

An aerial photograph of a mountain range, likely the Andes, with thick white clouds covering the lower slopes and valleys. The sky is a deep blue, and the horizon is visible in the distance.

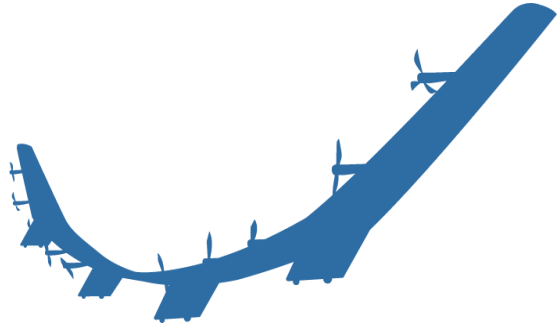
# **HIBS**

## **IMT base stations in the sky**

**July 26, 2022**  
**SoftBank Corp.**

## Disclaimer

This presentation material is made based on information available at the time of writing. Plans, forecasts, strategies, and other forward-looking statements in this presentation are not historical facts, and include elements of risk and uncertainty. Actual results may therefore differ materially from these forward-looking statements due to changes in the business environment and other factors.



# **HIBS Fundamentals**

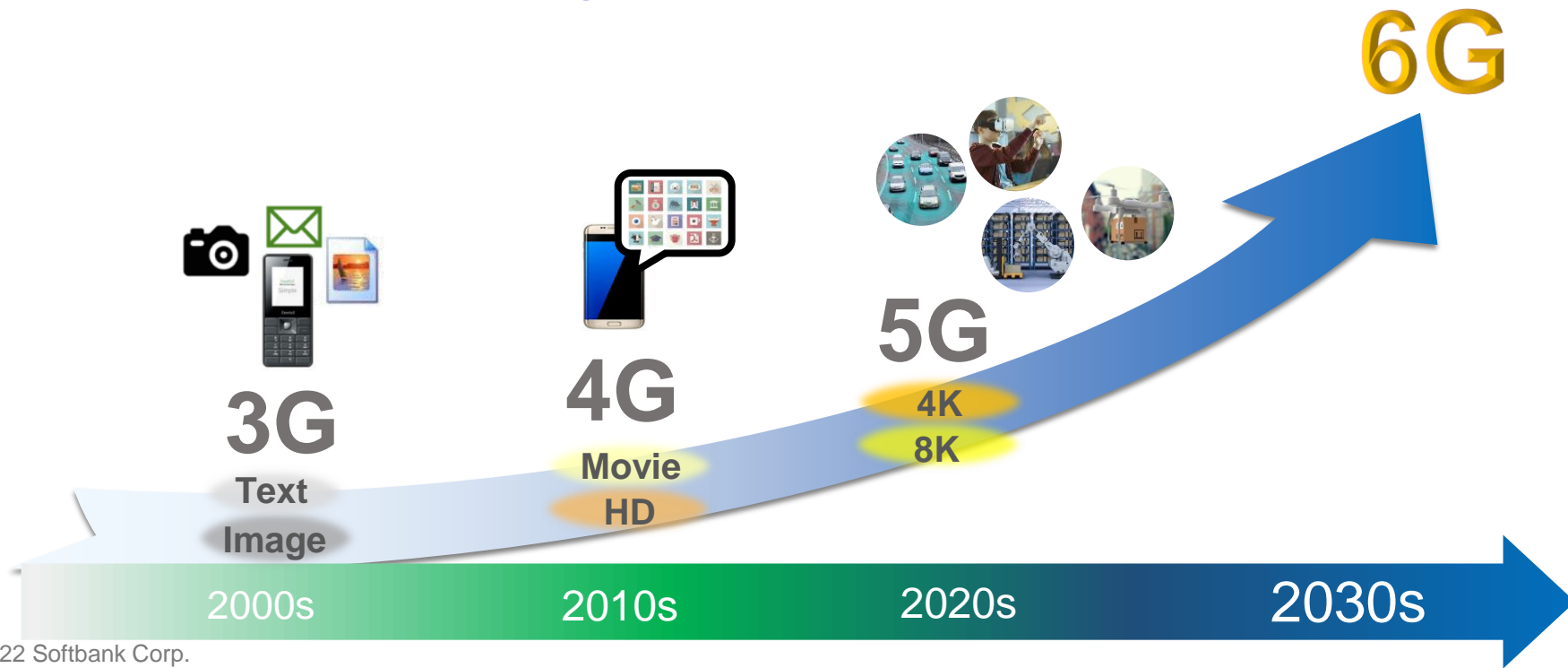
# HIBS

HIBS = High altitude platform stations  
as IMT base station

\*HAPS = High altitude platform stations

# Communication platform development

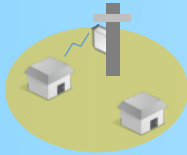
**Towards the new era Beyond 5G and 6G, communication platform needs to evolve to provide enriched connectivity for all things, information and humans**



