

Agenda Item 1.14 **High Altitude Platform Stations**

July 2019, Trinidad and Tobago

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- Sharing and compatibility
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HAPS – High Altitude Platform Stations

Overview

- Stations located at an altitude of 20-50 km at a specified fixed and nominal point
- Latest designs take the shape of unmanned solar-powered planes
- Use of spectrum allocated to the fixed service
- HAPS are increasingly considered as a solution to expand broadband connectivity to underserved areas



Next- Generation HAPS

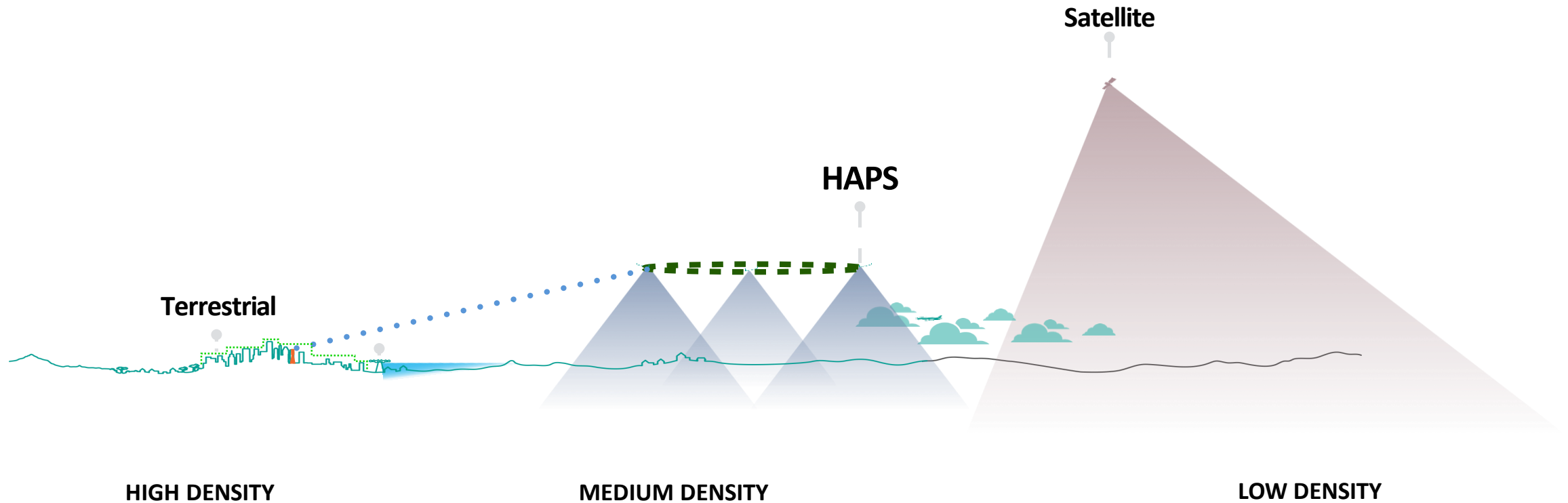
Tech Advances

- ✓ Li-ion batteries
- ✓ High efficiency solar panels
- ✓ Lightweight materials
- ✓ Autonomous aircraft avionics

Attributes

- ✓ Affordable/reliable backhaul solution
- ✓ Footprint – up to 100 km diameter
- ✓ Throughput – up to 30 Gbps
- ✓ Altitude – 20 km (above commercial airspace)
- ✓ Circles in 2-3 km radius
- ✓ Station-keeping – 12 months
- ✓ Service life – approximately 10 years

Identifying Gaps in Availability



HAPS Synergies

HAPS are designed to supplement mobile and satellite networks

- HAPS could play an important role in enabling and accelerating mobile deployments
- HAPS will provide effective and affordable backhaul to connect areas where terrestrial backhaul technologies are uneconomical
- HAPS could extend satellite capabilities to further integrate with ground-based infrastructure
- HAPS can act as a complement to geostationary satellite networks, creating hotspots of concentrated capacity within vast satellite footprints

Emergency Connectivity

HAPS are the perfect solution in disaster relief services

- ✓ Fast deployment
- ✓ Movement flexibility
- ✓ HAPS can assist emergency services while re-connecting people much faster than other connectivity infrastructure

WRC-19 – AI 1.14: Spectrum Certainty for HAPS

Frequency	Direction	Bandwidth	Current coverage	Proposed coverage
Existing bands for HAPS				
6 GHz	↓↑	80 MHz (x2)	5 Admins (R1, R3)	Global
28/31GHz	↓↑	300 MHz (x2)	23 Admins (R1, R3)	Global
47/48 GHz	↑↓	300 MHz (x2)	Global	Global
Candidate bands for HAPS				
21.4-22 GHz	↓	600 MHz	-	R2
24.25-27.5 GHz	↑↓	3250 MHz	-	R2
38-39.5 GHz	↑	1500 MHz	-	Global

