



# NTN workshop HEXA-X-II and NTN related projects

Thursday, November 7th 2024

## Use cases and sustainability

Cristóbal Vinagre Z (TNO)  
[cristobal.vinagrezuniga@tno.nl](mailto:cristobal.vinagrezuniga@tno.nl)

Stefan Wendt (Orange)  
[Stefan.wendt@orange.com](mailto:Stefan.wendt@orange.com)

[hexa-x-ii.eu](http://hexa-x-ii.eu)





# Hexa-X-II Principles

---

# Design 6G to deliver value and to be sustainable



Sustainability is the key value and driver in Hexa-X-II, encompassing the three pillars...

- Environmental sustainability
- Social sustainability (incl. Trustworthiness and inclusion)
- Economic sustainability

... the duality

- **Sustainable 6G:** 6G should be inherently designed to meet sustainability commitments (NetZero,...)
- **6G for sustainability:** 6G-based services enabling other sectors/verticals to minimize their impact

... and involve society

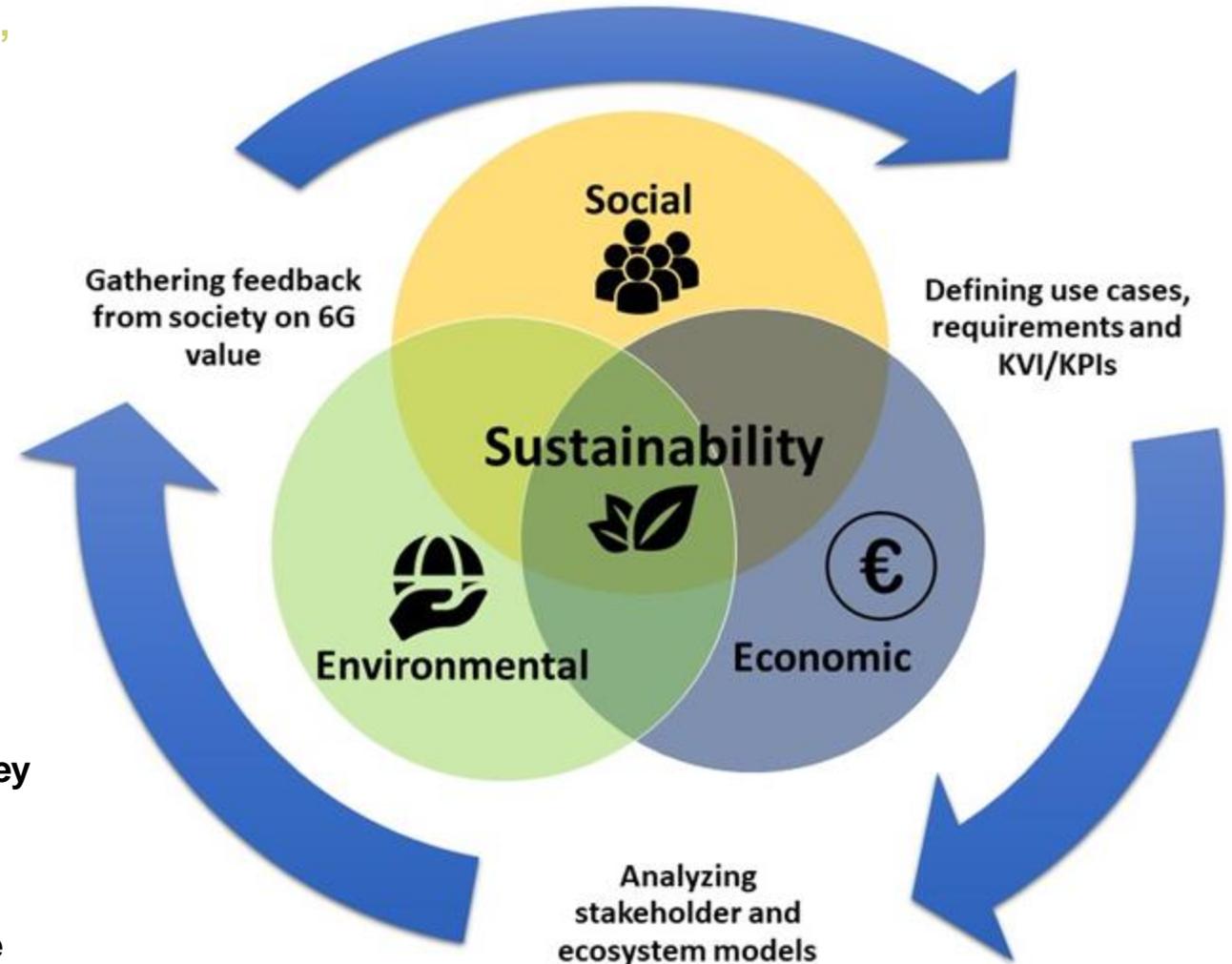
- Obtain **feedback on 6G value** addressing their needs and concerns