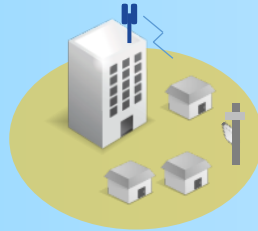
# Need new area coverage method



**Picocell  
(indoor)**



**Microcell  
(hotspot)**



**Macrocell  
(rooftop)**



**Wider  
Macrocell  
(tower)**



**Super  
Macrocell  
(...)**

**For those areas yet/hard to  
have ground-based coverage**

# NTN (Non-Terrestrial Network)

An approach from the sky  
which provides “wide” and  
“resilient” network



# NTN (Non-Terrestrial Network)

An approach from the sky  
which provides “wide” and  
“resilient” network



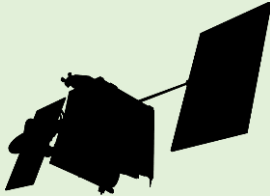


In case of disaster

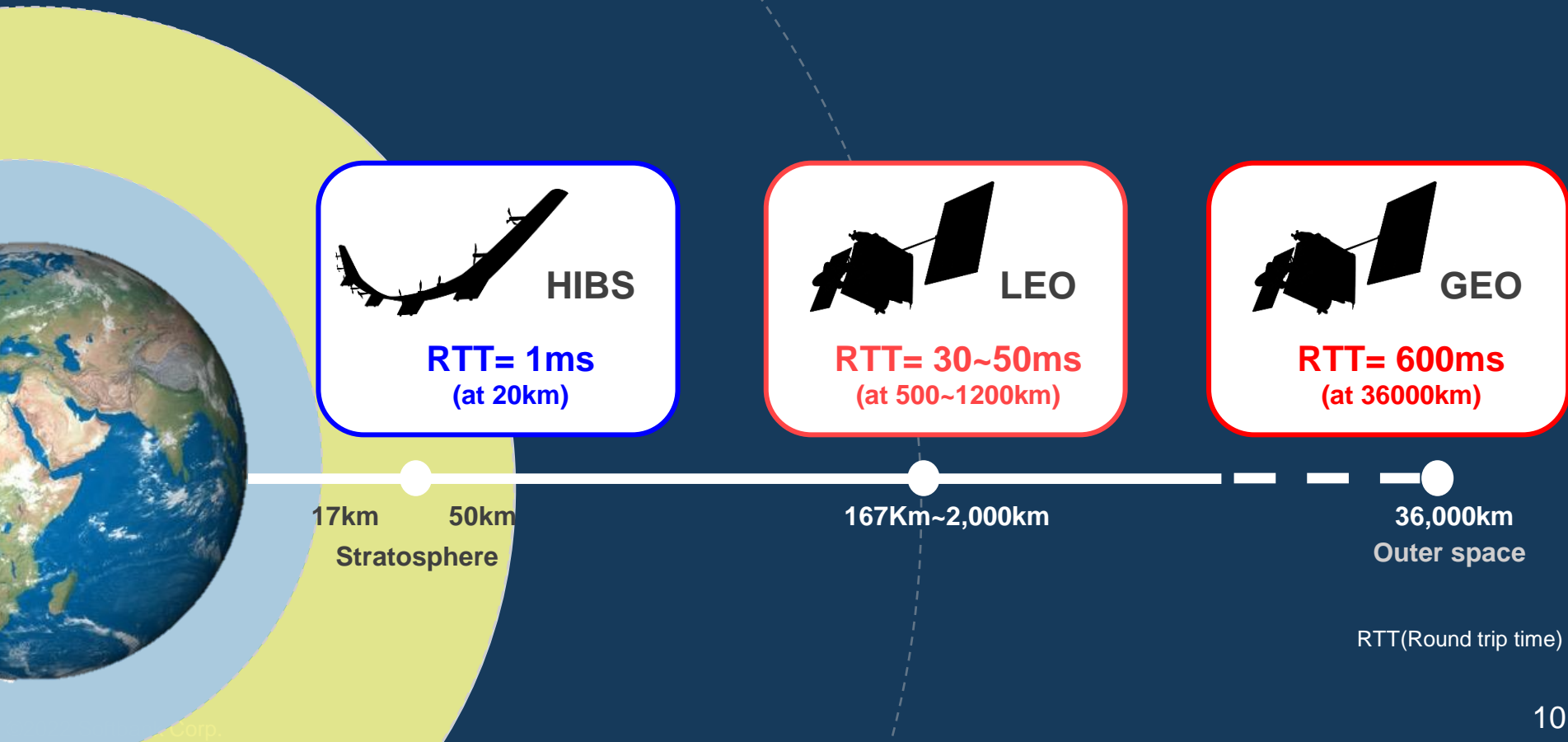




# Two types of NTN solutions: Stratosphere vs Space

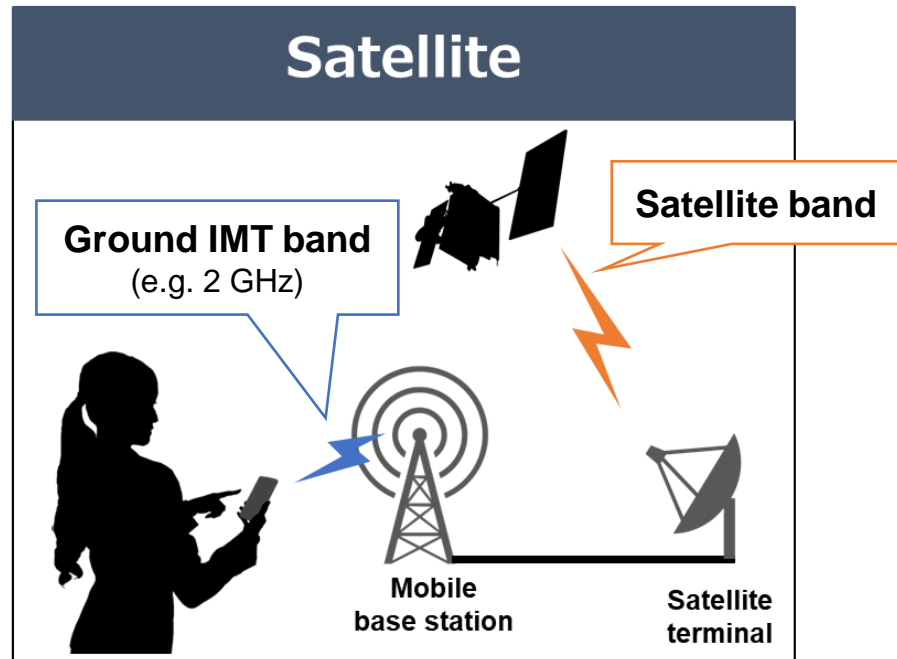
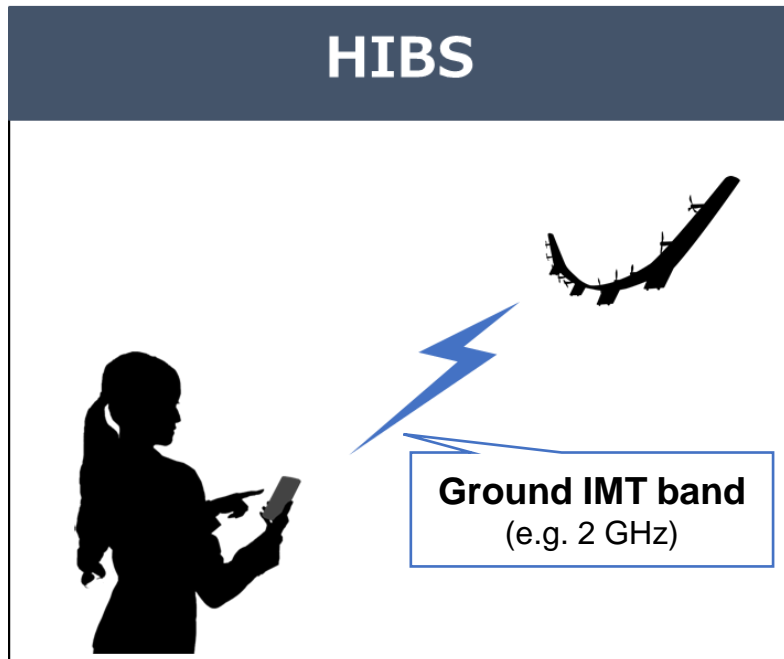
	<b>Terrestrial</b>	<b>Stratosphere</b>	<b>Space</b>
			
Coverage radius/station	~ Ten km	~ Hundred km	~ Thousands km
Latency	~1 ms	Similar as ground	30~50ms (LEO) 600ms (GEO)
Available frequencies	Terrestrial allocated (e.g. IMT)	Terrestrial allocated (e.g. IMT)	Satellite allocated (e.g. MSS)
User terminal	Regular cell phone	Regular cell phone	Dedicated satellite terminal

