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GROUP REPORT

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Foreword

This Group Report (GR) has been produced by ETSI Industry Specification Group (ISG) Network Functions Virtualisation (NFV).

Modal verbs terminology

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1 Scope

The present document contains a feasibility study on the application of a Service-Based Architecture (SBA) design style to the NFV-MANO architectural framework specified in ETSI GS NFV 006 [i.1]. This includes - but is not limited to - studying aspects such as making interfaces independent from reference points, identifying new functionality related to NFV services like service registration.

The present document provides recommendations on the evolution of the ETSI ISG NFV specifications structure and on normative work to be carried out to apply SBA design patterns to the NFV architectural framework, as well as solutions and recommendations for coexistence of SBA NFV-MANO with the non-SBA NFV-MANO architecture and for migration to an SBA target.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

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]   ETSI GS NFV 006: "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Architectural Framework Specification".

[i.2]   ETSI GR NFV 003: "Network Functions Virtualisation (NFV); Terminology for main concepts in NFV".

[i.3]   N. Ford: "Comparing Service-based Architectures".

NOTE: Available at http://nealford.com/downloads/Comparing_Service-based_Architectures_by_Neal_Ford.pdf.

[i.4]   ISO/IEC 18384-1: "Information technology -- Reference Architecture for Service Oriented Architecture (SOA RA) -- Part 1: Terminology and concepts for SOA".

NOTE: Available at https://standards.iso.org/ittf/PubliclyAvailableStandards/c063104_ISO_IEC_18384-1_2016.zip.

[i.5]   ETSI GS NFV-IFA 005: "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Or-Vi reference point - Interface and Information Model Specification".

[i.6]   ETSI GS NFV-IFA 006: "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Vi-Vnfm reference point - Interface and Information Model Specification".

[i.7]   ETSI GS NFV-IFA 007: "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Or-Vnfm reference point - Interface and Information Model Specification".

[i.8]   ETSI GS NFV-IFA 008: "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Ve-Vnfm reference point - Interface and Information Model Specification".

[i.9]   ETSI GS NFV-IFA 010: "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Functional requirements specification".

[i.10]   ETSI GS NFV-IFA 013: "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Os-Ma-Nfvo reference point - Interface and Information Model Specification".

[i.11]   ETSI GS NFV-IFA 030: "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Multiple Administrative Domain Aspect Interfaces Specification".

[i.12]   ETSI GS NFV-IFA 031: "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Requirements and interfaces specification for management of NFV-MANO".

[i.13]   ETSI GR NFV-IFA 041: "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Report on enabling autonomous management in NFV-MANO".

[i.14]   ETSI GS NFV-IFA 048: "Network Functions Virtualisation (NFV); Release 4; Management and Orchestration; Policy Information Model Specification".

[i.15]   ETSI GR NFV-REL 011: "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Report on NFV-MANO software modification".

[i.16]   ETSI GR NFV-SEC 005: "Network Functions Virtualisation (NFV); Trust; Report on Certificate Management".

[i.17]   ETSI GS NFV-SEC 014: "Network Functions Virtualisation (NFV) Release 3; NFV Security; Security Specification for MANO Components and Reference points".

[i.18]   ETSI GS NFV-SEC 022: "Network Functions Virtualisation (NFV) Release 2; Security; Access Token Specification for API Access".

[i.19]   ETSI GS NFV-SOL 002: "Network Functions Virtualisation (NFV) Release 4; Protocols and Data Models; RESTful protocols specification for the Ve-Vnfm Reference Point".

[i.20]   ETSI GS NFV-SOL 003: "Network Functions Virtualisation (NFV) Release 4; Protocols and Data Models; RESTful protocols specification for the Or-Vnfm Reference Point".

[i.21]   ETSI GS NFV-SOL 012: "Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Policy Management Interface".

[i.22]   ETSI GS NFV-SOL 013: "Network Functions Virtualisation (NFV) Release 4; Protocols and Data Models; Specification of common aspects for RESTful NFV MANO APIs".

[i.23]   ETSI GS ZSM 002: "Zero-touch network and Service Management (ZSM); Reference Architecture".

[i.24]   ETSI TS 123 222: "LTE; 5G; Common API Framework for 3GPP Northbound APIs (3GPP TS 23.222)".

[i.25]   ETSI TS 133 210: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; 5G; Network Domain Security (NDS); IP network layer security (3GPP TS 33.210)".

[i.26]   ETSI TS 133 310: "Universal Mobile Telecommunications System (UMTS); LTE; 5G; Network Domain Security (NDS); Authentication Framework (AF) (3GPP TS 33.310)".

[i.27]   ETSI TS 133 501: "5G; Security architecture and procedures for 5G System (3GPP TS 33.501 Release 17)".

[i.28]   IETF RFC 5246: "The Transport Layer Security (TLS) Protocol Version 1.2".

NOTE: Available at https://www.rfc-editor.org/info/rfc5246.

[i.29]   IETF RFC 5280: "Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile".

NOTE: Available at https://www.rfc-editor.org/info/rfc5280.

[i.30]   IETF RFC 6066: "Transport Layer Security (TLS) Extensions: Extension Definitions".

NOTE: Available at https://www.rfc-editor.org/info/rfc6066.

[i.31]   IETF RFC 6125: "Representation and Verification of Domain-Based Application Service Identity within Internet Public Key Infrastructure Using X.509 (PKIX) Certificates in the Context of Transport Layer Security (TLS).

NOTE: Available at https://www.rfc-editor.org/info/rfc6125

[i.32]   IETF RFC 6749: "The OAuth 2.0 Authorization Framework", D. Hardt, Ed.

NOTE: Available at https://www.rfc-editor.org/info/rfc6749.

[i.33]   IETF RFC 7540: "Hypertext Transfer Protocol Version 2 (HTTP/2)".

NOTE: Available at https://www.rfc-editor.org/info/rfc7540.

[i.34]   IETF RFC 8446: "The Transport Layer Security (TLS) Protocol Version 1.3".

NOTE: Available at https://www.rfc-editor.org/info/rfc8446.

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI GR NFV 003 [i.2] and the following apply:

NFV-MANO Endpoint: entity playing the role(s) of NFV-MANO Service consumer and/or NFV-MANO Service producer

NFV-MANO Consumer: entity, function or service which makes use of an NFV-MANO Service via an exposed NFV-MANO Service Interface

NFV-MANO Producer: entity that exposes an NFV-MANO Service it offers, via one or more NFV-MANO Service Interfaces

NOTE: Examples of NFV-MANO Producer are NFV-MANO FBs, VNFs, EMs and OSSs.

NFV-MANO Service: well-defined set of related NFV-MANO capabilities, defined in a consumer-agnostic manner

NFV-MANO Service Interface: set of operations that exposes NFV-MANO Service functionality

reference point: conceptual point at the conjunction of two functional blocks

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI GR NFV 003 [i.2] and the following apply:

5GC	5G Core
5GS	5G Security
CCM	Container Cluster Management
CBSE	Component-Based Software Engineering
FQDN	Fully Qualified Domain Name
MCCO	Managed CIS Cluster Object
MSCS	Multi Site Connectivity Service
NFV-C	NFV-MANO Consumer
NFV-P	NFV-MANO Producer
NFV-S	NFV-MANO Service
NFV-SI	NFV-MANO Service Interface

PKI   Public Key Infrastructure
REST   REpresentational State Transfer
ROA   Resource-Oriented Architecture
SBA   Service Based Architecture
SBI   Service Based Interfaces
SNI   Server Name Indication
SOA   Service Oriented Architecture
TLS   Transport Layer Security

4   General

4.1   Service Based Architecture design style

Service-Based Architecture (SBA) is an architectural style that places emphasis on the services provided by individual architectural components rather than on the relationships between pre-defined pairs of architectural components. The concept has been around for many years and has been revitalized by 3GPP's decision to apply this design style starting in the Core Network from Release 15.

There is no formal definition of what SBA really means. In the technical literature, the definition actually varies according to the authors. In some cases, SBA is used as a portmanteau word encompassing Service Oriented Architecture (SOA) [i.4], Resource-Oriented Architecture (ROA), Microservices architecture and other Component-Based Software Engineering (CBSE) variants. In other cases it is regarded as a way of combining the best of both SOA (service registration and discovery) and ROA (RESTful design). Sometimes, SBA is also pitched as a middle ground between SOA and Microservices [i.3].

When it comes to applying the SBA style to the design of network architectures, the most noticeable difference with a conventional approach is the way interactions are specified between functional blocks. While a conventional specification approach is centred on the description of information flows between functional blocks, the SBA approach focuses on specifying the services offered by the architecture, while allowing flexibility for the placement of these services. The concept of functional block becomes superfluous in an ideal SBA approach, which instead defines services independently from each other, as well as the interfaces exposed to offer these services to any potential consumers. Which consumers make use of the services and what are their end-to-end use cases, is not relevant beyond identifying the common requirements on the service. Hence, the need to tie the service-based interfaces to a specific consumer, or consumer use case, fades away.

An illustration of the main SBA concepts is depicted in the figure 4.1-1.
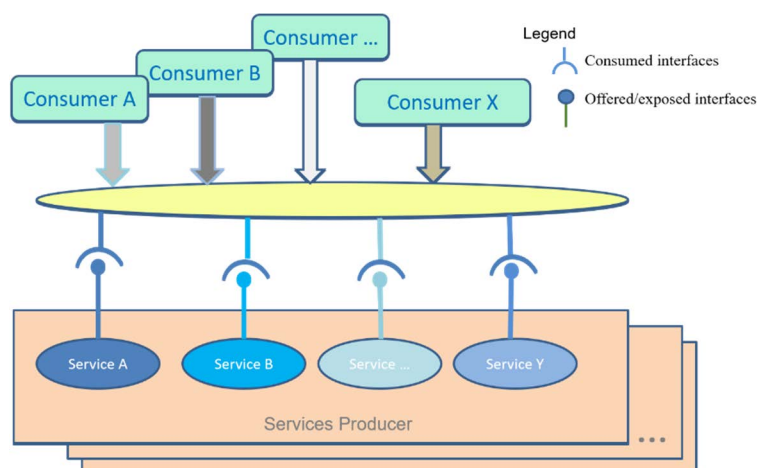

Figure 4.1-1: Illustration of SBA concept

4.2 Problem statement

The NFV-MANO architectural framework, as described in ETSI GS NFV 006 [i.1] identifies a number of functional blocks and reference points between them and refines the NFV architectural framework by focusing on the specification of the NFV-MANO framework and introducing the concept of interfaces exposed and consumed by NFV-MANO functional blocks. Clause 5.4.1 of ETSI GS NFV 006 [i.1] clarifies that "The collection of the interfaces exposed by an NFV-MANO functional block and consumed by another NFV-MANO functional block is mapped into an NFV-MANO reference point. An NFV-MANO interface can be exposed by an NFV-MANO producer on more than one NFV-MANO reference point". The interfaces applicable to a reference point, along with their associated information model, are described in set of NFV-IFA GSs. Restful APIs implementing the functional requirements specified in the NFV-IFA GSs are described in set of NFV-SOL GSs.

NFV-IFA GSs organized per reference point between two functional blocks declare producer and consumer functional block for every interface tied to this reference point. For example, ETSI GS NFV-IFA 007 [i.7] provides the specifications of all interfaces produced by the NFVO and consumed by the VNFM or vice-versa. The same approach applies to ETSI GS NFV-IFA 005 [i.5], ETSI GS NFV-IFA 006 [i.6], ETSI GS NFV-IFA 008 [i.8] and ETSI GS NFV-IFA 013 [i.10].

The concept of interface being produced and consumed by a functional block for every interface over a particular reference point leads to duplication of specification of these interfaces across multiple NFV-IFA GSs.

For example, the specification of:

- VNF LCM interface appears - with minor variations - in both ETSI GS NFV-IFA 007 [i.7] and ETSI GS NFV-IFA 008 [i.8] as this interface produced by the VNFM can be consumed by either an NFVO, a VNF or an EM at both the Or-Vnfm and Ve-Vnfm reference points;

- policy management interface specification appears in several NFV-IFA GSs: ETSI GS NFV-IFA 005 [i.5], ETSI GS NFV-IFA 006 [i.6], ETSI GS NFV-IFA 007 [i.7], ETSI GS NFV-IFA 008 [i.8] and ETSI GS NFV-IFA 013 [i.10] (NFV-MANO policy information model is specified in ETSI GS NFV-IFA 048 [i.14]).

However, in ETSI GS NFV-IFA 030 [i.11], which specifies the interfaces applicable to the Or-Or reference point, the specifications of the interfaces produced by the NFVO on the Os-Ma-Nfvo reference point are referenced rather than duplicated.

Similar concept has been applied to organize the specifications of the Restful APIs in the NFV-SOL GSs. For example the specification of the VNF LCM API exposed by the VNFM appears in both ETSI GS NFV-SOL 002 [i.19] and ETSI GS NFV-SOL 003 [i.20], as the scope of these NFV-SOL GSs maps to the Or-Vnfm and Ve-Vnfm reference points, respectively. However, the specifications of the Restful API for policy management interface have been provided in ETSI GS NFV-SOL 012 [i.21], where the specification of the protocol and data models for the interface is not tied to any reference point.

4.3 Potential impact

The current design of the NFV-MANO architectural framework as summarized in clause 4.2 exhibits the following characteristics:

- existence of predefined functional blocks;

- existence of reference points tightly coupled with specific and pre-defined functional blocks;

- functional block produces and consumes interfaces over a reference point;

- functional block might produce the same interface(s) over different reference points, in order to allow more than one consumer for an interface;

- addition of a new functional block implies definition of of new reference point(s) e.g. for Security Manager even when it is reusing existing interfaces;

- any new interface might need to be defined multiple times, over all applicable reference points.

ETSI NFV-IFA GSs which are organized per reference point between two functional blocks describe interfaces produced and consumed by functional blocks attached to the reference point. Such organization causes implications related to GS's structure e.g.:

- description of interfaces consumed by different consumers is duplicated in several GSs;

- addition of a new reference point might imply the creation of a new GS;

- duplicated descriptions require special attention during maintenance or when introducing new Release features in order to keep consistency among GSs.

5   Use cases

5.1   NFV-MANO Consumer request via NFV-S "Descriptor Management"

5.1.1   General

This clause describes a use case showing an example of a consolidated NFV-S, such as the "Descriptor Management". An NFV-C is using the operation "Update Descriptor" of the NFV-S "Descriptor Management", via the NFV-SI "Descriptor Management".

5.1.2   Actors and roles

Table 5.1.2-1 describes the use case actors and roles.

Table 5.1.2-1: Roles

#	Role	Description
1	NFV-MANO Consumer	See term defined in clause 3.1.
2	NFV-MANO Producer	See term defined in clause 3.1.

5.1.3   NFV-MANO Consumer request via NFV-SI "Descriptor Management"

5.1.3.1   Introduction

This use case describes how an authorized NFV-C uses an NFV-S offered by an NFV-P via the NFV-SI. Specifically, in this use case, an NFV-C is using the "Update Descriptor" operation on one of the descriptors (e.g. NSD) of the NFV-SI "Descriptor Management".

5.1.3.2   Pre-conditions

Table 5.1.3.2-1 describes the use case pre-conditions.

Table 5.1.3.2-1: Pre-conditions

#	Pre-condition	Additional Description
#1	NFV-P offers the NFV-S "Descriptor Management" and at least one instance of this service is running.	
#2	The NFV-C discovers the NFV-S "Descriptor Management" and its associated information.	See clause 5.2.4 for a description of the NFV-MANO Services Discovery use case
#3	The NFV-C is authorized to make use of NFV-SI "Descriptor Management", requesting operations offered via this interface.	
#4	An "Update Descriptor" operation is offered via the NFV-SI "Descriptor Management".	

5.1.3.3   Post conditions

Table 5.1.3.3-1 describes the use case post-conditions.

Table 5.1.3.3-1: Post-conditions

#	Post-condition	Additional Description
#1	The NFV-C has successfully performed the requested "Update Descriptor" operation on the NFV descriptor (e.g. NSD-x).	

5.1.3.4   Flow description

Table 5.1.3.4-1 describes the flow of information between the actors of this use case.

Table 5.1.3.4-1: Information flow

#	Actor/Role	Description
Begins when	NFV-C	The NFV-C has identified the need to make an update to an NFV descriptor e.g. NSD-x.
Step 1	NFV-C -> NFV-P	The NFV-C uses the "Update Descriptor" operation of the NFV-SI "Descriptor Management" offered by the NFV-P to request the update of the NSD-x.
Step 2	NFV-P -> NFV-C	The NFV-P performs the update of the NSD-x successfully and notifies the NFV-C for the update status.
Ends when	NFV-C	The NFV-C has updated successfully the NFV descriptor NSD-x.

5.2   NFV-MANO Services registration and discovery

5.2.1   General

This clause describes the use cases of NFV-Ss registration and discovery. In particular these use cases describe an NFV-P which registers the NFV-S "Descriptor Management" with its associated information in an NFV-S Registry Service and the NFV-C which discovers the NFV-S "Descriptor Management" using the NFV-S Registry Service using the NFV-C discovery criteria.

The NFV-S Registry Service is a combination of two common services:

- a registration service to NFV-Ps to register their NFV-Ss; and

- offers discovery services to the NFV-Cs which can request to discover certain NFV-Ss that meet the NFV-C discovery criteria.

5.2.2   Actors and roles

Table 5.2.2-1 describes the actors and their roles for these use cases.

Table 5.2.2-1: Roles

#	Role	Description
1	NFV-MANO Consumer	See term defined in clause 3.1.
2	NFV-MANO Producer	See term defined in clause 3.1.
3	NFV-S Registry Service	Common service exposing the capabilities to register NFV-Ss by NFV-Ps and to discover NFV-Ss by NFV-Cs.

5.2.3   NFV-MANO Services Registration

5.2.3.1   Introduction

This use case describes how an NFV-P who offers an NFV-S can register this NFV-S in an NFV-S Registry Service. Specifically, in this use case, an NFV-P is registering the NFV-S "Descriptor Management" exposing the NFV-SI "Descriptor Management" with its associated information.

5.2.3.2   Pre-conditions

Table 5.2.3.2-1 describes the use case pre-conditions.

Table 5.2.3.2-1: Pre-conditions

#	Pre-condition	Additional Description
#1	NFV-P offers the NFV-S "Descriptor Management" exposing the NFV-SI "Descriptor Management" and the NFV-S is enabled.	
#2	NFV-S Registry Service is available within NFV-MANO SBA framework.	
#3	An authorization service is available to enable authorized NFV-Ps to register services in NFV-S Registry Service.	
#4	A communication service is available to enable communication between NFV-Ps and the NFV-S Registry Service and is used in this use case.	

5.2.3.3   Post conditions

Table 5.2.3.3-1 describes the use case post-conditions.

Table 5.2.3.3-1: Post-conditions

#	Post-condition	Additional Description
#1	NFV-P has successfully registered with the NFV-S Registry Service the NFV-S "Descriptor Management" exposing the NFV-SI "Descriptor Management" with its associated information.	See note.
NOTE:	The NFV-S associated information registered with the NFV-S Registry Service can include, among others: the supported operations of the NFV-SI, NFV-P(s) information, authorization requirements, etc.	

5.2.3.4   Flow description

Table 5.2.3.4-1 describes the flow of information between the actors playing the roles involved in this use case.

Table 5.2.3.4-1: Flow description

#	Actor/Role	Description
Begins when	NFV-P	The NFV-P has identified the need to register the NFV-S "Descriptor Management" to enable the use of this service by NFV-Cs.
Step 1	NFV-P -> authorization service ->- NFV-S Registry Service	The NFV-P uses the authorization service in order to perform the authorization procedure that allows it to further register its NFV-Ss in NFV-S Registry Service.
Step 2	NFV-P -> communication service -> NFV-S Registry Service	The NFV-P registers the NFV-S "Descriptor Management" with the NFV-S Registry Service and provides all associated information to the NFV-S Registry Service using the communication service.
Ends when	NFV-P	The NFV-P has successfully registered with the NFV-S Registry Service the NFV-S "Descriptor Management" with its associated information.

5.2.4   NFV-MANO Services Discovery

5.2.4.1   Introduction

This use case describes how an NFV-C can discover an NFV-S in NFV-S Registry Service. Specifically, in this use case, an NFV-C is discovering the NFV-S "Descriptor Management" exposed on NFV-SI "Descriptor Management" on the basis of its own selection criteria.

