Network Working Group   X. Geng
Internet-Draft   J. Dong
Intended status: Informational   Huawei Technologies
Expires: August 26, 2021   R. Pang
                                                    China Unicom
                                                          L. Han
                                                    China Mobile
                                                        T. Niwa
                                                      Individual
                                                          J. Jin
                                                           LG U+
                                                          C. Liu
                                                    China Unicom
                                                     N. Nageshar
                                                      Individual
                                               February 22, 2021

   5G End-to-end Network Slice Mapping from the view of Transport Network
              draft-geng-teas-network-slice-mapping-03

Abstract

   Network Slicing is one of the core featrures in 5G. End-to-end
   network slice consists of 3 major types of network segments: Access
   Network (AN), Mobile Core Network (CN) and Transport Network (TN).
   This draft describes the procedure of mapping 5G end-to-end network
   slice to transport network slice defined in IETF. This draft also
   intends to expose some gaps in the existing network management plane
   and data plane technologies to support inter-domain network slice
   mapping. Further work may require cooperation between IETF and 3GPP
   (or other standard organizations). Data model specification,
   signaling protocol extension and new encapsulation definition are out
   of the scope of this draft.

Requirements Language

   The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
   "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
   document are to be interpreted as described in RFC 2119 [RFC2119].

Status of This Memo

   This Internet-Draft is submitted in full conformance with the
   provisions of BCP 78 and BCP 79.

   Internet-Drafts are working documents of the Internet Engineering
   Task Force (IETF). Note that other groups may also distribute

Table of Contents

1. Introduction

Driven by the new applications of 5G, the concept of network slicing
is defined to provide a logical network with specific capabilities
and characteristics. Network slice contains a set of network
functions and allocated resources(e.g. computation, storage and
network resources). According to [TS28530], a 5G end-to-end network
slice is composed of three major types network segments: Radio Access
Network (RAN), Transport Network (TN) and Mobile Core Network (CN).
Transport network is supposed to provide the required connectivity
between AN and CN, with specific performance commitment. For each
end-to-end network slice, the topology and performance requirement
for transport network can be very different, which requests transport
network to have the capability of supporting multiple different
transport network slices.

A transport network slice is a virtual (logical) network with a
particular network topology and a set of shared or dedicated network
resources, which are used to provide the network slice consumer with
the required connectivity, appropriate isolation and specific Service
Level Agreement (SLA). A transport network slice could span multiple
technology (IP, Optical) and multiple administrative domains.
Depending on the consumer's requirement, a transport network slice
could be isolated from other concurrent transport network slices, in
terms of data plane, control plane and management plane. Transport
network slice is being defined and discussed in IETF.

Editor's Note: The definition of transport network slice will align
with [I-D.ietf-teas-ietf-network-slice-definition].

The procedure of end-to-end network slice instance creation, network
slice subnet instance creation and network slice instance termination
in management plane is defined in [TS28531]. The end-to-end network
slice allocation is defined in ETSI [ZSM003]. But there is no
specifications about how to map end-to-end network slice in 5G system
to transport network slice. This draft describes the procedure of
mapping 5G end-to-end network slice into transport network slice in
management plane, control plane and user plane.

5G end-to-end network slice mapping is treated as an independent
mechanism from 5G end-to-end QoS mapping. The latter is not covered
by this version.

2. Terminologies

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
"SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
document are to be interpreted as described in [RFC2119].

The following terms are used in this document:

NS: Network Slice

NSI: Network Slice Instance

NSSI: Network Slice Subnet Instance

NSSAI: Network Slice Selection Assistance Information

S-NSSAI: Single Network Slice Selection Assistance Information

AN: Access Network

RAN: Radio Access Network

TN: Transport Network

CN: Mobile Core Network

DSCP: Differentiated Services Code Point

CSMF: Communication Service Management Function

NSMF: Network Slice Management Function

NSSMF: Network Slice Subnet Management Function

GST: General Slice Template

TNSII: Transport Network Slice Interworking Identifier

TNSI: Transport Network Slice Identifier

PDU: Protocol Data Unit

Editor's Note: Terminologies defined in 3GPP, e.g.,Network Slice
Subnet Management Function(NSSMF), Network Slice Subnet
Instance(NSSI) and Network Slice Selection Assistance
Information(NSSAI), are used in the end-to-end network slice mapping,
which may not be used necessarily within the transport network.

