HAPS Alliance

HIGH ALTITUDE PLATFORM STATION

Unlocking the potential of the stratosphere

Dex Halpin – HAPS Alliance – Board of Directors

SOaRS 2024

Tackling the Global Digital Divide

2.7
BILLION PEOPLE

or ~35% of the world's population don't have access to the internet

Source: ITU, Individuals Using the Internet, 2022

HAPS are important layers in modern 3D telecommunication infrastructure, together with satellite constellations and terrestrial networks. HAPS can offer wide coverage, low latency, and can act as a bridge between the ground and the orbit, reducing the power requirements of small devices.

Each Layer Has Its Own Value Proposition for Connectivity

Types of HAPS

Heavier-than-Air HAPS

Fixed Wing

- High maneuverability
- Wider operational envelope
- Endurance, with flight duration months at a time
- Greater flexibility in operation - enabling persistent coverage or readily re-tasked
- Various fuel options

Lighter-than-Air HAPS

Balloon

- Long duration – capabilities to stay afloat for months at a time
- Rapid deployment
- Wide area coverage
- Large payload capacity
- Low-cost stratospheric access

Airship

- High maneuverability
- Large payload capacity
- Station keeping abilities, remain in the Stratosphere for months at a time
- Rely on buoyancy (Helium, Hydrogen) and not on lift by cruising
- Large solar cell surface area – structure

HAPS Connectivity

Network coverage from the stratosphere

Connect the unconnected

High-speed Low latency

Power resilient

Direct connection with devices

Cost reduction

Weather resilient

IoT connectivity

Disaster recovery

Flexible Fast activation

Stratosphere: Enabling a Wide Range of Applications

- Connectivity
- Earth Observation
- Disaster Management
- Security and Defense
- Maritime
- Surveillance
- Monitoring and Detection
- Critical Infrastructure Inspections
- Government
- Mapping and Humanitarian Missions

Enabling a Wide Range of Applications

Connectivity

HAPS can close the digital divide and connect under-connected and unconnected areas

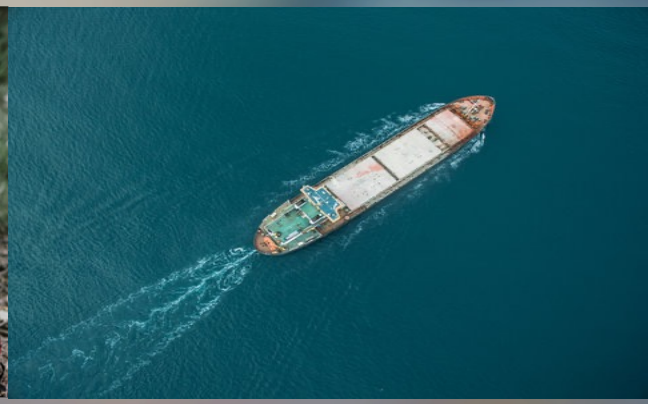
Monitoring and Detection

HAPS can help us detect natural disasters earlier and take action faster

Mapping and Humanitarian Missions

In an emergency situation, HAPS can be retasked on short notice to assist those in need faster

Earth Observation



HAPS enable real-time monitoring with high resolution images and sensors to identify the location of smoke generation

HAPS & Sustainable Development Goals

SUSTAINABLE DEVELOPMENT GOALS

Fighting poverty with remote work thanks to connectivity

Realizing a connected society by bridging the digital divide

Sustainable system (zero CO_2 emissions during flights)

Connecting societies around the world

New communication system that uses the stratosphere

Wide-area coverage

Connecting societies around the world

Realizing a connected society by bridging the digital divide

Sustainable system (zero CO_2 emissions during flights)