5.2.4.2   Pre-conditions

Table 5.2.4.2-1 describes the use case pre-conditions.

Table 5.2.4.2-1: Pre-conditions

#	Pre-condition	Additional Description
#1	NFV-S Registry Service is available within NFV-MANO SBA framework.	
#2	NFV-P offers the NFV-S "Descriptor Management" and has registered this service with its associated information with the NFV-S Registry Service.	
#3	The NFV-C is authorized and is capable to discover NFV-Ss from NFV-S Registry Service.	
#4	The communication service between NFV-Cs and the NFV-S Registry Service is available.	
#5	The NFV-C can perform the selection of the NFV-S based on its own selection criteria.	

5.2.4.3   Post conditions

Table 5.2.4.3-1 describes the use case post-conditions.

Table 5.2.4.3-1: Post-conditions

#	Post-condition	Additional Description
#1	The NFV-C has successfully discovered the NFV-S "Descriptor Management" with its associated information.	

5.2.4.4   Flow description

Table 5.2.4.4-1 describes the flow of information between the actors playing the roles involved in this use case.

Table 5.2.4.4-1: Flow description

#	Actor/Role	Description
Begins when	NFV-C	The NFV-C has identified the need to make use of NFV-S "Descriptor Management", that meets specific selection criteria.
Step 1	NFV-C -> communication service -> NFV-S Registry Service	The NFV-C discovers the available NFV-S(s) "Descriptor Management" via the NFV-S Registry Service based on the NFV-C specified criteria.
Step 2	NFV-C	If more than one NFV-Ss matching the NFV-C search criteria are discovered , the selection process of the NFV-S is further performed as described in clause 7.3.4.8.
Ends when	NFV-C	The NFV-C has successfully discovered the NFV-S "Descriptor Management" with its associated information.

6   SBA Principles for NFV

## 6.1   General SBA principles for NFV

Some core principles for the SBA applied to the management and orchestration framework provided by NFV-MANO are described in table 6.1-1.

Table 6.1-1: SBA Principles for NFV

SBA Principle	Description
NFV-SBA-001	NFV-MANO SBA enables NFV-Ss to be consumed independently.
NFV-SBA-002	The implementation of NFV-Ss into higher-level functional or physical architectural components (functional blocks, nodes, functional entities, etc.) is transparent to the NFV-MANO SBA.
NFV-SBA-003	NFV-Ss and NFV-SIs exposed by NFV-Ps are independent of their NFV-Cs use cases and of how they intend to use the NFV-Ss.

6.2   SBA principles applied to NFV-MANO - Examples

A generic representation of NFV-Ss and their exposure via NFV-SIs is depicted in figure 6.2-1.
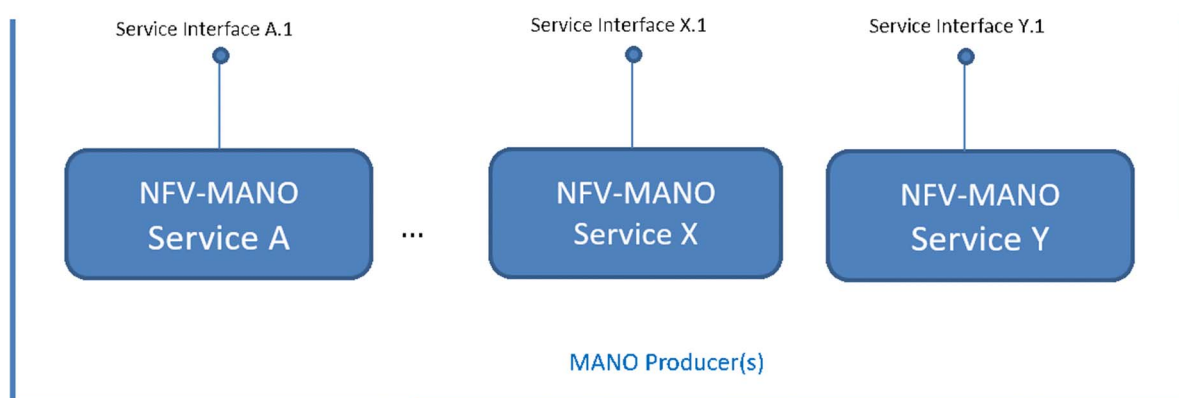
Figure 6.2-1: NFV-MANO Services representation

Each NFV-S has an NFV-SI defined, which exposes a set of operations for the NFV-S.

This can be applied in several ways:

EXAMPLE 1:   An NSD Management Service can be exposed via NFV-SI NSD Management, and NSD
              Subscription Management Service can be exposed via NSD Subscription Management Service
              Interface, as shown in the figure 6.2-2:

-    NSD-M1: NSD Management Service Interface

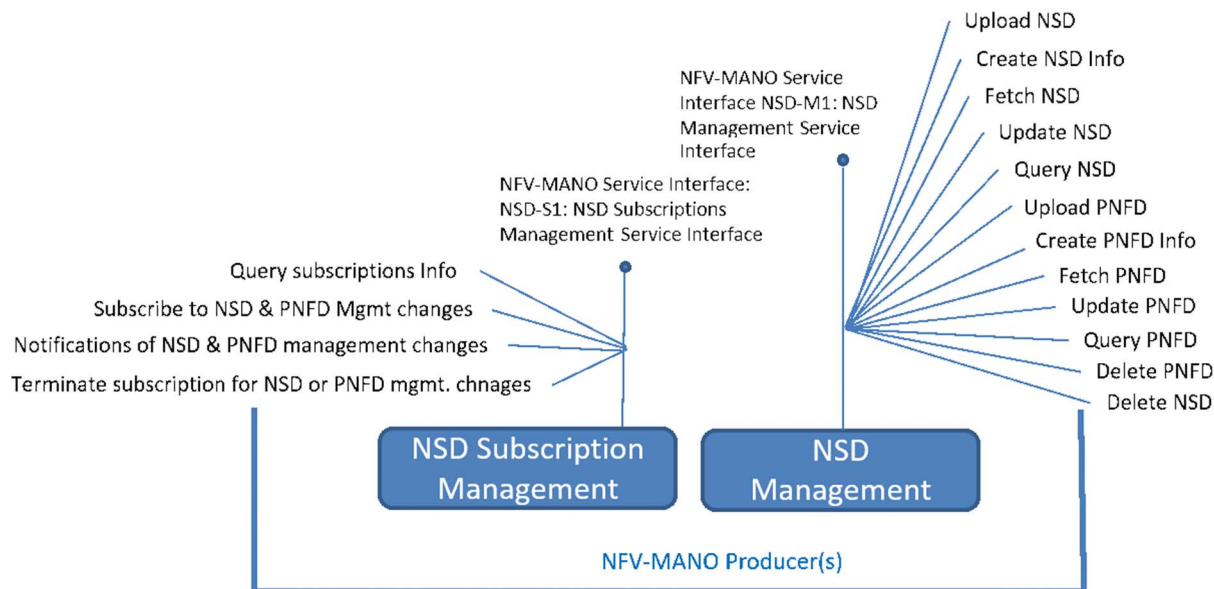-   NSD-S1: NSD Subscription Management Service Interface

Figure 6.2-2: NSD Subscription Management and NSD Management Services example

EXAMPLE 2:   Two generic NFV-Ss can be defined: Descriptor Management Service and Descriptor Subscription
              Management Service which can be exposed via their respective NFV-SIs, applicable to
              NFV-MANO descriptor objects, e.g. NSD, PNFD. This is shown in the figure 6.2-3:

-    D-M1: Descriptor Management Service Interface

-    D-S1: Descriptor Subscription Management Service Interface
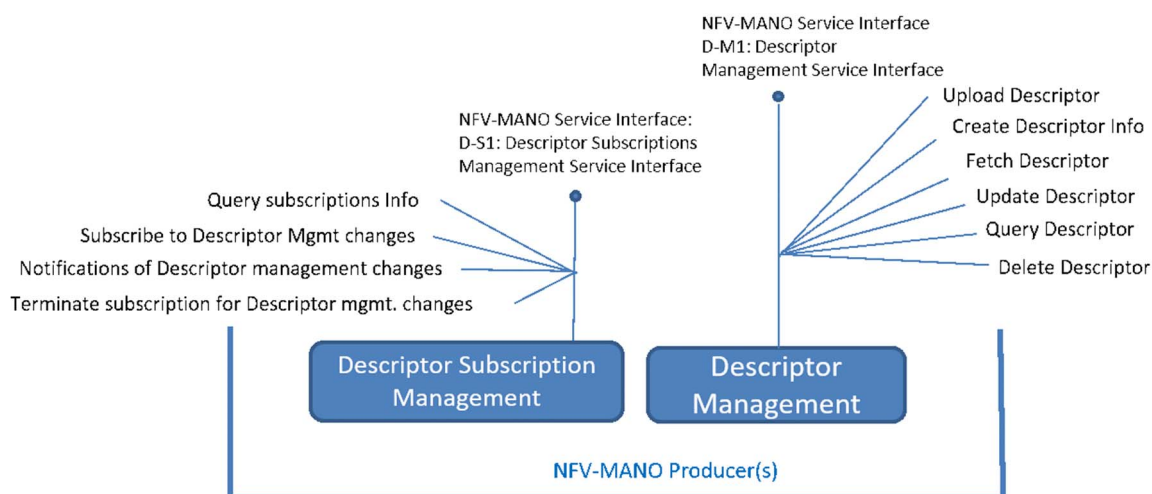

Figure 6.2-3: Descriptor Subscription Management and Descriptor Management Services example

7 SBA key issues and transformation targets

7.1 Overview

This clause identifies a number of key issues to be considered when designing an architecture according to the SBA paradigm, along with a set of transformation targets addressing one or more of these issues.

7.2 Key architectural issues and potential solutions

7.2.1 SBA key issues addressing SBA principles

7.2.1.1 Introduction

In order to realize the SBA principles described in clause 6.1 several architectural key issues are identified below, together with the potential solutions in remaining subclauses of this clause.

7.2.1.2 Key issue 1: Consumer agnostic NFV-Ss

7.2.1.2.1 Description

According to the SBA principle NFV-SBA-003 described in clause 6.1, in SBA, NFV-Ss and NFV-SIs exposed by NFV-Ps are independent of their consumers use cases and of how consumers intend to use the NFV-Ss. This key issue is making the NFV-Ss independent of the NFV-MANO reference points the functional blocks which are and consuming the NFV-Ss. This key issue addresses the fact that the SBA design of the NFV-Ss is not tied to a specific NFV-C and are thus defined independently of how many different NFV-Cs can consume them, but are expected to capture the commonality of the service requirements from known NFV-C use cases.

It is assumed that NFV-C can be assigned to one or more specific categories, which can influence the behaviour of NFV-Ss when serving a request. For example categories of NFV-C can reflect their relation regarding the operator's domain i.e. external or internal consumers, or their role in the architecture, see ETSI GS NFV-SOL 013 [i.22], clause 8.3.5 for more details on handling consumer roles and access rights, where the concept is extended to cover the case of consumer categories. NFV-C categories can be defined for example in the OSS, however details of this process are out of scope of the present key issue analysis.

7.2.1.2.2 Solution 1 (consumer agnostic services)

The NFV-Ss identified in clause 7.3 are specified individually, in a consumer agnostic manner. Restrictions, constraints or recommendations on the behaviour of the NFV-P with regards to certain categories of NFV-C are described independently from the main service definition e.g. in the NFV-P directly or in the NFV-S Registry Service. An example of such a case is when sending a particular information element in a response to a service request reserved to certain categories of NFV-C.

7.2.1.3 Key issue 2: Decoupling between NFV-Ss

7.2.1.3.1 Description

According to the SBA principle NFV-SBA-002 described in clause 6.1, in SBA, the implementation of NFV-Ss into higher-level functional or physical architectural components (functional blocks, nodes, functional entities, etc.) is transparent to the NFV-MANO SBA. Furthermore, according to SBA principle NFV-SBA 001 in clause, 6.1, the NFV-MANO SBA architecture enables for NFV-Ss to be consumed independently of each other. This key issue is removing any coupling between NFV-Ss.

7.2.1.3.2 Solution 1 (producer agnostic services)

The NFV-Ss are specified without indicating they are produced by a particular NFV-MANO Endpoint.

7.2.2   Other SBA key issues

7.2.2.1   Introduction

7.2.2.2   Key issue A: Services generalization

7.2.2.2.1   Description

Functional abstraction is a key property of well-defined SBAs. This refers to the ability to generalize and align the behaviour of related services, by encapsulating details of multiple variants of those services into a single one.

7.2.2.2.2   Solution 1 (generalization of services)

The NFV-Ss that can commonly apply to different NFV-MANO objects or constructs, are generalized (e.g. LCM service, Descriptor Management service, FM service, etc.).

This is an alignment of the NFV-SI definitions across the NFV-MANO Endpoints.

7.2.2.3   Key issue B: NFV-S discovery and NFV-S request routing

7.2.2.3.1   Description

In an SBA design, the list of NFV-Ss supported by an NFV-P is not pre-defined and many NFV-Ps can support the same NFV-Ss. This key issue is about the mechanisms to enable NFV-Cs to be able to discover NFV-Ss, and once an NFV-P instance is selected, to route the management service request to the chosen NFV-P instance. NFV-P and NFV-S selection is addressed by key issue G.

7.2.2.3.2   Solution 1 (direct discovery)

NFV-Cs send their discovery requests to an NFV-S Registry Service to discover the NFV-P instances providing the desired service and select the one (see key issue G) to which they send the management service request. The request is then routed via a communication service (see key issue H). The actual information exposed by the NFV-S Registry Service to the service consumer can vary (e.g. depending on the type of business agreement).

7.2.2.3.3   Solution 2 (indirect discovery without delegation)

This solution is similar to solution 1 except that the NFV-Cs send their discovery requests to a discovery function rather than to an NFV-S Registry Service. The discovery function in turn queries one or more NFV-S Registries and aggregates their responses. The NFV-C selects an NFV-P instance among those returned by the discovery function (see key issue G), and sends the management service request to the selected NFV-P instance. The request is then routed via a communication service (see key issue H).

7.2.2.3.4   Solution 3 (indirect discovery with delegation)

NFV-Cs send their management service request to an abstract NFV-S address, which is routed to a discovery function via a communication service (see key issue H). Both the discovery, and the selection of an NFV-S and NFV-P instance (see key issue G), are thus delegated to a discovery function. The management service request is then further routed to the selected NFV-P instance via a communication service (see key issue H). This solution assumes that the discovery function has enough information on NFV-Ss and NFV-Ps to make the selection on behalf of the NFV-C (including constraints on security, availability, regulatory, etc.).

7.2.2.3.5   Solution 4 (configuration-based discovery)

This solution relies on the configuration of the identity and/or address of NFV-P instances and NFV-Cs, through appropriate configuration services. Once the NFV-P instance has been selected, the management service request is routed via the communication service (see key issue H).

7.2.2.4   Key issue C: Dataless and stateless services

7.2.2.4.1   Description

Advanced SBAs typically provide support for exporting data and state information outside service instances, thereby making the implementation of service instances stateless and dataless.

7.2.2.4.2   Solution 1 (common data repositories)

This solution consists in employing common data repositories where NFV-Ps can store their data, including state information so it can be shared across NFV-P instances. Examples of data that could be stored in common data repositories include NFV descriptors, NFV instance records and the NFVI resource catalogue. The common data repositories expose services interfaces that offer capabilities to read and write data in the common data repositories.

7.2.2.5   Key issue D: Service exposure

7.2.2.5.1   Description

Advanced SBAs typically provide means to expose services to third parties in a secure and accountable manner.

7.2.2.5.2   Solution 1 (exposure framework)

A service exposure framework is used for re-exposing NFV-Ss (incl. multiple versions of the same NFV-S) to third parties in a secure and accountable manner. The service exposure framework provides various common services, including e.g. authentication, authorization, logging services and consumer-dependent information filtering. A description of the service exposure as a common service is provided in the clause 7.3.4.5.

7.2.2.6   Key issue E: NFV-S granularity

7.2.2.6.1   Description

NFV-Cs can discover NFV-Ss (see key issue B) and query data related to NFV-Ss (see key issue I) with various levels of granularity. NFV-Cs apply the levels of granularity for search criteria provided in the discovery or query request.

7.2.2.6.2   Solution 1 (NFV-S search granularity)

The NFV-C sets search criteria to be provided in discovery request or query request. The NFV-C can additionally set level of granularity for certain criterion. Setting granularity levels might be applicable only for some criteria. Different filters to be defined for search criteria to accommodate different granularity for the information of NFV-S expected in the response.

7.2.2.7   Key issue F: NFV-S registration

7.2.2.7.1   Description

Some of the solutions enabling discovery of NFV-Ss (see key issue B) assume that the list of services supported by an NFV-P is available in an NFV-S Registry Service. The mechanism for NFV-S registration is expected to be defined.

7.2.2.7.2   Solution 1 (direct registration)

This solution relies upon an NFV-S Registry Service where each NFV-P can register its active NFV-Ss (instances) and de-registers them upon NFV-Ss deactivation or termination. Registration information of the NFV-S includes the list of NFV-SI operations supported, the addressing information of the NFV-P and, where applicable, the type of NFV-MANO object or data supported. The registration request is sent by the NFV-P (instance) to the NFV-S Registry Service, via a communication service (see key issue H).

7.2.2.7.3   Solution 2 (indirect registration)

This solution relies upon an NFV-S Registry Service where a registration agent co-located with NFV-P instance registers on behalf of the NFV-P each NFV-S (instance) upon detecting that it becomes active, and de-registers it upon detecting deactivation. How the registration agent detects that the service becomes active or inactive depends on the type of registration agent. The registration agent might acquire this information by interacting with e.g. the NFV-Ss/NFV-Ps. The interoperability between the registration agent and NFV-P is internal to the NFV-P and might rely on agent specific interface or standardized interface (e.g. profiled de-facto standard). The registration agent might be dedicated to the NFV-S (instance(s)) or might be common to multiple NFV-Ss (instances) within the same NFV-P instance. The Consul®local client is an example of a registration agent. Registration information includes the identity of the NFV-P and, where applicable, the type of NFV-MANO object or data supported. The registration request is sent by the registration agent to the NFV-S Registry Service, via a communication service (see key issue H).

7.2.2.7.4   Solution 3 (3rd party registration)

This solution relies upon an NFV-S Registry Service where a management function (e.g. NFV-MANO management function) acts as the registration agent. The registration agent registers each NFV-S (instance) upon detecting that it becomes active and de-registers it upon detecting deactivation. A registration agent might be dedicated to the NFV-P instance or might be common to multiple NFV-Ps. Registration information includes the identity of the NFV-P instance and, where applicable, the type of NFV-MANO object or data supported. The registration request is sent by the registration agent within the management function to the NFV-S Registry Service, via a communication service (see key issue H). The service registration interface is thus not visible to the NFV-P.

7.2.2.8   Key issue G: NFV-S selection

7.2.2.8.1   Description

This key issue addresses the aspects of an NFV-S selection function that helps the NFV-Cs to select NFV-Ss that best satisfy their criteria and constraints. There might be multiple NFV-Ps providing the same NFV-Ss, or there could be different NFV-S instances from the same or different NFV-Ps that are discovered by the NFV-C. When multiple suitable NFV-S candidates are found, the selection function uses additional constraints:

- for the NFV-S selection (e.g. security and regulatory constraints); and/or

- for the NFV-P selection, when there are multiple NFV-Ps offering suitable NFV-Ss or NFV-S instances, such as criteria related to status and characteristics of the NFV-P (e.g. traffic load, local policies); and/or

- specific policies set for that NFV-C.

7.2.2.8.2   Solution 1 (direct selection)

The NFV-S selection function is collocated with the NFV-C and performs the NFV-S selection directly without involving another party.

7.2.2.8.3   Solution 2 (delegated selection)

The NFV-S selection is delegated by the NFV-C to an NFV-S selection function which resides outside the NFV-C. The NFV-S selection function is provided (via configuration, policies, information exchange between NFV-C and the NFV-S selection function, etc.) with any of the additional criteria and its order of priority, that is used to narrow down a selection specified by NFV-C. In the case where such information is provided by the NFV-C to the NFV-S selection function via an interface and for multi-vendor interoperability purposes, a standard interface is expected to be defined.

