Cross-domain network and service management in IBN

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Focus on Intent-Based Networking (IBN)

Cross-domain management in IBN

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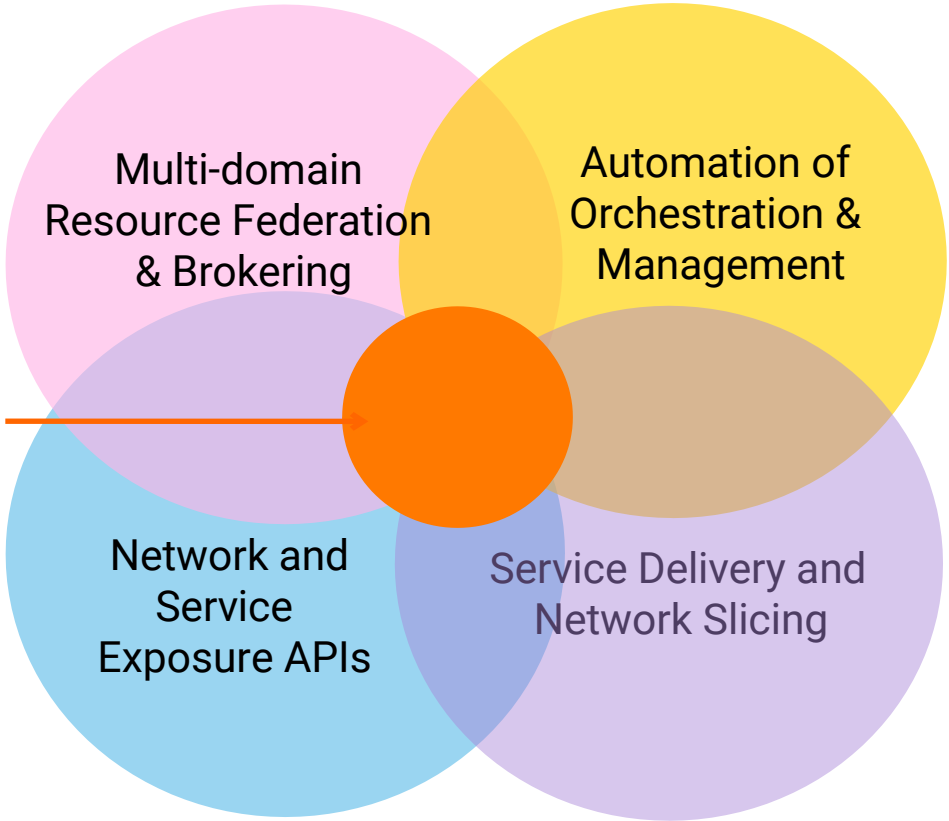
- Resource federation based on exposure APIs,
- On-demand slice design,
- Cross-domain deployment and orchestration



Multi-domain federation and brokering

- Different research works proposed models and frameworks for federated clouds through brokering to solve the issue of resource limitations so that Cloud service providers can share their resources as one Cloud infrastructure [1]–[3].
- Also, components for resource discovery, resource allocation and mapping of virtual topologies over a federated multi-domain network virtualization environment have been proposed [4].
- Moreover, a broker and federation architecture for resource allocation as per end-to-end SLA established in Cloud Networking Environment (IaaS and NaaS) has been proposed in [5].
- Particularly, a model of Virtual Cloud using the interaction model of “Rent Out the Rented Resources” based on renting 3rd-party resources to provide its own services was defined in [6]. It aims at reducing cloud service costs by virtualizing already virtualized infrastructures where a cloud provider offers its own cloud services by acquiring and federating underutilized resources from 3rd-party enterprises.
- Furthermore, falling within the “Edge Cloud” paradigm, solutions like Blue Horizon [7] proposes to extend the Cloud to the edge by gathering data from the edge.

➢ Federation of resources through brokering has been a vast topic mainly for Cloud and IT resources, while a larger scope needs to be considered to embrace IT and all network (connectivity, access and core) resources belonging to different profiles of actors, not only cloud providers (enterprises, local organizations, etc.) for resource optimization.

