Addressing the Sustainability Development Goals – An Overview of current 6G KPIs and KVIs

Presenters:

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Introduction

- **A new paradigm shift is essential in technology design and evaluation**, moving beyond just network-related parameters and market opportunities.**Equally important is addressing Societal Development Goals (SDGs):** To this end, **values are being introduced as key metrics** for assessing the societal and ecological impact of technological advancements.

- **Several EU-funded projects are taking on this challenge in the context of 6G networks**. Some projects emphasize on **Key Value Indicators (KVIs)**, while others (like **HEXA-X II**), introduce the concepts of **Sustainability Handprints and Footprints**.
- **However, a unified framework for values-driven development is still lacking!**

- **This presentation attempts to answer a simple question:**
  "What is the current state of the SNS-JU projects, regarding the assessment/evaluation of the impact on societal values?"

HEXA-X II's Methodology

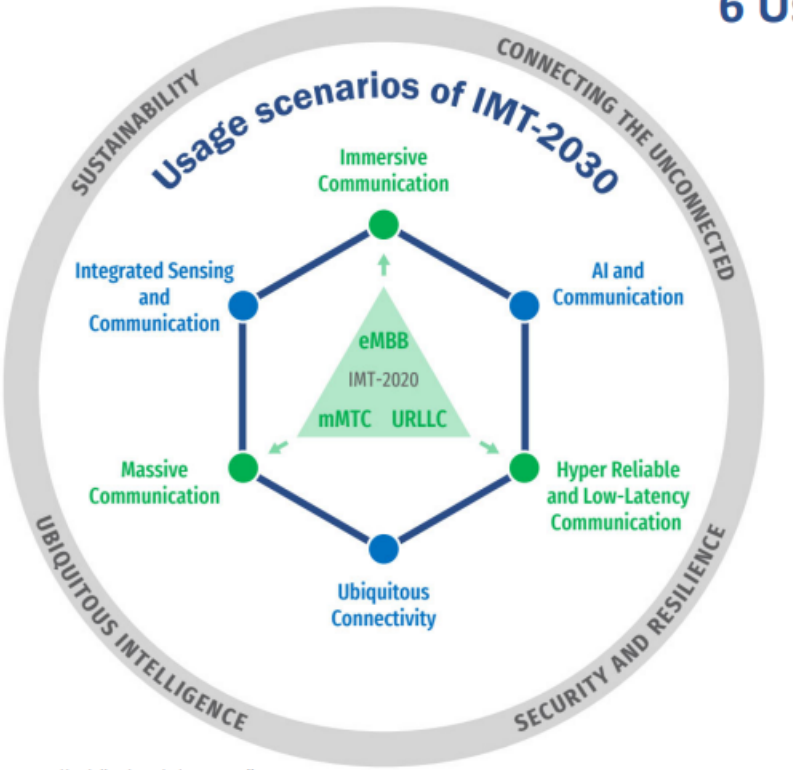
Overview

- HEXA-X II deals with the sustainability issues on a use case centered manner. For each use case a separate analysis takes place, investigating the benefits and costs to the environmental, social and economic aspects.
- All other projects examined in this paper define their own KVIs. On the contrary, HEXA-X II considers the sustainability handprints and footprints as a more descriptive approach than defining KVIs.

HEXA-X II's Methodology

KPIs inspired by the IMT-2030 Framework

Usage scenarios



So called "Wheel diagram"
Source: Document 5/131 and edited in SG 5

6 Usage scenarios

Extension from IMT-2020 (5G)

- eMBB ➡ Immersive Communication
- mMTC ➡ Massive Communication
- URLLC ➡ HRLLC (Hyper Reliable & Low-Latency Communication)

New

- Ubiquitous Connectivity
- AI and Communication
- Integrated Sensing and Communication

4 Overarching aspects:

act as design principles commonly applicable to all usage scenarios

Sustainability, Connecting the unconnected,
Ubiquitous intelligence, Security/resilience

HEXA-X II's Methodology

Sustainability Analysis

Network-Assisted Mobility Use Case		
	Sustainability Handprints (benefits)	Sustainability Footprints (costs)
Environmental	• **Reduction of Greenhouse Gas Emissions** by improving the traffic flow at the intersections thus requiring fewer traffic lanes and freeing up space for pedestrians	• To **enable the positioning services**, new low power devices would have an additional energy footprint for the computational power
Social	• **Enhanced driving safety** through a reduction in traffic-related accidents • **Enhanced continuity of transportation service in rural areas** (digital inclusion)	• ***Privacy risks associated to localization data*** • ***Decreased job opportunities***
Economic	• **Reduced costs for the stakeholders** from using the network for the monitoring tasks instead of additional sensors	• **High expenditure requirements of network infrastructure** to meet the high reliability constraints of the use cases

