3GPP TS 29.510 V16.2.0 (2019-12)

Technical Specification

3rd Generation Partnership Project;

Technical Specification Group Core Network and Terminals;

5G System;

Network Function Repository Services;

Stage 3

(Release 16)

** 

The present document has been developed within the 3rd Generation Partnership Project (3GPP TM) and may be further elaborated for the purposes of 3GPP.  
The present document has not been subject to any approval process by the 3GPPOrganizational Partners and shall not be implemented.  
This Report is provided for future development work within 3GPPonly. The Organizational Partners accept no liability for any use of this Specification.  
Specifications and Reports for implementation of the 3GPP TM system should be obtained via the 3GPP Organizational Partners' Publications Offices.

Keywords

3GPP, 5GS

***3GPP***

Postal address

3GPP support office address

650 Route des Lucioles - Sophia Antipolis

Valbonne - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet

http://www.3gpp.org

***Copyright Notification***

No part may be reproduced except as authorized by written permission.  
The copyright and the foregoing restriction extend to reproduction in all media.

© 2019, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).

All rights reserved.

UMTS™ is a Trade Mark of ETSI registered for the benefit of its members

3GPP™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners  
LTE™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners

GSM® and the GSM logo are registered and owned by the GSM Association

Contents

Introduction 9

1 Scope 10

2 References 10

3 Definitions and abbreviations 11

3.1 Definitions 11

3.2 Abbreviations 11

4 Overview 12

5 Services Offered by the NRF 12

5.1 Introduction 12

5.2 Nnrf\_NFManagement Service 12

5.2.1 Service Description 12

5.2.2 Service Operations 13

5.2.2.1 Introduction 13

5.2.2.2 NFRegister 14

5.2.2.2.1 General 14

5.2.2.2.2 NF (other than NRF) registration to NRF 14

5.2.2.2.3 NRF registration to another NRF 15

5.2.2.3 NFUpdate 15

5.2.2.3.1 General 15

5.2.2.3.2 NF Heart-Beat 16

5.2.2.4 NFDeregister 17

5.2.2.4.1 General 17

5.2.2.5 NFStatusSubscribe 18

5.2.2.5.1 General 18

5.2.2.5.2 Subscription to NF Instances in the same PLMN 18

5.2.2.5.3 Subscription to NF Instances in a different PLMN 19

5.2.2.5.4 Subscription to NF Instances with intermediate forwarding NRF 20

5.2.2.5.5 Subscription to NF Instances with intermediate redirecting NRF 21

5.2.2.5.6 Update of Subscription to NF Instances 22

5.2.2.5.7 Update of Subscription to NF Instances in a different PLMN 22

5.2.2.6 NFStatusNotify 23

5.2.2.6.1 General 23

5.2.2.6.2 Notification from NRF in the same PLMN 23

5.2.2.6.3 Notification from NRF in a different PLMN 24

5.2.2.6.4 Notification for subscription via intermediate NRF 25

5.2.2.7 NFStatusUnSubscribe 25

5.2.2.7.1 General 25

5.2.2.7.2 Subscription removal in the same PLMN 25

5.2.2.7.3 Subscription removal in a different PLMN 26

5.2.2.8 NFListRetrieval 26

5.2.2.8.1 General 26

5.2.2.9 NFProfileRetrieval 27

5.2.2.9.1 General 27

5.3 Nnrf\_NFDiscovery Service 28

5.3.1 Service Description 28

5.3.2 Service Operations 28

5.3.2.1 Introduction 28

5.3.2.2 NFDiscover 28

5.3.2.2.1 General 28

5.3.2.2.2 Service Discovery in the same PLMN 28

5.3.2.2.3 Service Discovery in a different PLMN 29

5.3.2.2.4 Service Discovery with intermediate redirecting NRF 30

5.3.2.2.5 Service Discovery with intermediate forwarding NRF 31

5.4 Nnrf\_AccessToken Service 32

5.4.1 Service Description 32

5.4.2 Service Operations 32

5.4.2.1 Introduction 32

5.4.2.2 Get (Access Token Request) 32

5.4.2.2.1 General 32

5.4.2.2.2 Access Token request with intermediate forwarding NRF 33

5.4.2.2.3 Access Token request with intermediate redirecting NRF 34

5.5 Nnrf\_Bootstrapping Service 35

5.5.1 Service Description 35

5.5.2 Service Operations 35

5.5.2.1 Introduction 35

5.5.2.2 Get 35

5.5.2.2.1 General 35

6 API Definitions 36

6.1 Nnrf\_NFManagement Service API 36

6.1.1 API URI 36

6.1.2 Usage of HTTP 37

6.1.2.1 General 37

6.1.2.2 HTTP Standard Headers 37

6.1.2.2.1 General 37

6.1.2.2.2 Content type 37

6.1.2.2.3 Accept-Encoding 37

6.1.2.3 HTTP custom headers 37

6.1.2.3.1 General 37

6.1.3 Resources 37

6.1.3.1 Overview 37

6.1.3.2 Resource: nf-instances (Store) 39

6.1.3.2.1 Description 39

6.1.3.2.2 Resource Definition 39

6.1.3.2.3 Resource Standard Methods 40

6.1.3.2.3.1 GET 40

6.1.3.2.3.2 OPTIONS 40

6.1.3.2.4 Resource Custom Operations 41

6.1.3.3 Resource: nf-instance (Document) 41

6.1.3.3.1 Description 41

6.1.3.3.2 Resource Definition 41

6.1.3.3.3 Resource Standard Methods 41

6.1.3.3.3.1 GET 41

6.1.3.3.3.2 PUT 42

6.1.3.3.3.3 PATCH 42

6.1.3.3.3.4 DELETE 43

6.1.3.4 Resource: subscriptions (Collection) 44

6.1.3.4.1 Description 44

6.1.3.4.2 Resource Definition 44

6.1.3.4.3 Resource Standard Methods 44

6.1.3.4.3.1 POST 44

6.1.3.5 Resource: subscription (Document) 45

6.1.3.5.1 Description 45

6.1.3.5.2 Resource Definition 45

6.1.3.5.3 Resource Standard Methods 45

6.1.3.5.3.1 DELETE 45

6.1.3.5.3.2 PATCH 45

6.1.4 Custom Operations without associated resources 46

6.1.5 Notifications 46

6.1.5.1 General 46

6.1.5.2 NF Instance Status Notification 46

6.1.5.2.1 Description 46

6.1.5.2.2 Notification Definition 46

6.1.6 Data Model 47

6.1.6.1 General 47

6.1.6.2 Structured data types 50

6.1.6.2.1 Introduction 50

6.1.6.2.2 Type: NFProfile 51

6.1.6.2.3 Type: NFService 57

6.1.6.2.4 Type: DefaultNotificationSubscription 60

6.1.6.2.5 Type: IpEndPoint 61

6.1.6.2.6 Type: UdrInfo 61

6.1.6.2.7 Type: UdmInfo 61

6.1.6.2.8 Type: AusfInfo 62

6.1.6.2.9 Type: SupiRange 62

6.1.6.2.10 Type: IdentityRange 63

6.1.6.2.11 Type: AmfInfo 63

6.1.6.2.12 Type: SmfInfo 65

6.1.6.2.13 Type: UpfInfo 66

6.1.6.2.14 Type: SnssaiUpfInfoItem 67

6.1.6.2.15 Type: DnnUpfInfoItem 67

6.1.6.2.16 Type: SubscriptionData 68

6.1.6.2.17 Type: NotificationData 70

6.1.6.2.18 Void 71

6.1.6.2.19 Type: NFServiceVersion 71

6.1.6.2.20 Type: PcfInfo 71

6.1.6.2.21 Type: BsfInfo 72