Network and Service Exposure

- From the architectural point of view, many initiatives have targeted to address the challenges that operators face today in providing network services to OTT 3rd party actors.
- Open Networking Foundation (ONF) defined SDN-based solution for “Operator Network Monetization” promoting SDN as a framework to enable interactions between operator’s network and applications [8] and has proposed “A Flexible NFV Networking Solution” using SDN for VNF deployment [9].
- Also, an SDN-aware NFV architecture for operators is presented in [10] enabling dynamic provisioning of network services.
- Moreover, T-NOVA project [11] proposed an operator architecture framework for providing network functions-as-a service while UNIFY project proposed a network unified programmability framework [12].

➢ Such initiatives have focused on the integration of SDN and NFV to enable efficient deployment of network services for applications. The interactions between the network operator and 3rd-party actors and the federation of their resources have not been jointly addressed.

Network Slicing for a cross-domain service

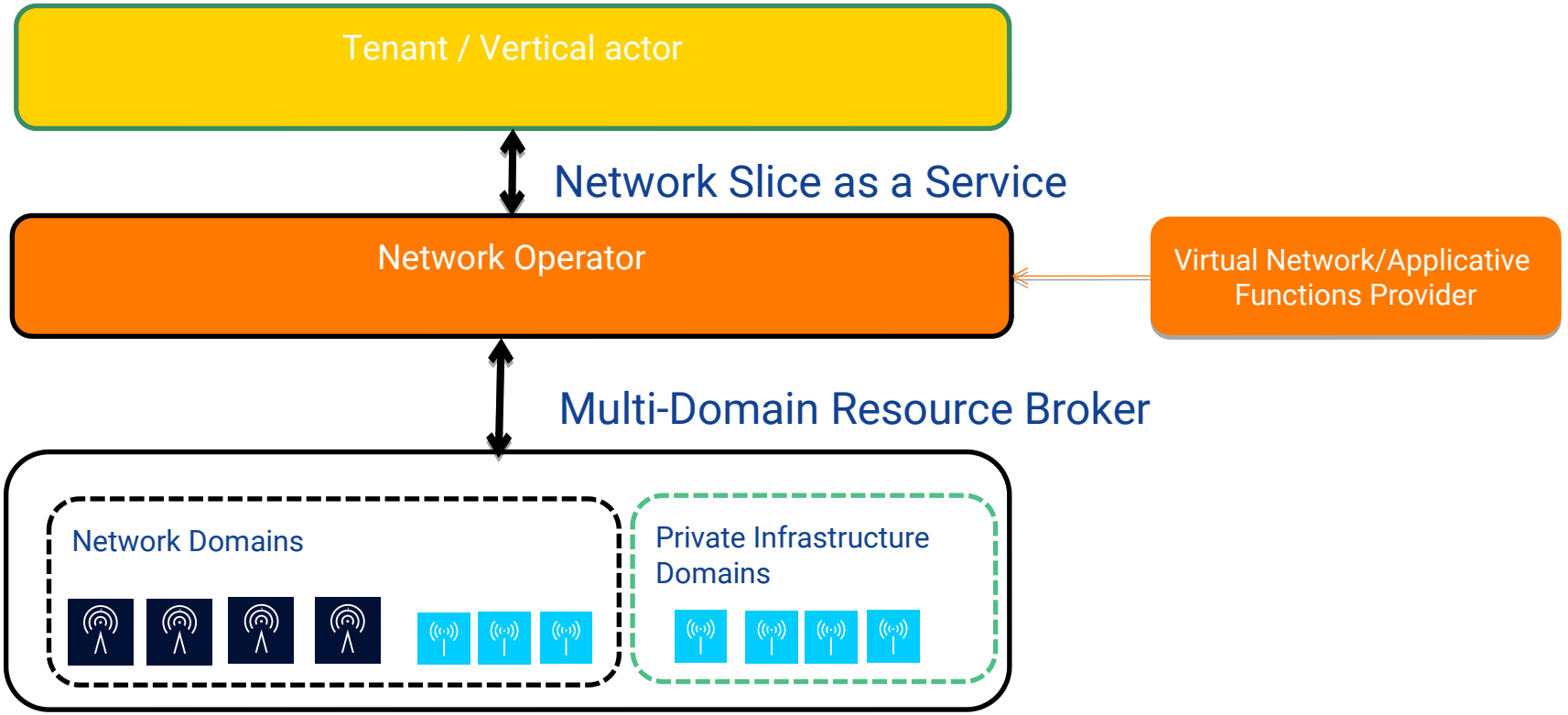
- Regarding network slicing, there is no consensus on one definition for a network slice. Several definitions exist in the literature [19]–[24]. For example, the logical architecture for network slicing based 5G systems proposed in [22] includes an introduction to the fundamental concepts of network slicing.
- These approach does not take into account the integration of resources from different actors and the means of enabling an interaction between different 5G system domains.
- In [25], a network slicing mechanism was defined for network edge nodes. This approach relies on cloud edge to achieve network slicing and core network functions and entities need to be shifted and placed into the network edge.