Development in HAPS Industry

Stratosphere Hasn't Received Much Commercial Attention Until Recently

Harsh conditions for long-duration flights

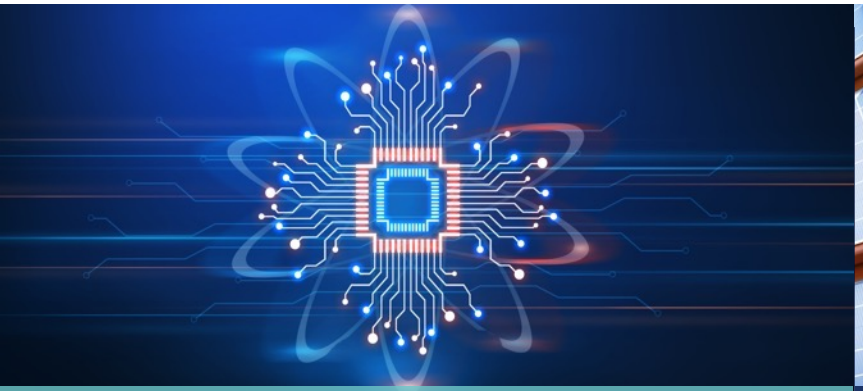
Low pressure and thermal conditions of -65°C in average

Jet stream winds exceeding 100km/hour and more

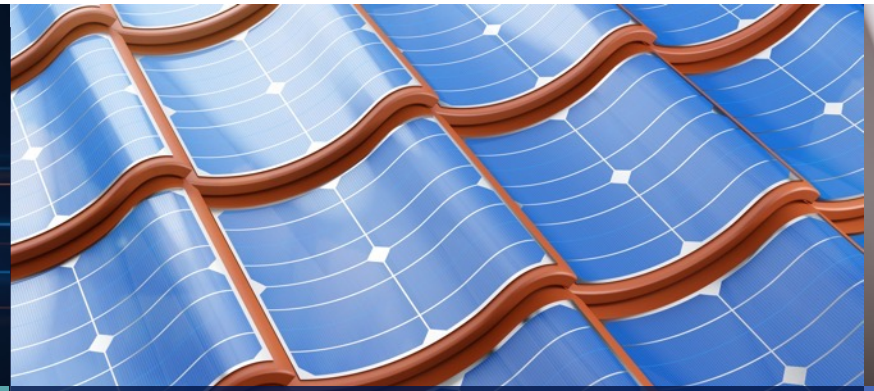
Wind speeds exceeding 40km/hour

Gravity waves and solar radiation at 20km above the earth

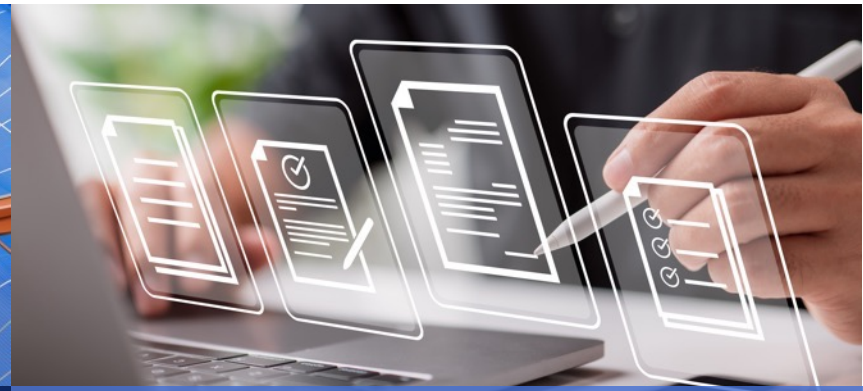
The Latest Tech and Regulatory Advancements Have Paved The Way for HAPS