Sharing & Compatibility

ITU Technical Studies

- WP-5C has already approved HAPS characteristics, HAPS spectrum requirements and the 6 GHz sharing and compatibility studies
 - ITU-R Reports: Rep. ITU-R F.2439, Rep. ITU-R F.2438, Rep. ITU-R F.2437.
- WP-5C last meeting, April 29 to May 8 in Geneva
 - Considered the studies of 22 GHz (region 2), 26 GHz (region 2), 28/31 GHz (global), 38 GHz (global) and 47/48 GHz (global)
- In the plenary session, all compatibility and sharing studies were upgraded to Draft New Reports (DNRs)

Measures to Protect Existing Services

- In a WP-5C meeting (Nov 2018), optimal solutions were agreed to protect in-band and adjacent-band incumbent services
- For the protection of terrestrial services (i.e., FS, MS, RAS, SRS/EESS and FSS earth stations), power flux density (pfd) approach was proposed
- For the protection of space services (i.e., FSS/ISS satellite, EESS (passive)), equivalent isotropic radiated power (EIRP) approach was proposed
- EIRP/pfd limits:
 - proven method to protect existing services and have been used in a several Resolutions
 - guarantee the protection of in-band and adjacent band services as they derived directly from the protection criteria of the incumbent service.
- The studies also demonstrated that HAPS systems can comply with the proposed pfd/EIRP limits.

Measures to Protect Existing Services

- HAPS downlink to FS, MS, RAS and EESS / SRS (in band): PFD limits
- HAPS downlink to EESS (passive), ISSb and FSS UL: radiated isotropic power limit equivalent (EIRP)
- HAPS downlink / uplink to FSS DL: PFD limits and protection distance / coordination
- HAPS uplink to SF: case by case coordination between administrations or method of liaison / usual planning + procedures used at national level
- HAPS uplink to RAS, EESS / SRS (in-band) and MS: PFD limits
- HAPS uplink to ISS, EESS (passive), and FSS UL: EIRP limits

Conclusion of the ITU – WP-5C Results

- HAPS can operate in the same bands as other services, without causing harmful interference, if used within certain parameters included in the proposals
- HAPS have the technical capacity to operate fully within those parameters that allow them not to cause harmful interference to other services
- There are no other technical studies showing HAPS will harm existing services if they are used under the parameters established by WP5C of the ITU

Opposite Direction Criteria

27.9-28.2 GHz

The FSS operates in the Earth-to-space direction (Uplink).

We propose HAPS operation to be limited to HAPS-to-ground direction (Downlink) to avoid any harmful interference towards the FSS satellite.

38-39.5 GHz

The FSS operates space-to-Earth direction (Downlink).

It is proposed HAPS operation to be limited to ground-to-HAPS direction (Uplink) to avoid any harmful interference towards the FSS earth stations

Regional Status

AI 1.14 Status in Other Regions

Regions with positions supporting HAPS identifications



African
Telecommunications
Union



European Conference of Postal
and Telecommunications
Administrations

AI 1.14 Status in Other Regions

Regions still discussing support for HAPS identifications



Asia-Pacific
Telecommunity



Regional Commonwealth in
the Field of Communications



Arab Spectrum
Management Group

Status of AI 1.14 in CITEI

BAND	PP	DIAP	IAP
6 GHz	US	Canada, Bahamas	-
22 GHz	US	-	Bahamas, Brazil, Canada, Dominican Republic, Guatemala, Mexico
26 GHz	US	Bahamas, Brazil, Canada, Colombia, Dominican Republic, [Ecuador]*	-
28-31 GHz	US	Canada, Bahamas	-
38 GHz	US	-	Bahamas, Brazil, Canada, Dominican Republic, [Ecuador]*, Guatemala, Mexico, [Perú]*
47-48 GHz	US	Bahamas, Brazil, Canada, Colombia, Mexico	-
Art 11 & App 4	-	Bahamas, Brazil, Canada	-

* Pending of confirmation since absent at last CCP.II

Pre-Ottawa Regional Discussions

- 7th Latin-American Telecommunications Congress, Córdoba, Argentina
- 152nd COMTELCA ordinary meeting
- SMTF Meeting, in Trinidad & Tobago

Why Support Spectrum Certainty for HAPS?

- **Because** it is a new technology under development that aims to bring broadband to areas where today's geography or demand does not allow access to quality Internet at affordable prices
- **Because** latest technological advances allow HAPS to become a reality and the certainty of spectrum (co-primary and global) is the missing enabler;
- **Because** supporting HAPS in the ITU does not imply identifying bands in the national frequency tables but rather granting spectrum certainty in case of hypothetical scenarios of cross-border conflict;
- **Because** the studies in the ITU show that compatibility and sharing is possible and it is based on these studies that countries and industry support this agenda item. It's not in anyone's interest to affect the existing services.