3. Network Slice Mapping Structure

The following figure shows the necessary elements for mapping end-to-
end network slice into transport network slice. All these network
slice elements are classified into three groups: requirements/
capabilities, identifiers and relevant functions.

```
                  +-----------------+
                  |      CSMF       |
                  +--------+--------+
                           |
                  +--------V--------+
                  |      NSMF       |
                  +-----------------+
        +---------|  NSI Identifier |----------+
        |         | Service Profile |          |
        |         |  TN  Network-   |          |
        |         | -Slice Profile  |          |
        |         +-----------------+          |
        |                  |                   |
 +------V------+ +---------V----------+ +------V------+
 |  AN NSSMF   | |     TN NSSMF       | |  CN NSSMF   |
 +-------------+ +--------------------+ +-------------+
 |   AN-NSSI-  | |  TN-NSSI Identifier| |   CN-NSSI-  |
 | -Identifier | |  Function Management| | -Identifier |
 |     ...     | |        ...         | |     ...     |   Management
 +-------------+ +--------------------+ +-------------+      Plane
      |               |                  |          |  -----------------
      |<----------PDU session (S-NSSAI)----------->|      Control
      |               |                  |          |       Plane
      V               V                  V          V  -----------------
     /\        +-----+            +-----+    +-------+      Data
    /AN\ -----|  PE |-----..-----|  PE  |----|  UPF  |      Plane
   /____\      +-----+            +-----+    +-------+
     |-->TNSII<--|------>TNSI<-------|-->TNSII<--|
```
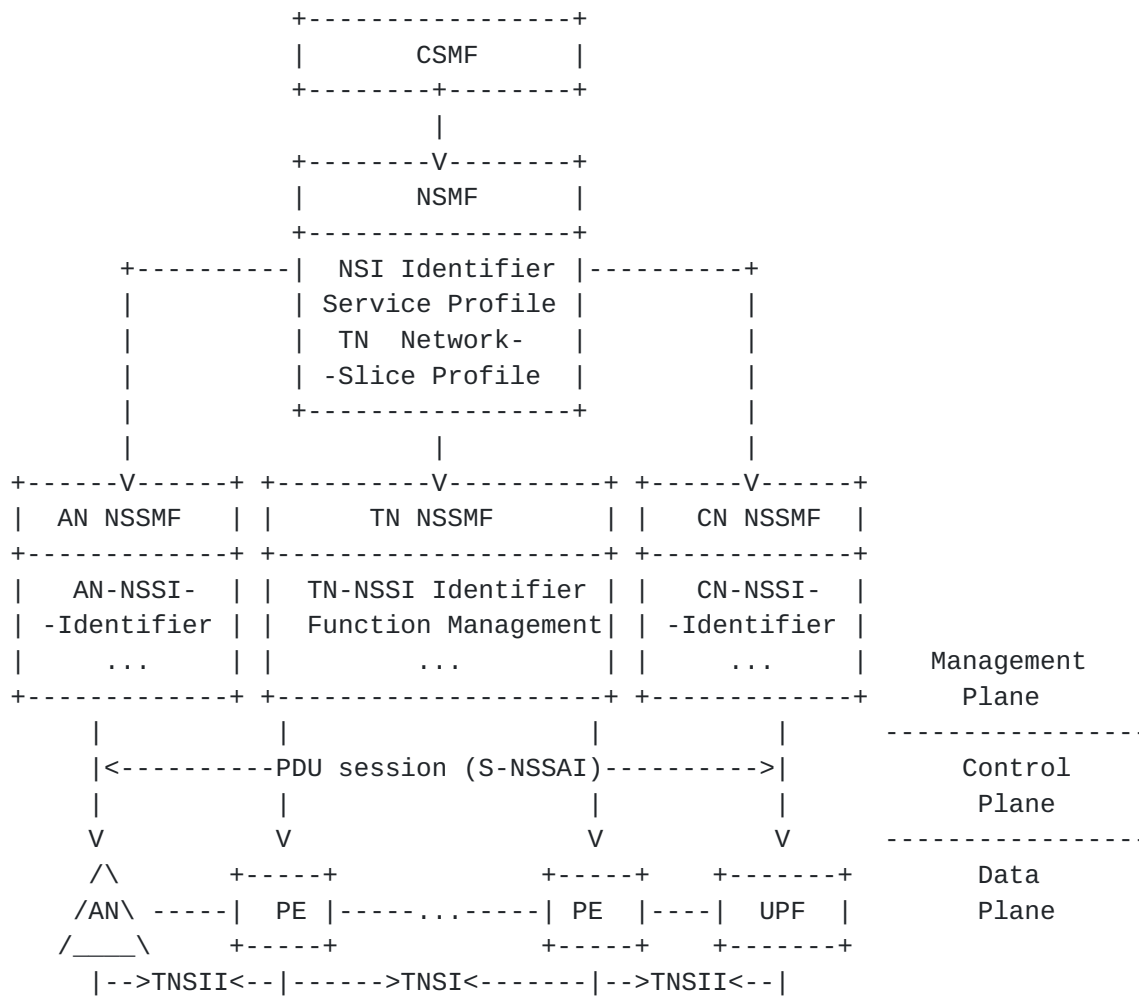
3.1. Requirements Profile