FIDAL's Methodology

Overview

- FIDAL envisions to deliver a platform and the enablers towards the support of advanced 5G Use Cases targeting the augmentation of human capabilities.
  It focuses on allowing Media and Public Protection and Disaster Relief (PPDR) vertical industry players to perform advanced technological and business validation in large-scale field trials.

- FIDAL aims to adopt a standardized methodology to identify the parameters that maximize the impact of 5G evolution services on the community.

- Key Value Indicators (KVIs) complement Key Performance Indicators (KPIs) to balance business and social performance metrics.

- FIDAL plans to involve relevant stakeholders throughout all trial phases, including the open call trials.
  To evaluate the KVIs, large-scale electronic surveys across all EU countries and workshops with industry, academia and societal stakeholders will be conducted.

FIDAL's Methodology

Key Values and Indicator Framework

FIDAL's Key Values and Indicator Framework	
Democracy	
Fairness	*Just treatment without discrimination; what is right for a group might conceal unfairness for individuals*
Inclusiveness/Equal Opportunity	Consider broader demographics in a community, giving access to the widest possible range
Trustworthy	Regarding infrastructures and networks; trust towards fellow users/governance; public trust in systems and authorities
Economic Ecosystem	
Sustainability	Competitive and resilient EU economy; investing in jobs, skills, education and digital transformation.
Business value	New value chains; inclusive commercial benefit
Tackling economic inequality	New business opportunities
Innovation	
Flexibility	Ability to work in multiple situations, configurations
Responsibility	*Accountability over 6G systems*
Environmental Ecosystem	
Environmental sustainability	To reduce its footprint on energy, resources and emissions; improve sustainability in other parts of society and industry
Waste management	Recycle and re-use of materials; emissions
Mitigation Strategies	Awareness of environmental impact with a strategy to minimize it
Safety and Security	
Safety	Protection of humans; safer communities
Security	Protection of data and socio-technical systems
Data protection	Appropriate use of personal data
Societal Ecosystem	
Societal sustainability	Support of convergence of physical, human and digital worlds
Healthier community	*Improve the mental health of individuals*
Knowledge	Training to new digital skills

TRIAL-NET's Methodology

Overview

- TRIALS-NET's approach complements the FIDAL framework,
  as both are use case-driven projects that rely on defined KPIs to establish KVIs.
- Both frameworks focus on the *economic, environmental, and societal* dimensions of large-scale trials.
  Potential evaluation methods may also exploit large scale international surveys.

TRIAL-NET's Methodology

Indicative Framework

Key Value (KV)	*What are the values that we care about? What are the values that hold significance for us?*
Key Value Indicator (KVI)	*What are the key indicators of those values? How could we measure or assess those values?*
Enablers	*What factors contribute to the promotion of those values? What are the factors that make those values possible? e.g. 6G features, low latency, reliability, etc ..*
KPIs	*What are the technical impacts of those values? e.g. coverage, capacity, energy efficiency, device access density and localization accuracy*

- The key values (KVs) relevant to the project use cases are identified and assigned measurable indicators to them, known as Key Value Indicators (KVIs).
- The enablers of these KVs are considered, along with their technical impact—referred to as KPIs. For example, if environmental sustainability is chosen as a KV, the related KVI would be the CO_2 emissions of the mobile network.
- The enablers would focus on creating a more efficient radio network, with the KPI being measured in bits per Joule.