➢ It is important to consider that a network slice spans end-to-end across different network domains and may include network functions deployed in the core, access and edge networks [26].

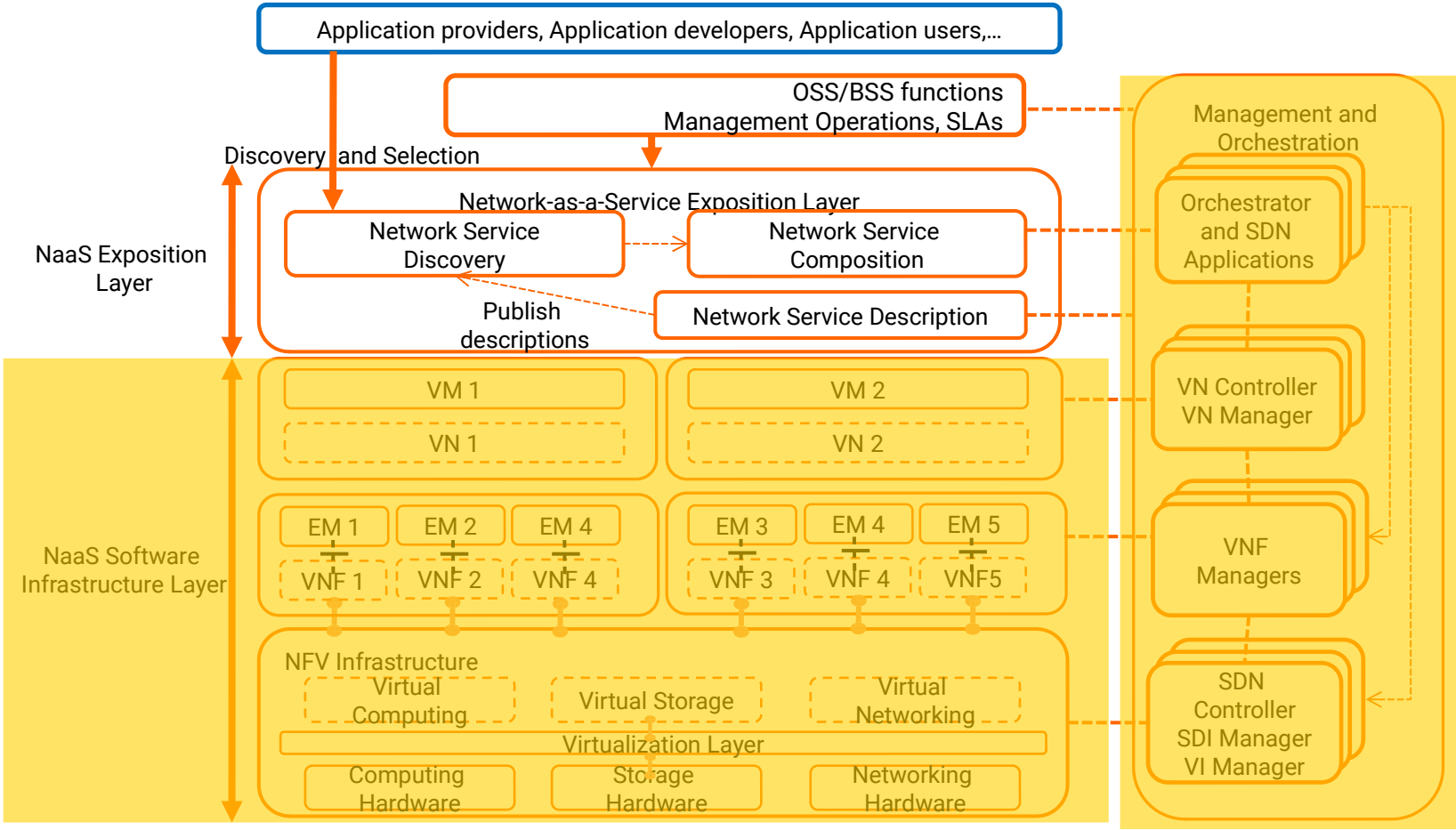
Automated Management and Orchestration

- Regarding orchestration and management, ETSI NFV reference framework defines virtual resource management and network service orchestration [27]. Different initiatives like TeNOR NFV orchestrator platform [28] provide orchestration for automated management of network services over virtualized infrastructures.
- Further, Open Source projects like Open NFV (OPNFV) [29], Open Source MANO [30], Open Baton [31] have implemented ETSI NFV architectural framework for NFV orchestration and management. However, these initiatives have been designed for the orchestration of a single domain where NFVO has full access and control over resources.
- More recently, Open Network Automation Platform (ONAP) [32] has emerged as the orchestration platform for carrier-scale automatic VNF and network services orchestration and management. The Active and Available Inventory (AAI) in ONAP provides real-time views of available resources and services and their relationships and is thus equivalent to a Resources Cartography. However, ONAP AAI, in its actual version, stores the resources and services of a single provider or tenant.
- The orchestration layers defined in these initiatives do not consider embracing resources from different domains and actors; they do not define resources federation orchestration and management functions with a brokering layer enabling multi-actors interactions and are not suitable for multi-domains network service orchestration. It is important to rely on approaches like X-MANO [33], BluePlanet [34] and ONAP future developments, as bases to allow for cross-domain multi-actors management and orchestration.

