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LM. Contreras
Telefonica
R. Rokui
Ciena
J.T. Tantsura
Microsoft
B. Wu
Huawei
X. Liu
IBM Corporation
D. Dhody
Huawei
S. Belloti
Nokia
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IETF Network Slice Controller and its ~~associated~~ Associated ~~data~~ Data ~~models~~Models

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Abstract

~~This document describes a potential division in major functional components of an IETF Network Slice Controller (NSC) as well as references the data models required for supporting the requests of IETF network slice services and their realization.~~

This document describes ~~a potential way~~an approach for ~~of~~ structuring the IETF
Network Slice Controller as well as how to use different data models being defined for IETF Network Slice Service provision (and how they are related). It is not the purpose of this document to standardize or constrain the implementation the IETF Network Slice Controller.

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1. Introduction

~~The~~ A ~~generic idea~~main promise of network slicing ~~intends~~ is to provide tailored end-to-end network capabilities to customers in the way that they could be perceived as a dedicated ~~network~~infrastructure, despite ~~the fact~~ that it makes use of shared physical infrastructure facilities.

~~Among the capabilities mentioned~~Particularly, the connectivity within and between ~~of~~ different ~~parts~~ segments of a network slice with ~~particular~~ specific performance characteristics ~~play a central role~~are key in characterizing a slice. Thus, ~~the concept of~~the IETF Network Slice, realized by any of the IETF technologies, emerges as complementary but essential part of an end-to-end network slice.

In order to facilitate the ~~request~~service exposure, service order handling, realization, and lifecycle control and management of a transport slice, a ~~new~~ dedicated element, ~~named~~ called IETF Network Slice Controller (NSC), is ~~being~~ proposed in [I-D.ietf-teas-ietf-network-slices].

The NSC from its ~~North Bound Interface (NBI)~~customer-facing interface, i.e., the IETF Network Slice Service interface, exposes a set of APIs that allow ~~a higher level system~~a third party to request ~~an end-to-end~~a transport slice. The NSC ~~It~~ receives ~~the~~ slice service requests from customers to manage ~~of enablement of~~ an IETF Network Slice ~~by a customer~~ (i.e., creation, modification, or deletion). Upon ~~receiving~~ receipt of a request to create a slice ~~from its NBI~~, the NSC ~~finds~~ assess and then identifies the resources needed for realization of

the IETF Network Slice. To that aim, the NSC may interact with ~~and in turn interfaces from its South Bound Interface (SBI) with~~ one or more Network Controllers for the realization of the requested IETF Network Slice request and the management of its lifecycle. Figure 1 presents a high-level view of the IETF NSC [I-D.ietf-teas-ietf-network-slices].

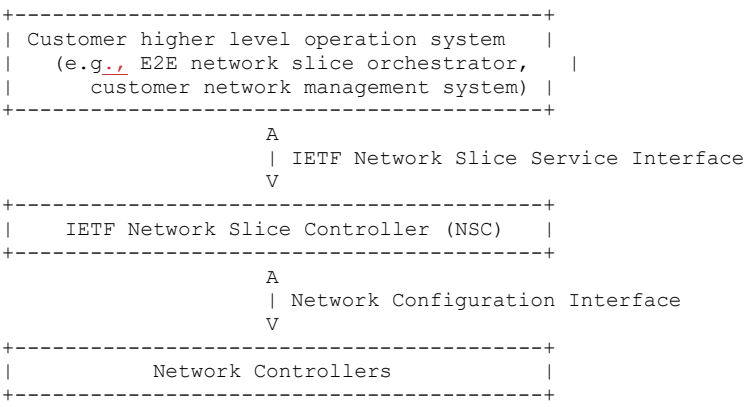


Figure 1: Interface of Transport Slice Controller

This document describes the characteristics of the NSC as well as a detailed structure of the NSC and its major components. In addition, it describes the characteristics of the data models to identify ~~the~~an IETF Network Slice and its realization. ~~Then the referred data models are mapped to the interfaces among components.~~

~~It is important to remark that t~~This document describes a potential way of structuring the IETF Network Slice Controller as well as how to use different data models being defined for IETF Network Slice Service provision (and how they are related). It is not the purpose of this document to ~~standardizing~~ standardize or constrain~~ing~~ the implementation the IETF Network Slice Controller~~s~~.

