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IETF Network Slice Intent
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Abstract

Slicing at the transport network is expected to be offered as part of end-to-end network slices, fostered by the introduction of new services such as 5G. This document explores the usage of intent technologies for requesting IETF network slices.

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1. Introduction

Network slicing is emerging as the future model for service offering in telecom operator networks. Conceptually, network slicing provides a customer with an apparent dedicated network built on top of logical (i.e. virtual) and/or physical functions and resources supported by a shared infrastructure, provided by one or more telecom operators.

The concept of network slicing has been largely fostered by the advent of 5G services that are expected to be deployed on top of different kind of slices, each built to support specific characteristics (extreme low latency, high bandwidth, etc).

As part of an end-to-end network slice it is expected to have a number of network slices at transport level (referred as IETF network slices) providing the necessary connectivity to the rest of components of the end-to-end slice, e.g., mobile packet core slice.

For a definition of an IETF network slice refer to [I-D.ietf-teas-ietf-network-slices]. The following paragraph is directly taken from it: "An IETF Network Slice Service enables connectivity between a set of CEs with specific Service Level Objectives (SLOs) and Service Level Expectations (SLEs) over a common underlay network."

Intent is a high-level, declarative goal that operates at the level of a network and services it provides, not individual devices. It is used to define outcomes and high-level operational goals.

In consequence, it seems very convenient to apply the intent-based mechanisms for the provision of IETF network slices, providing the adequate level of abstraction towards the transport network control and management planes.

This document leverages current industry trends in the definition of end-to-end network slices. The final objective is to describe intents that can be used to flexibly declare the operational aspects and goals of an IETF network slice, meaning that the customer could declare what kind of IETF network slice is needed (the outcome) and not how to achieve the goals of the IETF network slice.

2. IETF network slice intent

As stated in [RFC9315], "Intent is a declaration of operational goals that a network is supposed to meet and outcomes that the network is supposed to deliver, without specifying how to achieve or how to implement them. Those goals and outcomes are defined in a manner that is purely declarative - they specify what to accomplish, not how to achieve it."

When applied to transport networks, this implies that an intent for IETF network slices should provide the necessary abstraction with respect to implementation details, including the final devices (or resources) involved, and be focused on the characteristics and performance expectations related to it.

With that aim it can be expected that the intent based system can fulfill and assure the requested IETF network slice, triggering initial configurations at the time of initial provisioning and corrective actions during the IETF network slice lifetime.

Regarding the corrective actions it is possible to differentiate two levels. First, corrective actions that could be performed by the management and control capabilities of the network (i.e., by the IETF Network Slice Controller) to maintain the Service level Objectives (SLOs) as originally declared in the slice intent, so being these internal actions to the management and control elements of the network. Second, corrective actions that could be necessary to perform due to incongruences between the SLOs expressed in the intent and the observed monitoring information, then requiring some adaptation to the intent itself in order to perform the corrective action.

3. Foundation of IETF network slice intents

3.1. Slice templates

The industrial interest around 5G is accelerating network deployments and operational changes.

With this respect, the GSMA has been developing a universal blueprint that can be used by any vertical customer to request the deployment of a network slice instance (NSI) based on a specific set of service requirements. Such a blueprint is a network slice descriptor called Generic Slice Template (GST) [GSMA]. The GST contains multiple attributes that can be used to characterize a network slice. A particular template filled with values generates a specific Network Slice Type(NEST).

Such templates refer to the end-to-end network slice, including the transport part. Despite the fact that some of the values would not have applicability for the transport network, others do. An analysis of the relevant attributes is performed in [I-D.ietf-teas-ietf-network-slice-use-cases].

According to 3GPP propositions [TS28.541], an upper 3GPP Management System interacts with the transport network for establishing the necessary slices at the transport level. Such interaction can be expected to happen using the IETF network slice intent, described to an intent-based system (IBS) in the transport network part.

3.2. Additional information needed for a network slice at the IETF domain

The previous slice templates provide a number of parameters that functionally characterizes the behavior of the network slice as expected by the slice customer. However, apart from the slice characteristics, further information is needed in order to request the realization of a slice towards the IETF Network Slice controller, as follows:

* Identification of the slice endpoints to be connected where a given slice template applies. It is necessary to clearly identify which are the origins and destinations of the traffic flows in each IETF Network Slice.

* Information that could assist the slice provider in order to identify the endpoint counterpart at the provider side. This information could come in terms of some identifier meaningful for both customer and provider which can help to retrieve the necessary information to clearly identify the entry point of the traffic flow at the provider side. Such an identifier could have been negotiated beforehand between customer and provider (e.g., allocation of an administrative identifier corresponding to the attachment circuit connecting customer and provider premises).

* For advanced slices where the customer could have some control over the allocated network slice resources, the customer could provide information about the virtual network topology expected to form the requested IETF Network Slice. This relates e.g. to the concept of virtual network topology types in [RFC8454].

* Additional information that could assist on the further realization of the IETF network slice (e.g., protocols or mechanisms to used).

