

Stratospheric Telecommunications Platform HAPS

Representative Director & CTO, SoftBank Corp.

President and CEO, HAPSMobile Inc.

Junichi Miyakawa





We take a lot for granted in our daily lives



We take schools for granted



We take play for granted



We take hospitals for granted



We take access to information for granted



We take connecting with people for granted

We take all
these things for
granted



**Some do not
have what we
take for granted**





Some lack sufficient access to education



Some children work after school



Some have difficulty getting to hospitals



Some cannot freely express themselves



Some lack Internet access and connections to others

Half the world's population has no Internet access



Number of people without Internet connectivity

3.7 billion

We want to create an environment of equal access for all, regardless of birthplace



Bring the Internet to the whole world



What the Information Revolution brings through the Internet



Education

Google

Search Google or type a URL



Gmail



Web Store



Add shortcut

What the Information Revolution brings through the Internet



What the Information Revolution brings through the Internet



Jobs

What the Information Revolution brings through the Internet



Connection



The Information Revolution brings unlimited possibilities

The background is a composite image. The top half shows a sunset over a dense forest, with golden light breaking through the clouds. The bottom half shows a solar plane with a long, thin, white wing covered in solar panels, flying over a blue sky with white clouds. The plane has several small engines mounted along the bottom of its wing.

Information Revolution — Happiness for everyone

Stratospheric Telecommunication Platform Business



HAPS MOBILE





HAPS

High **A**ltitude **P**latform **S**tation

Floating **B**ase **S**tation
in **t**he **S**tratosphere

Why the Stratosphere?



It all started with the 3.11 disaster



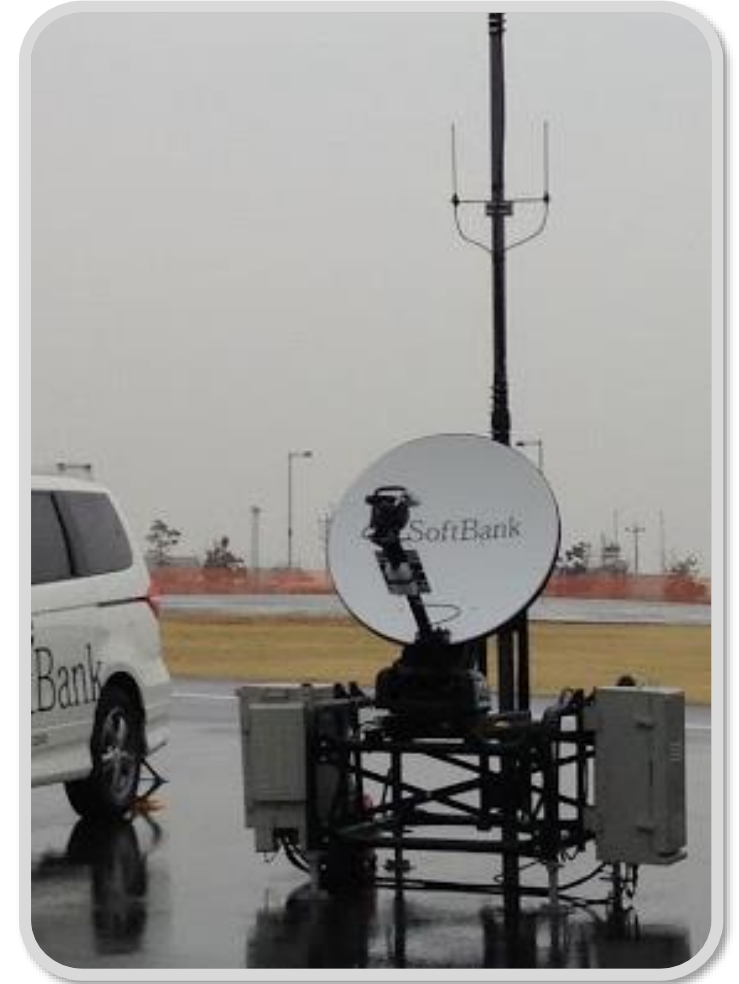
Deployed various mobile base stations



Large radio base station vehicle



Small radio base station vehicle



Portable base station

**Aimed to provide uninterrupted communication
in event of earthquakes or tsunamis**



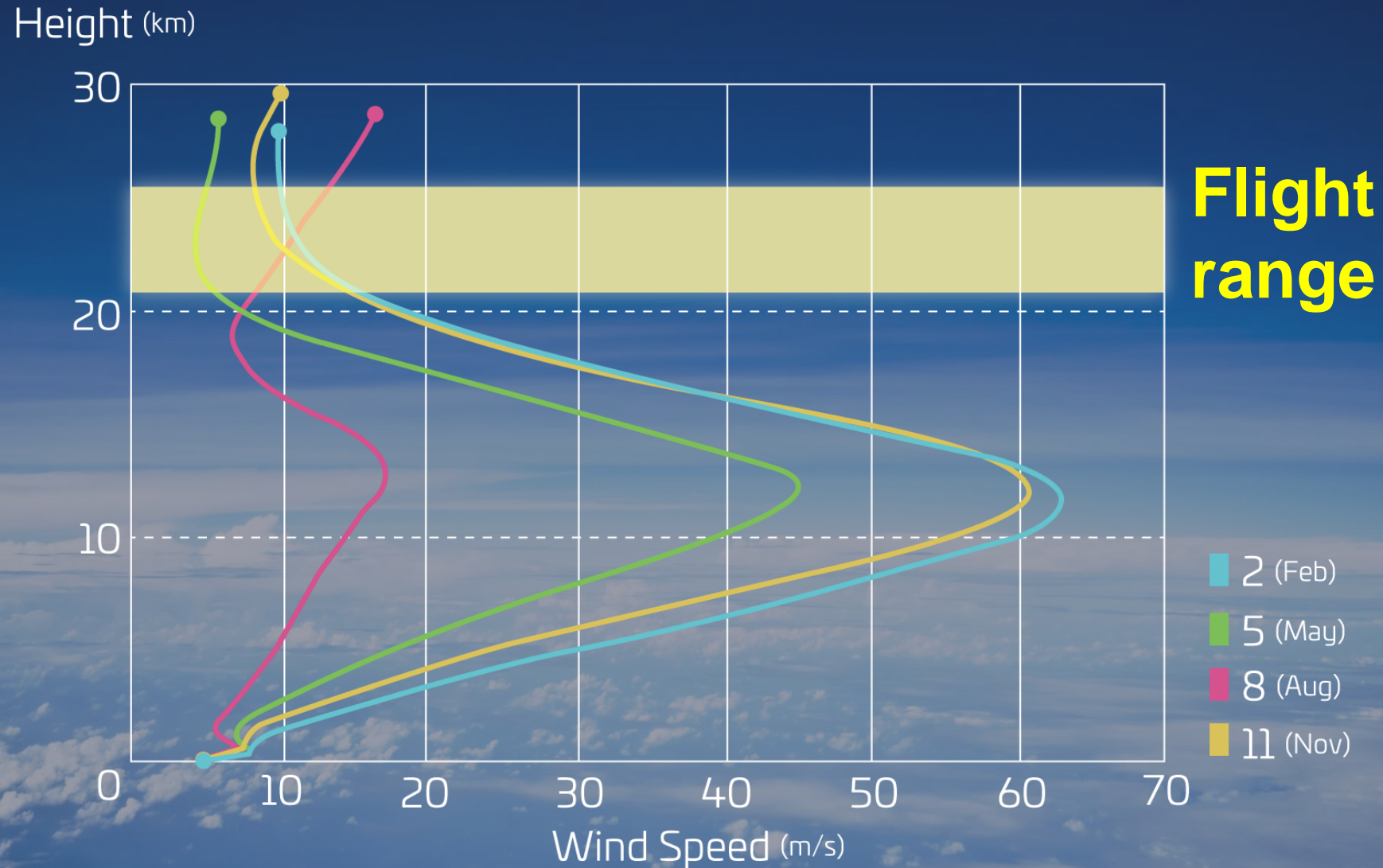
2011

**Developed a
tethered balloon
radio relay system**

So we focused on the stratosphere



Stratosphere characteristic: steady air current



What is the stratosphere?

36,000km



GEO area (outer space)

1,200km



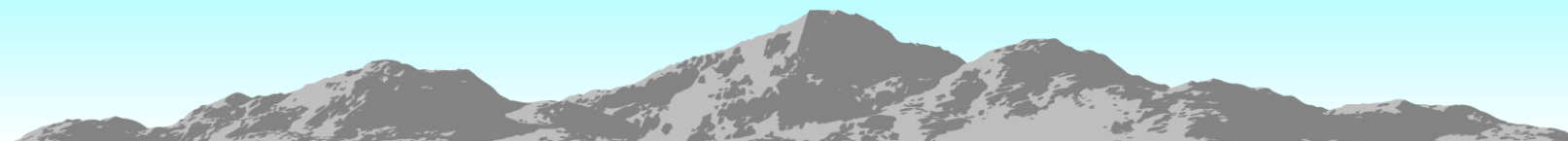
LEO area (outer atmosphere)

50km



HAPS area (stratosphere)

