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Northbound API Specification and Graphical Interface (Iteration I)

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Abstract

The current document is the outcome of the first iteration of Task 8.1. The task aims at providing the One Stop API solution for the complete SliceNet ecosystem. In this first iteration the task has interacted with the other technical and business tasks seeking a consolidated view of the slicing concept. With the provision of the refined architecture along with details of the various components the separation of roles and the technical details how this can be achieved has verified the assumptions of the task so that these can be now considered as valid concepts and principles. The effort committed to the task has not been analogous to its duration up to now as the verification process of the various assumptions had to wait certain resolutions in various technical aspects. As the business roles impact on slicing approaches is an ongoing state of the art subject, the ambition is that the proof of concept that is expected to be achieved will have a good exploitation and dissemination potential.

[End of abstract]

Disclaimer

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Executive summary

The One Stop API task of SliceNet has evolved along with the maturity of the slicing enablers in the technical tasks of the project. At the end of the first iteration the task can provide a quite consolidated description of the slicing concept and the foreseen business roles that are expected to be benefiting from this type of slicing. The task avoided to narrow the approach to a single server space solution with not clear positioning among the involved players at the expense of not proportional advancement of the task roadmap and it is currently investigating alternative approaches that can be exploitable from various perspectives. Although from implementation point of view the task is limited for the first iteration to an early prototype that was addressing the usability of the P&P information model ([6]), the consolidation of the slicing concept as well the resolution of the role transactions have driven design choices and approaches in other WPs. With the outcome of the first iteration it is additionally provided an adequate basis for the evolution of further slicing aspects that can potentially contribute to the ongoing feasibility studies on business role models for slicing.

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Abbreviations

API	Application Programming Interface
BBU	Base Band Unit
CN	Core Network
CP	Control Plane
CPS	Control Plane Service
CQI	Channel Quality Indicator
CQI	Channel Quality Indicator
CSP	Communication Service Providers
DECOR	Dedicated Core Network
DSP	Digital Service Provider
E2E	End-to-End
EPC	Evolved Packet Core
ETSI	European Telecommunications Standards Institute
ID	Identifier
IDE	Integrated Development Environment
IETF	Internet Engineering Task Force
IMSI	International Mobile Subscriber Identity
KPI	Key Performance Indicator
LCM	Lifecycle Management
MANO	Management and Orchestration
ME	Mobile Edge
MEC	Mobile/Multi-access Edge Computing
MEO	Mobile Edge Orchestrator
NE	Network Element
NEF	Network Exposure Function
NF	Network Function
NFV	Network Function Virtualisation
NFVI	NFV Infrastructure
NS	Network Service; Network Slice
NSS	Network Subslice
NSaaS	Network Slice as a Service
NSD	Network Service Descriptor
NSEP	Network Slice Provider
NSI	Network Slice Instance

NSP	Network Service Provider
NSSAI	Network Slice Selection Assistance Information
NST	Network Slice Template
OAM	Operations, administration and maintenance
OSS	Operations Support System
P&P	Plug & Play
PNF	Physical network Function
PoP	Point-of-Presence
QoE	Quality of Experience
QoS	Quality of Service
RAN	Radio Access Network
REST	Representational State Transfer
RO	Resource Orchestrator
RRH	Remote Radio Head
SBA	Service Based Architecture
SBI	Service Based Interface
SDN	Software Defined Networks
SDO	Standards Developing Organization
SLA	Service Level Agreement
SliceNet	End-to-End Cognitive Network Slicing and Slice Management Framework in Virtualized Multi-Domain, Multi-Tenant 5G Networks
SW	Software
SS-O	Slice Service Orchestrator
UC	Use Case
UE	User Equipment
URI	Uniform Resource Identifiers
VM	Virtual Machine
VNF	Virtual Network Function
VNFD	VNF Descriptors
VNFFG	VNF Forwarding Graphs
WG	Working Group

1 Introduction

Technology domains are addressing slicing from different perspectives based on the principles each domain is characterised. In all cases, however, the purpose is the same: exploitation of a granular framework for the provision of end to end services tailored to the heterogeneous needs of verticals. From SliceNet perspective the differences among the technological domains with respect to the slice representation are considered as highly complementary for the support of a wider slicing concept which:

- Utilises wireless technologies such as 4G and 5G
- Supports dynamicity and adaptability with respect to the varied and distributed demands of the served verticals
- Allows for the expression of a multitude of performance, security and other requirements
- Enables various stakeholders to be able to participate as providers
- Allows verticals to have certain level of control over their slices for applying the principles of their application logic

In order for this concept to be fully elaborated, it is required that the slice conceptions of each technological domain should not be accounted as the overall model or solution but only as a part of the overall concept applied to the proper partition or layer of the SliceNet slice where it is applicable. This will allow the full exploitation of the offerings a technological domain can expose. In most of the cases the slicing features, a technological domain can offer, are simply enablers for the provision of the slicing concepts of another domain. For example slicing in terms of NFV-MANO can be used to apply the automation, cloud and SBA principles that the 5G slicing requires. Similarly, an SDN based network slice can be seen as a backhaul solution for networking sessions through separate data center interconnection slices. Finally, but most importantly, it is required to understand that vertical needs are not expressed in terms of a technology related nomenclature but, on the contrary, in terms of a number of application specific semantics that neglect or at least tend to put aside what each technological domain can offer.