   In order to satisfy a tenant's request for a network slice with
   certain characteristics, creating a new network slice or using
   existing network slice instance is constrained by the requirement
   profile and the capability of the network slices.

   o Service Profile: represents the properties of network slice
      related requirement that should be supported by the network slice
      instance in 5G network. Service profile is defined in [TS28541]
      6.3.3.

   o TN Network Slice Profile: represents the properties of transport
      network slice related requirement that should be supported by the
      transport network slice in a 5G network. Slice Profile is defined
      in [TS28541] 6.3.4. TN Network slice profile is newly defined in
      this draft.

3.2. **Identifiers**

Network slice related identifiers in management plane, control plane
and data(user) plane play an important role in end-to-end network
slice mapping.

o Single Network Slice Selection Assistance Information(S-NSSAI):
   end-to-end network slice identifier in control plane, which is
   defined in [TS23501];

o Network Slice Instance(NSI) Identifier:end-to-end network slice
   identifier in management plane, which is created in NSMF; NSI is
   is set of Network Function instances and the required resources
   (e.g. computing, storage and networking resources) which form a
   deployed Network Slice, which is defined in [TS23501]; ;

o Transport Network Slice Instance(TN-NSSI) Identifier: transport
   network slice identifier in management plane, which is created in
   TN NSSMF; TN-NSSI is newly defined in this draft.

o Transport Network Slice Interworking Identifier (TNSII): network
   slice identifier which is used for mapping end-to-end network
   slice into transport network slice in data plane. TNSII is a new
   concept introduced by this draft, which can be instantiated with
   existing data plane identifiers and doesn't necessarilly request
   new encapsulation. TNSII could be pre-allocated as a global
   identifier.

o Transport Network Slice Identifier(TNSI): transport network slice
   identifier in data plane(user plane). TNSI is newly defined in
   this draft.

The relationship between these identifiers are specifies in the
following sections.

3.3. **Relevant functions**

There are a set of slice relevant functions that are necessary for
transport network slice management:
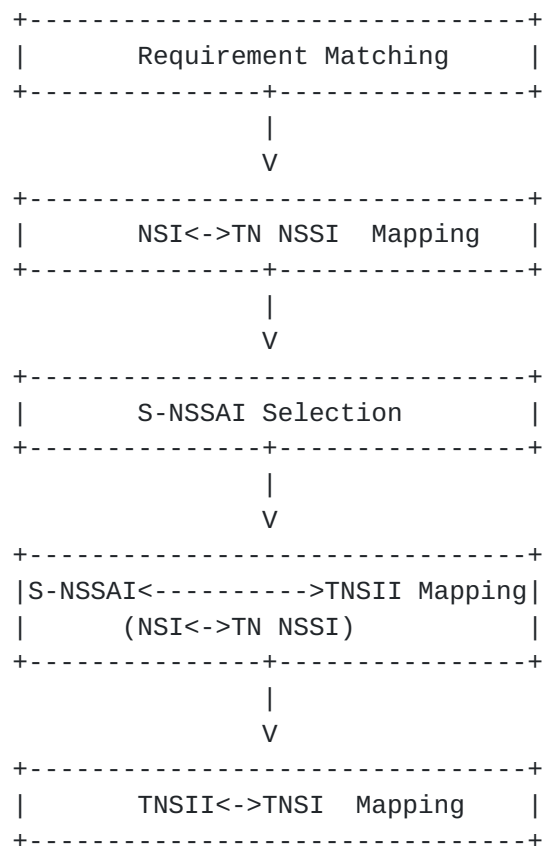
o Topology management

o QoS management

o Resource management

o Measurement management

o ...

Some of these functions are implemented inside the transport network
and independent from the end-to-end network slice, e.g., topology
management, QoS management, resource management; Some of the
functions are related to the end-to-end network slice and should
cooperate with other network elements from other domain, e.g.,
Measurement management.

[4](4). Network Slice Mapping Procedure

This section provides a general procedure of network slice mapping:

```
        +--------------------------------+
        |       Requirement Matching     |
        +---------------+----------------+
                        |
                        V
        +--------------------------------+
        |       NSI<->TN NSSI  Mapping   |
        +---------------+----------------+
                        |
                        V
        +--------------------------------+
        |       S-NSSAI Selection        |
        +---------------+----------------+
                        |
                        V
        +--------------------------------+
        |S-NSSAI<---------->TNSII Mapping|
        |       (NSI<->TN NSSI)          |
        +---------------+----------------+
                        |
                        V
        +--------------------------------+
        |       TNSII<->TNSI  Mapping    |
        +--------------------------------+
```

1. NSMF receives the request from CSMF for allocation of a network
slice instance with certain characteristics.

2. Based on the service requirement , NSMF acquires requirements for
the end-to-end network slice instance , which is defined in Service
Profile([TS28541] section 6.3.3).

