5G Evolution and 6G

− HAPS, metasurface lens and pinching antenna −

NTT DOCOMO, INC.

Progressing toward 5G Evolution and 6G

DOCOMO's White Paper

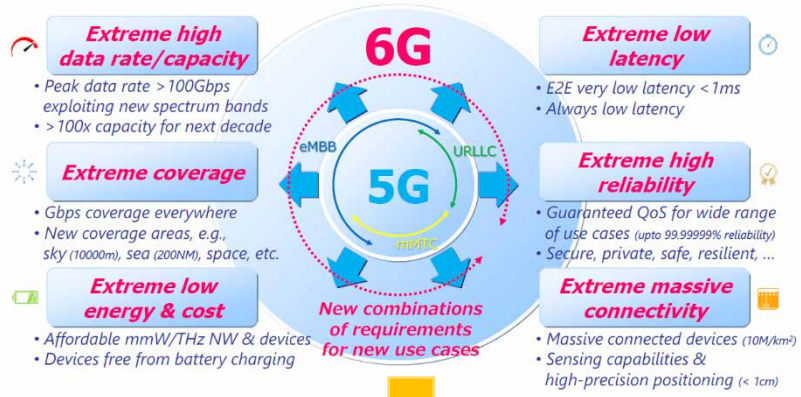
- 6G outlook
- Technical requirements
- R&D targets

Core R&D Initiatives

Improved coverage
- Metasurface lens
- Pinching antenna

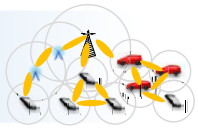
Extreme coverage
- High-altitude platform station (HAPS) systems

6G Requirements



Technology Developments

New radio network topology deployment in space



Coverage-extension technology including non-terrestrial networks

Extension of ultra-reliable and low latency communications (URLLC) and industrial networks

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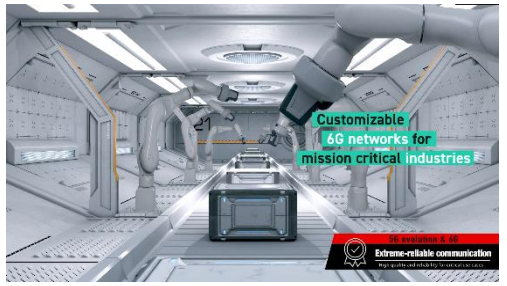
6G simulator