In the special case of key issue B "Solution 3 (indirect discovery with delegation)" the NFV-C makes a management service request (e.g. operation offered by a VNF LCM service) and the NFV-S discovery, selection and routing of the request to the right NFV-P and NFV-S instance are all done transparently, without further involvement of the NFV-C. This is also a case of a delegated selection solution.

7.2.2.9   Key issue H: Communication services

7.2.2.9.1   Description

This key issue discusses solutions for defining services enabling communication between NFV-Ps, NFV-Cs and other entities used in solutions with delegation (e.g. registration agents, selection function, etc.) and their accessibility to the NFV-MANO SBA common services such as NFV-S Registry Service, Authentication, Authorization, etc.

7.2.2.9.2   Solution 1 (basic IP routing)

The communication relies on basic IP routing functionality. The consumer of this service provides the FQDN or IP address of the target entity in management service requests and registration requests. The communication service is expected to perform any required FQDN to IP address translations and to route the requests to the correct destination.

7.2.2.9.3   Solution 2 (application layer proxies)

The communication relies on application-layer proxy functionality, including HTTP-aware load balancing, protocol interworking, and has the ability to query an NFV-S Registry Service when routeing the management service requests if indirect discovery is used (i.e. it can provide the discovery function described in key issue B).

The proxy functionality can be centralized and serve multiple NFV-P instances and NFV-Cs, or distributed, in which case a proxy function instance is dedicated to every NFV-C and NFV-P or NFV-S instance. In the latter case a proxy instance can be deployed as a single unit with the NFV-S instance or NFV-C it serves or be deployed independently.

7.2.2.10   Key issue I: Service querying

7.2.2.10.1   Description

NFV-Cs are expected to be able to query the registry regarding the status and additional data related to NFV-Ss they have already discovered, using different search criteria. The NFV-C can update the search criteria and repeat the service query. The NFV-C can optionally subscribe for notifications about future updates of status of the discovered NFV-Ss and to obtain data updates for the respective NFV-Ss.

7.2.2.10.2   Solution 1 (simple query)

The NFV-C queries status and additional data related to already discovered service using a search criteria that includes the NFV-S characteristics, constraints on the NFV-P, and/or other information related to NFV-S instances.

7.2.2.10.3   Solution 2 (query with subscription)

This solution is similar to solution 1 with the addition, that the NFV-C subscribes for notifications to receive further updates for NFV-S status and data.

7.2.2.11   Key issue J: NFV-MANO service authorization

7.2.2.11.1   Description

In SBA design ensuring that only authorized producers are offering services and only authorized consumers are accessing the services is of key importance, in particular for 3rd party entities external to NFV-MANO. An authorization framework to access NFV-Ss offers the following possibilities:

- authorization to discover and query the NFV-Ss available in the NFV-S Registry Service;

- authorization of NFV-P to register services in NFV-S Registry Service;

- authorization of access to the NFV-Ss exposed by the NFV-MANO domain.

The authorization to access NFV-Ss offers the possibility to control and restrict access to only the authorized services, within the NFV-C's access scope. The authorization applies to controlling the NFV-C's access to NFV-Ss, as well as to controlling the NFV-Ps which want to use NFV-Ss offered by other NFV-Ps.

7.2.2.11.2   Solution 1 (direct authorization)

The NFV-Cs send request to the NFV-S Registry Service or to NFV-Ps, which authorize the access to the requested NFV-S information, or respectively to use the NFV-S. The authorization is granted per NFV-MANO operator's policy. An example is the RBAC approach where different roles and their associated access permissions can be defined.

7.2.2.11.3   Solution 2 (indirect authorization)

An authorization framework issues authorization tokens to service requesters (NFV-C or NFV-P, which send authorization requests). The service requesters then use the granted tokens to obtain access to the requested services. The authorization token includes the "access scope" showing the authorized services for that service requester. An example of such solution is based on OAuth 2.0 defined in IETF RFC 6749 [i.32], used for NFV-SOL REST APIs in ETSI GS NFV-SOL 013 [i.22] and for 5GS SBI in ETSI TS 133 501 [i.27].

7.2.2.12   Key issue K: TLS certificate profile

7.2.2.12.1   Description

NFV-Cs and NFV-Ps are expected to communicate over secure channels providing security properties such as end-point authentication and confidentiality and integrity of exchanged data. The TLS protocol, over which HTTP is expected to run as described in ETSI GS NFV-SOL 013 [i.22], can provide these security guarantees. Given that a TLS session establishment and, more specifically, the handshake protocol typically involves end-point authentication based on TLS certificates, this key-issue addresses the TLS certificate profiles for SBA interfaces.

7.2.2.12.2   Solution 1 (SBA certificate profiles alignment with 3GPP 5GC certificate profiles)

This solution reuses the TLS certificate profile of the NF consumers and producers of the 3GPP 5GC.

Clause 6.1.3c of ETSI TS 133 310 [i.26] (3GPP Release 16 or later) contains provisions for the profile of the certificates to be used for 3GPP 5GC Service Based Architecture (SBA). Alongside the common rules in clause 6.1.1 of ETSI TS 133 310 [i.26] (3GPP Release 16 or later), the certificate field attributes (basic and extensions) of the NF TLS consumers and producers certificate profiles as described in clause 6.1.3c.3 of ETSI TS 133 310 [i.26] (3GPP Release 16 or later) can be used to provide the certificate profiles of the NFV-Cs and respectively NFV-Ps.

The attribute values from 3GPP certificate profile are to be analysed for NFV-MANO to determine if different values for some of the certificate fields or extensions are expected, compared to those in clause 6.1.3c in ETSI TS 133 310 [i.26] (3GPP Release 16 or later) (e.g. certificate validity).

   NOTE: Related to the subjectAltName certificate extension in this certificate profile: the Server Name Indication
             (SNI) extension to TLS (IETF RFC 6066 [i.30]) is often recommended or even mandatory to support by
             TLS implementations (e.g. HTTP/2 IETF RFC 7540 [i.33] and ETSI TS 133 210 [i.25] 3GPP Release 16
             or later) and is applicable to TLS 1.2 IETF RFC 5246 [i.28].
             In practice, this means that at least one subjectAltName attribute with FQDN is included in server-side
             (e.g. NFV-MANO Producer) TLS end-entity certificates.

7.2.2.13   Key issue L: Certificate validation policies

7.2.2.13.1   Description

Clause 4 in ETSI GR NFV-SEC 005 [i.16] introduces the applicability of PKI on the various NFV-MANO references points with the benefits of establishing security associations (e.g. TLS sessions) between different NFV-MANO entities. Certificate-based authentication being a recurrent method expected in SBA, the security of these associations depends on correctly validating the exchanged public-key certificates. This key-issue addresses certificate verification policies with focus on validating identities bound to the subject of the certificate. Authentication and various policy checks use these identities.

7.2.2.13.2   Solution 1 (use best practices for certificate validation)

Various considerations for the certificate validation, including certificate-path building and chain validation principles for the chain-of-trust verification, are provided in clause 4.5 of ETSI GR NFV-SEC 005 [i.16]. A detailed algorithm for certification path validation is provided in clause 6 of IETF RFC 5280 [i.29].

Some of the certificate extensions (previous TLS Certificate Profile clause) are marked critical by IETF RFC 5280 [i.29], verification of which becomes critical as well. In particular, verification of identities presented in a certificate should follow the procedures in IETF RFC 6125 [i.31].

A gap is identified in terms of certificate validation policies that cover the necessary validation steps during mutual HTTPS/TLS authentication. While ETSI TS 133 310 [i.28], clause 5.2.2.2 provides some descriptions on this area, this gap remains to be filled by ETSI NFV SEC through specifying a certificate validation policy for mutual HTTPS/TLS authentication addressing the mutual authentication in general.

7.2.2.14   Key issue M: TLS profiles support

7.2.2.14.1   Description

TLS based secure communications in the present SBA are expected to follow industry best practices as to support for TLS configurations and usage. This key-issue addresses recommended TLS profiles to be supported.

7.2.2.14.2   Solution 1 (TLS with mutual authentication)

The entities in the present SBA support mutually authenticated TLS and HTTPS. The identities in the NFV-Cs and NFV-Ps' certificates are used for authentication and policy checks. The NFV-Cs and NFV-Ps typically support both server-side and client-side certificates. TLS client and server certificates are assumed to be compliant with the SBA certificate profile described in key issue K "TLS certificate profile" in clause 7.2.2.12.

Similar to ETSI GS NFV-SOL 013 [i.22], TLS implementations are expected to meet or exceed the security algorithm, key length and strength requirements specified in ETSI TS 133 210 [i.25] (Release 16 or later) in clause 6.2.3 (if TLS version 1.2 as defined by IETF RFC 5246 [i.28] is used) or clause 6.2.2 (if TLS version 1.3 as defined by IETF RFC 8446 [i.34] is used)

The mutual TLS authentication is enabled by the TLS protocol with CertificateRequest towards the client, but client authentication is triggered by the server-side application.

7.2.2.15   Key issue N: SBA migration

7.2.2.15.1   Description

Migration of existing NFV-MANO system towards SBA design can be realized in two possible approaches:

- one-step replacement of legacy NFV-MANO system by SBA based NFV-MANO system;

- step-by-step evolutionary process of successively introducing of elements of SBA and removing elements of non-SBA NFV-MANO system.

Although migration refers to the NFV-MANO system itself, the unavailability period of NFV-MANO system during migration step impacts the managed network services and NFVI resources.

During migration NFVI resources can be shared between non-SBA NFV-MANO and SBA NFV-MANO. Implementation specific solutions can be applied to handle issues like isolation protection.

Replacement of the whole non-SBA NFV-MANO system in one step eliminates the need to assure coexistence of both systems during migration. The NFV-MANO system unavailability period depends on the replacement process used at switch-over between non-SBA NFV-MANO to SBA NFV-MANO system.

Evolutionary process consist of several interim steps according to the migration process design. Every migration step has the following challenges:

- assure coexistence of elements of non-SBA NFV-MANO system and SBA NFV-MANO system, which exist in the architecture of particular step;

- design the step in order to optimize the process of switching to next step in order to eliminate NFV-MANO system unavailability.

The design of the migration steps depends on the NFV-MANO system functionality expected before initiating the migration step and after completion of the migration step. In the beginning of the first migration step the source functionality can reflect the status of non-SBA NFV-MANO system. For the last migration step the functionality can reflect the target SBA NFV-MANO system. Examples of the migration steps are:

- implementation of communication services (key issue H) and NFV-MANO service authorization (key issue J);

- implementation of NFV-S Registry Service and NFV-S registration (key issue F);

- enabling service producers to register services in NFV-S Registry Service;

- implementation of common data repositories (key issue C);

- etc.

7.2.2.15.2   Solution 1 (migration without NFV-MANO service interruption)

This solution assumes, that the migration step is designed with the objective to assure service continuity for the NFV-MANO system. For this solution the operation of network services and NFVI resources managed by NFV-MANO system being migrated is not impacted. The step-by-step migration process considers the design of migration steps, which allow to seamlessly add new SBA specific capabilities to the NFV-MANO system and/or gradually remove non-SBA NFV-MANO system capabilities. The migration process design is expected to enable rollback actions to the status before the start of the migration step in case of failure identified during the migration.

For the migration between non-SBA NFV-MANO system towards SBA NFV-MANO system it might be possible to design the migration process in more than one manner. In such case the migration steps can differ in their scope, which depends on the design. The number of migration steps can also vary depending on the design manner.

Each migration step can be divided into multiple sub-steps, which allow to verify the successful realization of a sub-step and simplify rollback. The next sub-step is realized immediately after the previous one. This approach can be used if the migration process is realized as one step migration.

The period between migration steps, i.e. after successful completion of certain step and before initiating next step, can be used for verification of stability of the NFV-MANO system under migration, to assure that all objectives of the migration step were achieved and operation of managed network services and NFVI resources is not impacted.

Migration of stateful NFV-Ss can use the common data repositories (see key issue C) to share data between services being migrated.

This solution can be realized via a similar approach to the canary updates, where the non-SBA NFV-MANO system and the SBA system coexist and can process requests in parallel. In this case, only a part of the NFV-MANO traffic is handled by the SBA based NFV-MANO, and this part is increased over time based on a continuous assessment of the migrated SBA NFV-MANO key performance indicators.

7.2.2.15.3   Solution 2 (migration with NFV-MANO service interruption)

This solution differs from solution 1, as it assumes that a temporary unavailability of the NFV-MANO system during migration is allowed. During the period of NFV-MANO system unavailability, an NFV-C request sent over service interfaces for managed network services or NFVI resources will not be possible to be served (e.g. scaling) during the migration. Therefore the operation of network services managed by NFV-MANO system undergoing migration could be impacted. Such situation might be acceptable only for specific cases, when e.g. the period of unavailability is synchronized with service maintenance window covered by SLA.

In order to assure, that the operation of network services managed by NFV-MANO system under migration is not impacted, some possible mitigation approaches are:

- temporarily transfer management requests, that were originally addressed by the NFV-MANO system under migration, to another NFV-MANO system within the same administrative domain of the operator. After successful migration of the NFV-MANO system, the management requests are transferred back to the migrated NFV-MANO system;

- duplicate NFV-MANO system before start of migration (active-standby mode) and realize migration on NFV-MANO system in standby mode. After successful migration the migrated NFV-MANO system is switched back to active mode.

The second approach can be realized e.g. by implementing redundancy units, similarly as described in clause 5.3 of ETSI GR NFV-REL 011 [i.15], where active mode represents the NFV-MANO system before migration and standby mode represents NFV-MANO system being migrated.

## 7.2.2.16	Key issue O: SBA coexistence

### 7.2.2.16.1	Description

It is expected that SBA based NFV-MANO system can coexist with non-SBA NFV-MANO system or with another SBA based NFV-MANO system (e.g. during the migration phase) which has different NFV-S sets described in 7.3.

Coexistence between SBA -MANO and non-SBA NFV-MANO systems faces the following challenges:

- access from a non-SBA NFV-MANO FB to an NFV-S exposed by SBA based NFV-MANO system;

- registration of services offered by non-SBA NFV-MANO;

- access from an entity in SBA based NFV-MANO system to a service offered by non-SBA NFV-MANO.

NOTE:	Access includes authorization and discovery of the services, like also the use of communication service.

In the case of coexistence between SBA NFV-MANO systems (e.g. during the migration phase), which represent different transformation targets, faces the following challenges:

- access to services offered over consolidated service interfaces by consumers of non-consolidated service interfaces;

- access to services offered over non-consolidated interfaces by consumers of consolidated service interfaces;

- access to services offered over consolidated service interfaces by consumers of consolidated service interfaces with a different scope of consolidation.

The SBA based NFV-MANO systems which handle only NFV-Ss based on the same transformation target are not considered a coexistence case and the NFV-S interoperability is expected to be seamless. For consolidated interfaces, if the scope of consolidation is different between the targets, the challenges to access services by consumers are:

- access to services offered over consolidated service interfaces by consumers of non-consolidated service interfaces;

- access to services offered over non-consolidated interfaces by consumers of consolidated service interfaces.

Common aspects of coexistence, which are relevant for each scenario described above include:

- usage of service interfaces to enable consumption of services offered by producers;

- usage of SBA specific common services including registration, discovery, querying, etc. to support consumption of services offered by producers;

- usage of communication service to enable interactions between entities, functions or services in SBA architecture;

- authorization of consumers and producers to permit the consumption of services and use of common services.

To minimize the impact of coexistence and/or interworking with deployments based on non-SBA NFV-MANO architecture, specifications supporting the NFV-MANO architecture are expected to be continuously maintained and enhanced, as applicable. A specification approach can be taken whenever possible to describe the NFV-MANO interfaces and new functionality in a manner that can enable its applicability in both SBA and non-SBA NFV-MANO architectures. This allows to support a functional parity between SBA NFV-MANO and non-SBA NFV-MANO for coexistence scenarios. Functionality and capabilities that are unique only to SBA NFV-MANO are expected they will not impact the maintenance and/or improvement of non-SBA NFV-MANO.

7.2.2.16.2   Solution 1 (interworking gateway)

The interworking gateway enables interactions between coexisting systems, for the aspects where they cannot interact directly. An interworking gateway enables offering of NFV-Ss by NFV-Ps and consumption of NFV-Ss by NFV-Cs between entities belonging to coexisting systems. Interworking gateway provides interworking function to translate, in both directions, the service requests between non-SBA NFV-MANO and entities in SBA domain, between entities in SBA domain and non-SBA NFV-MANO or entities in other SBA domain, which represents different transformation target.

In case of multi-step migration process (see key issue N), the interworking gateway enables information exchange between entities of non-SBA NFV-MANO system and SBA system, or between SBA systems representing different transformation targets, for the periods between migration steps. The migration steps can be designed to choose which of the various functionalities of the interworking function to use.

The functionalities provided by interworking gateway to non-SBA NFV-MANO FBs and functions can include:

- registration of services offered by non-SBA NFV-MANO FBs and functions in NFV-S Registry Service (see key issue F);

- exposure of services offered by non-SBA NFV-MANO FBs and functions towards SBA consumers (see key issue D);

- enabling consumption of NFV-Ss offered by SBA producers by non-SBA NFV-MANO FBs and functions.

The functionalities provided by interworking gateway to SBA entities can include:

- discovery and selection of the services offered by non-SBA NFV-MANO entities or entities in other SBA domain, which represent different transformation target (see key issues B and G);

- querying the services offered by non-SBA NFV-MANO entities or entities in other SBA domain, which represent different transformation target (see key issue I);

- enabling consumption of services offered by non-SBA NFV-MANO entities using communication service(s) (see key issue H).

7.2.2.16.3   Solution 2 (direct interaction)

This solution enables direct interaction between coexisting systems.

For the coexistence between non-SBA NFV-MANO entities (e.g. FBs) and entities in SBA domain the direct interactions can be realized for service interfaces, which are not modified.

For the coexistence between SBA based NFV-MANO systems, which represent different transformation targets, the direct interaction can be realized for service interfaces with the same scope of service consolidation.

NFV-Cs have the option to query (key issue I), discover and select from common NFV-S Registry Service (key issues D, B and G) either NFV-Ss offered by non-SBA NFV-MANO or NFV-Ss offered by SBA based NFV-MANO. NFV-Cs when using NFV-Ss offered by non-SBA NFV-MANO will continue to perform requests using the existing NFV-MANO interfaces. In order to enable for NFV-Cs the discovery and selection of services, services querying, as well as to enable communication between entities (key issue H) it is expected, that coexisting systems implement common services as defined in clause 7.3.4.

Implementation of some common services might not be possible for non-SBA NFV-MANO system. In particular, if it is not possible to implement NFV-S Registry Service for non-SBA NFV-MANO system, this solution does not apply.

7.2.3   Pros/cons analysis of the solutions

Clause 7.2.2 describes two groups of key issues identified as relevant for designing architecture according to the SBA model and potential solutions to answer the key issues. One group of key issues addresses SBA principles and second group addresses other key issues. This clause provides analysis of solutions by indicating pros and cons aspects to be considered. Table 7.2.3-1 provides pros/cons of solutions for key issues addressing SBA principles and table 7.2.3-2 provides pros/cons of solutions addressing other key issues.