SliceNet, however, tries to build on top of the capabilities that 5G systems are expected to offer with slicing being one of the main features. 5G systems are being gradually deployed starting mainly from the radio access (RAN) segments. The adoption of 5G new RAN is expected to evolve along two different roadmaps based on the evolution of the specifications of the Next Generation Core. The first and most imminent approach is based on the collocation of the 5G RAN with the LTE eNodeB where the NG-RAN is connected with the 4G EPC. This approach is referred to as non-standalone (NSA) mode. The longer term approach involves the availability of the Next Generation Core and is referred to as standalone mode (SA). As SliceNet intends to support slicing for 5G networks, the managed domain (Control and Data Plane) architecture affects heavily the design choices and concepts applied in the Management Plane. More specifically, as slicing is defined on the basis of virtualization and SDN techniques, it will not be forward compatible to identify a Management Space design that follows a monolithic approach (e.g. non modular service endpoint connections) as well as a Managed Domain that relies heavily on a non-virtualized infrastructure. Therefore, SliceNet assumes that the managed domain in the NSA mode will be based on the virtualization of the EPC elements as it will be the case of Next Generation Core with NF virtualization. To this end the network subslice (NSS) and network slice (NS) concepts adopted in SliceNet with respect to the underlying NFs should be modular enough to address core network topologies of either 5G NFs or 4G virtual EPC elements.

The current document is the outcome of the first iteration of Task 8.1 and tries to consolidate the slicing aspects that the project aims to support. It also defines the SliceNet ecosystem in terms of the participating business domains and the foreseen high level interactions among them.

2 Slicing Concept

2.1 Involved Actors

The SBA approach implied by the ongoing 5G new core specification in combination with the DECOR/MOCN/CUPS approaches for 4G are paving the way, or at least providing room for assuming that in the near future operation practices will be based on a fully modular and softwarised approach. This assumption can be further elaborated when the question comes to the actual nature of the operator or better the NSP since the operation tasks can be segregated in self-contained parts which in turn can be utilised in more complex service assemblies spanning the borders of traditional administrative domains.

A **Network Service Provider (NSP)**, therefore, can be an entity that invests on hardware resources and is able to provide services on top of any (or combination) of the following offerings:

- (Radio) Access resources that can support slicing in terms of sharing of the access medium
- Network (IP) connectivity that can support slicing in terms of isolation of network overlays
- Data center resources that can support slicing in terms of isolation of running services that are offered as instances of onboarded images (VMs/containers)

Each of the above can be implemented by different technologies based on the investment decisions of the provider. SliceNet defines a set of network, resource and function abstractions to address the need for harmonisation of the management processes over the underlying resources that can be considered as a first level of offering exposure. These offerings regard parts of radio access or core network functionalities that can be supported by an NSP in the context of a subslice provisioning request. Apart from the functional role of these offerings, the need for quality based management and enforcement of Service Level Agreements (SLAs) requires that additional information relating to the operation (performance, faults) of the allocated resources or the delivered data services (achieved data rates, error, end to end delay and latency) as well as potential actuation options should be also made available for utilisation in higher level workflows. The level of provisioned support of these monitoring and actuations options by the underlying resources are subject to selection refinement process of the offered resources from a **Digital Service Provider (DSP)** entity that has to combine (and configure) resources across NSPs to build 4G/5G communication services and additionally activate its own business added value services that aim at the continuous evaluation and adjustment for the maintenance of the intended levels. A DSP is, therefore, an entity that selects resources across NSPs and manages these in the context of User Equipment (UE) communications with adequate performance and guaranteed stability.

The overall outcome of the DSP driven selection of resources caters for the communication needs of the UEs involved. Those communication needs are subject to application specific workflows that take place as part of a digital service. The digital services and their requirements are defining the context of the **Vertical** role with a specific business interest. It is worth mentioning that each UE, accessing the communication segment provided by the proper chain of network resources by attaching to the slice based radio access network for obtaining IP connectivity up to a gateway point but not necessarily reaching any Internet/Intranet services beyond that point, is part of a slice for which a combination of resources has been allocated.

2.2 Interactions among Actors

The above vertical relationships imply several transactions among them that are performed in the context of slicing support. The above roles can be provided by different administrative domains separately or in combination. The transactions, therefore, are performed in the context of a contract among the administrative domains. Such a contract identifies the access rights of the consuming side over the interface exposed by the producing side. The consuming side, however, is every time a set of

artifact objects acting on behalf of a topmost end user (vertical) but in the context of the arrangements that have been put in effect in the process of service provisioning by the involved roles (DSP and NSP).

The fact that SliceNet addresses interactions among several service roles (vertical relationships) and across different administrative domains (horizontal relationships) necessitates the clear definition of the borders and the placement of all the foreseen "players". The most challenging question in this respect is where the SliceNet components are positioned and who is administering these components.

Most probably, the way to answer this question is to consider that SliceNet aims at producing a management space that replaces the traditional proprietary BSS/OSS frameworks of nowadays telecommunication systems. This can occur for a limited set of (SliceNet compliant) committed resources by the operators so that legacy operations can be maintained. For those resources, however, that are committed, the SliceNet approach should be adopted.

As said, SliceNet roles interact on the basis of a producer-consumer relationship. Producer offerings are provided at the level of detail a consumer is able to link these with its own business context so that they can be selected by a single selection action on a list. On the basis of a selection, the consumer applies its own business logic in order to build its own offerings towards any further role on top of it.

NSP applies its business logic over its domain offerings as these are identified in terms of the resource types (any virtual or physical artifact or module that takes part on the provision of any data or control plane functions) available within its domain. NSP onboards descriptors to identify actuation and monitoring options per resource type available for automated or manual instantiation. These descriptors define, through exporting/abstraction (hiding underlying technology related information), the maximum set of available supported options for the specific domain along with their availability (where applicable). Additionally, in the context of SLA maintenance automation, each NSP can identify a set of supported rule based policies that can be applied for this purpose. These rules identify basic aggregation patterns over underlying monitoring counters and associated actuation options. The policies may include options to identify the exporting of produced metrics towards DSP data higher level monitoring subsystem.