3. NSMF derives transport network slice related requirements from
the Service profile, and maintains them in Transport Network Slice
Profile, So as to CN Slice Profile and AN Slice Profile, in order to

decide on the constituent NSSIs(including AN NSSI, CN NSSI and TN NSSI) of the NSI, based on the service profile and the endpoint information(AN/CN edge nodes).

4. NSMF sends the Transport Network Slice Profile, endpoint information, along with other TS NBI attributes to TN NSSMF for TN NSSI allocation.

5. TN NSSMF allocates TN NSSI which could satisfy the requirement of Transport Network Slice Profile between the specified endpoints (AN/ CN edge nodes) and sends the TN NSSI Identifier to NSMF.

6. NSMF acquires the mapping relationship between NSI and TN NSSI.

7. NSMF matains the mapping relationship between NSI and S-NSSAI and the mapping relationship between TN NSSI and TNSII, which could be used to set up mapping relationship between S-NSSAI and TNSII.

8. When a PDU session is set up between AN and CN, an S-NSSAI is selected for the PDU session.

9. AN/CN edge nodes encapsulates the packet using TNSII, according to the selected S-NSSAI. Network Slice could also be differentiated by physical interface, if different network slices are transported through different interface;

10. The edge node of transport network parses the TNSII from the packet and maps the packet to the corresponding transport network slice. It may encapsulate packet with TNSI. The nodes in transport network transit the packet inside the corresponding transport network slice according to TNSI.

The procedure of end-to-end network slice mapping involves the mapping in three network planes: management plane, control plane and data plane.

4.1. Network Slice Mapping in Management Plane

The transport network management Plane maintains the interface between NSMF and TN NSSMF, which 1) guarantees that transport network slice could connect the AN and CN with specified characteristics that satisfy the requirements of communication; 2) builds up the mapping relationship between NSI identifier and TN NSSI identifier; 3) maintains the end-to-end slice relevant functions;

Service Profile defined in[TS28541] represents the requirement of end-to-end network slice instance in 5G network. Parameters defined in Service Profile include Latency, resource sharing level,

availability and so on. How to decompose the end-to-end requirement
to the transport network requirement is one of the key issues in
Network slice requirement mapping. GSMA(Global System for Mobile
Communications Association) defines the [GST] to indicate the network
slice requirement from the view of service provider.
[I-D.contreras-teas-slice-nbi] analysis the parameters of GST and
categorize the parameters into three classes, including the
attributes with direct impact on the transport network slice
definition. It is a good start for selecting the transport network
relevant parameters in order to define Network Slice Profile for
Transport Network. Network slice requirement parameters are also
necessary for the definition of transport network northbound
interface.

Inside the TN NSSMF, it is supposed to maintain the attributes of the
transport network slice. If the attributes of an existing TN NSSI
could satisfy the requirement from TN Network Slice Profile, the
existing TN NSSI could be selected and the mapping is finished If
there is no existing TN NSSI which could satisfy the requirement, a
new TN NSSI is supposed to be created by the NSSMF with new
attributes.

TN NSSI resource reservation should be considered to avoid over
allocation from multiple requests from NSMF (but the detailed
mechanism should be out of scope in the draft)

TN NSSMF sends the selected or newly allocated TN NSSI identifier to
NSMF. The mapping relationship between NSI identifier and TN NSSI
identifier is maintained in both NSMF and TN NSSMF.

YANG data model for the Transport Slice NBI, which could be used by a
higher level system which is the Transport slice consumer of a
Transport Slice Controller (TSC) to request, configure, and manage
the components of a transport slices, is defined in
[I-D.wd-teas-transport-slice-yang]. The northbound Interface of IETF
network slice refers to [I-D.wd-teas-ietf-network-slice-nbi-yang].

4.2. Network Slice Mapping in Control Plane

There is no explicit interaction between transport network and AN/CN
in the control plane, but the S-NSSAI defined in [TS23501] is treated
as the end-to-end network slice identifier in the control plane of AN
and CN, which is used in UE registration and PDU session setup. In
this draft, we assume that there is mapping relationship between
S-NSSAI and NSI in the management plane, thus it could be mapped to a
transport network slice .

Editor's note: The mapping relationship between NSI defined in
[TS23501] and S-NSSAI defined in [TS23501] is still in discussion.