Table 7.2.3-1: Pros/cons of the solutions for key issues addressing SBA principles

Key issue	Solution	Pros	Cons	Analysis and comments
1: Consumer agnostic NFV-Ss	1: consumer agnostic services	- unification of main NFV-S definition - flexibility to add new objects and models that reuse the generalized service - facilitates adding new NFV-Cs and new categories as needed - NFV-Cs can use any NFV-S offered by NFV-MANO Service producers	with an RBAC authorization method, more roles need to be defined	
2: Decoupling between NFV-Ss	1: producer agnostic services	- NFV-P can produce any set of NFV-Ss - flexibility of exposure of NFV-S per NFV-P	authorization for multiple NFV-Ps	based on SBA principles additional services or interactions needed to identify what NFV-Ps produce which NFV-S

Table 7.2.3-2: Pros/cons aspects for the solutions addressing other key issues

Key issue	Solution	Pros	Cons	Analysis and comments
A: Services generalization	1: generalization of services	simplified addition of new objects and models to be used with existing generalized services	- not backward compatible change - added complexity for generalized service details needed at discovery	
B: NFV-S discovery and NFV-S request routeing	1: direct discovery	- information about all NFV-Ss available from one (or more) NFV-S Registry Service - dynamic discovery transparent for NFV-C wrt service updates on NFV-P side	interacting with several NFV-S Registry Services, if they exist	
	2: indirect discovery without delegation	- one point of interaction for NFV-C - dynamic discovery transparent for NFV-C wrt service updates on NFV-P side	none identified	

Key issue	Solution	Pros	Cons	Analysis and comments
	3: indirect discovery with delegation	• one point of interaction for NFV-C • dynamic discovery transparent for NFV-C wrt service updates on NFV-P side	• none identified	• solution 1 puts all functionality on NFV-C • solutions 2 and 3 rely on discovery function, which has to be integrated and managed within the architecture; discovery function can simplify discovery for the large NFV-MANO domain • solution 4 can be very efficient, as configuration can simplify many interactions, but configuration needs design, which is specific for particular NFV-MANO domain; configuration needs to be maintained for each NFV-MANO domain • additional complexity (managing policies/configuration of the discovery function to control which NFV-C and on which set of NFV-Ss can an NFV-C request the discovery and selection)
	4: configuration-based discovery	• less interactions needed • no need for NFV Registries • no preliminary discovery for NFV-C wrt service updates on NFV-P side	• managing configuration service • need to keep configuration information on NFV-C side up to date with NFV-Ps	
C: Dataless and stateless services	1: common data repositories	• facilitate resilience of NFV-MANO - in case of failure of an NFV-P any other NFV-P instance can take over from the failed instance as it has access to all runtime data, transaction states etc. • offloading of NFV-P • centralized management of storage • optimization of storage capacity	• single point of failure depending on storage implementation scenario • complexity added for design of storage	
D: Service exposure	1: exposure framework	• unified exposure of NFV-Ss	• none identified	
E: Service granularity	1: search granularity	• extended scope of search criteria defined by NFV-C	• complex discovery process	

Key issue	Solution	Pros	Cons	Analysis and comments
F: NFV-S registration	1: direct registration	• only a simple interface with the NFV-S-Registry is needed	• more complex NFV-P	• solution 1 puts all functionality on NFV-P • solutions 2 and 3 rely on registration agent, which is integrated and managed within the architecture; registration agent can simplify registration for a large NFV-MANO domain and addition of new NFV-Ss • high resilience of registration agent is expected for solutions 2 and 3 • risk of congestion/ loss of heavy registration traffic after e.g. un-expected registry failure. Control of independent registration signals, e.g. reliability, how to check the keep alive
	2: indirect registration	• offloading of NFV-P	• additional registration interface for the registration agent	
	3: 3rd party registration	• offloading of NFV-P • registration interface invisible for NFV-P	• additional registration interface for the registration agent	
G: NFV-S selection	1: direct selection	• NFV-C fully manages selection process	• more complex NFV-C	• solution 1 puts all functionality on NFV-C • solution 2 relies on selection function, which has to be integrated and managed within the architecture; selection function simplifies selection of NFV-Ss
	2: delegated selection	• offloading of NFV-C	• need for additional interface • need for additional selection function for each NFV-C, if selection function cannot be shared between many NFV-Cs	

Key issue	Solution	Pros	Cons	Analysis and comments
H: Communication services	1: basic IP routing	• use of well established network protocols • no additional communication services needed beyond provisioning of standard IP	• no support for delegation of service discovery to the communication service	• connectivity is established between authorized entities • solution 1 does not need any additional functions to provide communication within NFV-MANO domain
	2: application layer proxies	• enables taking into account HTTP headers in routing decisions, (e.g.to identify that a producer is unavailable or overloaded) • higher communication reliability at all protocol layers	• additional delay in request forwarding • additional elements (application layer proxies) to be considered in the network deployment on top of baseline communication network means (e.g. IP networking)	
I: Service querying	1: simple query	• none identified	• repeated query needed to identify NFV-S changes	• solutions 1 and 2 do not need any additional functions to provide query mechanisms within NFV-MANO domain
	2: query with subscription	• enabling of monitoring of NFV-S changes	• none identified	
J: NFV-MANO service authorization	1: direct authorization	• none identified	• every interaction needs authorization	• solution 1 relies on requester's identity, what might need verification mechanisms • solution 2 relies on tokens, what is aligned with standard recommended mechanisms
	2: indirect authorization	• less interactions needed	• none identified	
N: SBA migration	1: migration without NFV-MANO service interruption	• no need for mitigation strategy for NFV-MANO system operation continuity • no need for mitigation strategy of operation continuity of network services and NFVI resources managed by NFV-MANO system • NFV-MANO system verification after each migration step is possible	• migration logic design is necessary • migration strategy can be complex and time consuming, if is not automated	
	2: migration with NFV-MANO service interruption	• simplified migration process	• possible interruption of operation of network services and NFVI resources managed by NFV-MANO system	

Key issue	Solution	Pros	Cons	Analysis and comments
O: SBA coexistence	1: interworking gateway	• enables interactions between SBA NFV-MANO and non-SBA NFV-MANO systems • no or less interfaces between SBA NFV-MANO and non-SBA NFV-MANO system are needed	• need for additional interface • need to deploy and manage the interworking gateway	
	2: direct interaction	• no need for additional functionalities	• applies only for certain SBA NFV-MANO transformation targets	

The service-based architecture introduces flexible consumption of NFV-Ss, which become consumer agnostic (key issue 1) and enables decoupling between NFV-Ss, so NFV-Ps can offer various sets of NFV-Ss (key issue 2). Possible consumption of NFV-Ss is not limited by reference points between NFV-Ps and NFV-Cs.

NFV-Ss can be defined in various manners regarding scope of the NFV-S including consideration of categories of consumers (key issue 1), services generalization (key issue A) or services granularity (key issue E).

In order to enable consumption by NFV-Cs of NFV-Ss offered by NFV-Ps, the service based architecture provides several dedicated capabilities. Registration of NFV-Ss (key issue F) enables NFV-Ps to make their services discoverable for NFV-Cs. To support this functionality SBA introduces NFV-S Registry Service. Exposure of NFV-Ss by NVF-Ps (key issue D) makes the NFV-Ss accessible for use by NFV-Cs. NFV-Cs can discover the NFV-S and the NFV-P, who offers the NFV-S, (key issue B), then can select the NFV-P and the NFV-S it offers (key issue G and E), and finally route the service request to the selected NFV-P (key issue G). NFV-Cs can also query information about discovered NFV-Ss (key issue I). Those capabilities are common for NFV-Ps or NFV-Cs, and are provided by SBA as common services for relevant entities.

The capability to enable communication between entities in SBA to make use of NFV-Ss (key issue H) is common for all entities.

The capability to provide in SBA a shared storage (key issue C), which can be used by NFV-Ps to store data related to NFV-Ss, is common for all NFV-Ps.

In SBA the interactions between entities are not restricted by existing reference points. Therefore the aspects of authorization of interacting entities and their interactions (key issue J) and secure exchange of information between entities (key issues K, L, M) become even more critical; such aspects are provided by common services dxedicated to authorization and security. Due to critical role of security for enabling interactions in SBA, the solutions considered for key issues K, L and M are based on existing standards.

For key issues, which have identified only one solution i.e. 1, 2, A, C, D, E, K, L and M, SBA NFV-MANO architecture is expected to support the provided solution in order to resolve a particular key issue.

For key issues, which have identified more than one solution i.e. B, F, G, H, I and J, SBA NFV-MANO architecture is expected to support at least one (up to all) of the solutions in order to resolve a particular key issue.

Key issues N and O are related to the process of migration of NFV-MANO system towards SBA and potential coexistence of different NFV-MANO systems within the administrative domain of the operator. The migration process is expected to be designed specifically to cover the strategy of the operator and managed by the operator until the migration to the SBA NFV-MANO target is completed.

7.3   NFV Services

7.3.1   NFV Services Set#1

This NFV-Ss set includes the services offered by NFV-Ps.

NOTE 1: The services include subscription management, where applicable.

General functional services are:

g.1. NSD Management

g.2. NS Lifecycle Management

g.3. NS Performance Management

g.4. NS Fault Management

g.5. VNF Package Management

g.6. VNF Lifecycle Operation Granting

g.7. NS Instance Usage Notification

g.8. NS LCM Granting

g.9. VNF Lifecycle Management

g.10. VNF Performance Management

g.11. VNF Fault Management

g.12. VNF Indicator (exposed by the VNFM)

g.13. VNF Snapshot Package Management

g.14. VNF Configuration

g.15. NFV-MANO Policy Management

g.16. NFVI Capacity Information Management

g.17. NFV-MANO Intent Management

g.18. NFV-MANO Management Data Analytics

NFV-Cs (i.e. VNF, EM or OSS/BSS) of NFV-MANO services are expected to expose following services:

c.1. VNF LCM Coordination

c.2. NS LCM Coordination

c.3. VNF Indicator (exposed by the EM and/or the VNF)

Management NFV-Ss for NFV-MANO:

m.1. NFV-MANO Configuration and Information Management

m.2. NFV-MANO Performance Management

m.3. NFV-MANO Fault Management

m.4. NFV-MANO Logging Management

NOTE 2: m.1 to m.4 services are related to NFV-MANO management.

Multi-Site Connectivity Services (MSCS):

>
> msc.1. MSCS Management
>
> msc.2. MSCS Performance management
>
> msc.3. MSCS Fault management
>
> msc.4. WAN Capacity Management

NFV-Ss specific to virtualisation technologies:

VIM based resource management services:

>
> vm.1. Virtualised Resources Management

NOTE 3: Virtualised Resources Management is assumed to include the functionality of: resources management, information management and capacity management

>
> vm.2. Virtualised Resources Change Notification: for compute, network, and storage
>
> vm.3. Virtualised Compute Flavour Management
>
> vm.4. Network Forwarding Path Management
>
> vm.5. Virtualised Resources Performance Management
>
> vm.6. Virtualised Resources Fault Management
>
> vm.7. Virtualised Resource Reservation: for compute, network, and storage

NOTE 4: Virtualised Resources Reservation Management is assumed to include the functionality of: virtualised resource reservation changes.

>
> vm.8. Virtualised Resources Quota Management: for compute, network, and storage

NOTE 5: Virtualised Resources Quota Management is assumed to include the functionality of: virtualised resource quota changes.

>
> vm.9. Virtualised Resources Quota Available Notification
>
> vm.10. Compute Host Reservation Management
>
> vm.11. Compute Host Capacity Management

Containers Infrastructure Service Management (CISM) and cluster management services exposed by CISM:

>
> cism.1. OS container workload management
>
> cism.2. OS container compute management
>
> cism.3. OS container storage management
>
> cism.4. OS container network management
>
> cism.5. OS container configuration management
>
> cism.6. CIS instance management
>
> cism.7. CIS MCCO management

OS Container Image Registry (CIR) service:

>
> cir.1. OS container image management

Container Sluster Management (CCM) services:

    ccm.1. CIS cluster lifecycle management

    ccm.2. CIS cluster fault management

    ccm.3. CIS cluster configuration management

    ccm.4. CIS cluster performance management

    ccm.5. CIS cluster security management

7.3.2   NFV Services Set#2

This alternative design for the NFV-Ss set covers services offered by NFV-MANO based on the Release 4 functionality and takes a step forward by consolidating some of the NFV-S services that have common scoping.

    NOTE 1: The services include subscription management, where applicable.

Generalized functional services:

    g.1. Descriptor management:

        -    NSD, VNFD, PNFD management

    g.2. Onboarding (SW packages, models, archives):

        -    Onboarding of VNF package, NSD archive, PNFD archive

    g.3. Performance and event reporting:

        -    PM reporting for NS, VNF and VRs

    NOTE 2: The VRs do not include resources based on OS containers.

    g.4. Fault Management:

        -    FM reporting for NS, VNF and VRs

    NOTE 3: The VRs do not include resources based on OS containers.

    g.5. Policy Management

NFV-MANO specialized services:

    sp.1. NS Instance Usage Notification

    sp.2. NS LCM Granting

    sp.3. VNF Lifecycle Management

    sp.4. VNF Lifecycle Operation Granting

    sp.5. VNF Indicator (exposed by the VNFM)

    sp.6. VNF Snapshot Package Management

    sp.7. VNF Configuration

    sp.8. NS LCM

    sp.9. VNF Package Management Information

    NOTE 4: The VNF Package Management Information service does not include create info, upload, update info and delete VNF Package operations, which are in scope of g.2 Onboarding service.

    sp.10. NFVI Capacity Information Management

sp.11. NFV-MANO Intent Management

sp.12. NFV-MANO Management Data Analytics

NFV-Cs (i.e. VNF, EM or OSS/BSS) of NFV-MANO services are expected to expose following services:

c.1. VNF LCM Coordination

c.2. NS LCM Coordination

c.3. VNF Indicator (exposed by the EM and/or the VNF)

Multi-Site Connectivity Services (MSCS):

msc.1. MSCS Management

msc.2. MSCS Performance management

msc.3. MSCS Fault management

msc.4. WAN Capacity Management

Management NFV-Ss for NFV-MANO entities:

m.1. NFV-MANO Configuration and Information Management

m.2. NFV-MANO Performance Management

m.3. NFV-MANO Fault Management

m.4. NFV-MANO Logging Management

NOTE 5: m.1 to m.4 services are related to NFV-MANO management.

NFV-Ss specific to virtualisation technologies:

VM based resource management services

vm.1. Virtualised Resources Management

NOTE 6: Virtualised Resources Management is assumed to include the functionality of: resources management, information management and capacity management

vm.2. Virtualised Resources Change Notification: for compute, network, and storage

vm.3. Virtualised Compute Flavour Management

vm.4. Network Forwarding Path Management

vm.5. Virtualised Resource Reservation: for compute, network, and storage

NOTE 7: Virtualised Resources Reservation Management is assumed to include the functionality of: virtualised resource reservation changes.

vm.6. Virtualised Resources Quota Management: for compute, network, and storage

NOTE 8: Virtualised Resources Quota Management is assumed to include the functionality of: virtualised resource quota changes.

vm.7. Virtualised Resources Quota Available Notification

vm.8. Compute Host Reservation Management

vm.9. Compute Host Capacity Management

Containers Infrastructure Service Management (CISM) and cluster management services exposed by CISM:

    cism.1. OS container workload management

    cism.2. OS container compute management

    cism.3. OS container storage management

    cism.4. OS container network management

    cism.5. OS container configuration management

    cism.6. CIS instance management

    cism.7. CIS MCCO management

OS Container Image Registry (CIR) service:

    cir.1. OS container image management

Container Cluster Management (CCM) services:

    ccm.1. CIS cluster lifecycle management

    ccm.2. CIS cluster fault management

    ccm.3. CIS cluster configuration management

    ccm.4. CIS cluster performance management

    ccm.5. CIS cluster security management

7.3.3   NFV Services Set#3

This NFV-Ss set covers services offered by NFV-MANO based on the Release 4 functionality and takes an evolutionary step forward by introducing a level of abstraction, that can also use when applicable, intents as a model for the information exchange over the service-based interfaces.

NOTE 1: The services include subscription management, where applicable.

Generalized functional services:

    g.1. Descriptor, model management:

       -    NSD, VNFD, PNFD management

       -    Knowledge objects management

          ▪   Intent models

             -    The service offers the management operations on the intent objects, such as described in ETSI GR NFV-IFA 041 [i.19] (e.g. create, query, delete, subscribe/notify, etc.)

          ▪   ML models

             -    Management of the ML models, following a CRUD approach, to support the services provided by MDA: the data analysis

    g.2. Onboarding (SW packages, models, archives, etc.):

       -    Onboarding of VNF package, NSD archive, PNFD archive

    g.3. Performance and event reporting:

       -    PM reporting for NS, VNF, VRs, MSCSs and NFV-MANO entities

NOTE 2: The VRs do not include resources based on OS containers.

g.4. Fault Management:

- FM reporting for NS, VNF, VRs, MSCSs and NFV-MANO entities

NOTE 3: The VRs do not include resources based on OS containers.

g.5. Policy Management

g.6. Intent Handling (generic service for intents):

- The Intent handling service which provides the general support for intents providing access to common intent handling functions, such as:

  ▪ authentication and authorization of intent requests

  ▪ parsing, validating the intent requests and the intent object present in the request

  ▪ providing the main intent management operations and processing the intent requests to determine which domain specific intent handler is responsible to process the intent object present in the request (e.g. NS intent handler)

  ▪ receiving fulfilment information from a domain specific intent handler (e.g. NS intent handler), and formatting it into the general intent fulfilment report and send it to the intent consumer,

  ▪ interactions with intelligent functions that support processing of intents e.g. a knowledge base, an MDA service or function, etc.

NOTE 4: The Intent Handling service is not specific to NFV-MANO but is a generic service, offered also to various domain specific intent management services outside of NFV-MANO scope.

NFV-Cs of NFV-Ss are expected to expose following services:

c.1. LCM Coordination

c.2 Indicator:

- Providing notifications related to VNF indicator value change, query VNF indicator values

NFV-MANO specialized services:

sp.1. NS Instance Usage Notification

sp.2. NS LCM Granting

sp.3. NS LCM

sp.4.VNF Lifecycle Management

sp.5. VNF Lifecycle Operation Granting

sp.6. VNF Snapshot Package Management

sp.7. VNF Configuration

sp.8. NS intent handling:

- NFV-MANO domain specific intent handling, specialized in the intent handling for NS

sp.9. VNF Package Management Information

NOTE 5: The VNF Package Management Information service does not include create info, upload, update info and delete VNF Package operations, which are in scope of g.2 Onboarding service.

sp.10. NFVI Capacity Information Management

sp.11. NFV-MANO Management Data Analytics (MDA)

Multi-Site Connectivity Services (MSCS):

    msc.1. MSCS Management

    msc.2. WAN Capacity Management

Management NFV-Ss for NFV-MANO entities:

    m.1. NFV-MANO Configuration and Information Management

    m.2. NFV-MANO Logging Management

    NOTE 6: m.1 to m.2 services are related to NFV-MANO management.

NFV-Ss specific to virtualisation technologies:

    VM based resource management services:

        vm.1. Virtualised Resources Management

    NOTE 7: Virtualised Resources Management is assumed to include the functionality of: resources management, information management and capacity management.

        vm.2. Virtualised Resources Change Notification: for compute, network, and storage

        vm.3. Virtualised Compute Flavour Management

        vm.4. Network Forwarding Path Management

        vm.5. Virtualised Resource Reservation: for compute, network, and storage

    NOTE 8: Virtualised Resources Reservation Management is assumed to include the functionality of: virtualised resource reservation changes.

        vm.6. Virtualised Resources Quota Management: for compute, network, and storage

    NOTE 9: Virtualised Resources Quota Management is assumed to include the functionality of: virtualised resource quota changes.

        vm.7. Virtualised Resources Quota Available Notification

        vm.8. Compute Host Reservation Management

        vm.9. Compute Host Capacity Management

    Containers Infrastructure Service Management (CISM) services:

        cism.1. OS container workload management

        cism.2. OS container compute management

        cism.3. OS container storage management

        cism.4. OS container network management

        cism.5. OS container configuration management

        cism.6. CIS instance management

        cism.7. CIS MCCO management

    OS Container Image Registry (CIR) and cluster management service exposed by CISM:

        cir.1. OS container image management

Container Cluster Management (CCM) services:

ccm.1. CIS cluster lifecycle management

ccm.2. CIS cluster fault management

ccm.3. CIS cluster configuration management

ccm.4. CIS cluster performance management

ccm.5. CIS cluster security management

7.3.4   NFV-MANO SBA Common Services

7.3.4.1   Overview

The service-based architecture offers common services that can be used regardless of the design of the NFV-Ss. Common services are intended to resolve some of key issues identified in clause 7.2.2.

An example of common functions providing common services in a service-based management architecture is the integration fabric (domain, or cross-domain) defined in the ETSI GS ZSM 002 [i.23].

The entities in NFV-MANO SBA can use one or more common services, such as:

- NFV-S registration and discovery:

    - Services of registration of NFV-Ss by authorized NFV-Ps (key issue F) and their discovery by authorized NFV-Cs (key issue B).

- Selection among several instances of NFV-S offered by one NFV-P or among various NFV-Ps, which offer the same NFV-S (key issue G).

- Authorization of access to the services exposed by the SBA NFV-MANO domain (key issue J).

