



Small Cells as “Enablers” of the 5G World: The approach of the SESAME Project

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The 5G Infrastructure Public Private Partnership

Introductory Scope_(1)

- **Internet and communication networks** are **“critical” tools** for most areas and sectors of our **modern societies & economies**. They are radically transforming our world and do constitute **fundamental “pillars”** for any evolutionary process supporting effort for **growth and development**.
- The communication networks and the wider modern services/facilities environment of the *year 2020* will be ***“enormously richer and much more complex than that of today”***.
- **The underlying (usually heterogeneous) network infrastructure will be able of “connecting everything”** according to an extended multiplicity of application-specific requirements (*thus including users, equipment, things, goods, computing centres, content, knowledge, information and processes*), **in a purely flexible, mobile, and quite powerful way**.

Introductory Scope_(2)

- Modern innovative aspects not only necessitate but also imply for the **proper establishment** and the **effective operation** of a relevant **novel kind of infrastructure**, *able to provide network features and performance characteristics assuring progress and growth in all corresponding domains (i.e., technical, business, financial, regulatory, social, etc.).*
- The **“inclusion” of modern features** (such as of **virtualisation** and of **software-based network functionalities**) in network communications infrastructures **will support the actual transitional process**, **via further strengthening network flexibility and reactivity**, and by providing a proper means for **better network management** and for **offering of new services**.

Introductory Scope_(3)

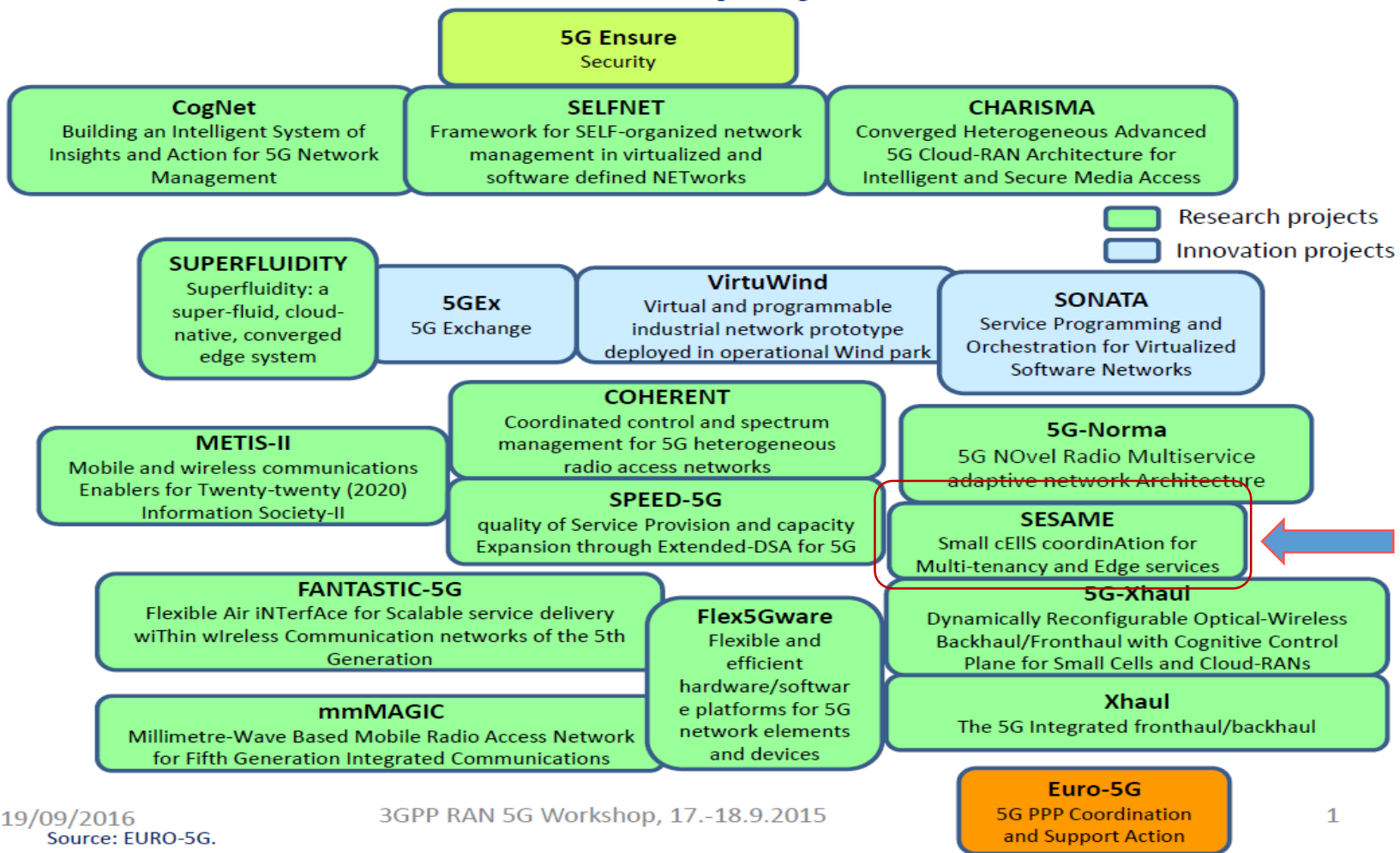
- **Market “actors”** (*network operators and service providers, manufacturers, SMEs, end-users, etc.*) **are expected to be strongly involved in such processes.**
 - **This will “redefine” existing value chains and reform roles and/or relationships between market “players”,** *whilst creating new opportunities for novelty and investments.*
 - ➡ **These chances will also take place within the forthcoming “fifth generation” -or 5G- of telecoms systems, that will be the most critical building block of our “digital society” in the next decade.**
- 5G will not only be an evolution of mobile broadband networks, but:**
- ❖ will bring **new unique network** and **service capabilities**,
 - ❖ will **create** a **sustainable and scalable technology**
 - ❖ will **establish** a **proper ecosystem for technical/business innovation.**

