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GROUP SPECIFICATION

Zero-touch network and Service Management (ZSM); End-to-end management and orchestration of network slicing

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Foreword

This Group Specification (GS) has been produced by ETSI Industry Specification Group (ISG) Zero touch network and Service Management (ZSM).

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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1 Scope

The present document specifies the E2E network slicing management solutions and related management interfaces. The E2E network slicing including provisioning, performance assurance and fault management of an E2E slice instance across multiple management domains.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

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The following referenced documents are necessary for the application of the present document.

[1] ETSI TS 123 501 (V15.2.0): "5G; System Architecture for the 5G System (3GPP TS 23.501 version 15.2.0 Release 15)".

[2] ETSI TS 123 502 (V15.2.0): "5G; Procedures for the 5G System (3GPP TS 23.502 version 15.2.0 Release 15)".

[3] ETSI TS 123 503 (V15.2.0): "5G; Policy and Charging Control Framework for the 5G System; Stage 2 (3GPP TS 23.503 version 15.2.0 Release 15)".

[4] ETSI TS 128 530 (V15.0.0): "5G; Management and orchestration; Concepts, use cases and requirements (3GPP TS 28.530 version 15.0.0 Release 15)".

[5] ETSI TS 128 531 (V15.0.0): "5G; Management and orchestration; Provisioning (3GPP TS 28.531 version 15.0.0 Release 15)".

[6] ETSI TS 128 550 (V16.7.0): "5G; Management and orchestration; Performance assurance (3GPP TS 28.550 version 16.7.0 Release 16)".

[7] ETSI TS 128 541 (V15.0.1): "5G; Management and orchestration; 5G Network Resource Model (NRM); Stage 2 and stage 3 (3GPP TS 28.541 version 15.0.1 Release 15)".

[8] ETSI TS 128 552 (V15.0.0): "5G; Management and orchestration; 5G performance measurements (3GPP TS 28.552 version 15.0.0 Release 15)".

[9] ETSI TS 128 554 (V15.0.1): "5G; Management and orchestration; 5G end to end Key Performance Indicators (KPI) (3GPP TS 28.554 version 15.0.1 Release 15)".

[10] ETSI GS NFV-IFA 013: "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Os-Ma-nfvo reference point - Interface and Information Model Specification".

[11] ETSI GS ZSM 007: "Zero-touch network and Service Management (ZSM); Terminology for concepts in ZSM".

[12] ETSI GS ZSM 002: "Zero-touch network and Service Management (ZSM); Reference Architecture".

[13] ETSI TS 128 532 (V15.0.1): "5G; Management and orchestration; Generic management services (3GPP TS 28.532 version 15.0.1 Release 15)".

[14]   ETSI TS 128 545 (V15.0.0): "5G; Management and orchestration; Fault Supervision (FS) (3GPP TS 28.545 version 15.0.0 Release 15)".

[15]   ETSI TS 128 526 (V16.0.0): "LTE; Telecommunication management; Life Cycle Management (LCM) for mobile networks that include virtualized network functions; Procedures (3GPP TS 28.526 version 16.0.0 Release 16)".

[16]   GSMA PRD NG.116 v1.0 (2019-05): "Generic Network Slice Template", v1.0.

[17]   ETSI GS ZSM 001: "Zero-touch network and Service Management (ZSM); Requirements based on documented scenarios".

[18]   ETSI TS 133 501 (V16.4.0): "5G; Security architecture and procedures for 5G System (3GPP TS 33.501 version 16.4.0 Release 16)".

[19]   ETSI TS 128 622 (V16.7.1): "Universal Mobile Telecommunications System (UMTS); LTE; 5G; Telecommunication management; Generic Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS) (3GPP TS 28.622 version 16.7.1 Release 16)".

2.2   Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1]   3GPP TR 33.811 (V0.4.0) (2018-01): "Study on security aspects of 5G network slicing management".

[i.2]   GSMA: "5G Network Slicing Report: From Vertical Industry Requirements to Network Slice Characteristics".