# Latency comparison



# Direct connectivity to regular user terminal

No need to replace for specific device for HIBS



# 3GPP Release-17 NTN (June 2022)

Operating band for Satellite and HIBS were specified

## Satellite

3GPP TS 38.108 and 38.101-5 (New technical specification for satellite)

Operating band	Uplink	Downlink	Duplex mode
n255	1626.5-1660.5MHz	1525-1559MHz	FDD
n256	1980-2010MHz	2170-2200MHz	FDD

**Specific  
bands & technical conditions  
for satellite**

## HIBS

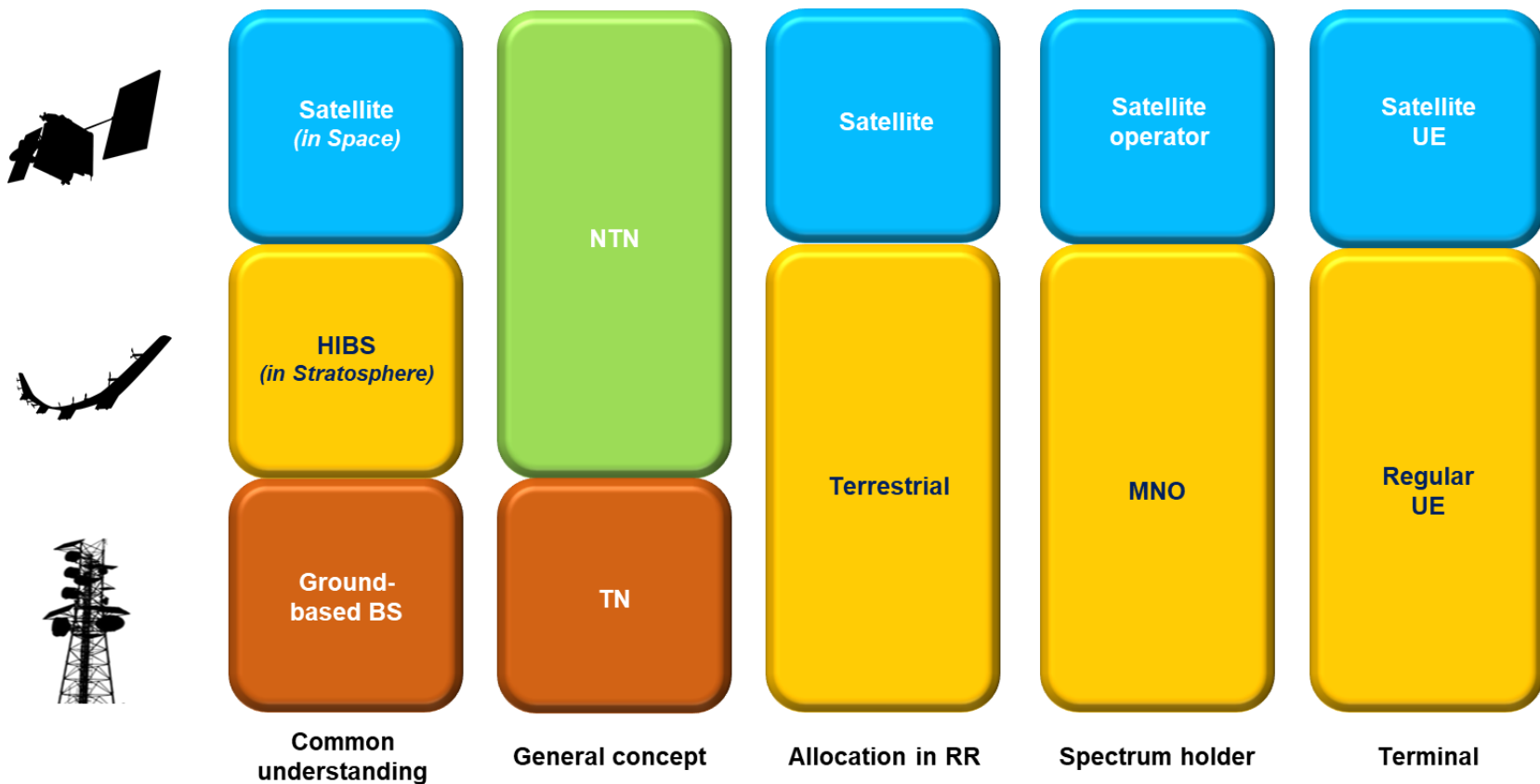
3GPP TS 38.104 (Existing technical specification for terrestrial)

Operating band	Uplink	Downlink	Duplex mode
n1	1920-1980MHz	2110-2170MHz	FDD

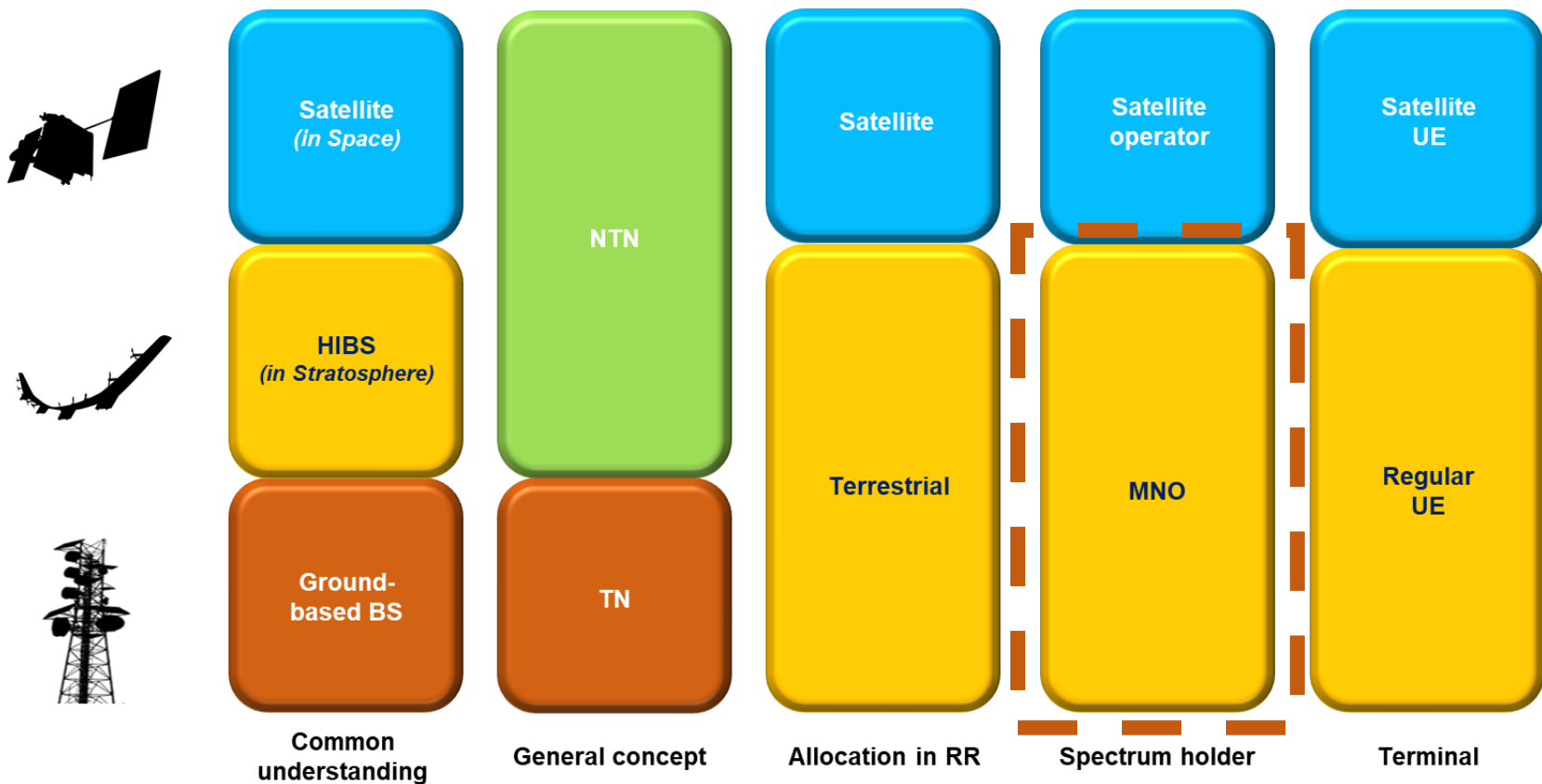
**Same  
band & technical conditions  
for terrestrial**