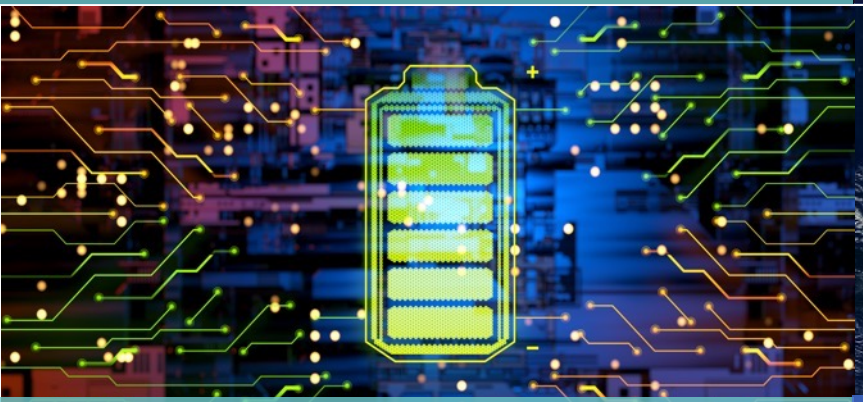
Artificial Intelligence & Machine Learning



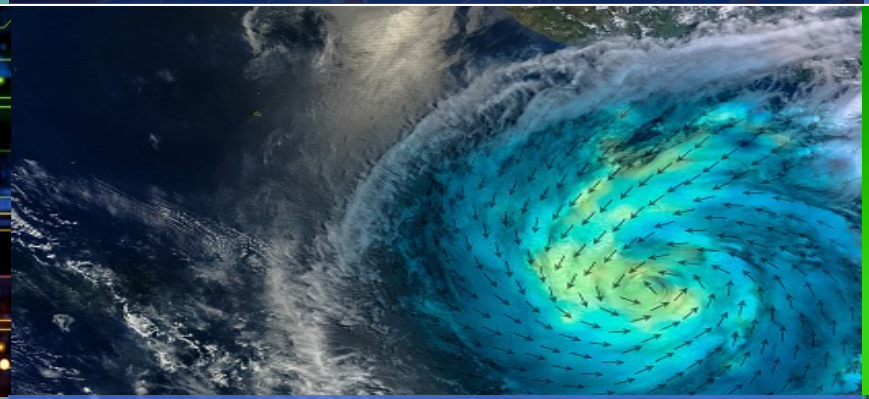
New Materials



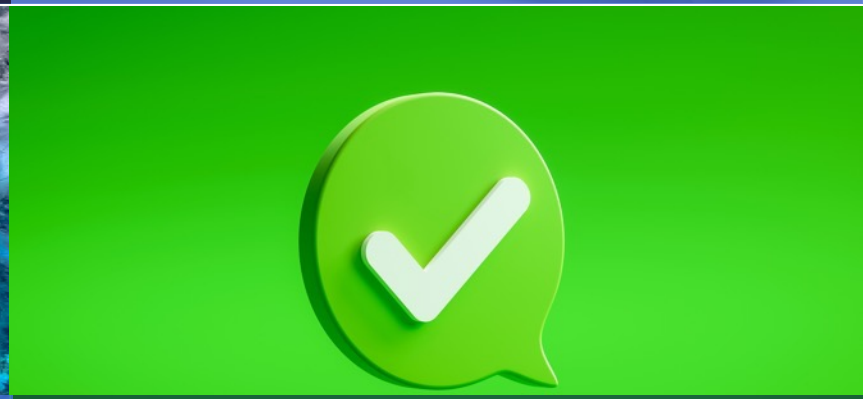
Regulation Advancements



Batteries & Power Improvements



Weather Models & Forecast



Public UAS Acceptance

HAPS Alliance
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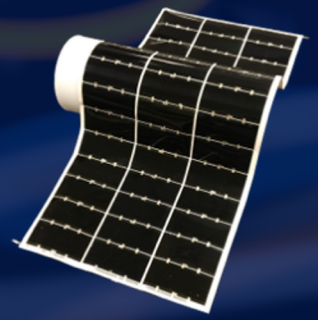
Technological Progress

Solar Cells

Power and weight of solar cells are critical parameters for solar-powered HAPS. The development of high-efficiency, lightweight and flexible solar cells has been significantly improved and resulted in lighter HAPS aircrafts.

Microlink Devices' 150mm diameter ELO foil
Foil is <30 µm thick and flexible



Next-Generation Batteries

Batteries with higher capacity have heavier batteries, which in turn means that flying heavier HAPS aircrafts require more energy. There has been significant progress in the development of lightweight and high energy density (above 400Wh/kg) next-generation batteries which can enable HAPS to fly in the stratosphere for longer hours.