to define use cases and requirements

- Extract **Requirements, Key Performance Indicators** and **Key Values and Indicators**

and analyse stakeholders & ecosystem models

- Identify key **stakeholders** and define **business and revenue models** and establish the **6G ecosystem**





# The Methodology

---





## Use Case

1

Use Case  
Analysis

2

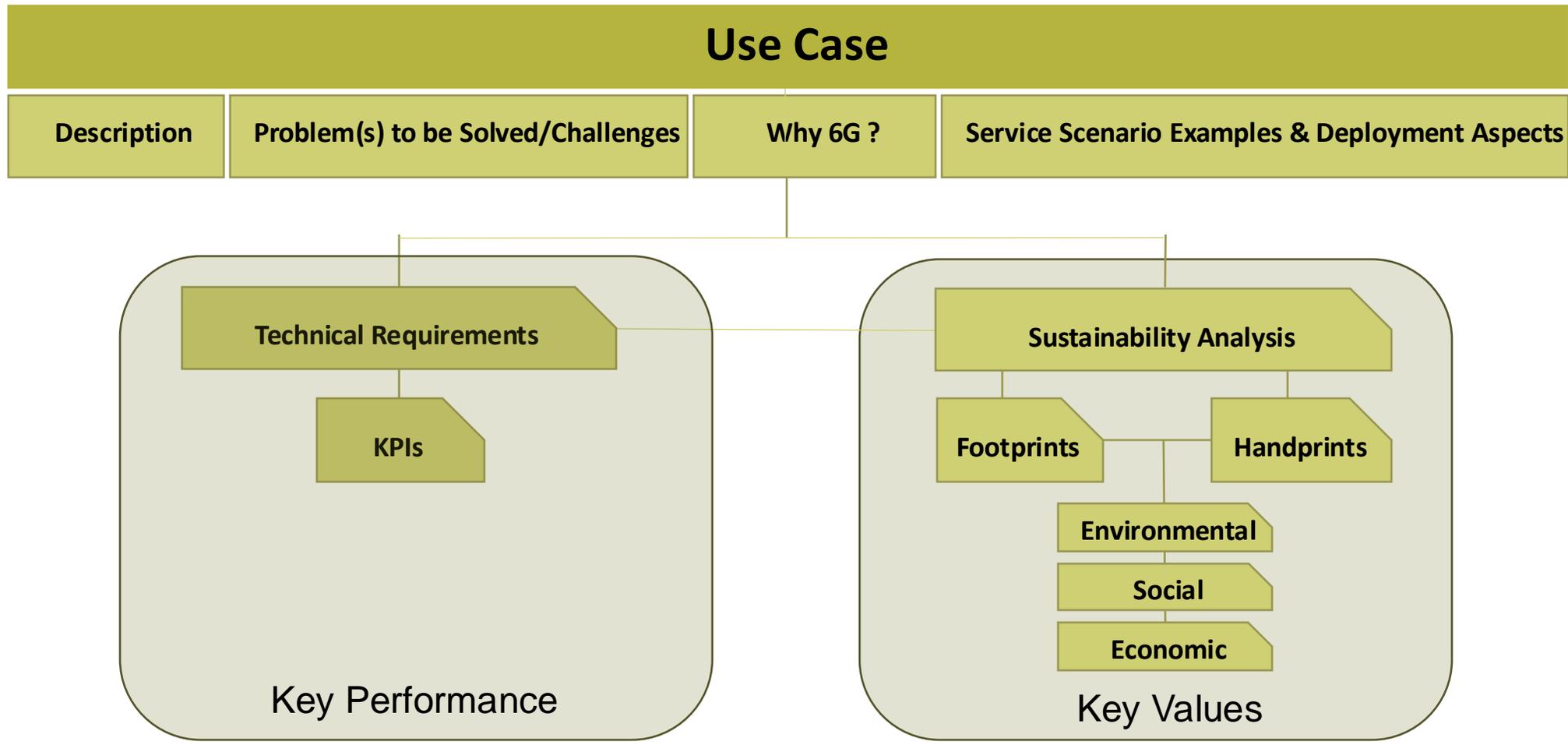
Business  
Model &  
Stakeholder  
Analysis