10km



Providing mobile Internet from the sky by utilizing the stratosphere



Uninterrupted communication in event of disaster made possible

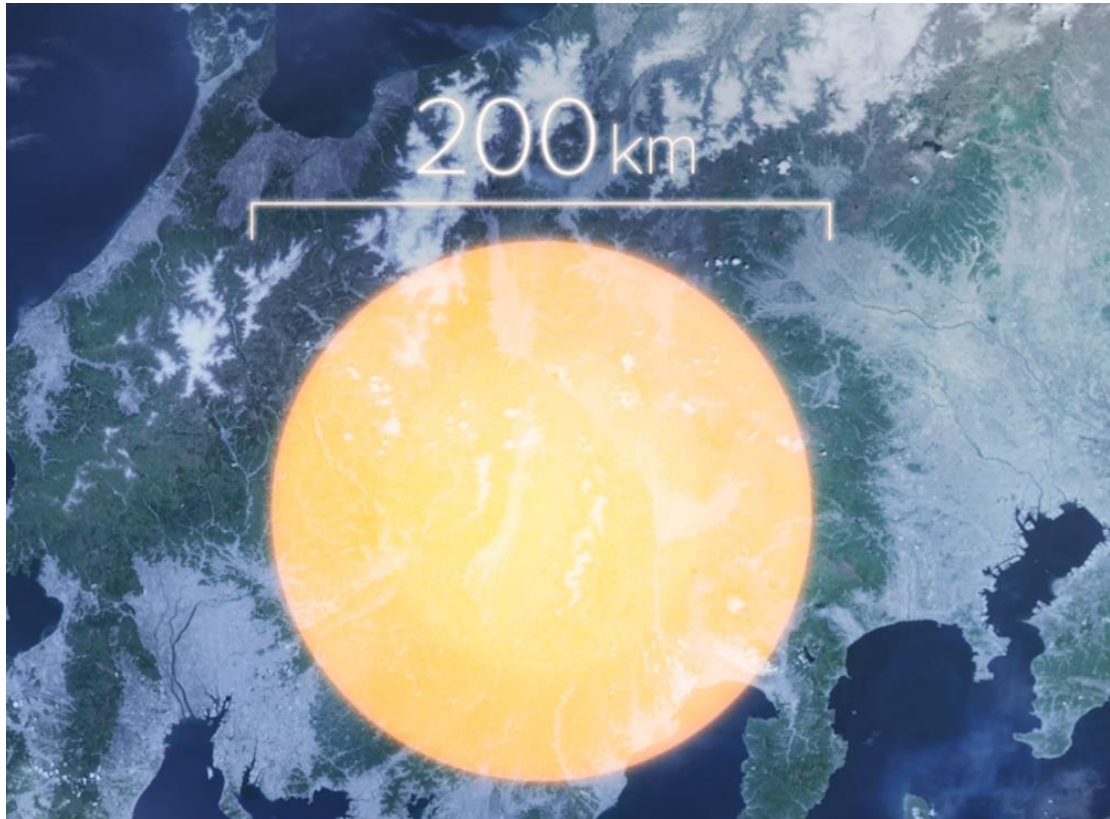


Normal times

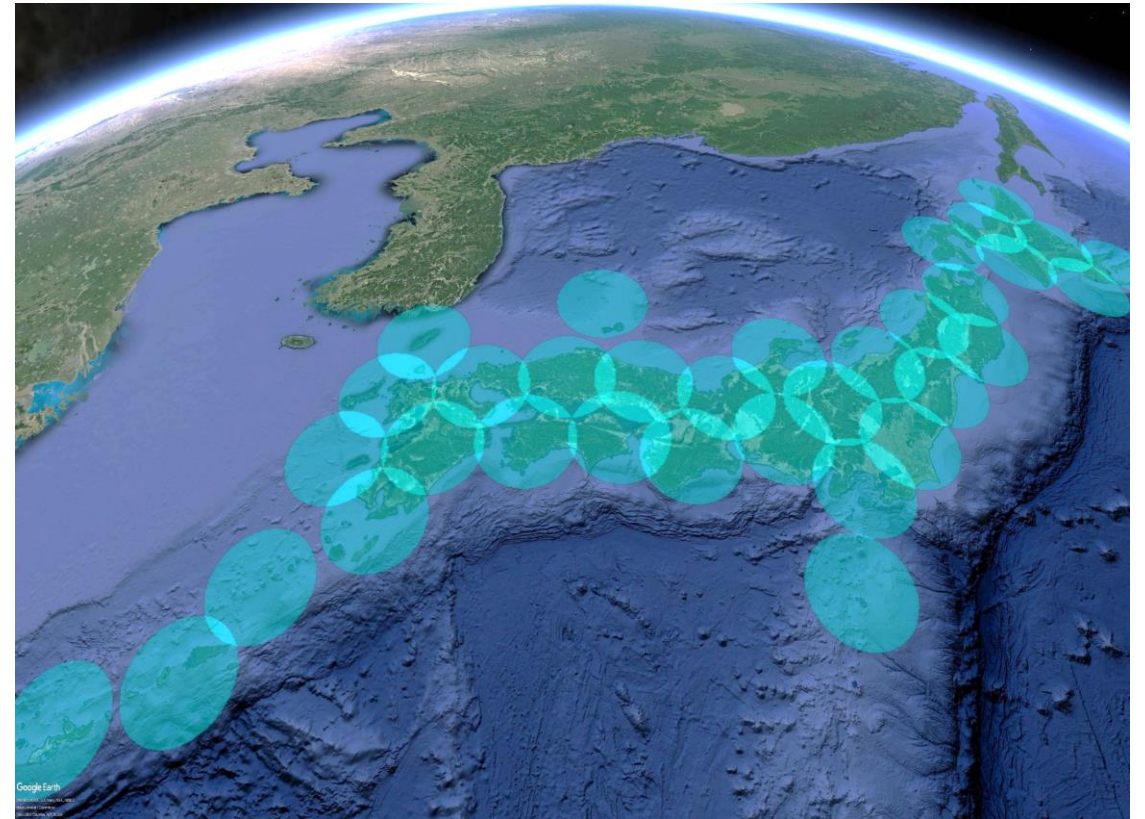


Time of disaster

Super-wide LTE/5G coverage



200km diameter
covered with 1 HAPS



Approx. 40 HAPS cover
Japanese archipelago

High operability



Ability to fly for 6 months continuously



Stationary rotation possible at any coordinate

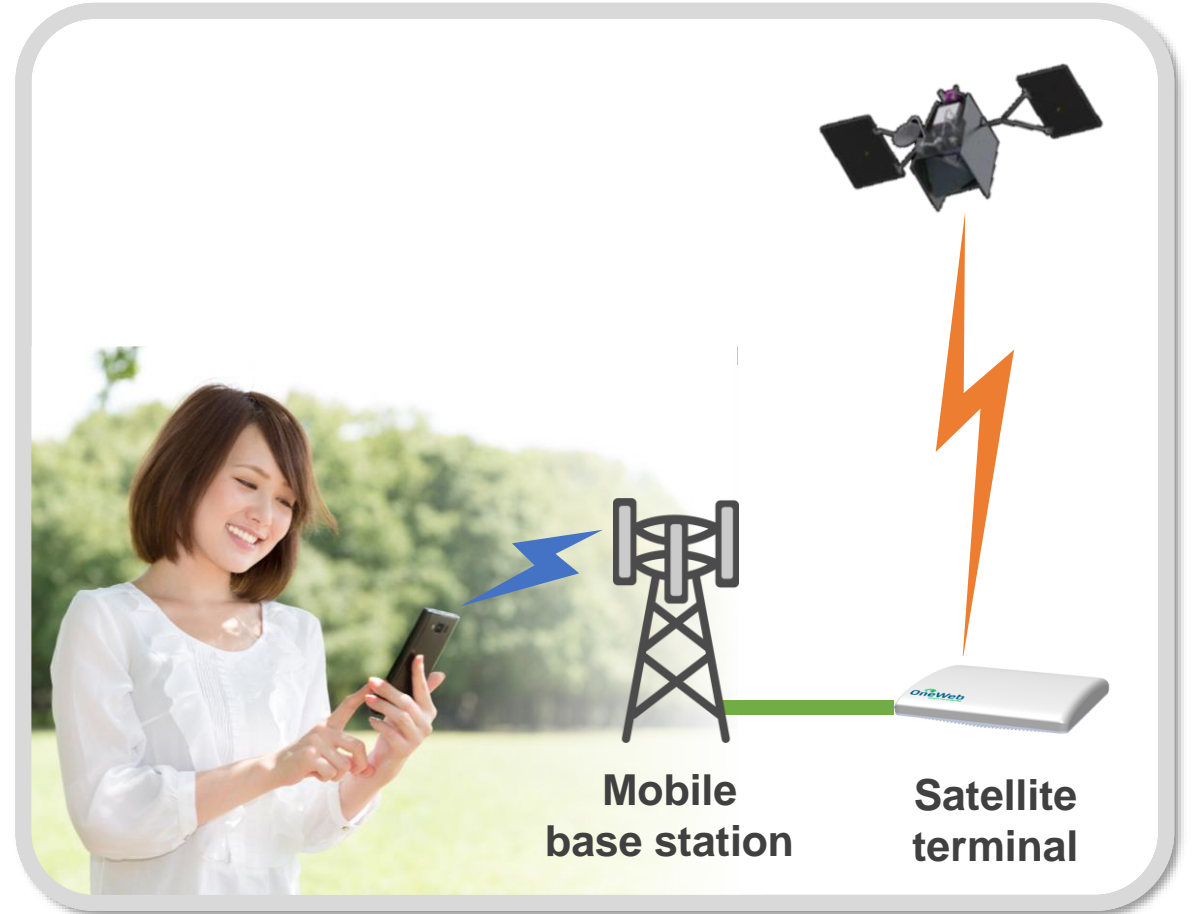
Mobile Internet can be provided for high-flying objects