SESAME Project – Positioning_(1)

- ➡ The **development of the 5G ecosystem** involves numerous groups of industry stakeholders, research institutions, standard developing organizations, certification bodies and other institutions and/or legal entities.
- ➡ In particular, **5G-PPP is a “joint” initiative between the European Commission and the European ICT industry**, intending to further reinforce the European presence in this field, *at the global level*.
- ➡ The **main objective** is to ***design and deliver appropriate solutions, architectures, technologies and standards*** for the next generation communication infrastructure.
- ➡ ***The European Union funds 19 projects under the 5G-PPP Phase 1 programme and 21 projects under the 5G-PPP Phase 2 programme. All these projects work together to deliver the critical 5G technology “building block”.***

SESAME Project – Positioning_(2)

Horizon 2020 5G-PPP Call 1 selected projects



19/09/2016
Source: EURO-5G.

3GPP RAN 5G Workshop, 17.-18.9.2015

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SESAME Project – Positioning_(3)



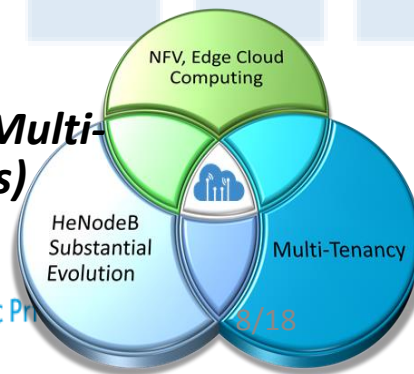
The **SESAME project (GA No.671596)** addresses the needs of future 5G mobile networks from the perspective of a **scalable and flexible system**, rather than focusing in new 5G waveforms or protocol stacks.

SESAME Innovation Framework_(1)

SESAME targets innovations around three central elements in 5G:

- ➡ **Placement of network intelligence and applications in the network edge** through Network Functions Virtualization (NFV), Software Defined Networking (SDN) and Edge Cloud Computing.
- ➡ **Substantial evolution of the Small Cell concept**, already mainstream in 4G but expected to deliver its full potential in the challenging high dense 5G scenarios.
- ➡ **Consolidation of multi-tenancy in communications infrastructures**, allowing several operators/service providers to engage in new sharing models of both access capacity and edge computing capabilities. **Capability to accommodate multiple operators under the same infrastructure**, satisfying the profile and requirements of each operator separately.