6.1.6.2.22 Type: Ipv4AddressRange 72

6.1.6.2.23 Type: Ipv6PrefixRange 72

6.1.6.2.24 Type: InterfaceUpfInfoItem 72

6.1.6.2.25 Type: UriList 72

6.1.6.2.26 Type: N2InterfaceAmfInfo 73

6.1.6.2.27 Type: TaiRange 73

6.1.6.2.28 Type: TacRange 73

6.1.6.2.29 Type: SnssaiSmfInfoItem 74

6.1.6.2.30 Type: DnnSmfInfoItem 74

6.1.6.2.31 Type: NrfInfo 75

6.1.6.2.32 Type: ChfInfo 77

6.1.6.2.33 Type: ChfServiceInfo 77

6.1.6.2.34 Type: PlmnRange 77

6.1.6.2.35 Type: SubscrCond 78

6.1.6.2.36 Type: NfInstanceCond 78

6.1.6.2.37 Type: NfTypeCond 78

6.1.6.2.38 Type: ServiceNameCond 78

6.1.6.2.39 Type: AmfCond 79

6.1.6.2.40 Type: GuamiListCond 79

6.1.6.2.41 Type: NetworkSliceCond 79

6.1.6.2.42 Type: NfGroupCond 79

6.1.6.2.43 Type: NotifCondition 80

6.1.6.2.44 Type: PlmnSnssai 80

6.1.6.2.45 Type: NwdafInfo 80

6.1.6.2.46 Type: LmfInfo 81

6.1.6.2.47 Type: GmlcInfo 81

6.1.6.2.48 Type: NefInfo 81

6.1.6.2.49 Type: PfdData 82

6.1.6.2.50 Type: AfEventExposureData 82

6.1.6.2.51 Type: WAgfInfo 82

6.1.6.2.52 Type: TngfInfo 82

6.1.6.2.53 Type: PcscfInfo 82

6.1.6.2.54 Type: NfSetCond 83

6.1.6.2.55 Type: NfServiceSetCond 83

6.1.6.2.56 Type: NfInfo 83

6.1.6.2.57 Type: HssInfo 83

6.1.6.2.58 Type: ImsiRange 84

6.1.6.2.59 Type: InternalGroupIdRange 84

6.1.6.3 Simple data types and enumerations 84

6.1.6.3.1 Introduction 84

6.1.6.3.2 Simple data types 84

6.1.6.3.3 Enumeration: NFType 84

6.1.6.3.4 Enumeration: NotificationType 85

6.1.6.3.5 Enumeration: TransportProtocol 85

6.1.6.3.6 Enumeration: NotificationEventType 86

6.1.6.3.7 Enumeration: NFStatus 86

6.1.6.3.8 Enumeration: DataSetId 86

6.1.6.3.9 Enumeration: UPInterfaceType 86

6.1.6.3.10 Relation Types 86

6.1.6.3.10.1 General 86

6.1.6.3.11 Enumeration: ServiceName 87

6.1.6.3.12 Enumeration: NFServiceStatus 88

6.1.7 Error Handling 88

6.1.7.1 General 88

6.1.7.2 Protocol Errors 88

6.1.7.3 Application Errors 88

6.1.8 Security 88

6.2 Nnrf\_NFDiscovery Service API 89

6.2.1 API URI 89

6.2.2 Usage of HTTP 89

6.2.2.1 General 89

6.2.2.2 HTTP Standard Headers 89

6.2.2.2.1 General 89

6.2.2.2.2 Content type 89

6.2.2.2.3 Cache-Control 89

6.2.2.2.4 ETag 89

6.2.2.2.5 If-None-Match 89

6.2.2.3 HTTP custom headers 90

6.2.2.3.1 General 90

6.2.3 Resources 90

6.2.3.1 Overview 90

6.2.3.2 Resource: nf-instances (Store) 91

6.2.3.2.1 Description 91

6.2.3.2.2 Resource Definition 91

6.2.3.2.3 Resource Standard Methods 91

6.2.3.2.3.1 GET 91

6.2.3.2.4 Resource Custom Operations 99

6.2.3.3 Resource: Stored Search (Document) 99

6.2.3.3.1 Description 99

6.2.3.3.2 Resource Definition 99

6.2.3.3.2.1 GET 100

6.2.3.4 Resource: Complete Stored Search (Document) 100

6.2.3.4.1 Description 100

6.2.3.4.2 Resource Definition 100

6.2.3.4.2.1 GET 101

6.2.4 Custom Operations without associated resources 101

6.2.5 Notifications 101

6.2.6 Data Model 101

6.2.6.1 General 101

6.2.6.2 Structured data types 103

6.2.6.2.1 Introduction 103

6.2.6.2.2 Type: SearchResult 104

6.2.6.2.3 Type: NFProfile 105

6.2.6.2.4 Type: NFService 109

6.2.6.2.5 Type: StoredSearchResult 110

6.2.6.2.6 Type: PreferredSearch 110

6.2.6.3 Simple data types and enumerations 110

6.2.6.3.1 Introduction 110

6.2.6.3.2 Simple data types 110

6.2.7 Error Handling 110

6.2.7.1 General 110

6.2.7.2 Protocol Errors 110

6.2.7.3 Application Errors 110

6.2.8 Security 111

6.2.9 Features supported by the NFDiscovery service 111

6.3 Nnrf\_AccessToken Service API 112

6.3.1 General 112

6.3.2 API URI 112

6.3.3 Usage of HTTP 112

6.3.3.1 General 112

6.3.3.2 HTTP standard headers 112

6.3.3.2.1 General 112

6.3.3.2.2 Content type 112

6.3.3.3 HTTP custom headers 112

6.3.3.3.1 General 112

6.3.4 Custom Operation without Associated Resources 112

6.3.4.1 Overview 112

6.3.4.2 Operation: Get (Access Token Request) 113

6.3.4.2.1 Description 113

6.3.4.2.2 Operation Definition 113

6.3.5 Data Model 113

6.3.5.1 General 113

6.3.5.2 Structured data types 114

6.3.5.2.1 Introduction 114

6.3.5.2.2 Type: AccessTokenReq 115

6.3.5.2.3 Type: AccessTokenRsp 116

6.3.5.2.4 Type: AccessTokenClaims 117

6.3.5.3 Simple data types and enumerations 117

6.3.5.3.1 Introduction 117

6.3.5.3.2 Simple data types 118

6.3.5.3.3 Enumeration: GrantType 118

6.3.5.4 Data types describing alternative data types or combinations of data types 118

6.3.5.4.1 Type: Audience 118

6.4 Nnrf\_Bootstrapping Service API 118

6.4.1 API URI 118

6.4.2 Usage of HTTP 118

6.4.2.1 General 118

6.4.2.2 HTTP standard headers 118

6.4.2.2.1 General 118

6.4.2.2.2 Content type 118

6.4.2.3 HTTP custom headers 119

6.4.2.3.1 General 119

In this release of this specification, no custom headers specific to the Nnrf\_Bootstrapping Service API are defined. For 3GPP specific HTTP custom headers used across all service-based interfaces, see clause 5.2.3 of 3GPP TS 29.500 [4].6.4.3 Resources 119

6.4.3.1 Overview 119

6.4.3.2 Resource: Bootstrapping (Document) 119

6.4.3.2.1 Description 119

6.4.3.2.2 Resource Definition 119

6.4.3.2.3 Resource Standard Methods 120

6.4.3.2.3.1 GET 120

6.4.4 Custom Operations without associated resources 120

6.4.5 Notifications 120

There are no notifications defined for the Nnrf\_Bootstrapping service in this release of the specification.6.4.6 Data Model 120

6.4.6.1 General 120

6.4.6.2 Structured data types 121

6.4.6.2.1 Introduction 121

6.4.6.2.2 Type: BootstrappingInfo 121

6.4.6.3 Simple data types and enumerations 121

6.4.6.3.1 Introduction 121

6.4.6.3.2 Enumeration: Status 121

6.4.6.3.3 Relation Types 121

6.4.6.3.3.1 General 121

Annex A (normative): OpenAPI specification 122

A.1 General 122

A.2 Nnrf\_NFManagement API 122

A.3 Nnrf\_NFDiscovery API 147

A.4 Nnrf\_AccessToken API (NRF OAuth2 Authorization) 158

A.5 Nnrf\_Bootstrapping API 161

Annex B (normative): NF Profile changes in NFRegister and NFUpdate (NF Profile Complete Replacement) responses 161

B.1 General 161

Annex C (informative): Change history 163

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

# Introduction

This clause is optional. If it exists, it is always the second unnumbered clause.