Direct access possible with existing devices

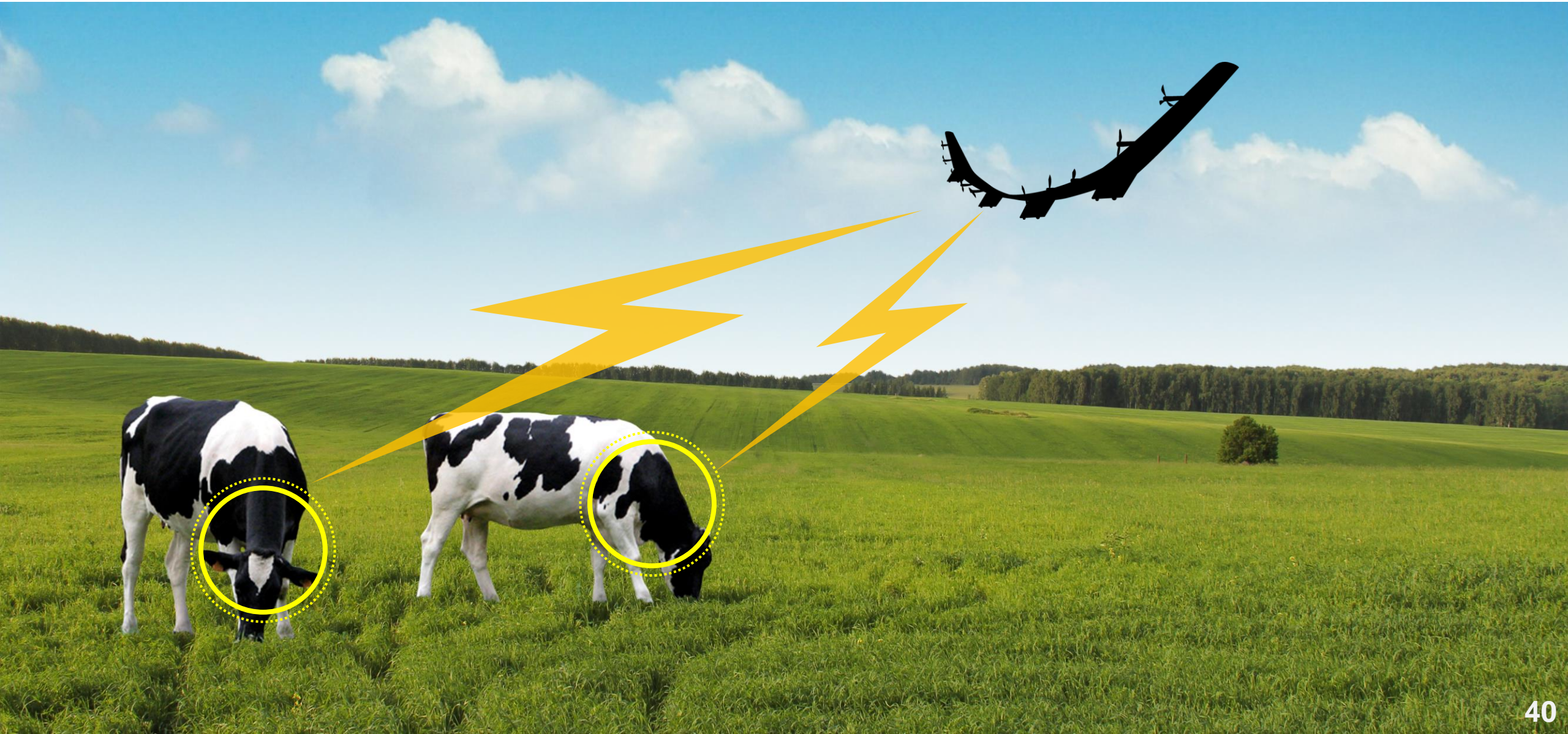


HAPS



Satellite communication

Expand mobile coverage areas



Aviation certification process

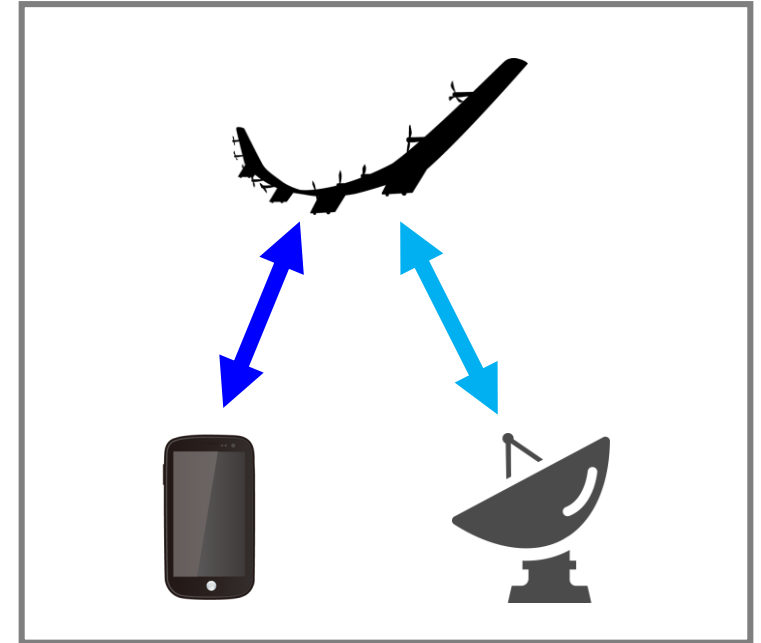
Type certificate



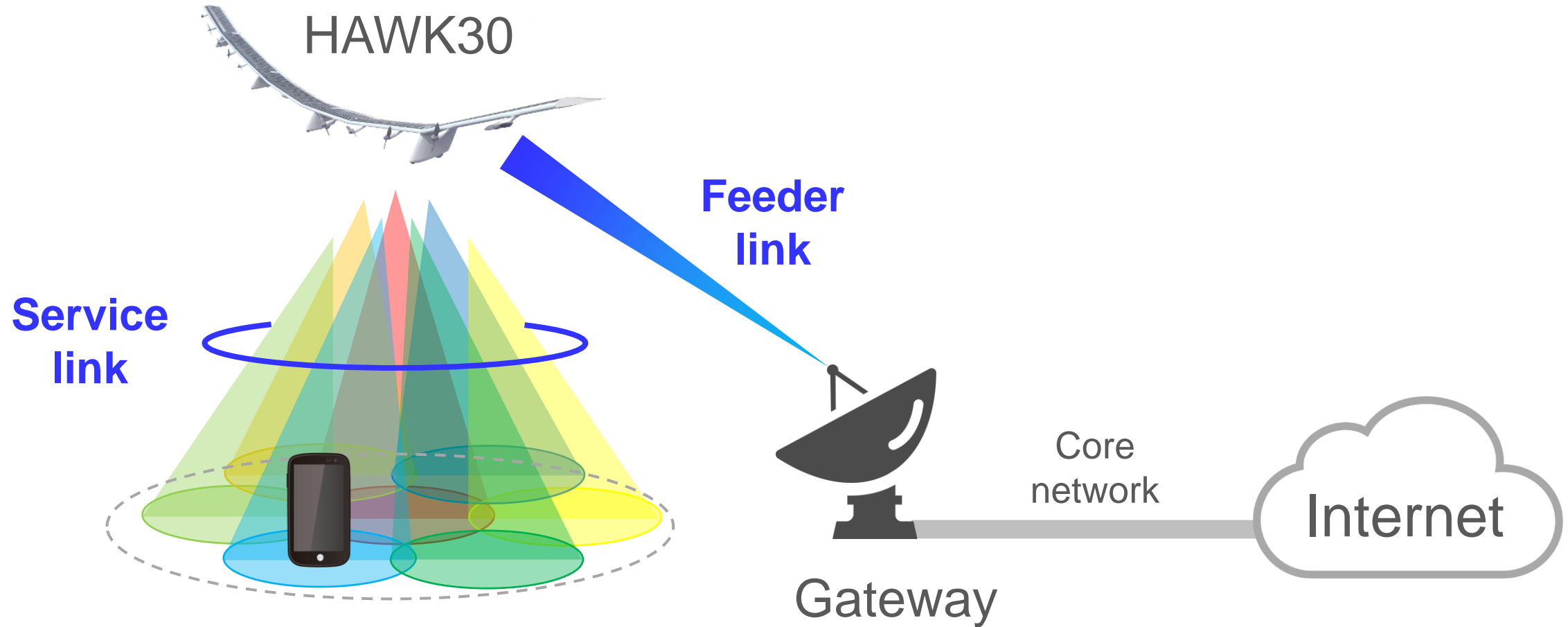
Airworthiness certificate



Spectrum



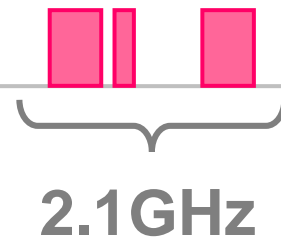
HAPS to use 2 spectrums



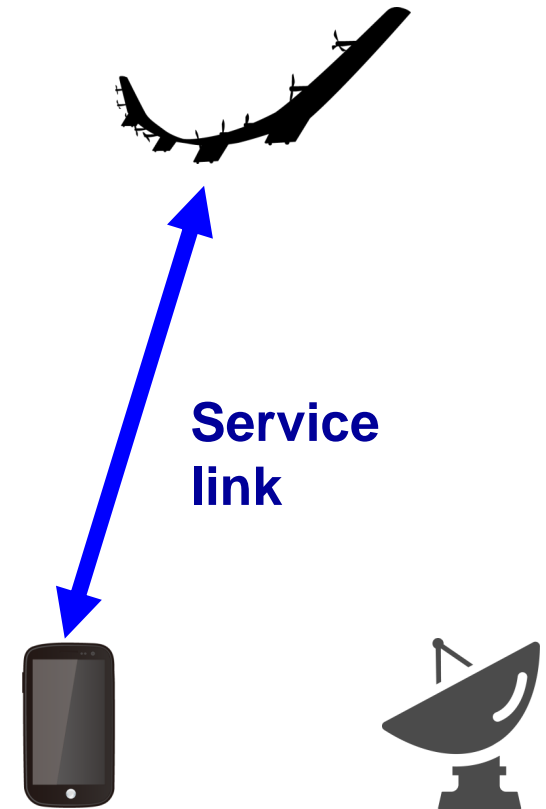
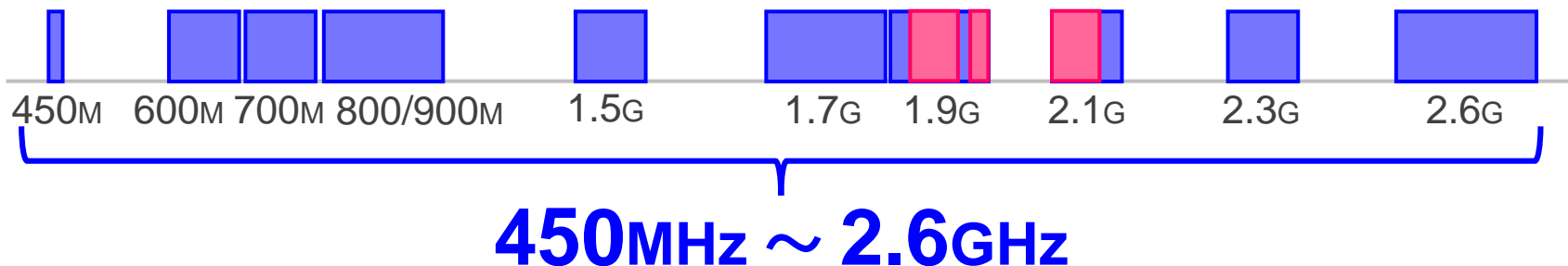
Service link standardization efforts

Until 2024

Spectrum identified in 2000

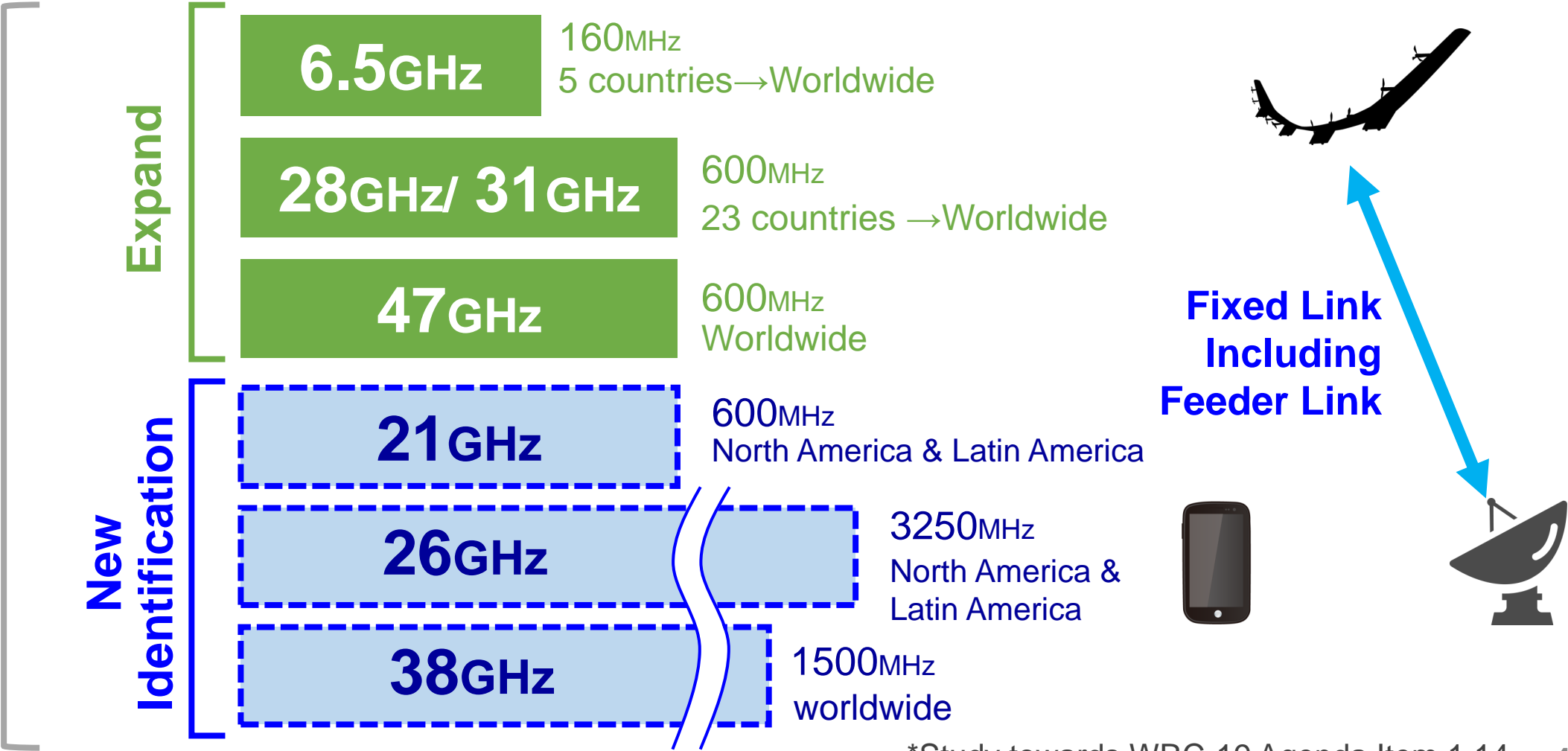


Beyond 2024 (To be identified in WRC-23)



