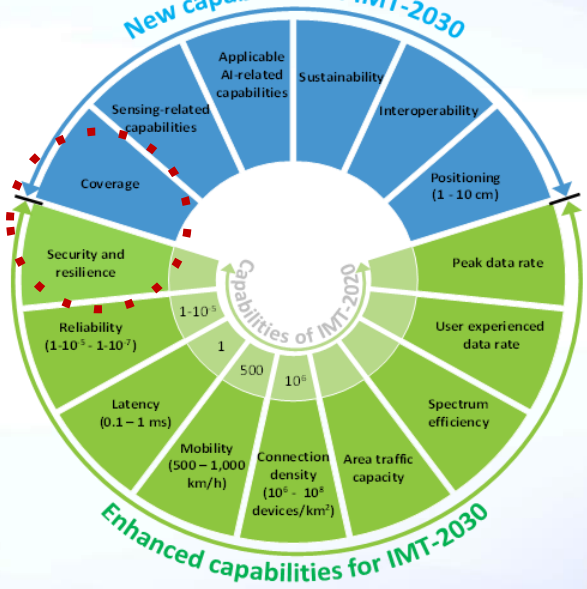
【5G charts】





【6G charts in the framework recommendation】





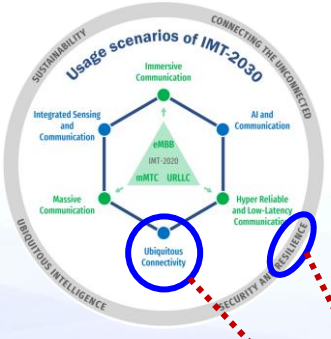
Ubiquitous Connectivity...Connecting The Unconnected... Coverage...Resilience...

NTN related elements are included in the official 6G concept in ITU-R

IMT-2030 (6G) TPRs

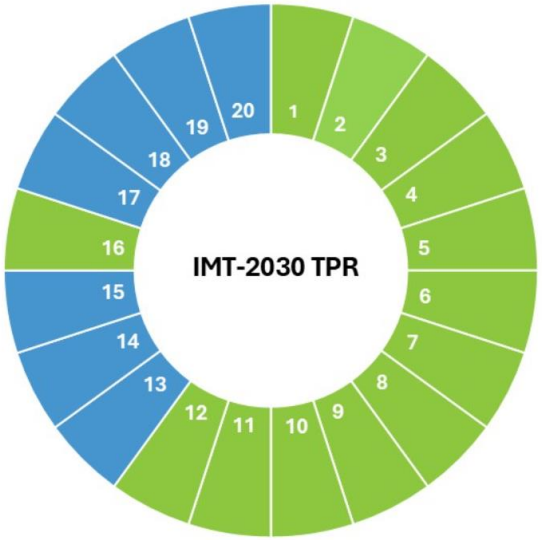
TPRs (Technical Performance Requirement) for 6G have been effectively decided in the ITU-R WP 5D February meeting.

【IMT-2030 usage scenarios】



IMT-2030 TPRs (Document 5/116)

Minimum technical performance requirements
1. Theoretical peak data rate
2. 5th percentile user data rate
3. Peak spectral efficiency
4. Average spectral efficiency
5. 5th percentile user spectral efficiency
6. Area traffic capacity
7. Connection density
8. Mobility
9. Mobility interruption time
10. User plane latency
11. Control plane latency
12. Reliability
13. Composite requirement new
14. Link distance new
15. Positioning accuracy new
16. Bandwidth
17. Sensing-related requirements new
18. AI-related requirement new
19. Energy efficiency for sustainability new
20. Resilience and Extended Connectivity new



“Resilience and Extended Connectivity”

Seamless Connectivity During Disasters

Source: Document 5/116

4.20 Resilience and Extended Connectivity
This requirement includes the following capabilities:

Resilience: It refers to capabilities of the networks and systems operating correctly during and after a service disruption, such as the loss of primary source of power, etc. The RIT/SRIT should support functionalities over the radio interface that enable continuous operation or rapid temporary restoration during and after disturbance to radio infrastructure.

Extended Connectivity: It refers to the capability to provide connectivity in areas that are currently uncovered or scarcely covered due to challenges arising from geographical conditions, such as the lack of ground infrastructure (e.g. fibre cables and power supply), where users desire access to communication services. The RIT/SRIT should have functionalities that support providing [illegible] extended connectivity in these areas.

