On the stimulation of an evolution of test and experimentation infrastructures to measure value

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6G-SANDBOX main figures

Particip. No.	Participant organisation name	Country
1 (PC)	Keysight Technologies Belgium BV (KEYB)	Belgium
3 (TM)	Universidad de Malaga (UMA)	Spain
2	Keysight Technologies Denmark AsP (KEYD)	Denmark
4	Fogus Innovations & Services (FOG)	Greece
5	Infolysis (INF)	Greece
6	Boreal Technology & Investments (OWO)	Spain
7	Telefonica (TEL)	Spain
8	National Centre of Scientific Research "Demokritos" (NCSRD)	Greece
9	COSMOTE (COS)	Greece
10	Nokia (NOKIA)	Spain
11	Oulu University (OULU)	Finland
12	Ictficial (ICTF)	Finland
13	OpenNebula (ON)	Spain
14	Eurescom (EURE)	Germany
15	IS-Wireless (ISRD)	Poland
16	Franhoufer (FOKUS)	Germany
17	Lenovo (LNV)	Germany
18	The Queen's University of Belfast (QUB)	UK

Project Information

6G-SANDBOX

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Belgium

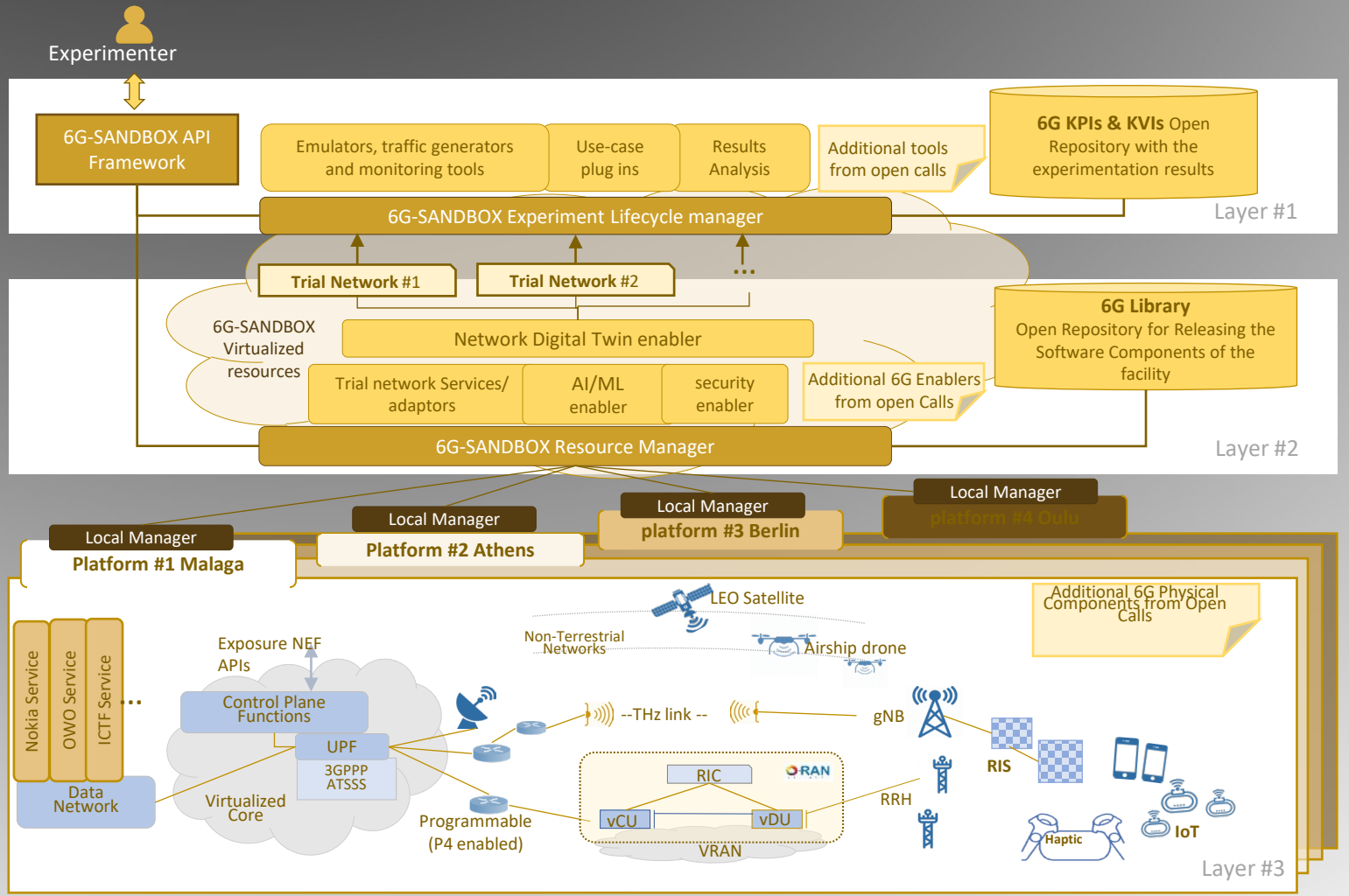
6G SANDBOX scope

- **From the technical perspective**, it is mapped to the target of designing, developing, and managing the 6G-SANDBOX facility that i) realises the concept of Trial Networks, ii) adopts the API potential for internal and external extensibility to the facility interactions, iii) validates of the most challenging 6G KPIs and KVIs, and iv) provides related tools open to third parties.
- **From the implementation and impact perspective** it reflects the need for solutions and pathways that guarantee Modularity, Openness, Reusability, Innovation, and Sustainability, i.e., the main characteristics that the facility will be built on, and the realization of a cascade funding competitive process to engage technologies, third-parties and stakeholders beyond the project borders.
- **From the research perspective** it encompasses the request for validating 6G advancements at all the domains of service provisioning chain (end-to-end), and at all planes (user, control and management).
- **From the deployment perspective**, it is related to a wide and well distributed deployment of physical infrastructures in EU region, which within the project is fulfilled by four sites (Athens, Berlin, Malaga and Oulu) and any other potential node that third parties will contribute where the enablers developed in 6G-SANDBOX can be deployed

Project topics

- 6G Candidate technologies
- Open (distributed) experimental platforms
  - At locations: Malaga, Berlin, Athens, Oulu
- KPI & KVI evaluation
  - Experimentation framework as a service on trial networks
  - KPIs & KVIs validation
- 6G use cases
- Open Calls