Feeder link standardization efforts

WRC-19
Agenda Item
1.14



HAPS feeder link standardization proponents

AIRBUS

facebook

 SoftBank

+ Others

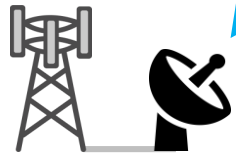


HAWK30

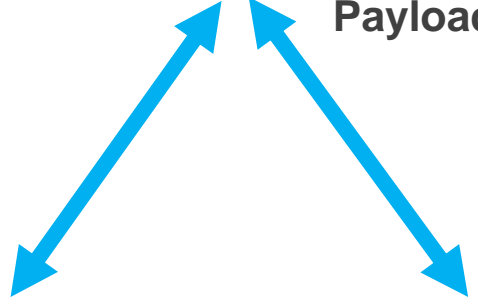


FWA
Payload

facebook



Mobile Backhaul



WiFi Backhaul

HAPSMobile has entered into a technology licensing agreement with Facebook for their advanced communication system

HAPSMobile
and
Facebook
Share the Same Vision,
**Connecting
Everyone.**

HAPS Progress in Japan

Millennium Project started in 1999

NICT



Pathfinder Plus

Success of stratospheric flight in 2002



—————● Altitude 20km (stratosphere)

Stratosphere fixed point communication flight: 4 hours
Night flight impossible due to insufficient power performance

Formula for Implementing Stratospheric Base Stations

(Required specification = altitude: above 20km, continuous flight period: 6 months)

$$W/S = (\rho C_L)^{\frac{1}{3}} \left[R(L/D) \frac{\eta_{cells} \cdot \eta_{motor} \cdot \eta_{geardrive} \cdot \eta_{propeller}}{[(1 - night) + night/\eta_{battery}] \cdot [1 + Ps]} CF \right]^{\frac{2}{3}}$$

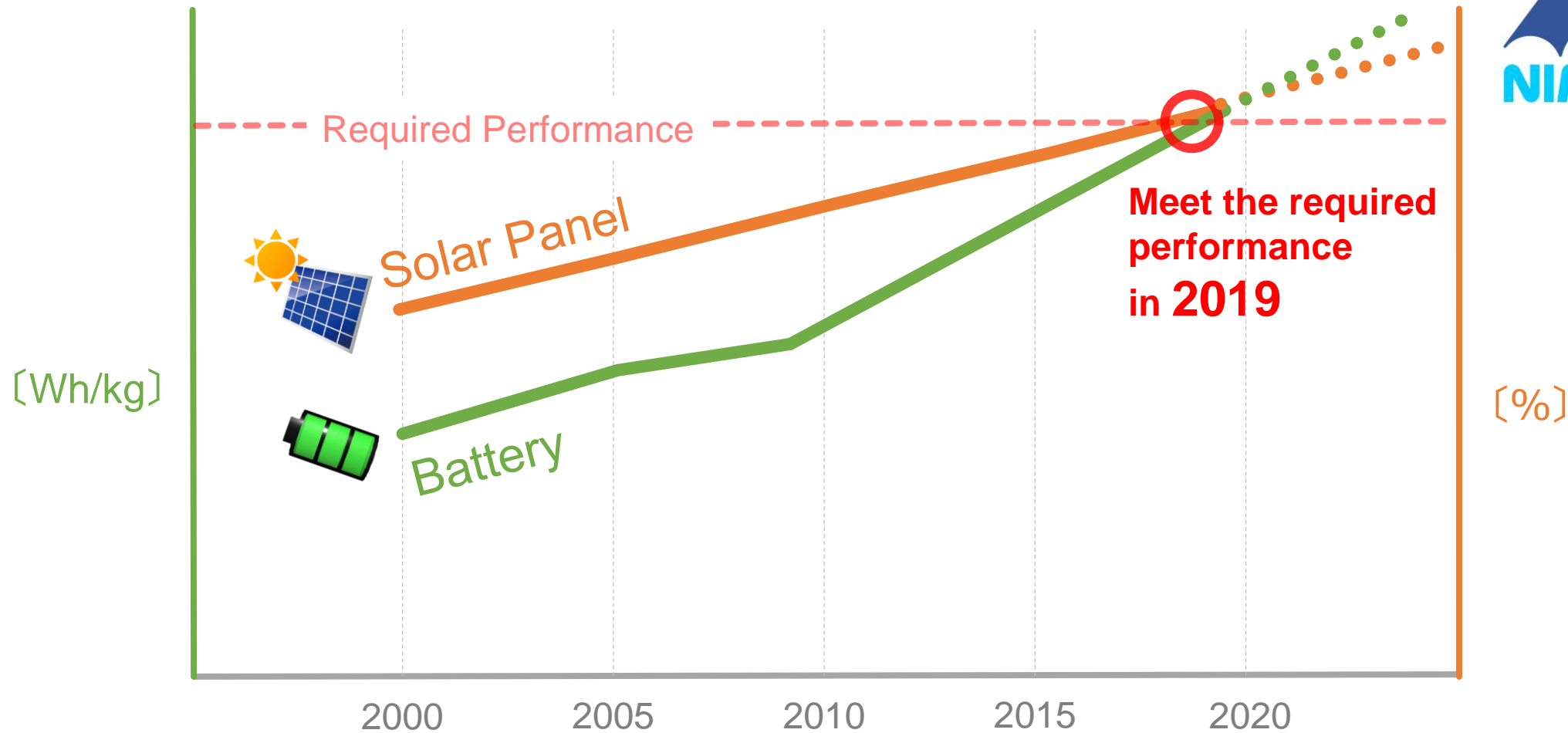


Required performance	Solar panel power efficiency	above XX%
	Battery capacity density	above XXXWh/kg

2016.10

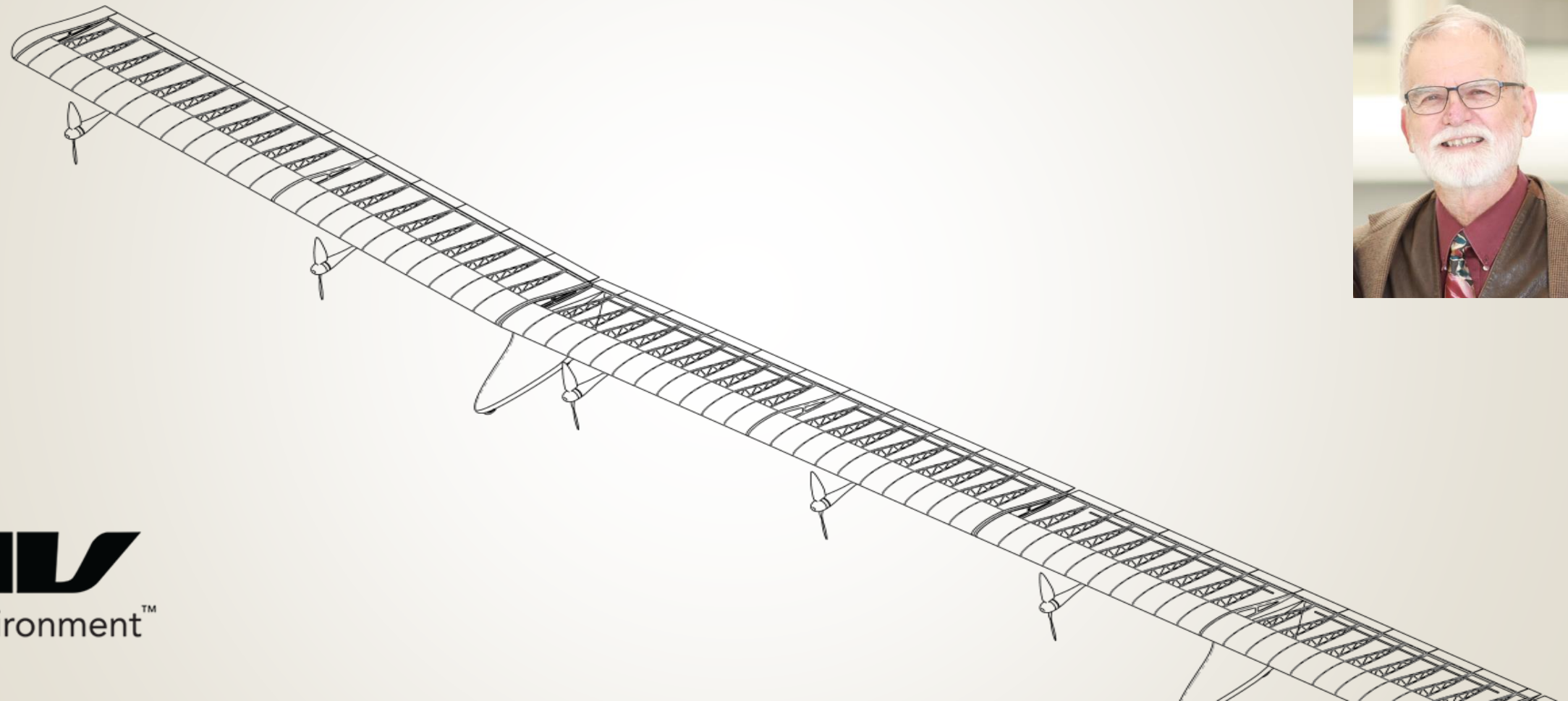
Discovered that battery and solar panel performance will catch up

Innovative Battery



2017.4

Aircraft design starts



2017.12

Stratospheric platform
business entity established



HAPS MOBILE

 SoftBank


AeroVironment™

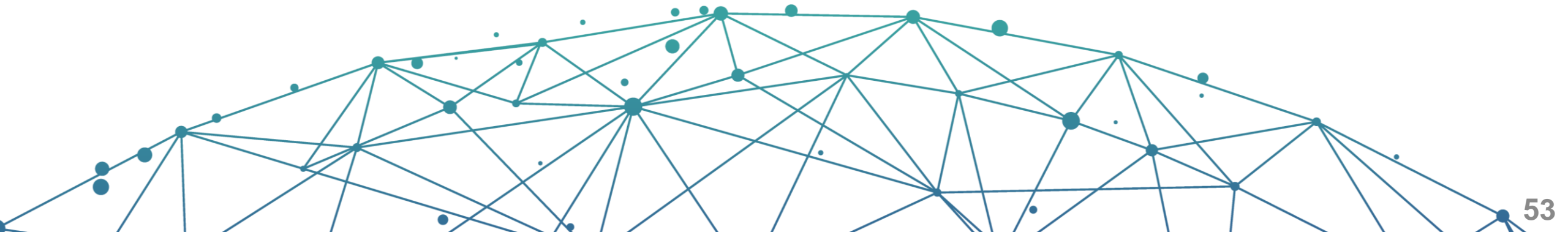
90%



10%



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Aircraft Development Partner



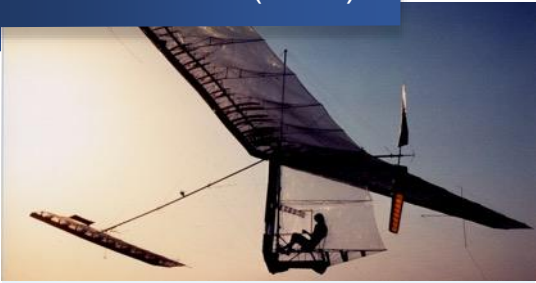
Wahid Nawabi
President & CEO



PROCEED
WITH
CERTAINTY

- ◆ **Founded**
1971
- ◆ **Head Quarters**
Simi Valley, California, United States
- ◆ **Main Business Activities**
As the largest unmanned aircraft supplier
 - Development of unmanned aircrafts & systems
 - Produce and Supply them

Gossamer Condor
Human Power (1977)



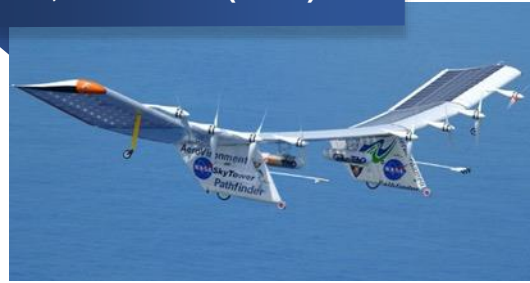
First successful human-powered airplane

Pathfinder
71,504 feet / (1997)



World's first solar-powered high altitude UAS

Pathfinder Plus
80,201 feet / (1998)



World's first 3G and HDTV connectivity from stratosphere

Helios
96,863 feet / (2001)



World's highest flying aircraft in level flight

Gossamer Condor
Human Power (1977)



First successful human-powered airplane

Pathfinder
71,504 feet / (1997)



World's first solar-powered high altitude UAS

Pathfinder Plus
80,201 feet / (1998)



World's first 3G and HDTV connectivity from stratosphere

Helios
96,863 feet / (2001)



World's highest flying aircraft in level flight

HAWK30
Next Gen HAPS (2019)



HAWK30 rollout at AeroVironment HAPS Innovation Center

 SoftBank



AV
AeroVironment™

PROCEED
WITH
CERTAINTY



HAPS MOBILE



Company Overview

Company Name

HAPSMobile Inc.