Motor & Propellers

A highly efficient motor is necessary for HAPS, which is used to convert solar energy into propulsive power. There has been significant progress in the development of light-weight, high-efficiency and high-reliability motor for HAPS, which enables HAPS to endure continuous long flight times and to keep stable performance in the stratosphere's hypobaric environment.

Lightweight Aircraft

Development and advancement of solar, battery, payload and aircraft structure and design technologies has led to the design of improved lightweight stratospheric vehicles. Lightweight aircrafts enables overnight flights and maximum capacity of payload which makes HAPS services stable and sustainable.

Fuel Options

Hydrogen
Helium
Heavy Fuels
Solar
Battery

Technological Progress: Heavier-than-Air HAPS

Airbus

Airbus' Zephyr achieved:

- 64 days of stratospheric flight, across two 2021 flights, proving Zephyr can operationalize the stratosphere
- 2,435 total flight hours and demonstrating precise stratospheric maneuverability and station-keeping over points on the ground

Source: https://www.airbus.com/en/newsroom/press-releases/2021-10-airbus-zephyr-solar-high-altitude-platform-system-haps-reaches-new

SoftBank

SoftBank's Sunglider:

- Succeeded in a stratospheric test flight in 2020 that lasted 20 hours and 16 minutes, with 5 hours and 38 minutes in the Stratosphere
- Demonstrated its high-performance capabilities under demanding conditions and strong wind
- Successfully completed multiple previous test flights

Source: https://www.hapsmobile.com/en/

Kraus Hamdani Aerospace

Kraus Hamdani Aerospace developed:

- HAPS which achieved 26 hours and 10 minutes airborne with the K1000P (group-2 fully electric UAS) running high power mil spec radios and a highly capable EO/IR ISR FMV payload

Source: https://krausaerospace.com/

Technological Progress: Lighter-than-Air-HAPS

Aerostar

Aerostar develops stratospheric balloons that:

- Successfully delivered LTE networks connections from an altitude of 20km in 2022
- Demonstrated linger over a certain area for weeks to months by using solar power
- More than 10,000 operational flights in the stratosphere and 2 million flight hours

Source: https://aerostar.com/news/raven-provides-cellular-connectivity-from-the-stratosphere-via-thunderhead-balloon-system

SCEYE

SCEYE builds high-performance HAPS for stratospheric infrastructure that:

- Successfully provided an internet connection from stratosphere to the ground in 2021, and
- Demonstrated the airship's ability to stay over a designated area for operation for months by using renewable energy in 2022
- Demonstrated high-resolution environmental mapping in 2023

Source: https://www.sceye.com/sceye-media/

Stratosyst

Stratosyst develops SkyRider as their stratospheric platform:

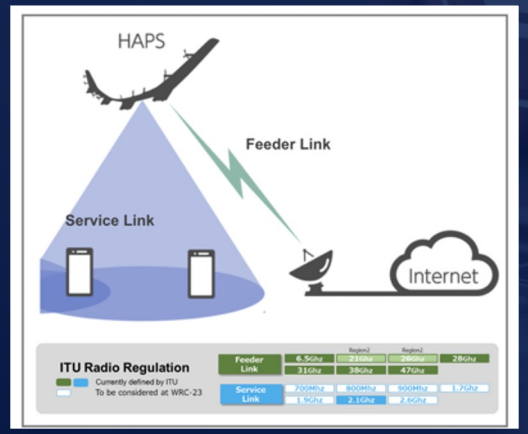
- To provide long-term commercial flights in order to provide connectivity, earth observation, natural disaster monitoring and more
- Designed for smaller payloads and global operation

Source: https://www.stratosyst.com/#press-and-news

Regulation Progress

Frequency Band Expansion

- 3 additional frequency bands were approved for HAPS feeder link at ITU WRC-19
- An agenda item for WRC-23 to expand additional frequency bands for HAPS service link were approved at WRC-19



3GPP Standardization

- HAPS operating band and base station class are successfully included to Release-17 specifications. HAPS is approved to be used in 3GPP specifications.