# 1 Scope

The present document specifies the stage 3 protocol and data model for the Nnrf Service Based Interface. It provides stage 3 protocol definitions and message flows, and specifies the API for each service offered by the NRF.

The 5G System stage 2 architecture and procedures are specified in 3GPP TS 23.501 [2] and 3GPP TS 23.502 [3].

The Technical Realization of the Service Based Architecture and the Principles and Guidelines for Services Definition are specified in 3GPP TS 29.500 [4] and 3GPP TS 29.501 [5].

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".

[3] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".

[4] 3GPP TS 29.500: "5G System; Technical Realization of Service Based Architecture; Stage 3".

[5] 3GPP TS 29.501: "5G System; Principles and Guidelines for Services Definition; Stage 3".

[6] 3GPP TS 29.518: "5G System; Access and Mobility Management Services; Stage 3".

[7] 3GPP TS 29.571: "5G System; Common Data Types for Service Based Interfaces; Stage 3".

[8] ECMA-262: "ECMAScript® Language Specification", <https://www.ecma-international.org/ecma-262/5.1/>.

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

[10] OpenAPI Initiative, "OpenAPI 3.0.0 Specification", <https://github.com/OAI/OpenAPI-Specification/blob/master/versions/3.0.0.md>.

[11] IETF RFC 7807: "Problem Details for HTTP APIs".

[12] 3GPP TS 23.003: "Numbering, Addressing and Identification".

[13] IETF RFC 6902: "JavaScript Object Notation (JSON) Patch".

[14] IETF RFC 6901: "JavaScript Object Notation (JSON) Pointer".

[15] 3GPP TS 33.501: "Security architecture and procedures for 5G system".

[16] IETF RFC 6749: "The OAuth 2.0 Authorization Framework".

[17] IETF RFC 3986: "Uniform Resource Identifier (URI): Generic Syntax".

[18] IETF RFC 4122: "A Universally Unique IDentifier (UUID) URN Namespace".

[19] IETF RFC 7232: "Hypertext Transfer Protocol (HTTP/1.1): Conditional Requests".

[20] IETF RFC 7234: "Hypertext Transfer Protocol (HTTP/1.1): Caching".

[21] 3GPP TS 29.244: "Interface between the Control Plane and the User Plane Nodes; Stage 3".

[22] IETF RFC 8259: "The JavaScript Object Notation (JSON) Data Interchange Format".

[23] IETF RFC 2782: "A DNS RR for specifying the location of services (DNS SRV)".

[24] IETF RFC 7515: "JSON Web Signature (JWS)".

[25] IETF RFC 7519: "JSON Web Token (JWT)".

[26] W3C HTML 4.01 Specification, <https://www.w3.org/TR/2018/SPSD-html401-20180327/>.

[27] 3GPP TS 23.527: "5G System; Restoration Procedures; Stage 2".

[28] 3GPP TS 29.513: "5G System; Policy and Charging Control signalling flows and QoS parameter mapping; Stage 3".

[29] 3GPP TS 38.413: "NG-RAN; NG Application Protocol (NGAP)".

[30] IETF RFC 1952: "GZIP file format specification version 4.3".

[31] 3GPP TR 21.900: "Technical Specification Group working methods".

[32] 3GPP TS 29.520: "5G System; Network Data Analytics Services; Stage 3".

[33] 3GPP TS 29.572: "5G System; Location Management Services; Stage 3".

[34] 3GPP TS 23.288: "Architecture enhancements for 5G System (5GS) to support network data analytics services".

[35] 3GPP TS 29.517: "Application Function Event Exposure Service".

[36] 3GPP TS 29.503: "Unified Data Management Services".

[37] 3GPP TS 29.336: "Home Subscriber Server (HSS) diameter interfaces for interworking with packet data networks and applications".

# 3 Definitions and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

5GC 5G Core Network

CHF Charging Function

NF Network Function

NRF NF Repository Function

NWDAF Network Data Analytics Function

PFD Packet Flow Description

SNPN Stand-alone Non-Public Network

# 4 Overview

The Network Function (NF) Repository Function (NRF) is the network entity in the 5G Core Network (5GC) supporting the following functionality:

- Maintains the NF profile of available NF instances and their supported services;

- Allows other NF instances to subscribe to, and get notified about, the registration in NRF of new NF instances of a given type;

- Supports service discovery function. It receives NF Discovery Requests from NF instances, and provides the information of the available NF instances fulfilling certain criteria (e.g., supporting a given service).

Figures 4-1 shows the reference architecture for the 5GC, with focus on the NRF:



Figure 4-1: 5G System architecture

For the sake of clarity, the NRF is never depicted in reference point representation figures, given that the NRF interacts with every other NF in the 5GC. As an exception, in the roaming case, the reference point between the vNRF and the hNRF is named as N27. The reference point name of N27 is used only for representation purposes, but its functionality is included in the services offered by the Nnrf Service-Based Interface.

# 5 Services Offered by the NRF

## 5.1 Introduction

The NRF offers to other NFs the following services:

- Nnrf\_NFManagement

- Nnrf\_NFDiscovery

- Nnrf\_AccessToken (OAuth2 Authorization)

## 5.2 Nnrf\_NFManagement Service

### 5.2.1 Service Description

The Nnrf\_NFManagement service allows a Network Function Instance in the serving PLMN to register, update or deregister its profile in the NRF.

The Nnrf\_NFManagement service also allows an NRF Instance to register, update or deregister its profile in another NRF in the same PLMN.

NOTE: Alternatively, other means such as OA&M can also be used to register, update or deregister NRF profile in another NRF.

It also allows an NF to subscribe to be notified of registration, deregistration and profile changes of NF Instances along with their NF services.

The NF profile consists of general parameters of the NF Instance, and also the parameters of the different NF Service Instances exposed by the NF Instance.

The PLMN of the NRF may comprise one or multiple PLMN IDs (i.e. MCC and MNC). An NRF configured with multiple PLMN IDs shall support registering, updating and deregistering the profile of Network Function Instances from any of these PLMN IDs.

The Nnrf\_NFManagement service also allows retrieving a list of NF Instances currently registered in the NRF or the NF Profile of a given NF Instance.

### 5.2.2 Service Operations

#### 5.2.2.1 Introduction

The services operations defined for the Nnrf\_NFManagement service are as follows:

- NFRegister: It allows an NF Instance to register its NF profile in the NRF; it includes the registration of the general parameters of the NF Instance, together with the list of services exposed by the NF Instance. This service operation is not allowed to be invoked from an NRF in a different PLMN.

- NFUpdate: It allows an NF Instance to replace, or update partially, the parameters of its NF profile (including the parameters of the associated services) in the NRF; it also allows to add or delete individual services offered by the NF Instance. This service operation is not allowed to be invoked from an NRF in a different PLMN.

- NFDeregister: It allows an NF Instance to deregister its NF profile in the NRF, including the services offered by the NF Instance. This service operation is not allowed to be invoked from an NRF in a different PLMN.

- NFStatusSubscribe: It allows an NF Instance to subscribe to changes on the status of NF Instances registered in NRF. This service operation can be invoked by an NF Instance in a different PLMN (via the local NRF in that PLMN).