Founded

December 21, 2017

Capital

12,000,000,000 JPY

Headquarters

1-9-1 Higashi-shimbashi,
Minato-ku, Tokyo, Japan

President
and CEO

Junichi Miyakawa

Main Business
Activities

Research, development, production,
operation and management of HAPS and
network equipment



Business Concept

**Build a new
infrastructure globally**

Stratospheric Platform

HAPS



Ground Relay Station

Gateway



Create a new generation with HAPS

GEO



Altitude 36,000km

LEO



Altitude 1,200km

HAPS



Altitude 20km

動画をご覧ください

HAPSMobile's "HAPS"

Stratospheric Aircraft

HAWK30

HAWK30 completed



Front side view

HAWK30 completed



Whole view

HAWK30 Features

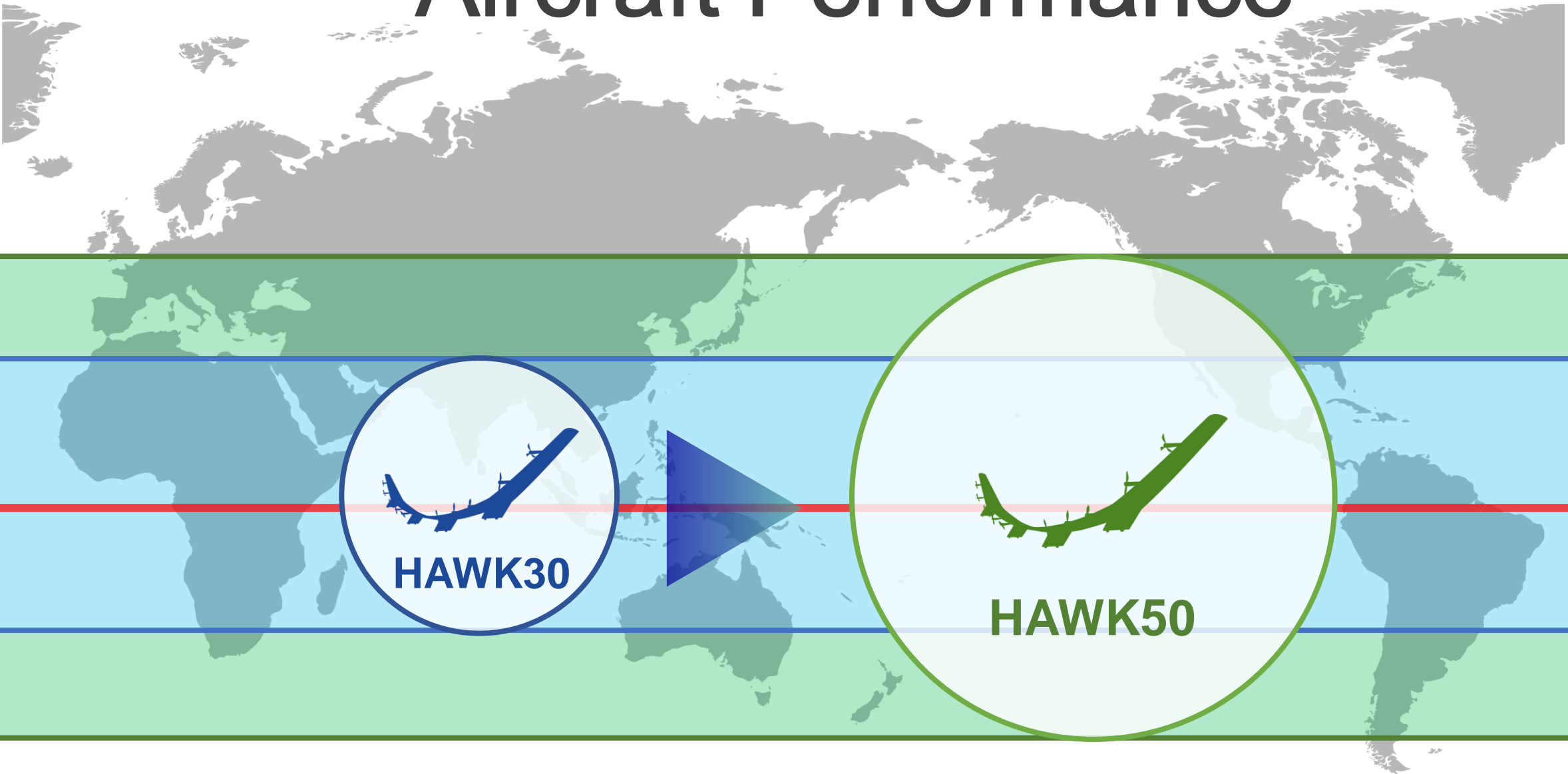


- ◆ **Low resistance:** minimizes flight energy with a tailless aircraft
- ◆ **Versatile:** large payload and large power supply are possible
- ◆ **Mass production:** simple structure uses carbon pipes (spar)

Scheduled to provide service around 2023
after flight tests and commercial production



Aircraft Performance



Deliver Internet connectivity to all people around the world



February 2019

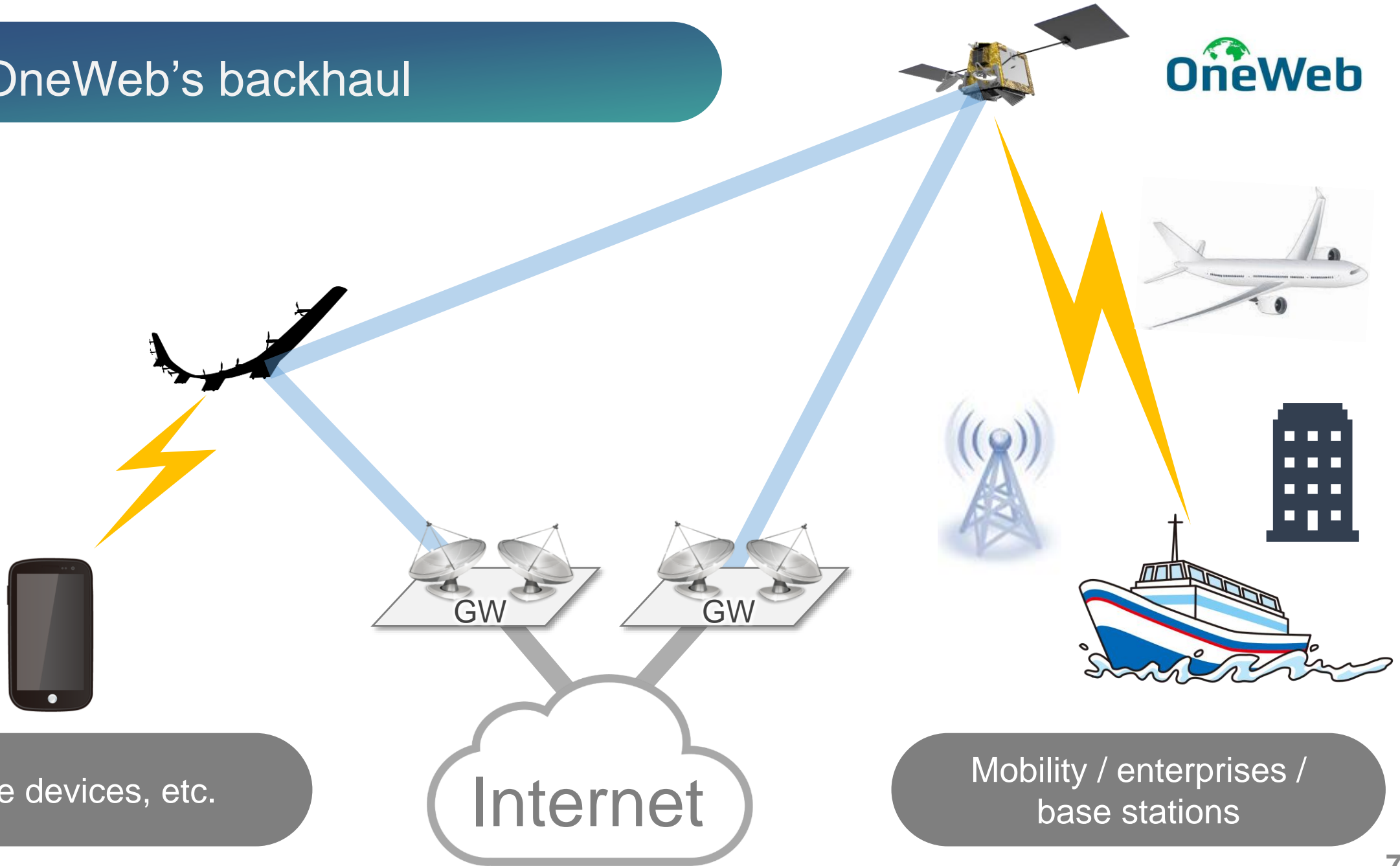


Successful satellite launch



Using OneWeb's backhaul

OneWeb

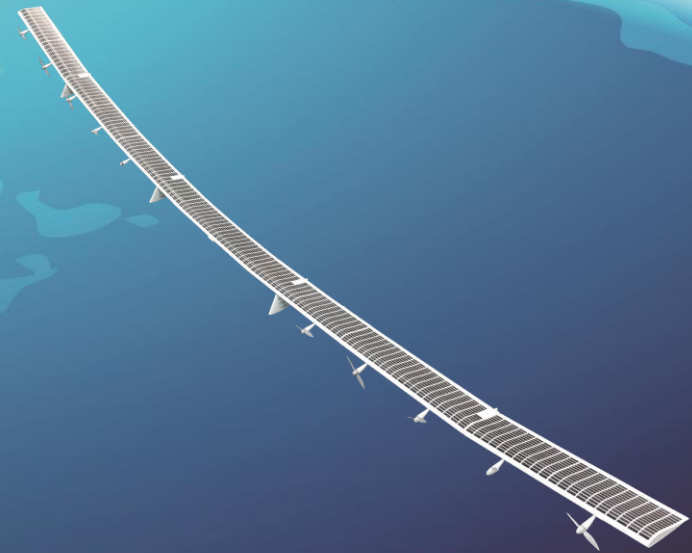


Mobile devices, etc.