- Exposure of services beyond SBA NFV-MANO domain boundaries (key issue D).

- Communication between NFV-Ps, NFV-Cs, NFV-S Registries and discovery functions (key issue H).

- Securing the communication between entities in SBA NFV-MANO domain and the data exchanged (key issues K, L and M).

7.3.4.2   NFV-MANO service registration

An NFV-P offering services would need to make sure that its NFV-Ss are visible to NFV-Cs. Therefore, an offered NFV-S is registered in an NFV-S Registry Service. The NFV-S Registry Service would manage and expose the following information:

- List of all NFV-Ss offered.

- List of the NFV-SI operations available to NFV-C for the NFV-S.

- List of NFV-Ps and the NFV-Ss offered by each NFV-P.

- Individual information for each NFV-S offered. This includes information provided as the example in table 7.3.4.2-1.

Table 7.3.4.2-1: Example of information in the NFV-MANO service registry

	Information available in the registry	Level of exposure	
		NFV-MANO internal consumers	External consumers
NFV-P information	Addressing, geo-location, availability, policies, load level, regulatory constraints, levels of security supported, information on the VR resources it can use (e.g. geo-locations, capabilities), etc.	Based on authorization level	Based on their authorization level, external consumers might have access to only partial, or to full information
NFV-S information	Information Models (possibly also data models) applicable for the NFV-S.	Based on authorization level	Based on authorization level
Available instances for this NFV-S (see note).	Inventory of the existing runtime instances (NSI, VNFI, VNFCI) for which the NFV-S is applicable.	Based on authorization level	Based on authorization level
NOTE: This is valid for cases where instance sharing is allowed at the instance level for the NFV-S.			

7.3.4.3   NFV-MANO service discovery

Several factors impact the service discovery approach offered to an NFV-C in NFV-MANO SBA, such as:

- the level of discoverability intended for the NFV-Ss (e.g. controlled via service provider policies);

- the discoverability authorization level set for the NFV-C;

- the architectural option used for the service discovery solution (e.g. with or without a proxy, with or without delegation).

The key issue B is addressed by the introduction of the NFV-MANO service discovery as a common service.

7.3.4.4   NFV-MANO service authorization

According to key issue J, it is expected that NFV-Ss are exposed by authorized NFV-Ps, and that these NFV-Ss are accessed by authorized NFV-Cs. The authorization service is responsible to perform the authorization for both NFV-Cs and NFV-Ps.

An authorization service based on solution 1 of key issue J, i.e. direct authorization, would offer the access authorization based on a local operator's policy, which can be applied at two levels:

- At the service discoverability stage (indicated in clause 7.3.4.3), authorization of the authenticated consumers is performed in order to allow them to discover the expected service(s):

  - This policy can be based on the expected service(s), the profile and policies set for the consumers and potentially other contexts.

- At the NFV-Ps exposing the discovered service(s).

An authorization service based on solution 2 of key issue J, i.e. indirect authorization, uses a token-based authorization framework. Using the example of the OAuth2.0 framework as specified in IETF RFC 6749 [i.32], the mapping with the OAuth2.0 roles can consider:

- a common service, such as the discovery service, with the role of "Authorization Server" issuing the access tokens;

- the NFV-Ps exposing the services as "Resource servers";

- NFV-Cs as "Clients".

An access token includes "scopes" for the allowed services, or to authorize specific service operations and/or resources/data.

NOTE: ETSI GS NFV-SEC 022 [i.18] describes mechanisms to mitigate the risk of access token stealing and how to enable strong authentication of the consumers.

7.3.4.5   NFV-MANO service exposure

The NFV-MANO service exposure was identified as key issue D.The NFV-Ss are offered by their NFV-Ps via the NFV SIs of each NFV-S. The NFV-S exposure to 3rd parties depends in most cases on the business agreements made by the service providers with each 3rd party, which impose certain requirements on a service exposure function.

Traditionally, these requirements are addressed by:

- an authorized access for 3rd parties to the service provider's service exposure function (e.g. a service exposure gateway);

- re-exposure of the NFV-Ss based on the specific business agreements with the 3rd parties (e.g. via tailored SDKs, application of policies); and

- additional services provided by a service exposure function, ranging from a few necessary common services for all 3rd parties (e.g. authentication, authorization), to a more complex framework, with a standard architecture, supporting advanced features like:

  - common services like logging, charging, provisioning;

  - 3rd party onboarding/offboarding of NFV-Ss;

  - registration/de-registration and discovery of APIs;

  - enabling sharing of exposed NFV-Ss with partner API providers;

  - interconnection between API providers;

  - federation functions for distributed API environments, etc.

An example of such standard service exposure architecture can be found in ETSI TS 123 222 [i.24] CAPIF architecture.

7.3.4.6   NFV-MANO communication service

The NFV-MANO communication service enables the communication between NFV-Ps, NFV-Cs, NFV-S Registries and other entities like the registration agents and it can be used with any combination of NFV-Ps and NFV-Ss offered.

The key issue H is addressed by the introduction of the NFV-MANO communication service as a common service.

There are several possible variants to realize the NFV-MANO communication service, from a basic IP routing solution, to more complex application layer proxies.

The NFV-MANO communication service provides message forwarding and routing functionality possibly augmented with features such as:

- load balancing;

- overload control;

- event subscription/publication/notification management, where the NFV-MANO communication service manages the subscriptions from NFV-Ps, NFV-Cs and NFV-S Registries to receive specific events, the publication of events by NFV-Ps, NFV-Cs and NFV-S Registries, and the transport of the events notifications to the subscribers upon event publication; and

- management traffic monitoring.

7.3.4.7   NFV-MANO service security

The NFV-MANO service security ensures that NFV-Cs and NFV-Ps communicate over secure channels, with end-point authentication, confidentiality and integrity of the exchanged data. The NFV-MANO service security provides a solution for each of the SBA security key issues K, L and M.

The NFV-MANO service security:

- Involves using NFV-MANO certificate over TLS. However, such NFV-MANO certificate profile(s) are expected to be defined as proposed in the solution 1 for key issue K, where the resulting attribute values for the certificate fields based on the clause 6.1.3c of ETSI TS 133 310 [i.26] (3GPP Release 16 or later) and any potential extensions are determined for NFV-MANO.

- Is expected to follow certificate verification policies, validating the identities that are bound to the subject of the certificate.

- Uses HTTPS over mutually authenticated TLS, where it uses the identities in the NFV-Cs and NFV-Ps' certificates for authentication and policy checks.

Various provisions from the risk analysis conducted on the NFV-MANO in ETSI GS NFV-SEC 014 [i.17] can be reused in terms of identifying the assets to protect, threats and mitigations.

The NFV-MANO service security has a holistic responsibility for the security of NFV-Ss, related to:

- The authentication and authorization framework:

  - If token-based authorization is used, then mechanisms to protect tokens (e.g. secure communications with TLS) are needed.

- Trust domain separation:

  - If NFV-MANO common services are intended to be separated from other services, then they would rely on their own PKI separated from PKIs of other services; this is due to the certificate partial chain verification deficiency in many current open-source TLS implementations.

- Access and usage control:

  - Prevention alongside continuous monitoring and reaction controls are expected.

- The certificate profile defined for NFV-MANO common services:

  - Although the solution 1 for key issue K reuses the TLS certificate profile of the 3GPP 5GC, for the NFV-Cs and NFV-Ps, the common services could apply a stricter definition of the SBA certificate profile. Whether a stricter definition is used for common services or not, it is subject to the certificate policy, as indicated in ETSI GR NFV-SEC 005 [i.16].

7.3.4.8   NFV-MANO service selection

In SBA NFV-MANO the same NFV-S can be offered by several NFV-Ps. In addition an NFV-P can offer several instances of the same NFV-S. Criteria to be considered for selection of the most suitable NFV-S for an NFV-C include:

- the service provider policies for particular NFV-C;

- the constraints related to NFV-S selection for the NFV-C e.g. regulatory, security, performance;

- the constraints related to selection of an NFV-P by the NFV-C e.g. geolocation, traffic load.

The key issue G is addressed by the introduction of the NFV-MANO service selection as a common service.

7.4   SBA transformation alternatives

7.4.1   Overview

The evolution of the NFV-MANO architecture and interfaces, towards a service-based approach results in different alternatives to achieve service based architecture. Possible alternatives are referred in this clause as SBA transformation targets and are described in the remaining subclauses of this clause.

This clause identifies, describes and evaluates possible SBA transformation targets. For each transformation target, the description includes the list of common services described in clause 7.3.4 and key issues identified in clause 7.2.2 (if not resolved by any common service) that the transformation target addresses.

The first step in service-based design is the identification of the services offered by the NFV-MANO. After the NFV-Ss have been identified, an analysis of the possible options available to offer them via NFV-SIs is provided.

7.4.2   Common services applicability to SBA transformation targets

The support of the SBA NFV-MANO common services is independent of the selected NFV-S sets described in clause 7.3. The SBA transformation targets can incorporate one or more of the common services described in clause 7.3.4.

When supporting the SBA NFV-MANO common services, the SBA transformation targets also address the corresponding key issues described in clause 7.2.2:

- By supporting the common service "NFV-MANO service registration" described in clause 7.3.4.2., the SBA transformation target addresses:

  - Key issue F: "NFV-S registration" described in clause 7.2.2.7.

- By supporting the common service "NFV-MANO service discovery" described in clause 7.3.4.3., the SBA transformation target addresses:

  - Key issue B: "NFV-S discovery and NFV-S request routeing" described in clause 7.2.2.3.

  - Key issue E: "Service granularity" described in clause 7.2.2.6.

- By supporting the common service "NFV-MANO service selection" described in clause 7.3.4.8., the SBA transformation target addresses:

  - Key issue G: "NFV-S selection" described in clause 7.2.2.8.

- By supporting the common service "NFV-MANO service exposure" described in clause 7.3.4.5., the SBA transformation target addresses:

  - Key issue D: "Service exposure" described in clause 7.2.2.5.

Some of the SBA NFV-MANO common services are essential services which are expected to be supported by all SBA transformation targets. These are:

- The NFV-MANO communication service described in clause 7.3.4.6, which supports the communication between the NFV-Ps, NFV-Cs and NFV-S Registry Services:

  - It addresses the key issue H: "Communication services" described in clause 7.2.2.9.

- The NFV-MANO service authorization described in clause 7.3.4.4 and NFV-MANO service security described in clause 7.3.4.7, which help the NFV-Ps and NFV-Cs get authenticated by each other and secures that only authorized access is allowed to the NFV-Ss and the NFV registries. Other aspects of security like installation and use of certificates, configuration of security framework, etc. are also included:

  - It addresses the key issue J: "NFV-MANO service authorization" described in clause 7.2.2.11.

  - It addresses the key issue K: "TLS certificate profile" described in clause 7.2.2.12.

  - It addresses the key issue L: "Certificate validation policies" described in clause 7.2.2.13.

-        It addresses the key issue M: "TLS profiles support" described in clause 7.2.2.14.

Key issues that can be addressed by any of the SBA transformation targets, independently of the NFV-S set or of the supported common services are the key issue C: "Dataless and stateless services" described in clause 7.2.2.4 and key issue I: "Service querying" described in clause 7.2.2.10.

Key issues that are related to aspects of NFV-MANO architecture i.e. key issue N: "SBA migration" described in clause 7.2.2.15 and key issue O: "SBA coexistence" described in clause 7.2.2.16 are expected to be supported by all SBA transformation targets.

7.4.3   SBA Target#1: Minimal Service-based evolution

7.4.3.1   Overview

This transformation target bases the NFV-Ss definition on the existing NFV-MANO interface design. The NFV-SIs offering the NFV-Ss undergo a transformation to eliminate the grouping of interfaces specification based on reference-points. Specifically, this transformation target has the following properties:

•   It implicitly eliminates the need to duplicate specifications of the same NFV-MANO interfaces for each NFV-C and facilitates consistency of the NFV-MANO interfaces.

•   It does not make any optimizations, nor leverages on the commonalities between the NFV-Ss, or the NFV-SIs that offer them.

•   It does not make any changes to the functional assignment of NFV-MANO functionality to the existing NFV-MANO FBs.

This transformation target addresses the following key issues described in clause 7.2:

•   Key issue 1: "Consumer agnostic NFV-Ss" described in clause 7.2.1.2.

This transformation target can incorporate one or more of the common services described in clause 7.3.4 and hence address their respective key issues.

7.4.3.2   NFV Services for target#1

7.4.3.2.1   NFV-MANO Services for target#1

Current NFV-MANO reference points are structured as a set of different interfaces focused on specific sets of functionalities. This transformation target reuses the structural definition of the NFV Release 4 reference points and eliminates the specification duplication of NFV-SIs definitions over the different reference points.

The NFV-Ss used in the SBA transformation target#1 are the service set#1 described in clause 7.2.1.

The services offered per NFV-P (e.g. NFV-MANO FB, VNF, EM, OSS, WIM) are described in remaining clauses.

NOTE: The services include subscription management, where applicable.

7.4.3.2.2   NFV-Ss offered by the NFVO

The NFV-Ss offered by the NFVO as NFV-P are:

g.1. NSD Management

g.2. NS Lifecycle Management

g.3. NS Performance Management

g.4. NS Fault Management

g.5. VNF Package Management

g.6. VNF Lifecycle Operation Granting

g.7. NS Instance Usage Notification

g.8. NS LCM Granting

g.9. Virtualised Resources Quota Available Notification

g.10. Virtualised Resources Management in indirect mode

g.13. VNF Snapshot Package Management

g.16. NFVI Capacity Information Management

7.4.3.2.3   NFV-Ss offered by the VNFM

The NFV-Ss offered by the VNFM as NFV-P are:

g.9. VNF Lifecycle Management

g.10. VNF Performance Management

g.11. VNF Fault Management

g.12. VNF Indicator

7.4.3.2.4   NFV-Ss offered by the VIM

The NFV-Ss offered by the VIM as NFV-P are:

vm.1. Virtualised Resources Management:

NOTE 1: Virtualised Resources Management is assumed to include the functionality of: resources management, information management and capacity management.

vm.2. Virtualised Resources Change Notification: for compute, network, and storage

vm.2. Virtualised Compute Flavour Management

vm.3. Network Forwarding Path Management

vm.5. Virtualised Resources Performance Management

vm.6. Virtualised Resources Fault Management

vm.7. Virtualised Resource Reservation: for compute, network, and storage

NOTE 2: Virtualised Resources Reservation Management is assumed to include the functionality of: virtualised resource reservation changes.

vm.8. Virtualised Resources Quota Management: for compute, network, and storage

NOTE 3: Virtualised Resources Quota Management is assumed to include the functionality of: virtualised resource quota changes.

vm.9. Virtualised Resources Quota Available Notification

vm.10. Compute Host Reservation Management

vm.11. Compute Host Capacity Management

7.4.3.2.5   NFV-Ss offered by the CISM

The NFV-Ss offered by the CISM as NFV-P are:

cism.1. OS container workload management

cism.2. OS container compute management

cism.3. OS container storage management

cism.4. OS container network management

cism.5. OS container configuration management

cism.6. CIS instance management

cism.7. CIS MCCO management

7.4.3.2.6   NFV-Ss offered by the CIR

The NFV-Ss offered by the CIR as NFV-P are:

cir.1. OS container image management

7.4.3.2.7   NFV-Ss offered by the CCM

The NFV-Ss offered by the CCM as NFV-P are:

ccm.1. CIS cluster lifecycle management

ccm.2. CIS cluster fault management

ccm.3. CIS cluster configuration management

ccm.4. CIS cluster performance management

ccm.5. CIS cluster security management

7.4.3.2.8   NFV-Ss offered by the VNF

The NFV-Ss offered by the VNF as NFV-P are:

g.12. VNF Indicator

g.14. VNF Configuration

c.1. VNF LCM Coordination

7.4.3.2.9   NFV-Ss offered by the EM

The NFV-Ss offered by the EM as NFV-P are:

g.12. VNF Indicator

c.1. VNF LCM Coordination

7.4.3.2.10   NFV-Ss offered by the OSS

The NFV-Ss offered by the OSS as NFV-P are:

c.2. NS LCM Coordination

7.4.3.2.11   NFV-Ss offered by the WIM

The NFV-Ss offered by the WIM as NFV-P are:

msc.1. MSCS Management

msc.2. MSCS Performance management

msc.3. MSCS Fault management

msc.4. WAN Capacity Management

7.4.3.2.12   Management NFV-Ss for NFV-MANO

The NFV-Ss offered by the NFV-MANO FBs as NFV-Ps are:

   m.1. NFV-MANO Configuration and Information Management

   m.2. NFV-MANO Performance Management

   m.3. NFV-MANO Fault Management

   m.4. NFV-MANO Logging Management

7.4.3.2.13   Other management NFV-Ss

The NFV-Ss offered by the NFV-MANO FBs as NFV-Ps are:

   g.15. NFV-MANO Policy Management

   g.17. NFV-MANO Intent Management

   g.18. NFV-MANO Management Data Analytics (MDA)

   NOTE: NFV-MANO Intent Management and NFV-MANO Management Data Analytics (MDA) services can be
             offered by the NFVO or by separate FBs as described in ETSI GR NFV-IFA 041 [i.13].

7.4.4   SBA Target#2: Service-Based Interfaces (SBI) Consolidation

7.4.4.1   Overview

This transformation target does not define any change to the functional assignment of NFV-MANO functionality to the existing NFV-MANO FBs, but introduces a generalization for some of the services which operate on different types of NFV-MANO objects (e.g. both NFVO and VNFM can expose the "Fault Management Service" but NFVO on NS instances and VNFM on VNF instances).

This transformation target addresses the following key issues described in clause 7.2:

   •   key issue 1 "Consumer agnostic NFV-Ss" as described in clause 7.2.1.2;

   •   key issue A "Services generalization" as described in clause 7.2.2.2.

This transformation target can incorporate one or more of the common services described in clause 7.3.4 and hence address their respective key issues.

7.4.4.2   NFV Services for target#2

7.4.4.2.1   NFV-MANO Services for target#2

This transformation target reuses the structural definition of the NFV Release 4 reference points and eliminates the specification duplication of NFV-Ss interfaces over the different reference points.

The NFV-Ss used in the SBA transformation target#2 are listed based on the service set#2 described in clause 7.3.2.

The services offered per NFV-P (e.g. NFV-MANO FB, VNF, EM, OSS, WIM) are listed in remaining clauses.

   NOTE: The services include subscription management, where applicable.