4.3. Network Slice Mapping in Data Plane

If multiple network slices are carried through one physical interface
between AN/CN and TN, transport network slice interworking
identifier(TNSII) in the data plane needs to be introduced. If
different network slices are transported through different physical
interfaces, Network Slices could be distinguished by the interface
directly. Thus TNSII is not the only option for network slice
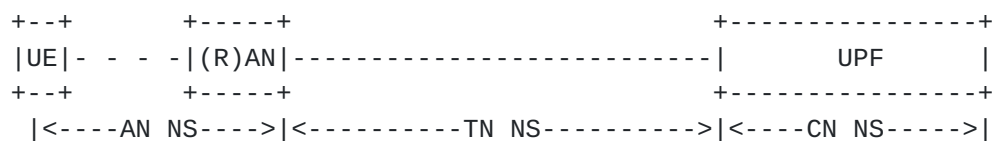mapping, while it may help in introducing new network slices.

4.3.1. Data Plane Mapping Considerations

The mapping relationship between AN or CN network slice identifier
(either S-NSSAI in control plane or NSI/NSSI in management plane) and
TNSII needs to be maintained in AN/CN network nodes, and the mapping
relationship between TNSII and TNSI is maintained in the edge node of
transport network. When the packet of a uplink flow goes from AN to
TN, the packet is encapsulated based on the TNSII; then the
encapsulation of TNSII is read by the edge node of transport network,
which maps the packet to the corresponding transport network slice.

Editor's Note: We have considered to add "Network Instance" defined
in [TS23501]in the draft. However, after the discussion with 3GPP
people, we think the concept of "network instance" is a 'neither
Necessary nor Sufficient Condition' for network slice. Network
Instance could be determined by S-NSSAI, it could also depends on
other information; Network slice could also be allocated without
network instance (in my understanding) And, TNSII is not a
competitive concept with network instance.TNSII is a concept for the
data plane interconnection with transport network, network instance
may be used by AN and CN nodes to associate a network slice with
TNSII

4.3.2. Data Plane Mapping Options

The following picture shows the end-to-end network slice in data
plane:

```
+--+         +-----+                              +----------------+
|UE|- - - -|(R)AN|-----------------------------|       UPF      |
+--+         +-----+                              +----------------+
  |<----AN NS---->|<----------TN NS---------->|<----CN NS----->|
```
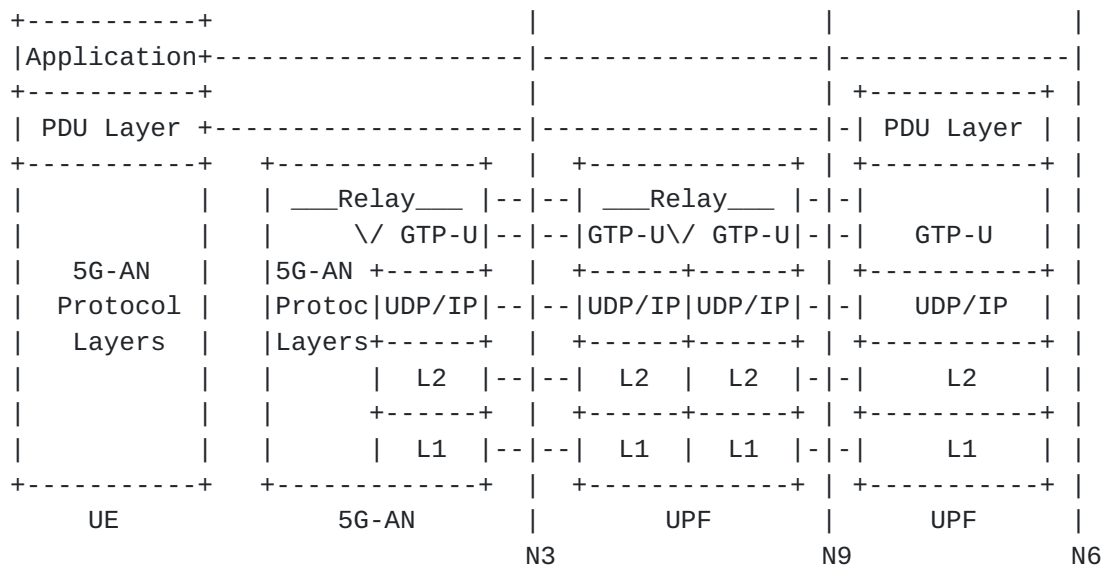
The mapping between 3GPP slice and transport slice in user plane
could happens in:

(R)AN: User data goes from (radio) access network to transport
network

UPF: User data goes from core network functions to transport network

Editor's Note: As figure 4.7.1. in [TS28530] describes, TN NS will
not only exist between AN and CN but may also within AN NS and CN NS.
However, here we just show the TN between AN and CN as an example to
avoid unncessary complexity.

