



## From service design to network slices: Software Development Kits for 5G Cities

*(Nextworks – Paolo Cruschelli/ Gino Carrozzo)*

Telecommunication networks have become a critical infrastructure for any society, enabling economic growth and social prosperity. Services continue to evolve, generating ever increasing workloads and network traffic with a wide diversity of patterns. This evolution is forcing the underlying network technologies to change, increasing the level of programmability, control and flexibility of configuration, while reducing the overall costs related to network operations. In parallel novel service delivery mechanisms are required, to reduce the time for service design and roll-out and simplify the service operation at runtime. In this sense, 5G will not only be an evolution of mobile broadband networks but it will involve all the layers of the architecture, from the infrastructure up to the orchestration and service framework.

Key terms which boosts the 5G vision are SDN and NFV enablers that offer the technological pillars to build services upon a physical shared infrastructure. On top of them, neutral hosting and slicing concepts offer a business paradigm where the physical infrastructure owner offers pools of virtual resources to the operators, with different levels of control. From the Virtual Operator point of view, the critical point slightly shifts from how the service is deployed to how the service can be self-designed and tailored to its own business needs. In this sense the 5G network control platform becomes also a comprehensive framework which offers tools for a complete end-to-end service lifecycle management, from the design to the operational phase.

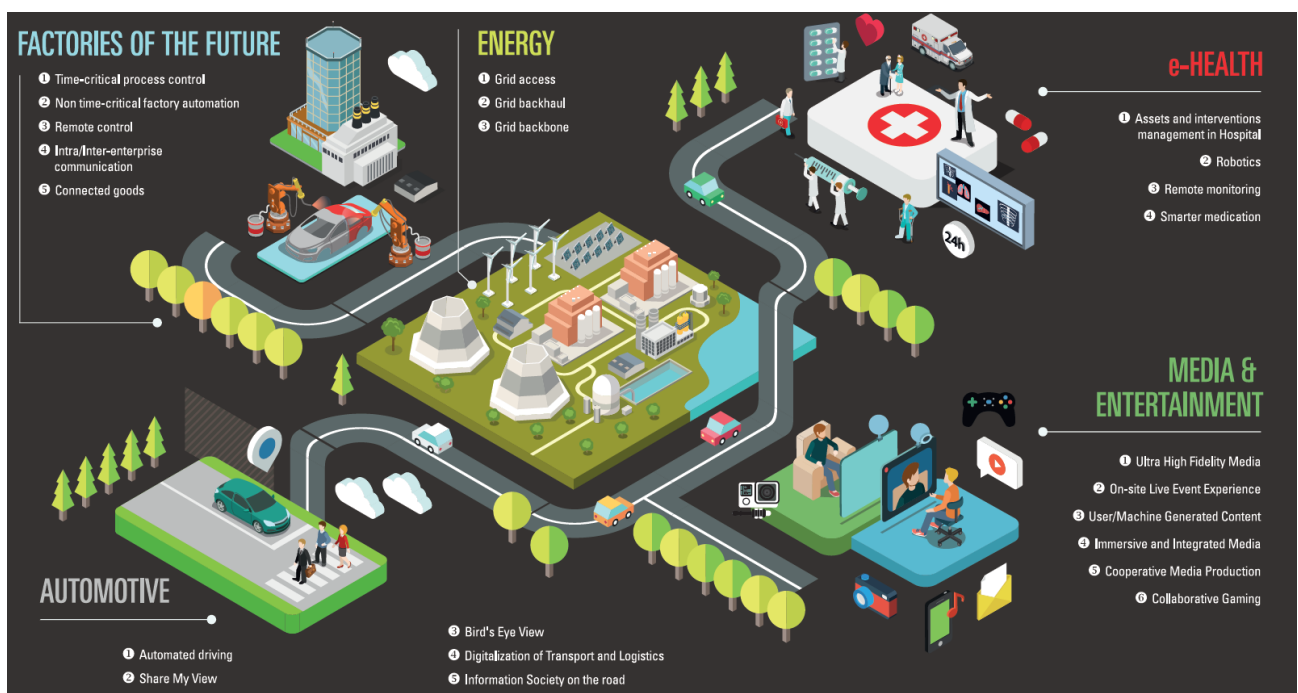
**In 5GCity, we look at the municipality as an infrastructure owner who can rent pools of virtual resources to various “virtual” Service Providers** (e.g. for Media production, broadcast & distribution, for connectivity - Virtual Mobile Operator, for security). Each operator is able to cast its own network services, has its own requirements in terms of services and thus should be able to design network service tailored to the need of its own business.

Service development kits (SDK) are a fundamental component to open-up the virtualization advantages to these third party Vertical industries, also in terms of commercial relationships. An SDK is generally as a stand-alone collection of services, functionally integrated with a networks orchestrator platform and able to craft network service templates ready to be deployed by the operator itself over its pool of virtual resources.

Different SDK toolkits are just available within the NFV realm (e.g. the COHERENT SDK, the SONATA SDK, etc.). However, most of these SDKs adopt a network-centric approach, aiming at defining and testing Network Services and VNFs before their instantiation in runtime MANO environments.

In 5GCity we are developing an SDK Toolkit capable to offer a wide set of features to help Virtual operators to more easily design and deploy their services in the 5G network infrastructure deployed in the city. The 5GCity SDK comes with:

- a **graphical environment to compose functions in end-to-end services**. This tool allows wiring, in an arbitrary sequence, a pre-defined set of functions defining a logical pipe to enforce traffic handling across subsequent service stages. This operation exploits the flow-based programming to create network services, represented as service templates, ready to be deployed in 5GCity infrastructures.
- an **adaptation layer** which hides the complexity of 5GCity infrastructure low level details and automatically translates functional components and business requirements into an operational service deployed over virtual computing and networking resources.
- a **validation module** which performs the formal validation of the service template designed by the users and verify the consistency of the end-to-end pattern.



(NxW presentation – Gino Carrozzo, Milan IoTThings 2018)  
[www.5gcity.eu/project-material](http://www.5gcity.eu/project-material)

The 5GCity SDK abstraction layer is one of the main innovations introduced by 5G-CITY and offers major advantages in comparison with the current state of the art. Existing SDK toolkits for 5G NFV-enabled infrastructures (e.g. from other EU projects like SONATA, SuperFluidity, Charisma or embedded in open-source MANO solutions like OSM or Openstack Tacker) still requires the user to have a full understanding of MANO information models and awareness of the MANO stack details. Contrarily, the 5GCity SDK toolkit adopts a different perspective and allows the user to play with more abstract and business oriented concepts without caring of infrastructure details, MANO stack procedures or specific information models.

This is well described in the figure which depicts the three abstraction layers which describe 5GCity infrastructure and clearly position the 5GCity SDK toolkit user to the highest level of abstraction.

In 5GCity project we plan to use this SDK concept on top of the city-wide pilots under deployment in the cities of Barcelona (ES), Bristol (UK) and Lucca (IT).

The 5GCity SDK will be used to design the various network service and experimentation scenarios of the three 5GCity groups of use cases, which will simultaneously take place in the city pilots sharing the 5G/NFV

infrastructure: (i) neutral host; (ii) media industry use cases; and (iii) waste management through video analytics.

The 5GCity SDK Toolkit is currently under development and we plan to make a first release publicly available in Q1-2019, fully integrated with the 5GCity NFV orchestrator.