3GPP TS 38.104 V17.5.0 (2022-03)

Technical Specification

3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;
NR;
Base Station (BS) radio transmission and reception
(Release 17)

5G

3GPP

Aviation Regulations & Standards

- FAA releases ETM Concept of Operations to support traffic management in Upper Class E airspace, which is crucial for future HAPS operations
- European concept for higher airspace operation (ECHO) is currently developing a Concept of Operations for the use of higher airspace, including HAPS operations

ITU: International Telecommunication Union
WRC-19: World Radiocommunication Conference 2019
WRC-23: World Radiocommunication Conference 2023

3GPP: Third Generation Partnership Project
FAA: Federal Aviation Administration (U.S.)
ETM: Upper Class E Traffic Management

Academia & Research Progress

Universities

- Collaboration on modern technologies
- Diploma thesis
- Hands-on experience
- Applied Research

Stratospheric Research

- Pollution
- Temperature, wind speed
- Chemical composition
- Long-term changes – climate change

HAPS Alliance

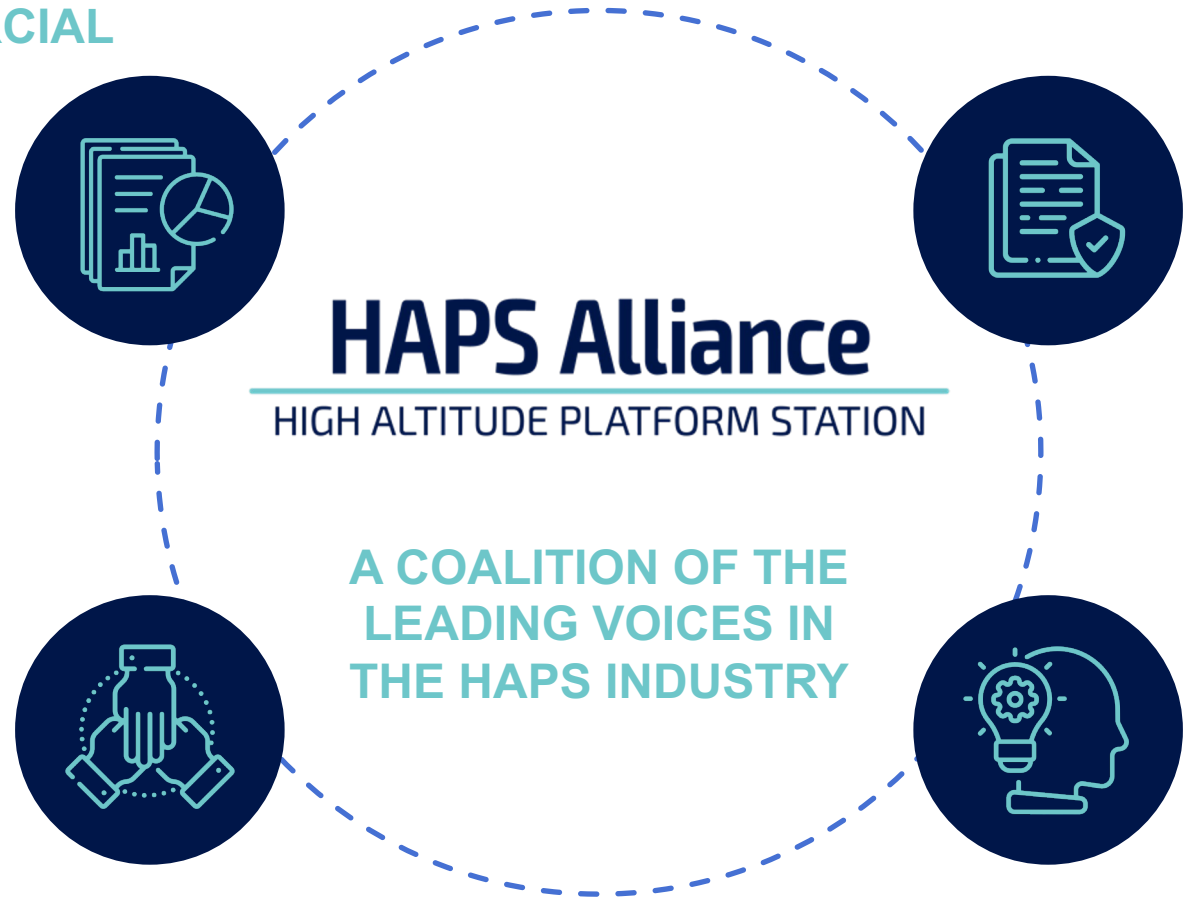
A Consortium of Leading Companies Catalyzing the HAPS Ecosystem