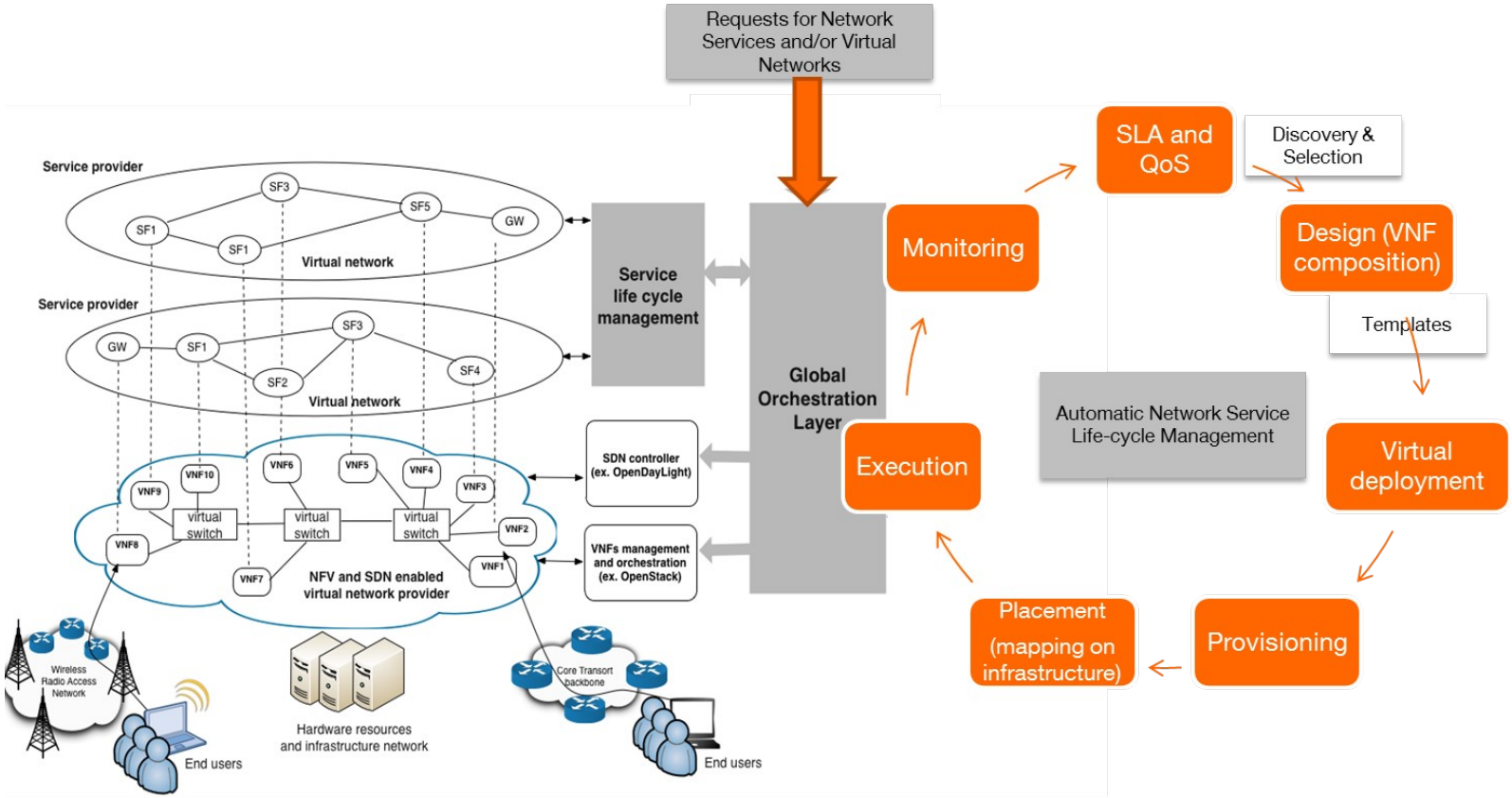
Network (Slice)-as-a-Service Architecture