\*Some bands below 2.7 GHz are expected to be added after WRC-23

# Categorization study



# Categorization study



# Basic concept of HIBS Service

HIBS operator should be a carrier of carrier

## Local MNO's mobile service

All communications via HIBS will go through local MNO's network and will be subject to all local rules

HIBS Service

Ground-Based  
IMT Base Station



Dense Urban

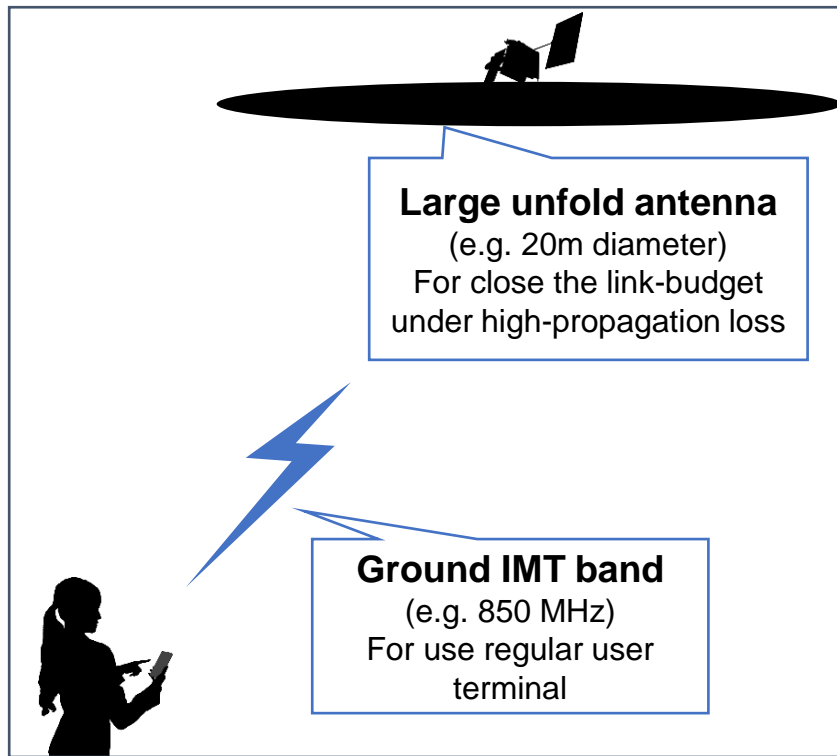
Urban



HIBS

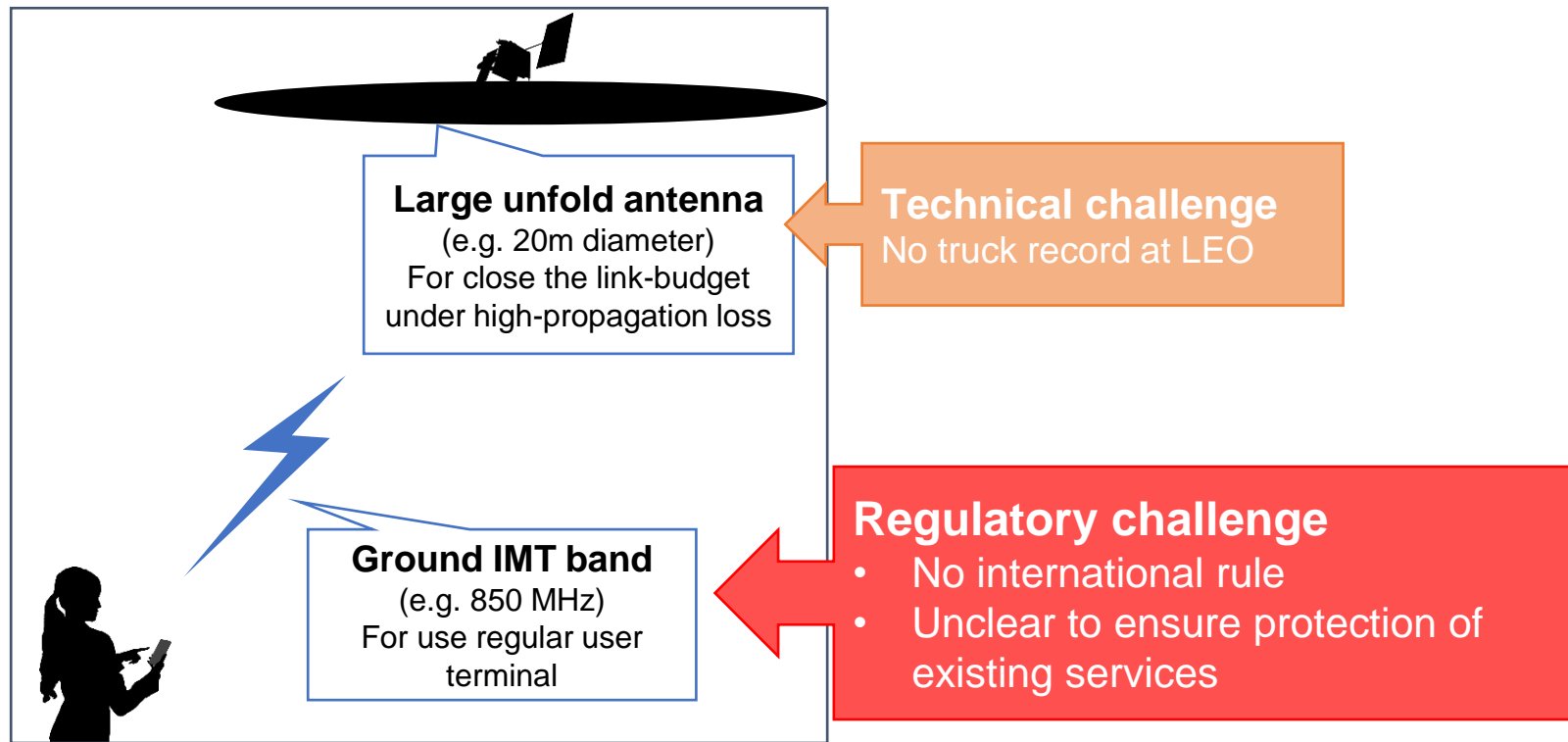
Rural

# Another concept: Mobile-direct via LEO constellation

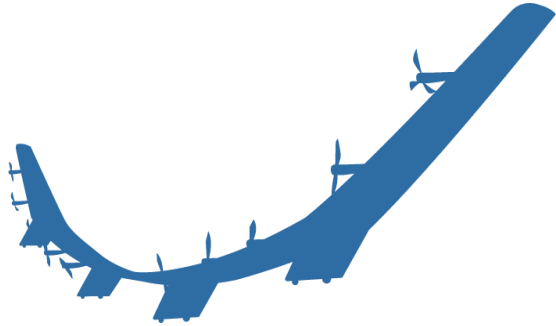




# Another concept: Mobile-direct via LEO constellation



**Proper regulations of international rule should be developed in timely manner.**



## HAPS industry update

# Relevant activities worldwide (1)

- Zephyr High Altitude Platform Station (HAPS) achieves connectivity in trial conducted by Airbus and NTT DOCOMO (Nov. 2021)

<https://www.airbus.com/en/newsroom/press-releases/2021-11-zephyr-high-altitude-platform-station-haps-achieves-connectivity-in>

- Airbus, NTT, DOCOMO and SKY Perfect JSAT Jointly Studying Connectivity Services from High-Altitude Platform Stations (HAPS) (Jan. 2022)

[https://www.docomo.ne.jp/English/info/media\\_center/pr/2022/0117\\_00.html](https://www.docomo.ne.jp/English/info/media_center/pr/2022/0117_00.html)

- World-First Trial of 5G HAPS Technology Takes Place in Saudi Arabia In the Red Sea Project (Feb. 2022)

<https://www.citc.gov.sa/en/mediacenter/pressreleases/Pages/2022030201.aspx>

- NTT and SKY Perfect JSAT Agree to Establish Space Compass Corporation (Apr. 2022)

<https://group.ntt/en/newsrelease/2022/04/26/220426a.html>

- SCEYE REACHES STRATOSPHERE; FLIES AT 64,000 FT. (May. 2021)