[i.3]   ETSI GR NFV-EVE 012: "Network Functions Virtualisation (NFV) Release 3; Evolution and Ecosystem; Report on Network Slicing Support with ETSI NFV Architecture Framework".

[i.4]   TMF641: "Service Ordering API REST Specification".

[i.5]   TMF638: "Service Inventory Management API REST Specification".

[i.6]   TMF633: "Service Catalog Management API REST Specification".

[i.7]   TMF628: "Performance Management API REST Specification".

[i.8]   TMF642: "Alarm Management API REST Specification".

[i.9]   IETF RFC 8453: "Framework for Abstraction and Control of TE Networks (ACTN)".

[i.10]   IETF RFC 8632: "A YANG Data Model for Alarm Management", S. Vallin et al.

[i.11]   draft-ietf-teas-yang-te work in progress: "A YANG Data Model for Traffic Engineering Tunnels and Interfaces", T. Saad et al.

[i.12]   draft-ietf-teas-actn-pm-telemetry-autonomics work in progress: "YANG models for VN/TE Performance Monitoring Telemetry and Scaling Intent Autonomics", Y. Lee et al.

[i.13]   IETF RFC 8795: "YANG Data Model for TE Topologies".

[i.14]   draft-ietf-teas-enhanced-vpn work in progress: "A framework for Enhanced Virtual Private Networks (VPN+) Service", J. Dong et al.

[i.15]   draft-ietf-teas-ietf-network-slices-03: "Framework for IETF Network Slices".

[i.16]   IETF RFC 8466: "A YANG Data Model for Layer 2 Virtual Private Network (L2VPN) Service Delivery".

[i.17]   NGMN Alliance: "Description of Network Slicing Concept", September 2016.

[i.18]   NGMN Alliance: "5G E2E Architectural framework v2.0", February 2018.

[i.19]   IETF RFC 8299: "YANG Data Model for L3VPN Service Delivery".

3   Definition of terms, symbols and abbreviations

3.1   Terms

For the purposes of the present document, the terms given in ETSI GS ZSM 007 [11] and the following apply:

E2E network slicing: set of management and orchestration activities that allow the deployment and operation of network slices across multiple management domains

network slice: logical network that provides specific network capabilities and network characteristics, supporting various service properties for network slice customers

network slice subnet: representation of a set of network functions and the associated resources (e.g. compute, storage and networking resources) supporting network slice

3.2   Symbols

Void.

3.3   Abbreviations

For the purposes of the present document, the abbreviations given in ETSI GS ZSM 007 [11] and the following apply:

AAA	Authentication-Authorisation-Accounting
ACTN	Abstraction and Control of TE Networks
AI	Artificial Intelligence
AMF	Access and Mobility Management Function
AN	Access Network
API	Application Programming Interface
AS	Access Stratum
BBF	Broadband Forum
CMI	Customer Network Controller - Multi-Domain Service Coordinator Interface
CN	Core Network
CSC	Communication Service Customer
CSM	Communication Service Management
CSP	Communication Service Provider
DCN	Data Center Network
DL	DownLink
DN	Distinguished Name
DRB	Data Radio Bearer
DSL	Domain Specific Language
EVR	Evaluation Result
GSM	Global System for Mobile communications
GSMA	GSM Association
GST	Generic network Slice Template
IOC	Information Object Class
KPI	Key Performance Indicator