3

Preparedness  
for 6G  
Sustainability  
- Challenges  
and Risk  
Analysis

1

# Use Case Analysis Methodology - (more details in Hexa-X-II Deliverable D1.2)





## Business & Stakeholder Analysis

How do companies create, capture, and deliver value?

### Ecosystem business model canvas

ecosystem-level business model for the use case including identification of stakeholder

#### Supply Side

Stakeholders/  
key partners,  
Resources,  
Activities

#### Ecosystem Value Propositions

Value proposition  
Value co-creations  
Value capture  
Value co-destruction  
Partnerships

#### Demand Side

Customer segments,  
Stakeholders/key partners,  
Customer relationships,  
Channels,

#### Outcomes

Benefits  
Revenues (revenue streams)  
Pricing  
Costs

### Stakeholder Analysis

analysis of key stakeholders

Stakeholders

Description

Role

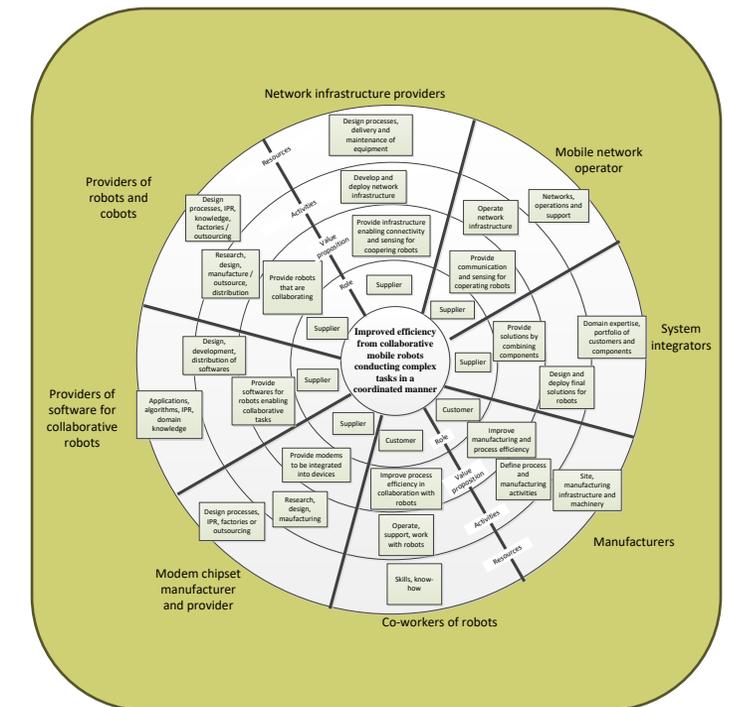
Value Proposition

Activities

Resources

### Ecosystem pie

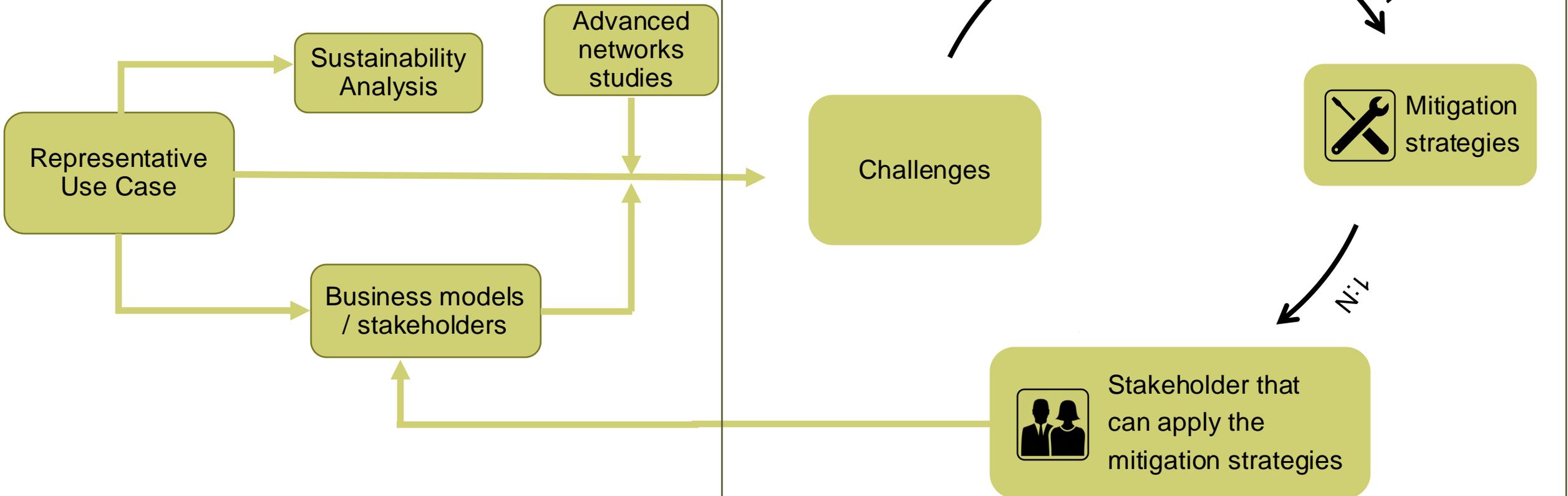
ecosystem-level business model visualization





## Objective:

- Analyse challenges and risks which may counteract the sustainability targets
- Identify & apply mitigation strategies