https://6g-sandbox.eu/


Experimenter
6G-SANDBOX API Framework
Emulators, traffic generators and monitoring tools
Use-case plug ins
Results Analysis
Additional tools from open calls
6G KPIs & KVIs Open Repository with the experimentation results
6G-SANDBOX Experiment Lifecycle manager
Layer #1
Trial Network #1
Trial Network #2
...
6G-SANDBOX Virtualized resources
Network Digital Twin enabler
Trial network Services/ adaptors
AI/ML enabler
security enabler
Additional 6G Enablers from open Calls
6G Library
Open Repository for Releasing the Software Components of the facility
6G-SANDBOX Resource Manager
Layer #2
Local Manager
Platform #1 Malaga
Local Manager
Platform #2 Athens
Local Manager
platform #3 Berlin
Local Manager
platform #4 Oulu
Nokia Service
OWO Service
ICTF Service
Data Network
Exposure NEF APIs
Control Plane Functions
UPF
3GPPP ATSSS
Virtualized Core
Programmable (P4 enabled)
LEO Satellite
Non-Terrestrial Networks
Airship drone
Additional 6G Physical Components from Open Calls
--THz link --
gNB
RIS
RIC
O-RAN
vCU
vDU
VRAN
RRH
Haptic
IoT
Layer #3

Need a shift in focus

- Technology development and evaluation has been driven by functional performance increase and optimization and estimated market opportunities
- Today, societal challenges and sustainable development goals are calling for a paradigm shift to align technology development with a values-based consideration and re-prioritization of outcomes

Policy frameworks

- Provide the anchor points to derive specific values and demonstrate positive outcomes and impact in a wider context

- UN – Sustainable Development Goals
- EU – Green Deal, Strategic Agenda
- OECD – …
- …

Sustainable development goals

- #8 Promote sustained, inclusive and sustainable **economic growth**, full and productive employment and decent work for all
- #9 Build **resilient infrastructure**, promote inclusive and sustainable industrialization and **foster innovation**
- #11 Make **cities** and human settlements inclusive, safe, resilient and sustainable
- #12 Take urgent action to combat **climate change** and its impacts

…

Values

- Values as criteria: Human values providing motivating goals for technological development and criteria for evaluating intermediary results
- Values as outcomes: the enabled benefits or detriments
  - As an outcome of "value creation" economic, social and / or ecological benefits stem from a technology, service or business model, but also detriments or risks can result.
- (Key) Values: A selection of values agreed among stakeholders.
  - Together, the set "values as criteria" and "values as outcomes" are the basis for value analysis.