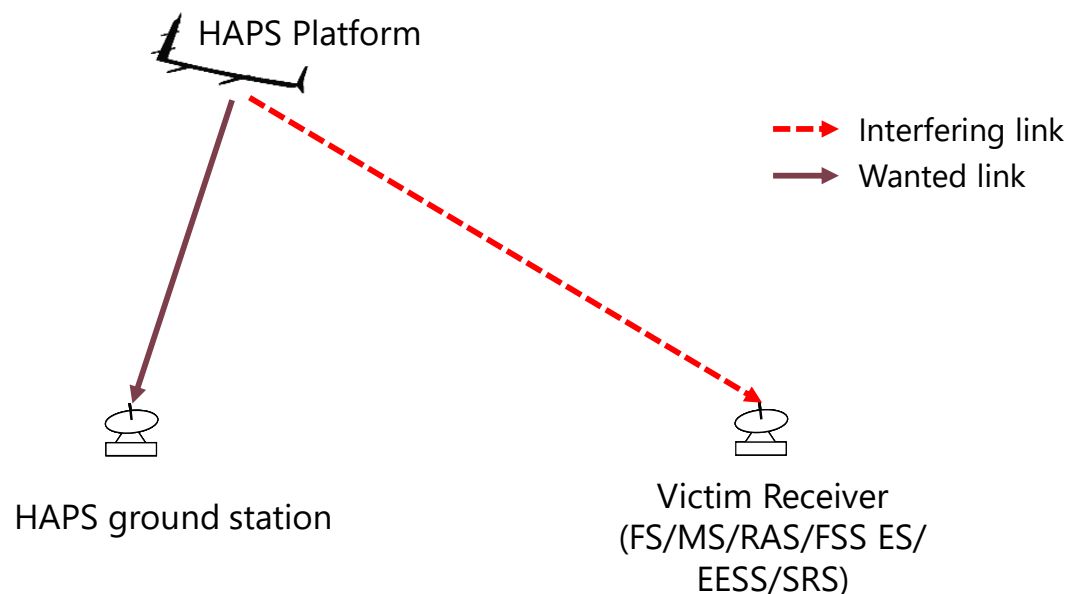
Thank You

Annexes – Coexistence Analyses

HAPS Downlink to Incumbent Services

1. HAPS downlink to FS, MS, RAS, FSS E/S and EESS/SRS Earth Stations (in-band)

Scenario considered



1. Impact from HAPS platform into FSS Earth stations

Band: 38-39.5 GHz

This direction is not proposed.

2. Impact from HAPS platform into EESS/SRS Earth stations

Bands: 25.5-27 GHz and 38-39.5 GHz

This direction is not proposed.

3. Impact from HAPS platform into FS/MS terrestrial stations

Bands: 6440-6520 MHz, 21.4-22 GHz, 24.25-25.25 GHz, 27-27.5 GHz, 27.9-28.2 GHz, 31-31.3 GHz, 47.2-47.5 GHz, and 47.9-48.2 GHz

Protection: pfd mask included in the respective proposed new resolutions and then mandatory coordination

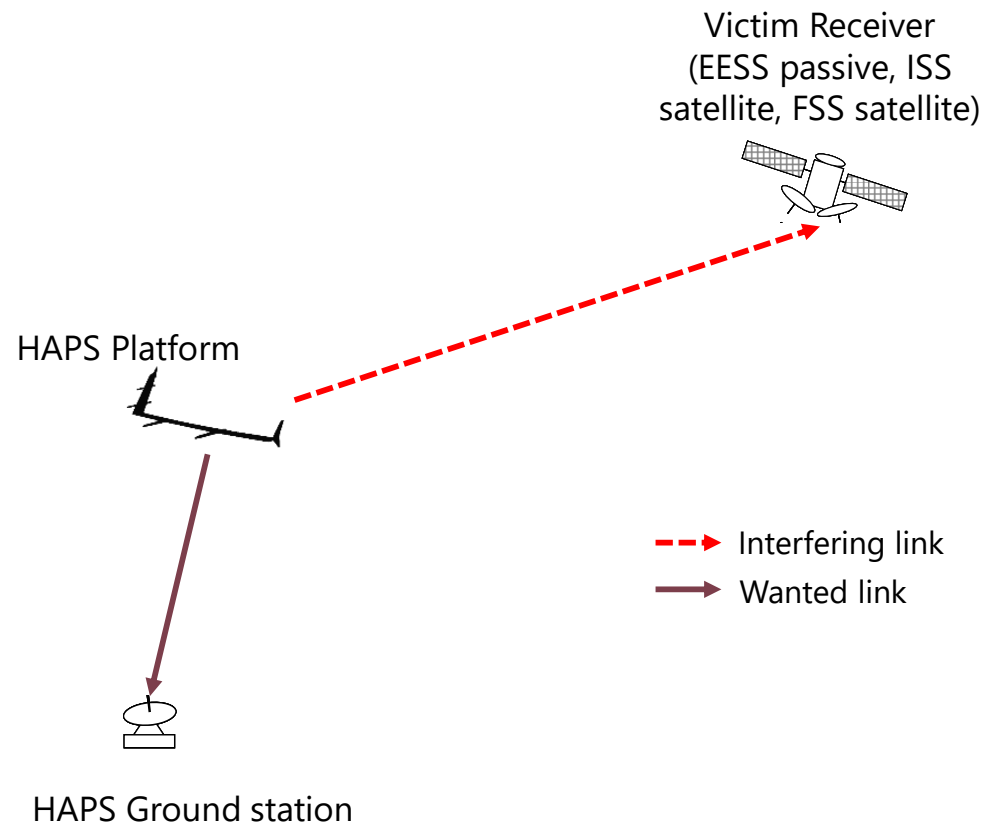
4. Impact from HAPS platform into RAS Earth stations