7.4.4.2.2   NFV-Ss offered by the NFVO

The NFV-Ss offered by the NFVO as NFV-P are:

   g.1. Descriptor Management (on NSD, VNFD, PNFD)

   g.2. Onboarding (on VNF packages, models, NSD archives, PNFD archives)

sp.8. NS LCM

g.3. Performance and event reporting (on NS)

g.4. Fault Management (on NS)

sp.9. VNF Package Management Information

sp.4. VNF Lifecycle Operation Granting

sp.6. VNF Snapshot Package Management

sp.1. NS Instance Usage Notification

sp.2. NS LCM Granting

vm.7. Virtualised Resources Quota Available Notification

sp.10. NFVI Capacity Information Management

7.4.4.2.3   NFV-Ss offered by the VNFM

The NFV-Ss offered by the VNFM as NFV-P are:

sp.3. VNF Lifecycle Management

g.3. Performance and event reporting (on VNF)

g.4. Fault Management (on VNF)

sp.5. VNF Indicator

7.4.4.2.4   NFV-Ss offered by the VIM

The NFV-Ss offered by the VIM as NFV-P are:

vm.1. Virtualised Resources Management:

NOTE 1: Virtualised Resources Management is assumed to include the functionality of: resources management, information management and capacity management.

vm.2. Virtualised Resources Change Notification: for compute, network, and storage

vm.3. Virtualised Compute Flavour Management

vm.4. Network Forwarding Path Management

g.3. Performance and event reporting (on VRs)

g.4. Fault Management (on VRs)

vm.5. Virtualised Resource Reservation: for compute, network, and storage

NOTE 2: Virtualised Resources Reservation Management is assumed to include the functionality of: virtualised resource reservation changes.

vm.6. Virtualised Resources Quota Management: for compute, network, and storage

NOTE 3: Virtualised Resources Quota Management is assumed to include the functionality of: virtualised resource quota changes.

vm.8. Compute Host Reservation Management

vm.9. Compute Host Capacity Management

7.4.4.2.5   NFV-Ss offered by the CISM

The NFV-Ss offered by the CISM as NFV-P are:

cism.1. OS container workload management

cism.2. OS container compute management

cism.3. OS container storage management

cism.4. OS container network management

cism.5. OS container configuration management

cism.6. CIS instance management

cism.7. CIS MCCO management

7.4.4.2.6   NFV-Ss offered by the CIR

The NFV-Ss offered by the CIR as NFV-P are:

cir.1. OS container image management

7.4.4.2.7   NFV-Ss offered by the CCM

The NFV-Ss offered by the CCM as NFV-P are:

ccm.1. CIS cluster lifecycle management

ccm.2. CIS cluster fault management

ccm.3. CIS cluster configuration management

ccm.4. CIS cluster performance management

ccm.5. CIS cluster security management

7.4.4.2.8   NFV-Ss offered by the VNF

The NFV-Ss offered by the VNF as NFV-P are:

sp.5. VNF Indicator

sp.7. VNF Configuration

c.1. VNF LCM Coordination

7.4.4.2.9   NFV-Ss offered by the EM

The NFV-Ss offered by the EM as NFV-P are:

sp.5. VNF Indicator

c.1. VNF LCM Coordination

7.4.4.2.10   NFV-Ss offered by the OSS

The NFV-Ss offered by the OSS as NFV-P are:

c.2. NS LCM Coordination

7.4.4.2.11   NFV-Ss offered by the WIM

The NFV-Ss offered by the WIM as NFV-P are:

   msc.1. MSCS Management

   msc.2. MSCS Performance management

   msc.3. MSCS Fault management

   msc.4. WAN Capacity Management

7.4.4.2.12   Management NFV-Ss for NFV-MANO

The NFV-Ss offered by the NFV-MANO FBs as NFV-Ps are:

   m.1. NFV-MANO Configuration and Information Management

   m.2. NFV-MANO Performance Management

   m.3. NFV-MANO Fault Management

   m.4. NFV-MANO Logging Management

7.4.4.2.13   Other management NFV-Ss

The NFV-Ss offered by the NFV-MANO FBs as NFV-Ps are:

   g.5. Policy Management

   g.17. NFV-MANO Intent Management

   g.18. NFV-MANO Management Data Analytics (MDA)

   NOTE: NFV-MANO Intent Management and NFV-MANO Management Data Analytics (MDA) services can be offered by the NFVO or by separate FBs as described in ETSI GR NFV-IFA 041 [i.13].

7.4.5   SBA Target#3: Full SBA

7.4.5.1   Overview

This transformation target implies the optimization and generalization of the NFV-SIs, but it also relaxes the requirements on the grouping of the NFV-Ss and removes the concept of NFV-MANO FBs from the architecture. Specifically, this transformation target has the following properties:

- The SBA architecture defines the NFV-Ss without mandating anything about their placement.

- Any new NFV-S and its NFV-SI are defined based on the SBA principles defined in clause 6.1.

This transformation target addresses the following key issues described in clause 7.2:

- key issue 1 "Consumer agnostic NFV-Ss" as described in clause 7.2.1.2;

- key issue 2 "Decoupling between NFV-Ss" as described in clause 7.2.1.3;

- key issue A "Services generalization" as described in clause 7.2.2.2.

This transformation target can incorporate one or more of the common services described in clause 7.3.4 and hence address their respective key issues.

7.4.5.2   NFV Services for target#3

7.4.5.2.1   NFV-MANO Services for target#3

For this SBA transformation target NFV-Ss are offered by NFV-Ps with the indication of the NFV-MANO objects or virtualization technologies supported. Depending on the supported NFV-Ss the NFV-P functionality can relate to one or more NFV-MANO objects or virtualization technologies e.g. Fault Management Service can support either only VNF, or only NS, or only MSCS, or only NFV-MANO entities, or VNF and NS, or any other group of NFV-MANO objects.

The NFV-Ss used in the SBA transformation target#3 are listed based on the service set#3 described in clause 7.3.3.

The services offered by NFV-Ps are listed in clause 7.4.5.2.2.

NOTE: The services include subscription management, where applicable.

7.4.5.2.2   NFV-Ss offered by the NFV-Ps

The NFV-Ss offered by the NFV-Ps for NFV-MANO objects are:

   g.1. Descriptor management (on NSD, VNFD, PNFD), model management (on Intent models, ML models)

   g.2. Onboarding (SW packages, models, archives)

   g.3. Performance and event reporting (on NS, VNF, MSCSs and NFV-MANO entities)

   g.4. Fault Management (on NS, VNF, MSCSs and NFV-MANO entities)

   g.5. Policy Management

   g.6. Intent Handling

   g.7. NFV-MANO Management Data Analytics (MDA)

   c.1. LCM Coordination (on NS, VNF)

   sp.1. NS Instance Usage Notification

   sp.2. NS LCM Granting

   sp.3. NS LCM

   sp.4.VNF Lifecycle Management

   sp.5. VNF Lifecycle Operation Granting

   sp.6. VNF Indicator

   sp.7. VNF Snapshot Package Management

   sp.8. VNF Configuration

   sp.9. Network Service intent handling

   sp.10. VNF Package Management Information

   sp.11. NFVI Capacity Information Management

   msc.1. MSCS Management

   msc.2. WAN Capacity Management

   m.1. NFV-MANO Configuration and Information Management

   m.2. NFV-MANO Logging Management

   NOTE 1: m.1 to m.2 services are related to NFV-MANO management and can be produced by an NFV-MANO
             entity, that offers other NFV-Ss.

The NFV-Ss specific to virtualization technologies offered by the NFV-Ps are:

vm.1. Virtualised Resources Management:

NOTE 2: Virtualised Resources Management is assumed to include the functionality of: resources management, information management and capacity management.

vm.2. Virtualised Resources Change Notification: for compute, network, and storage

vm.3. Virtualised Compute Flavour Management

vm.4. Network Forwarding Path Management

g.3. Performance and event reporting (on VRs)

g.4. Fault Management (on VRs)

vm.5. Virtualised Resource Reservation: for compute, network, and storage

NOTE 3: Virtualised Resources Reservation Management is assumed to include the functionality of: virtualised resource reservation changes.

vm.6. Virtualised Resources Quota Management: for compute, network, and storage

NOTE 4: Virtualised Resources Quota Management is assumed to include the functionality of: virtualised resource quota changes.

vm.7. Virtualised Resources Quota Available Notification

vm.8. Compute Host Reservation Management

vm.9. Compute Host Capacity Management

cism.1. OS container workload management

cism.2. OS container compute management

cism.3. OS container storage management

cism.4. OS container network management

cism.5. OS container configuration management

cism.6. CIS instance management

cism.7. CIS MCCO management

cir.1. OS container image management

ccm.1. CIS cluster lifecycle management

ccm.2. CIS cluster fault management

ccm.3. CIS cluster configuration management

ccm.4. CIS cluster performance management

ccm.5. CIS cluster security management

7.4.6   SBA Target#4: SBA without service consolidation

7.4.6.1   Overview

This transformation target bases the NFV-Ss definition on the existing interface design and eliminates the grouping of interfaces based on reference-points, as per SBA Target#1. It also relaxes the requirements on the grouping of the NFV-Ss and removes the concept of standard NFV-MANO FBs from the architecture, as per SBA Target#3. Existing NFV-MANO FBs become examples of how multiple NFV-Ss can be grouped.

Specifically, this transformation target has the following properties:

- It implicitly eliminates the need to duplicate definitions of the same NFV-MANO interfaces for each NFV-C and facilitates consistency of the NFV-MANO interfaces.

- It does not make any optimizations, nor leverages on the commonalities between the NFV-Ss, or the NFV-SIs that offer them.

- It does not make any assumption on the implementation of NFV-Ss in particular on their assignment to a FB.

- Any new NFV-S and its NFV-SI are defined based on the SBA principles defined in clause 6.1.

This transformation target addresses the following key issues described in clause 7.2:

- key issue 1: "Consumer agnostic NFV-Ss" described in clause 7.2.1.2;

- key issue 2: "Decoupling between NFV-Ss" as described in clause 7.2.1.3.

This transformation target can incorporate common services described in clause 7.3.4 and hence address their respective key issues.

7.4.6.2   NFV Services for target#4

7.4.6.2.1   NFV-MANO Services for target#4

Current NFV-MANO reference points are structured in different interfaces focused on specific sets of functionalities. This SBA transformation target reuses the structural definition of the NFV Release 4 reference points and eliminates the duplication of services and interfaces definition.

The NFV-Ss used in the SBA transformation target#4 are the service set#1 described in clause 7.3.1.

The services offered by NFV-Ps are listed in clause 7.4.6.2.2.

NOTE: The services include subscription management, where applicable.

7.4.6.2.2   NFV-Ss offered by the NFV-Ps

The NFV-Ss offered by the NFV-Ps for NFV-MANO objects are:

g.1. NSD Management

g.2. NS Lifecycle Management

g.3. NS Performance Management

g.4. NS Fault Management

g.5. VNF Package Management

g.6. VNF Lifecycle Operation Granting

g.7. NS Instance Usage Notification

g.8. NS LCM Granting

g.9. VNF Lifecycle Management

g.10. VNF Performance Management

g.11. VNF Fault Management

g.12. VNF Indicator

g.13. VNF Snapshot Package Management

g.14. VNF Configuration

g.15. NFV-MANO Policy Management

g.16. NFVI Capacity Information Management

g.17. NFV-MANO Intent Management

g.18. NFV-MANO Management Data Analytics (MDA)

c.1. VNF LCM Coordination

c.2. NS LCM Coordination

m.1. NFV-MANO Configuration and Information Management

m.2. NFV-MANO Performance Management

m.3. NFV-MANO Fault Management

m.4. NFV-MANO Logging Management

msc.1. MSCS Management

msc.2. MSCS Performance management

msc.3. MSCS Fault management

msc.4. WAN Capacity Management

NOTE 1: m.1 to m.4 services are related to NFV-MANO management.

The NFV-Ss specific to virtualization technologies offered by the NFV-Ps are:

VIM based resource management services:

vm.1. Virtualised Resources Management

NOTE 2: Virtualised Resources Management is assumed to include the functionality of: resources management, information management and capacity management.

vm.2. Virtualised Resources Change Notification: for compute, network, and storage

vm.3. Virtualised Compute Flavour Management

vm.4. Network Forwarding Path Management

vm.5. Virtualised Resources Performance Management

vm.6. Virtualised Resources Fault Management

vm.7. Virtualised Resource Reservation: for compute, network, and storage

NOTE 3: Virtualised Resources Reservation Management is assumed to include the functionality of: virtualised resource reservation changes.

vm.8. Virtualised Resources Quota Management: for compute, network, and storage

NOTE 4: Virtualised Resources Quota Management is assumed to include the functionality of: virtualised resource quota changes.

vm.9. Virtualised Resources Quota Available Notification

vm.10. Compute Host Reservation Management

vm.11. Compute Host Capacity Management

Containers-related resource management services:

cism.1. OS container workload management

cism.2. OS container compute management

cism.3. OS container storage management

cism.4. OS container network management

cism.5. OS container configuration management

cism.6. CIS instance management

cism.7. CIS MCCO management

cir.1. OS container image management

ccm.1. CIS cluster lifecycle management

ccm.2. CIS cluster fault management

ccm.3. CIS cluster configuration management

ccm.4. CIS cluster performance management

ccm.5. CIS cluster security management

7.4.7 Evaluation

Clause 7.4.7 provides an assessment, comparison and evaluation of the targets described in clause 7.4 which addresses different level of adoption to SBA i.e. identified SBA transformation targets. The SBA transformation targets are assessed by a set of evaluation/comparison aspects described in the table 7.4.7-1.

Table 7.4.7-1: Evaluation of the SBA transformation targets

Evaluation/Comparison criteria (see notes for more details)	Target#1 Minimal Service-based evolution	Target#2 SBI consolidation	Target#3 Full SBA	Target#4 SBA without service consolidation
1. Co-existence with non-SBA (part of) system, e.g. latest Release based NFV-MANO system (entities). See note 1	See table 7.4.7-2.	See table 7.4.7-2.	See table 7.4.7-2.	See table 7.4.7-2.
2: List of impacted NFV-MANO functional blocks	No impact.	Consolidated interfaces are exposed by e.g. NFVO and VNFM. OSS, VNF and EM consume consolidated interfaces.	Same as Target#2 See note 2.	See note 2.
3: List of impacted reference points and interfaces	Interfaces are not modified but their specification is no longer bound to a reference point.	All interfaces subject to consolidation are impacted (e.g. NSD management, VNF package management, FM/PM interfaces). Other interfaces are not modified but their specification is no longer bound to a reference point.	All NFV-MANO reference points are removed. All interfaces subject to consolidation are impacted (e.g. NSD management, VNF package management, FM/PM interfaces). Other interfaces are not modified but their specification is no longer bound to a reference point.	All NFV-MANO reference points are removed. Interfaces are not modified but are no longer bound to a functional block.

Evaluation/Comparison criteria (see notes for more details)	Target#1 Minimal Service-based evolution	Target#2 SBI consolidation	Target#3 Full SBA	Target#4 SBA without service consolidation
4: List of impacted NFV-IFA specifications See notes 3 and 4.	All IFA GSs whose scope is a reference point are impacted to remove duplicated descriptions. The actual impact depends on the selected documentation scenario. There are no functional changes. New GSs can be created for the specification of common services.	Same as Target#1 + additional technical changes to consolidate some interfaces. New GSs can be created for the specification of consolidated interfaces.	ETSI GS NFV-IFA 010 [i.9] to remove the concepts of reference point and functional block. All IFA GSs whose scope is a reference point are impacted to remove the concepts of reference point and functional block and remove duplicated descriptions. The actual impact depends on the selected documentation scenario. Technical changes to consolidate interfaces. New GSs can be created for the specification of common services and consolidated interfaces.	ETSI GS NFV-IFA 010 [i.9] to remove the concepts of reference point and functional block. All IFA GSs whose scope is a reference point are impacted to remove the concepts of reference point and functional block and remove duplicated descriptions. The actual impact depends on the selected documentation scenario. There are no functional changes. New GSs can be created for the specification of common services.
NOTE 1: Need to evaluate the level of co-existence/compatibilities of the system e.g. by interface/service level basis or functional block basis, or whole system-wide basis, how and what kind of level of interoperability can be fulfilled, or whether no interoperable mechanism/concept between systems can be achieved. NOTE 2: Functional blocks could be considered as examples of how services can be grouped. NOTE 3: Annex A provides examples of possible scenarios to evolve documentation of IFA GSs. NOTE 4: The specifications of NFV-MANO are expected to contain information about how existing and new functionality and capabilities can be applied to both SBA NFV-MANO and non-SBA NFV-MANO to support various deployment scenarios (e.g. coexistence). Depending on the documentation scenario, there is a potential case that parts of the documentation can be used to support both non-SBA NFV-MANO and SBA NFV-MANO.				

Table 7.4.7-2 evaluates the SBA transformation targets from the point of view of coexistence with non-SBA deployments and between entities representing the same or different SBA transformation targets. The interworking function, which is able to translate between the implementations on either side of the interface, is expected to be introduced for interactions of consumers and producers representing different targets or non-SBA to provide the functionality like convert a consolidated API request into the equivalent legacy API request and vice-versa.

Table 7.4.7-2: Evaluation of the SBA transformation targets for SBA and non-SBA coexistence regarding interface usage

Producer / Consumer	Non-SBA	SBA Target#1 Minimal Service-based evolution	SBA Target#2 SBI consolidation	SBA Target#3 Full SBA	SBA Target#4 SBA without service consolidation
Non-SBA	Seamless	Seamless	Interworking function is expected due to SBI consolidation to enable the use of NFV-S provided over consolidated interfaces.	Interworking function is expected due to SBI consolidation to enable the use of NFV-S provided over consolidated interfaces.	Seamless. See note.

Producer Consumer	Non-SBA	SBA Target#1 Minimal Service-based evolution	SBA Target#2 SBI consolidation	SBA Target#3 Full SBA	SBA Target#4 SBA without service consolidation
SBA Target#1	Seamless	Seamless	Interworking function is expected due to SBI consolidation to enable the use of NFV-S provided over consolidated interfaces.	Interworking function is expected due to SBI consolidation to enable the use of NFV-S provided over consolidated interfaces.	Seamless.
SBA Target#2	Interworking function is expected due to SBI consolidation to translate interfaces provided by NFV-P to allow NFV-C to consume them.	Interworking function is expected due to SBI consolidation to translate interfaces provided by NFV-P to allow NFV-C to consume them.	Seamless	Seamless for consolidated interfaces. Interworking function is expected to enable NFV-C to use NFV-S provided over consolidated interfaces.	Interworking function is expected due to SBI consolidation to translate interfaces provided by NFV-P to allow NFV-C to consume them.
SBA Target#3	Interworking function is expected due to SBI consolidation to translate interfaces provided by NFV-P to allow NFV-C to consume them as consolidated interfaces.	Interworking function is expected due to SBI consolidation to translate interfaces provided by NFV-P to allow NFV-C to consume them as consolidated interfaces.	Seamless for consolidated interfaces. Interworking function is expected to consolidate interfaces provided by NFV-P to allow NFV-C to consume consolidated interfaces.	Seamless	Interworking function is expected due to SBI consolidation to translate interfaces provided by NFV-P to allow NFV-C to consume them as consolidated interfaces.
SBA Target#4	Seamless	Seamless	Interworking function is expected due to SBI consolidation to enable the use of NFV-S provided over consolidated interfaces.	Interworking function is expected due to SBI consolidation to enable the use of NFV-S provided over consolidated interfaces.	Seamless.
NOTE: As specified in ETSI GS NFV-IFA 031 [i.12], API endpoints can be configured at the consumer side on a per-interface basis.					

In addition to the aspects of interface usage evaluated in table 7.4.7-2, the coexisting NFV-MANO systems are expected to make use of offered NFV-Ss. NFV-MANO system which represents SBA transformation target is expected to be able to use the NFV-Ss offered by a non-SBA NFV-MANO system. This includes registration, discovery and selection of NFV-Ss, which are offered by a non-SBA NFV-MANO system over service interfaces bound to predefined reference points. The NFV-Ss offered by a non-SBA NFV-MANO system can be registered, as described in key issue F (see clause 7.2.2.7). When registered, NFV-Ss can be discovered by coexisting SBA based NFV-MANO system, as described in key issue B (see clause 7.2.2.3) and selected, as described in key issue G (see clause 7.2.2.8).

If coexisting NFV-MANO systems represent different SBA transformation targets, the registration of NFV-Ss is rather straightforward. During discovery and selection of NFV-Ss the discovery (key issue B, see clause 7.2.2.3) and selection (key issue G, see clause 7.2.2.8) are straightforward for NFV-Ss, which are not consolidated or have the same scope of consolidation. In other cases the discovery and selection functions are expected to consider the functionality of interworking function to enable the discovery and selection of NFV-Ss that can be used due to translation of API requests provided by interworking function.

8   Recommendations for future work

8.1   Recommendations for the solutions

Clause 7.2 describes architectural key issues and potential solutions identified to realize SBA design for NFV-MANO. The table 8.1-1 provides recommendations for the solutions, which are recommended to be supported by SBA design.