<https://www.sceye.com/sceye-press-releases/sceye-reaches-stratosphere-flies-at-64000-ft/>

- SoftBank Corp.'s HAPSMobile and Lendlease establish joint venture to explore HAPS deployment in Australia (May 2022)

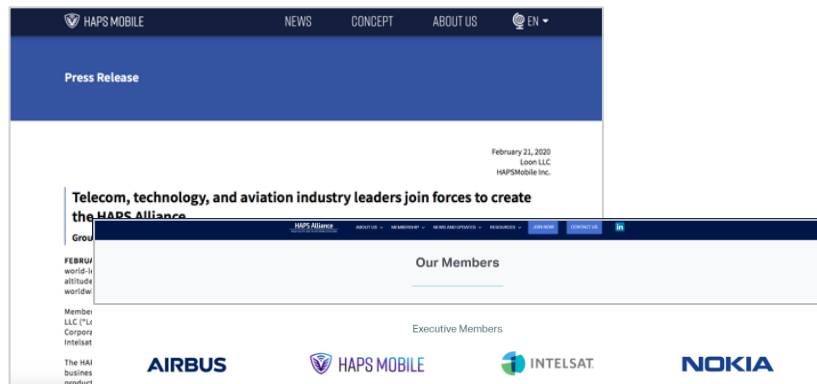
[https://www.hapsmobile.com/en/news/press/2022/20220510\\_01/](https://www.hapsmobile.com/en/news/press/2022/20220510_01/)

# Relevant activities worldwide (2)

- Airbus to deliver connectivity services using the Zephyr (Jul. 2022)  
<https://www.airbus.com/en/newsroom/press-releases/2022-07-airbus-to-deliver-connectivity-services-using-its-leading-zephyr#>
- NTT and SKY Perfect JSAT have established a connectivity services from HAPS (Jul. 2022/Japanese only)  
[https://www.skyperfectjsat.space/news/detail/post\\_181.html](https://www.skyperfectjsat.space/news/detail/post_181.html)
- NTT and SKY Perfect JSAT will be established a connectivity services from HAPS (April. 2022/)  
<https://group.ntt/en/newsrelease/2022/04/26/220426a.html>

# HAPS Alliance

By accelerating HAPS technologies and development  
building a cooperative ecosystem



## Aviation



- Promote and build standards and guidelines for the upper airspace while cooperating with ICAO, FAA and other aviation regulators

## Telecom



- Advocate for global harmonization of HAPS/HIBS spectrum at global/national level
- Influence commercial standards including 3GPP NTN

## Interoperability



- Develop product specifications
- Standardization of HAPS/HIBS network interoperability

## Commercialization



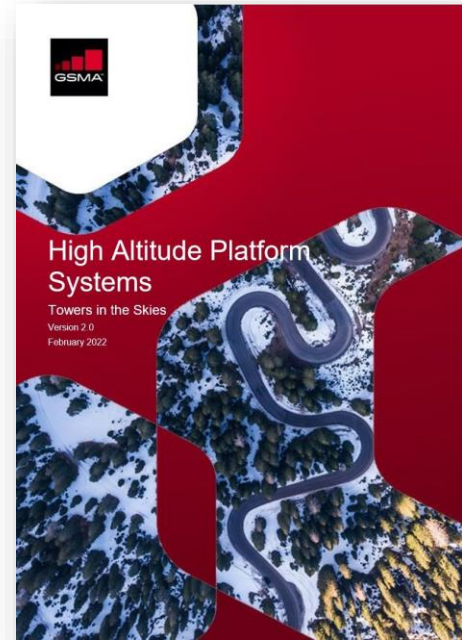
- Publish case studies/whitepapers
- Joint pilot/Proof of Concepts
- Build a cooperative HAPS/HIBS ecosystem

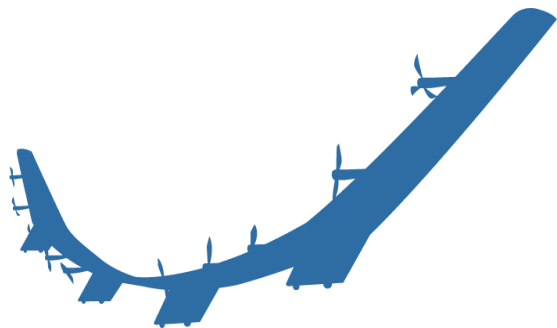
\* SOURCE: [HAPS Mobile website](https://www.hapsmobile.com)