The customer needs then to combine the information coming from the slice templates with this additional information to form the IETF network slice template for further processing.

3.3. Slice intent lifecycle

According to the intent lifecycle in [RFC9315], the IBS, after recognizing the intent, will proceed to translate it in order to interact with a IETF network slice controller by using a NBI as proposed in [I-D.ietf-teas-ietf-network-slice-use-cases].

Figure 1 captures the intent procedure for the fulfillment phase.

```
          User Space   :       Translation / IBS       :  Network Ops
                       :            Space              :     Space
                       :                               :
        +----------+   :  +----------+   +-----------+ : +-----------+
 Fulfill |recognize/|---> |translate/|-->|  learn/   |-->| configure/|
         |generate  |     |          |   |  plan/    |   | provision |
         |intent    |<--- |  refine  |   |  render   | : |           |
        +----------+   :  +----------+   +-----------+ : +-----------+
                       :                               :
 ..........................................................................

     Slice Customer    :                  Slice Provider
     --------------    :                  --------------
                       :
    - Customized Slice :  - Identification of IETF     : - Slice request
      Templates        :    network slice endpoints    :   to IETF NSC by
    - Service SLOs as  :    and connectivity pattern   :   using slice
      understood by    :  - Derivation of network SLOs :   NBI YANG model
      slice customer   :    and SLEs from high-level   :
                       :    Customer Service SLOs      :
                       :                               :
```

Figure 1: Fulfillment phase of the IETF Network Slice service Intent

Similarly, Figure 2 sketches the intent procedure for the assurance phase.

```
                       :                  +--------+   :
                       :                  |validate|   :  +----------+
                       :                  +----^---+ <----| monitor/ |
 Assure    +-------+   :  +---------+    +-----+---+   :  | observe/ |
           |report | <---- |abstract |<---| analyze | <----|          |
           +-------+   :  +---------+    |aggregate|   :  +----------+
                       :                 +---------+   :
   .....................................................................

     Slice Customer    :                  Slice Provider
     --------------    :                  --------------
                       :
  - Analysis of the    : - Checking of monitored data  : - Collection of
    reported metrics   :   for internal closed loops   :   monitoring info
    against the slice  :   to ensure commited SLOs and :   related to the
    request            :   SLEs (inner closed loop)    :   slice (i.e.,
  - Trigger of actions : - Aggregation of data         :   SLOs and SLEs of
    if needed, e.g.,   :   producing an abstracted view:   connectivity
    slice modification :   fitted to the slice request :   constructs, sdp,
    (outer closed loop):                               :   etc.)
```

Figure 2: Assurance phase of the IETF Network Slice service Intent

Both Fulfillment and Assurance phases are integral part of the IETF Network Slice service intent.

4. Mechanisms for translating IETF network slice intents

This section describes approaches for implementing mechanisms to translate IETF network slice intents. As part of such translation it could be necessary to translate the slice needs expressed by the customer in terms of service-specific SLOs (e.g., high-resolution real-time video quality) to network- or connectivity-specific SLOs (e.g., a correspondent throughput and/or latency) which are the SLOs an IETF Network Slice Controller understands. More on this can be found in [TMV].

4.1. Translation approaches and interaction with the upper systems

A suite of mechanisms will be required to allow instantiation of the user’s intent into a IETF network slice. In order to be able to deliver an end2end Intent driven slice - a well defined set of context aware attributes that allow unambiguous instantiation of the intent should be agreed upon. A combination of a structured set of attributes communicated between an IBN and an upper layer system with user input would allow an IBN to have intent modeled and reason about its completeness/validity. Translation approaches and interaction with the upper systems might benefit from Natural Language Processing (NLP) technics that are needed for enabling high level expression of requirements found missing. The goal would be to identify and classify the answers for as many fields as possible from the Generic Slice Template (GST), based on the free text / speech provided by the user. As it is highly unlikely that the minimum set of fields to properly define an IETF network slice (geo-temporal characteristics, performance characteristics, SLO and SLA properties) will be fulfilled in this first step, a follow up two-step approach might need to be implemented.

* The minimum missing fields from the GST have to be identified and appropriate questions have to be generated (e.g. based on a pool of available questions correlated with each field, or based on AI approaches).

* An iterative interrogation phase will be initiated towards the user using the previously generated questions, until the user provides all the missing information, so the intent can be modeled accordingly.

Interaction with the user and higher-up systems can potentially be further improved by utilizing Machine Learning techniques.

4.2. Intent-based system suite

In order to consolidate on the set of devices, technologies and resources to be used, a combination of deterministic or stochastic computation approaches will be needed. Deterministic approaches will rely on mathematical models and respective algorithms. Stochastic approaches will rely on technologies like machine learning. Their goal will be to learn from experience, so as to optimize future decisions from the viewpoint of speed and reliability. The target of learning will be related to the service behavior and to the anticipated network status in the area and time period of the service provision.

5. Security Considerations

To be done.

6. IANA Considerations

This draft does not include any IANA considerations

7. References

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