6G-INTENSE Methodology

Relevance

KVI	Relevance
Innovation	
I1: Safety	Safety refers to the ability of a system to avoid harming human life, the environment, or private property due to its unavailability (lack of communication)
I2: Security	It entails the creation of systems that outline who has responsibility for monitoring threats as failure, hacking, and infection
I3: Regulation	Comply with the legal and regulatory framework imposed by the law
I4: Responsibility	*Discrete roles/accountability for collaborating partners towards the design, management and use of 6G systems. Additional consideration of how actions may impact the greater society*
I5: Energy efficiency	Reduced energy consumption in the operation of the 6G system end-to-end targeting the long-term challenge of a sustainable and carbon-neutral world by 2030, according to United Nations Sustainable Development Goals (UN SDGs)
Democracy	
D1: Privacy	Appropriate use of the collected end-user data. Updated data protection framework (GDPR) includes more privacy-enhancing measures such as 'the right to be forgotten' and 'the right to access' (personal data concerning them is being processed, where and for what purpose)
D2: Fairness	Ability of the AI/ML algorithms to perform decisions free of discrimination and bias
D3: Digital Inclusion	*Deploy technologies that serve the historically under-served*
D4: Trustworthiness	6G network design should support trustworthiness, collaborative sensing, and distributed learning to enable AI applications
Ecosystem	
E1: Sustainability	Sustainability is the ultimate objective of 6G network design, since 6G should be sustainable from a wider socio-economic and environmental perspective, encompassing not only energy related aspects, but also natural resources consumption, products lifecycles, social sustainability, etc.
E2: Business value	*6G systems should demonstrate their commercial benefit for vertical industries and telco operators*
E3: Economic growth	Building a competitive and resilient economy, investing in skills, education, and digital transformation
E4: Open collaboration	Use methods based on collaboration and knowledge sharing and interaction according to their capacities
E5: New value chain	The value chain in 6G is expected to increase as a consequence of inclusive (cooperative and interactive) industrialization

Mapping of KVIs per application developed

KVI	Measurement Method	Frequency	Target Group	Distributed Continuum	Metaverse
Innovation					
I1: Safety	*Questionnaire and focused group surveys of stakeholders*	Ad-hoc	Stakeholders, Webinar participants		++
I2: Security	Questionnaire and focused group surveys of stakeholders and Nº of incidents	Ad-hoc		+++	
I3: Regulation	*OTE and ORO to report on D6.2 – directly engage with policy makers*	Ad-hoc	Policy Makers	+++	
I4: Responsibility	RACI charts (identify and interview consortium stakeholders)	Ad-hoc		+	
I5: Energy efficiency	energy consumption per bit >90% (standardized methodologies of ETSI)	Ad-hoc	N/A	+++	+++
Democracy					
D1: Privacy	Nº of privacy issues in the datasets for ML/AI training	Ad-hoc	N/A	+	+++
D2: Fairness	Whitebox testing	Ad-hoc	N/A	+++	
D3: Digital Inclusion	*Questionnaires/group surveys (can people with disabilities access network resources?)*	Ad-hoc	Disabled people	+++	+++
D4: Trustworthiness	Demonstration of trust through PoCs	Ad-hoc		+	
Ecosystem					
E1: Sustainability	>30% CO_2 emissions reductions in 6G systems	Ad-hoc	N/A	+++	
E2: Business value	Arcadia framework – leverage of different levels of expertise	Ad-hoc		+++	
E3: Economic growth	Arcadia framework – leverage of different levels of expertise	Ad-hoc			
E4: Open collaboration	*Collaboration with other SNS JU projects*	Ad-hoc		+	
E5: New value chain	Raise awareness and engage relevant stakeholders from interested vertical industries	Ad-hoc			

Concluding Remarks

Continuation of works in WGs

- Four different projects' methodologies are presented:
  (i) HEXA-X II, (ii) FIDAL, (iv) TRIAL-NET, (v) 6G-INTENSE.
- The choice of the projects was performed so that it gives an indication of the challenges encountered towards the development of a common Evaluation Framework.

Societal Needs and Value Creation sub-group (SNVC SG)

- Looks for how 6G will be beneficial for all other players on the market, including the society at large.
- SNVC analyzes societal acceptance and develops KVIs