ACCELERATE COMMERCIAL ADOPTION

Identify commercial use cases and business models, and build industry-wide standards and interoperability guidelines.

SAFETY & REGULATORY ADVOCACY

Build the HAPS ecosystem in a safe and non-discriminatory way, in collaboration with both telecom and aviation regulators.



CROSS-INDUSTRY COLLABORATION

Liaise with industry organizations by delivering focused and pertinent guidance relating to HAPS technology and market opportunities.

THOUGHT LEADERSHIP & EDUCATION

Coalesce the voices of HAPS industry leaders into a compelling message for partners, regulators, and the public.

Complementing the Work of Other Leading Organizations

TELECOM

3GPP
Technical requirements & recommendations

ITU & National Regulators
Spectrum studies & recommendations

GSMA
Business case & market studies

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AEROSPACE

Aerospace Industries Association
Regulatory policy alignment

ICAO & National Regulators
ATC & safety policies

GSMA: Global System for Mobile Communication Association
ICAO: International Civil Aviation Organization
ATC: Air traffic control

HAPS Alliance Working Groups

	Telecommunications WG	Aviation WG	Marketing & Communications WG
Goals	Advance the global HAPS ecosystem for telecommunications use cases	Advance aviation regulations, concept of operations, technologies, and standards to foster the HAPS industry	Driving awareness, safety and regulatory alignment and commercial adoption
Achievements	**ITU-R** Joint proposal for studies on HAPS frequencies Proposed HAPS as one of the 6G concepts **3GPP** Completed Release-17 specifications including HAPS operating band and base station class **Public Consultations** Radio Spectrum Policy Group, Asia-Pacific Telecommunity Wireless Group, FCC **Technical Studies** Viability of HAPS: Feeder-link capacity, coexistence, payload specification guidance	**Thought Leadership on International Stage** • *"From the Stratosphere and Beyond – the HAPS Alliance is Connecting the Unconnected"* at 2021 World ATM Congress • HAPS Alliance vision for operations at scale • HAPS appropriate risk assessment process • Introduced vision for Cooperative Traffic Management in the Stratosphere (CTMS) philosophy and work in progress **Visionary White Papers Published** • Papers describing how we envision HAPS operations being managed at scale • SoftBank Flight/Comms Test experience	**Promotion / Education** • Hosted annual conferences: Member Meetings (Spring) and Summit (Fall) • Attended and promoted at various industry events **Supporting Alliance Presence** • Launched social media, LinkedIn • Shared industry news at regular basis • Created blog posts and articles **Publishing and Promoting White Papers** • Issued HAPS White Paper "*Driving the Potential of the Stratosphere*" • Promoted Telecom/Aviation WGs' papers
Plan	• Continue contributions towards international 6G standardization and expansion of HAPS frequency utilization (WRC-23 Agenda Item 1.4) • HAPS payload specification guidance	• Develop and promote guidance for upper airspace through cooperation with Global Community – FAA, ICAO, EASA, NASA, JARUS, etc. • Participation in global events - ICAO Drone Enable, World ATM Congress, ATCA Technical Symposium • Continue thought leading white papers	• Increased awareness of HAPS and developed presence of HAPS Alliance by hosting and attending events • Educate globally by publishing White Papers, blogs, social media and more

ITU-R: International Telecommunication Union Radiocommunication Sector
FCC: Federal Communication Commission (U.S.)