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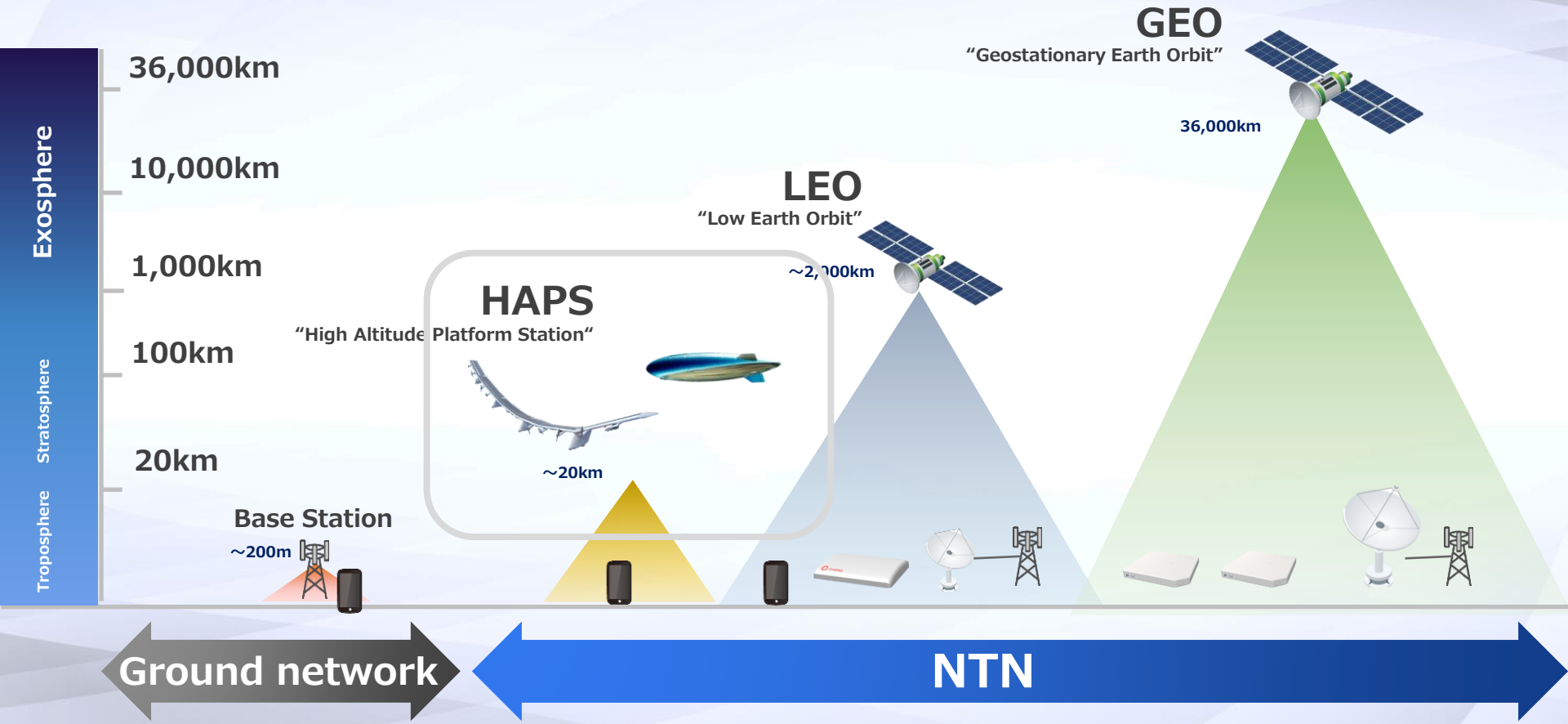
Bridging Digital Divide

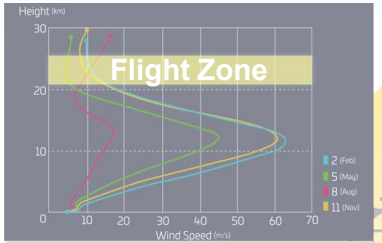
3D coverage in the sky

Non-Terrestrial Network system



Features of HAPS

Around 20km



Stratosphere
stable atmospheric conditions throughout the year

Ground base station: 3~10km

HAPS' coverage range: 200km

Fly on solar power

Stationary rotation at any coordinate

Providing mobile direct communication from the stratosphere

HAPS as NTN / HAPS as TN

Functional perspective: NTN / Regulatory perspective (ITU RR): TN

Functional perspective

- **Regarded as an NTN solution**
  - HAPS provides satellite-like functionality, enabling wide-area coverage and offering disaster-resilient solutions
  - In technology-oriented standardization (e.g., 3GPP), HAPS is positioned within NTN

ITU Radio Regulations

- **Categorized under TN**
  - RR No.1.66A defines HAPS as a station of terrestrial radiocommunication services in the sky at a nominal fixed point relative to the earth*

    *In the RR, HAPS is treated as equivalent to a very high tower station in the sky, and therefore falls under the TN regulatory framework.