Table 8.1-1: Recommendations for the solutions identified in the present document

Identifier	Key issue	Solution	Support in SBA recommended See note	Comments
Sba-sol-11.001	1: Consumer agnostic NFV-Ss	1: consumer agnostic services	YES	Only one solution
Sba-sol-21.002	2: Decoupling between NFV-Ss	1: producer agnostic services	YES	Only one solution
Sba-sol-A1.003	A: Services generalization	1: generalization of services	YES	Only one solution
Sba-sol-B1.004	B: NFV-S discovery and NFV-S request routing	1: direct discovery	YES	By specifying support for direct access to NFV-S Registry Service by NFV-Cs and NFV-Ps
Sba-sol-B2.005		2: indirect discovery without delegation	YES	By specifying NFV-S discovery function
Sba-sol-B3.006		3: indirect discovery with delegation	YES	By specifying NFV-S discovery function and requirements for NFV-Cs to provide information to enable NFV-S discovery function to make selection of NFV-Ss
Sba-sol-B4.007		4: configuration-based discovery	YES	Configuration information is operator specific. An NFV-MANO Interworking function handles the registration and discovery of non-SBA NFV-MANO services on behalf of the non-SBA system, so the SBA NFV-MANO does not require configuration/hard coded discovery. Applicable for coexistence with non-SBA NFV-MANO FBs to keep backward compatibility
Sba-sol-C1.008	C: Dataless and stateless services	1: common data repositories	YES	Only one solution
Sba-sol-D1.009	D: Service exposure	1: exposure framework	YES	Only one solution
Sba-sol-E1.010	E: NFV-S granularity	1: NFV-S search granularity	YES	Only one solution
Sba-sol-F1.011	F: NFV-S registration	1: direct registration	YES	By specifying support for direct access to NFV-S Registry Service by NFV-Ps
Sba-sol-F2.012		2: indirect registration	NO	Type of registration agent depends on operator decision
Sba-sol-F3.013		3: 3rd party registration	YES	By specifying requirements for an NFV-S Registry Service to support registration of NFV-Ss by NFV-Ps
Sba-sol-G1.014	G: NFV-S selection	1: direct selection	YES	By specifying requirements for enabling NFV-Cs to select NFV-Ss
Sba-sol-G2.015		2: delegated selection	YES	By specifying NFV-S selection function
Sba-sol-H1.016	H: Communication services	1: basic IP routeing	YES	Is available using existing mechanisms
Sba-sol-H2.017		2: application layer proxies	YES	By specifying application proxy function
Sba-sol-I1.018	I: Service querying	1: simple query	NO	Is included in solution 2, if subscription is not used
Sba-sol-I2.019		2: query with subscription	YES	Is available using existing mechanisms
Sba-sol-J1.020		1: direct authorization	YES	By the use of identification

Identifier	Key issue	Solution	Support in SBA recommended See note	Comments
Sba-sol-J2.021	J: NFV-MANO service authorization	2: indirect authorization	YES	By the use of token
Sba-sol-K1.022	K: TLS certificate profile	1: SBA certificate profiles alignment with 3GPP 5GC certificate profiles	YES	Only one solution
Sba-sol-L1.023	L: Certificate validation policies	1: use best practices for certificate validation	YES	Only one solution
Sba-sol-M1.024	M: TLS profiles support	1: TLS with mutual authentication	YES	Only one solution
Sba-sol-N1.025	N: SBA migration	1: migration without NFV-MANO service interruption	YES	By specifying requirements for NFV-MANO migration strategy from non-SBA NFV-MANO to SBA NFV-MANO that enables coexistence of the two systems for the duration of the migration, in such a way that it does not interrupt the handling of the NFV-S requests
Sba-sol-N2.026		2: migration with NFV-MANO service interruption	NO	Migration strategy and design is an operator decision
Sba-sol-O1.027	O: SBA coexistence	1: interworking gateway	YES	By specifying NFV-MANO SBA interworking function
Sba-sol-O2.028		2: direct interaction	YES	Is available using existing mechanisms
NOTE: Not all of the solutions are applicable to all transformation targets.				

8.2   Recommendations for SBA transformation targets

8.2.1   Overview

The present clause documents recommendations about potential enhancements or changes to existing ETSI NFV specifications as well as new standardization work proposed in order to enable support of an SBA based NFV-MANO system according to SBA transformation targets. The recommendations are derived based on the key issues identification and analysis documented in clause 7.2, and SBA transformation targets identification and evaluation documented in clause 7.4.

The recommendations are categorized and elaborated as follows:

- recommendations applicable to all SBA transformation targets (see clause 8.2.2);

- recommendations for SBA transformation target#1 (see clause 8.2.3);

- recommendations for SBA transformation target#2 (see clause 8.2.4);

- recommendations for SBA transformation target#3 (see clause 8.2.5);

- recommendations for SBA transformation target#4 (see clause 8.2.6);

- other recommendations (see clause 8.2.7).

In order to enable specification of SBA based NFV-MANO system according to particular SBA transformation target, the standardization work is expected to fulfil the common recommendations applicable to all SBA transformation targets as listed in clause 8.2.2, the recommendations specific for that target and other recommendations as listed in clause 8.2.7.

8.2.2   Recommendations applicable to all SBA transformation targets

The present clause provides recommendations applicable to all SBA transformation targets described in clauses 7.4.3 to 7.4.6.

Table 8.2.2-1 provides the recommendations applicable to all SBA transformation targets.

Table 8.2.2-1: Recommendations applicable to all SBA transformation targets

Identifier	Recommendation description	Comments
Sba.001	It is recommended that NFV-S Registry Service and its service interfaces be specified.	New GS to specify NFV-S Registry Service.
Sba.002	It is recommended that requirements be specified for NFV-Ps for direct access to the NFV-S Registry Service.	Extension to ETSI GS NFV-IFA 010 [i.9] to address solution 1 of key issue F: NFV-S registration (see clause 7.2.2.7.1). See note 1.
Sba.003	It is recommended that requirements be specified for NFV-Cs for direct access to the NFV-S Registry Service.	Extension to ETSI GS NFV-IFA 010 [i.9] to address solution 1 of key issue B: NFV-S discovery and NFV-S request routeing (see clause 7.2.2.3.1). See note 2.
Sba.004	It is recommended that SBA NFV-MANO Common Services be specified.	New GS to specify SBA NFV-MANO Common Services or set of new GSs to specify individually every SBA NFV-MANO Common Service (see clause 7.3.4). See note 3.
Sba.005	It is recommended that interworking function be specified to support interactions between consumers and producers, if interactions between non-consolidated interfaces and consolidated interfaces apply.	New GS to support coexistence between different NFV-MANO systems, as described in solution 1 of key issue O (see clause 7.2.2.16). Analysis for use of interworking function between different NFV-MANO systems is provided in clause 7.4.7.
NOTE 1: This recommendation does not apply for legacy NFV-MANO FBs, for which solution 3 for key issue F: NFV-S registration (see clause 7.2.2.7) is recommended instead, in order to access the NFV-S Registry Service.		
NOTE 2: This recommendation does not apply for legacy NFV-MANO FBs, for which solution 4 for key issue B: NFV-S discovery (see clause 7.2.2.3) is recommended instead, in order to access the NFV-S Registry Service.		
NOTE 3: This recommendation addresses Sba.002, if common service NFV-MANO service registration is specified, and addresses Sba.003, if common service NFV-MANO service discovery is specified.		

8.2.3   Recommendations for SBA transformation target#1

The present clause provides recommendations focusing on enabling specification of SBA based NFV-MANO system according to SBA transformation target#1 described in clause 7.4.3.

Table 8.2.3-1 provides the recommendations related to enabling specification of SBA based NFV-MANO system according to SBA transformation target#1.

Table 8.2.3-1: Recommendations related to SBA transformation target#1

Identifier	Recommendation description	Comments
Sba.t1.001	It is recommended that guidelines be specified for migration strategy of non-SBA NFV-MANO system towards an SBA NFV-MANO system based on SBA transformation target#1.	Guidelines to support solution 1 of key issue N (see clause 7.2.2.15).

8.2.4   Recommendations for SBA transformation target#2

The present clause provides recommendations focusing on enabling specification of SBA based NFV-MANO system according to SBA transformation target#2 described in clause 7.4.4.

Table 8.2.4-1 provides the recommendations related to enabling specification of SBA based NFV-MANO system according to SBA transformation target#2.

Table 8.2.4-1: Recommendations related to SBA transformation target#2

Identifier	Recommendation description	Comments
Sba.t2.001	It is recommended that guidelines be specified for migration strategy of non-SBA NFV-MANO system towards an SBA NFV-MANO system based on SBA transformation target#2.	Guidelines to support solution 1 of key issue N (see clause 7.2.2.15).
Sba.t2.002	It is recommended that consolidated NFV-SIs are specified.	New GS to specify all NFV-SIs or set of new GSs to specify individually every consolidated NFV-SI.

8.2.5   Recommendations for SBA transformation target#3

The present clause provides recommendations focusing on enabling specification of SBA based NFV-MANO system according to SBA transformation target#3 described in clause 7.4.5.

Table 8.2.5-1 provides the recommendations related to enabling specification of SBA based NFV-MANO system according to SBA transformation target#3.

Table 8.2.5-1: Recommendations related to SBA transformation target#3

Identifier	Recommendation description	Comments
Sba.t3.001	It is recommended that guidelines be specified for migration strategy of non-SBA NFV-MANO system towards an SBA NFV-MANO system based on SBA transformation target#3.	Guidelines to support solution 1 of key issue N (see clause 7.2.2.15).
Sba.t3.002	It is recommended that consolidated NFV-SIs are specified.	New GS to specify all NFV-SIs or set of new GSs to specify individually every consolidated NFV-SI.

8.2.6   Recommendations for SBA transformation target#4

The present clause provides recommendations focusing on enabling specification of SBA based NFV-MANO system according to SBA transformation target#4 described in clause 7.4.6.

Table 8.2.6-1 provides the recommendations related to enabling specification of SBA based NFV-MANO system according to SBA transformation target#4.

Table 8.2.6-1: Recommendations related to SBA transformation target#4

Identifier	Recommendation description	Comments
Sba.t4.001	It is recommended that guidelines be specified for migration strategy of non-SBA NFV-MANO system towards an SBA NFV-MANO system based on SBA transformation target#4.	Guidelines to support solution 1 of key issue N (see clause 7.2.2.15).

8.2.7   Other recommendations

The present clause provides other recommendations resulting from the analysis held during work on SBA design for NFV-MANO. The following recommendations are related to the maintenance and evolution of NFV-MANO specifications during migration.

As migration towards SBA NFV-MANO can differ for each network deployment (e.g. between different network operators), it is important to facilitate the coexistence and migration processes. A functionality parity between SBA and non-SBA NFV-MANO, supported by relevant maintenance and extensions of NFV-MANO specifications in support of non-SBA NFV-MANO deployments, can facilitate the coexistence and migration processes.

Furthermore, to minimize standardization effort, not only during migration but also after migration is completed, avoiding duplication of specifications to support SBA NFV-MANO and non-SBA NFV-MANO is expected to be promoted, e.g. following a specification format that makes specifications and their specified functionality reusable by both SBA and non-SBA NFV-MANOs.

In addition the present clause provides recommendation for specification of certification validation policy, which was identified when defining solution 1 (use best practices for certificate validation) for key issue L: Certificate validation policies in clause 7.2.2.13.

See table 8.2.7-1 for recommendations related to specification evolution and security.

Table 8.2.7-1: Other recommendations

Identifier	Recommendation description	Comments
Sba.o.001	It is recommended that functionality and capabilities that are unique to enable SBA NFV-MANO do not impact the maintenance and/or improvement of non-SBA NFV-MANO systems.	Essential new features which are applicable only to SBA NFV-MANO are expected to be provided and specified (either in new or reusing existing specifications) without impacting the specification of features applicable to non-SBA NFV-MANO. See note. An example of such functionality is related to common services as described in clause 7.4.2 (e.g. service registry).
Sba.o.002	It is recommended that functionality and capabilities that are unique to enable non-SBA NFV-MANO do not impact the maintenance and/or improvement of SBA NFV-MANO systems.	Essential new features or maintenance which are applicable only to non-SBA MANO are expected to be provided in current or new specifications, without impacting NFV-MANO specifications dedicated to support SBA-based deployments. See note. An example of such functionality is related to NFV-MANO management aspects.
Sba.o.003	It is recommended that maintenance and enhancements which are both applicable to non-SBA NFV-MANO systems and SBA-based NFV-MANO systems are specified in NFV-MANO specifications in a way to facilitate the reusability for both types of NFV-MANO systems.	See note.
Sba.o.004	It is recommended to specify a certificate validation policy for mutual HTTPS/TLS authentication addressing the mutual authentication.	See clause 7.2.2.13.2 for detailed description of the identified gap.
NOTE:	Depending on the documentation scenario, there is a potential case that parts of the documentation can be used to support both non-SBA NFV-MANO and SBA NFV-MANO. As such a clear boundary between non-SBA and SBA based specifications is not pursued, as all could be regarded simply as NFV-MANO specifications but supporting both non-SBA and SBA-based NFV-MANO deployments.	

8.3 Recommendations for next steps of SBA standardization

Analysis provided in the present document leads to four possible targets to achieve transformation of NFV-MANO system towards SBA design. The identified SBA transformation targets differ in their scope and expected standardization effort to enable the SBA based NFV-MANO system. The main characteristics of the targets can be summarized as follows:

- Targer#1: backward compatible with non-SBA NFV-MANO, relaxes bundling of service interfaces to reference points.

- Target#2: partially backward compatible with non-SBA NFV-MANO, relaxes bundling of service interfaces to reference points with consolidation of a few service interfaces with obvious synergies and common design, and preservation of other existing interfaces as new NFV-SIs.

- Target#3: partially backward compatible with non-SBA NFV-MANO, removes from the architecture the concepts of reference points and functional blocks with consolidation of some service interfaces which have functional synergies, and for which such consolidation is possible, and preservation of other existing interfaces as new NFV-Sis.

- Target#4: partially backward compatible with non-SBA NFV-MANO, removes from the architecture the concepts of reference points and functional blocks and introduces the SBA common services, but preserves the existing interfaces design and re-publishes them as new NFV-SIs.

NOTE 1: For partially backward compatible Targets (i.e. Target #2, #3, #4), the consolidated NFV-Ss are likely to follow a design that is not backward compatible with their existing NFV-MANO service counterparts (described in Target#1). The NFV-Ss left unchanged, as well as their NFV-SIs, are fully backward compatible with existing non-SBA NFV-MANO.

NOTE 2: The analysis of backward compatibility is performed from the perspective of NFV-Ss and NFV-SIs design.

The normative work (if pusued) for NFV-MANO transformation towards SBA is expected to consider the impacts and differences between the SBA transformation targets listed above. The scope of normative work for implementation of selected target is expected to be based on recommendations provided in clause 8.2.

Other potential approaches might consider a multi-step approach. As an example, the following approach can be considered to reach the implementation of taget#3 (full SBA) from the perspective of easing the standardization effort, which includes as interim steps implementation of target#1 and target#4:

- Step 1: normative work to enable target#1:

  - minimum set of recommendations to be included: Sba.001, Sba.002, Sba.003, Sba.004 (for NFV-MANO communication service, NFV-MANO service authorization and NFV-MANO service security), Sba.t1.001;

  - optional set of recommendations to be included in addition to those added as minimum set: Sba.004 (for other common services not included in the minimum set). Inclusion of recommendation Sba.004 eliminates the need to include recommendations Sba.002 and Sba.003.

- Step 2: normative work to enable target#4:

  - to be started after the finalization of step 1;

  - recommendations to be included in addition to those added in step 1: Sba.004 (for common services not included in the step 1), Sba.t4.001;

  - might need another GR in Release 5 with the scope to analyze the impact of removing the concept of functional blocks from NFV-MANO architecture.

- Step 3: normative work to enable target#3:

  - to be started after the finalization of step 2;

  - recommendations to be included in addition to those added in step 2: Sba.005, Sba.t3.001, Sba.t3.002;

  - might need another GR in Release 5 with the scope to analyze the impact of consolidation of service interfaces on the NFV-MANO.

Besides the approach illustrated above there are other possible approaches, which might include the work to enable target#2. An analysis of the impact and development effort in the migration to reach the target has not been considered in the approach described above.

8.4   Conclusion

Clause 8.1 summarized the key issues and their potential solutions, with some recommendations on the possible realizations for SBA NFV-MANO.

There are several potential SBA transformation targets identified in clause 7.4 and each is addressing different needs based on the key issues it resolved. While there are pros and cons for each NFV-MANO SBA transformation target, the decision about proposing further normative work for NFV-MANO transformation towards SBA is expected to consider various criteria e.g.:

- interoperability in multi-vendor setting;

- integration with the rest of the standardized OSS architecture layers;

- backward compatibility and migration considerations;

- facilitating innovation and addition of new features on a standardized SBA architecture for the NFV-MANO framework.

An assessment of the most important considerations is driving the preference towards one specific SBA transformation target versus another. Such choice is recommended to be made as part of the subsequent normative work items that might continue the NFV-MANO SBA transformation journey.

Annex A:
Documentation scenarios for NFV-MANO SBA

A.1   Introduction

Evaluation of SBA transformation targets provided in clause 7.4.7 analyses as one of the evaluation criteria the impact on NFV-IFA specifications. The analysis is provided in table 7.4.7-1. This annex describes several possible scenarios to adapt NFV-IFA specifications to the NFV-MANO SBA design. The description concerns the evolution of GSs which specify reference points, and resulting evolution of specifications of interfaces, for which the technical scope is not modified. For consolidated interfaces and common services new GSs are expected to be created in addition to the GSs described in this annex. Proposed scenarios might be applicable only for some SBA transformation targets.

Scenario 1 describes the approach, where all interfaces are specified in new GSs, where scenario 1a assumes that every interface is specified in a separate new GS, and scenario 1b assumes, that interfaces having similar functionality are specified in one GS.

Scenario 2 describes the approach, where only the interfaces, which are applicable for more than one reference point are specified in new GSs. The interfaces, which are specific to one reference point will remain in the GS, which specifies that reference point.

Scenario 3 describes the approach, that NFV-MANO is specified in ETSI GS NFV 006 [i.1] and set of new GSs to specify interfaces.

Other scenarios can be also described, including the one assuming that documentation structure for GSs, which specify reference points, is not modified.

A.2   Scenario 1

A.2.1   Scenario 1a

All existing GSs, which specify a reference point, remain valid but are modified, and the descriptions of all interfaces are moved to new GSs, where each new GS focuses on one interface. The GSs, which specify a reference point, would only contain the list of interfaces applicable for the reference point they focus on and a reference to the new GSs describing the applicable interfaces. If the interface is applicable for more than one reference point, the GS, which specifies a reference point, will contain additional profiling information, e.g. if an operation of the VNF LCM interface is supported towards the NFVO but not towards the VNF, ETSI GS NFV-IFA 007 would still describe this restriction.

   NOTE: The GSs mentioned in this clause as ETSI GS NFV-IFA 007, ETSI GS NFV-IFA 008 and ETSI GS NFV-IFA 013 refer to modified versions of currently available specifications referenced as ETSI GS NFV-IFA 007 [i.7], ETSI GS NFV-IFA 008 [i.8], ETSI GS NFV-IFA 013 [i.10] respectively.

Table A.2.1-1 provides list of new specifications to be referenced by ETSI GS NFV-IFA 007 with indication of profiling information.

Table A.2.1-1: New specifications referenced by ETSI GS NFV-IFA 007

New GS title	Profiling information
IFA xxx-1 VNF Package Management Interface	Produced by NFVO towards VNFM
IFA xxx-2 VNF Lifecycle Operation Granting Interface	Not Applicable
IFA xxx-3 Virtualised Resources Management in indirect mode Interface	Not Applicable
IFA xxx-4 Virtualised Resources Quota Available Notification Interface	Not Applicable
IFA xxx-5 VNF Snapshot Package Management Interface	Produced by NFVO towards VNFM
IFA xxx-6 VNF Lifecycle Management Interface	Produced by VNFM towards NFVO, VNFC-level details are not visible to the NFVO
IFA xxx-7 VNF Performance Management Interface	Produced by VNFM towards NFVO, VNFC-level details are not visible to the NFVO
IFA xxx-8 VNF Fault Management Interface	Produced by VNFM towards NFVO, VNFC-level details are not visible to the NFVO
IFA xxx-9 VNF Indicator Interface	Produced by VNFM towards NFVO
IFA xxx-10 Policy Management Interface	Produced by VNFM towards NFVO

Table A.2.1-2 provides list of new specifications to be referenced by ETSI GS NFV-IFA 008 with indication of profiling information.

Table A.2.1-2: New specifications referenced by ETSI GS NFV-IFA 008

New GS title	Profiling information
IFA xxx-11 VNF Configuration Interface	Not Applicable
IFA xxx-9 VNF Indicator Interface	Produced by EM/VNF towards VNFM
IFA xxx-12 VNF LCM Coordination Interface	Not Applicable
IFA xxx-6 VNF Lifecycle Management Interface	Produced by VNFM towards EM
IFA xxx-7 VNF Performance Management Interface	Produced by VNFM towards EM/VNF
IFA xxx-8 VNF Fault Management Interface	Produced by VNFM towards EM/VNF
IFA xxx-10 Policy Management Interface	Produced by VNFM towards EM

Table A.2.1-3 provides list of new specifications to be referenced by ETSI GS NFV-IFA 013 with indication of profiling information.