Depending on the contract enforced at the interaction between DSP and NSP, a descriptor may be narrowed to reflect the expected sub-slice instance support in terms both of actuation and monitoring options. Such options are further exploited as DSP domain offerings that can be bundled within higher level business combinations to form the service offering towards vertical role players. The combinations can be expressed via QoE, Cognition, and P&P artifacts. Typically, a DSP defines QoE, Cognition, and P&P selectable options that rely on particular NSP offerings via, again, business abstractions. Particularly, DSPs can define Quality of Experience (QoE) policies to be put in effect and exploit the NSP exposed information so as to i) maintain the QoE levels, ii) evaluate NSPs performance for continuously optimizing the interdomain orchestration processes. Thereafter, verticals can identify the required service characteristics through these business abstractions to order the provision of their service slices.

Provision should follow the opposite process. Service characteristics should be analysed at the DSP level to identify among NSP offerings and availabilities that can fulfill the requirements posed by the DSP modules (QoE, Cognition, and P&P) the Vertical has indirectly indicated.

2.3 The Role of One Stop API

The transactions identified above serve a single purpose: the provision of end to end communication services leveraging all the aspects of emerging technologies. Considering this fact, SliceNet proposes a common approach for the support of all the interactions via different projections of the information accessible at each point based on the role of the entity that consumes or influences the information. This translates into the definition of the concept of the One Stop API (OSA) as an approach that is

expected to allow for the creation of an ecosystem with easy participation of various players in the context of the business purposes the related role.

In the above process, starting from bottom to top the following OSA transactions/projections are foreseen per role:

- NSP
    - actuation descriptors onboarding
    - monitoring descriptors onboarding
    - resource types registration associated with actuation and monitoring descriptors
    - identification of resource types availabilities
    - onboarding of policy based rules with dependencies on actuation and monitoring descriptors
    - coverage (location) support
    - resources are listed based on type and capabilities
- DSP
    - observes technology agnostic information of descriptors
    - identifies monitoring and actuation capabilities offered by NSPs
    - is able to select SLA related automation rules
    - is able to indicate which of the monitoring and actuation options should be activated per slice type
    - enhances management of underlying NSP supported monitoring and actuation options by crafting and registration of QoE, Cognition, and P&P service aspects
    - registration of slice templates with dependencies on QoE, Cognition, and P&P service aspects
    - slice templates are listed based on service tailored aspects and underlying dependencies including location support per aspect
    - slice templates are annotated with service features
- Vertical
    - observes slice templates through service features
    - selects service features to be activated
    - gets access to slice specific actuations and slice monitoring as exposed via P&P functions

Vertical requests trigger the provision of the slice through a multi-level orchestration process. Along the instantiation of the artifacts at each level to support the deployment and operation of the slice, the descriptors are instantiated on the basis of the resolution of the provisioning details to form an inventory distributed across the involved domains. Inventory entries created shall be sufficient to allow management modules per domain to align with the required support for monitoring, actuation, cognition and QoE processing as well as the support of the vertical tailored view of the slice via P&P approach.

2.4 Layered Model and Abstraction

From the above foreseen OSA interactions it is evident that there are different views for different roles as far as the management of the information space of each role is concerned, while an inter-role role workflow is foreseen to deliver and enforce the contract requests that are necessary to support the slice operation. For example, assuming that a vertical selects a slice type that offers particular QoE options as these have been defined from the DSP management UI view. These options should have been registered from the DSP with specific dependencies on monitoring and actuation offerings from NSPs (red-dashed arrows in Figure 1). When the slice is requested to be provisioned, NSPs are selected

on the basis of the availability of the monitoring and actuation options the QoE processing is requiring. As these monitoring and actuation options might be subsets of NSPs' offerings, a narrowed definition of descriptors should be produced and registered in the slice information space of the NSPs that have to support these options (green-dashed arrows in Figure 1). Thereafter, instantiation or correlation of resource types in each domain should trigger the monitoring collection FCAPS mechanisms so that the information is properly reaching (solid black arrows in Figure 1) the DSP's QoE instances of the specific slice.