“Resilience and Extended Connectivity”

4.20 Resilience and Extended Connectivity

Source: Document 5/116

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Functionalities related to resilience and extended connectivity may include, but are not limited to, support for connecting to one or more of the following advanced network infrastructures within the terrestrial component of IMT:

– HIBS.

HIBS (HAPS as IMT base station) is listed as a key technology to meet this requirement

– Relays and repeaters.
– Shared network infrastructures to provide extended connectivity, redundancy, or backup.
– Base station onboard a vehicle, airship and/or vessel.
– Or other mechanisms for these capabilities using network infrastructures within the terrestrial component of IMT.

This requirement is defined for the purpose of evaluation in the Ubiquitous Connectivity usage scenario and may also be relevant to other usage scenarios.

HAPS (HIBS) is explicitly recognized as an enabling technology for IMT-2030 (6G)

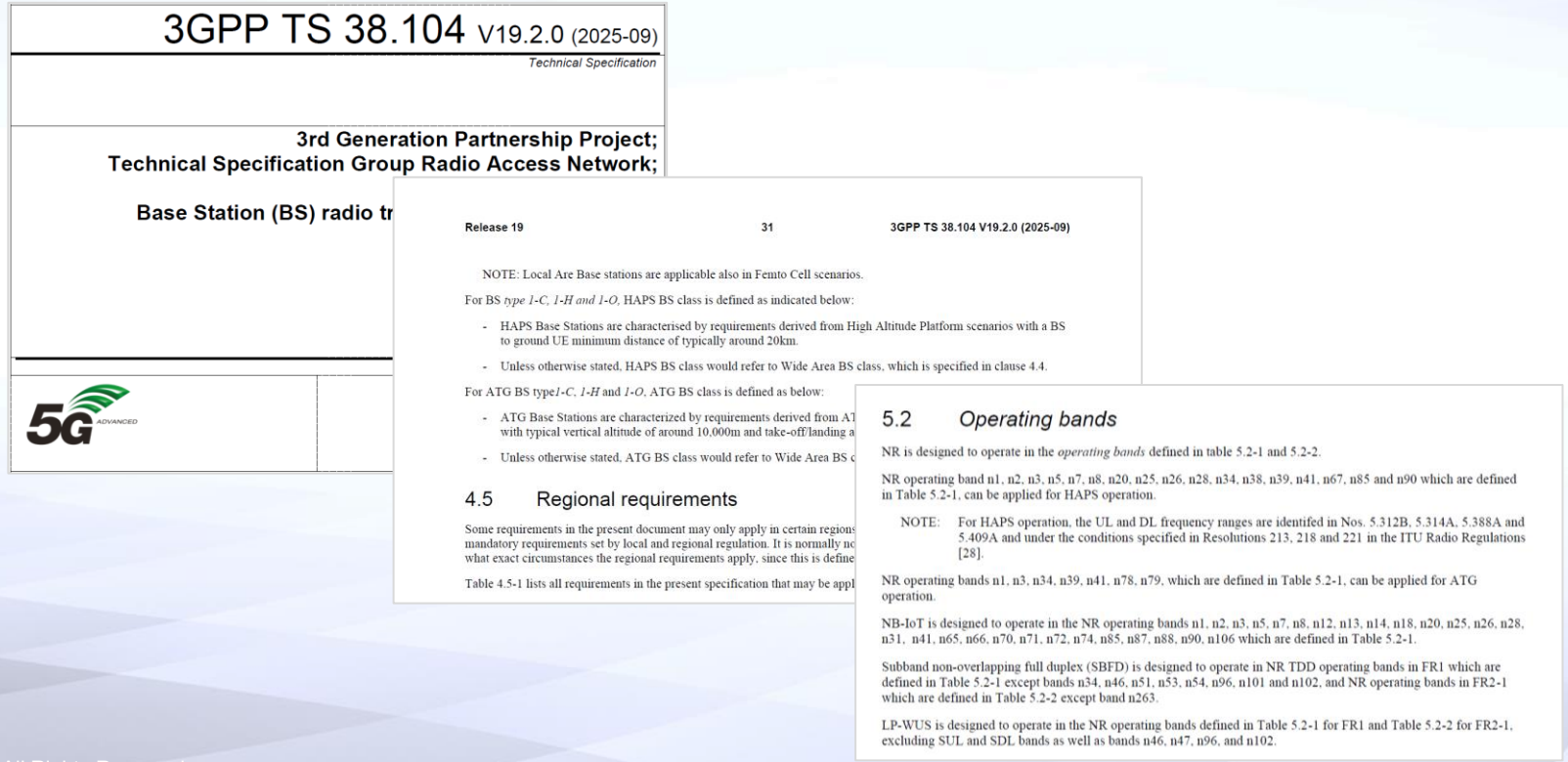
Spectrum available for HAPS/HIBS

HAPS/HIBS spectrum already identified in ITU Radio Regulations

HIBS (Service link)	694-960 MHz	Regions 1 and 2, and 14 countries in Region 3
	1710-1980/2010-2025/2110-2170 MHz	Worldwide
	2500-2690 MHz	Worldwide
HAPS in the fixed service (Feeder link)	6440-6520/6560-6640 MHz	5 countries
	21.4-22 GHz	Region 2
	24.25-27.5 GHz	Region 2
	27.9-28.2 GHz	24 countries
	31-31.3 GHz	Worldwide
	38-39.5 GHz	Worldwide
	47.2-47.5/47.9-48.2 GHz	Worldwide

3GPP specifications

Officially defined in 3GPP specification that HIBS can be used within existing IMT concepts in 700-900 MHz, 1.7-2.1 GHz and 2.6 GHz bands



3GPP TS 38.104 V19.2.0 (2025-09)

Technical Specification