LCM	Life Cycle Management
MD	Management Domain
MDSC	Multi-Domain Service Coordinator
MEF	Metro Ethernet Forum
MNO	Mobile Network Operator
MnS	Management Service
MOI	Managed Object Instance
MPI	Main Path Interface
MPLS	Multiprotocol Label Switching
NBI	Northbound Interface
NEST	NEtwork Slice Type
NF	Network Function
NFVI	NFV Infrastructure
NFVO	NFV Orchestrator
NG	Next Generation
NGMN	Next Generation Mobile Networks
NG-RAN	NG Radio Access Network
NOP	Network Operator
NRM	Network Resource Model
NSC	Network Slice Controller
NSDT	Network Slice Design Team
NSE	Network Slice Endpoints
NSI	Network Slice Instance
NSM	Network Service Management
NSRE	Network Slice Realization Endpoints
NSS	Network Slice Subnet
NSSAI	Network Slice Selection Assistance Information
NSSI	Network Slice Subnet Instance
OAM	Operation, Administration and Maintenance
PDU	Protocol Data Unit
PLMN	Public Land Mobile Network
PM	Performance Management
PNC	Provisioning Network Controller
PNF	Physical Network Function
PRB	Physical Resource Block
PRD	Permanent Reference Document
PSA	PDU session anchor
RAN	Radio Access Network
RRM	Radio Resource Management
SBI	SouthBound Interface
Serv-Orch	Service Orchestration service
SLA	Service Level Agreement
SLS	Service-Level Specification
SMF	Session Management Function
S-NSSAI	Single Network Slice Selection Assistance Information
TEAS	Traffic Engineering and Architecture Signaling
TM	Telecom Management
TN	Transport Network
T-NSSMF	Transport Network Slice Subnet Management Function
TSG	Technical Specification Group
UE	User Equipment
UL	UpLink
UPF	User Plane Function
VLAN	Virtual Local Area Network
VN	Virtualised Network
VNF	Virtualised Network Function
VPN	Virtual Private Network
WAN	Wide Area Network
YANG	Yet Another Next Generation

4 Concept of E2E network slicing management and orchestration

4.1 Roles in network slicing

In the context of 5G networks, responsibilities regarding network management operations have been defined and assigned to different roles, see clause 4.8 of ETSI TS 128 530 [4]. The ZSM Framework Consumer plays the role of Communication Service Customer (CSC) and uses communication services provided by Communication Service Provider (CSP). The communication provider in turn uses the network provided by the role network operator.

4.2 Communication service provided by network slice

The following diagram shows the relation between communication service instance, network slice instance and network slice subnet instance.
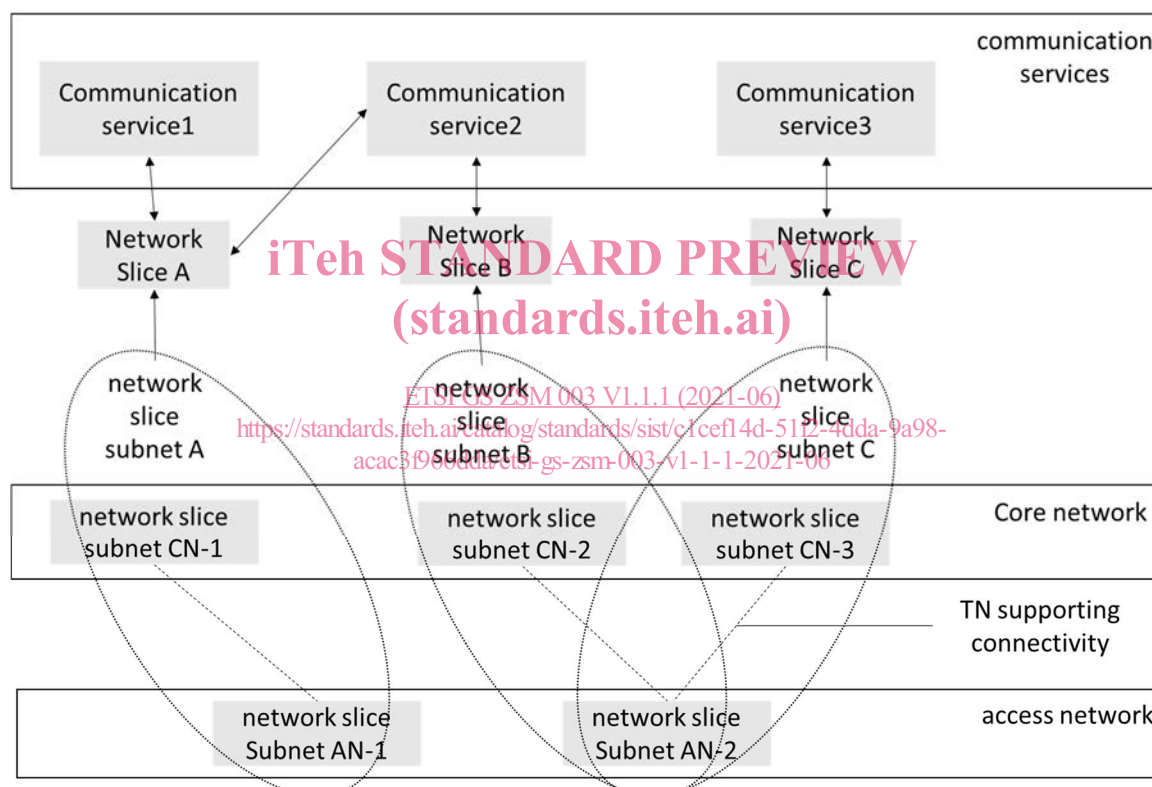
Figure 4.2-1: A variety of communication services provided by multiple network slices