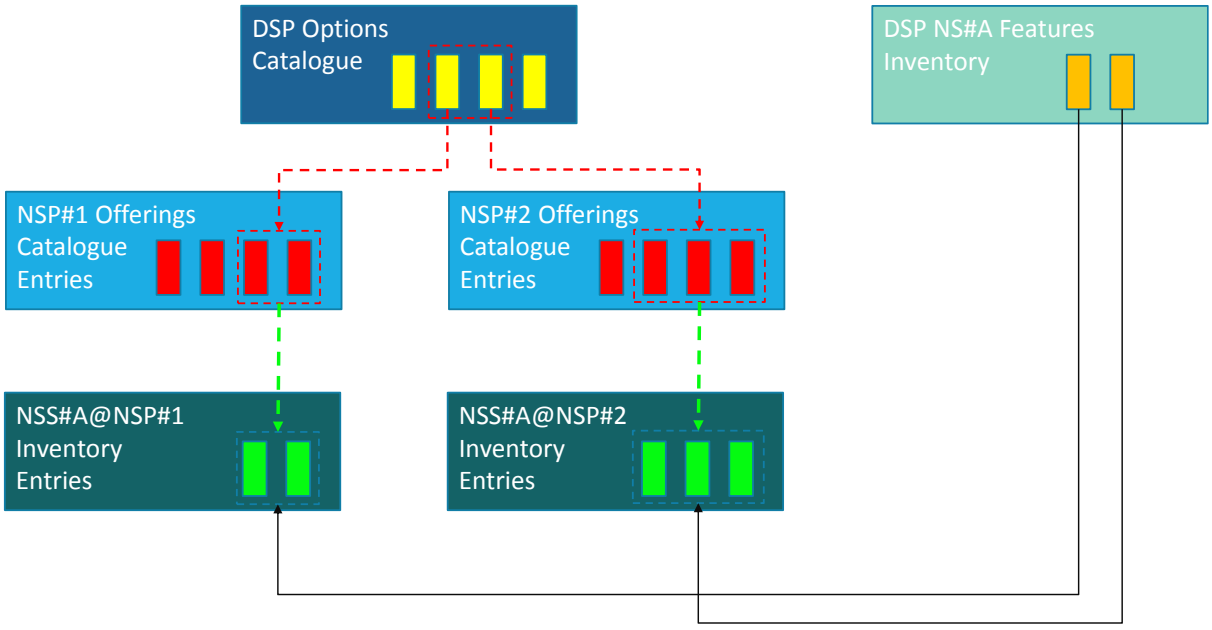

Figure 1: Inter-role dependencies

Similar aspects apply in the case of definitions, by the DSP, of additional (Cognition, P&P) selectable features to be offered to verticals. Any offering should be defined according to its dependencies on both available same domain's artifacts and underlying domains' required offerings.

In the context of the above inter-role resolutions of dependencies and considering the One-Stop API as an enabler for the support of both the business and technology transactions two management spaces are foreseen for the same set of information. A vertical management space intended to be utilised by the consuming side of the inter-role transactions and a horizontal one to be utilised by the provider side. The difference between the views produced for each of the two spaces relates with the roles assigned to the users. One role is provided with the service characteristics (offerings) to be used for selection among the available templates whereas the other relates with the way these offerings are provided in terms of integration of available resources and additional technology related aspects.

In order for this separation to be possible, it is necessary that each Network Function (NF) is observed also from two different angles (Figure 2):

- one listing the technical details (fault, configuration, performance and security) that need to be considered for combining an NF with other NFs for the definition of one Network Subslice (NSS). These details will be aggregated at the NSS level to allow proper inclusion of the NSS into NSs (Figure 3) from orchestration and operation point of view.
- and the other listing the qualitative details that can be used to influence the features of any higher level synthesis an NF is related.

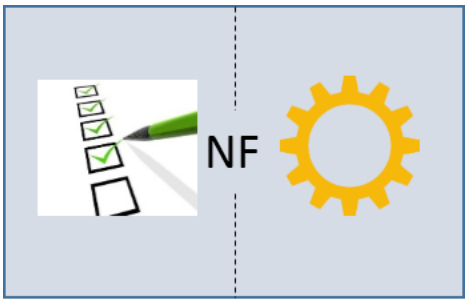

Figure 2: NF Dual View

This dual view model is inherited to higher level aggregations that in turn are producing the result of the synthesis of the contained NF views with any restrictions or dependencies resolved (Figure 3).

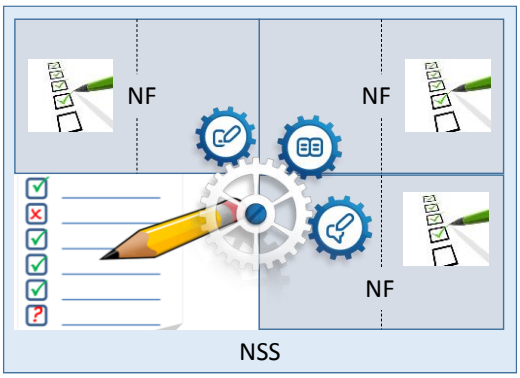

Figure 3: Aggregation of NFs in NSS

Additionally, the NSS may be augmented with more features that depend on NF details. Such feature enrichment is achieved by the inclusion of features such as P&P, cognition or simple rule based automations. The enrichments are added on top of the already selected NF characteristics. For example, a P&P plugin is included when the underlying sensing or actuation elements are available.

This pattern is preserved also when Network Slice templates are created exposing as a topmost offering the vertical view of these NS Templates which are based on the supported features and also on location aspects. The provisioning phase, once indicated by the vertical, involves resolution of features vs location support among underlying providers and concludes with the propagation of the proper orchestration requests per each of the identified administrative NSP domains (Figure 4).

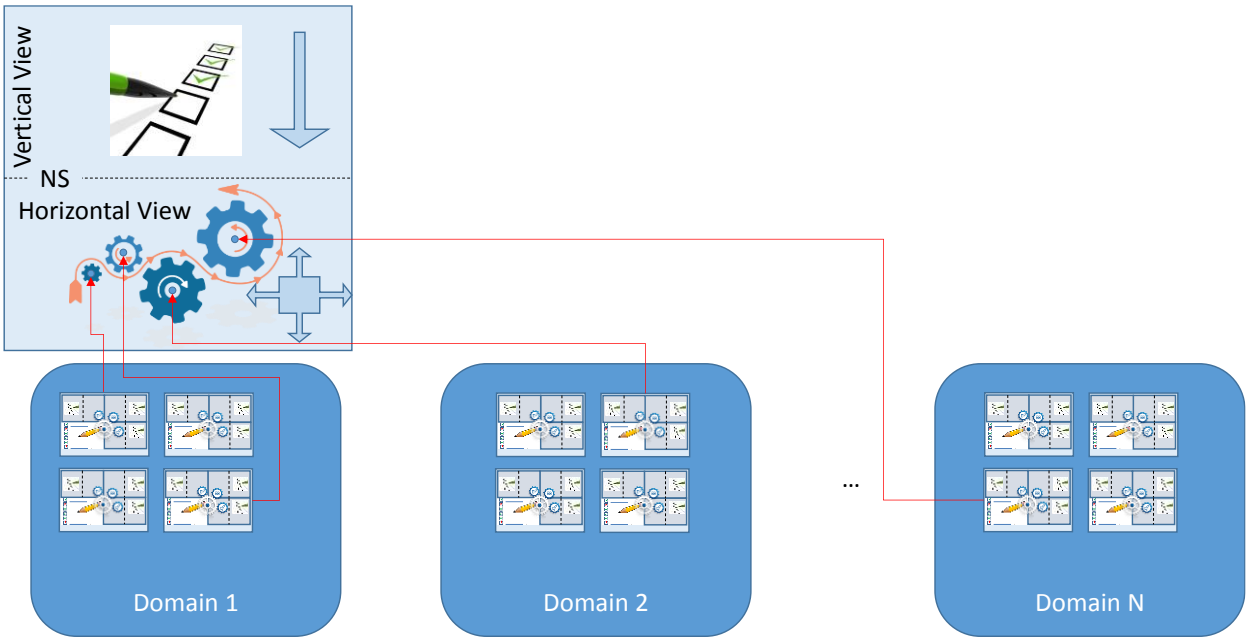

Figure 4: Slice Selection and Provisioning

Overall, the above process can be summarised in the following workflow (Figure 5):

