

Stream B (RIA): Revolutionary research towards 6G

- Address **long-term** challenges to ensure European leadership in 6G networks
- A successful **digital and green transitions** for the **vertical industries**
- Solution that **address UN's SDGs** (coverage, affordability, accessibility) in cases of high public value (e.g., healthcare, agriculture, education, public safety, etc.)
- Efficient **support of upcoming innovative applications** with performance requirements beyond current technological capabilities
- **Extend** the current set of patchy **technologies for security and trust** towards a comprehensive end-to-end framework, covering virtualized and software based heterogeneous networking environment
- end-to-end **security frameworks** must be “**dynamic**”, integrating the different ICT involved, establishing monitoring and evaluation provisions, and identifying those responsible for ownership and successful implementation

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- Stream B takes a holistic research approach towards the needed technology (a **value chain perspective** covering an integrated ecosystem with IoT, devices and software-based solutions in unified networks)
- The target is a **globally connected continuum platform** with the convergence of networks and IT systems to enable new future digital services
- This continuum must provide users with **improved performance, higher level of control**, increased **transparency** in interactions with digital services, adequate **support of ethical values** and **conformance with societal requirements** and **readiness** (e.g., GPDR, EMF awareness, etc.)

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- Starting point for KPIs and KVIs: NetWorldEurope SRIA, 5G PPP ICT-52-2020 projects, national initiatives in EU or in other regions of the world)
- Projects working on micro-electronics components for future 6G platforms (e.g., IoT devices, virtualized and disaggregated network implementations) are expected to deliver outcomes that can be used as direct specific 6G component requirements towards KDT
- Cloud and edge cloud technologies and software implementation of network/device control functions are expected to provide a clear strategy in relation to EU supply capabilities and the future cloud continuum that may involve interoperation with non-EU systems such as the hyperscalers.
- Projects in topics SNS-2022-STREAM-B-01-01, SNS-2022-STREAM-B-01-02, SNS-2022-STREAM-B-01-03 and SNS-2022-STREAM-B-01-04 are expected to actively cooperate with the SNS-2022-STREAM-B-01-05 “6G Holistic System” project (e.g., provide KVIs, KPIs, 6G enablers and solutions, etc.)

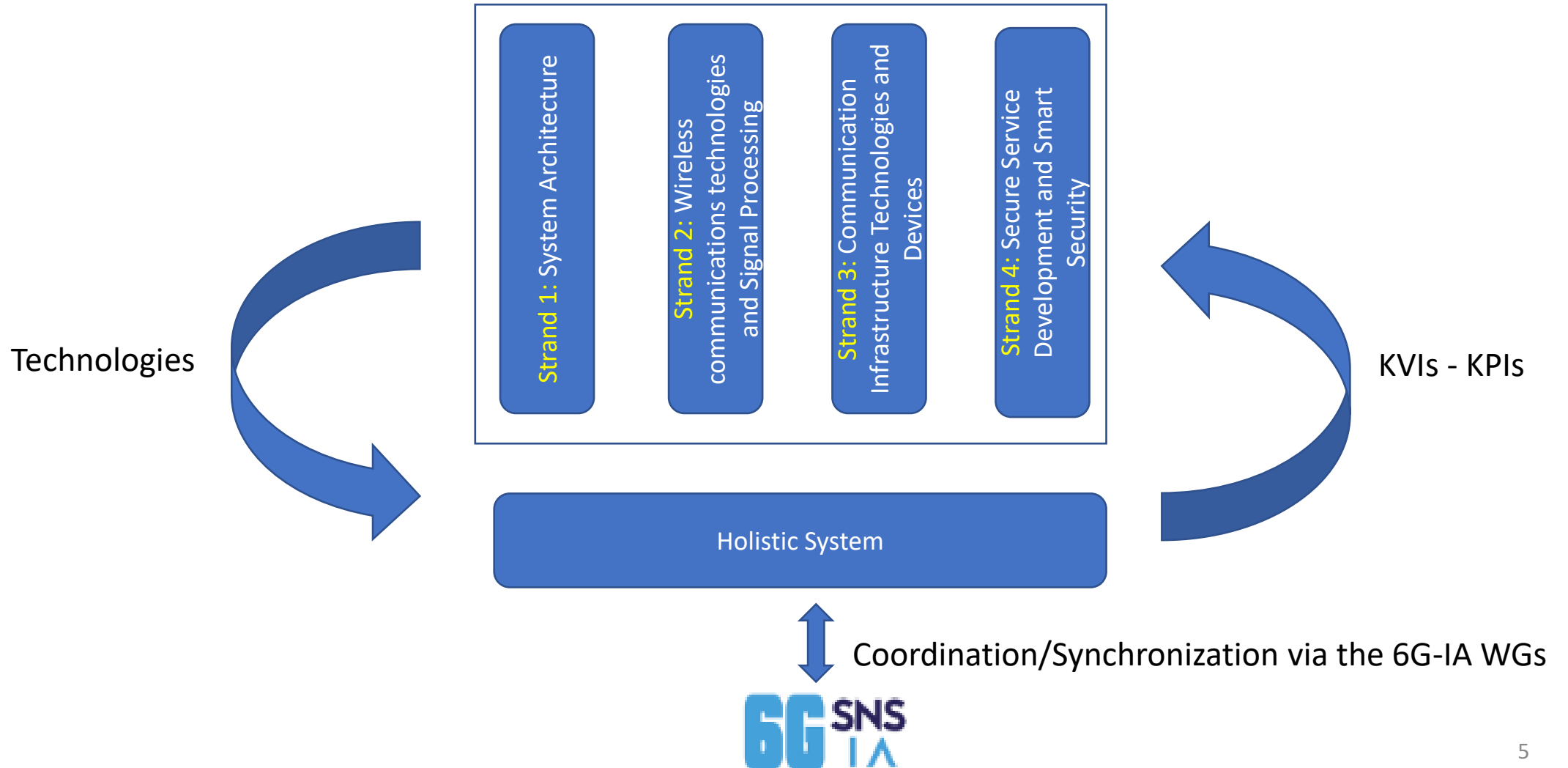
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- Specific objectives:
 - ✓ Establishment of a globally accepted set of KVI's and KPI's framing future 6G developments
 - ✓ Dynamic end-to-end distributed security for connectivity, devices and service infrastructures (including distributed systems, operational security - e.g., a dedicated SoC- , security quantification and threat assessment)
 - ✓ A comprehensive zero-touch open end-to-end resource management system with drastic OPEX reduction and innovation support.
 - ✓ Trustworthy and energy-efficient device, network, and service infrastructures, delivering critical services as well as a dynamic multi-vendor supply market, through new open network and service paradigms
 - ✓ Increased spectrum efficiency and dynamic spectrum across multiple (and potentially new) frequency bands (potentially above 100GHz), also addressing citizen concerns like low EMF exposure
 - ✓ Foster European capabilities in key technologies and notably AI/ML (provide open data sets) , advanced signal processing and microelectronics realizing visual vanishing (e.g., making the infrastructure imperceptible to the end-users) by fusion with physical environment
 - ✓ Provide a set of technologies and architectures to reinforce the European industry position during the 6G standardisation phase expected to start around 2025