- NFStatusNotify: It allows the NRF to notify subscribed NF Instances of changes on the status of NF Instances. This service operation can be invoked directly between the NRF and an NF Instance in a different PLMN (without involvement of the local NRF in that PLMN).

- NFStatusUnsubscribe: It allows an NF Instance to unsubscribe to changes on the status of NF Instances registered in NRF. This service operation can be invoked by an NF Instance in a different PLMN (via the local NRF in that PLMN).

NOTE 1: The "change of status" of the NFStatus service operations can imply a request to be notified of newly registered NF Instances in NRF, or to be notified of profile changes of a specific NF Instance, or to be notified of the deregistration of an NF Instance.

NOTE 2: An NRF instance can also use the NFRegister, NFUpdate or NFDeregister service operations or OA&M system to register, update or deregister its profile in another NRF in the same PLMN.

- NFListRetrieval: It allows retrieving a list of NFs currently registered in the NRF. This service operation is not allowed to be invoked from an NRF in a different PLMN.

- NFProfileRetrieval: It allows retrieving the NF Profile of a given NF instance. This service operation is not allowed to be invoked from an NRF in a different PLMN.

The NFStatusSubscribe / NFstatusNotify / NFStatusUnsubscribe operations can be invoked by an NF Service Consumer (i.e., "source NF") requesting to be notified about events (registration, deregistration, profile change) related to an NF instance (i.e., "target NF") located in the same PLMN, or in a different PLMN.

In the description of these operations in clauses 5.2.2.5, 5.2.2.6 and 5.2.2.7, when the NF instances are located in the same PLMN, both source NF and target NF are said to be located in the "Serving PLMN" but, in the general case, the functionality is not restricted to the PLMN that is serving a given UE, and it shall be applicable as well to any scenario in which source NF and target NFs belong to the same PLMN.

When source NF and target NF are located in different PLMNs, the source NF is said to be in the "Serving PLMN", and the target NF (and the NRF where such NF is registered) is said to be in the "Home PLMN", similarly to the scenarios described in 3GPP TS 23.502 [3], but the functionality shall be equally applicable to any scenario between any pair of PLMNs (e.g. with the source NF in the Home PLMN and the target NF in the Serving PLMN).

#### 5.2.2.2 NFRegister

##### 5.2.2.2.1 General

This service operation is used:

- to register an NF in the NRF by providing the NF profile of the requesting NF to the NRF, and the NRF marks the requesting NF as available to be discovered by other NFs;

- to register services associated to an existing NF Instance;

- to register NRF information in another NRF, and this information is used for forwarding or redirecting service discovery request.

##### 5.2.2.2.2 NF (other than NRF) registration to NRF



Figure 5.2.2.2.2-1: NF Instance Registration

1. The NF Service Consumer shall send a PUT request to the resource URI representing the NF Instance. The URI is determined by the NF Instance. The variable {nfInstanceID} represents an identifier, provided by the NF Service Consumer, that shall be globally unique inside the PLMN of the NRF where the NF is being registered. The format of the NF Instance ID shall be a Universally Unique Identifier (UUID) version 4, as described in IETF RFC 4122 [18].

EXAMPLE: UUID version 4: "4947a69a-f61b-4bc1-b9da-47c9c5d14b64"

The payload body of the PUT request shall contain a representation of the NF Instance to be created.

2. On success, "201 Created" shall be returned, the payload body of the PUT response shall contain the representation of the created resource and the "Location" header shall contain the URI of the created resource. Additionally, the NRF returns a "heart-beat timer" containing the number of seconds expected between two consecutive heart-beat messages from an NF Instance to the NRF (see clause 5.2.2.3.2). The representation of the created resource may be a complete NF Profile or a NF Profile just including the mandatory attributes of the NF Profile and the attributes which the NRF added or changed (see Annex B).

If the registration of the NF instance fails at the NRF due to errors in the encoding of the NFProfile JSON object, the NRF shall return "400 Bad Request" status code with the ProblemDetails IE providing details of the error.

If the registration of the NF instance fails at the NRF due to NRF internal errors, the NRF shall return "500 Internal Server Error" status code with the ProblemDetails IE providing details of the error.

The NRF shall allow the registration of a Network Function instance with any of the NF types described in clause 6.1.6.3.3, and it shall also allow registration of Network Function instances with custom NF types (e.g., NF type values not defined by 3GPP, or NF type values not defined by this API version).

NOTE: When registering a custom NF in NRF, it is recommended to use a NF type name that prevents collisions with other custom NF type names, or with NF types defined in the future by 3GPP. E.g., prefixing the custom NF type name with the string "CUSTOM\_".

During the registration of a Network Function instance with a custom NF type, the NF instance may provide NF-specific data (in the "customInfo" attribute), that shall be stored by the NRF as part of the NF profile of the NF instance.

The NRF shall accept the registration of NF Instances containing Vendor-Specific attributes (see 3GPP TS 29.500 [4], clause 6.6.3), and therefore, it shall accept NF Profiles containing attributes whose type may be unknown to the NRF, and those attributes shall be stored as part of the NF's profile data in NRF.

##### 5.2.2.2.3 NRF registration to another NRF

The procedure specified in clause 5.2.2.2.2 applies. Additionally:

a) the registering NRF shall set the nfType to "NRF" in the nfProfile;

b) the registering NRF shall set the nfService to contain "nnrf-disc" and "nnrf-nfm" in the nfProfile;

c) the registering NRF may include nrfInfo which contains the information of udrInfo, udmInfo, ausfInfo, amfInfo, smfInfo, upfInfo, pcfInfo, bsfInfo, nefInfo, chfInfo, pcscfInfo, lmfInfo, gmlcInfo and nfInfo in the nfProfile locally configured in the NRF or the NRF received during registration of other NFs, this means the registering NRF is able to provide service for discovery of NFs subject to that information;

d) if the NRF receives an NF registration with the nfType set to "NRF", the NRF shall use the information contained in the nfProfile to target the registering NRF when forwarding or redirecting NF service discovery request.

#### 5.2.2.3 NFUpdate

##### 5.2.2.3.1 General

This service operation updates the profile of a Network Function previously registered in the NRF by providing the updated NF profile of the requesting NF to the NRF. The update operation may apply to the whole profile of the NF (complete replacement of the existing profile by a new profile), or it may apply only to a subset of the parameters of the profile (including adding/deleting/replacing services to the NF profile).

To perform a complete replacement of the NF Profile of a given NF Instance, the NF Service Consumer shall issue an HTTP PUT request, as shown in Figure 5.2.2.3.1-1:



Figure 5.2.2.3.1-1: NF Profile Complete Replacement

1. The NF Service Consumer shall send a PUT request to the resource URI representing the NF Instance. The payload body of the PUT request shall contain a representation of the NF Instance to be completely replaced in the NRF.

2a. On success, "200 OK" shall be returned, the payload body of the PUT response shall contain the representation of the replaced resource. The representation of the replaced resource may be a complete NF Profile or a NF Profile just including the mandatory attributes of the NF Profile and the attributes which the NRF added or changed (see Annex B).

2b. If the update of the NF instance fails at the NRF due to errors in the encoding of the NFProfile JSON object, the NRF shall return "400 Bad Request" status code with the ProblemDetails IE providing details of the error.

If the update of the NF instance fails at the NRF due to NRF internal errors, the NRF shall return "500 Internal Server Error" status code with the ProblemDetails IE providing details of the error.

To perform a partial update of the NF Profile of a given NF Instance, the NF Service Consumer shall issue an HTTP PATCH request, as shown in Figure 5.2.2.3.1-2. This partial update shall be used to add/delete/replace individual parameters of the NF Instance, and also to add/delete/replace any of the services (and their parameters) offered by the NF Instance.



