

# NTN DEVELOPMENTS AT ESA

Mr. Frank Zeppenfeldt  
Future Projects  
European Space Agency (ESA)

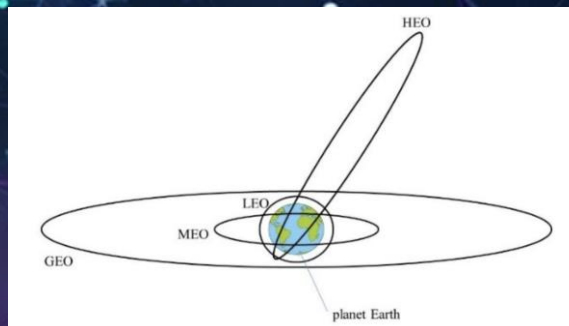
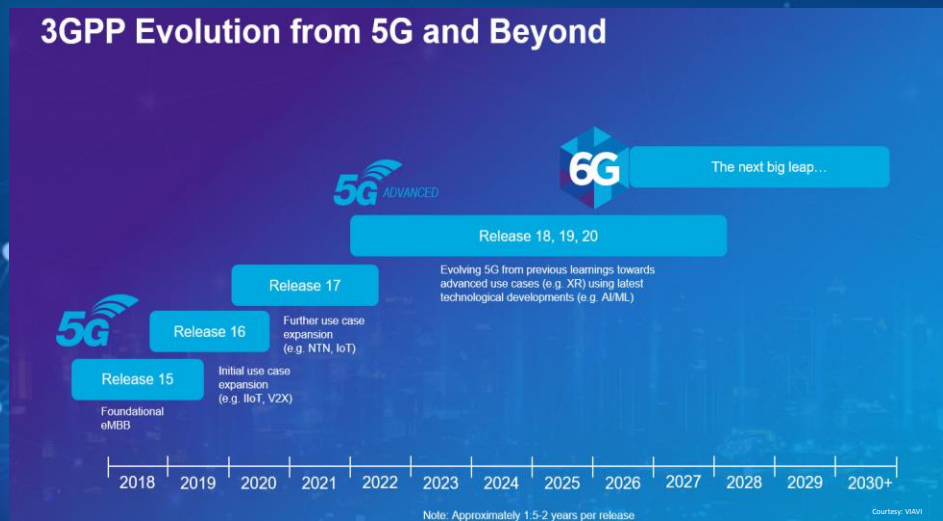


**ROHDE & SCHWARZ**

Make ideas real



# SPACE FOR 5G & 6G



**3GPP TR 22.822 V0.1.0 (2017-10)**  
*Technical Report*

**3rd Generation Partnership Project;  
 Technical Specification Group Services and System Aspects;  
 Study on using Satellite Access in 5G;  
 Stage 1  
 (Release 16)**



**Mobile Test Summit 2024**  
 Munich, November 19&20



# Who are we?

We fund research and development in satcom via a program called **ARTES** (Advanced Research in Telecommunications Systems)

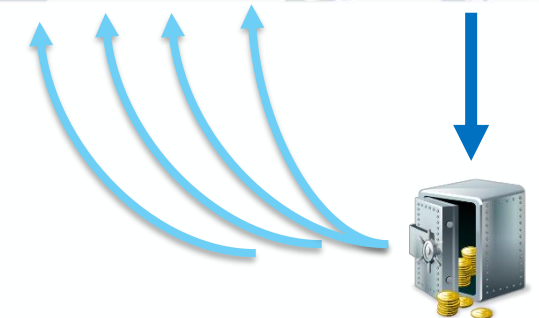
We fund developments or studies in **ground segment, space segment, payload and system – including in-orbit validation**

We issue tenders for **long-term developments – we fund 100%**

**Industry** can always submit a proposal for a development you see a market opportunity for – **we co-fund 80 to 50%, Industry brings 20 to 50%**

We build partnerships with operators to validate **innovative technology, equipment and services** in-orbit and on-ground

We support European companies with **patents, test facilities**, advice on **regulatory matters and technical trade-off's**.