1. NSPs identify their offerings in terms of NFs and annotate these with supported monitoring and actuation capabilities.
2. NSPs expose NSSs aiming at offering access or core network functionalities along with location (mainly for access network) options and additional options for P&P, cognition (QoS) or rule automation.
3. DSPs create end to end slice templates (from core and access network segments among available NSPs) and augment these (based on underlying features) with additional QoE cognitive management features. This allows DSPs to provide their own added value services beyond simple NSS brokering, thus enabling business competitiveness among DSPs.
4. Verticals finally select the features for their end to end slices and trigger provisioning and interdomain connectivity to be applied.

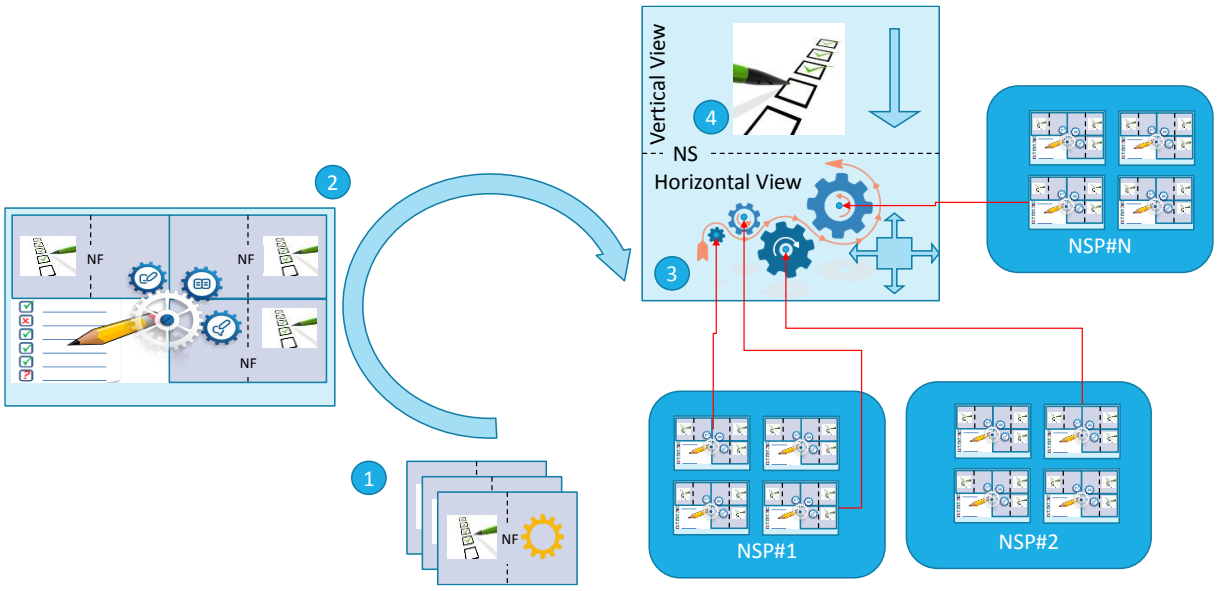

Figure 5: Slicenet Overall Workflow

3 Principles of Northbound Views

As it was described in the previous chapter (2.4) each role is supported by a relevant view that is tailored to its business aspects. In the current chapter, an elaboration on the details of the expected views is provided to consolidate the business related principles that SliceNet OSA framework aims at supporting. In this respect SliceNet considers as a starting point the business roles models ([3]) and the related scenarios ([2]) that have been highlighted in 3GPP documents. It is worth mentioning that SliceNet consortium with respect to its selected vertical players (e-health, power grid, smart city) along with the related use cases are highly relevant to the foreseen business roles scenarios foreseen in [2].

Although slicing support has been earlier addressed via a bottom-up approach to highlight the abstraction workflows and processing of the available resources that are foreseen for the design phase of the offerings, the northbound views analysis follows a top-down approach in order to highlight the provisioning and operation phase as well as the vertical centric approach.

3.1 Vertical View

Slicing for SliceNet starts from the vertical or end user perspective which, above all, identifies the UE as a key element in the definition of the slice. Thus the UE is not simply utilising or connecting to a slice, but it is in most of the cases one of the, potentially several, ends of what has to be supported under the term of end-to-end slicing.

Figure 6: Simplest Slice – Vertical View

Figure 6 above presents this fundamental aspect of a slice. The application space of the UEs are able to interconnect with each other according to the particular vertical needs. Indeed, UEs will have heterogeneous requirements and customized vertical capabilities, depending on the specific vertical use cases and services. This translates into a complex combination of deployment options (i.e. mobile vs. fixed UEs), network requirements (latency vs. ultra-high bandwidth vs. high reliability), service requirements (best effort vs. stringent SLAs).