Figure 5.2.2.3.1-2: NF Profile Partial Update

1. The NF Service Consumer shall send a PATCH request to the resource URI representing the NF Instance. The payload body of the PATCH request shall contain the list of operations (add/delete/replace) to be applied to the NF Profile of the NF Instance; these operations may be directed to individual parameters of the NF Profile or to the list of services (and their parameters) offered by the NF Instances. In order to leave the NF Profile in a consistent state, all the operations specified by the PATCH request body shall be executed atomically.

2a. On success, "200 OK" shall be returned, the payload body of the PATCH response shall contain the representation of the replaced resource.

2b. If the NF Instance, identified by the "nfInstanceID", is not found in the list of registered NF Instances in the NRF's database, the NRF shall return "404 Not Found" status code with the ProblemDetails IE providing details of the error.

The NRF shall allow updating Vendor-Specific attributes (see 3GPP TS 29.500 [4], clause 6.6.3) that may exist in the NF Profile of a registered NF Instance.

##### 5.2.2.3.2 NF Heart-Beat

Each NF that has previously registered in NRF shall contact the NRF periodically (heart-beat), by invoking the NFUpdate service operation, in order to show that the NF is still operative.

The time interval at which the NRF shall be contacted is deployment-specific, and it is returned by the NRF to the NF Service Consumer as a result of a successful registration.

When the NRF detects that a given NF has not updated its profile for a configurable amount of time (longer than the heart-beat interval), the NRF changes the status of the NF to SUSPENDED and considers that the NF and its services can no longer be discovered by other NFs via the NFDiscovery service. The NRF notifies NFs subscribed to receiving notifications of changes of the NF Profile that the NF status has been changed to SUSPENDED.

If the NRF modifies the heart-beat interval value of a given NF instance currently registered (e.g. as a result of an OA&M operation), it shall return the new value to the registered NF in the response of the next periodic heart-beat interaction received from that NF and, until then, the NRF shall apply the heart-beat check procedure according to the original interval value.



Figure 5.2.2.3.2-1: NF Heart-Beat

1. The NF Service Consumer shall send a PATCH request to the resource URI representing the NF Instance. The payload body of the PATCH request shall contain a "replace" operation on the "nfStatus" attribute of the NF Profile of the NF Instance, and set it to the value "REGISTERED" or "UNDISCOVERABLE".

In addition, the NF Service Consumer may also provide the load information of the NF, and/or the load information of the NF associated NF services. The provision of such load information may be limited by this NF via appropriate configuration (e.g. granularity threshold) in order to avoid notifying minor load changes.

2a. On success, the NRF should return "204 No Content"; the NRF may also answer with "200 OK" along with the full NF Profile, e.g. in cases where the NRF determines that the NF Profile has changed significantly since the last heart-beat, and wants to send the new profile to the NF Service Consumer (note that this alternative has bigger signalling overhead).

2b. If the NF Instance, identified by the "nfInstanceID", is not found in the list of registered NF Instances in the NRF's database, the NRF shall return "404 Not Found" status code with the ProblemDetails IE providing details of the error.

EXAMPLE:

PATCH .../nf-instances/4947a69a-f61b-4bc1-b9da-47c9c5d14b64

Content-Type: application/json-patch+json

[

{ "op": "replace", "path": "/nfStatus", "value": "REGISTERED" },

{ "op": "replace", "path": "/load", "value": 50 }

]

HTTP/2 204 No Content

Content-Location: .../nf-instances/4947a69a-f61b-4bc1-b9da-47c9c5d14b64

#### 5.2.2.4 NFDeregister

##### 5.2.2.4.1 General

This service operation removes the profile of a Network Function previously registered in the NRF.

It is executed by deleting a given resource identified by a "NF Instance ID". The operation is invoked by issuing a DELETE request on the URI representing the specific NF Instance.



Figure 5.2.2.4.1-1: NF Instance Deregistration

1. The NF Service Consumer shall send a DELETE request to the resource URI representing the NF Instance. The request body shall be empty.

2a. On success, "204 No Content" shall be returned. The response body shall be empty.

2b. If the NF Instance, identified by the "nfInstanceID", is not found in the list of registered NF Instances in the NRF's database, the NRF shall return "404 Not Found" status code with the ProblemDetails IE providing details of the error.

#### 5.2.2.5 NFStatusSubscribe

##### 5.2.2.5.1 General

This service operation is used to:

- create a subscription so an NF Service Consumer can request to be notified when NF Instances of a given set, following certain filter criteria are registered/deregistered in NRF or when their profile is modified;

- create a subscription to a specific NF Instance so an NF Service Consumer can request to be notified when the profile of such NF Instance is modified or when the NF Instance is deregistered from NRF.

##### 5.2.2.5.2 Subscription to NF Instances in the same PLMN

The subscription to notifications on NF Instances is executed creating a new individual resource under the collection resource "subscriptions". The operation is invoked by issuing a POST request on the URI representing the "subscriptions" resource.



Figure 5.2.2.5.2-1: Subscription to NF Instances in the same PLMN

1. The NF Service Consumer shall send a POST request to the resource URI representing the "subscriptions" collection resource.

The request body shall include the data indicating the type of notifications that the NF Service Consumer is interested in receiving; it also contains a callback URI, where the NF Service Consumer shall be prepared to receive the actual notification from the NRF (see NFStatusNotify operation in 5.2.2.6) and it may contain a validity time, suggested by the NF Service Consumer, representing the time span during which the subscription is desired to be kept active.

The subscription request may also include additional parameters indicating the list of attributes (including Vendor-Specific attributes, see 3GPP TS 29.500 [4], clause 6.6.3) in the NF Profile to be monitored (or to be excluded from monitoring), in order to determine whether a notification from NRF should be sent, or not, when any of those attributes is changed in the profile.

The NF Service Consumer may request the creation of a subscription to a specific NF Instance, or to a set of NF Instances, where the set is determined according to different criteria specified in the request body, in the "subscrCond" attribute of the "SubscriptionData" object type (see clause 6.1.6.2.16).

The subscription shall be authorized, or rejected, by the NRF by checking the "reqNfType" and "reqNfFqdn" input attributes in the subscription request body (along with the contents of any optional Oauth2 access token provided in the API request) against the list of authorization attributes in the NF Profile of the target NF Instance to be monitored.

When the subscription request is for a set of NFs, the authorization attributes of the NF Instances in the set may differ, resulting in positive authorization of the subscription for only a part of the NF Instances in the set; in that case, the subscription to the set of NFs may be accepted by the NRF, but the NF Instances in the set that are not authorized for the NF Service Consumer that requested the subscription, shall not result in triggering any notification event from the NRF to the NF Service Consumer.

2a. On success, "201 Created" shall be returned. The response shall contain the data related to the created subscription, including the validity time, as determined by the NRF, after which the subscription becomes invalid. Once the subscription expires, if the NF Service Consumer wants to keep receiving status notifications, it shall create a new subscription in the NRF.

2b. If the creation of the subscription fails at the NRF due to errors in the SubscriptionData JSON object in the request body, the NRF shall return "400 Bad Request" status code with the ProblemDetails IE providing details of the error.

If the creation of the subscription fails at the NRF due to NRF internal errors, the NRF shall return "500 Internal Server Error" status code with the ProblemDetails IE providing details of the error.

##### 5.2.2.5.3 Subscription to NF Instances in a different PLMN

The subscription to notifications on NF Instances in a different PLMN is done by creating a resource under the collection resource "subscriptions", in the NRF of the Home PLMN.

For that, step 1 in clause 5.2.2.5.2 is executed (send a POST request to the NRF in the Serving PLMN); this request shall include the identity of the PLMN of the home NRF in the SubscriptionData parameter in the request body.

Then, steps 1-2 in Figure 5.2.2.5.3-1 are executed, between the NRF in the Serving PLMN and the NRF in the Home PLMN. In this step, the presence of the PLMN ID in the SubscriptionData parameter is not required. The NRF in the Home PLMN returns a subscriptionID identifying the created subscription.