Internet

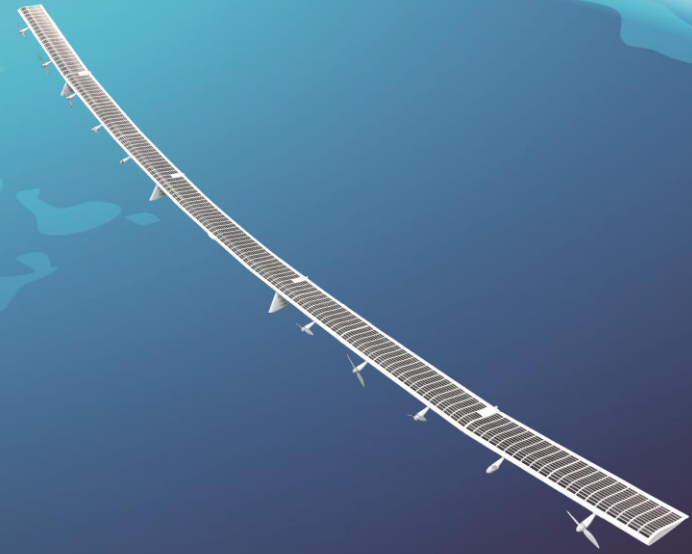
Mobility / enterprises /
base stations

Today's challenge will be
tomorrow's normal



Beyond Carrier

Beyond Japan



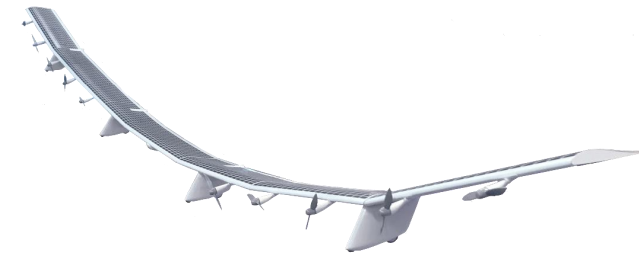
Stratospheric platformer with a common vision