\* SOURCE: [HAPS ALLIANCE website](https://www.hapsalliance.com)

# HAPS related Whitepapers

Internet access to the ground from the sky  
is getting more attention

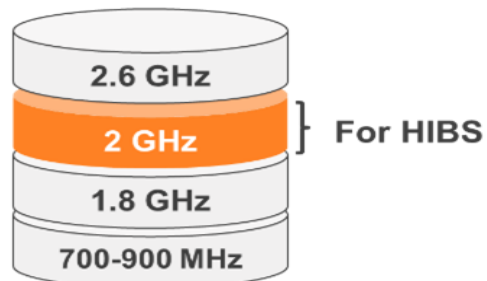




## **WRC-23 agenda item 1.4**

# Establishment of WRC-23 Agenda Item

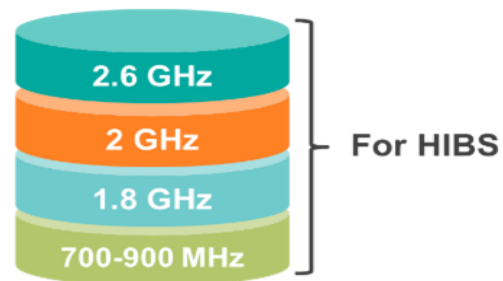
## Current Regulation



**NO FLEXIBILITY**

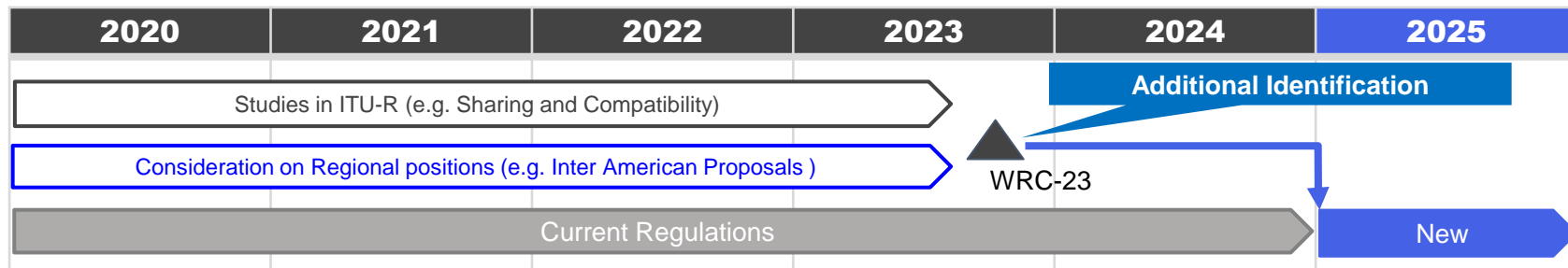
Only 2GHz is allowed in the RR

## Candidate bands for WRC-23



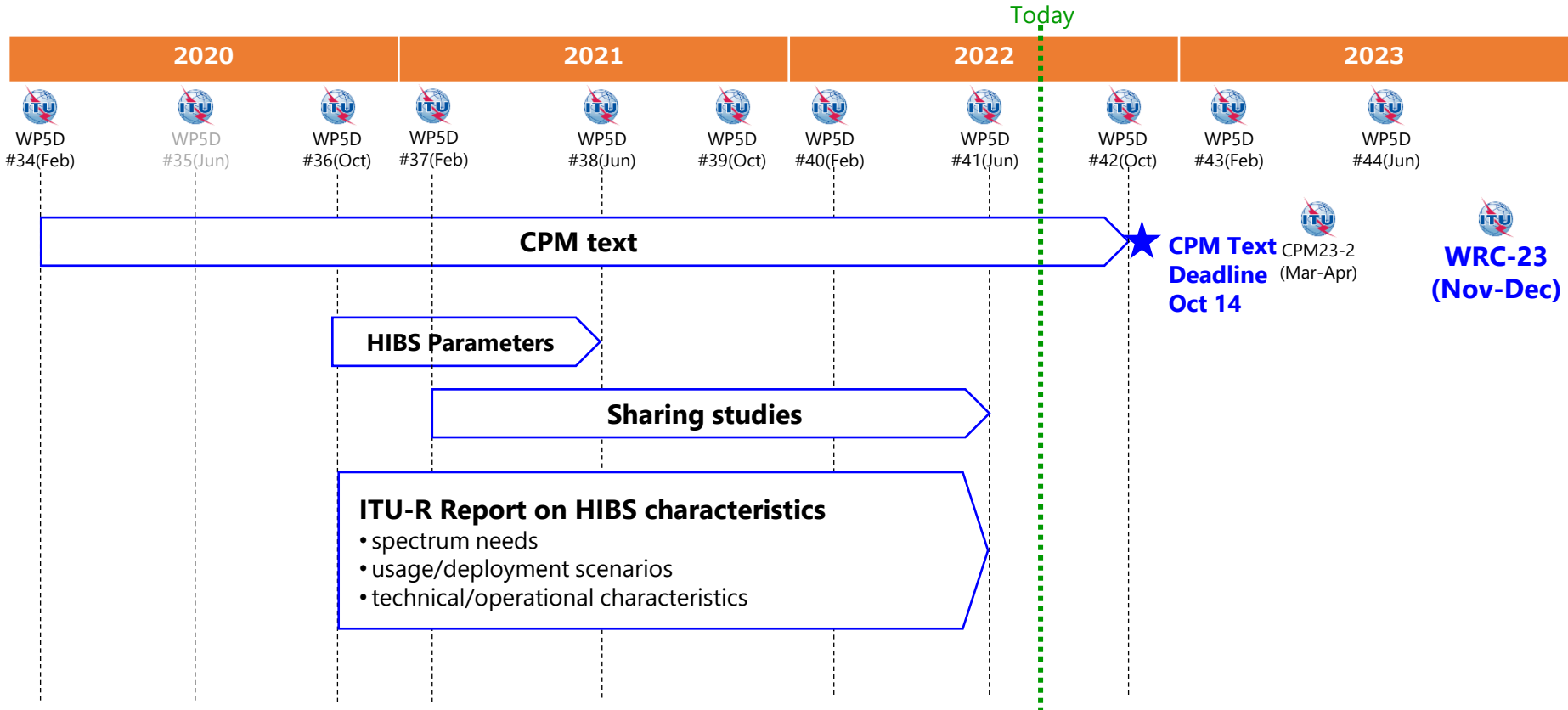
**FLEXIBILITY**

Originally proposed by 3 regions (CITEL, ATU and APT) as a new agenda item at WRC-19





# Overall schedule on WRC-23 AI 1.4



CPM: Conference Preparatory Meeting

# Status quo of sharing studies

## Band 1 (694-960 MHz)

In-band

- LMS except IMT
- IMT
- ARNS
- BS

Adjacent band

- ARNS (960-1164 MHz)
- AMS (R) (960-1164 MHz)
- *[RAS (1 610.6-1 613.8 MHz)  
\*2nd Harmonic]*