Finally, step 2 in clause 5.2.2.5.2 is executed; a new subscriptionID shall be generated by the NRF in the Serving PLMN as indicated in step 2 of Figure 5.2.2.5.3-1, and shall be sent to the NF Service Consumer in the Serving PLMN.



Figure 5.2.2.5.3-1: Subscription to NF Instances in a different PLMN

1. The NRF in Serving PLMN shall send a POST request to the resource URI in the NRF in Home PLMN representing the "subscriptions" collection resource. The request body shall include the SubscriptionData as received by the NRF in Serving PLMN from the NF Service Consumer in the Serving PLMN (see 5.2.2.5.2), containing the data about the type of notifications that the NF Service Consumer is interested in receiving and the callback URI where the NF Service Consumer shall be prepared to receive the notifications from the NRF (see NFStatusNotify operation in 5.2.2.6).

2a. On success, "201 Created" shall be returned. The NRF in Serving PLMN should not keep state for this created subscription and shall send to the NF Service Consumer in Serving PLMN (step 2 in 5.2.2.5.2) a subscriptionID that shall consist on the following structure: <MCC>+<MNC>+"-"+<OriginalSubscriptionID>

EXAMPLE: If the NRF in a Home PLMN (where MCC = 123, and MNC=456) creates a subscription with value "subs987654", the subscriptionID that the NRF in Serving PLMN would send to the NF Service Consumer in Serving PLMN is: "123456-subs987654"

The URI in the Location header that the NRF in Serving PLMN returns to the NF Service Consumer in Serving PLMN shall contain a <subscriptionId> modified as described above and, if it is as an absolute URI, an apiRoot pointing to the address of the NRF in Serving PLMN.

2b. If the creation of the subscription fails at the NRF due to errors in the SubscriptionData JSON object in the request body, the NRF shall return "400 Bad Request" status code with the ProblemDetails IE providing details of the error.

If the creation of the subscription fails at the NRF due to NRF internal errors, the NRF shall return "500 Internal Server Error" status code with the ProblemDetails IE providing details of the error.

##### 5.2.2.5.4 Subscription to NF Instances with intermediate forwarding NRF

When multiple NRFs are deployed in one PLMN, an NF Instance can subscribe to changes of NF Instances registered in an NRF to which it is not directly interacting. The subscription message is forwarded by an intermediate NRF to which the subscribing NF instance is directly interacting.

For that, step 1 in clause 5.2.2.5.2 is executed (send a POST request to the NRF-1 in the Serving PLMN); this request shall include the SubscriptionData parameter in the request body.

Then, steps 1-4 in Figure 5.2.2.5.4-1 are executed between NF Service Consumer in Serving PLMN, NRF-1 in Serving PLMN and NRF-2 in Serving PLMN. In thest steps, NRF-1 sends the subscription request to a pre-configured NRF-2. NRF-2 requests corresponding NRF (e.g. the NF Service Producer registered NRF) and returns a subscriptionID identifying the created subscription and this subscriptionID is sent to the NF Service Consumer via NRF-1.

Finally, step 2 in clause 5.2.2.5.2 is executed; the subscriptionID shall be sent to the NF Service Consumer.

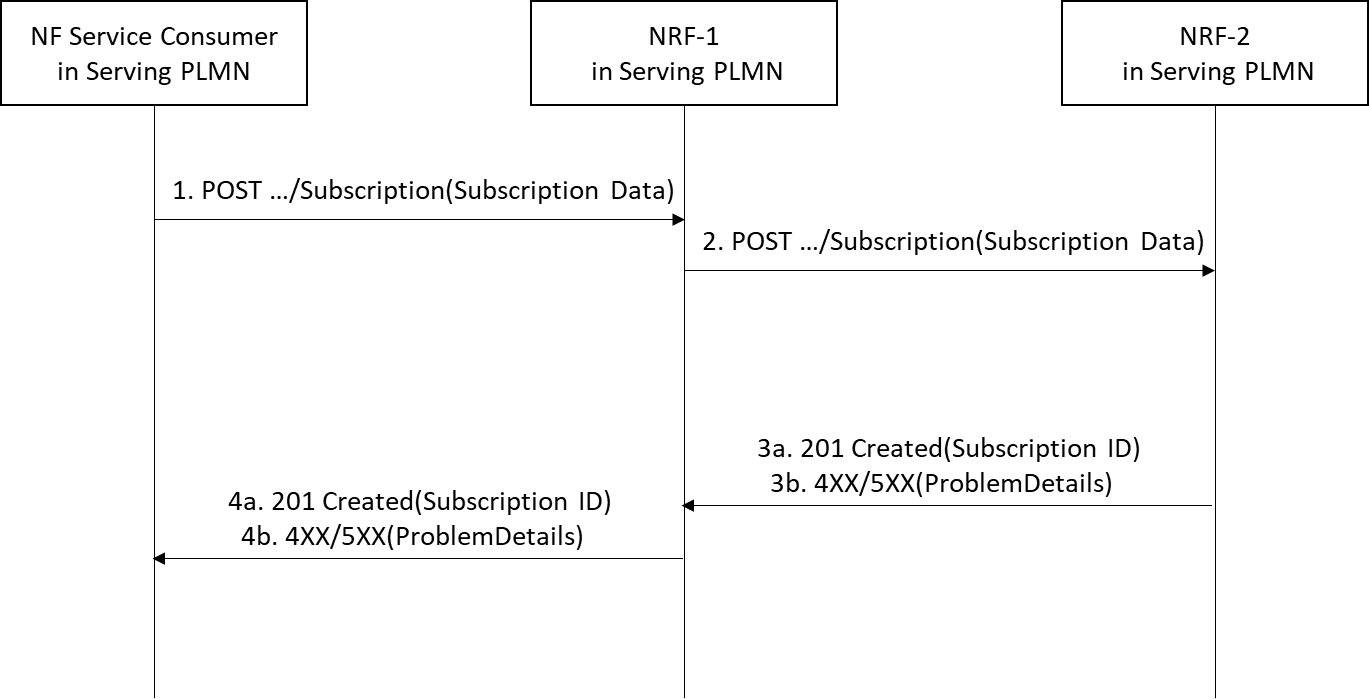


Figure 5.2.2.5.4-1: Subscription with intermediate forwarding NRF

1. NRF-1 receives a subscription request but does not have the information to fulfil the request. Then NRF-1 sends the subscription request to a pre-configured NRF-2.

2. Upon receiving a subscription request, based on the SubscriptionData contained in the subscription request (e.g.NF type) and locally stored information (see clause 5.2.2.2.3), NRF-2 shall identify the next hop NRF and forward the subscription request to that NRF (i.e. NF Service Producer registered NRF).

3a. On success, "201 Created" shall be returned by NRF-2.

3b. If the creation of the subscription fails, the NRF-2 shall return "4XX/5XX" response.

4a. NRF-1 forwards the success response to NF Service Consumer. The payload body of the POST response shall contain the representation describing the status of the request and the "Location" header shall be present and shall contain the URI of the created resource. The authority and/or deployment-specific string of the apiRoot of the created resource URI may differ from the authority and/or deployment-specific string of the apiRoot of the request URI received in the POST request.

4b. NRF-1 forwards the error response to NF Service Consumer.

##### 5.2.2.5.5 Subscription to NF Instances with intermediate redirecting NRF

When multiple NRFs are deployed in one PLMN, an NF Instance can subscribe to changes of NF Instances registered in another NRF. The subscription message is redirected by a third NRF.

For that, step 1 in clause 5.2.2.5.2 is executed (send a POST request to the NRF-1 in the Serving PLMN); this request shall include the SubscriptionData parameter in the request body.