Bands: 6440-6520 MHz, 21.4-22 GHz (adjacent), 24.25-25.25 GHz (adjacent), and 31-31.3 GHz (adjacent).

Protection: Hard pfd limit towards the RAS Earth stations

2. HAPS downlink to EESS (passive), ISS satellite, and FSS satellite

Scenario considered



1. Impact from HAPS platform into EESS (passive) satellites

Bands: 6440-6520 MHz, 24.25-25.25 GHz (adjacent), 31-31.3 GHz (adjacent).

Protection: EIRP density mask for HAPS emissions for off-nadir angles > 85 degrees (HARD LIMIT)

2. Impact from HAPS platform into FSS/ISS satellites

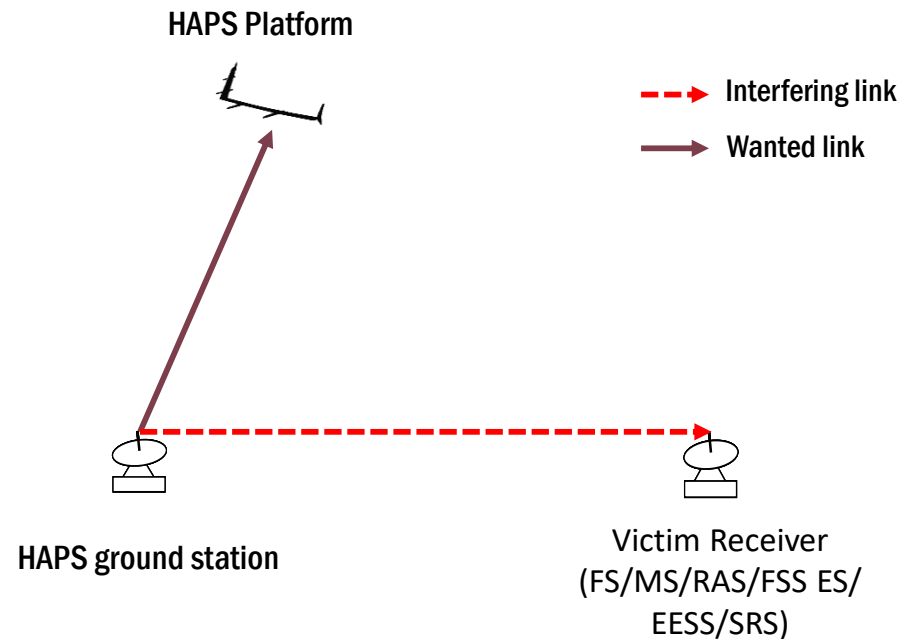
Bands: 6440-6520 MHz, 24.25-25.25 GHz, 27-27.5 GHz, 27.9-28.2 GHz, 47.2-47.5 GHz, and 47.9-48.2 GHz

Protection: EIRP density limit for HAPS emissions for off-nadir angles > 85 degrees (HARD LIMIT).

HAPS Uplink to Incumbent Services

3. HAPS uplink to FS, MS, FSS, RAS and EESS/SRS E/S:

Scenario considered



1. Impact from HAPS ground station into FS/MS

Bands: 6560-6640 MHz, 25.25-27 GHz, 38-39.5 GHz, 47.2-47.5 GHz, and 47.9-48.2 GHz.

Protection: HAPS ground stations are defined as terrestrial stations operating within the fixed service. Protection between HAPS ground stations and conventional FS stations will be managed by coordination amongst administrations in the case of a cross border scenario or usual link/planning method and procedures used at national level for conventional FS stations.