# ARTES 4.0 – 5G/6G NTN Office Snapshot



## Standardisation

## Outreach

2500+ visitors

GSMA

700+ visitors

## ECSAT 5G/6G Hub & ESTEC Telecom 5G/6G Lab

## New ARTES Projects

5G 6G



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→ THE EUROPEAN SPACE AGENCY



# On the way to 6G



6G IOE

Spectrum

Orchestration

3D Networks

Automotive

D2D

Next Generation Mobility

ETSI

GSOA

GSMA

5G

Future Releases

3GPP

Standardization

Energy

Joint Communication & Sensing (JCAS)

Sustainability

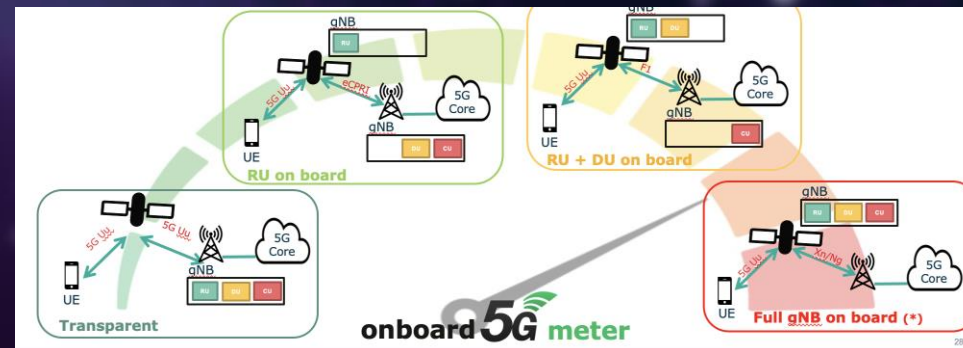
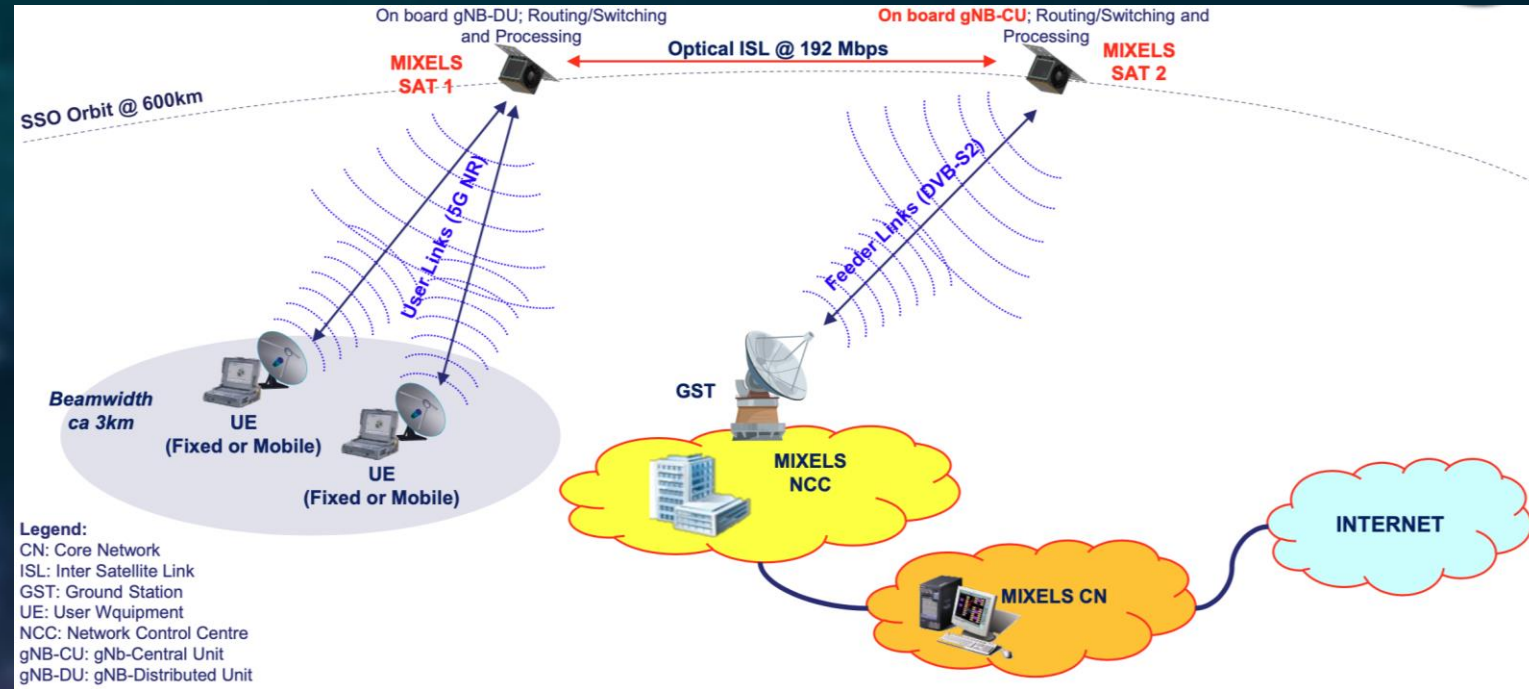
XR & Industrial Metaverse