A vertical may have multiple communication services and one or more communication services may be supported by one network slice instance as shown in ETSI TS 128 530 [4], clause 4.1.3.

NOTE: The concepts of "vertical" and "vertical customer" are used interchangeably throughout the present document.

4.3 Typical scenarios of using network slicing

4.3.1 Overview

There are two scenarios for using network slicing, as specified in clauses 4.1.6 and 4.1.7 of ETSI TS 128 530 [4]:

- Network Slices as NOP internals.

- Network Slice as a Service (NSaaS).

4.3.2 Using "Network Slices as NOP internals"

In the "Network Slices as NOP internals" scenario, one entity takes both CSP and NOP roles and provides communication services to vertical customers, which take the role of CSCs. The network slice instances are not visible to the verticals. The entity decides whether the network slices instances or the network is used to support the communication services (e.g. for internal network resource utilization consideration, etc.). This scenario allows the vertical consumer to use the communication service and optionally allows the vertical to monitor the network status of the network that supports the communication service.

Figure 4.3.2-1 quoted from 3GPP (see ETSI TS 128 530 [4]) illustrates an example of how network slices can be utilized to deliver communication services based on the 3GPP defined roles.
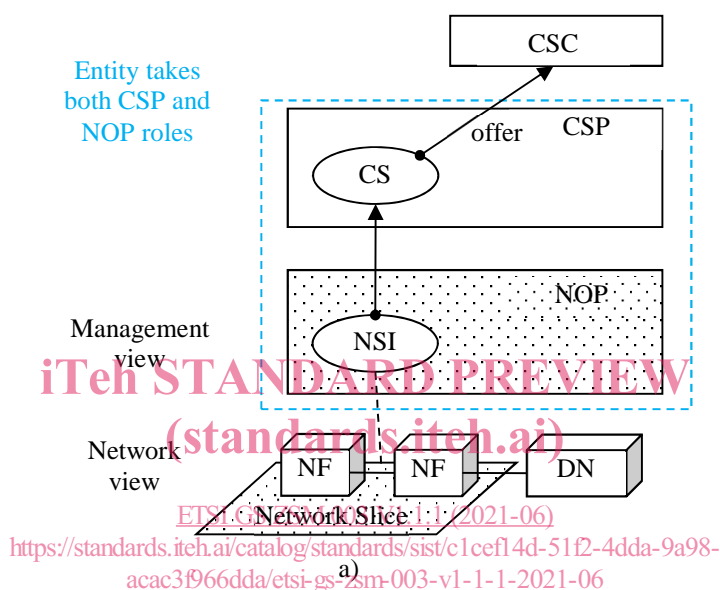
Figure 4.3.2-1: 3GPP example of Network Slice as NOP internals

Figure 4.3.2-2 illustrates an example of how network slices from business view can be utilized to deliver communication services in ZSM.