Line-shaped pinched antenna

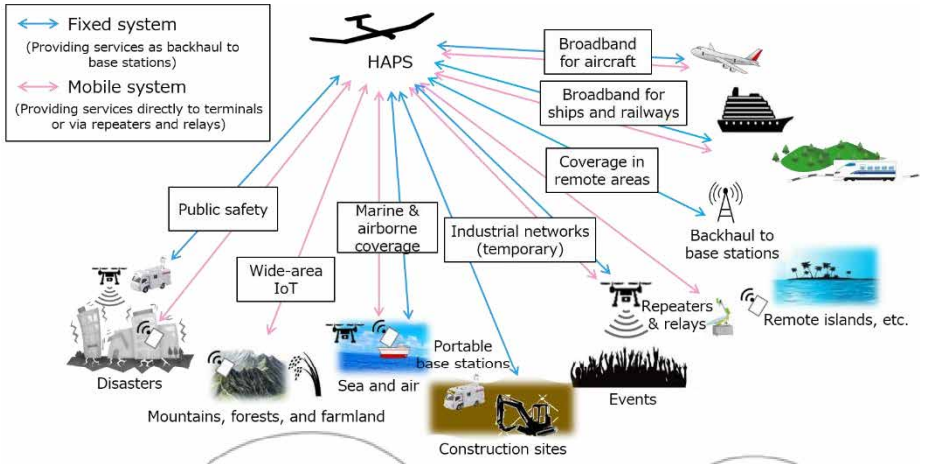
Current Deployments



Non-terrestrial Network using HAPS

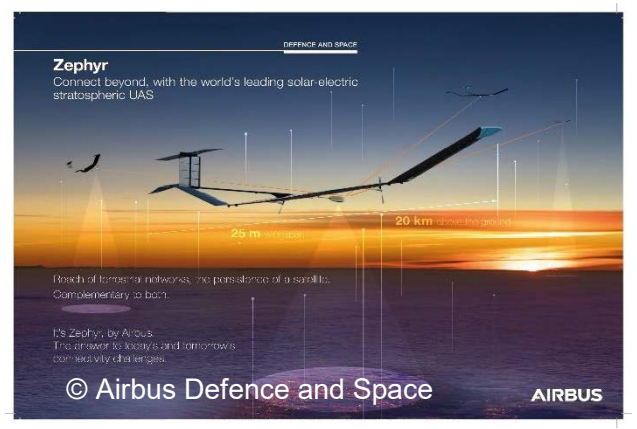
Non-terrestrial network (NTN) technology

Satellites and high-altitude platform station (HAPS) systems for coverage in mountainous, remote, marine and high-altitude areas.



Current HAPS aircraft

HAPS aircraft, such as Airbus's Zephyr, have dramatically improved flight capabilities and costs.

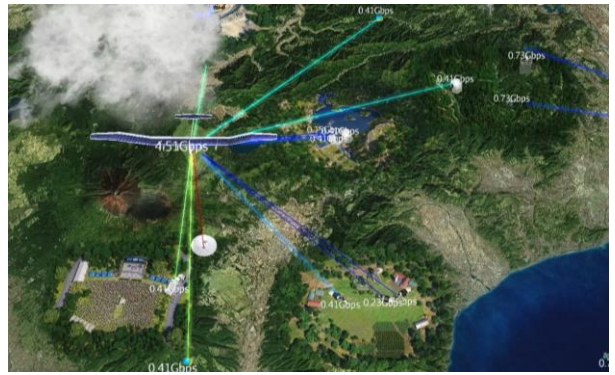


Collaboration partner

AIRBUS

HAPS simulator

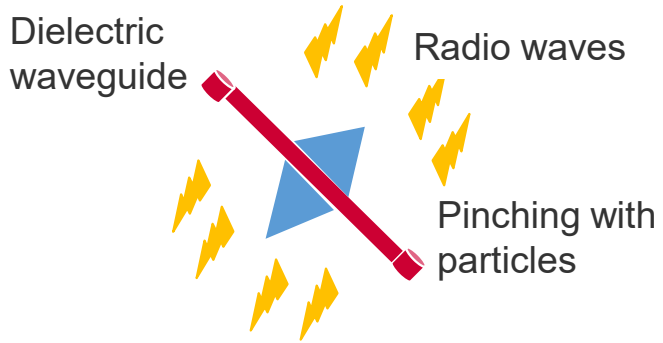
Visualize various use cases that are expected to be realized by HAPS. Based on the simulation, we implemented the evaluation of the expected throughput for each use case.



Pinching Antenna to Extend Coverage

Radio wave propagation via dielectric waveguide

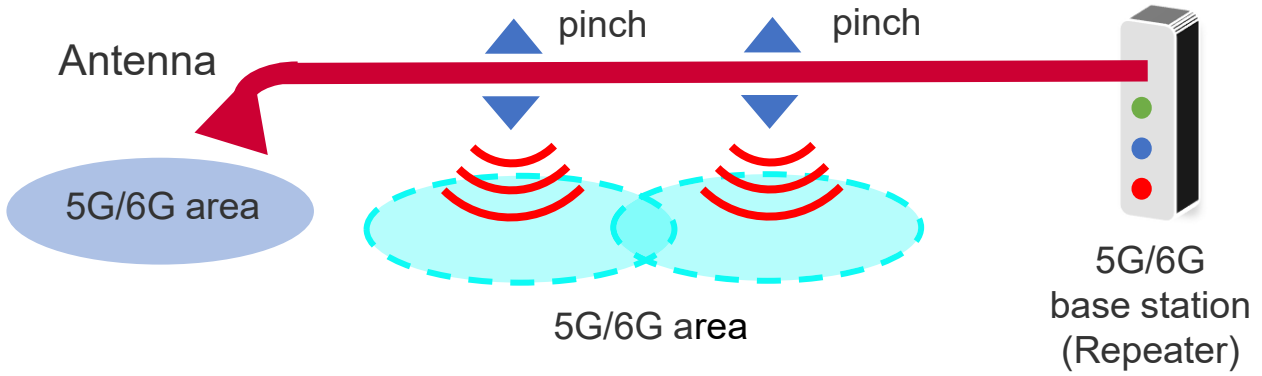
- Pinching a dielectric waveguide with small particles leaks (radiates) radio waves, creating a communication area around it.
- Additional pinches can create additional communication areas.