# Demonstration of a 5G g-NodeB in Space

To develop and demonstrate **in orbit an experimental 5G g-NodeB**, distributed between a regenerative (processed) payload and a satellite gateway.

The demonstration will focus on showing the main functionalities of a gNodeB for **New radio Non-Terrestrial Network from LEO**.

- Definition of the In-Orbit-Demonstration (DEMO) requirements, test scenarios and KPIs
- Study different DEMO 5G system architectures and on-board regeneration functions
- Manufacturing, deployment and commissioning of the DEMO system and its components
- Operation of the DEMO



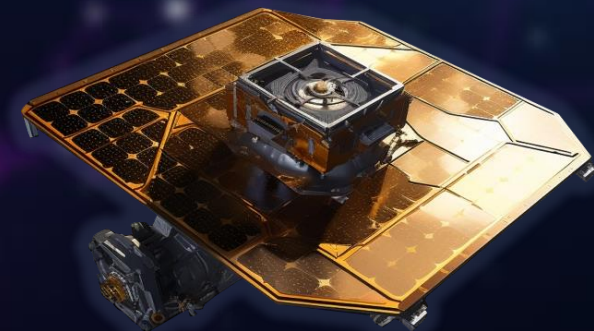
# 6G Satellite Precursor – STERLING In-Orbit Laboratory (3E.011)



Satellite is necessary to deliver 6G  
(broad consensus among worldwide 6G initiatives)

ESA initiated activity, as part of the ARTES 5G/6G Workplan and supported by a Concurrent Design Facility (CDF ) study, with the following objectives:

- Deliver a **satellite in-orbit laboratory**, to test **seamless integration and interoperability** with terrestrial 6G R&D networks and equipment
- Demonstrate benefits of satellite in the context of **6G use-cases**, based on hands-on/real-world experience
- Provide **inputs to 3GPP** to support future Standard Releases for 6G NTN based on seamless TN-NTN integration and interoperability
- Identify **further technology development needs for 6G**

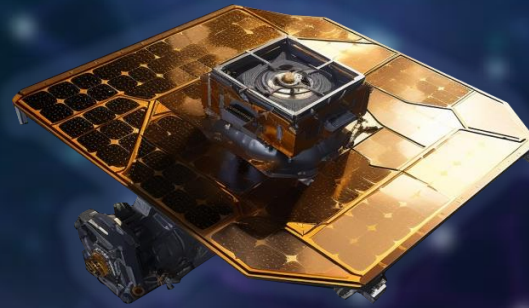


## 6G STERLING ESA CDF Study

AI-assisted DSM  
TN-NTN handover  
E2E orchestration  
Neuromorphic processors  
...