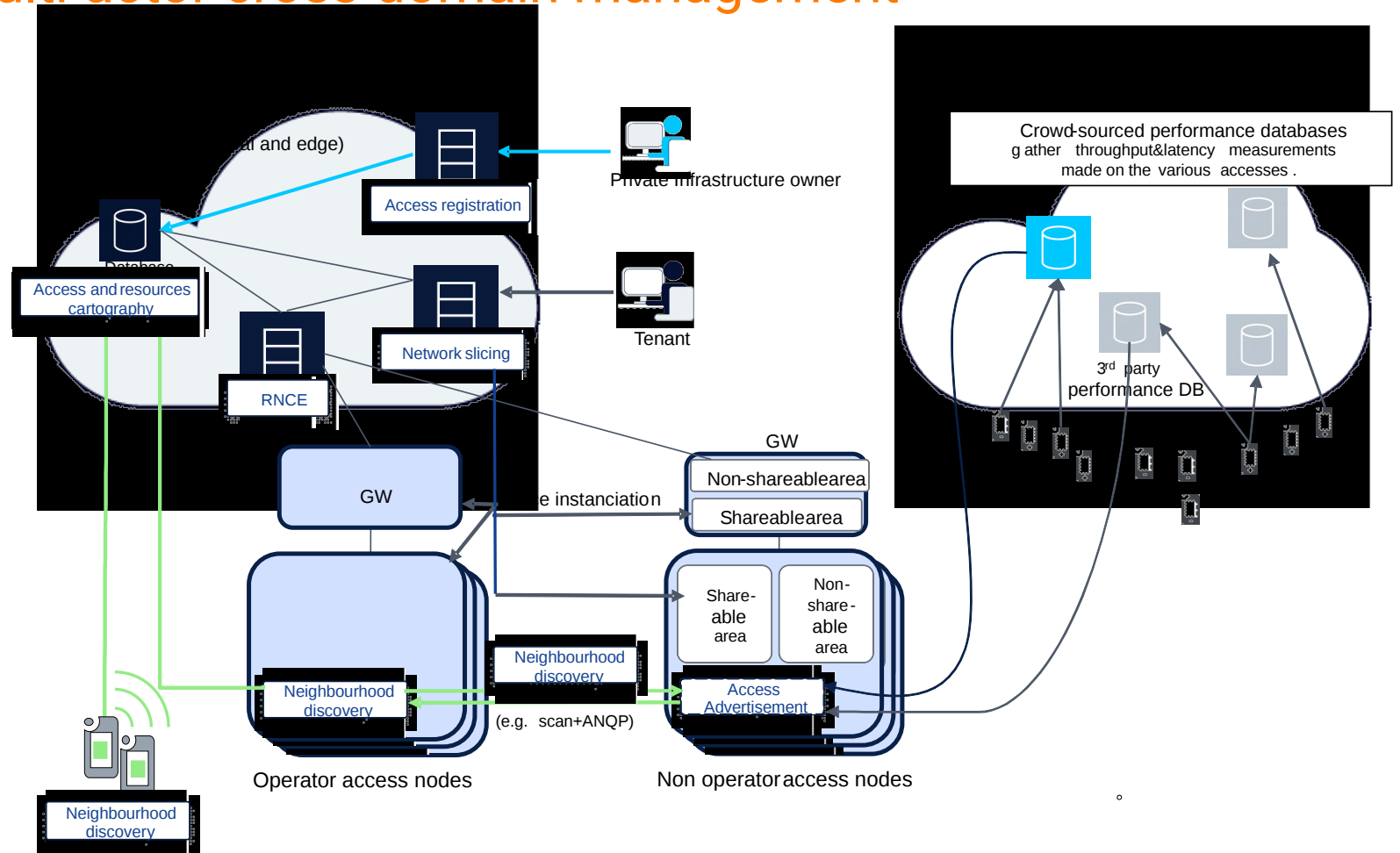
Network (Slice)-as-a-Service Architecture