Then, steps 2-5 in Figure 5.2.2.5.5-1 are executed between NRF-1, NRF-2 and NRF-3.

Finally, step 2 in clause 5.2.2.5.2 is executed; the subscriptionID shall be sent to the NF Service Consumer.

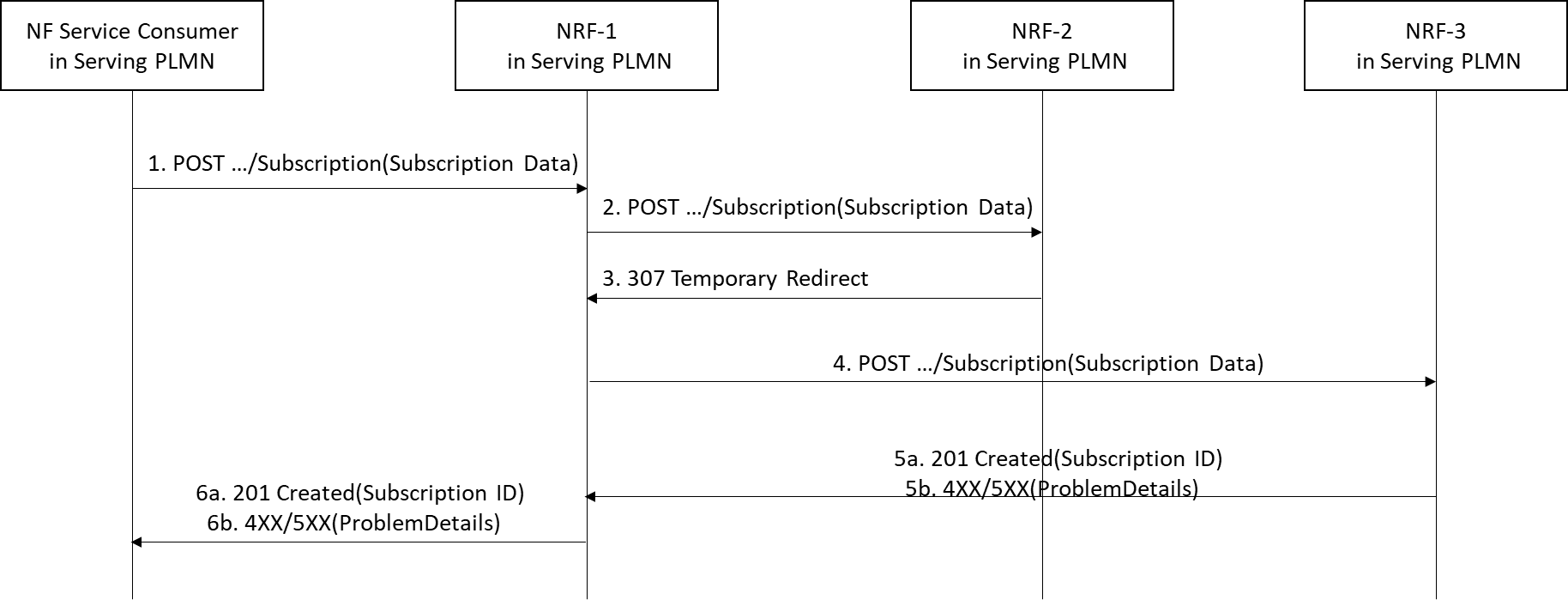


Figure 5.2.2.5.5-1: Subscription to NF Instances with intermediate redirecting NRF

1. NF Service Consumer send a subscription request to NRF-1.

2. NRF-1 receives a subscription request but does not have the information to fulfil the request. Then NRF-1 sends the subscription request to a pre-configured NRF-2.

3. Upon receiving a subscription request, based on the SubscriptionData contained in the subscription request (e.g.NF type) and locally stored information (see clause 5.2.2.2.3), NRF-2 shall identify the next hop NRF, and redirect the subscription request by returning HTTP 307 Temporary Redirect response.

The 307 Temporary Redirect response shall contain a Location header field, the host part of the URI in the Location header field represents NRF-3.

4. Upon receiving 307 Temporary Redirect response, NRF-1 sends the subscription request to NRF-3 by using the URI contained in the Location header field of the 307 Temporary Redirect response.

5a. On success, "201 Created" shall be returned by NRF-3.

5b. If the creation of the subscription fails at the NRF-3, the NRF-3 shall return "4XX/5XX" response.

6a. On success, "201 Created" shall be forwarded to NF Service Consumer via NRF-1. The payload body of the POST response shall contain the representation describing the status of the request and the "Location" header shall be present and shall contain the URI of the created resource. The authority and/or deployment-specific string of the apiRoot of the created resource URI may differ from the authority and/or deployment-specific string of the apiRoot of the request URI received in the POST request.

6b. If the creation of the subscription fails, "4XX/5XX" shall be forwarded to NF Service Consumer via NRF-1.

##### 5.2.2.5.6 Update of Subscription to NF Instances

The subscription to notifications on NF Instances may be updated to refresh the validity time, when this time is about to expire. The NF Service Consumer may request a new validity time to the NRF, and the NRF shall answer with the new assigned validity time, if the operation is successful.

This operation is executed by updating the resource identified by "subscriptionID". It is invoked by issuing an HTTP PATCH request on the URI representing the individual resource received in the Location header field of the "201 Created" response received during a successful subscription (see clause 5.2.2.5).



Figure 5.2.2.5.6-1: Subscription to NF Instances in the same PLMN

1. The NF Service Consumer shall send a PATCH request to the resource URI identifying the individual subscription resource. The payload body of the PATCH request shall contain a "replace" operation on the "validityTime" attribute of the SubscriptionData structure and shall contain a new suggested value for it; no other attribute of the resource shall be updated as part of this operation.

2a. On success, if the NRF accepts the extension of the lifetime of the subscription, and it accepts the requested value for the "validityTime" attribute, a response with status code "204 No Content" shall be returned.

2b. On success, if the NRF accepts the extension of the lifetime of the subscription, but it assigns a validity time different than the value suggested by the NF Service Consumer, a "200 OK" response code shall be returned. The response shall contain the new resource representation of the "subscription" resource, which includes the new validity time, as determined by the NRF, after which the subscription becomes invalid.

2c. If the update of the subscription fails at the NRF due to errors in the JSON Patch object in the request body, the NRF shall return "400 Bad Request" status code with the ProblemDetails IE providing details of the error.

If the update of the subscription fails at the NRF due to NRF internal errors, the NRF shall return "500 Internal Server Error" status code with the ProblemDetails IE providing details of the error.

EXAMPLE:

PATCH .../subscriptions/2a58bf47

Content-Type: application/json-patch+json

[

{ "op": "replace", "path": "/validityTime", "value": "2018-12-30T23:20:50Z" },

]

HTTP/2 204 No Content

##### 5.2.2.5.7 Update of Subscription to NF Instances in a different PLMN

The update of subscription in a different PLMN is done by updating a subscription resource identified by a "subscriptionID".

For that, step 1 in clause 5.2.2.5.6 is executed (send a PATCH request to the NRF in the Serving PLMN); this request shall include the identity of the PLMN of the home NRF (MCC/MNC values) as a leading prefix of the susbcriptionID.

Then, steps 1-2 in Figure 5.2.2.5.7-1 are executed, between the NRF in the Serving PLMN and the NRF in the Home PLMN. In this step, the subscriptionID sent to the NRF in the Home PLMN shall not contain the identity of the PLMN (i.e., it shall be the same subscriptionID value as originally generated by the NRF in the Home PLMN). The NRF in the Home PLMN returns a status code with the result of the operation.

Finally, step 2 in clause 5.2.2.5.7-2 is executed; a status code is returned to the NF Service Consumer in Serving PLMN in accordance to the result received from NRF in the Home PLMN.