2. Impact from HAPS ground station into FSS, EESS/SRS Earth stations

Bands: 25.5-27 GHz and 38-39.5 GHz

Protection: HAPS ground stations are defined as terrestrial stations operating within the fixed service. Hence it is proposed that those HAPS ground stations shall coordinate as any other FS terrestrial station (Nos 9.17 and 9.18 apply). No amendment to the Radio Regulation is required in this case

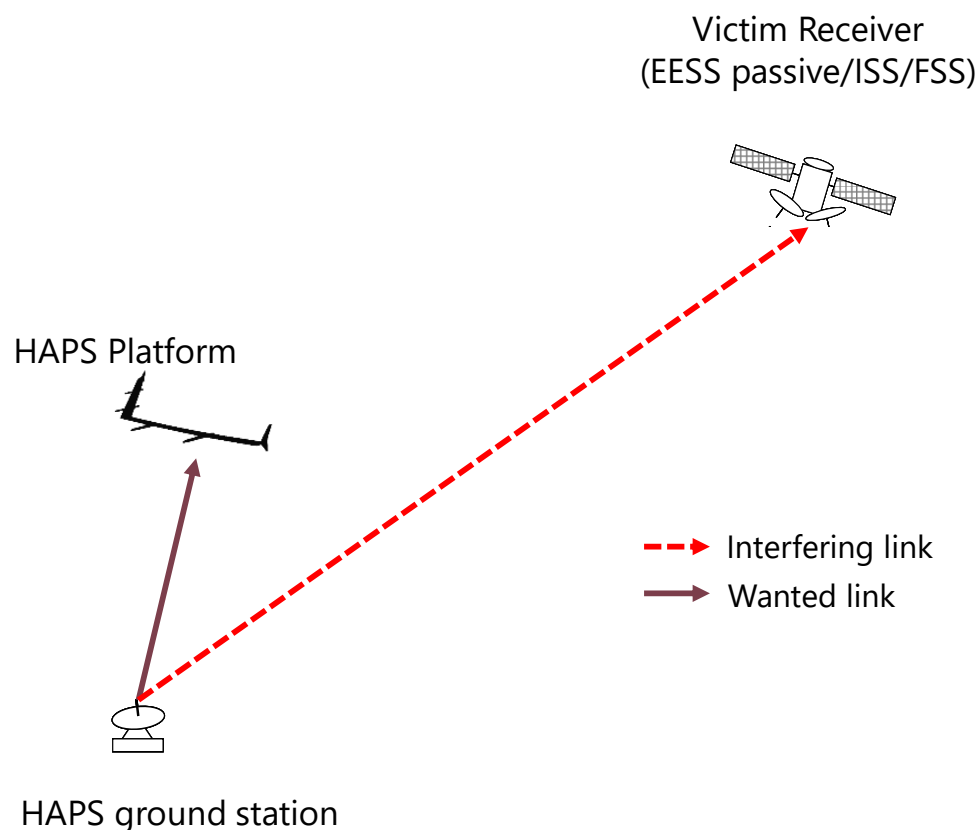
3. Impact from HAPS ground station into RAS Earth stations

Bands: 47.2-47.5 GHz and 47.9-48.2 GHz

Protection: Hard pfd limit towards the RAS Earth stations.

4. HAPS uplink to ISS, EESS (passive) and FSS satellite:

Scenario considered



1. Impact from HAPS ground stations into EESS passive satellite

Bands: 6440-6520 MHz, 24.25-25.25 (adjacent), 21.4-22 GHz (adjacent), 31-31.3 GHz (adjacent)

This direction is not proposed.

2. Impact from HAPS ground stations into FSS satellite

Bands: 6440-6520 MHz, 24.25-25.25, 27-27.5 GHz, 27.9-28.2 GHz

This direction is not proposed.

Bands: 47.2-47.5 GHz, and 47.9-48.2 GHz

Protection: EIRP density limit for HAPS ground stations emissions towards the satellite (HARD LIMIT).