Deploying HAPS service using balloons

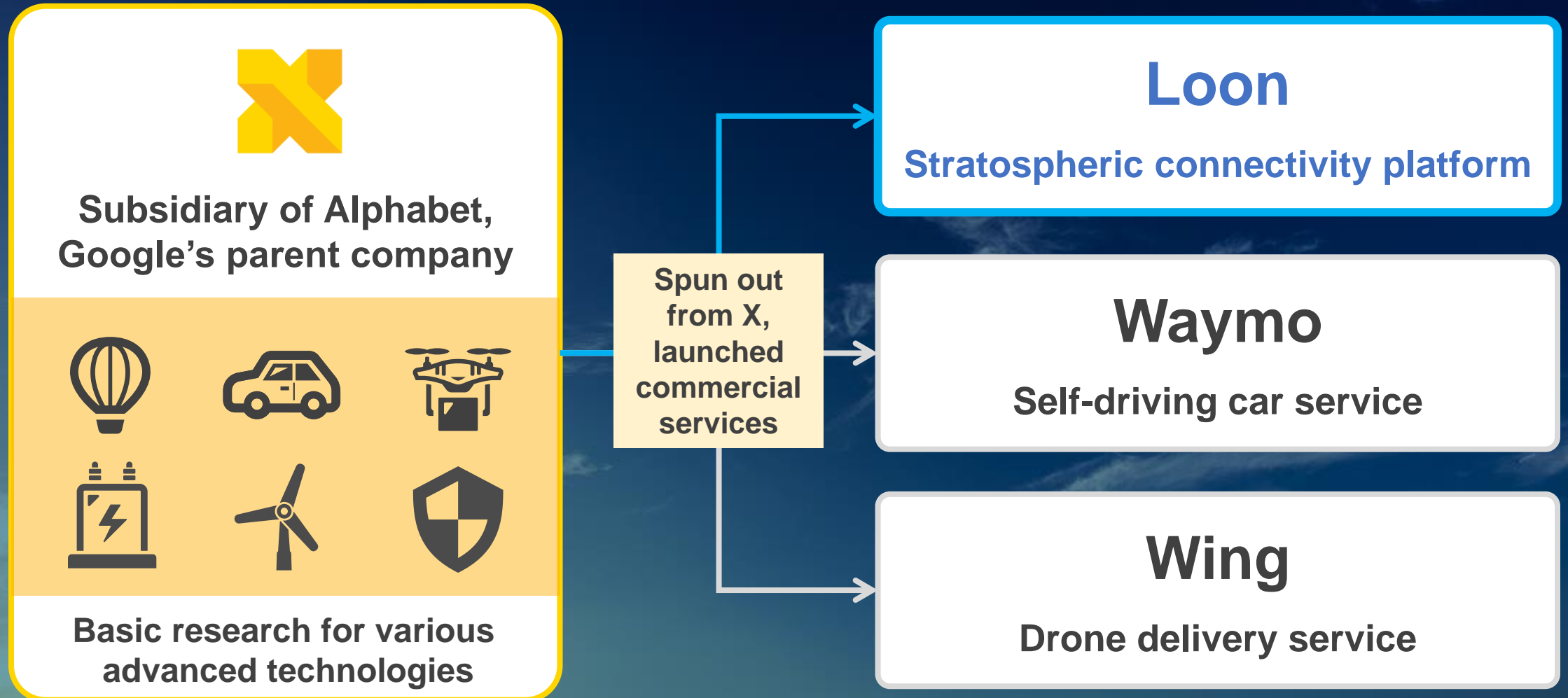


Ability to predict winds
& steering of balloon



Aircraft that can be
controlled remotely

About Loon



Strategic Relationship



LOON



HAPS MOBILE



CEO

Alastair Westgarth





Connect People Everywhere



BALLOON-POWERED CONNECTIVITY



ENGINEERED FOR THE STRATOSPHERE



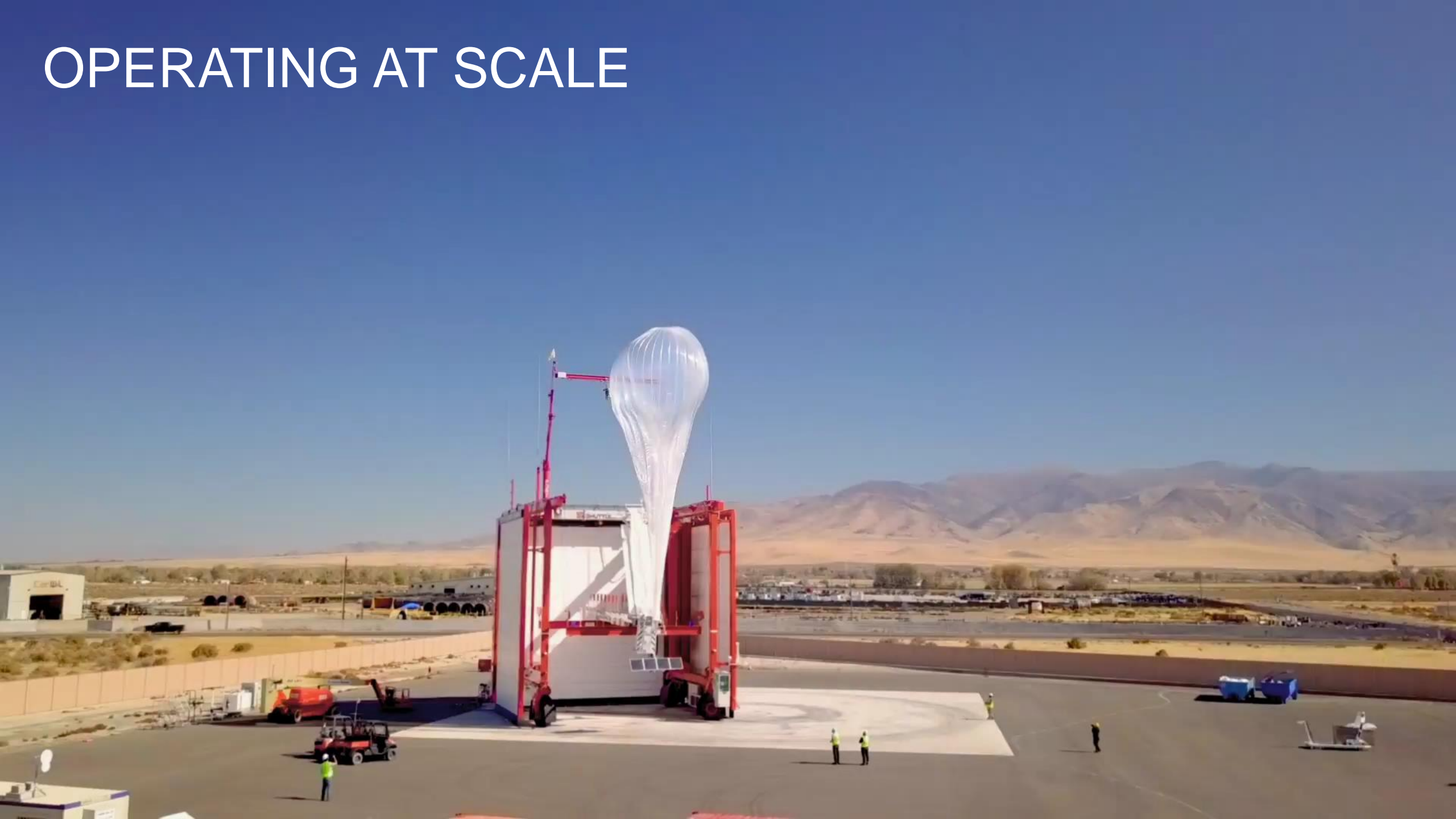
A PROVEN FLIGHT VEHICLE



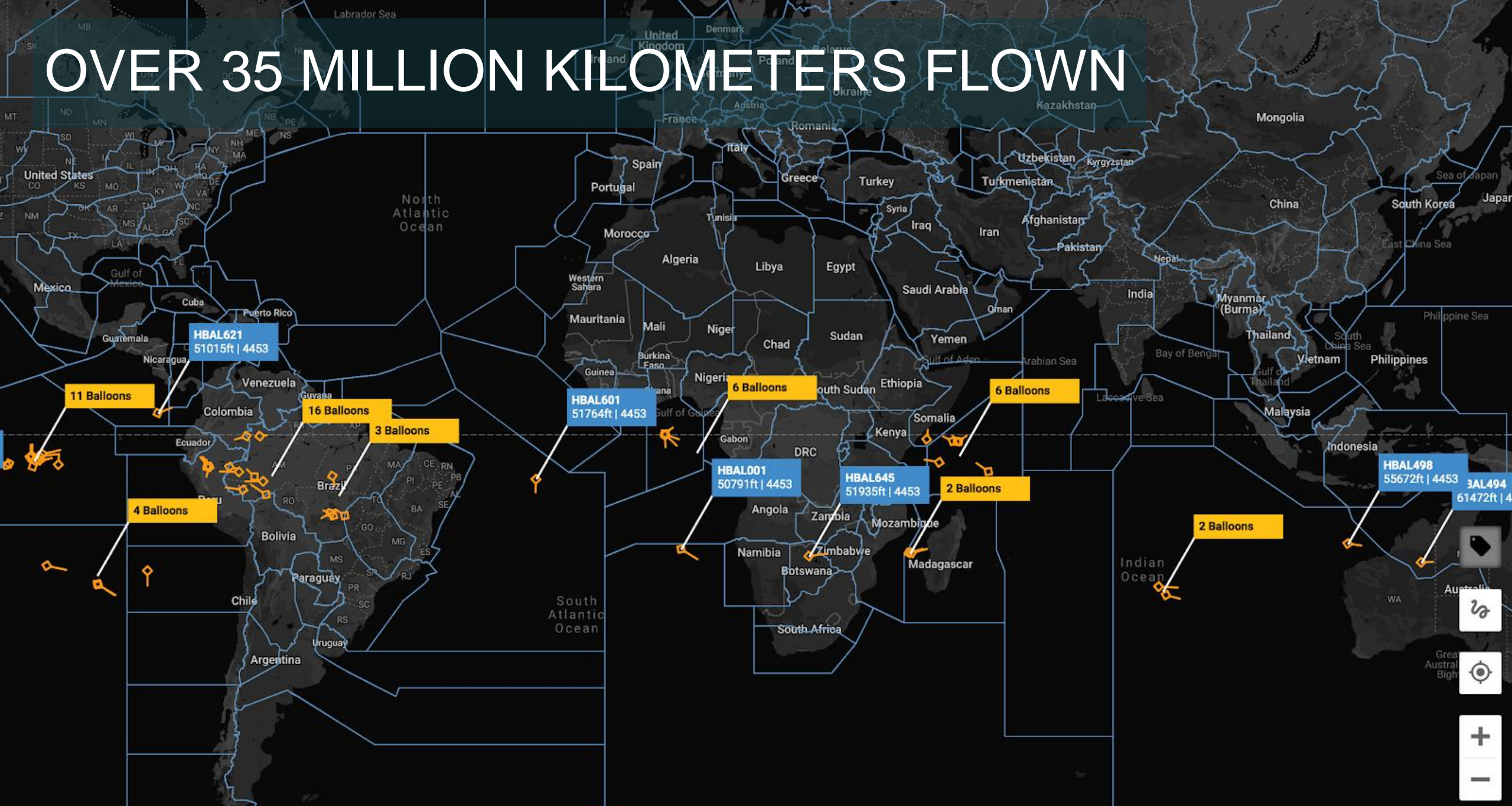
A PROVEN COMMUNICATIONS PAYLOAD



OPERATING AT SCALE



OVER 35 MILLION KILOMETERS FLOWN

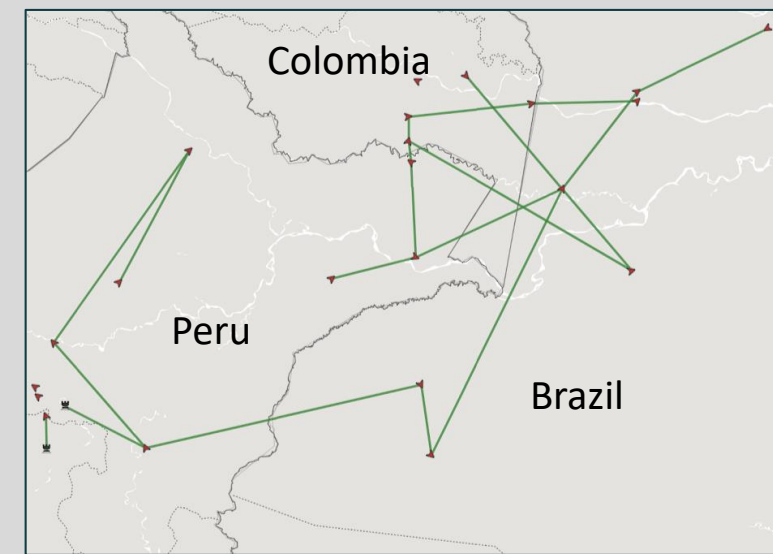
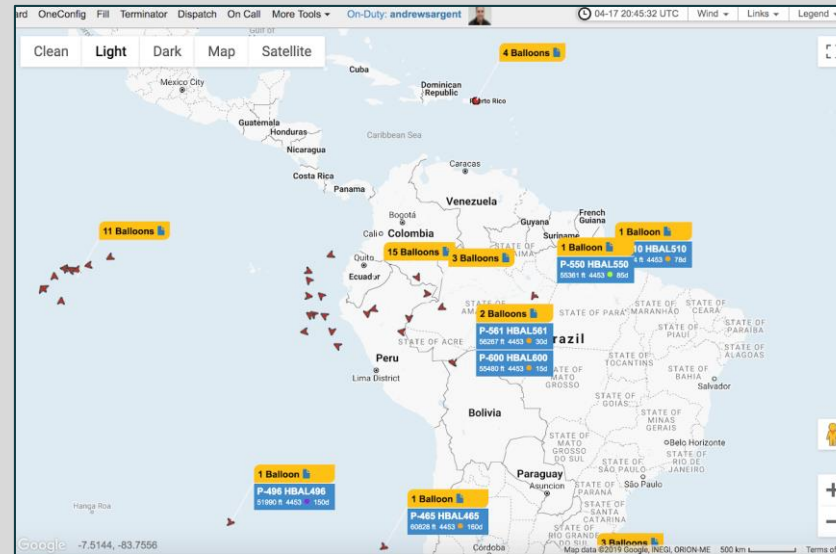
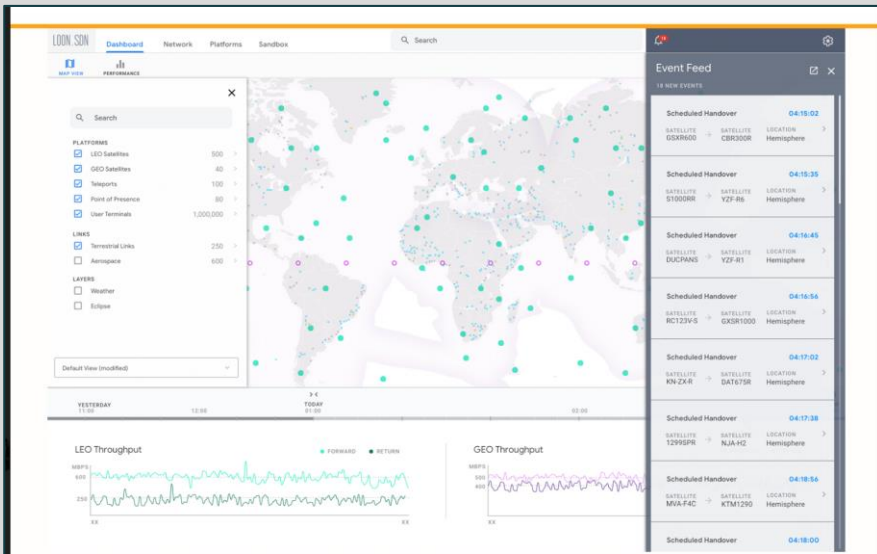


INNOVATIVE TECHNOLOGY

SOFTWARE DEFINED NETWORKING

HIGH ALTITUDE FLEET MANAGEMENT

HAPS-TO-HAPS CONNECTIONS



BUSINESS MOMENTUM

CNBC MARKETS BUSINESS INVESTING TECH POLITICS CNBC TV

TECH

Alphabet spins drone and internet balloon projects into independent companies

PUBLISHED WED, JUL 11 2018 · 9:35 AM EDT | UPDATED WED, JUL 11 2018 · 10:00 AM EDT

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Technology

Google's Loon brings internet-by-balloon to Kenya

19 July 2018

Loon's balloons float 20km above sea level

THE VERGE

Image: Alphabet

GOOGLE

LOON WILL SELL ITS NEXT-GEN NETWORKING TECH TO SATELLITE COMPANY TELESAT

Satellite company Telesat will use Loon's networking software to manage low Earth orbit constellations

By Nick Statt | @nickstatt | Jan 31, 2019, 6:00am EST

A VISION FOR THE FUTURE OF CONNECTIVITY



HAPS MOBILE



LOON™



THANK YOU



Strategic Relationship



LOON



HAPS MOBILE

Strategic Capital Relationship HAPS to invest in Loon (\$125M)

*Loon retains a right to invest at the same amount



Why are competitors joining hands?

Using the stratosphere = major challenge



Working towards the same goal



And to spread stratospheric telecommunications even faster and wider to more people around the world...