Key Value Indicators

- KVIs: quantitative or qualitative indicators for gauging effects on values as outcomes.
- The purpose is to gauge the impact from the execution of a use case in terms of economic, social and/or ecological benefits (gain) or detriments (loss).
- KVIs are defined as metrics, either on a qualitative scale (good-bad, etc.), or when possible on a quantitative scale (high-low, etc.).
- Defined in the scope of a specific use case and scenario (use case KVIs), e.g. related to the **ICT for Sustainability** ambition;
- Or defined in relation to a use case enabler (enabler KVIs), e.g. related to the **Sustainable ICT** ambition.

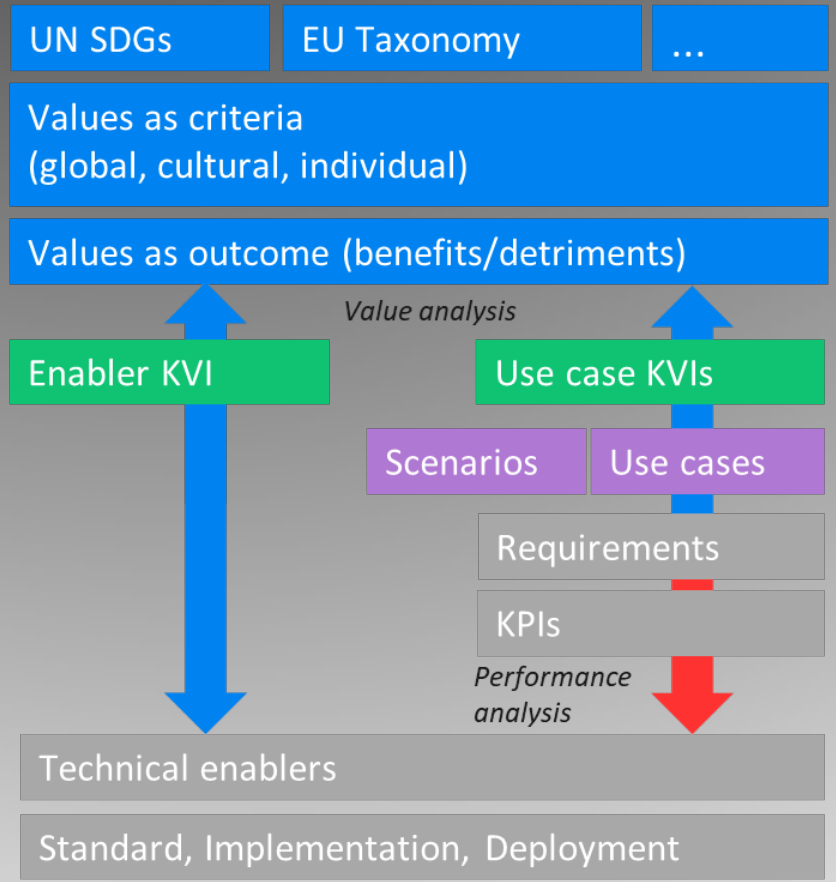
Scenario vs. use case

- We use the term *Scenario* to denote a general setting of a situation and how different stakeholders and actors interact and behave in this setting. It describes general responsibilities and expectations. A scenario can be decomposed in use cases.
- We use the term *Use Case* to describe a specific sequence of actions that must occur when a system part or an actor interacts with the rest of the system. A use case is more granular than the scenario.

Some more terminology

- *Performance*: the technical capabilities needed to deliver a use case.
- *KPIs*: Key performance indicators as quantitative results of gauging performance.
- *Requirements*: needed performance (measured against KPIs) or functionalities to deliver a use case.
- *Technical enablers*: the realization of technical capabilities, i.e. ICT solutions.