## In-Orbit Lab



## Future Generation of 6G Satellites

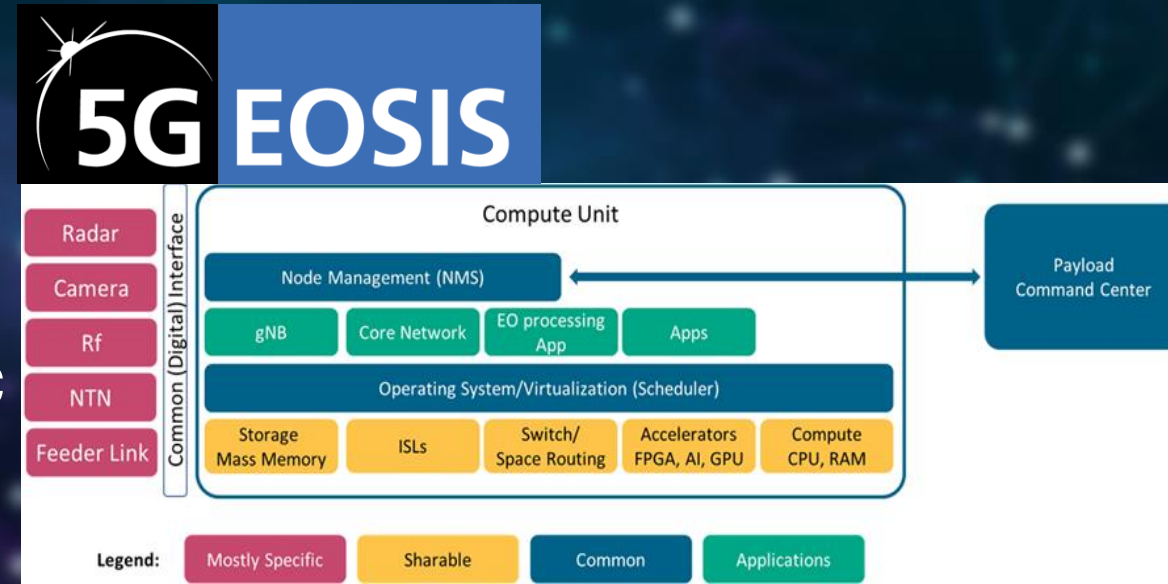
D2D  
AI-assisted DSA  
Sub-THz transmission  
6G waveforms  
JCAS



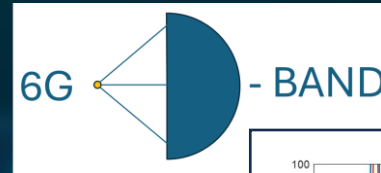


# 5G Repurposable Payload As A Service (5A.080)

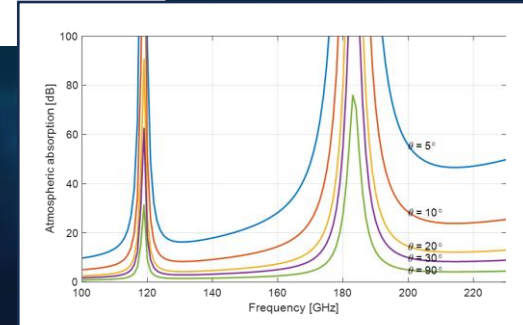
- **5GEOSIS – 5G EARTH OBSERVATION SERVER IN SPACE**
- **Objective: provide a suitable hardware test-bed supporting initial trade-off studies.**
  - **regenerative gNB on the satellite**
  - **EO payload communications (both TM/TC and Data traffic) handled by the 5G payload**
  - **provision of full processing services also for the EO payload**
- **Contractor: Eurescom (Prime) + Fraunhofer FOKUS + Airbus**



Source: <https://connectivity.esa.int/projects/5geosis---5g-earth-observation-server-space>