FAA: Federal Aviation Administration (U.S.)
EASA: European Union Aviation Safety Agency
NASA: National Aeronautics and Space Administration (U.S.)
JARUS: Joint Authorities for Rulemaking on Unmanned Systems

HAPS D2D Communications

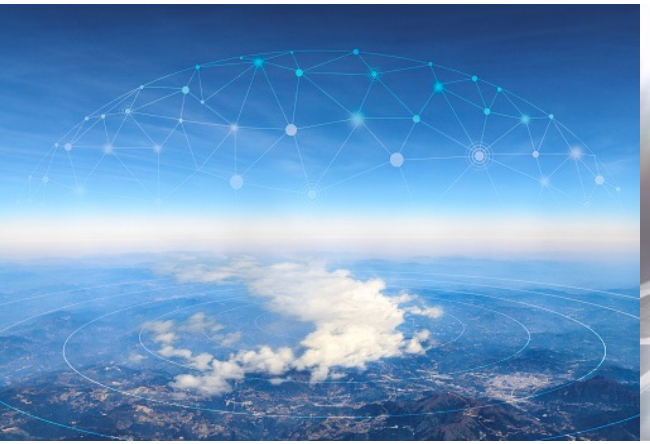
Each communication layer has its own connectivity value proposition and use cases.

In comparison to satellite-based direct-to-device (D2D) communications, HAPS-based solutions provide:

- Faster connection speeds with lower latency
- An “industrial strength” 4G/5G user experience
- Better indoor penetration/connectivity
- Higher network capacity

HAPS Alliance Publications (Highlights)

Creating and Enabling Regulatory Environment for HAPS Deployment



The Telecommunications WG published its first Regulatory Positions white paper, highlighting the regulatory environment for HAPS deployment.

HAPS Operation Using Attended Autonomous Fleet Systems

The Aviation WG published a white paper which explains the Collaborative Traffic Management for the Stratosphere as an operational end-state that enables safe and scalable operations of HAPS.

Guidelines for Payload Operation in the Stratosphere

The Telecommunications WG published white paper that provides integration and environmental guidelines for potential payload providers to consider when developing a payload for operation on a flight vehicle in the stratosphere.

Driving the Potential of the Stratosphere

The Marketing & Communications WG published a white paper which highlights the stratosphere's potential to offer greater connectivity and support a wide range of applications.

Visit: https://hapsalliance.org/publications/

HAPS Alliance Events

The HAPS Alliance convenes twice annually, hosting both virtual and in-person Member Meetings. In 2023, members gathered virtually in June and November in-person at Capgemini: Applied Innovation Exchange in San Francisco, California.

The HAPS Alliance actively participates in a variety of industry events throughout the calendar year, such as International Civil Aviation Organization, Mobile World Congress, World Satellite Business Week, and various other events.

Recap blog: https://hapsalliance.org/blog/haps-alliance-soars-at-mwc-2023/

HAPS Alliance Podcast

In 2023, the HAPS Alliance unveiled its own podcast series, “The Race to Near Space.” The podcast series delves into tales of adventure, innovation, and unwavering determination featuring leading entrepreneurs, technologists, and companies driving the quest for stratospheric exploration. The Alliance looks forward to continued publications in 2024.

Podcast Blog: https://hapsalliance.org/blog/exploring-the-stratosphere-alan-eustaces-record-breaking-jump/