Stream B: Research Foundations for 6G -RIA

Implementation concept: guarantee minimal funding for each one of the main areas.

Provide the **research foundations for low TRL technology** advancement in preparation for the upcoming 6G networks



Implementation concept: at least four projects addressing the topics above (at least one, preferably more.)

➤ **Strand 1 - System Architecture**

Expected outcome:

- Intelligent connectivity and service provision across a huge number of **heterogeneous domains, resources**, and with a considerable number of **6G application requirements**.
- An architecture able to **break the boundaries** between different **infrastructure, service, business, and application** environments, capable for a unified service provision across heterogeneous communication and computing environments.
- inter-computing **beyond** the inter-networking **capabilities of the Internet**, making possible the execution of **services across multiple heterogeneous but seamlessly inter-working domains**, each possibly applying **different policies** (e.g., in terms of security, routing, access to resources, etc.), **routing mechanisms, access mode to application services**, etc.
- An internet-like architecture supporting much **higher dynamics and versatility for its topology and service instantiation** while significantly **lowering energy consumption**.
- Architecture and technologies enabling the connectivity and service infrastructure to be **programmable with a single, unifying, and open controllability framework**, spanning all resources a tenant is authorized to control, including resources from currently separate and heterogeneous domains, such as enterprise and telecom networks, virtual and physical, data centres and routers, satellites, and terrestrial nodes.

Implementation concept: at least four projects addressing the topics above (at least one, preferably more.)

➤ **Strand 1 - System Architecture**

- Technologies for scaling Inter-computing systems
- Control and controllability separation
- Frictionless inter-domain resource management
- Native integration of AI for telecommunications
- New Data Transfer Paradigms with deep Edge integration
- Improve data plane performance
- Deterministic Networking

Implementation concept: at least five projects addressing the topics above (at least one, preferably more.)