Therefore, the UEs might be using different radio or fixed access technologies but from application point of view the requirement is satisfied by the establishment of one TCP or UDP socket over the logical link that is presented by the green line. Obviously, this logical green line requires that a quite extensive coordination of several components and infrastructure resources along with continuous adaptation and optimisation processes are taking place. In several cases these processes require also coordination among different administrative domains that may be utilising different technologies as well. The provision of this green line, which actually starts from the network layer of the communication stack in the one UE and terminates at the same layer of the communication stack of its peer UE, is what SliceNet has to support and offer as slice to the vertical which, in the simplest case, requires that there is always such a green line between its UEs with a guaranteed level of performance, quality and security attributes as well as physical aspects such as geographical location, distribution and mobility of the devices.

With this top-down approach vertical requirements can be summarised in the form of a number of identifiable UEs and the interconnections among them attributed with performance, quality, security and physical (geographical) constraints. The way the interconnections among the UEs will be utilised are application specific and not subject to slicing procedures. A more extensive view of the vertical end-to-end slicing view is presented in the next figure (Figure 7) where the vertical is a power grid (PG) operator and the requirement is to connect a number of PG pieces of equipment distributed over a wide geographical area with low latency links.

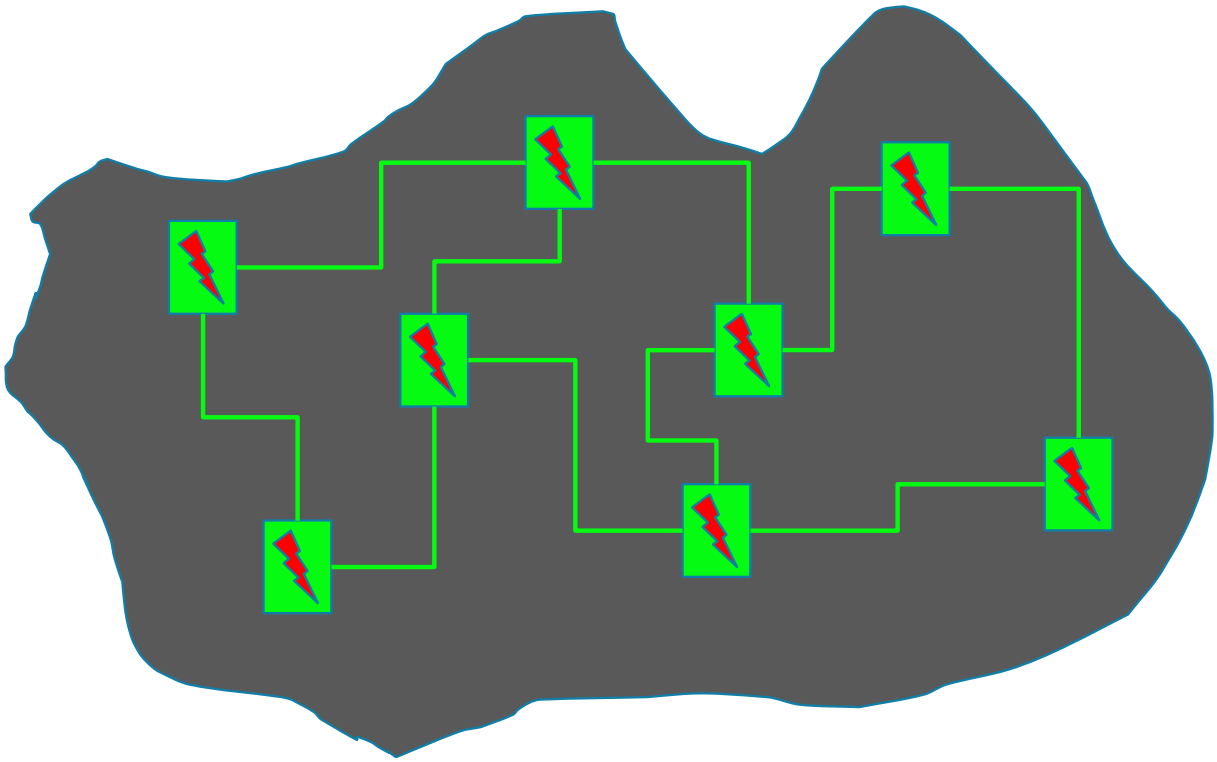

Figure 7: Power Grid Slice

A graph like the one displayed is what the vertical is requesting: a slice tailored to the communication needs of a distributed system with low demands in volumes of data exchanged but with high demands in terms of communication latency and link availability. It is expected that the vertical view can be dynamically customised by means of user interface (UI) tools and methodologies that may allow the vertical administrator to tune node and link attributes by simply clicking on the UI and modifying node and link parameters as well as by adding or removing nodes and links.

In a more complex scenario where mobility is also required, the vertical may define areas of interest where the slice services have to be always available. For example, in order to cover the communication needs between an ambulance and the hospital. In such case, the DSP should orchestrate the access network parts of the slice in a way that for each part of the potential routes of the ambulance the service characteristics are preserved. This may require that RAN subslices are allocated across different NSP based on the coverage adequacy they can provide. For the ambulance this will mean seamless communication “without changing the network selection information stored in the UE” ([2]) and this is the exact benefit for an e-Health Use Case through SliceNet.