3. Impact from HAPS ground stations into ISS satellite

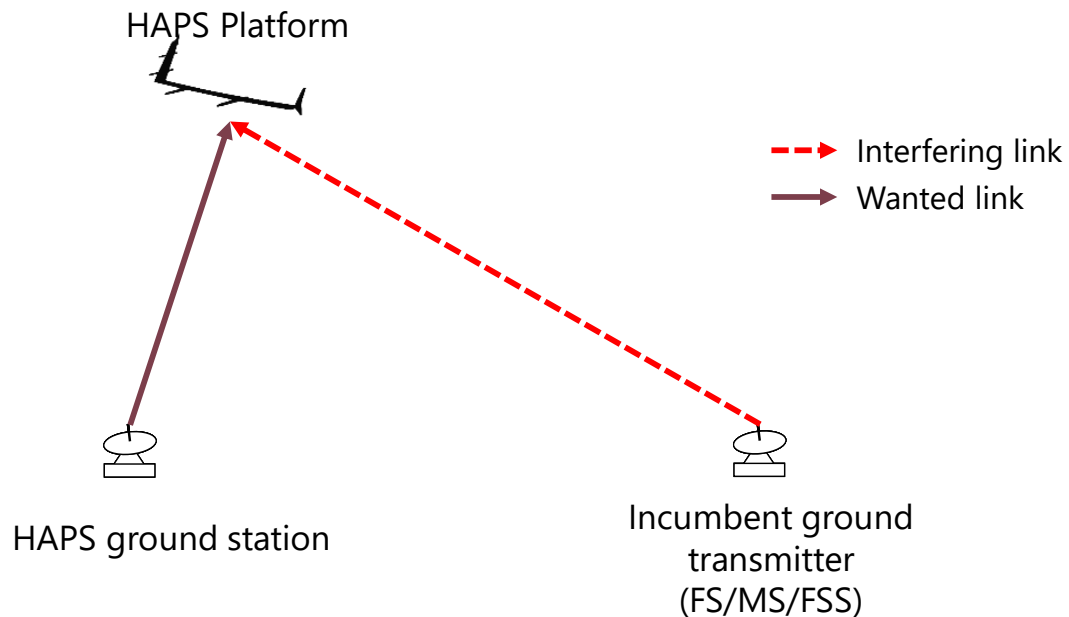
Bands: 25.25-27 GHz

Protection: EIRP density limit for HAPS ground stations emissions towards the satellite (HARD LIMIT)

Incumbent Services to HAPS

5. FS, MS, FSS Earth stations to HAPS platform

Scenario considered



1. Impact from FS/MS into HAPS platform

Bands: 38-39.5 GHz, 47.2-47.5 GHz, and 47.9-48.2 GHz

Protection: HAPS is a fixed service. Hence, coordination amongst administrations can be used in the case of a cross border scenario or usual link/planning method and procedures used at national level for conventional FS stations. No amendment to the Radio Regulation is required in this case.

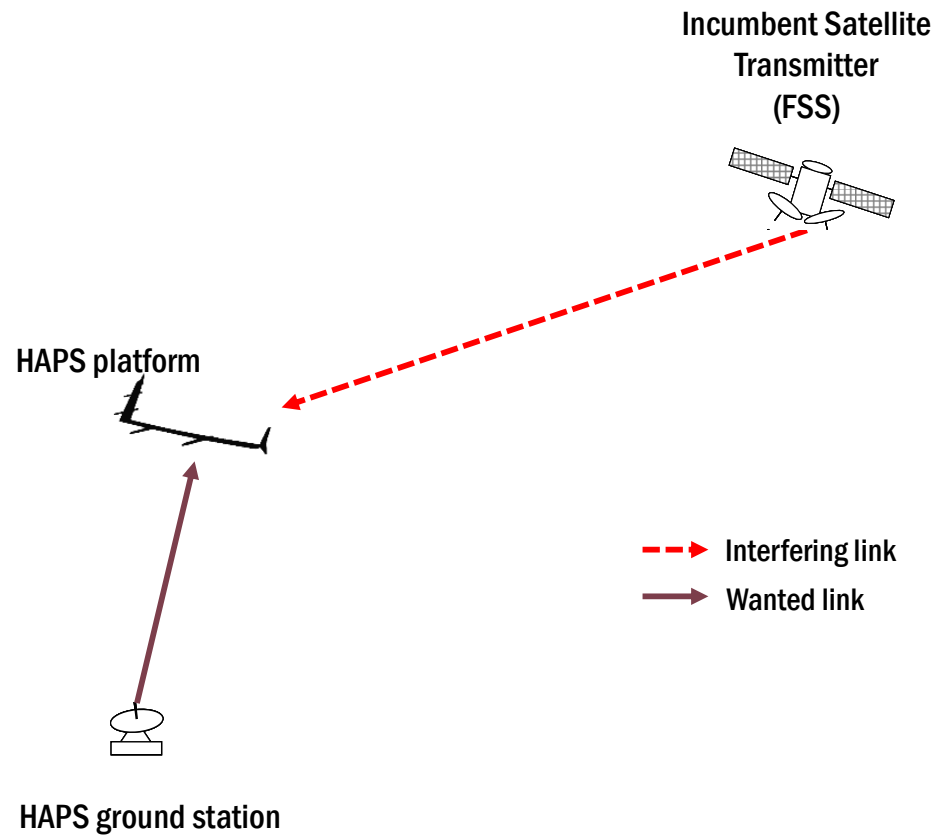
2. Impact from FSS Earth stations into HAPS platform

Bands: 24.25-25.25 GHz, 27-27.5 GHz, 27.9-28.2 GHz, 47.2-47.5 GHz, and 47.9-48.2 GHz

This direction is not proposed.