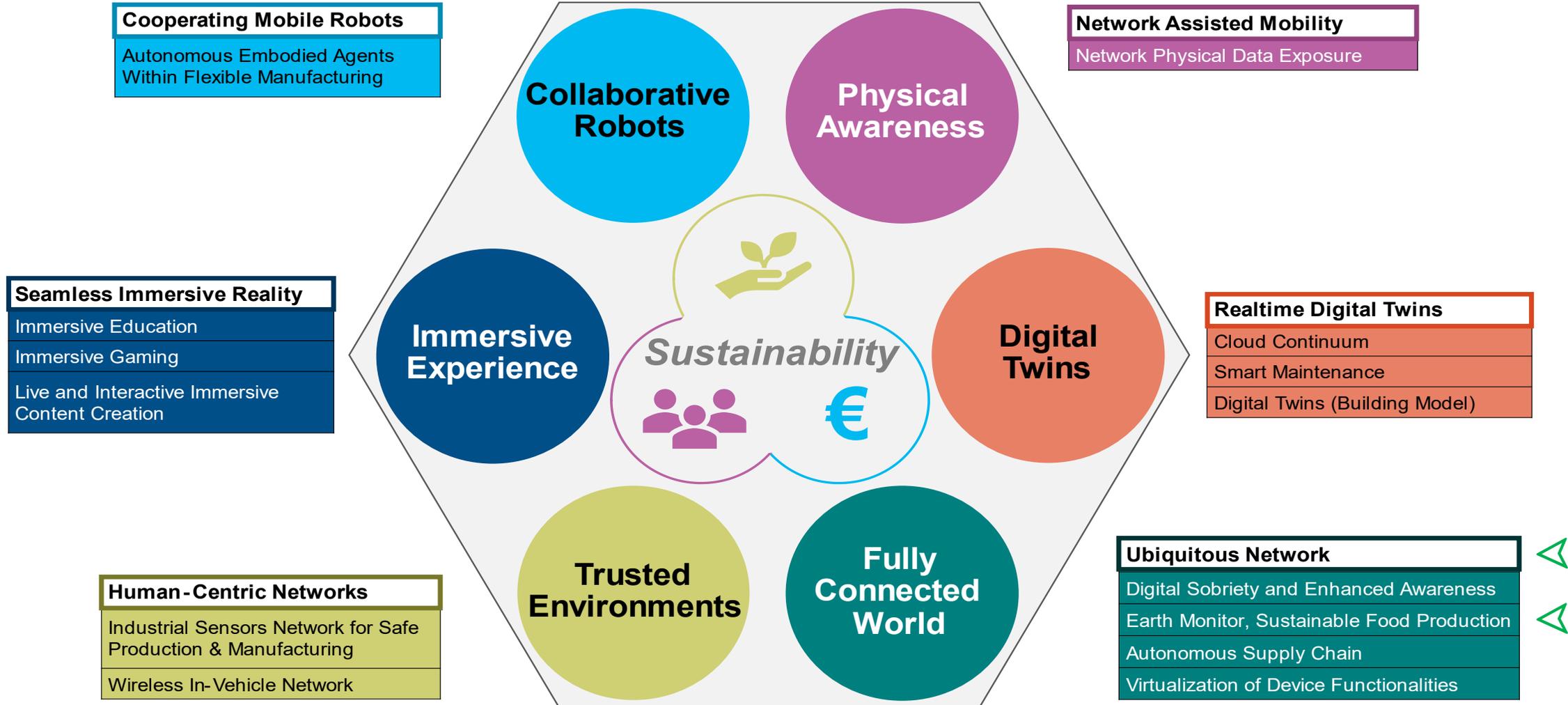




# Hexa-X-II's NTN-related Use cases

---

# Hexa-X-II Use Case Families



Hexa-X-II Use Cases with **Highlighted** Representative Use Cases

# FULLY CONNECTED WORLD

*Ensuring connectivity **everywhere**, expanding beyond purely traditional terrestrial networks to deliver the benefits of communications to everybody.*

*Besides expanding coverage cost-effectively, it also enables network function availability for crisis management, earth monitoring, digital health services, virtualisation of device functionalities, or support of autonomous supply chains.*

