



Small Cells Coordination for Multi-tenancy and Edge Services: The SESAME Project Context

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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.



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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".

HORIZON 2020

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SESAME Project – Positioning_(2a)





PPP

Athens, Greece, October 25th, 2017

SESAME Project – Positioning_(2b)



5G-PPP Phase 2 programme



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HORIZON 2020

PPP

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.

NFV, Edge Cloud Computing

Multi-Tenancy

(Small cEIIS coordinAtion for Multitenancy and Edge services)

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HeNodeB Substantial Evolution

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.



SESAME Innovation Framework_(3)



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



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SESAME Innovation Framework_(5)





SESAME intended applicability in a variety of areas



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SESAME Innovation Framework_(6)



Challenges addressed:

- Possibility to "slice down" a single CESC (or a CESC cluster) in order to furnish and allocate resources to different operators.
 - Solutions for aggregation of data, transcoding of video content with optimized delivery in edge networks and caching at the very edge of the network, will enable a reduction in transport time and, therefore, provide a crucial route to successfully reducing service-level latency.
 - For this, a **CESC platform needs to include functions for:** cache management and placement; edge-optimized content delivery; aggregation at the edge through placing scenario-specific computation closer to the infrastructure (such as 5G point of attachments) and other relevant entities.



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SESAME Innovation Framework_(7)



Challenges addressed:

- Introduction of an overall optimal configuration of the CESC infrastructure, including resource allocation & re-configuration in case of faults or sudden demand changes.
- The optimal configuration problem becomes significantly complex because of the multilayer nature of the SESAME architecture as well as of the heterogeneous networking and computing assets which are involved, assigned to multiple tenants with diverse needs and constraints.
- This problem would be addressed by moving some of these dependencies and layer interactions into a central place, in order to do a "per-box" configuration.
- Apart from having to understand all layer dependencies and interactions, which becomes impossible for a human network operator with the current infrastructure interdependencies, such an approach would be tailored only to specific circumstances...
- 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 will be 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 CESCs 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

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Thank you for your attention!



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