3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;

Base Station (BS) radio tr

5G ADVANCED

NOTE: Local Are Base stations are applicable also in Femto Cell scenarios.

For BS *type 1-C, 1-H and 1-O,* HAPS BS class is defined as indicated below:

- HAPS Base Stations are characterised by requirements derived from High Altitude Platform scenarios with a BS to ground UE minimum distance of typically around 20km.
- Unless otherwise stated, HAPS BS class would refer to Wide Area BS class, which is specified in clause 4.4.

For ATG BS type*1-C, 1-H* and *1-O*, ATG BS class is defined as below:

- ATG Base Stations are characterized by requirements derived from AT
with typical vertical altitude of around 10,000m and take-off/landing a
- Unless otherwise stated, ATG BS class would refer to Wide Area BS c

4.5 Regional requirements

Some requirements in the present document may only apply in certain regions
mandatory requirements set by local and regional regulation. It is normally nc
what exact circumstances the regional requirements apply, since this is define

Table 4.5-1 lists all requirements in the present specification that may be appl

5.2 *Operating bands*

NR is designed to operate in the *operating bands* defined in table 5.2-1 and 5.2-2.

NR operating band n1, n2, n3, n5, n7, n8, n20, n25, n26, n28, n34, n38, n39, n41, n67, n85 and n90 which are defined in Table 5.2-1, can be applied for HAPS operation.

NOTE: For HAPS operation, the UL and DL frequency ranges are identifed in Nos. 5.312B, 5.314A, 5.388A and 5.409A and under the conditions specified in Resolutions 213, 218 and 221 in the ITU Radio Regulations [28].

NR operating bands n1, n3, n34, n39, n41, n78, n79, which are defined in Table 5.2-1, can be applied for ATG operation.