## **Use Cases**

Ubiquitous Networks | Digital Sobriety and Enhanced Awareness | Earth Monitor & Sustainable Food Production | Autonomous Supply Chain | Virtualization of Device Functionalities



# Ubiquitous Network - Scenarios



Delivers Mobile Broadband connectivity to every human on Earth, leaving no “white zones” through tight integration of TN & NTN

## Connectivity at remote locations/developing countries

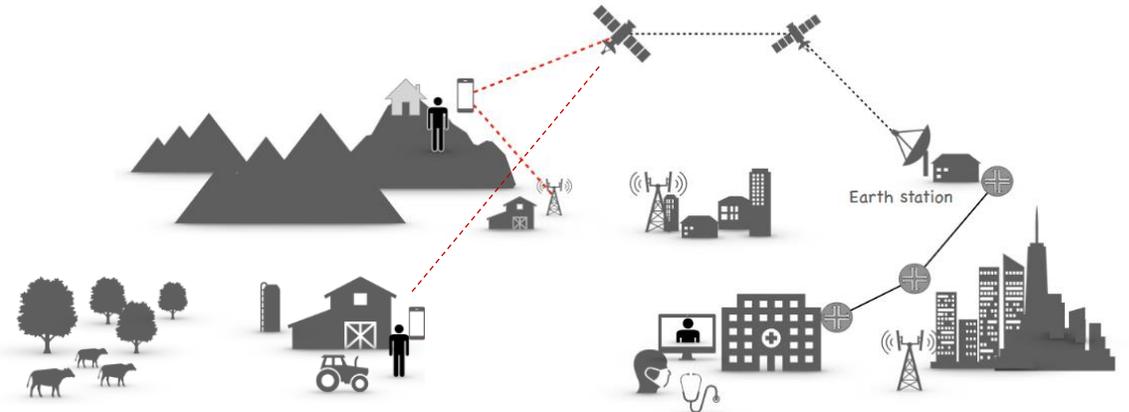
Enabling connectivity in hard-to-reach areas (e.g., cost constraints, deployment difficulties)

- Access to video streaming, remote health consultations, earth monitoring, agricultural services, etc.

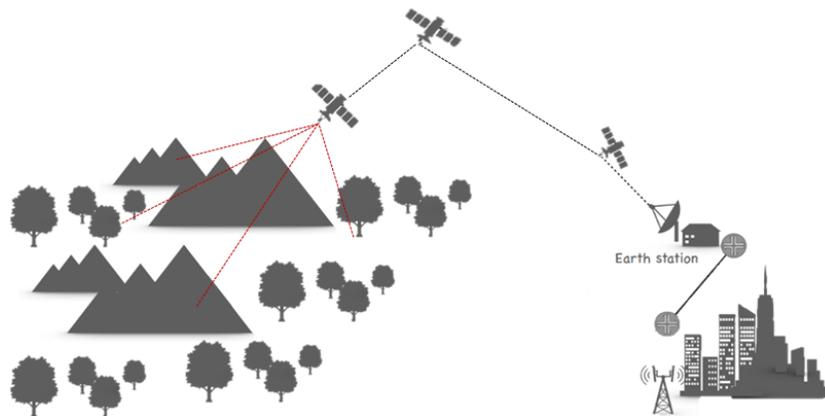
## Connectivity during natural disasters or emergencies