2. IETF Network Slice ~~data~~ Data ~~models~~Models

At the time of provisioning and operating IETF Network Slices different views can be identified as necessary:

* The Customer's view~~:, mostly~~ focused on the individual IETF Network Slice request process, reflecting the needs of each particular customer, including SLOs and other characteristics of the slice relevant for it. This view is ~~technology~~ technology-agnostic and describes the characteristics of the IETF Network Slice from a customer's point of view. It can include the slice topology, performance parameters, endpoints of the slice, traffic characteristics of the slice, and the KPIs to monitor the slice.

* Provider's view:~~,~~ In addition to the view that is exposed to customers, ~~mostly~~ the provider maintains an more network-centric view that ~~focused~~ focuses on the internal provisioning and operation of IETF Network Slices in the underlay network, considering how a particular IETF Network Slice interplays with other IETF Network Slices maintained by the provider on a shared infrastructure. In other words, operator's view shows how an IETF Network Slice is ~~realized~~ implemented in the operator's network along with all the resources used during the its realization. This view is not exposed to the customers.

Both views are complementary~~, each of them specialized for a given purpose. In consequence, it should be consistency between both in order to ensure alignment~~ as they are invoked in different stages of service provisioning and delivery lifecycles. For the sake of automated procedures, some consistency should be ensured between these views to ease the service mapping as per [RFC8969]~~.~~

~~Currently there are two different models proposed, one for each of the categories above. The model in [I-D.ietf-teas-ietf-network-slice-nbi-yang] fits into the customer view, while the model defined in [I-D.liu-teas-transport-network-slice-yang] fits in to the provider view.~~

It should be noted that for the realization of an IETF Network Slice, the NSC interacts with one or more Network Controllers underneath. Whether one or more NSCs/Network Controllers are used is deployment specific.

~~In that case, t~~The data models to be used are ~~particular~~ specific for each Network Controller (e.g., ~~technology~~ technology-dependent), as well as the mapping function from its ~~NBI~~ customer-facing interface (i.e., IETF Network Slice Service interface) to ~~SBI~~ network-facing interfaces (i.e., Network Configuration Interface) and the details of this mapping function are both out of the scope of this document.

3. Structure of the IETF Network Slice Controller (NSC)

The NSC should ~~work~~ support ~~with~~ both service and network data models. The NSC exposes service models to customers. Customers uses these models for their slice service request placements. The NSC then ~~takes first the customer's view by analyzing the needs of the customer,~~ process customers requests~~ing such requests~~ taking into account local policies and guidelines (e.g., mapping strategy 1:1/1:M/N:M), the overall view of the network resources (e.g., service functions) and the IETF Network Slices already instantiated, normalizing its instantiation across different technologies, and ~~finally~~ map it to ~~generates thea~~ provider view.

Once ~~the~~ a new request is processed and ~~declared~~ tagged as feasible, ~~the~~ an NSC

triggers its realization by interacting with the relevant Network Controllers
underneath and communicates backreporting to the higher level controller to
start the billing cyclefor accounting/billing purposes. The actual start of the billing process is deployment specific and depends on whether a slice request is a scheduled request or has immediate effect.

In order to accommodate these procedures, the internal structure ofan the NSC can be divided intomay be structured to embed the following components:

* IETF Network Slice Service Mapper: this high-level component processes the customer requests, putting it into the context of the overall IETF Network Slices in the network.

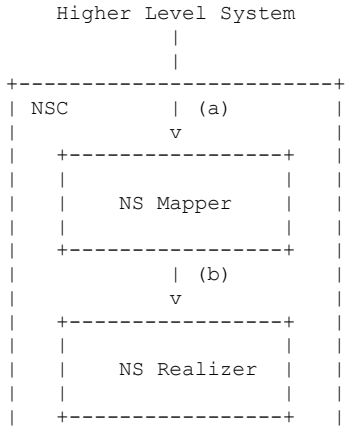
* IETF Network Slice Realizer: this high-level component processes the complete view of transport slices including the one requested by the customer, decides the proper technologies for realizing the IETF Network Slice and triggers its realization.