Potential Technical/Business Collaboration

Wholesale business



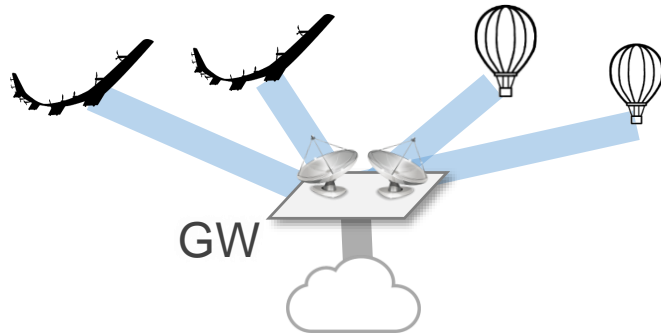
Payload joint development



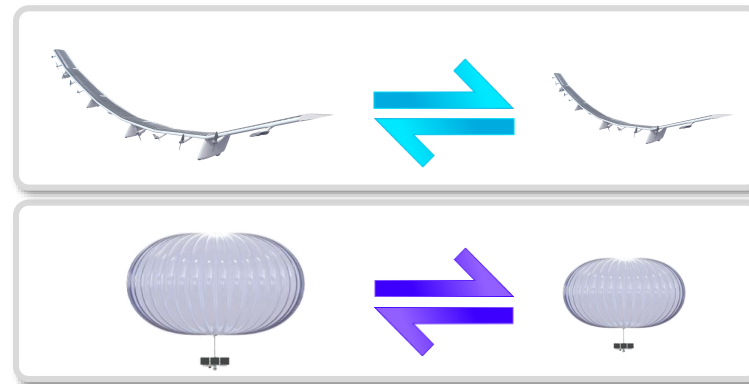
Optimization of fleet management system



Integration of gateway services



HAPS to HAPS interconnection



Create HAPS alliance



Wholesale Business

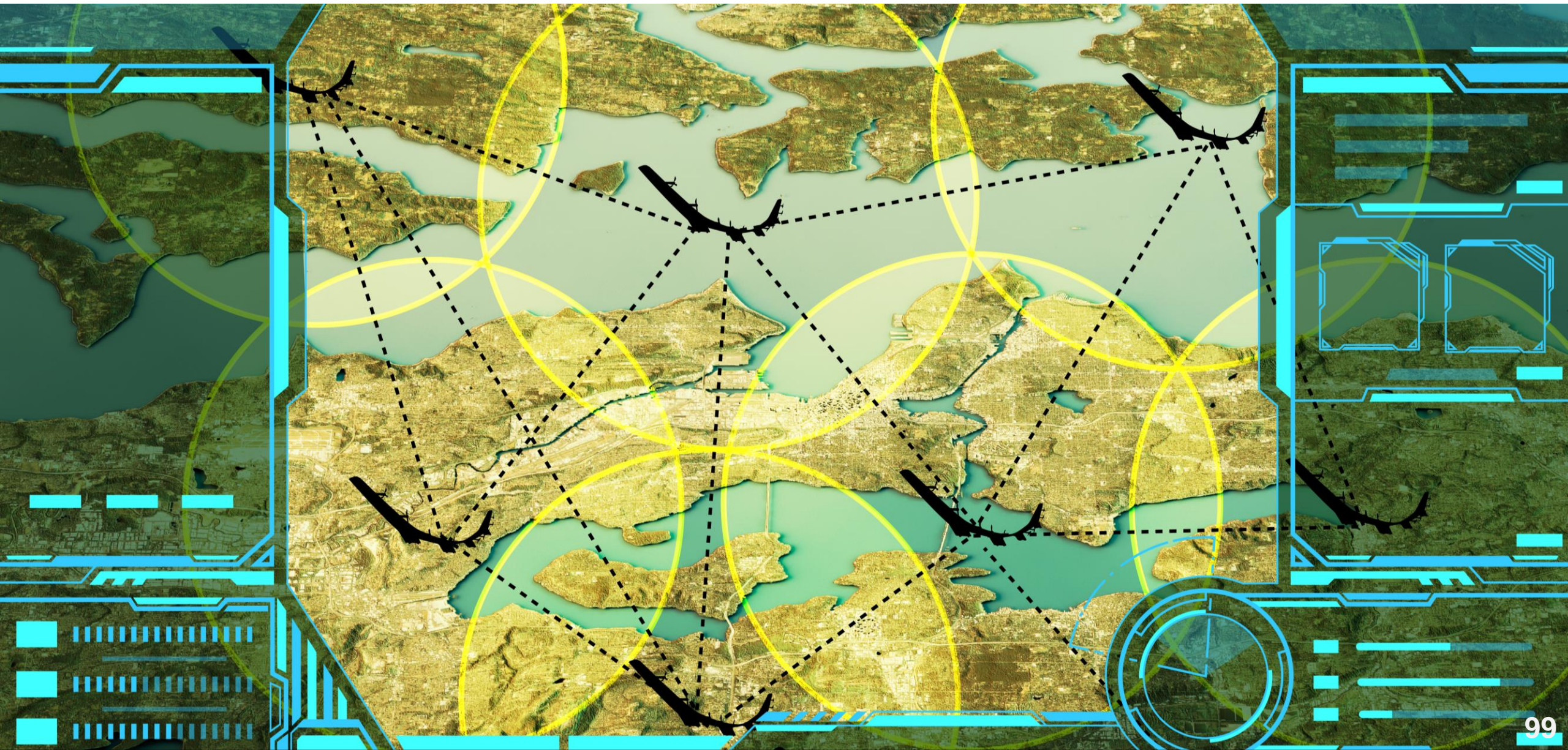


Payload Joint Development



Joint development of payload adaptable to multiple flight vehicles and ITU compliant frequency bands

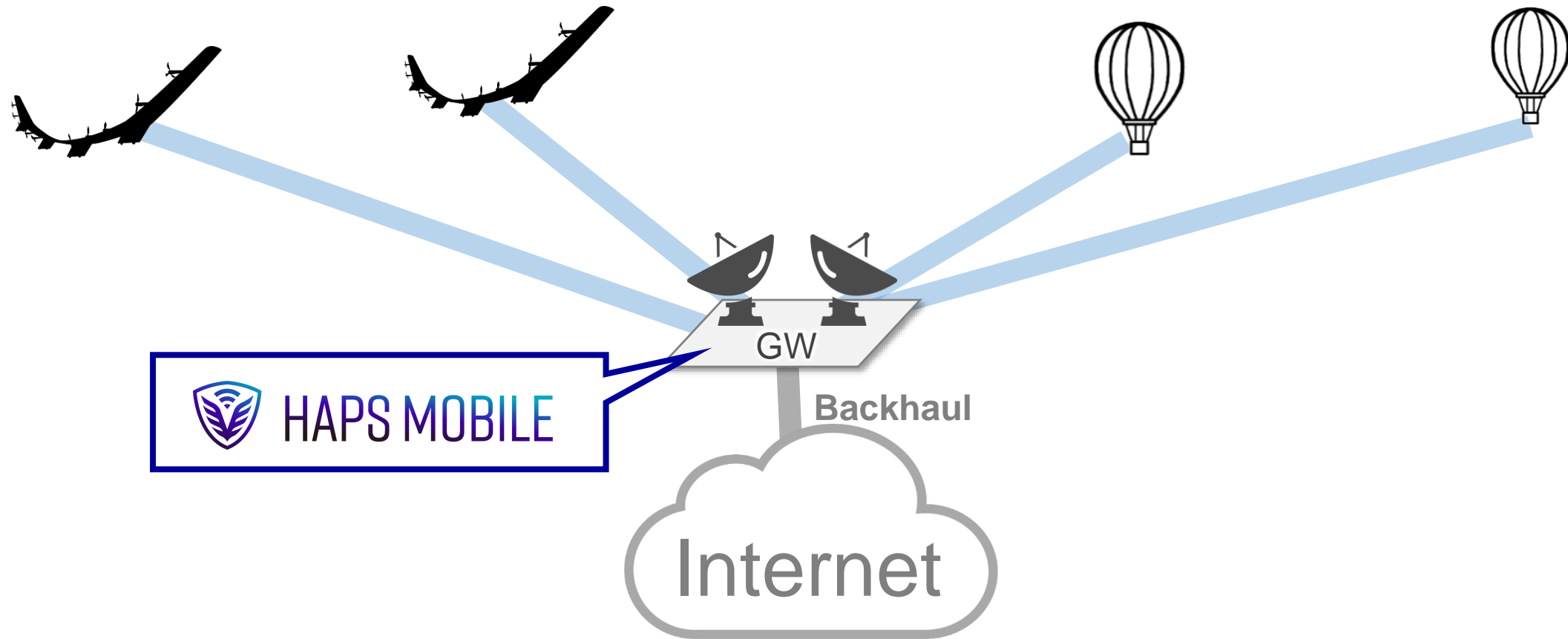
Optimization of Fleet Management System



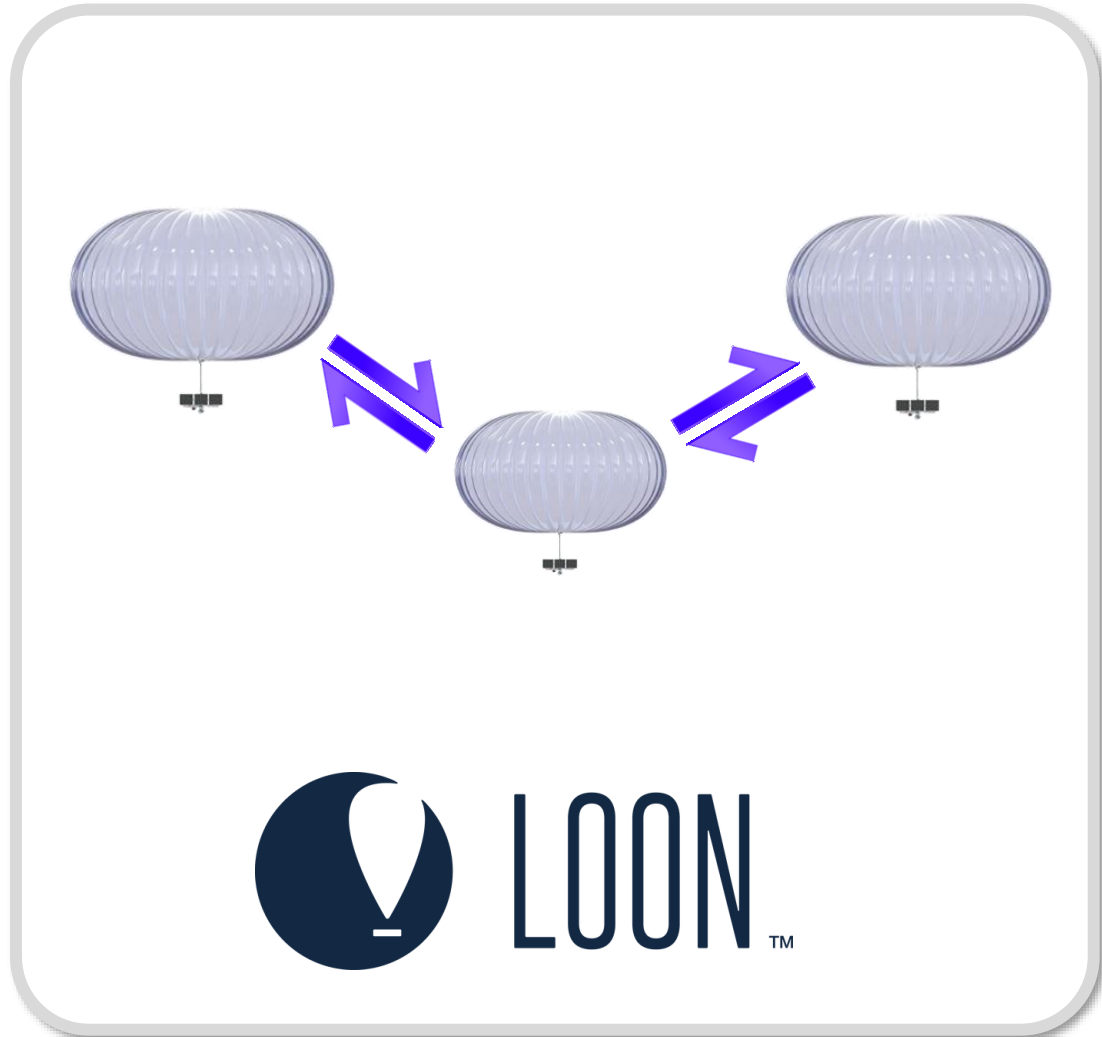
Integration of Gateway Services

From 2023
HAPSMobile

From 2019
LOON



H2H – HAPS to HAPS Interconnection –



Create HAPS alliance



HAPS Alliance

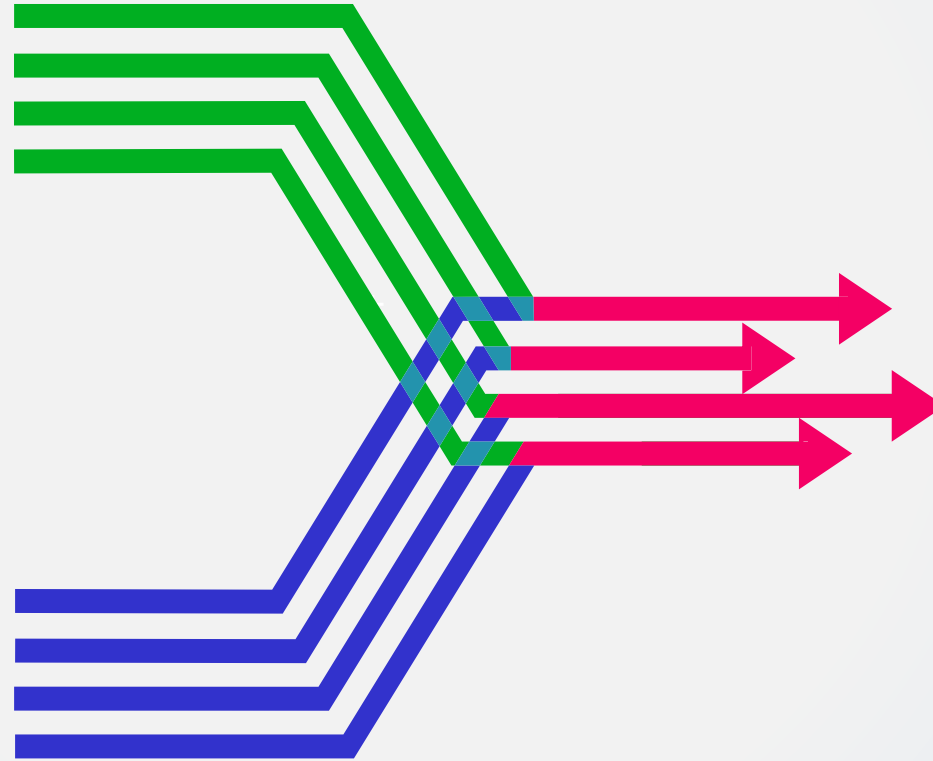


HAPS MOBILE

Alphabet



SoftBank



Smile for All

A night sky with the Milky Way galaxy visible over a body of water. The sky is dark with many stars, and the Milky Way is a bright, hazy band of light stretching across the sky. The water in the foreground is dark and reflects the light from the sky. The horizon is visible in the distance, with some faint lights on the right side.

Revolutionize the world's mobile networks