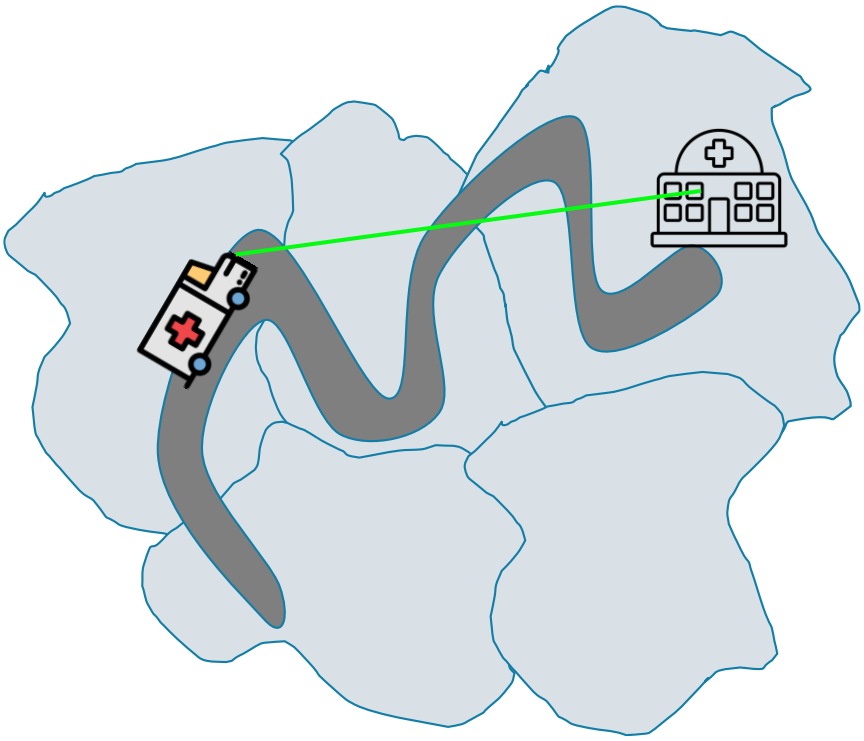

Figure 8: e-Health Slice

3.2 DSP View

Obviously, the provisioning or slice modifications processes, which are stemming from the vertical requirements indicated above, are closely related with the underlying infrastructure segments that are involved to support slice provisioning or SLA maintenance. When the vertical view is processed in the context of the management procedures of the DSP, each logical green line that is interconnecting UEs is split into two parts. Each part relates with the segments of the slice that are involved for attaching the UE to the slice. For each of the two parts, the DSP resolves the access network subslices that are involved the for the connectivity of each part of the slice as well the single core network subslice with which the access subslices are linked (Figure 9). Those subslices may be instantiated in different NSPs.

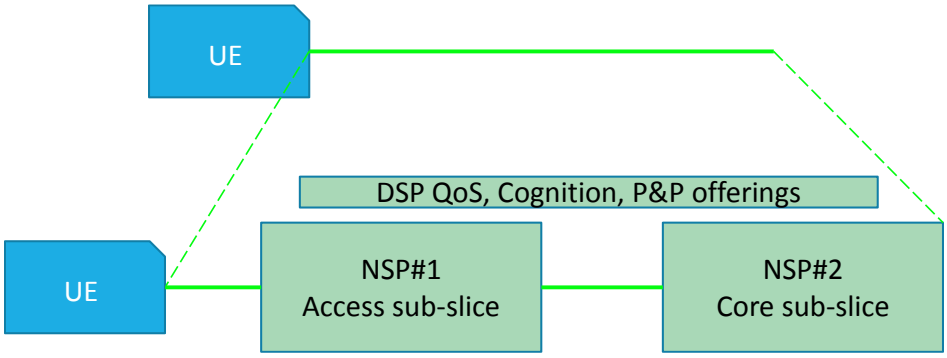

Figure 9: DSP View

In the above figure (Figure 9) the UE is still considered as the endpoint of the end-to-end slice. Since the part of the logical link that integrates this UE into the slice is projected onto a more detailed graph of sub-slices, the accompanying configuration options via the UI have to be translated according to the actuation options exposed by the subslices and the way these options may be used by optimisation offerings the DSP is supporting.

3.3 NSP View

At the NSP level the view of each provided subslice can essentially be a description of how virtual and physical resources are interconnected and obviously how many (along with their type) of such resources are taking part for the support of the one end (out of many) of a slice. The graph can be further augmented (Figure 10) with information about the location of the control and data plane resources across RAN, MEC, CORE, Backhaul, WAN infrastructure pillars ([4]).

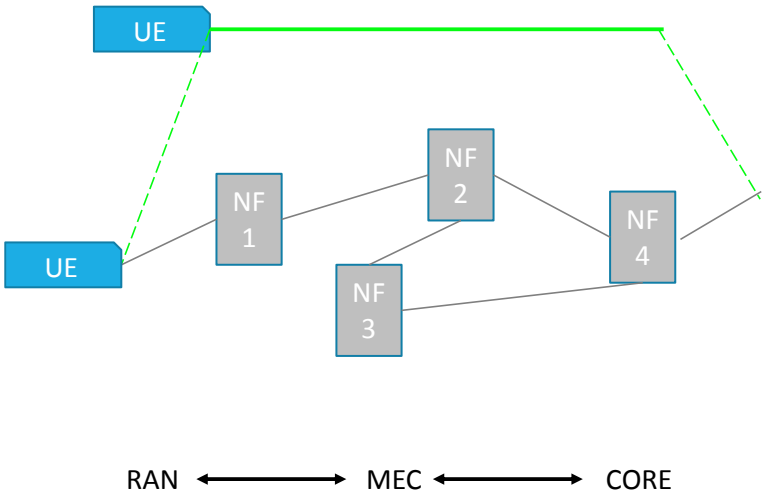

Figure 10: High level NSP view

This further clarification of the positioning of resources will allow Management Plane to properly address the vertical requirements in terms of modifying the resource pool allocated to the part of the slice that is under consideration. Isolation, sharing and performance can influence the way virtual resource are instantiated and allocated to slice parts. Additionally, distribution of functions across PoPs are also subject to this processing of requirements either for initial slice provisioning or during adaptations. At this stage the overall view has to be expanded down to PoP details for orchestration of virtualised resources that accommodate pillar related functionality (Figure 11).