The following picture shows the user plane protocol stack in end-to-
end 5G system.

```
+-----------+                    |                  |                  |
|Application+--------------------|------------------|------------------|
+-----------+                    |                  | +-----------+    |
| PDU Layer +--------------------|------------------|-| PDU Layer |    |
+-----------+   +-------------+   |   +-------------+ | +-----------+   |
|           |   | ___Relay___ |--|--| ___Relay___ |-|-|           |    |
|           |   |    \/ GTP-U |--|--|GTP-U\/ GTP-U|-|-|   GTP-U   |    |
|   5G-AN   |   |5G-AN +------+   |   +------+------+ | +-----------+   |
|  Protocol |   |Protoc|UDP/IP|--|--|UDP/IP|UDP/IP|-|-|   UDP/IP   |    |
|  Layers   |   |Layers+------+   |   +------+------+ | +-----------+   |
|           |   |      |  L2  |--|--|  L2  |  L2  |-|-|     L2     |    |
|           |   |      +------+   |   +------+------+ | +-----------+   |
|           |   |      |  L1  |--|--|  L1  |  L1  |-|-|     L1     |    |
+-----------+   +-------------+   |   +-------------+ | +-----------+   |
     UE              5G-AN        |         UPF       |      UPF        |
                                 N3                  N9               N6
```

The following figure shows the typical encapsulation in N3 interface
which could be used to carry the transport network slice interworking
identifier (TNSII) between AN/CN and TN.

```
+-----------------------+
| Application Protocols  |
+-----------------------+
|        IP (User)       |
+-----------------------+
|          GTP           |
+-----------------------+
|          UDP           |
+-----------------------+
|           IP           |
+-----------------------+
|        Ethernet        |
+-----------------------+
```

4.3.2.1. Layer 3 and Layer 2 Encapsulations

If the encapsulation above IP layer is not visible to Transport
Network, it is not able to be used for network slice interworking
with transport network. In this case, IP header and Ethernet header
could be considered to provide information of network slice
interworking from AN or CN to TN.

```
+-----------------------+-----------
| Application Protocols  |      ^
+-----------------------+      |
|        IP (User)       | Invisible
+-----------------------+     for
|          GTP           |     TN
+-----------------------+      |
|          UDP           |      V
+-----------------------+------------
|           IP           |
+-----------------------+
|        Ethernet        |
+-----------------------+
```

The following field in IP header and Ethernet header could be
considered :

IP Header:

o DSCP: It is traditionally used for the mapping of QoS identifier
   between AN/CN and TN network. Although some values (e.g. The
   unassigned code points) may be borrowed for the network slice
   interworking, it may cause confusion between QoS mapping and
   network slicing mapping.;

o Destination Address: It is possible to allocate different IP
   addresses for entities in different network slice, then the
   destination IP address could be used as the network slice
   interworking identifier. However, it brings additional
   requirement to IP address planning. In addition, in some cases
   some AN or CN network slices may use duplicated IP addresses.

o Option fields/headers: It requires that both AN and CN nodes can
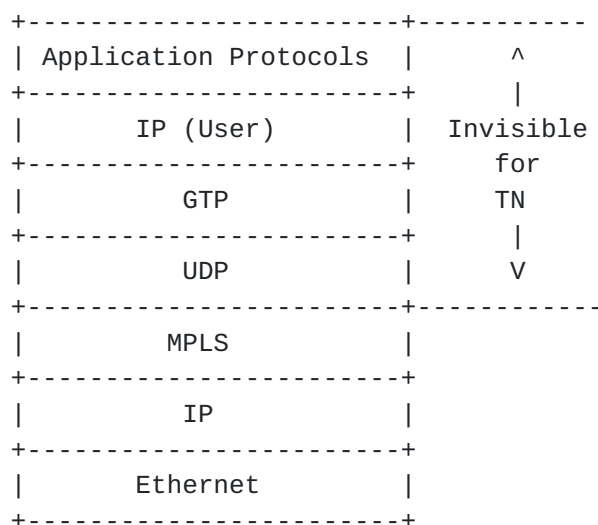   support the encapsulation and decapsulation of the options.

Ethernet header

o VLAN ID: It is widely used for the interconnection between AN/CN
   nodes and the edge nodes of transport network for the access to
   different VPNs. One possible problem is that the number of VLAN
   ID can be supported by AN nodes is typically limited, which
   effects the number of transport network slices a AN node can
   attach to. Another problem is the total amount of VLAN ID (4K)
   may not provide a comparable space as the network slice
   identifiers of mobile networks.

Two or more options described above may also be used together as the
TNSII, while it would make the mapping relationship more complex to
maintain.