- Builds resilience in the network

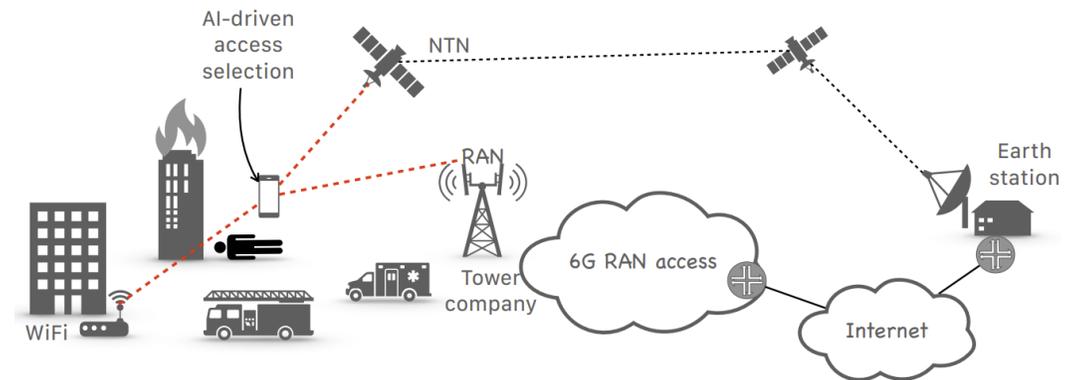
## Connectivity at remote locations | Improved connectivity in developing countries



## (UC) Earth Monitoring



## Connectivity during natural disasters and emergencies



# Ubiquitous Network



## Functional Requirements



Coverage/  
Connectivity  
everywhere



Flexibility



Resilience



Privacy &  
Security



Service continuity  
across diverse  
topologies



Affordability

## KPIs



Data rates  
[Mb/s]

0.1 –25 DL  
2 UL

For single UE, measured on the device. Based on current standards, from 0.1 (sensor data) to 25 Mb/s (4K video).



Availability  
[%]

98.5

Appropriate combination of full coverage and capacity to deliver video streaming-like services is required.



Coverage  
[%]

TN:  $\leq 10-15$  km  
cell radius  
TN/NTN: 99.9%  
of human environment

Coverage means both extending the range of TN, but also the coverage % of an area, combining TN & NTN.



E2E Latency  
[ms]

10-100

Targeting video calls/streaming. 'Real-time' interactions are not considered.



Reliability  
[%]

99.9 –99.999

Associated with the service requirements, considering fallback between TN & NTN.

# Ubiquitous Network

## Main categories for further impact analysis

<b>Environmental</b> 	<b>Social</b> 	<b>Economic</b> 
 Ecosystems: monitoring, land use, waste	 Resilience	 Resource efficiency
 Behaviour change caused by enablers	 Trustworthiness	 Reliability and Resilience
 Resources	 Digital Inclusion, digital divide	 New business opportunities
 Energy Consumption	 Digital reliance	 Investments, maintenance costs

# Ubiquitous Network Business model



## Supply

- **Stakeholders/key partners:** Infrastructure NW provider; NTN incl Earth station providers; Wide area network provider (CSP, ISP); Local networks provider (DSP) and small-scale base station operator/owner (radio resource); Provider of energy infrastructure; Planet Earth and Future Generations
- **Resources:** Design processes; IPR; Factories; TN & NTN infrastructure; Raw materials; Water; Workforce; Energy; Collaborative funding
- **Activities:** Research, Development ; Design; Manufacturing; Deployment; Sales; Operation Maintenance; Circular business; Sustainability Management; Life cycle management; Ethical management