A network slice consists of a group of NFs. The business entity X (e.g. MNO) takes the role of both NOP and CSP and delivers communication services to vertical customers. Only the communication service is exposed to the vertical customer. The vertical should be able to monitor the communication service status (e.g. administrative status, operational status, etc.) and performance data via the exposed interfaces.
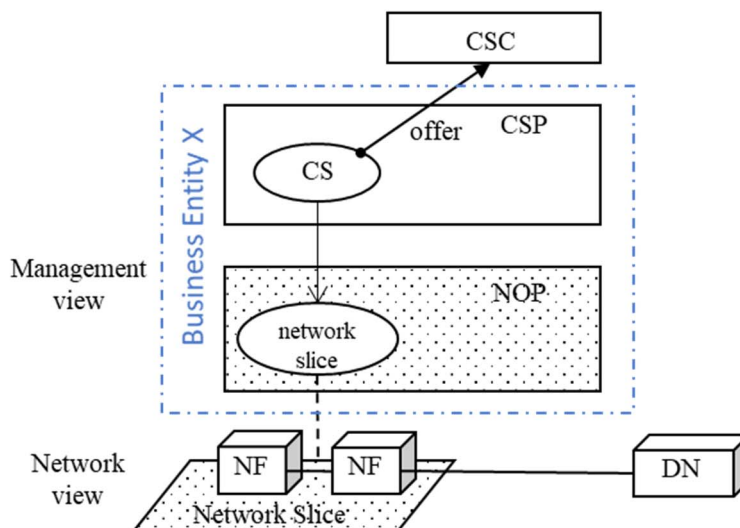
Figure 4.3.2-2: ZSM example of Network Slice as NOP internals

4.3.3   Adopting "Network Slices as a Service" model

In the "Network Slice as a Service" scenario, a network slice can be offered to vertical as a service. This scenario allows a vertical customer to use the network slice and optionally allows the vertical to manage the network slice instance via management exposure interface. In addition, verticals can offer their own services (e.g. communication services) that rely on the new network slice.

Figure 4.3.3-1 quoted from 3GPP (see [4]) illustrates an example of how network slices can be utilized to deliver communication services, including Network Slice as a Service reusing the 3GPP defined roles.
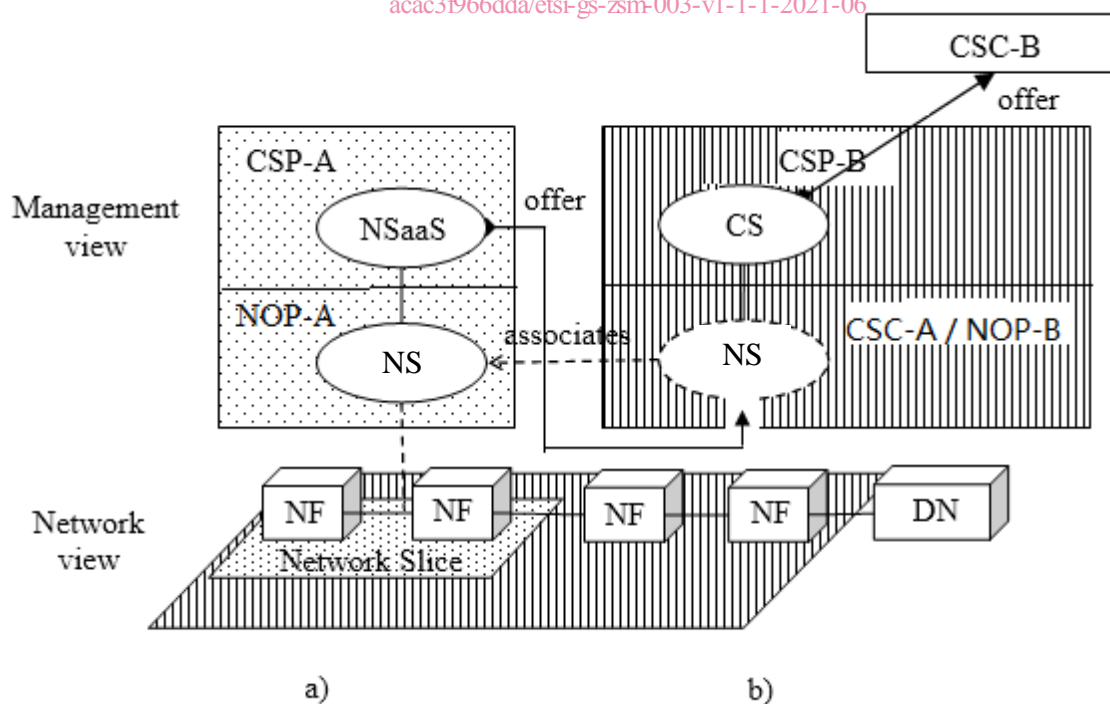
**Figure 4.3.3-1: 3GPP examples of Network Slice as a Service being utilized
to deliver communication services to customers**