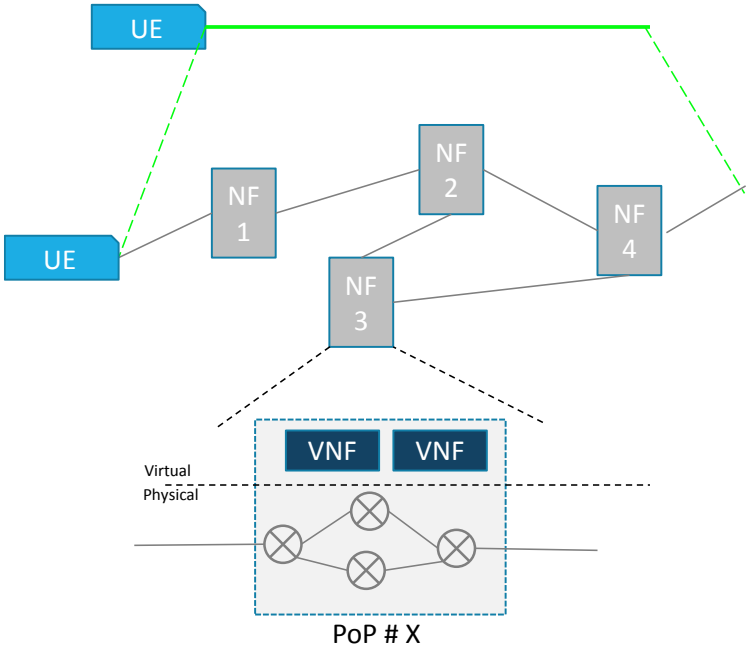

Figure 11: Detailed NSP View

NSP offerings are abstracting technology related constraints that can trigger further processes. For example, modification on the latency requirements of a link may result in the tuning of some data plane hardware acceleration or in other cases in a change in the S-NSSAI negotiation and potentially in the transition of the affected UEs to a new 5G slice. Additional processing over offered actuation resolution may regard:

- QoS control per UE Session
- Interconnectivity among segments
- Configuration of functional instances
- Data plane tuning
- Inter-domain management and configuration

It is expected that ([4]) different implementations per infrastructure pillar will be at the disposal of the Management Plane for the instantiation of a slice segment. These differences are also expected to be harmonised by the use of targeted adaptors that expose a common set of functionalities/services per pillar at their NBI on top of which the Slice Control Contexts are provided. Once the resources have been provisioned, the Management Plane applies the proper configuration with respect to inter-PoP connectivity graphs, UE related management, inter-domain configurations, data plane tuning for user plane performance and also configuration of the slice segment for the proper attachment of the UE in the slice.

4 One Stop API Requirements

Based on the analysis about the slicing concept and the separation of roles and also taking into account verticals' requirements ([5]), the following set of initial requirements has been produced and expected to further evolve so as to allow the design of the One Stop API to be exploitable in the context of future business roles approaches.

- The One Stop API should accommodate all the interactions within the SliceNet platform covering both design and operation phases.
- User roles should be provided with different views and different control and management options tailored to their workflow needs.
- The identity of the user utilizing the One Stop API user interface should be subject to role analysis for the resolution of the access rights across the domain's functional endpoints and information sets – including inventory and monitoring data – as these are stemming from the service agreements and the related foreseen privileges.
- The role resolution should be reflected on the operation space through which the user interacts either with the slice and service instances as vertical user or with the resource instances – ranging from physical to logical and service resources – in provider role (network or digital service provider) during the process of designing network, communication or digital service offerings aimed to be selected and utilized by the consumer role (network or digital service consumer respectively) on top of it.
- At the interfacing border between the role of a provider with the role of the related consumer, offerings should be abstracted to be conceived by the consumer role's design and/or operation processes.
- Consumer requests should be expanded and handled in more complex workflows for the delivery of the higher level requirements.
- One Stop API should be as much as decentralised as possible. Role resolution should therefore be resolvable through collaborative processes.
- There cannot be ownership of the One Stop API backend by a single player as it will avert equal level players from joining the ecosystem.

In the context of supporting the vertical oriented views, an early OSA prototype was developed utilising mainly the exposed information via the P&P components. In this prototype the focus was on the support of:

- automated UI generation based on underlying technologies (Figure 12)
- visualisation of performance indicators retrieved through established web sockets streams with the backend P&P services (Figure 12)
- options for actuations (Figure 13)

Figure 12: OSA Early Prototype – Vertical View

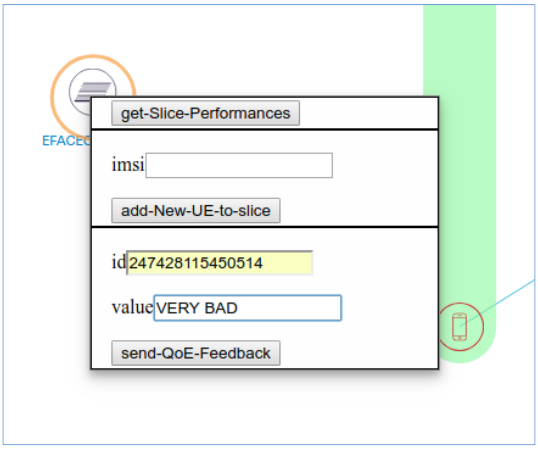

Figure 13: OSA Exposure of Actuation Option

5 Conclusions

The overall outcome of this first iteration is expected to be further elaborated together with the Use Case stakeholders as well with the technology providers within the project so that the second iteration can be completed with the provision of the final One Stop API components. The task has not evolved in proportion to its duration up to now, as several sub-iterations were required to take place. During these sub-iterations assumptions had to be evaluated from the technological feasibility point of view or from the applicability with respect to business domains before accounted as design principles. With technological aspects being also evolving in an agile way, it was reasonable that the process of transforming assumptions into design principles was not possible to advance linearly. Such a sub-iteration is currently ongoing with respect to the definition of realistic technology framework where different roles can apply their slicing business logic producing a proof of concept solution that can also feed dissemination, exploitation and standardisation channels.

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