Practical demonstration

Pinching antenna has been verified to enhance propagation performance around a dielectric waveguide.

Applying the method to implement stable communication in factories, offices, etc. is being studied.



Future capabilities

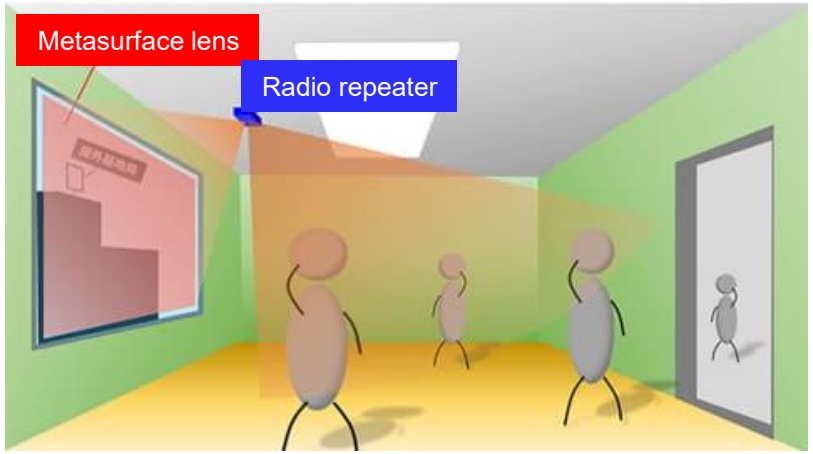
Pinching Antenna technology will be adopted for terahertz communications.

Metasurface Lens for Coverage Extension

Enhanced coverage indoors

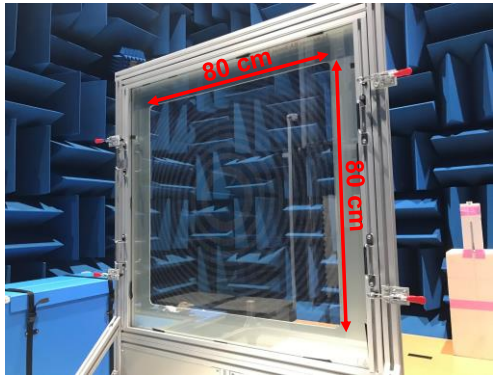
Millimeter waves from outdoors propagate to a focal point (metasurface lens) and then are amplified and transmitted indoors efficiently via a repeater.

Basic Concept



Development status of metasurface lens

Strength of signals received at metasurface-lens focal point can be increased 200-fold.

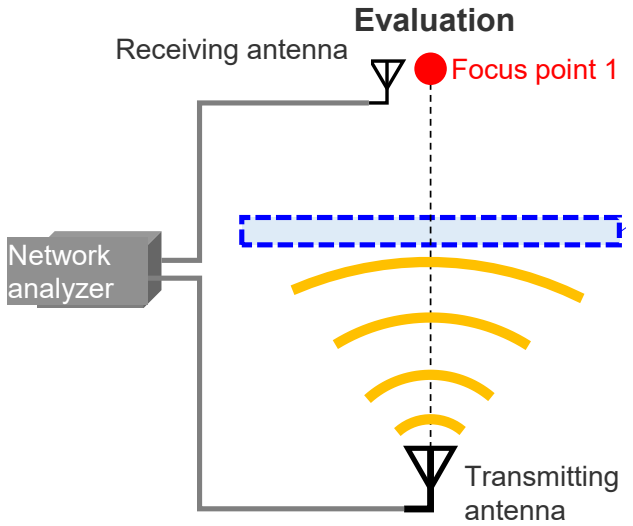


Metasurface lens

Verification results	
Normal glass	Metasurface lens
0 dB	>24 dB

Outdoor-to-indoor (O2I) verification

Currently, we are evaluating the performance of indoor coverage with metasurface lens and radio repeater.



Collaboration partner

(Transparent structure and microfabrication)

Testing support

(5G relay station)

For more information, please contact us at

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