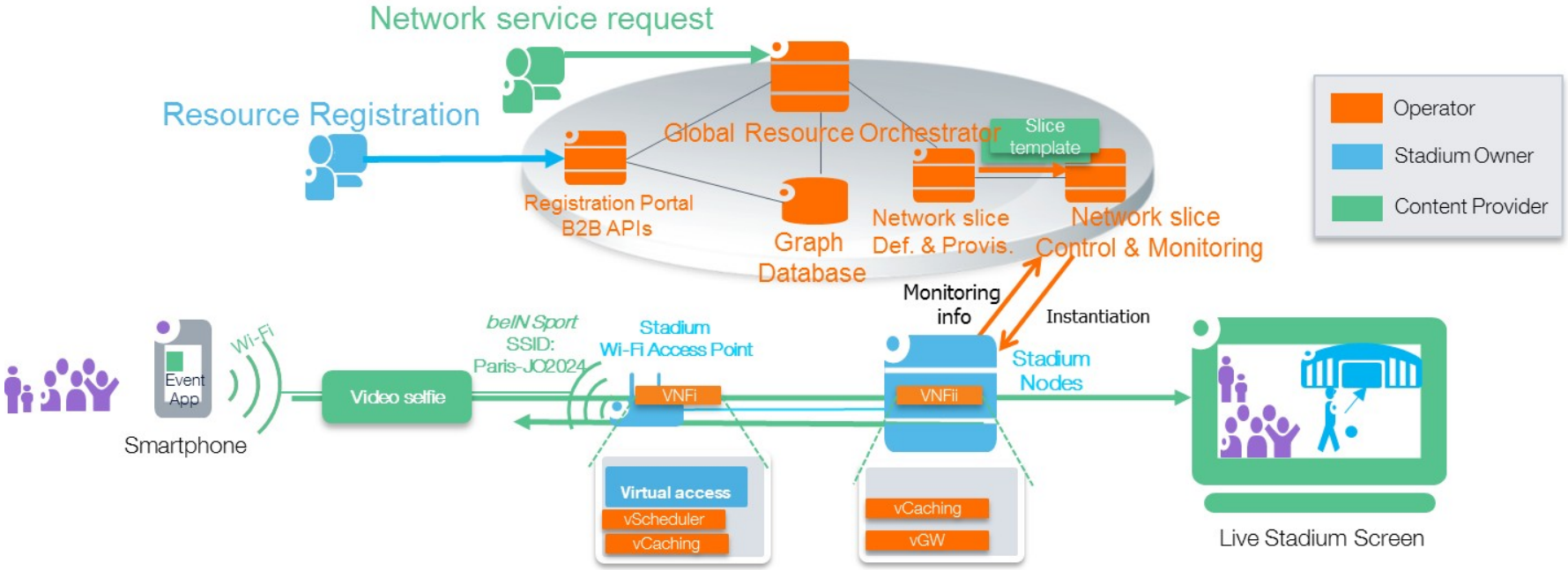
Automation for Management and Orchestration



Multi-actor cross-domain management



Application of cross-domain slicing



Identified challenges

- ✓ Need to consider a large scope of resources embracing IT and all network (connectivity, access and core) resources belonging to different profiles of actors,
- ✓ The interactions between the network operator and 3rd-party actors and the federation of their resources need to be jointly addressed,
- ✓ Need to investigate management and orchestration of network slices that span across different network domains and may include network functions deployed in the core, access and edge networks,
- ✓ Work on evolving approaches and initiatives targeting the cross-domain multi-actors management and orchestration,