Figure 2 illustrates the components described and the associated models, as follows

* (a) -> customer's view, e.g., [I-D.ietf-teas-ietf-network-slice-nbi-yang] and [I-D.boro-opsawg-teas-attachment-circuit].

* (b) -> provider's view, including more detailed but yet technology-agnostic resource view as, e.g., [I-D.liu-teas-transport-network-slice-yang], and/or alternative technology-specific augmentations as, e.g., for OTN [I-D.ietf-ccamp-yang-otn-slicing] or for IP/MPLS NRP [I-D.wd-teas-nrp-yang].

* (c) -> models per network controller, out of scope of this document. An example of applicability of existing models is in [I-D.barguil-teas-network-slices-instantation].



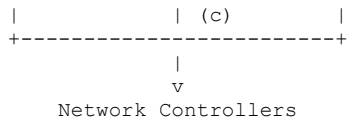


Figure 2: IETF Network Slice Controller ~~structure~~ Structure and ~~asspociated~~associated ~~data~~ Data ~~M~~models

IETF Network Slices with different level of detail could be requested:

* The IETF network slice can be abstracted as a set of edge-to-edge links (Type 1).

* The IETF network slice can be abstracted as a topology of virtual nodes and virtual links (Type 2) which represent the partitioning of underlay network resources for use by network slice connectivity.

The use cases of these two types of networks are further described by [RFC8453].

Regarding IETF Network Slice service requests, it is possible to model the Type 1 service by means of [I-D.ietf-teas-ietf-network-slice-nbi-yang]~~.~~, while it is possible to model the Type 2 service using [I-D.liu-teas-transport-network-slice-yang]~~.~~. Moreover, when a customer intends to request a Type 2 service, [I-D.liu-teas-transport-network-slice-yang] can also be used at the point (a) in Figure 2. It should be noted that according to [I-D.ietf-teas-ietf-network-slices], the customer might ask for some level of control of the IETF Network Slice, for instance to customize the service paths in a network slice. The abstract topology defined in [I-D.liu-teas-transport-network-slice-yang] could serve to enable this capability and optimize the resource utilization for network slice connections activated on top of the abstract topology.

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In respect to IETF Network Slice ~~ealization~~realization, as an example, when ACTN is used to realize an IETF network slice, model mappings are described in more details in [I-D.ietf-teas-actn-yang].

3.1. NS Mapper

The Mapper will receive ~~the~~ a IETF Network Slice Service request from the customer. It will process it obtaining an overall view of how this new request complements or fits with the rest of IETF Network Slices, if any, as provisioned in the network. As part of that processing, a single customer IETF Network Slice Service request could result in the need of actually provisioning different IETF Network Slices in the network. The Mapper will maintain the relationship among customer IETF Network Slice request and provisioned IETF Network Slices. The Mapper also will provide performance notifications in relation with the SLOs dictated in the slice request by the customer.

The Mapper performs resource partitions of the filtered topologies provided by the Realizer component, generating specific Network Resource Partitions (NRPs). An NRP represents a collection of resources such as buffers~~,~~ or queues~~, etc,~~ of the links of a filtered topology. The Mapper, when processing the slice request, will map the connectivity constructs to one or more NRPs, e.g., according to specific SLOs.

As part of the performance monitoring of the IETF Network Slice service, the Mapper will aggregate performance information from the distinct NRPs used for mapping the connectivity constructs forming the slice.

3.2. NS Realizer

The Realizer will receive from the Mapper one or more requests for provision of IETF Network Slices, potentially including some technology-specific information (e.g., an indication about the use of Layer 2 or Layer 3 capabilities to put into effect a slice). With that information, the Realizer will determine the realization of each ~~particular~~ IETF Network Slice Service interacting with technology-specific Network Controllers.