## Band 2

(1710-1980, 2010-2025,  
2110-2170 MHz)

- LMS except IMT
- IMT
- FS
- SRS (E-s)
- AMS

- MetSat (1 670-1 710 MHz)
- MSS (1980-2010 MHz,  
2160/2170-2200MHz)
- FS (2010-2110 MHz)
- SOS, EESS, SRS  
(2010-2110 MHz)

## Band 3

(2500-2690 MHz)

- IMT
- FS
- BSS\*
- MSS (2500-2535 MHz,  
2655-2690 MHz)\*

- MSS (2483.5-2500 MHz)
- RDSS (2483.5-2500 MHz)\*
- ARNS (2700-2900 MHz)
- Meteorological Rader  
(2700-2900 MHz)
- RAS (2690-2700 MHz)

- Most of studies have finished → Summary table was developed
- There are still diverse views on RAS 2<sup>nd</sup> harmonic and HIBS UE studies(\*), but less discussion.

Being carried out, proposed  
*Controversial views of study  
itself*

# Status quo of the draft CPM text development

- Since the current discussions under WRC-23 AI 1.4 are not controversial, Methods to satisfy this agenda are simply identified as two for each frequency band.

Frequency band	Methods	
694 – 960 MHz	A1	NOC (No change)
	A2	<a href="#">Identification of the frequency band 694-960 MHz</a> , or portions thereof, for the use of HIBS and to include a new WRC.
1710 -1885 MHz	B1	NOC (No change)
	B2	<a href="#">Identification of the frequency band 1 710-1 885 MHz</a> , or portions thereof, for the use of HIBS in accordance with revised RR No. 5.388A and revised Resolution 221 (Rev.WRC-07).
1885 – 1980 MHz, 2010-2025 MHz and 2110- 2170 MHz	C1	NOC (No change)
	C2	<a href="#">Review existing conditions in the frequency bands 1 885-1 980 MHz, 2 010-2 025 MHz, and 2 110-2 170 MHz</a> , or portions thereof, for the use of HIBS, in accordance with revised RR No. 5.388A and revised Resolution 221 (Rev.WRC-07).
2500 – 2690 MHz	D1	NOC (No change)
	D2	<a href="#">Identification of the frequency band 2 500-2 690 MHz</a> , or portions thereof, for the use of HIBS and to include a new WRC.

**The regulations for the protection of existing services under each Method are key issues for the future meetings.**

# Regulations for the protection of other systems

- Potential regulations are almost established in the draft WRC Resolutions. The values for possible pfd limits or separation distances are still under discussion.

## Band 1

(694-960 MHz)

In-band

- LMS except IMT **None\***
- IMT **PFD**
- ARNS **Distance\*\*\***
- BS **PFD**

Adjacent band

- ARNS (960-1164 MHz) **None**
- AMS (R) (960-1164 MHz) **None**
- [RAS (1 610.6-1 613.8 MHz)  
2nd Harmonic] **TBD**

## Band 2

(1710-1980, 2010-2025,  
2110-2170 MHz)

- LMS except IMT **None\***
- IMT **PFD**
- FS **PFD**
- SRS (E-s) **Tx limit\*\***
- AMS **Distance\*\*\***

- MetSat (1670-1710 MHz) **Tx limit\*\***
- MSS (1980-2010 MHz,  
2160/2170-2200MHz) **PFD**
- FS (2010-2110 MHz) **None**
- SOS, EESS, SRS  
(2010-2110 MHz) **Tx limit\*\***

## Band 3

(2500-2690 MHz)

- IMT **PFD**
- FS **PFD**
- BSS **PFD**
- MSS (2500-2535 MHz,  
2655-2690 MHz) **TBD**

- MSS (2483.5-2500 MHz) **TBD**
- RDSS (2483.5-2500 MHz) **TBD**
- ARNS (2700-2900 MHz) **PFD**
- Meteorological Rader  
(2700-2900 MHz) **PFD**
- RAS (2690-2700 MHz) **PFD**

\* Protection of IMT conditions may also be reused.

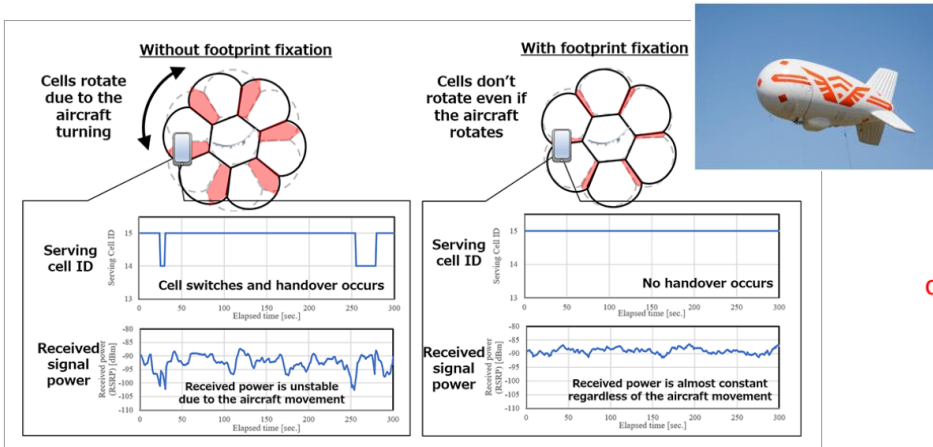
\*\* Restriction of HIBS transmission direction (i.e. Uplink or Downlink only frequencies) may be applied.

\*\*\* Separation distances for coordination threshold.

# Potential technical and operational measures

- Input document from HAPS Alliance (5D/1275) shows the examples of technical and operational measures to protect existing services and systems:

## Footprint fixations



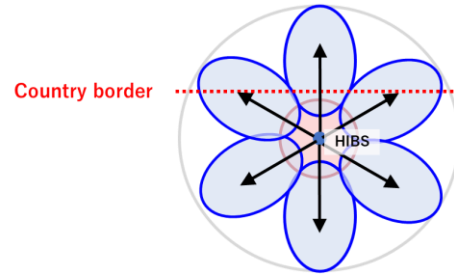
(e.g. Beamforming and mechanical adjustment of antenna direction)

- ✓ SoftBank successfully tested footprint fixation technology with high altitude tethered balloon system in June 2022.