In some other case, when AN or CN could support more layer 3
encapsulations, more options are available as follows:

If the AN or CN could support MPLS, the protocol stack could be as
follows:

```
+------------------------+-----------
| Application Protocols  |      ^
+------------------------+      |
|       IP (User)        |  Invisible
+------------------------+     for
|          GTP           |     TN
+------------------------+      |
|          UDP           |      V
+------------------------+------------
|          MPLS          |
+------------------------+
|           IP           |
+------------------------+
|        Ethernet        |
+------------------------+
```

A specified MPLS label could be used to as a TNSII.

If the AN or CN could support SRv6, the protocol stack is as follows:

```
+------------------------+-----------
| Application Protocols  |     ^
+------------------------+     |
|       IP (User)        | Invisible
+------------------------+    for
|          GTP           |    TN
+------------------------+     |
|          UDP           |     V
+------------------------+-----------
|          SRH           |
+------------------------+
|          IPv6          |
+------------------------+
|        Ethernet        |
+------------------------+
```
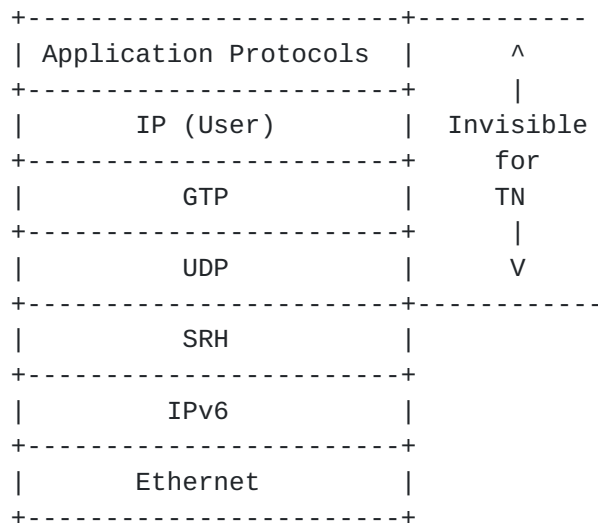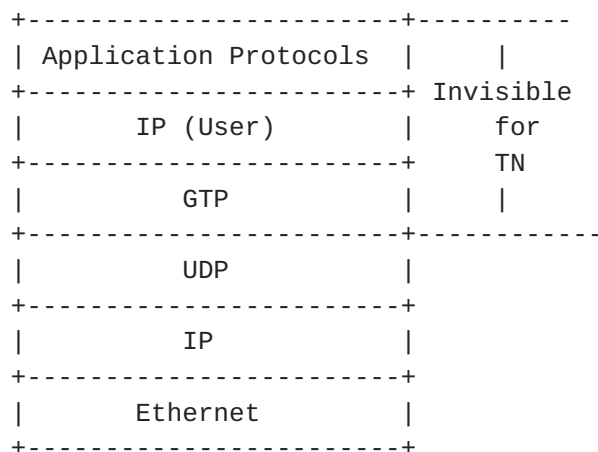
The following field could be considered to identify a network slice:

SRH:

o SRv6 functions: AN/CN is supposed to support the new function
   extension of SRv6.

o Optional TLV: AN/CN is supposed to support the extension of
   optional TLV of SRH.

4.3.2.2. Above Layer 3 Encapsulations

If the encapsulation above IP layer is visible to Transport Network,
it is able to be used to identify a network slice. In this case, UPD
and GTP-U could be considered to provide information of network slice
interworking between AN or CN and TN.

```
+------------------------+----------
| Application Protocols  |    |
+------------------------+ Invisible
|       IP (User)        |   for
+------------------------+   TN
|          GTP           |    |
+------------------------+-----------
|          UDP           |
+------------------------+
|          IP            |
+------------------------+
|        Ethernet        |
+------------------------+
```
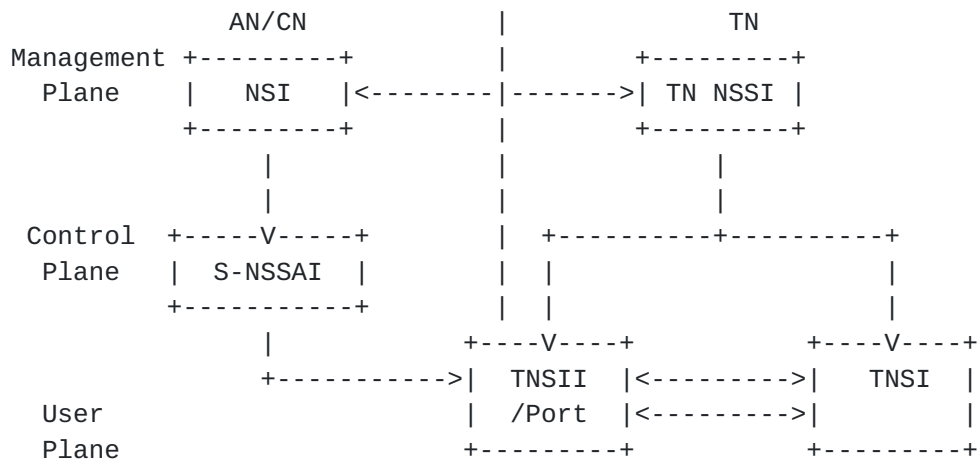
The following field in UDP header could be considered:

UDP Header:

o UDP Source port: The UDP source port is sometimes used for load
   balancing. Using it for network slice mapping would require to
   disable the load-balancing behavior.