Figure 4.3.3-2 illustrates an example of how network slices from a business view can be utilized to deliver communication services in ZSM.

In this example, CSP uses the network slice offered by NOP and its own network functions to deliver communication services to vertical customers (CSC). CSP and NOP corresponds to different business entities in this example.
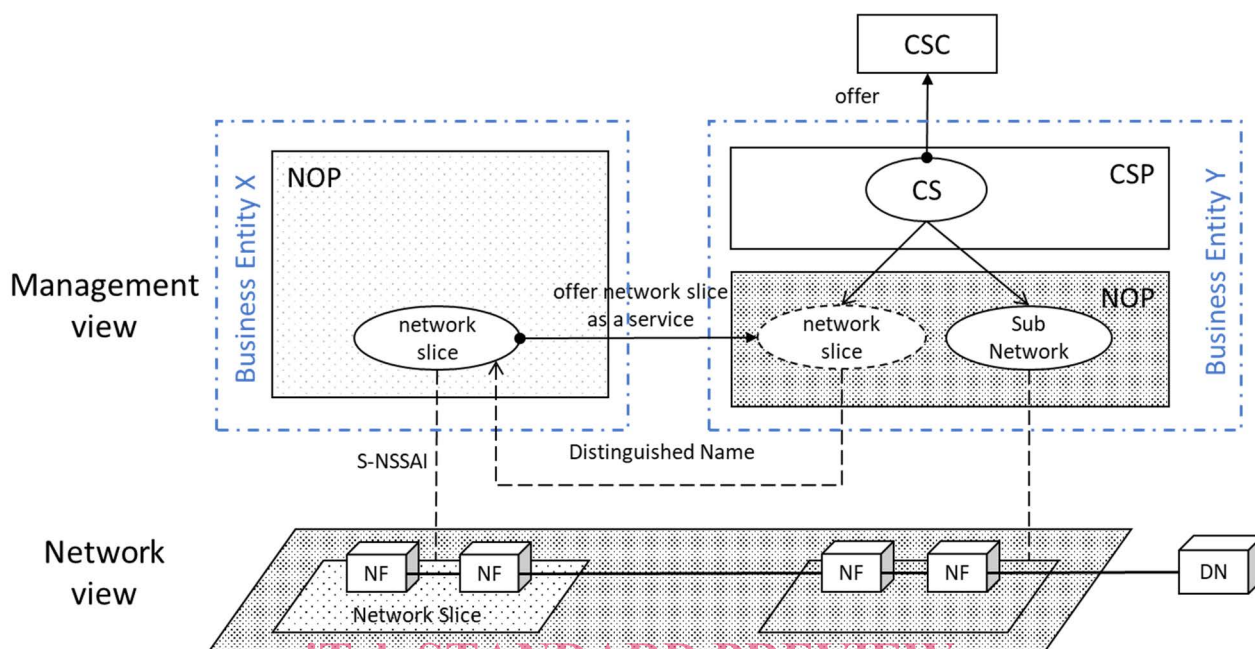
NOTE 1:   Network slice shown on the left side of Figure 4.3.3-2 is a managed object instance created by NOP of Business Entity X. It is offered as a network slice as a service to Business Entity Y as a network slice shown on the right side of the same figure. CSP of Business Entity Y uses Distinguished Name to refer to and access the network slice created in the NOP.