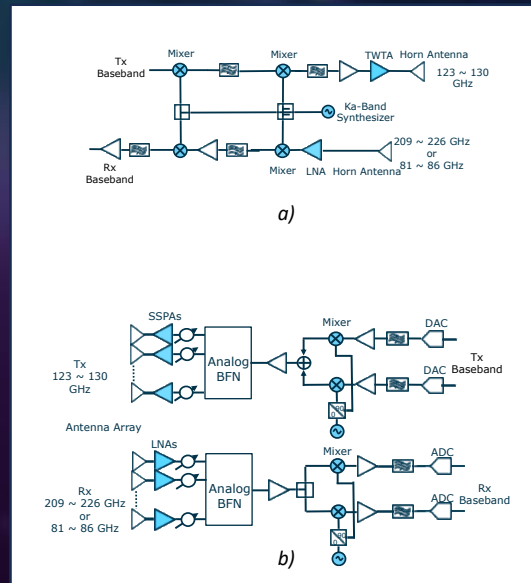
Source: Plum Consulting



- **D-BAND SATELLITE LINKS FOR 6G (3F.002)**
- **Objective:** the first steps, towards assessing the optimum use for D-Band in future 6G networks, through detailed computer simulations at system and link level.
- **Contractor:** Plum Consulting (Prime) + Univ of Sussex + Filtronic

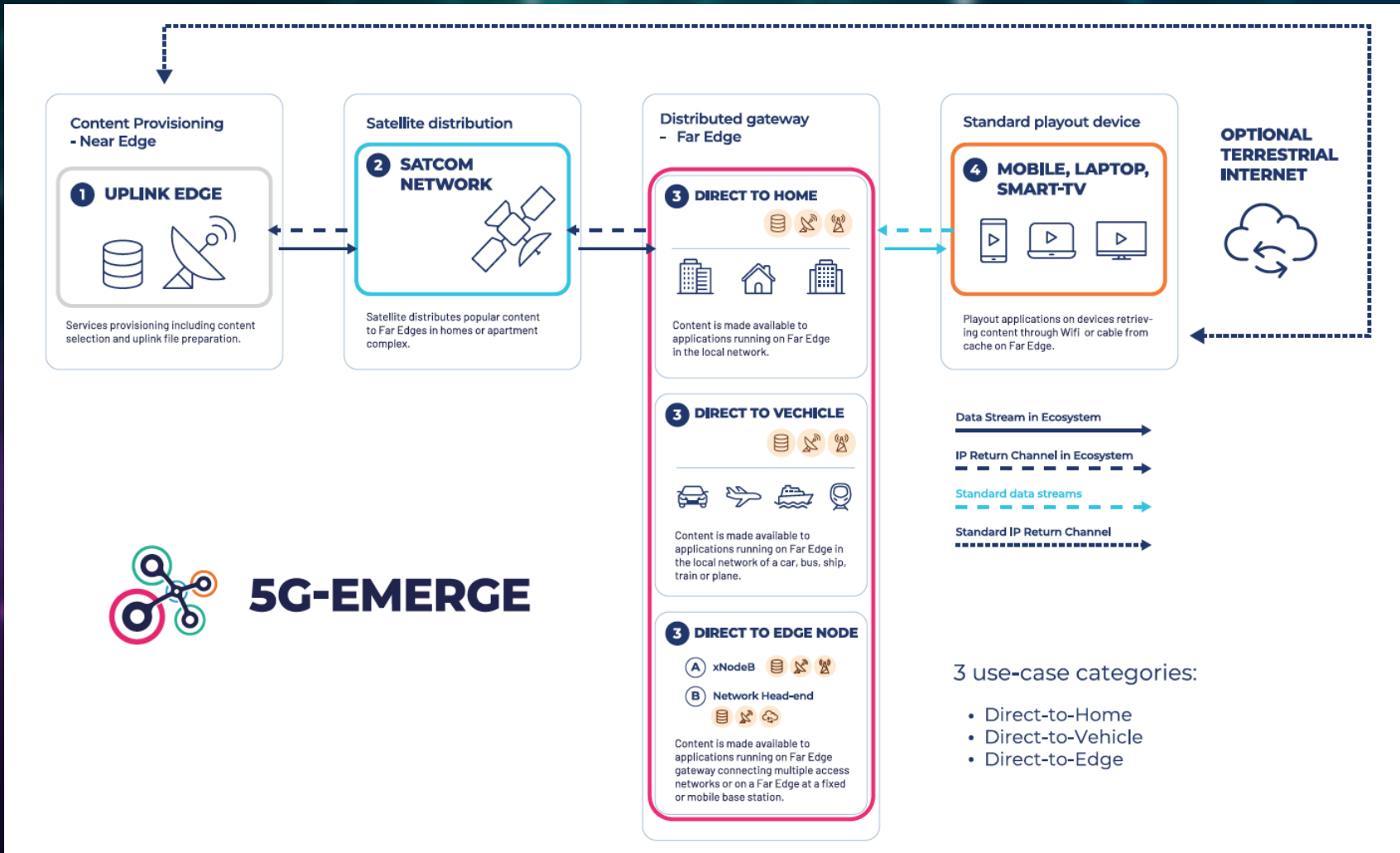
- **D-BAND PAYLOAD BUILDING BLOCKS FOR 6G SATELLITE SYSTEMS (5C.472)**
- **Objective:** develop and test critical payload building blocks necessary for D-band satellite links in 6G systems.
- **Contractor:** RAL Space