5. Network Slice Mapping Summary

The following picture shows the mapping relationship between the
network slice identifier in management plane, control plane and user
plane.

```
             AN/CN              |              TN
Management +---------+         |        +---------+
  Plane    |   NSI   |<--------|------->| TN NSSI |
           +---------+         |        +---------+
                |              |             |
                |              |             |
 Control  +-----V-----+        |  +----------+----------+
  Plane   |  S-NSSAI  |        |  |                     |
          +-----------+        |  |                     |
                |           +----V----+          +----V----+
                +---------->|  TNSII  |<--------->|   TNSI  |
  User                      |  /Port  |<--------->|         |
  Plane                     +---------+          +---------+
```

6. IANA Considerations

TBD

Note to RFC Editor: this section may be removed on publication as an
RFC.

7. Security Considerations

TBD

8. Acknowledgements

The authors would like to thank Shunsuke Homma for reviewing the
draft and giving valuable comments.

9. Normative References

[GST]   "Generic Network Slice Template",
            <https://www.gsma.com/newsroom/all-documents/generic-
            network-slice-template-v2-0/>.

[I-D.contreras-teas-slice-nbi]
            Contreras, L., Homma, S., and J. Ordonez-Lucena, "IETF
            Network Slice use cases and attributes for Northbound
            Interface of controller", draft-contreras-teas-slice-
            nbi-03 (work in progress), October 2020.

[I-D.ietf-teas-ietf-network-slice-definition]
            Rokui, R., Homma, S., Makhijani, K., Contreras, L., and J.
            Tantsura, "Definition of IETF Network Slices", draft-ietf-
            teas-ietf-network-slice-definition-00 (work in progress),
            January 2021.

[I-D.wd-teas-ietf-network-slice-nbi-yang]
            Bo, W., Dhody, D., Han, L., and R. Rokui, "A Yang Data
            Model for IETF Network Slice NBI", draft-wd-teas-ietf-
            network-slice-nbi-yang-01 (work in progress), November
            2020.

[I-D.wd-teas-transport-slice-yang]
            Bo, W., Dhody, D., Han, L., and R. Rokui, "A Yang Data
            Model for Transport Slice NBI", draft-wd-teas-transport-
            slice-yang-02 (work in progress), July 2020.

[RFC2119]   Bradner, S., "Key words for use in RFCs to Indicate
            Requirement Levels", BCP 14, RFC 2119,
            DOI 10.17487/RFC2119, March 1997,
            <https://www.rfc-editor.org/info/rfc2119>.

[TS23501]   "3GPP TS23.501",
            <https://portal.3gpp.org/desktopmodules/Specifications/
            SpecificationDetails.aspx?specificationId=3144>.

[TS28530]   "3GPP TS28.530",
            <https://portal.3gpp.org/desktopmodules/Specifications/
            SpecificationDetails.aspx?specificationId=3273>.

[TS28531]   "3GPP TS28.531",
            <https://portal.3gpp.org/desktopmodules/Specifications/
            SpecificationDetails.aspx?specificationId=3274>.

   [TS28541]   "3GPP TS 28.541",
               <https://portal.3gpp.org/desktopmodules/Specifications/
               SpecificationDetails.aspx?specificationId=3400>.

   [ZSM003]   "ETSI ZSM003",
               <https://portal.3gpp.org/desktopmodules/Specifications/
               SpecificationDetails.aspx?specificationId=3144>.

Authors' Addresses

   Xuesong Geng
   Huawei Technologies

   Email: gengxuesong@huawei.com

   Jie Dong
   Huawei Technologies

   Email: jie.dong@huawei.com

   Ran Pang
   China Unicom

   Email: pangran@chinaunicom.cn

   Liuyan Han
   China Mobile

   Email: hanliuyan@chinamobile.com

   Tomonobu Niwa
   Individual

   Email: tomonobu.niwa@gmail.com

   Jaehwan Jin
   LG U+

   Email: daenamu1@lguplus.co.kr

Chang Liu
China Unicom

Email: liuc131@chinaunicom.cn

Nikesh Nageshar
Individual

Email: nikesh.nageshar@gmail.com