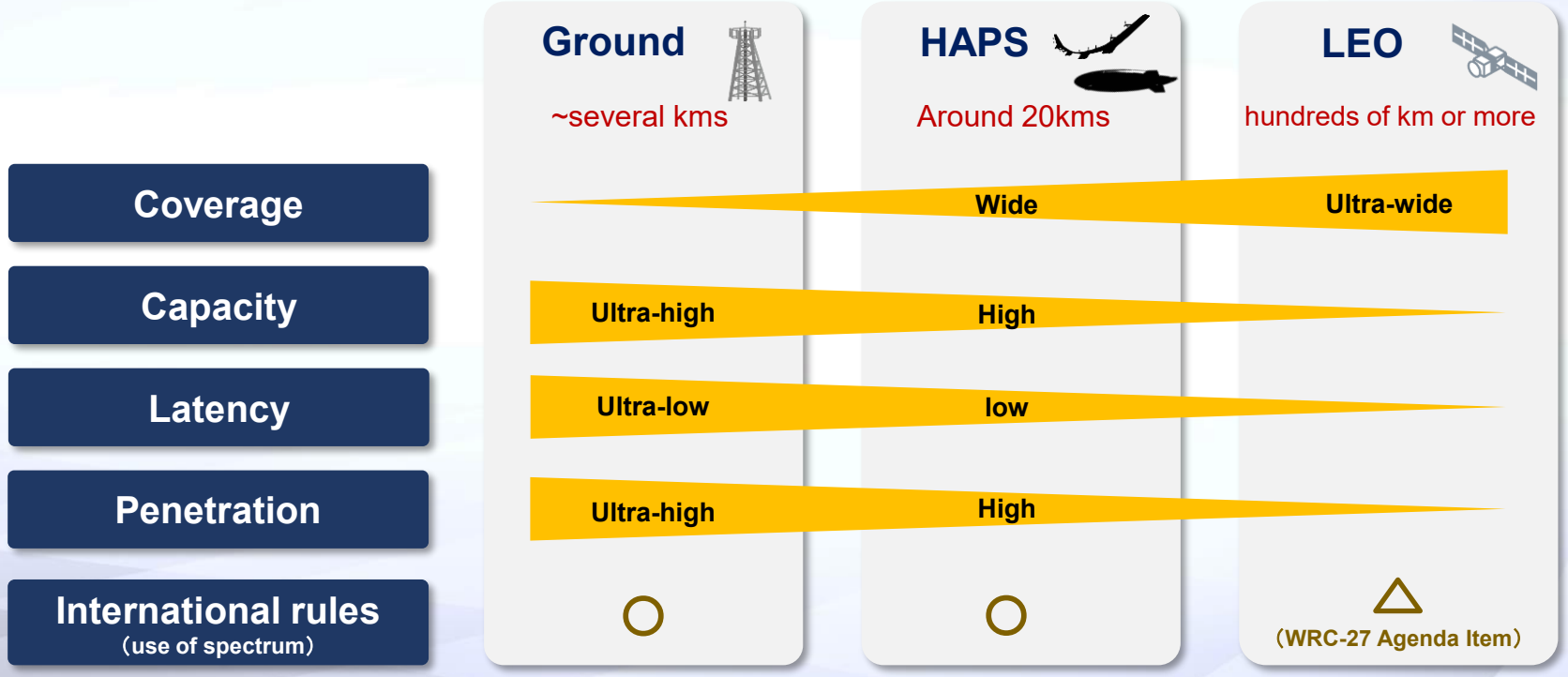
NB-IoT is designed to operate in the NR operating bands n1, n2, n3, n5, n7, n8, n12, n13, n14, n18, n20, n25, n26, n28, n31, n41, n65, n66, n70, n71, n72, n74, n85, n87, n88, n90, n106 which are defined in Table 5.2-1.

Subband non-overlapping full duplex (SBFD) is designed to operate in NR TDD operating bands in FR1 which are defined in Table 5.2-1 except bands n34, n46, n51, n53, n54, n96, n101 and n102, and NR operating bands in FR2-1 which are defined in Table 5.2-2 except band n263.

LP-WUS is designed to operate in the NR operating bands defined in Table 5.2-1 for FR1 and Table 5.2-2 for FR2-1, excluding SUL and SDL bands as well as bands n46, n47, n96, and n102.

Comparison of NTN D2D Communication

Important to capitalize on the unique characteristics of HAPS and LEO as each offers distinct advantages