(Small cEllS coordinAtion for Multi-tenancy and Edge services)



SESAME Innovation Framework_(2)

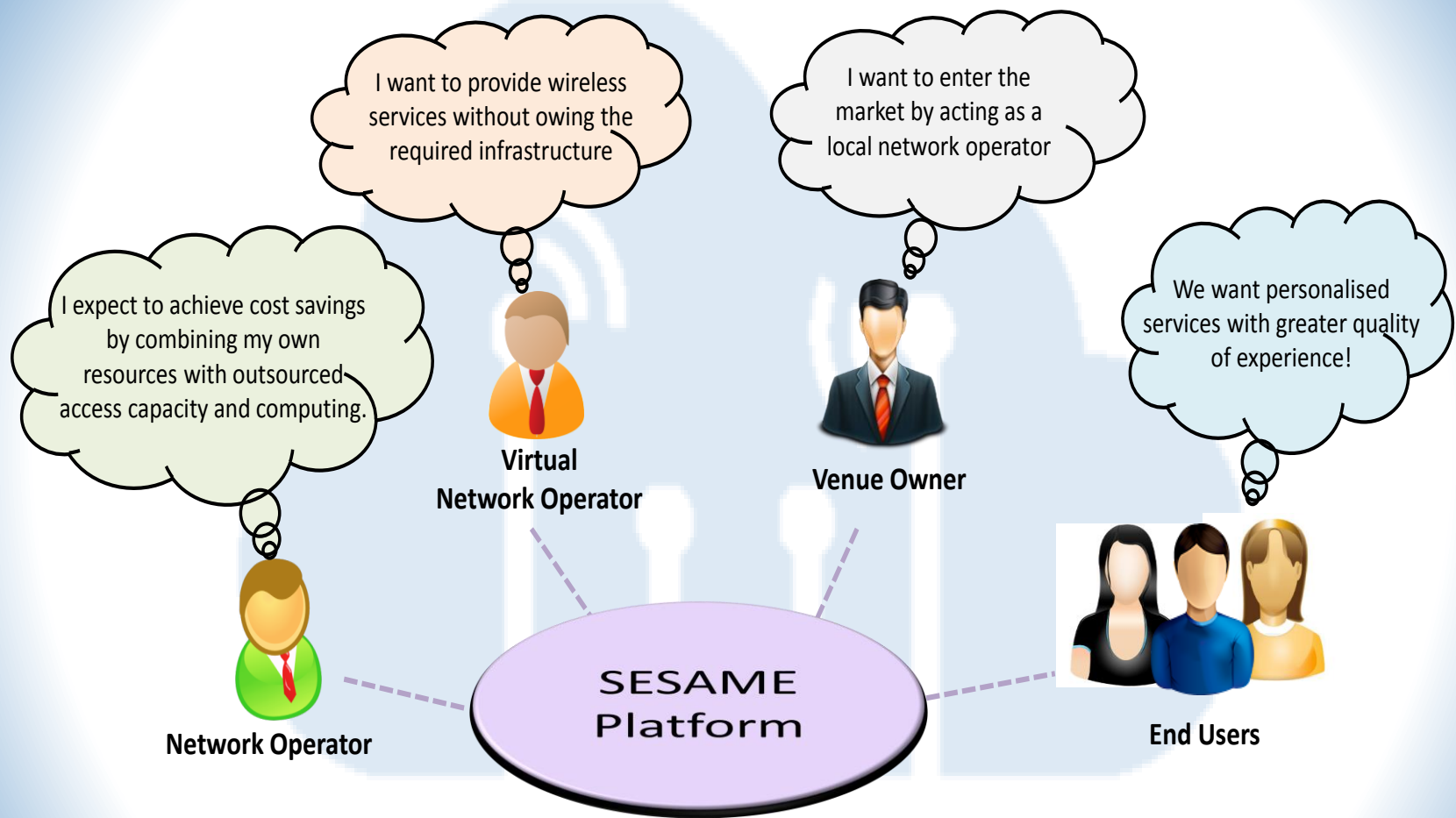
Addressed areas:

- **Incorporation of general-purpose computing and storage assets at the edge of mobile networks.**
 - *In this direction, new industry initiatives have already introduced the **concept of Mobile-Edge Computing** and the related **key market drivers**.*
 - *To enhance further the virtualisation capabilities of the Small Cell deployment, to include not only network capacity resources but also edge processing capabilities, **a micro scale virtualised execution infrastructure is proposed by SESAME, in the form of a “Light Data Centre” (Light DC)**.*
 - *The Light DC concept will be designed in order to build a clustered infrastructure with high manageability and will be optimised to reduce power consumption, cabling, space and cost.*
- **Small Cells Context: Proposition of the **Cloud-Enabled Small Cell (CESC)** concept for deploying Virtual Network Functions (VNFs) supporting of powerful “Self-x” management & executing novel applications and services, **inside the access network infrastructure**.**
 - *To realise SESAME’s vision, “**Cloud-Enabled Small Cells**” (CESCs) will be designed, developed and implemented, to offer access to network capacity coupled with mobile edge computing resources in a single device.*
 - *Such resources will be offered on-demand to Communications Service Providers (CSPs), profiling both access and edge computation resources to satisfy the specific CSPs’ needs.*

Addressed areas:

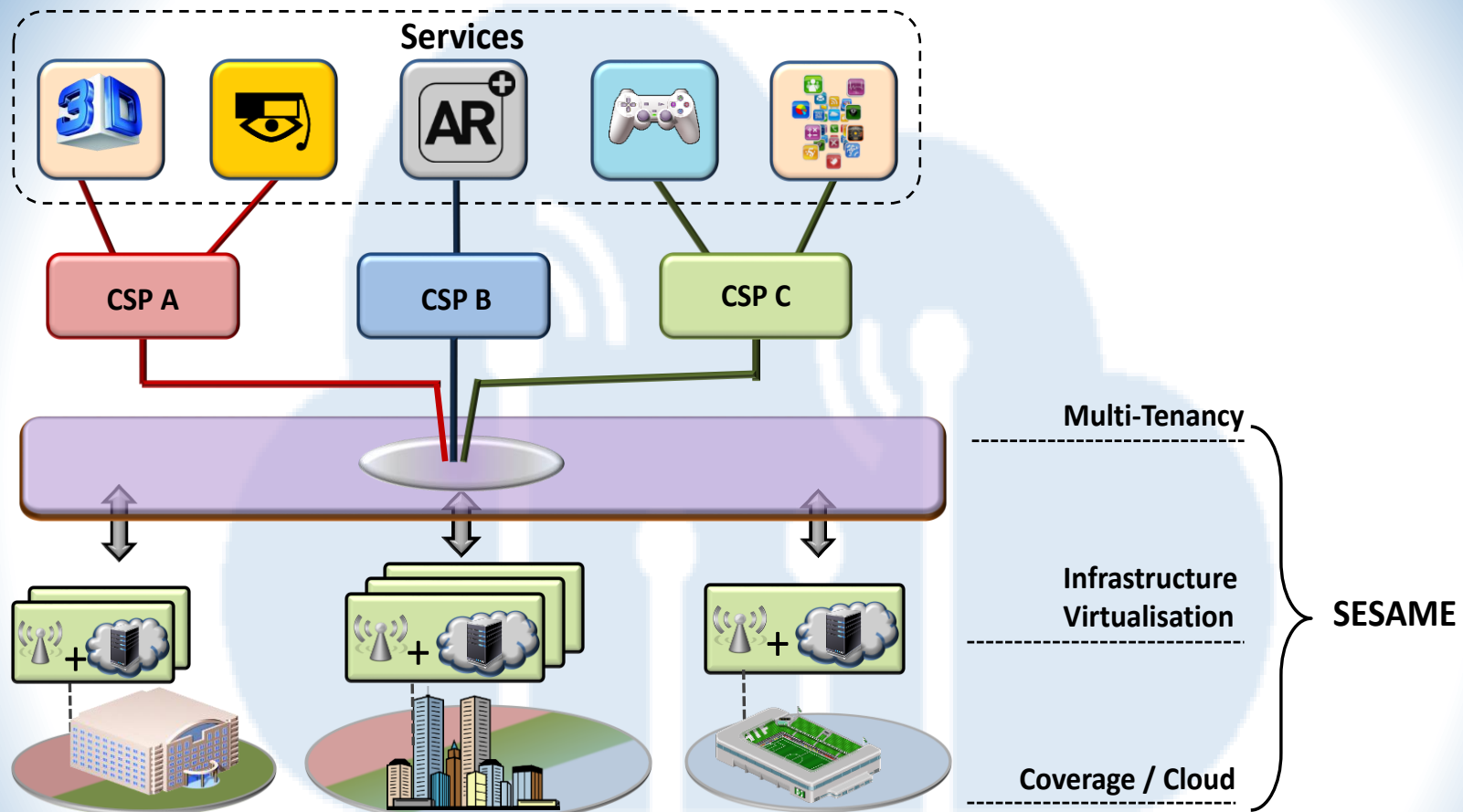
- From the perspective of service provisioning, **the proposed approach can be used to provide edge cloud capabilities and enable accelerated services, content and application due to the increased network responsiveness.**
- Operators may provide the network's edge (i.e., the Light DC) to third party partners, allowing the **rapid deployment of cutting-edge services to users and enterprises, translating to added value and creating opportunities for vendors, service providers and operators by enabling them complementary and advantageous positions.**
- The Light DC will enable the rapid on-demand deployment of cutting-edge network services in the form of Virtual Network Functions (VNFs) – *such as data processors, security appliances, proxies, media transcoders, M2M gateways etc., close to the mobile nodes.*
Locating virtual service processing nodes closer to users reduces latency, improves throughput, and reduces traffic in the network core.