Table A.1.1-3: New specifications referenced by ETSI GS NFV-IFA 013

New GS title	Profiling information
IFA xxx-13 NS LCM Coordination Interface	Not Applicable
IFA xxx-14 NSD Management Interface	Not Applicable
IFA xxx-15 NS Lifecycle Management Interface	Not Applicable
IFA xxx-16 NS Performance Management Interface	Not Applicable
IFA xxx-17 NS Fault Management Interface	Not Applicable
IFA xxx-1 VNF Package Management Interface	Produced by NFVO towards OSS/BSS
IFA xxx-18 NFVI Capacity Information Interface	Not Applicable
IFA xxx-10 Policy Management Interface	Produced by NFVO towards OSS/BSS
IFA xxx-5 VNF Snapshot Package Management Interface	Produced by NFVO towards OSS/BSS

# A.2.2	Scenario 1b

The approach is the same as for scenario 1a, but multiple interfaces addressing a similar functionality (e.g. all PM interfaces) are grouped in one new GS. The grouping of interfaces in one GS does not mean consolidation of interfaces, but only describing grouped interfaces e.g. IFA yyy-1 Performance Management Interface includes specification of NS Performance Management Interface and VNF Performance Management Interface.

A.3   Scenario 2

All existing GSs, which specify a reference point, remain valid but are modified, and the description of the interfaces applicable for more than one reference point is moved to new GSs, where each new GS focuses on one interface. The GSs, which specify a reference point, would contain the list of interfaces applicable for the reference point they focus on, a reference to the new GSs describing interfaces applicable for more than one reference point, along with some profiling information, and the full specification of the interfaces that are specific to this reference point.

A.4   Scenario 3

A.4.1   Scenario 3a

Existing GSs are not used anymore. The list of interfaces applicable per reference point are transferred to ETSI GS NFV 006, which would reference new GSs, where each new GS focuses on one interface. ETSI GS NFV 006 would also contain profiling information for interfaces, which are applicable to more than one reference point.

   NOTE: The GS mentioned as ETSI GS NFV 006 refers to modified version of currently available specification
                    referenced as ETSI GS NFV 006 [i.1].

A.4.2   Scenario 3b

The approach is the same as for scenario 3a, but multiple interfaces addressing a similar functionality (e.g. all PM interfaces) are grouped in one new GS. The grouping of interfaces in one GS does not mean consolidation of interfaces, as described for scenario 1b.

A.4.3   Scenario 3c

The approach is the same as for scenario 3a or 3b, but with a new GS focused on NFV-MANO reference points instead of extending ETSI GS NFV 006 [i.1]. This new GS would contain list of interfaces applicable per reference point, reference to GSs which specify interfaces, and profiling information for interfaces, which are applicable to more than one reference point.

Annex B:
Change History

Date	Version	Information about changes
09-10-2019	0.0.1	Creation of skeleton of the report. Update with contributions: NFVIFA(19)000786r1_SBA_Study_-_ToC NFVIFA(19)000787r1_SBA_Study_-_Scope NFVIFA(19)000788r2_SBA_Study_-_Introduction
02-11-2019	0.0.2	Update with contributions: NFVIFA(19)000836r2_IFA039_-_Overview_of_NFV_specifications Rapporteur action: IFA031 mentioned in contribution should be IFA030, correction of references and text. NFVIFA(19)000883r4_IFA039_Use_Case_simplified_example NFVIFA(19)000895_IFA039_-_Remove_Annex_-_Authors_and_contributors
06-12-2019	0.0.3	Update with contributions: NFVIFA(19)000863r3_IFA039-SBA_terms_and_principles Rapporteur action: alignment of tables and figures numbering. NFVIFA(19)000939r4_IFA039___Potential_benefits_of_SBA NFVIFA(19)000947r4_IFA039_SBA_Design_Options
24-02-2020	0.0.4	Update with contributions: NFVIFA(20)000045_IFA039_SBA_Clause_7_new_structure_post-drafting NFVIFA(20)000078r2_FEAT23-IFA039_SBA_Clause_7___SBA_key_issue_1 NFVIFA(20)000079r1_FEAT23-IFA039_SBA_Clause_7___SBA_key_issue_2 NFVIFA(20)000080r2_FEAT23-IFA039_SBA_Clause_7___other_key_issue_A NFVIFA(20)000081r2_FEAT23-IFA039_SBA_Clause_7___other_key_issue_B NFVIFA(20)000082r1_FEAT23-IFA039_SBA_Clause_7___other_key_issue_X NFVIFA(20)000083r1_FEAT23-IFA039_SBA_Clause_7___other_key_issue_Y NFVIFA(20)000099r3_FEAT23_IFA039_SBA_Services_target_1 NFVIFA(20)000117_FEAT23-IFA039_SBA_Clause_7___other_key_issue_C NFVIFA(20)000118r1_FEAT23_IFA039_SBA_Services_clause
11-09-2020	0.0.5	Update with contributions: NFVIFA(20)000495r3_FEAT23_IFA039_Updates_to_Key_Issues_1___2 NFVIFA(20)000496r5_FEAT23_IFA039_Re-structuring_Key_Issue_B
04-11-2020	0.0.6	Update with contributions: NFVIFA(20)000733r1_FEAT23_IFA039___3__Definition_of_terms__symbols_and_abbrevia NFVIFA(20)000734r1_FEAT23_IFA039___3_1_Terms_new_definition NFVIFA(20)000735r2_FEAT23_IFA039___Adoption_of_NFV-MANO_endpoint_definition_for NFVIFA(20)000736_FEAT23_IFA039___5_1_Consumer_request_via_NFV-MANO_Service_In NFVIFA(20)000738_FEAT23_IFA039___6_1_General_SBA_principles_for_NFV_update NFVIFA(20)000739r1_FEAT23_IFA039___6_2_SBA_principles_applied_to_MANO_-_Example NFVIFA(20)000740_FEAT23_IFA039___7_2_2_2_Key_issue_A_update NFVIFA(20)000741r1_FEAT23_IFA039___7_2_2_4_Key_issue_C_update NFVIFA(20)000742_FEAT23_IFA039___7_4_3_SBA_Target_2_update NFVIFA(20)000743_FEAT23_IFA039___7_4_4_SBA_Target_3_update
25-11-2020	0.0.7	Update with contributions: NFVIFA(20)000780r1_FEAT23_IFA039_SBA_common_services

Date	Version	Information about changes
16-12-2020	0.0.8	Update with contributions: NFVIFA(20)000737r3_FEAT23_IFA039___5_2_Services_Registration_and_Discovery_use_(Rappoteur acton: adding missing captions for tables 5.2.3.4-1 and 5.2.4.4-1) NFVIFA(20)000814r3_FEAT23_IFA039___7_2_2_7_NFV-S_indirect_registration_solution NFVIFA(20)000815r1_FEAT23_IFA039___7_2_2_7_NFV-S_3rd_party_registration_solutio NFVIFA(20)000867r1_FEAT23-IFA039_SBA_Clause_7_2_1_2___Key_issue_1_Consumer_agno NFVIFA(20)000868r1_FEAT23-IFA039_SBA_Clause_7_2_1_3___Key_issue_2_Decoupling_be NFVIFA(20)000869r1_FEAT23-IFA039_SBA_Clause_7_2_2_3_Key_issue_B_NFV-S_discovery NFVIFA(20)000870_FEAT23-IFA039_SBA_Clause_7_2_2_4_Key_issue_C_Dataless_and_st NFVIFA(20)000871r1_FEAT23-IFA039_SBA_Clause_7_2_2_5_Key_issue_D NFVIFA(20)000874_FEAT23-IFA039_SBA_Clause_7_2_2_9_Key_issue_H_Communication_b NFVIFA(20)000893r2_FEAT23_IFA039_completing_Service_set1
29-01-2021	0.0.9	Update with contributions: NFVIFA(21)000044_FEAT23-IFA039_SBA_Clause_7_2_2_8_Key_issue_G_NFV-S_selection
17-02-2021	0.0.10	Update with contributions: NFVIFA(21)000043r3_FEAT23-IFA039_SBA_Clause_7_2_2_x_Key_issue_X_Service_queryin NFVIFA(21)000085r2_FEAT23_IFA039_Service_set2_alternative Rapporteur action: correction of numbering of generalized functional services. NFVIFA(21)000086r2_FEAT23_IFA039_Service_set3_alternative Rapporteur action: correction of numbering and order for g.5. Policy Management. NFVIFA(21)000087r1_FEAT23_IFA039_Common_Serv_Exposure NFVIFA(21)000107r2_FEAT23_IFA039_Service_set1_additionalVIMservices Rapporteur action: correction of numbering of VM based resource management services.
24-03-2021	0.0.11	Update with contributions: Rapporteur action: correction of clause, sub-clause and figures numbering for duplicated number 7.3.3. NFVIFA(21)000182r1_FEAT23-IFA039_SBA_harmonization_for_service_discovery
06-05-2021	0.0.12	Update with contributions: NFVIFA(21)000338_FEAT23_IFA039_alignment_Service_set2 Rapporteur action: correction of numbering of NFV-MANO specialized services and VM based resource management services. NFVIFA(21)000339_FEAT23_IFA039_alignment_Service_set3 Rapporteur action: correction of numbering of VM based resource management services. NFVIFA(21)000342r3_FEAT23_IFA039_Target1_add_key_issues
12-05.2021	0.0.13	Update with contributions: NFVIFA(21)000333r2_FEAT23-IFA039_7_4_2_SBA_target_1_update NFVIFA(21)000334r2_FEAT23-IFA039_7_4_3_SBA_target_2_update NFVIFA(21)000335r2_FEAT23-IFA039_7_4_4_SBA_target_3_update NFVIFA(21)000340r3_FEAT23_IFA039_common_services_in_targets Rapporteur action: editorial correction "this present document » to « the present document". NFVIFA(21)000341r2_FEAT23_IFA039_common_services_communication_service NFVIFA(21)000368_FEAT23-IFA039_7_3_NFV_Services_update
16-06-2021	0.0.14	Update with contributions: NFVIFA(21)000466r1_FEAT23-IFA039_7_4_4_SBA_target_2_NFV_services_update NFVIFA(21)000467r2_FEAT23-IFA039_7_4_5_SBA_target_3_NFV_services_update NFVIFA(21)000470_FEAT23-IFA039_7_3_3_NFV_services_set_3_update NFVIFA(21)000486r1_FEAT23-IFA039_Clause_7_4_x_Evaluation_skeleton NFVIFA(21)000529_FEAT23_IFA039_Rel4_missing_services
05-07-2021	0.0.15	Update with contributions: NFVIFA(21)000525r3_FEAT23-IFA039_7_2_2_11__Key_issue_J__NFV-MANO_service_authen NFVIFA(21)000572r1_FEAT23-IFA039_7_4_Harmonization_for_service_sets_for_targets

Date	Version	Information about changes
16-08-2021	0.0.16	Update with contributions: Rapporteur action: fixing references containing links by moving them to notes. NFVIFA(21)000564r4_FEAT23-IFA039_7_4_5_SBA_target_4_proposal NFVIFA(21)000654r1_FEAT23_IFA039_security_key_issues_certificates_validation NFVIFA(21)000655r3_FEAT23_IFA039_security_key_issues_TLS_profiles_support
08-09-2021	0.0.17	Update with contributions: NFVIFA(21)000653r1_FEAT23_IFA039_security_key_issues Rapporteur action: renumbering of references i.19, i.20, i.21 due to duplication with existing ones. NFVIFA(21)000752_FEAT23_IFA039_4_2_clean_up NFVIFA(21)000766r2_FEAT23_IFA039_7_2_2_7_Registration_agent_EN_resolution NFVIFA(21)000770_FEAT23_IFA039_3_2_Symbols_3_3_Abbreviations_clean_up NFVIFA(21)000779r1_FEAT23_IFA039_7_2_2_3_7_2_2_8_cleanup NFVIFA(21)000780r1_FEAT23_IFA039_7_2_3_Pros_cons_template
05-10-2021	0.0.18	Update with contributions: NFVIFA(21)000805r1_FEAT23_IFA039_7_4_2_harmonization_for_security_aspects_EN_re
03-11-2021	0.0.19	Update with contributions: NFVIFA(21)000790r7_FEAT23_IFA039_7_2_3_Pros_cons_update_key_issue_1_2_A_B NFVIFA(21)000874r2_FEAT23_IFA039__7_3_4_6_communication_service_update NFVIFA(21)000926r1_IFA039_VNF_indicator_service_categorization NFVIFA(21)000927r2_FEAT23_IFA039_7_2_3_pros_cons_analysis_part_1 NFVIFA(21)000931r1_IFA039_Alignment_on_AN_related_services_ NFVIFA(21)000933_FEAT23_IFA039_7_3_2_7_3_3_EN_resolution_for_VRs
17-11-2021	0.0.20	Update with contributions: NFVIFA(21)000875r6_FEAT23_IFA039_7_4_7_evaluation_description NFVIFA(21)000928r3_FEAT23_IFA039_7_2_3_pros_cons_analysis_part_2 NFVIFA(21)000930r1_FEAT23_IFA039_7_2_3_Pros_cons_update_key_issue_1 NFVIFA(21)000972r1_FEAT23-IFA039_7_2_2_y__Key_issue_y__SBA_migration NFVIFA(21)000975r1_FEAT23_FA039_3_1_consumer_definition_EN_resolution
02-12-2021	0.0.21	Update with contributions: NFVIFA(21)000971r2_FEAT23_IFA039_7_2_2_x_SBA_coexistence_key_issue NFVIFA(21)000992r1_FEAT23_IFA039_7_4_4_2_2_Onboarding_EN_resolution
16-12-2021	0.0.22	Update with contributions: NFVIFA(21)000929r2_FEAT23_IFA039_7_2_3_pros_cons_analysis_part_3 NFVIFA(21)000993_FEAT23_IFA039_Rename_VNF_Package_Management_service_in_Servi NFVIFA(21)0001014_FEAT23_IFA039_Apply_Consumer_definition_change NFVIFA(21)0001029r1_FEAT23_IFA039_7_3_3_Clarification_of_Intent_Handling_and_MDA NFVIFA(21)0001036r2_FEAT23_IFA039_authorization_service NFVIFA(21)0001056r1_FEAT23_IFA039_security_services_clause7_3_4_7
24-01-2022	0.0.23	Update with contributions: NFVIFA(21)0001030r6_FEAT23_IFA039_7_2_2_15_SBA_migration_solutions NFVIFA(21)0001031r3_FEAT23_FA039_7_2_2_x_SBA_coexistence_solutions
07-02-2022	0.0.24	Update with contributions: NFVIFA(22)000040r2_FEAT23_IFA039_7_2_3_pros_cons_summary NFVIFA(22)000041r1_FEAT23_IFA039_7_3_4_Common_services_aligment_with_key_issues NFVIFA(22)000068r1_FEAT23_IFA039_7_3_4_x_NFV_S_Selection_Common_Service NFVIFA(22)000069_FEAT23_IFA039_7_4_1_7_4_2_Transformation_alternatives_update NFVIFA(22)000079r1_FEAT23_IFA039__7_4_3_SBA_Target_1_update NFVIFA(22)000080r1_FEAT23_IFA039_7_4_4_SBA_Target_2_update NFVIFA(22)000081r1_FEAT23_IFA039_7_4_5_SBA_Target_3_update NFVIFA(22)000082r1_FEAT23_IFA039_7_4_6_SBA_Target_4_update
11-03-2022	0.0.25	Update with contributions: NFVIFA(22)000130r1_FEAT23_IFA039_7_4_5_SBA_target_3_EN_resolution NFVIFA(22)000131_FEAT23_IFA039_7_4_1_EN_resolution NFVIFA(22)000132r1_FEAT23_IFA039_7_2_3_Pros_cons_analysis_update NFVIFA(22)000133r2_FEAT23_IFA039_7_2_2_16_SBA_coexistence_update NFVIFA(22)000134r1_FEAT23_IFA039_7_2_2_6_Service_granularity_EN_resolution
06-04-2022	0.0.26	Update with contributions: NFVIFA(22)000214r3_FEAT23_IFA039_Annex_on_documentation_scenarios Rapporteur action: alignment of numbering of nes annex. NFVIFA(22)000224r1_FEAT23_IFA039_8_x_Recommendations_for_the_solutions

Date	Version	Information about changes
06-05-2022	0.0.27	Update with contributions: NFVIFA(22)000286r2_FEAT23_IFA039_7_4_7_Evaluation_update
15-06-2022	0.0.28	Update with contributions: NFVIFA(22)000287r7_FEAT23_IFA039_8_x_Recommendations_for_targets NFVIFA(22)000295r4_FEAT23_IFA039_8_y_Recommendations_for_next_steps NFVIFA(22)000323r2_FEAT23_IFA039_Conclusion_clause
15-07-2022	0.0.29	Update with contributions: NFVIFA(22)000451r1_FEAT23_IFA039_8_x_7_Recommendation_for_security_gap NFVIFA(22)000452_FEAT23_IFA039_7_4_7_Removal_of_ENs
23-08-2022	0.0.30	Update with contributions: NFVIFA(22)000418r7_FEAT23_IFA039_specification_evolution_ NFVIFA(22)000511_FEAT23_IFA039_Review_Removal_of_empty_clauses NFVIFA(22)000582_FEAT23_IFA039_review_7_2_2_16_Coexistence_clarification NFVIFA(22)000583r1_FEAT23_IFA039_review_Release_5_alignment NFVIFA(22)000584r1_FEAT23_IFA039_review_NFV002_reference_removal NFVIFA(22)000598r1_FEAT23_IFA039_review_harmonization_with_IFA036 NFVIFA(22)000599r1_FEAT23_IFA039_review_3_3_Abbreviations_update NFVIFA(22)000600_FEAT23_IFA039_review_3_1_Terms_update NFVIFA(22)000601r2_FEAT23_IFA039__review_v029_editorial_cleanup NFVIFA(22)000602_FEAT23_IFA039_review_NFV_S_for_VRs_renumbering NFVIFA(22)000611r2_FEAT23_IFA039_review_Ericsson_cmmts_scope NFVIFA(22)000612r1_FEAT23_IFA039_review_Ericsson_cmmts_clause4 Rapporteur actions: - align terms and abbreviations with EDR - align tables styles with EDR - unify style for text paragraphs
13-09-2022	0.0.31	Update with contributions: NFVIFA(22)000606r2_FEAT23_IFA039_final_review_sections_3_and_4 NFVIFA(22)000607r2_FEAT23_IFA039_final_review_section_5 NFVIFA(22)000608r1_FEAT23_IFA039_final_review_section_6 NFVIFA(22)000613r2_FEAT23_IFA039_review_Ericsson_cmmts_clause5 NFVIFA(22)000614r3_FEAT23_IFA039_review_Ericsson_cmmts_clause7 NFVIFA(22)000622_FEAT23_IFA039_review_harmonization_of_NFV-MANO_communication NFVIFA(22)000642_FEAT23_IFA039_review_8_2_1_update Rapporteur actions: - corrections of capitalization - corrections on "a" versus "an"
06-10-2022	0.0.32	Update with contributions: NFVIFA(22)000585_FEAT23_IFA039_review_2_2_Informative_references_restructurin NFVIFA(22)000609r2_FEAT23_IFA039_final_review_section_8 NFVIFA(22)000615r3_FEAT23_IFA039_review_Ericsson_cmmts_clause8 NFVIFA(22)000616r4_FEAT23_IFA039_final_review_sections_7_1_and_7_2 NFVIFA(22)000617r2_FEAT23_IFA039_final_review_section_7_3 NFVIFA(22)000618r2_FEAT23_IFA039_final_review_section_7_4 Rapporteur actioms: - add "an SBA" to the text of the first recommendation in tables 8.2.4-1, 8.2.5-1, 8.2.6-1. - corrections of implementation of C609r2, C614r4, C615r3 - replacement of figures 6.2-1, 6.2-2, 6.2-3 (requested by C608r1) - harmonization of use of the term "NFV-S Registry Service" - adding missing reference to ETSI GS NFV-IFA 048 - deletion of unused reference to ETSI GS NFV-SOL 005 - add missing notes in clause 7.4.6.2.2 - replacement of "common data storage" with "common data repositories" - fonts and styles editorial alignment

History

Document history		
V5.1.1	December 2022	Publication