Bringing Together Telecom, Aviation and Technology Industries

AA Access Partnership Limited
Aeroprobe Corporation
Aeropuerto de Teruel, PLATA
Aerostar
Aerovironment, Inc.
Airbus Defense and Space GmbH
Airbus US Space and Defense
Airservices Australia
Amprius Technologies, Inc.
armasuisse Science & Technology
AT&T
Auriga Aerospace Ltd
Aurora Flight Sciences
AEALTO Ltd
B2Space
Bharti Airtel Limited
BIANOR SERVICES EOOD
CACI, Inc.
Capgemini
Carleton University
Clay County Economics Development Corporation
Deutsche Telekom AG
Dhruva Space Private Limited
Digital Council Africa
EANT GmbH
Ericsson AB
ESEN, University of Manouba, Tunisia
Filtronic
Florida Atlantic University Harbor Branch Oceanographic Institute
Geoinformation Unmanned Aerial Systems Ltd 'GeinUAS'
Gilat Satellite Networks
KDDI Corporation
GMV Aerospace and Defence S.A.U.
Hacettepe University
Indonesia-ITU Concern Forum (IICF)
Intelsat US LLC
Kea Aerospace Limited
King Abdullah University of Science and Technology (KAUST)
Kratos
Kraus Hamdani Aerospace, Inc.
Liverpool Hope University
Loon LLC
Luxon Consulting Group, LLC
MEISEI ELECTRIC CO., LTD
Meteomatics
MicroLink Devices
MSB Technologies
Mynaric AG
NAL Research Group
National Institute of Information and Communications Technology
NEAR SPACE CORPORATION
Near Space Labs
Newspace Research and Technologies Pvt Ltd
Nokia Solutions and Networks Japan G.K.
Northern Territory Government of Australia
NTT DOCOMO, INC
Orbit Communications
picoNETS
Prismatic Limited
Radical
Radisys
San Jose University Research Foundation
Sceye Inc.
SKY Perfect JSAT Corporation

*Information current as of December 2023 and may be subject to change. For full list of active members, visit: https://hapsalliance.org/our-members/

Bringing Together Telecom, Aviation and Technology Industries (Cont.)

SoftBank

Space Data Corporation

Strasa Technologies

Stratocom

Stratodynamics Aviation Inc.

Stratolia

Stratospheric Platforms Limited

STRATOSYST s.r.o.

Stratotegic Inc

Swift Engineering

TAO Trans Atmospheric Operations GmbH

Technology Park of Fuerteventura

Telecommunications Management Group, Inc

Telefonica Investigacion Y Desarrollo S.A.U.

The MITRE Corporation

The Regents of New Mexico State University

The WX Company

TJ Innovation

Tonomus

TURKCELL ILETISIM HIZMETLERI A.S.

UAVOS Inc.

Ulak Haberlesme AS

University of Applied Sciences and Arts Northwestern Switzerland

University of Washington

University of York

World Food Porgramme

World Mobile Group, Ltd

*Information current as of December 2023 and may be subject to change. For full list of active members, visit: https://hapsalliance.org/our-members/

HAPS Alliance Member Achievements

Through innovative technologies and collaborative efforts, HAPS Alliance members have achieved groundbreaking milestones across a spectrum of industries and applications.

For a deeper dive into these achievements, please visit https://bit.ly/46tfUbT or scan the QR code below!

HAPS Alliance Membership Offers

Principal Member
$25,000 / per year

Same as General Member, plus:

- Eligible to be elected to Executive Board*
- Voting rights for Alliance documents (Executive Board members)
- May chair working groups and committees
- May propose new work items
- May participate and vote in working groups and committees

*Additional $10,000 annual Director Fee if elected to the Executive Board

General Member
$1,000 - $10,000 / per year

- May participate and vote in working groups
- May attend committee meetings as an observer, where applicable
- Invited to attend virtual and face-to-face events
- Access to work products in process
- Early access to published work products
- May participate in co-marketing opportunities
- Will receive member mailings and announcements
- Company logo & link on HAPS Alliance public website
- Dedicated Member Spotlight blog posts
- Promotion of member company media coverage, speaking engagements, and news

*Fee varies based on company size (# of employees)

Supporter Member
$0 / per year

- Participate in select co-marketing opportunities
- Receive member mailings and announcements
- Have your company name listed on the HAPS Alliance public website
- Become an informed member of the HAPS Alliance community
- Access to select member meeting sessions and events
- Early access/discounts to published work products

Join Now/More Info

https://hapsalliance.org/membership/

Thank You!