Feature and territory of each solution

LEO

Message / Voice / Internet / Entertainment

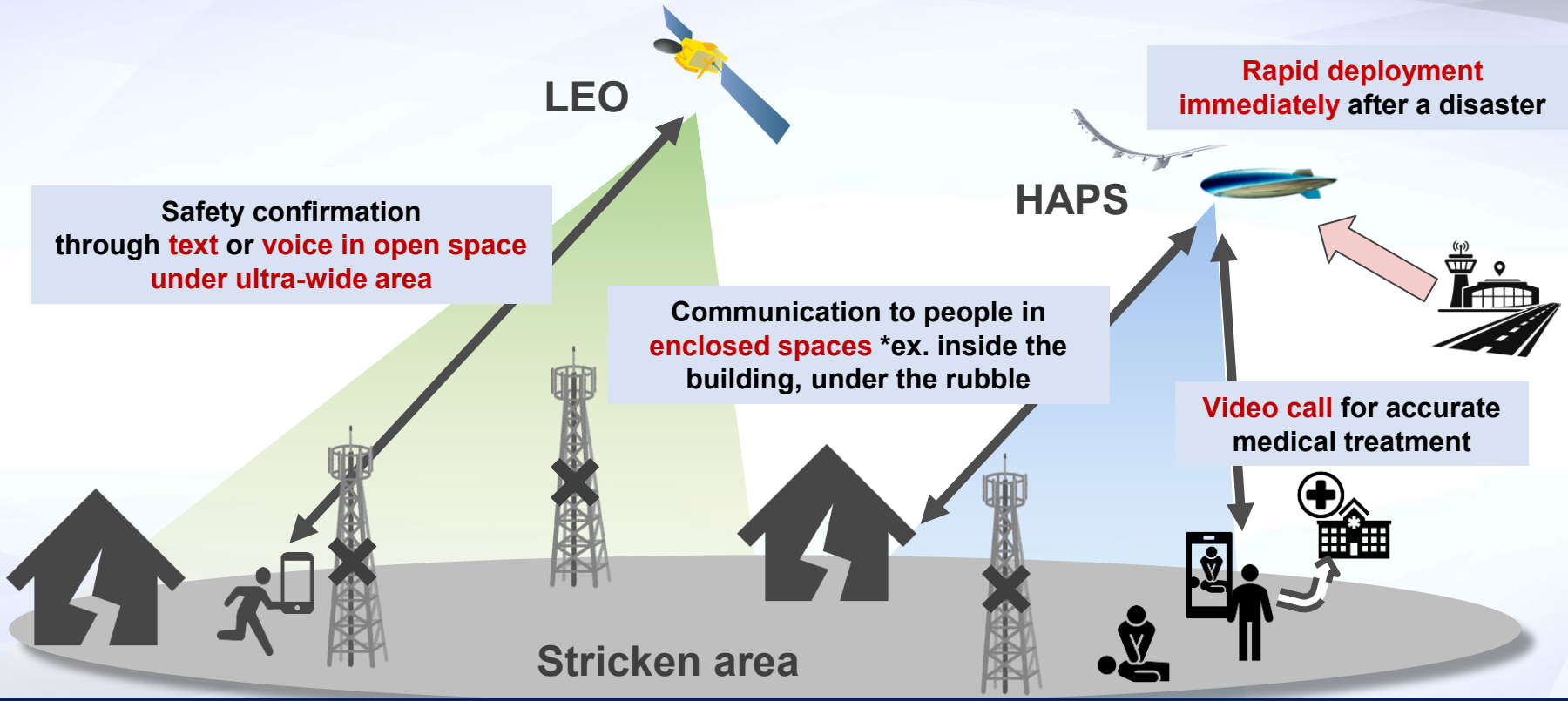
HAPS

Message / Voice / Internet / Entertainment

Ground

Message / Voice / Internet / Entertainment

NTN in disaster situation



NTN is resilient during disasters because of its widespread coverage and stability. Moreover, for specific penetration needs, HAPS is more powerful

SoftBank's HAPS aircraft development

Fixed-wing platform that has reached the stratosphere multiple times since 2020

Accelerating the realization of next-generation network

Airship-type platforms successfully stay in the stratosphere for long durations

Image and technology © Sceye, Inc., New Mexico, developer of the HAPS shown above.

2 Types of HAPS Platforms

HTA-type
(Heavier Than Air)

LTA-type
(Lighter Than Air)

Pre-commercial Services from 2026

LTA
“Sceye”

2026
Limited services for disaster recovery

2027
or after
Disaster recovery communications
+
Regular communications

HTA
“Sunglider”

2029
or after
Commercial Services

Japan’s domestic regulations for HAPS services

Japan completed its domestic regulatory framework for HAPS services in May 2026, enabling this year’s pre-commercial launch

	Outline
Service link (2 100-2 170 MHz)	• Defined as Land mobile service; High-altitude base station (altitude: 18–25 km; new station category) • The most of technical requirements follow the requirements for LTE/NR base stations which is described in 3GPP TS 38.104
Feeder link (38.0-39.5 GHz)	• Defined as Fixed service; Fixed station (altitude: 18–50 km; modification of existing station category) • Technical requirements for HAPS operation and frequency sharing are specified
General	• The operational area of a HAPS station is defined as “over land, territorial waters, and the surrounding airspace” • The installation location of HAPS is defined by the latitude and longitude at the center of the HAPS operational area

Source: The Ministry of Internal Affairs and Communications (MIC) website (Japanese only)

HAPS Alliance

By accelerating HAPS technologies and development building a cooperative ecosystem