6. FSS satellites into HAPS platform

Scenario considered



1. Impact from FSS satellites into HAPS platform

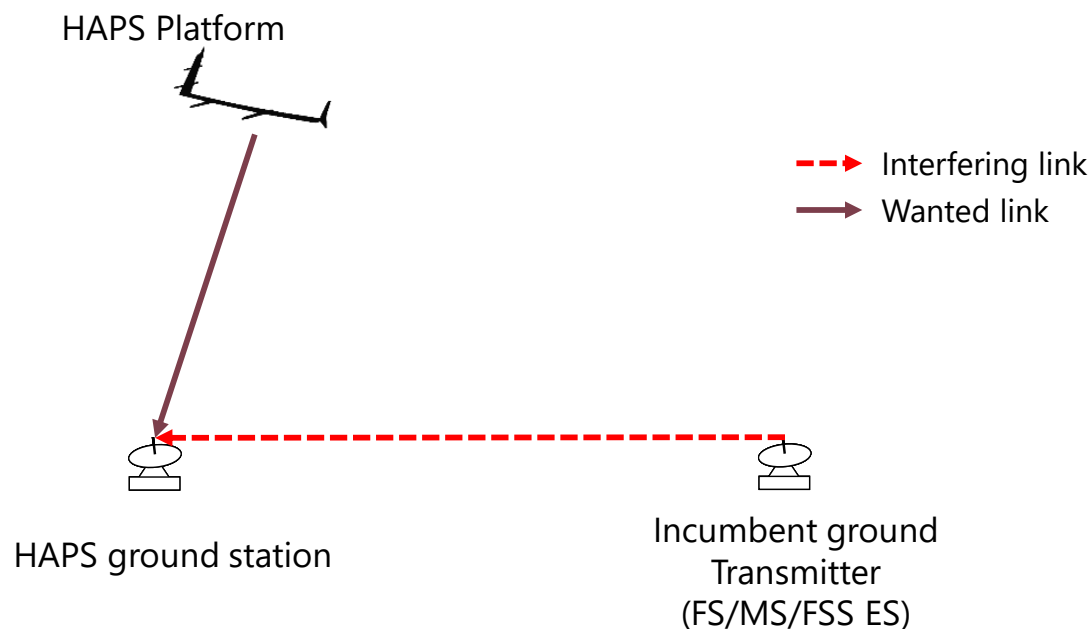
Band: 38-39.5 GHz

Protection: HAPS operate within the fixed service. Article 21 applies to FSS satellite emissions. No amendment to the Radio Regulation is required in this case.

Incumbent Services to HAPS Ground Stations

7.FS, MS, FSS Earth stations to HAPS ground stations

Scenario considered



1. Impact from FS/MS into HAPS ground stations

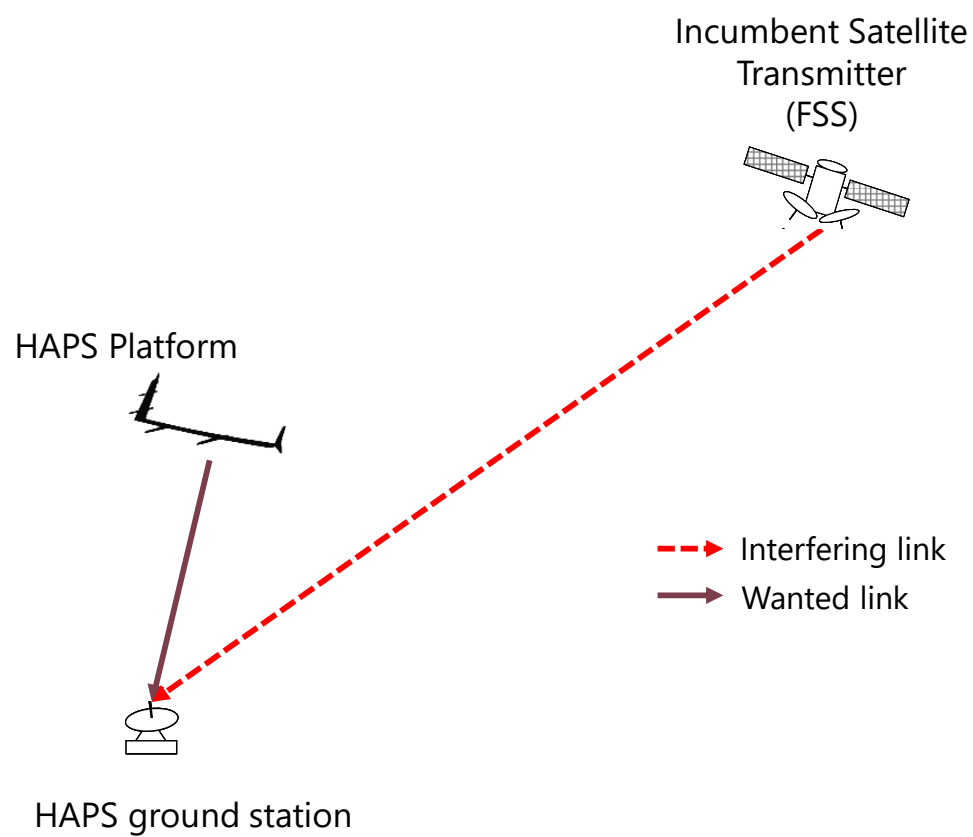
Bands: 6 440-6 520 MHz, 24.25-25.25 GHz, 27-27.5 GHz, 27.9-28.2 GHz, 31-31.3 GHz, 47.2-47.5 GHz, and 47.9-48.2 GHz
Protection: HAPS ground stations are defined as terrestrial stations operating within the fixed service. Protection between HAPS ground stations and conventional FS stations will be managed by coordination amongst administrations in the case of a cross border scenario or usual link/planning method and procedures used at national level for conventional FS stations.