How things come together



Goals/Targets

Enabled/induced value

Benefiting values

Value metrics

Getting results for users/stakeholder engagements

Context; Technology proliferation

Service definition

Performance metrics

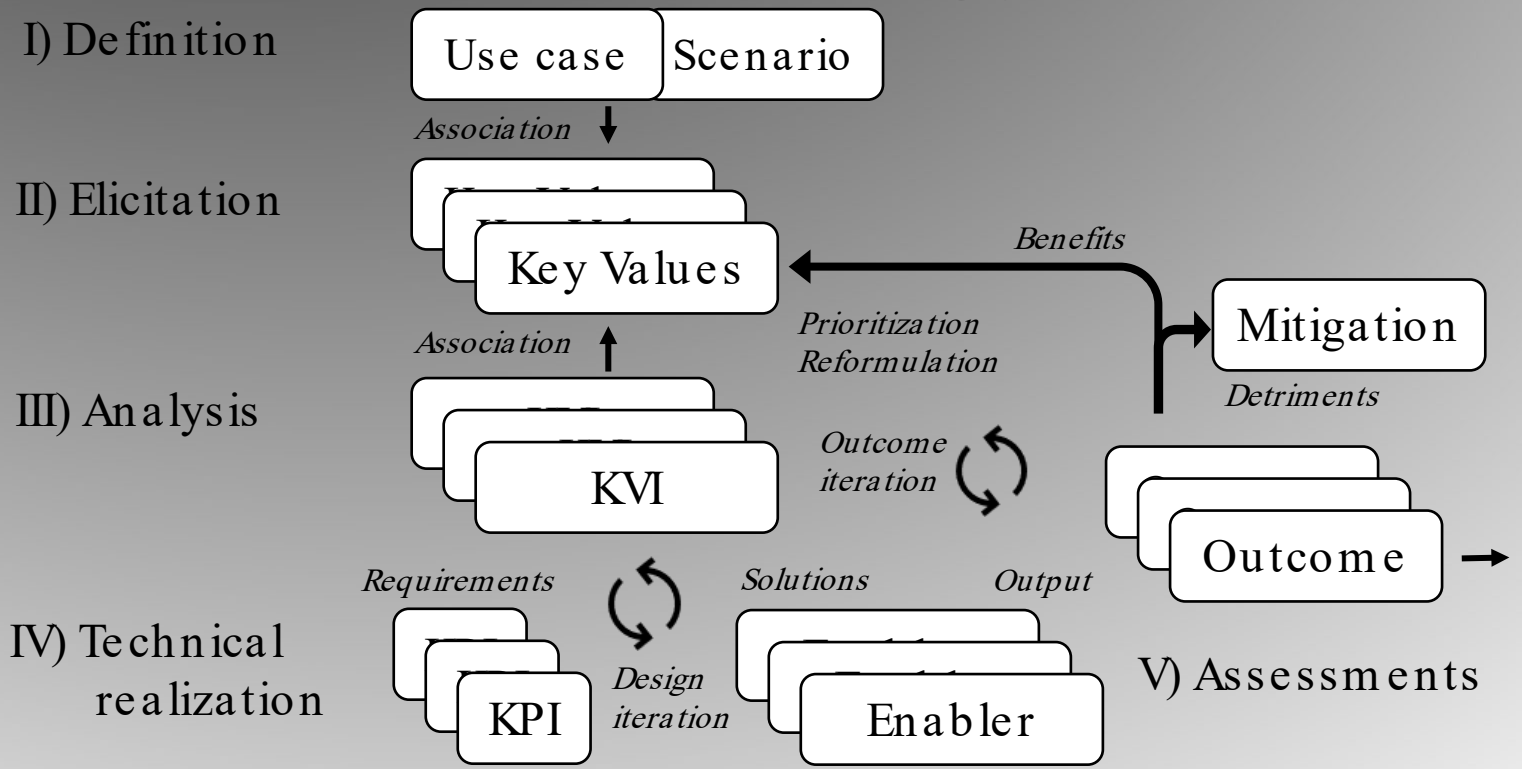
Delivering performance

Realization of capabilities

Enabled performance

SAND BOX

KVI framework → Evaluation methodology



KVI framework → Evaluation methodology

- Step I: **Definition** of scenario and use cases
- Step II: **Elicitation** - Identification of key values (KVs) as criteria and key values as outcome
- Step III: **Analysis**
  - of outcome on value domains
  - of value proposition
  - prioritization and balance between KVIs and KPIs
- Step IV: **Technical realisation** – design, specification, implementation…
- Step V: **Assessment**

Assessment

- Expert assessment
- Simulation
- Twinned System
- Actual deployment
- …or a combination

Examples

- Number of incidents of health problems caused by air pollution in the city - measured in % decrease compared to current baseline.
  - *Simulation* based on suitable models can provide a theoretical estimate of the expected reduction in health incidents.
  - In complement, the *actual system* can provide data that can be compared to agreed baselines, *expert assessment* can provide professional judgment on the potential impact of the proposed solution, and a *twinned system* can be used to relate real-time data for judging the effectiveness of the solution.
- Efficiency in the detection of dangerous areas for vulnerable groups - measured in % increase compared to current baseline.
  - A *twinned system* through real-time data integration, proactive monitoring and scenario-based *simulation* appears to be the best way to evaluate this KVI, because it could be constructed with a feedback loop for incorporating improvements.
  - *Expert assessment* and *actual system* may not be able to respond properly to the dynamic nature of the KVI and the need for fast adaptation.

Contacts

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www.smart-networks.europa.eu