Aviation

・Promote industry-managed cooperative separation in the upper airspace, including collaborative testing, simulations, and pilot programs

Telecom

・Advocate for global harmonization of HAPS spectrum at ITU and the national level
・Influence emerging commercial standards, including 3GPP non-terrestrial networks

Interoperability

・Develop product specifications and promote the standardization of interoperable HAPS network elements

Commercialization

・Demonstrate the industry's viability to potential customers and build a cooperative HAPS ecosystem

Latest information continuously published

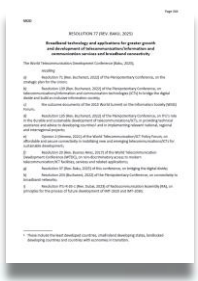
* SOURCE: HAPSALLIANCE website

Standardization for HAPS in ITU-D

HAPS, confirmed as one of the efficient solutions contributing to the remote area and emergency situations in the recent ITU-D conference

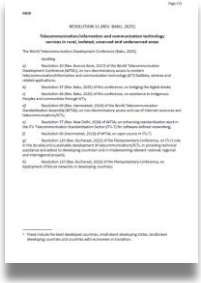
SOURCE: Provisional Final Report of WTDC-25

e) that high-altitude platform stations (HAPS) are solutions in the terrestrial service, among others, which can be used to provide backhaul and direct access connectivity in rural and remote areas, and are defined in No. 1.66A of the Radio Regulations,



Resolution 11

solutions in the terrestrial service, which can be used to provide backhaul and direct access connectivity in rural and remote areas



Resolution 77

solutions in the terrestrial service, which can be used to provide backhaul and direct access connectivity in rural and remote areas

Resolution 34

enable the rapid restoration of communications in emergency and disaster situations

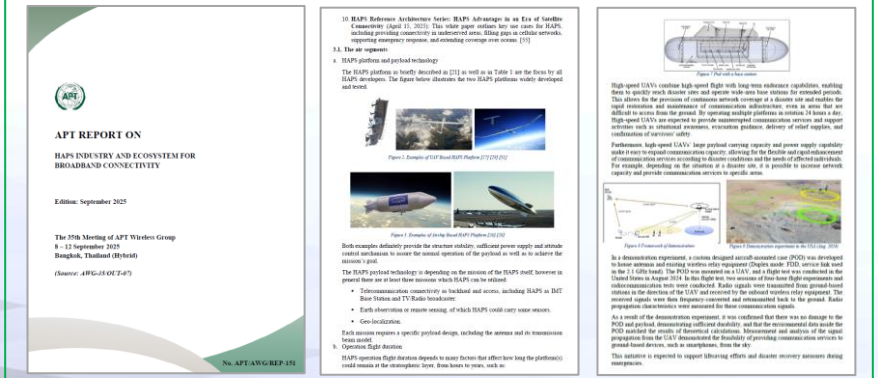
Resolution37

contribute significantly to bridging the digital divide

Standardization for HAPS in AWG

Information on the status of the HAPS industry and its ecosystem, and a technical analysis of HIBS are provided for the APT region

APT Report-151 (URL)
HAPS industry and ecosystem for broadband connectivity



APT REPORT ON

HAPS INDUSTRY AND ECOSYSTEM FOR BROADBAND CONNECTIVITY

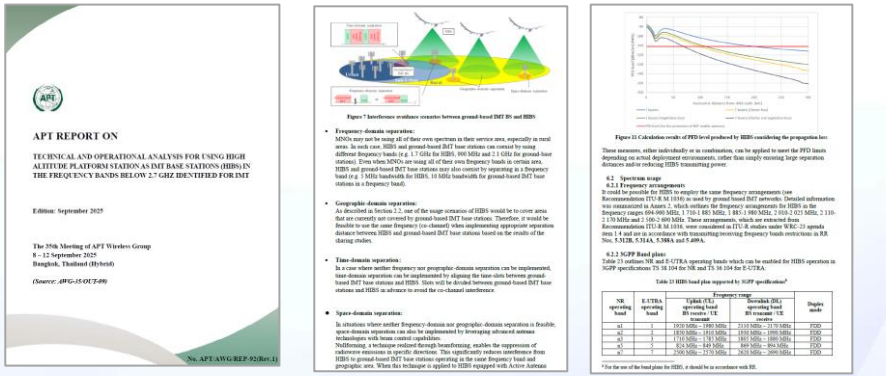
Edition: September 2025

The 35th Meeting of APT Wireless Group
8 – 12 September 2025
Bangkok, Thailand (Hybrid)