## Value

- **Value proposition:** Giving everyone, everywhere the possibility to access digital services. Global mobile broadband connectivity through reliable integration of multiple networks securing digital inclusion and privacy
- **Value co-creations:** Examples: Suppliers: re-use of infrastructure and collaboration reduce costs for R&D. Customer&Supplier: Sharing of customer data can be used to improve services. Enhanced knowledge in workforce. Co-funding of investments.
- **Value capture:** More customers when global connectivity (but probably many customers with low income), higher efficiency, shared investments, new business opportunities
- **Value co-destruction:** Complex collaboration contracts; Exploitation of commons; Unintended Reduced Fundamental Freedoms
- **Partnerships:** Partnerships needed for covering the unconnected but also to expand services given, i.e. payments; education; health services based on local needs and legislation

## Demand

- **Customer segments:** end-user; subscriber
- **Stakeholders/key partners:** end-user; authorities; private companies; governments; Non-Governmental Organizations (NGOs); Planet Earth and Future Generations; Workforce
- **Customer relationships:** B2B and B2C and B2B2C
- **Channels:** Word of mouth (trusted); Social media; Government/Authority channels; Feedback channels from stakeholders

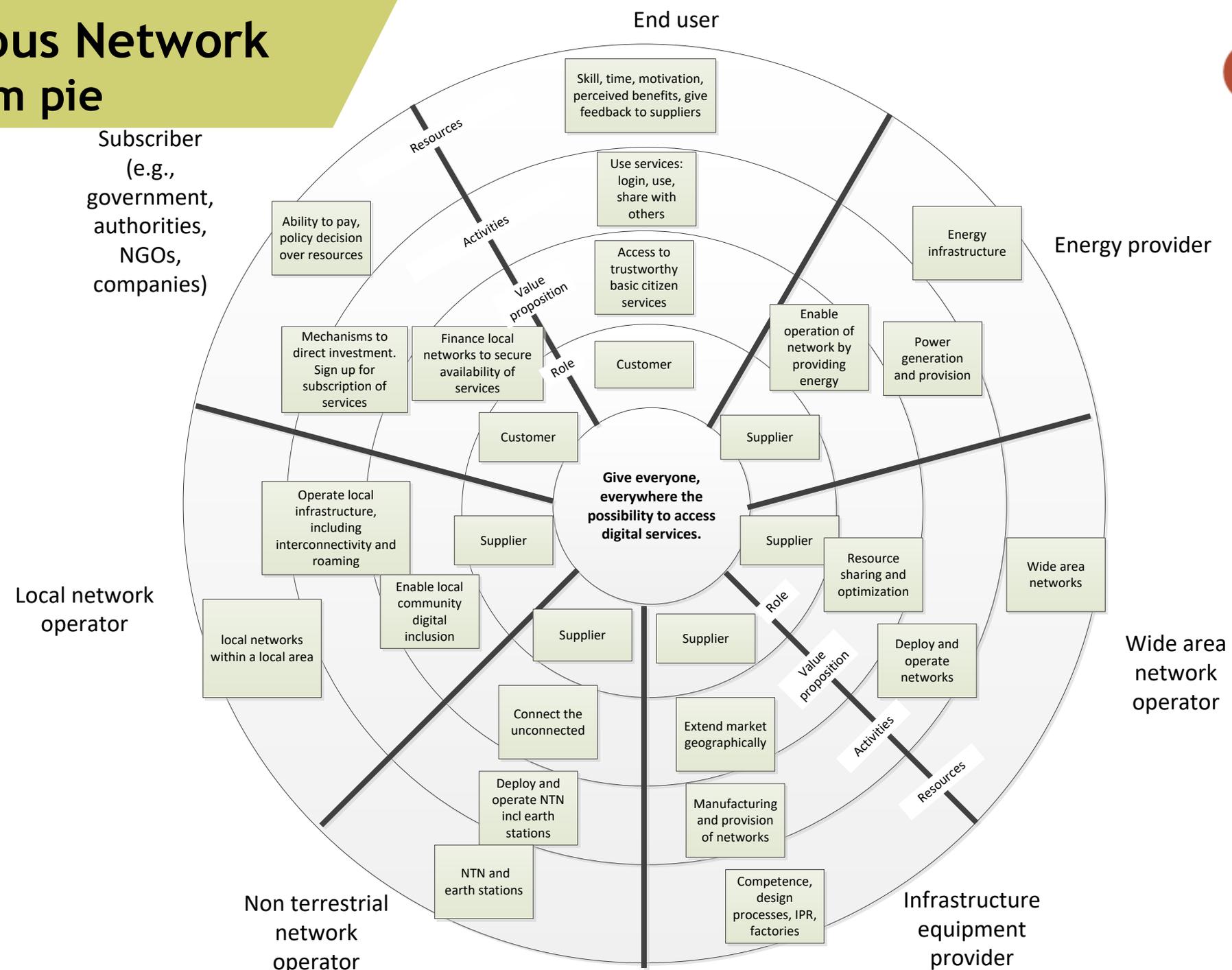
## Outcomes

- **Benefits (incl. benefits to environmental and social):** digital inclusion; reuse of resources; faster distribution of information and new ideas; increased competition; facilitated market transactions; environmental monitoring; reduced GHG emissions if more services can be accessed without travelling; enhanced trustworthiness of networks