NOTE 2:   Depending on the use case, the business entity Y could represent a vertical customer or another MNO.

Figure 4.3.3-2: ZSM example of Network Slice as a Service being utilized to deliver communication services to customers

In another example, as shown in Figure 4.3.3-3, CSP of Business Entity Y may use the network slice offered by NOP of Business Entity X and additional network functions to build a new network slice.
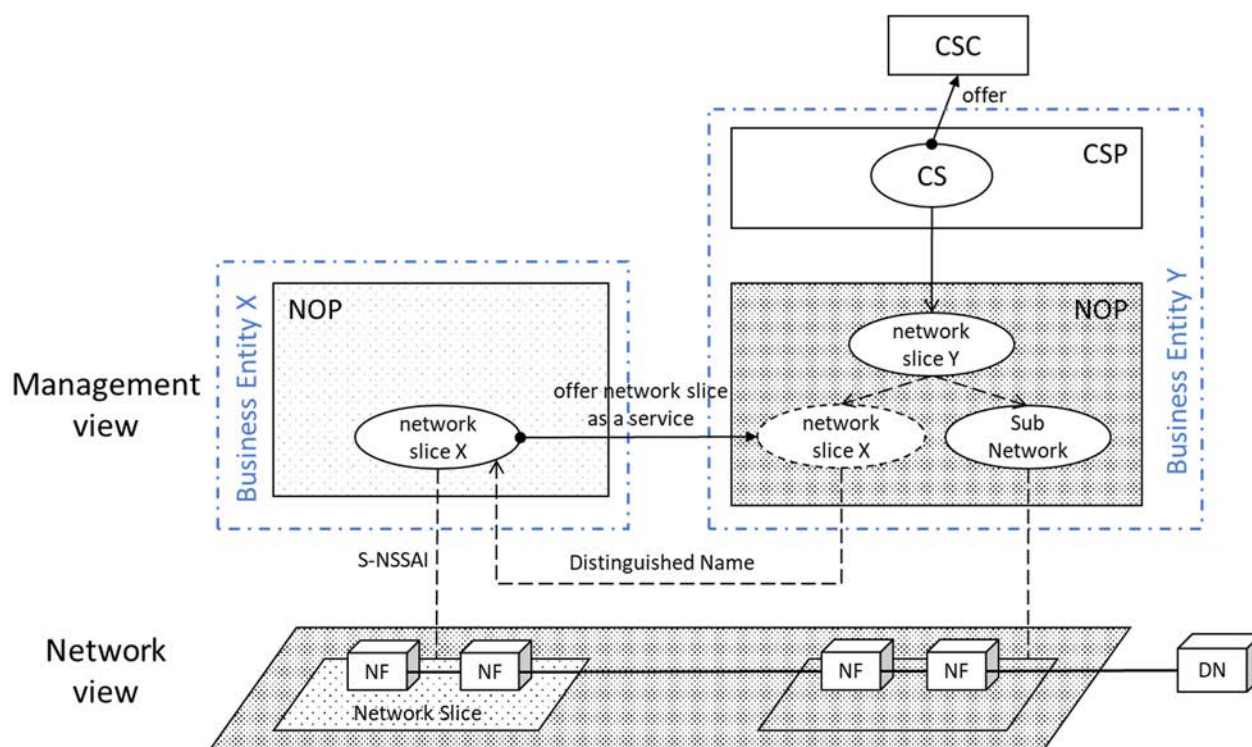
Figure 4.3.3-3: ZSM example of Network Slice as a Service being utilized to build a new network slice