(Source: AWG-35/OUT-07)

No. APT/AWG/REP-151

APT Report-92 (Rev.1) (URL)
Technical and operational analysis of HIBS below 2.7GHz



APT REPORT ON

TECHNICAL AND OPERATIONAL ANALYSIS FOR USING HIGH ALTITUDE PLATFORM STATION AS IMT BASE STATIONS (HIBS) IN THE FREQUENCY BANDS BELOW 2.7 GHZ IDENTIFIED FOR IMT

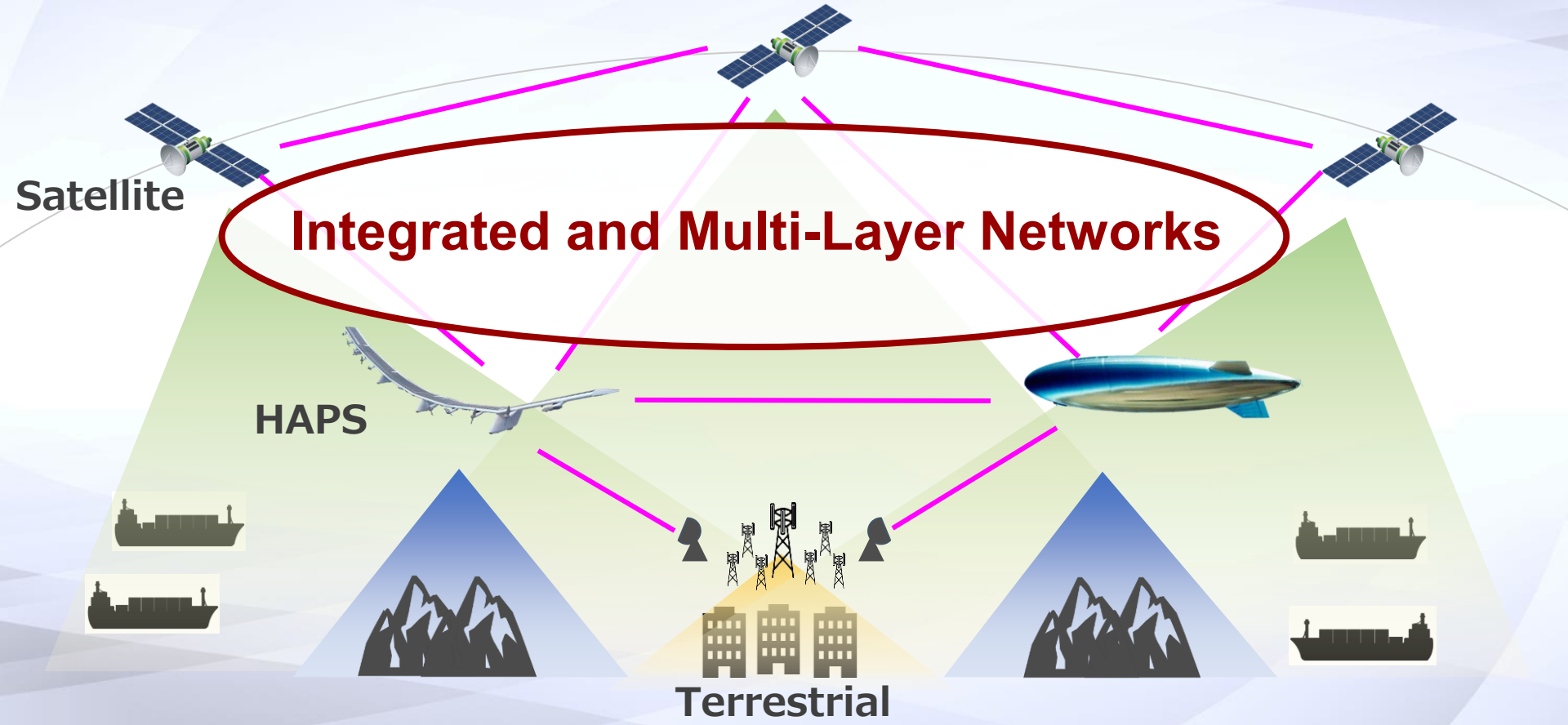
Edition: September 2025

The 35th Meeting of APT Wireless Group
8 – 12 September 2025
Bangkok, Thailand (Hybrid)

(Source: AWG-35/OUT-09)

No. APT/AWG/REP-92(Rev.1)

Future structure makes everywhere connected



Information Revolution — Happiness for everyone