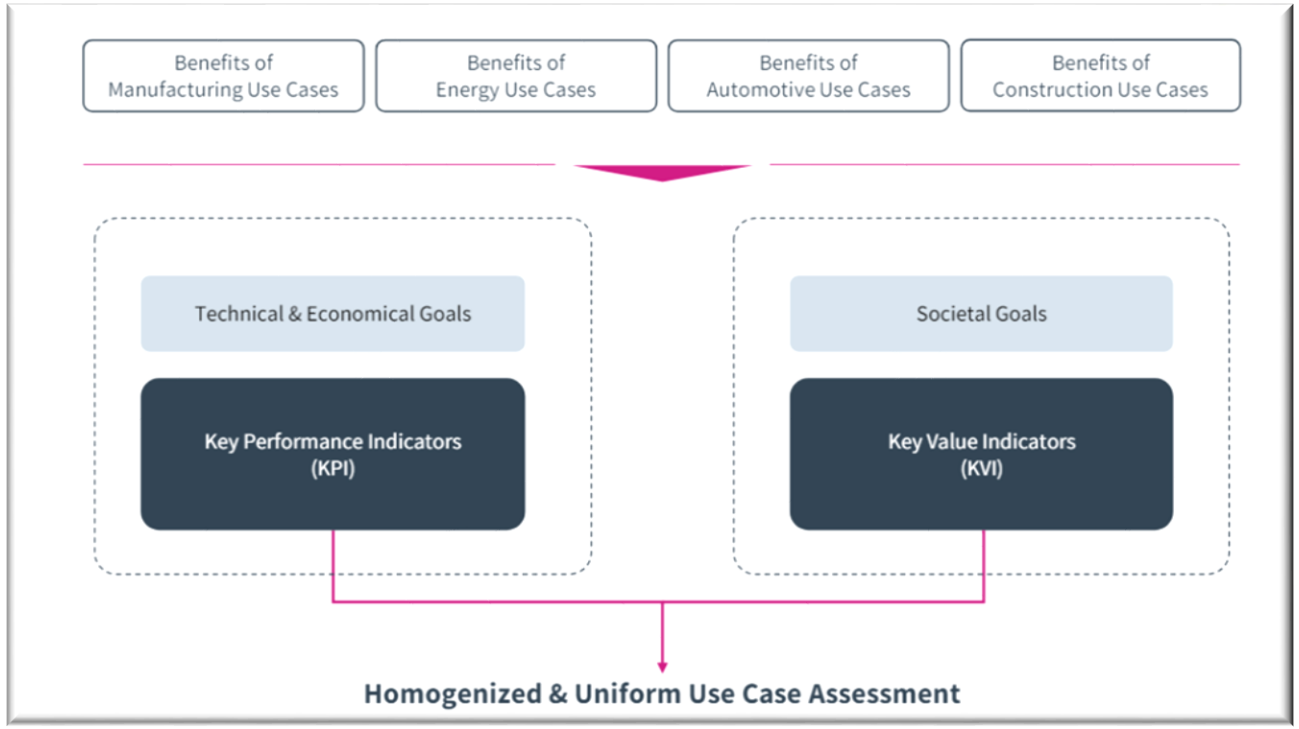
Thank you

For your attention!

BACKUP SLIDES

TARGET-X's Methodology

Overview



- TARGET-X introduces a KPI/KVI-based *Methodological Assessment Framework (MAF)* designed to quantify the value proposition of its use cases following their implementation and application.
- The framework evaluates technical, economic, and *societal* benefits.

CENTRIC's Methodology

Overview

CENTRIC is a *use case-agnostic* project that *focuses on technological enablers* rather than specific 6G use cases.
As a result, assessing the societal impact of the developed technologies is challenging.
CENTRIC's vision emphasizes on developing enablers for a sustainable 6G network.

Sustainability is addressed in three key dimensions:

- *Environmental Sustainability*
  Two KVIs are defined here:
  (i) Energy efficiency improvements, which measure the energy required to deliver a 6G service.
  (ii) material efficiency improvements, based on ITU-T L.1023 (providing a methodology for assessing the circularity potential of ICTs).

- *Economic Sustainability*
  KVIs are focused on CAPEX and OPEX, particularly in relation to network deployment and operation.

- *Societal Sustainability*
  This includes addressing trustworthiness issues, such as
  (i) EMF-aware networks, which respond to public concerns about the health risks of electromagnetic fields, and;
  (ii) user data protection and privacy, which focus on safeguarding user data, particularly when AI and ML algorithms are involved.

TARGET-X's Methodology

Possible Societal Goals

TARGET-X's Possible Societal Goals		
Democracy	*Ecosystem*	*Innovation*
Privacy	Sustainability	Safety
Fairness	Business Value	Security
Digital Inclusion	Economic Growth	Regulation
Trust	*Open Collaboration*	Responsibility
	New Value Chain	*Energy Consumption*

TARGET-X will examine further in the course of the project the potential societal goals according to *SNS-JU R&I Work Programme 2021 – 2022*