- **Revenues (revenue streams):** Fixed yearly fee per government, private companies, NGOs giving basic service. Additional fee for end-users based on usage.
- **Pricing:** Differentiated pricing for countries based on GDP and purchasing power among individuals
- **Costs (incl. costs to environmental and social):** Shared infrastructure investments and cost to create interfaces between networks; higher energy and maintenance costs; GHG emissions; Waste handling; Imposed monitoring; Increased land use could cause biodiversity loss; Higher energy usage; Potential digital divide if all services digital

# Ubiquitous Network Ecosystem pie



Fully Connected World



# Ubiquitous Network Preparedness for 6G Sustainability



## Risk

- Increased connectivity may not result in less travel/transport in total
- Risk of the technology being used with harmful purposes
- Deployment costs become too high hindering wider availability of connectivity



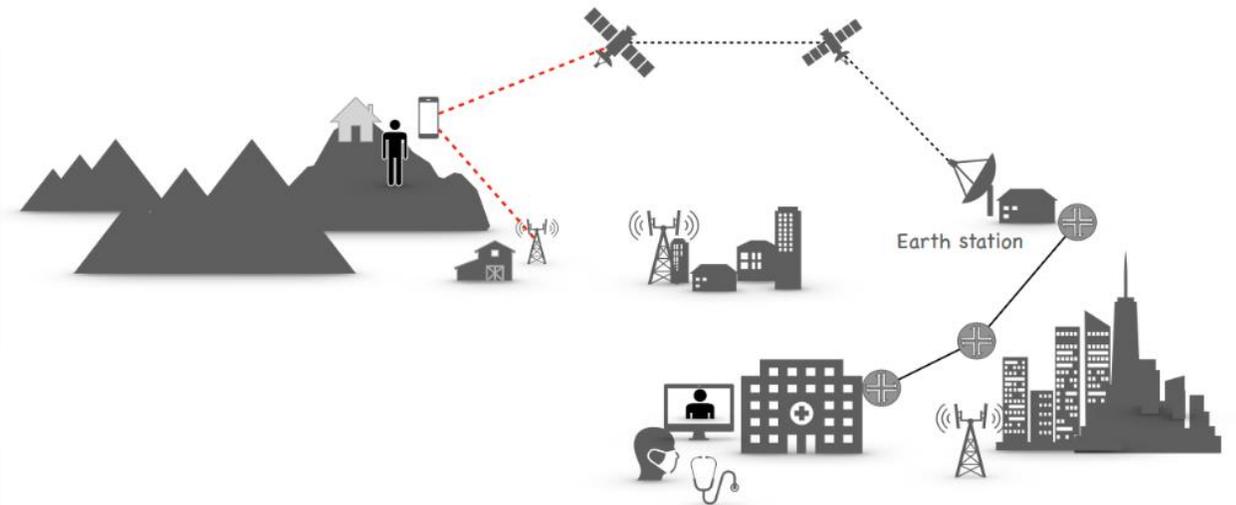
## Mitigation

- Understand the needs and decide on what is good enough from a capabilities level/QoS.
- Security / privacy by design
  - Create affordable satellite connection for the most remote areas.



## Mitigating stakeholders

- Investors in network infrastructure and operation force consolidation;
- Policy makers, local and central legislators; Providers
- Local networks provider (DSP); Local, small-scale base station operator/owner (radio resource)



Indicative example of Risks / Mitigation / Mitigation stakeholders for each sustainability axis (environmental, social, economic)



---

HEXA-X-II.EU //   



This project has received funding from the European Union's Horizon Europe research and innovation programme and Smart Networks and Services Joint Undertaking (SNS JU) under grant agreement No 101095759.