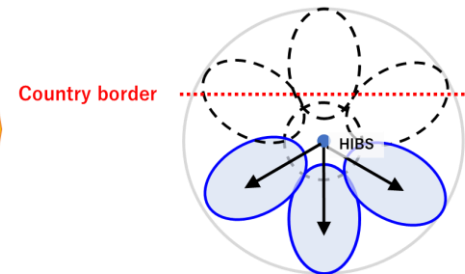
(URL:[https://www.softbank.jp/en/corp/news/press/sbkk/2022/20220622\\_01/](https://www.softbank.jp/en/corp/news/press/sbkk/2022/20220622_01/))

## Beam suppression

Transmission with all antennas



Transmission suspending for 4 antennas



**These measures can be used to satisfy regulations to protect existing systems (e.g. pfd limits).**

# Regulations for HIBS altitude definition (20km → 18km)

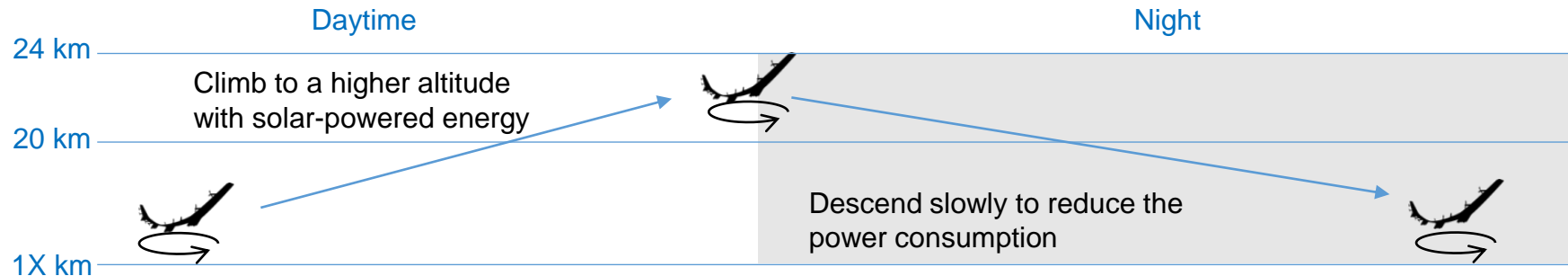
- Based on the proposals from HAPS Alliance\*, it was agreed that sensitivity analysis with HIBS at the altitude down to 18 km could be conducted for the purpose of determining appropriate sharing and compatibility measures to protect existing services. (Baseline study: 20 km, Sensitivity analysis: 18 km)  
\*Our motivation is described in the next page
- Some sharing and compatibility studies have considered the sensitivity analysis of HIBS at altitude of 18 km and shown that the sharing conditions are similar in both altitudes of 18 km and 20 km.
- This issue was also addressed at the last WP 5D meeting from regulatory point of view for Section 5 in the draft CPM text. Four alternative texts were discussed, and further input is expected to the next WP 5D meeting in October.

# Motivation to operate at the altitude below 20 km

## HIBS may temporarily operate at the altitude below 20 km during a day

- Although stratospheric flight has been achieved by some HAPS proponents, further improvement of key technologies (battery, solar power, weight etc.) is still necessary to achieve long-term stable flight at altitudes of 20 km or higher, and this may take more time.
- For the time being, a certain degree of flexibility is needed in terms of operational altitude. For example, the following method is being considered to maintain stratospheric flight while changing the operation altitude during a day.

### Example of the operational methods to maintain the stratospheric flight at night



## Views on WRC-23 agenda item 1.4

- Supports Methods A2, B2, C2 and D2 in the draft CPM text, which are to enable identification of HIBS in the bands under this agenda item including any modifications to the existing provisions.
  - Additional spectrum identifications are necessary for the flexibility of HIBS spectrum usage.
  - Potential regulations for the protection of existing systems are almost established in the draft WRC Resolutions under these Methods.
- Supports stipulating regulations in RR for HIBS operations at the altitude that could go down to 18 km.
  - Such regulations are necessary for the flexibility of HIBS operations considering the current status of technology developments for HIBS.
  - Sensitivity analysis of HIBS at altitude of 18 km and shown that the sharing conditions are similar in both altitudes of 18 km and 20 km.



# Summary

- ✓ **NTN is solution for MNOs to expand area coverage in terms of wide cover and resilience to disasters, especially HIBS has an advantage that can connect regular user terminal directly.**
- ✓ **Technology is just around corner, commercial service will be seen right after the proper rulemaking.**
- ✓ **WRC-23 AI1.4 will provide the flexibility of spectrum usage for HIBS. SoftBank's views on AI1.4 are as follows:**
  - **Supports Methods A2, B2, C2 and D2 in the draft CPM text, which are to enable identification of HIBS in the bands under AI1.4.**
  - **Supports stipulating regulations for HIBS operations at the altitude that could go down to 18 km.**

**Supports from CTU administrations are appreciated !**

# HAPS

High Altitude Platform Station

Today's challenge will be tomorrow's normal



# Appendix

# Frequencies Available for HIBS

## Mobile service (Service link)

1885-1980/2010-2025/2110-2170 MHz	Region 1, 3
1885-1980/2110-2160 MHz	Region 2

Consideration for appropriate modification in WRC-23 AI1.4

694-960 MHz

1710-1885 MHz

Consideration for additional identification in WRC-23 AI1.4

2500-2690 MHz

## 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

# WRC-23 Agenda Item 1.4

1.4 to consider, in accordance with Resolution **247 (WRC-19)**, the use of highaltitude platform stations as IMT base stations (HIBS) in the mobile service in certain frequency bands below 2.7 GHz already identified for IMT, on a global or regional level;

## ***resolves to invite the ITU Radiocommunication Sector in Resolution 247***

- 1 to study spectrum needs, as appropriate, for high-altitude platform stations as IMT base stations to provide mobile connectivity in the mobile service taking into account:
  - the existing identification in *2GHz frequency band*;
  - the usage and deployment scenario envisioned for high-altitude platform stations as IMT base stations as complementary for terrestrial IMT networks;
  - the technical and operational characteristics and requirements of high-altitude platform stations as IMT base stations;
- 2 to conduct and complete in time for WRC-23, taking into account the results of studies already performed and those in progress within ITU-R, sharing and compatibility studies to ensure the protection of services, without imposing any additional technical or regulatory constraints in their deployment, to which the frequency band is allocated on a primary basis, including other IMT uses, existing systems and the planned development of primary allocated services, and adjacent services, as appropriate, for certain frequency bands below 2.7 GHz, or portions thereof, globally or regionally harmonized for IMT, i.e.:
  - 694-960 MHz;
  - 1 710-1 885 MHz (1 710-1 815 MHz to be used for uplink only in Region 3);
  - 2 500-2 690 MHz (2 500-2 535 MHz to be used for uplink only in Region 3, except 2 655-2 690 MHz in Region 3);
- 3 to study appropriate modifications to the existing footnote and associated resolution in the identification in *recognizing b)* in order to facilitate the use of high-altitude platform stations as IMT base stations with the latest radio interface technologies of IMT;
- 4 to study the definition of high-altitude platform stations as IMT base stations (HIBS) including possible modifications to the provisions of the Radio Regulations, as appropriate;
- 5 to develop ITU-R Recommendations and Reports, as appropriate, taking into account *resolves to invite ITU-R 1, 2, 3, and 4 above*,

**EOF**