SESAME Innovation Framework_(4)



Independent actors' requirements addressed by SESAME

SESAME Innovation Framework_(5)



SESAME intended applicability in a variety of areas

Challenges addressed:

- Possibility to “slice down” a single CESC (or a CESC cluster) in order to furnish and allocate resources to different operators.
- Introduction of an overall optimal configuration of the CESC infrastructure, *including resource allocation & re-configuration in case of faults or sudden demand changes.*
- SESAME provides an added value characteristic enabling autonomic networking towards providing holistic “Self-x” characteristics (where “x” could stand for configuring, healing, optimising, etc.) to the proposed CESC devices.
- SESAME is capable of providing a distributed network management system that can be developed even from third-party providers.

SESAME – Fundamental Objectives

- **Objective #1: Definition and specification of the system architecture** and interfaces for the provisioning of multi-operator Small Cell networks, optimized for the most promising scenarios and use cases.
- **Objective #2: Specification, design and implementation of a multi-operator CESC prototype**, supporting self-x features enabling multi-tenant and multi-service access infrastructure.
- **Objective #3: Specification, design and implementation of a low-cost Light DC prototype** as NFV Point-of-Presence providing support for intensive low latency applications, secure connections and high quality of experience, while minimizing space, infrastructure costs and energy consumption.
- **Objective #4: Launching of at least three high impact sample Virtual Network Functions (VNFs) for demonstration and assessment of SESAME CESC platform** – Small Cell virtualization through providing Multi-Operator Core Network (MOCN) as a VNF.
- **Objective #5: Design and development of a framework for efficient resource planning and coherent management of the multi-operator Small Cells as light NFV distributed infrastructure.**
- **Objective #6: Design and implementation of CESCm**, capable of chaining and orchestrating the different VNFs required to cope with the dynamic SLAs between the CESC provider and the network operators.
- **Objective #7: Integration into one Pre-Commercial Prototype of Small Cells, Light DC and management and orchestration functionalities** - The prototype will be used to perform testing and evaluation against solidly defined use cases.
- **Objective #8: Conduct of Market Analysis, Road-mapping, as well as establishment of new Business Models** - Detailed Techno-economic Analysis towards exploitation and commercialization by industrial partners is also a priority.
- **Objective #9: Communication/dissemination of project results raising awareness and impact on stakeholders and the wider community**, as well as assessment of received feedback - **Creation and exploitation of synergies with the rest 5G-PPP projects** and the Association towards building a consistent 5G view.

SESAME – Advances

Technical Advances & Innovations:

- 5G Networks
- Small Cells
- “Self-x” features
- Cloud Technologies
- Software-Defined Networking
- Network Functions Virtualization for multi-tenancy
- Hardware acceleration through non-X86 processors
- Artificial Intelligence-*based* radio access management

Market Innovation Potential:

- Small Cell “*as a Service*”
- “Light DC” prototype
- Orchestrator prototype

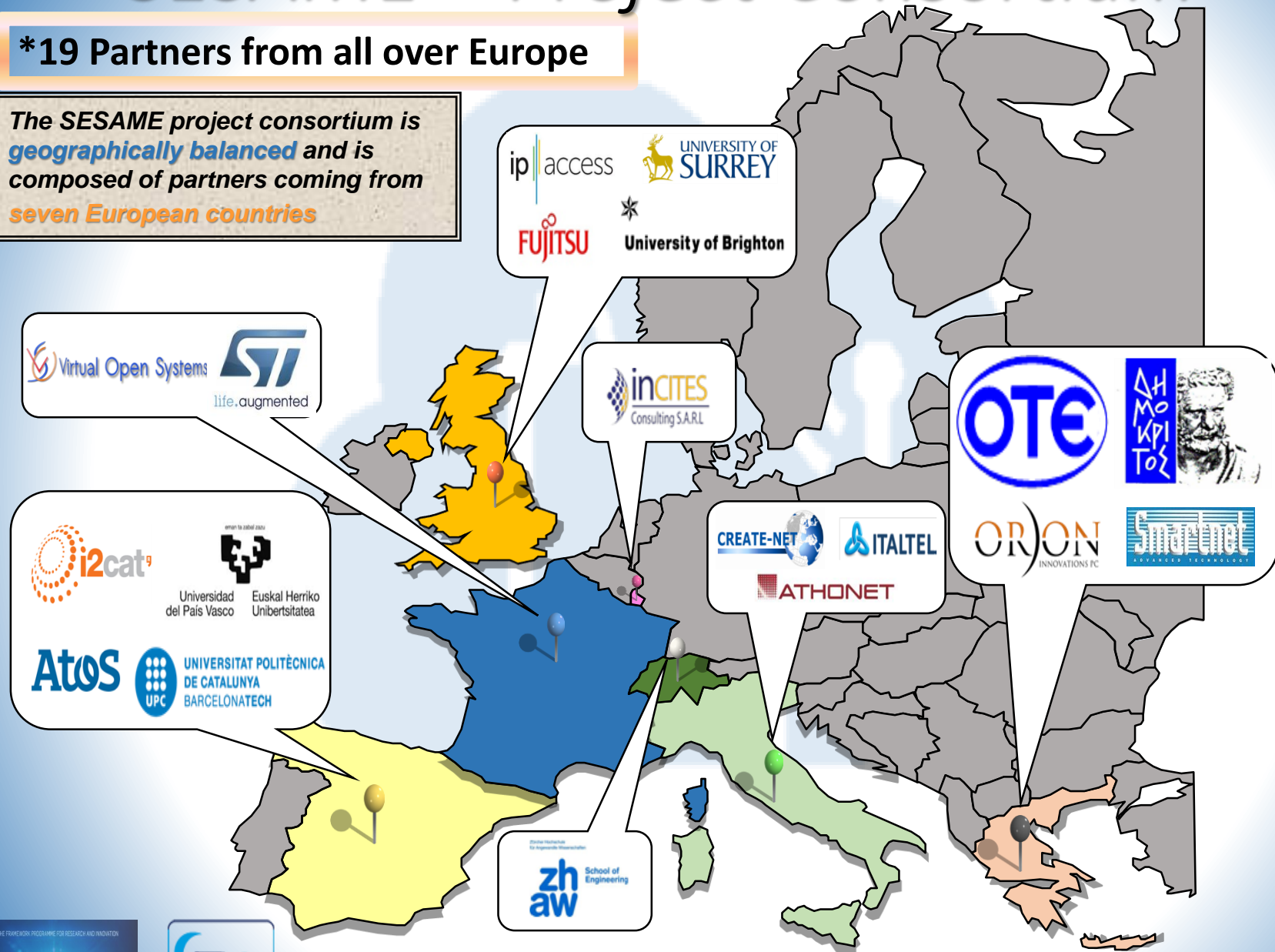
SESAME – Main Impact

- **Ecosystem development to sustain network infrastructure openness** *through the development of CESC's for 5G, **built on the pillars of network virtualization, mobile-edge computing capabilities and cognitive network management.***
- **Multi-tenancy and flexible cloud-network integration**, with highly-predictable and flexible end-to-end performance characteristics.
- **Contribution to the 5G-architecture vision** through the development of **programmable mobile network infrastructures**, allowing for continuous innovation by means of key functionalities exposed to CSPs.
- **Decrease network management OPEX**, whilst increasing **user perceived quality of service/experience** and **security**.
- ✦ **Contribution to the improvement of innovation capacity and the integration of new knowledge**
- ✦ **Contribution to Community societal objectives**
- ✦ **Contribution to 5G-PPP KPIs**

SESAME – Project Consortium

***19 Partners from all over Europe**

The SESAME project consortium is **geographically balanced** and is composed of partners coming from **seven European countries**



Thank you for your attention!

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