Source: ESA



- **INTEGRATED D-BAND MMIC CHIPSET FOR 5G/6G PHASED ARRAY APPLICATIONS (3F.028)**
- **Objective:** Definition Phase for the specification of MMIC chipset/module for a phased array system operating at D-band frequencies.
- **Contractor:** VIPER RF

# 5G EMERGE – Phase 1

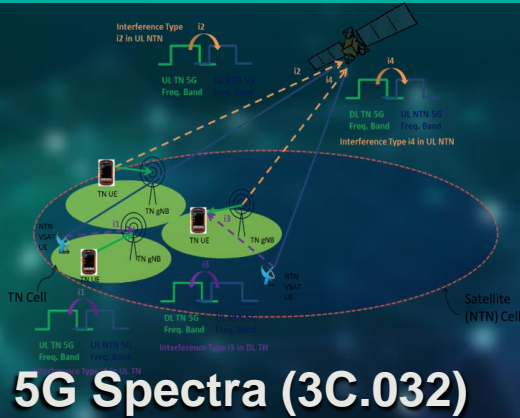


- Optimised 5G micro-edge terminals for multiple scenarios
  - Direct to Home (individual/collective)
  - Direct to vehicles (e.g., bus)
  - Direct to Edge (maritime, CDN PoPs)
- Open system architecture for multi-tenant operations with standardized interfaces
- Common IP based streaming and higher layers optimisations for the content preparation/consumption through all playout devices & scenarios

# How can ESA influence the 5G / 6G standardization?



5G EMERGE (3F.005)



5G Spectra (3C.032)

# SATis5

SATis5 (3A.075)



5G System Infrastructure Study (1A.111)



5G4Space (3C.017)



HELENA (1D.023)



6G Satellite Precursor - STERLING(3E.011)



DAWN (3A.181)

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# Increasing outreach toward unified standards



- **NTN Forum** – evolution of **SSIG**, that encourages collaboration, knowledge sharing, and collective efforts among a variety of industrial and academic stakeholders to promote the integration of NTN in the evolving 5G Advanced and 6G networks.



- **ESA / GSMA Joint Challenges:** ESA partners with GSMA for funding opportunities and launch of

TN/NTN initiatives

- NTN Open Gateway
- Mobility Makerspace



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# ECSAT 5G/6G Hub – overview

5G Engineering Lab

5G Demonstrations & Applications

Collaborative place

Events & Showcases



700+ visitors

# ECSAT 5G/6G Hub: Lab environment

## 5G Vodafone MPN terrestrial network

- Carrier grade
- 300 Mbps indoor / outdoor

## GEO and LEO satellite links

## Satellite connectivity simulator

## Automated configuration switching

## MEC and Edge compute functionality

## Spatial computing

- XR (MR/AR/VR)



## Radio interference from satellites is threatening astronomy

Just as human development leads to more light pollution, increasing numbers of satellites are leading to more radio interference.

By Christopher Gordon De Pree | Published: March 9, 2023 | Last updated on May 18, 2023

Commercial

### Omnispace reports interference from Starlink direct-to-device payloads

Omnispace says it is seeing interference from direct-to-device payloads on recently launched SpaceX Starlink satellites, offering an early test of new Federal Communications Commission regulations about such services.