➤ **Strand 2 – Wireless Communication Technologies and Signal Processing**

Expected outcome:

- ✓ Wireless technologies and systems capable to **meet expected 6G radio capabilities** such as Tbps data throughput, sub-ms latency, extremely high reliability, massive mMTC, extreme energy and spectrum efficiency, very high security, and cm-level accuracy localization
- ✓ Technological progress towards **exploitation of new spectrum** such as the sub-THz or THz spectrum
- ✓ Innovative RAN (Radio Access Network) facilitating multi-vendor interoperability, and flexible service introduction
- ✓ Technologies and architectures enabling support of new **higher efficiency mobile communication approaches**, such as **cell free networking**, with capability to drastically **reduce energy consumption** and to **control EMF exposure levels**
- ✓ Applicability and validation of **innovative AI/ML based architectures to control L1/L2 functions** with optimised feedback control and operations.
- ✓ **Identification of microelectronics solutions** and technologies at RF, Baseband, DSP, processing levels to support future 6G RANs.

Stream B - RIA

Research Foundations for 6G

Implementation concept: at least five projects addressing the topics above (at least one, preferably more.)

- **Strand 2 - Wireless Communication Technology and Signal Processing**
 - Terahertz Communications and Ultra-Massive MIMO
 - Joint communications and sensing
 - New Waveforms, Random and Multiple Access
 - Enhanced Modulation and Coding
 - Wireless Edge Caching
 - Human-friendly Radio systems
 - Spectrum Re-farming and Reutilisation

Implementation concept: at least five projects addressing the topics above (at least one, preferably more.)

➤ **Strand 3 – Communication Infrastructure Technologies and Devices**

Expected outcome:

- ✓ The availability of **fixed backhaul and longhaul networks** with **performance levels compatible with 6G KPI's** in terms of bandwidth, capacity, latency, and flexibility.
- ✓ The availability of viable solutions, both from a technological and cost perspectives, allowing to bring beyond 5G and 6G services to places where terrestrial solutions are not economically viable, hence **maximising coverage and access to services**.
- ✓ The availability of solutions addressing the need to **develop 3D scalable networks** capable to address flying devices, beyond current network solutions primarily designed for 2D usage.

Stream B - RIA

Research Foundations for 6G

Implementation concept: at least five projects addressing the topics above (at least one, preferably more.)

➤ **Strand 3 – Communication Infrastructure Technologies and Devices**

- Flexible Capacity Scaling
- Ultra-high Energy Efficiency
- Integration of Optical and Wireless Technologies
- NTN Infrastructures
- Integrated NTN service provision
- New IoT components and devices
- Troposphere Networking
- New Physical Layers
- Nano-things networking

Implementation concept: at least four projects addressing the topics above (at least one, preferably more.)

➤ **Strand 4 – Secure Service development and Smart Security**

Expected outcome:

- ✓ **Identification/characterisation of the threat landscape** applying to future end-to-end 6G connectivity and service systems and of the **technologies** and **architecture** to **mitigate them**
- ✓ Technologies for the necessary levels of **trustworthiness, resilience, openness, transparency, and dependability** expected under the EU regulations (such as GDPR and Cyber Security Act, new certification processes etc) across a **complete continuum** (human-cyber-physical system & connectivity-service provision).
- ✓ Technologies ensuring **secure, privacy preserving and trustworthy services** in the context of a **programmable platform accessed by multi-stakeholders** and tenants including vertical industries as users.
- ✓ **Security technologies** addressing the challenge of **open-source solutions** (multi-vendor interoperability).
- ✓ **Secure host-neutral infrastructure** where multiple infrastructure providers are involved in the deployment, hosting and orchestration of the network service.
- ✓ Identification of the **life cycle of smart services security and trust requirements** including development, provision, operation, maintenance and of their business impact on the stakeholders' ecosystem.
- ✓ **AI technology applied to security** in two ways (AI to enhance security, potential security threats using AI)

Stream B - RIA

Research Foundations for 6G

Implementation concept: at least four projects addressing the topics above (at least one, preferably more.)

➤ **Strand 4 – Secure Service Development and Smart Security**

- Human-centric security and privacy technologies
- Holistic smart service development frameworks
- Secure lifecycle service management and smart operation
- Enhanced service features for fostering security
- Efficient security enablers for dynamic heterogeneous untrusted environments

Expected outcome:

- A **complete system perspective** of future 6G SNS platform,
- **Consolidating 6G KPI's and KVI's** as federating SNS targets for European R&I in the field.
- **Identify 6G use cases**, their **requirements**, and how they can be **supported by the 6G** retained architecture/technologies.
- Identify the **most promising technologies** towards the realisation of the 6G vision.
- Translate **societal/ethical use cases requirements** into **technological requirements**
- **Identify critical technologies** for **future standardisation work**.

- The project should equally investigate both technical and societal aspects to cover citizen needs in 2030 and beyond.
- Well-defined means of communication with the 6G-IA to ensure the European ICT community vision is appropriately captured
- An advisory board may be considered
- The project is planned to start concurrently with other Stream B RIAs (work on KPIs & KVIs,...)