The Realizer will be in charge of generating filtered topologies from the underlying (physical) network information provided by the Network Controllers. The handling of filtered topologies is optional, then if not filtering is applied, the Realizer could expose the physical network. The filtered topologies represent a selection of nodes and links from the underlying network(s), e.g., as result of applying certain policies.

The Realizer will provide the telemetry information from the filtered topologies to the Mapper for further processing in support of the performance assurance of the IETF Network Slices.

4. Model ~~types~~ Types in IETF Network Slice Controller interfaces

Both [RFC8309] and [RFC8969] offer a complete view of customer, service and network model types. In this sense a potential mapping of models to IETF Network ~~Sleie~~ Slice Controller interfaces is as follows:

* ~~NBI of the IETF NSC, i.e.~~ IETF Network Slice Service interface (interface (a) in Figure 2) -> Customer service model. According to [RFC8309] "a customer's service request is (or should be) technology agnostic. That is, a customer is unaware of the technology that the network operator has available to deliver the service, so the customer does not make requests specific to the underlying technology but is limited to making requests specific to the service that is to be delivered". This definition matches the expected behavior of the IETF NSC ~~NBI~~ Slice Service Interface as considered in [I-D.ietf-teas-ietf-network-slices].

* Interface between NS Mapper and NS Realizer (interface (b) in Figure 2) -> Service Delivery model. According to [RFC8309] "a

service delivery module is expressed as a core set of parameters that are common across a network type and technology [...] Service delivery modules include technology-specific modules.". Furthermore, [RFC8969] (in its Figures 3 and 5) considers L3SM or VN Service models to be later on fed into a controller.

* ~~SBI of the IETF NSC, i.e.~~ Network Configuration interface (interface (c) in Figure 2~~)~~ -> Network Configuration model. According to [RFC8309] "the orchestrator must map the service request to its view, and this mapping may include a choice of which networks and technologies to use depending on which service features have been requested". This is ~~coincidcent~~coincident with the expected behavior of the IETF NSC ~~SBI~~ network configuration as considered in in [I-D.ietf-teas-ietf-network-slices].

5. Security Considerations

This ~~draft~~ document considers both the Mapper and the Realizer component as internal modules of the IETF Network Slice Controller. However, anything prevents that these modules could be separated components, communicating through standard protocols (i.e., not as an internal communication to the IETF NSC).

In that case, some security requirements apply such as:

* Authentication between Mapper and Realizer, to prevent malicious behaviors.

* Privacy of the information shared between components.

* Secure transport between components based on the kind of interface used in the communication (e.g., NETCONF, RESTCONF~~, etc~~).

6. Points for further ~~dicussion~~discussion (TODO)

There are a number of open points that require more discussion among authors:

* Alignment of the references to [I-D.liu-teas-transport-network-slice-yang] with respect the new scope of the draft in its latest version, which provides a topology view of slice request, that is, becoming topology-intent service from the customer (not related to realization).

* Consideration of the ~~funcationality~~functionality enabled by the topological information included in [I-D.ietf-teas-ietf-network-slice-nbi-yang].

These open points will be covered in the next version of the draft.

7. IANA Considerations

This draft does not include any IANA considerations

8. References

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Authors' Addresses

Luis M. Contreras
Telefonica
Ronda de la Comunicacion, s/n
Sur-3 building, 3rd floor
28050 Madrid
Spain
Email: luismiguel.contrerasmurillo@telefonica.com
URI: http://lmcontreras.com/

Reza Rokui
Ciena
Canada
Email: rrokui@ciena.com

Jeff Tantsura
Microsoft
United States of America
Email: jefftant.ietf@gmail.com

Bo Wu
Huawei Technologies
101 Software Avenue, Yuhua District
Nanjing, Jiangsu
210012
China
Email: lana.wubo@huawei.com

Xufeng Liu
IBM Corporation
Email: xufeng.liu.ietf@gmail.com

Dhruv Dhody
Huawei Technologies
Divyashree Techno Park

Bangalore, Karnataka 560066
India
Email: dhruv.ietf@gmail.com

Sergio Belloti
Nokia
Email: sergio.belotti@nokia.com