5   E2E network slicing management and orchestration Architecture

5.1   Network slicing management architecture

Figure 5.1-1 describes an example of ZSM architecture deployment for network slicing management. In this scenario, the management domains for E2E Service, AN, CN and TN exist. The deployment is according to the architecture defined in ETSI GS ZSM 002 [12].
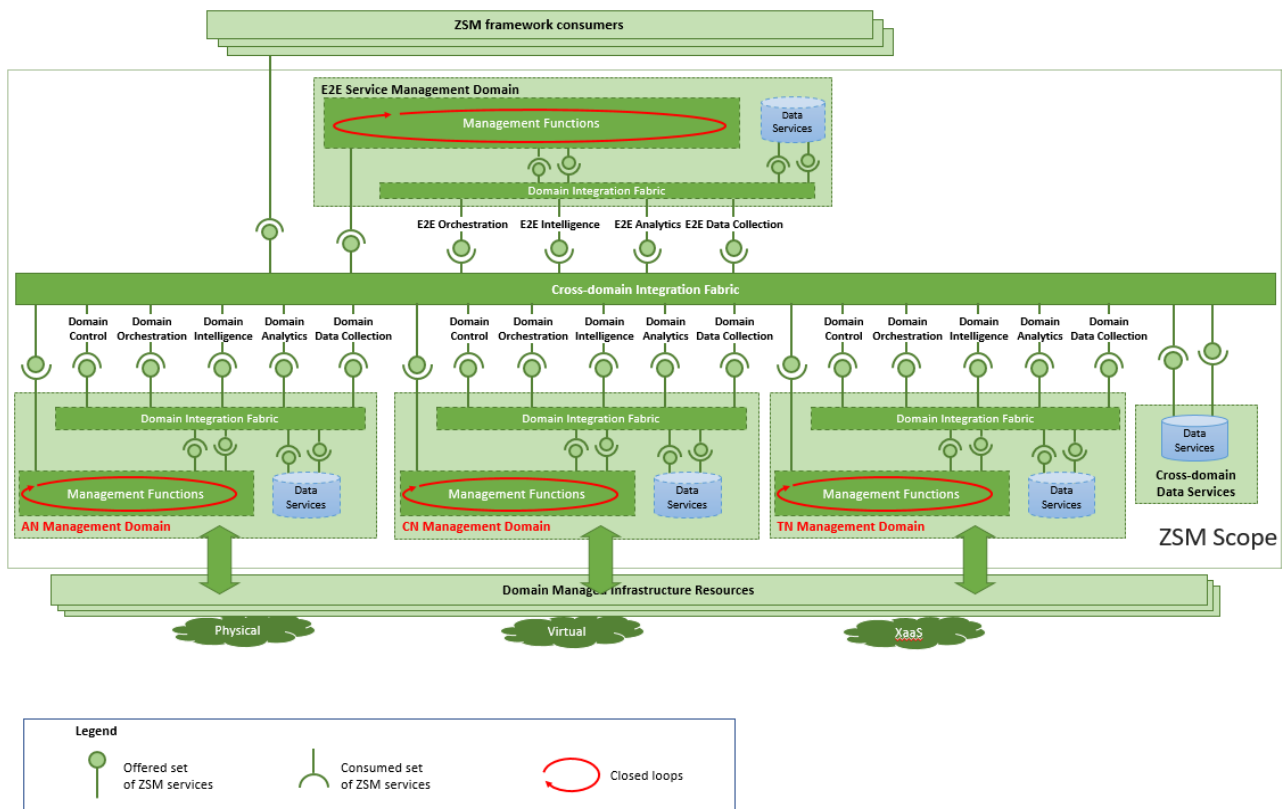
Figure 5.1-1: ZSM architecture deployment example for network slicing management

NOTE: This is one possible example shows how to deploy management domains.

The components of E2E network slicing architecture are described as follows:

- E2E Service MD (E2E Service Management Domain) is a provider of the E2E network slicing related management services based on Management Functions. E2E Service MD is also a consumer of the management services provided by AN MD, CN MD and TN MD.

- AN MD (Access Network Management Domain) is a provider of the AN slice subnet-related management services based on Management Functions.

- CN MD (Core Network Management Domain) is a provider of the CN slice subnet-related management services based on Management Functions.

- TN MD (Transport Network Management Domain) is a provider of the TN slice subnet-related management services based on Management Functions.

A network slice instance is composed of one E2E network slice subnet. One E2E network slice subnet is composed of one or more network slice subnets as shown in ETSI TS 128 541 [7], clause 6.2.1.