2. Impact from FSS Earth stations into HAPS ground stations

Bands: 6 440-6 520 MHz, 24.25-25.25 GHz, 27-27.5 GHz, 27.9-28.2 GHz, 47.2-47.5 GHz, and 47.9-48.2 GHz
Protection: It is proposed to deal with HAPS ground stations as any FS terrestrial station (No 9.17 apply). No amendment to the Radio Regulation is required in this case.

8. HAPS downlink to EESS (passive), ISS satellite, and FSS satellite

Scenario considered



1. Impact from FSS satellites into HAPS ground stations

Band: 38-39.5 GHz

This direction is not proposed.

Options for Co-Primary Identifications for HAPS

With Method B, CPM text includes options for co-primary identifications

Bands	Method	Option	Summary
6 440- 6 520 MHz	B1	Option 1	Global HAPS identification on a co-primary basis for DOWNLINK in the band 6 440- 6 520 MHz
21.4-22 GHz	B2	Option 1a or 1b Draft Resolution Option 1	Region 2 HAPS identification on a co-primary basis for DOWNLINK in the band 21.4-22 GHz
24.25-25.25 GHz	B3	Option 2 Draft Resolution Option 2	Region 2 HAPS identification on a co-primary basis for DOWNLINK in the band 24.25-25.25 GHz
25.25-27.5 GHz	B2	Option 1	Region 2 HAPS identification on a co-primary basis: <ul style="list-style-type: none"> • 25.25-25.5 GHz: UPLINK • 25.5-27 GHz: UPLINK limited to GW • 24-27.5 GHz: DOWNLINK
27.9-28.2 GHz	B1	Option 1	Global HAPS identification on a co-primary basis for DOWNLINK in the band 27.9-28.2 GHz
31.0-31.3 GHz	B1	Options 1A + 1B	Global identification HAPS on a co-primary basis and in both directions in the band 31-31.3 GHz
38-39.5 GHz	B2	Option 1C	Global HAPS identification on a co-primary basis for UPLINK in the band 38-39.5 GHz
47.2-47.5 GHz / 47.9-48.2 GHz	B1	Example 2	An updated Resolution 122 to facilitate the use for HAPS

Studies in 28 GHz

Proposal to support a co-primary identification for HAPS in the band 27.9-28.2 GHz

- After discussions with the FSS community, the HAPS proponents have agreed to limit the operation of the HAPS to downlink - the opposite direction to FSS operations in this band.
- An associated Resolution that contains regulatory provisions (pfd masks, p.i.r.e. limits) for the operation of HAPS based on the hypothesis of the most unfavorable coexistence scenario, which guarantees the protection of pre-existing services.

Resolution 160 – WRC-15

- “That existing services and their applications shall be protected from HAPS applications, and no **undue constraints** shall be imposed on the future development of existing services by HAPS;
- “Undue constrains” does not mean “no constrains”, otherwise, there would be no possible coexistence between any other two services in any band.

Protecting HAPS Ground Stations

- No undue constraints are not imposed on the FSS in the protection scenario for HAPS ground stations.
- The coordination needed to protect HAPS is simpler than that needed to protect conventional applications of the Fixed Service (short distances between HAPS ground terminals and FSS Earth Stations)
- HAPS ground stations receive a minimum elevation angle of 20° - possible interference from the FSS would only enter the lateral lobe and would not affect HAPS communications