- ✓ ….

Merci

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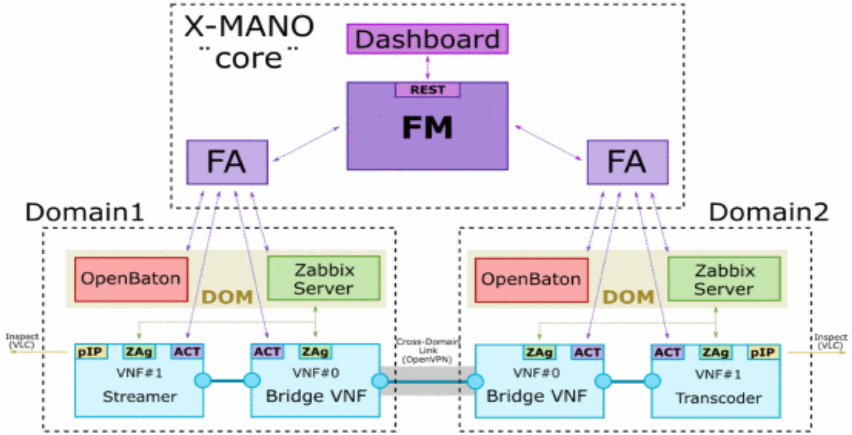
Multi-domain Orchestration: X-MANO



The aim is to show that the X-MANO is able to deploy network services with a negligible overhead and without imposing limitations on the underlying domains.

The X-MANO architecture. A federation manager (fm) is interfaced with one or more federation agents (fa). The user interacts with the FM trough a web dashboard. Each domain is locally managed by its local domain orchestrator/manager (dom).

A cross-domain link is created between the two domains using openvpn. Zabbix is used to monitor each domain. Each instantiated VNF can be accessed by the FA to trigger actions (i.e., local scripts).