Jeff Foust | May 17, 2024 | <https://spacenews.com/?s=interference>



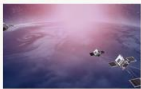
SPACENEWS

Commercial

### Space-based monitoring of electronic signals is now a commercial battleground

Radio-frequency (RF) monitoring companies are broadening their capabilities beyond ship tracking

Sandra Erwin | June 3, 2024 | <https://spacenews.com/space-based-electric-eavesdropping-becomes-commercial-battle>



SPACENEWS

Global map showing SMAP Radio Frequency Interference during the month of March and April 2023. The height of the bar indicates the maximum RFI contribution to the antenna temperature (Kelvin) observed in horizontal polarization and the color indicates the persistence of the RFI averaged over a four week period (defined below)

<https://smap.jpl.nasa.gov/rfi/>

## ITU issues warning on interference with radio navigation satellite service

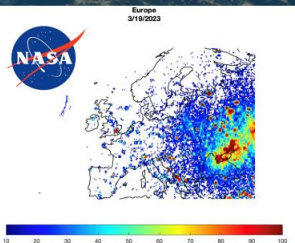
News · 23 Aug 2022



By ITU News

The blocking, jamming or serious degradation of services that rely on radio waves – known in the telecommunication world as harmful interference – can be either accidental or intentional.

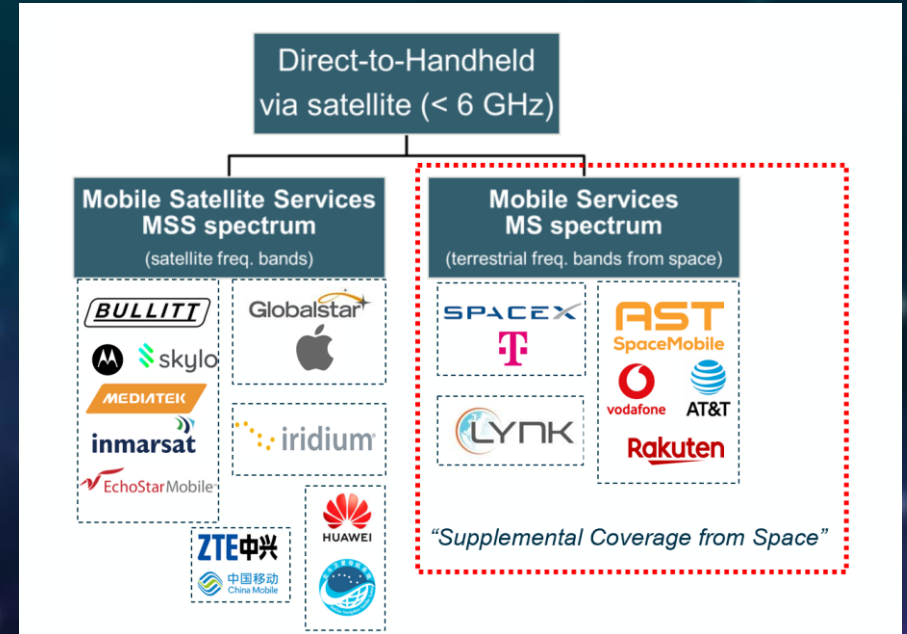
<https://www.itu.int/hub/2022/08/warning-harmful-interference-rnss/>



## FINANCIAL TIMES

The satellite spectrum battle that could shape the new space economy

<https://www.ft.com/content/ac7702c8-238f-4656-bd26-a2ba445af971>



## CleanWaves conference

Nov 27th at ESA HQ (Paris)  
14:00 – 17:30

**REGISTER TODAY**

<https://connectivity.esa.int/upcoming-workshop-clean-spectrum-driving-innovation-and-growth>

Towards Spectrum Sustainability

DIRECT-TO-DEVICE CONNECTIVITY:  
AN OPPORTUNITY FOR EUROPE

28 November 2024 | ESA-HQ | Paris, France



Test. Measure. Innovate

THANK YOU  
VERY MUCH

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Make ideas real