Figure 5.2.2.5.7-1: Update of Subscription to NF Instances in a different PLMN

1. The NRF in Serving PLMN shall send a PATCH request to the resource URI representing the individual subscription. The payload body of the PATCH request shall contain a "replace" operation on the "validityTime" attribute of the SubscriptionData structure and shall contain a new suggested value for it;

2a. On success, if the NRF in the Home PLMN accepts the extension of the lifetime of the subscription, and it accepts the requested value for the "validityTime" attribute, a response with status code "204 No Content" shall be returned.

2b. On success, if the NRF in the Home PLMN accepts the extension of the lifetime of the subscription, but it assigns a validity time different than the value suggested by the NF Service Consumer, a "200 OK" response code shall be returned. The response shall contain the new resource representation of the "subscription" resource, which includes the new validity time, as determined by the NRF in the Home PLMN, after which the subscription becomes invalid.

2c. If the update of the subscription fails at the NRF due to errors in the JSON Patch object in the request body, the NRF shall return "400 Bad Request" status code with the ProblemDetails IE providing details of the error.

If the update of the subscription fails at the NRF due to NRF internal errors, the NRF shall return "500 Internal Server Error" status code with the ProblemDetails IE providing details of the error.

#### 5.2.2.6 NFStatusNotify

##### 5.2.2.6.1 General

This service operation notifies each NF Service Consumer that was previously subscribed to receiving notifications of registration/deregistration of NF Instances, or notifications of changes of the NF profile of a given NF Instance. The notification is sent to a callback URI that each NF Service Consumer provided during the subscription (see NFStatusSubscribe operation in 5.2.2.5).

##### 5.2.2.6.2 Notification from NRF in the same PLMN

The operation is invoked by issuing a POST request to each callback URI of the different subscribed NF Instances.



Figure 5.2.2.6.2-1: Notification from NRF in the same PLMN

1. The NRF shall send a POST request to the callback URI.

For notifications of newly registered NF Instances, the request body shall include the data associated to the newly registered NF, and its services, according to the criteria indicated by the NF Service Consumer during the subscription operation. These data shall contain the NFInstanceID of the NF Instance, an indication of the event being notified ("registration"), and the new profile data (including, among others, the services offered by the NF Instance).

For notifications of changes of the profile of a NF Instance, the request body shall include the NFInstancceID of the NF Instance whose profile was changed, an indication of the event being notified ("profile change"), and the new profile data.

For notifications of deregistration of the NF Instance from NRF, the request body shall include the NFInstanceID of the deregistered NF Instance, and an indication of the event being notified ("deregistration").

When an NF Service Consumer subscribes to a set of NFs (using the different subscription conditions specified in clause 6.1.6.2.35), a change in the profile of the monitored NF Instance may result in such NF becoming a part of the NF set (e.g., an NF Service Consumer subscribing to all NFs offering a given NF Service, and then, a certain NF Instance changes its profile by adding a new NF Service to its NF Profile); in such case, the NRF shall use the "profile change" event type in the notification.

When an NF Service Consumer subscribes to a set of NFs, using the subscription conditions specified in clause 6.1.6.2.35, in case of a change of profile(s) of NFs potentially related to those subscription conditions, the NRF shall send notification to subscribing NF Service Consumer(s) to those NFs no longer matching the subscription conditions, and to subscribing NF Service Consumer(s) to NFs that start matching the subscription conditions.

2a. On success, "204 No content" shall be returned by the NF Service Consumer.

2b. If the NF Service Consumer does not consider the "nfStatusNotificationUri" as a valid notification URI (e.g., because the URI does not belong to any of the existing subscriptions created by the NF Service Consumer in the NRF), the NF Service Consumer shall return "404 Not Found" status code with the ProblemDetails IE providing details of the error.

##### 5.2.2.6.3 Notification from NRF in a different PLMN

The operation is invoked by issuing a POST request to each callback URI of the different subscribed NF Instances.



Figure 5.2.2.6.3-1: Notification from NRF in a different PLMN

Steps 1 and 2 are identical to steps 1 and 2 in Figure 5.2.2.6.2-1.

It should be noted that the POST request shall be sent directly from the NRF in Home PLMN to the NF Service Consumer in Serving PLMN, without involvement of the NRF in Serving PLMN.

##### 5.2.2.6.4 Notification for subscription via intermediate NRF

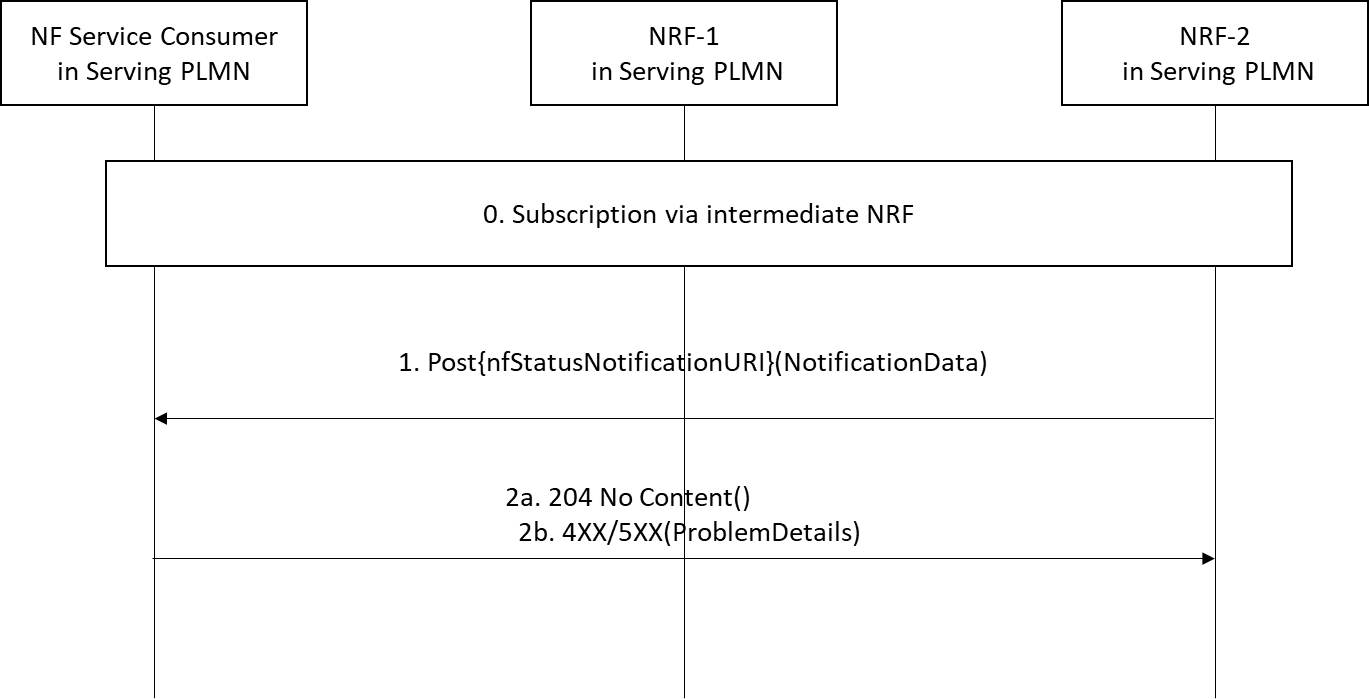


Figure 5.2.2.6.4-1: Notification for subscription via intermediate NRF

Step 0 is the NF Service Consumer creates a subscription to NRF-2 via intermediate NRF.

Steps 1 and 2 are identical to steps 1 and 2 in Figure 5.2.2.6.2-1.

The POST request shall be sent directly from NRF-2 to the NF Service Consumer without involvement of NRF-1.

#### 5.2.2.7 NFStatusUnSubscribe

##### 5.2.2.7.1 General

This service operation removes an existing subscription to notifications.

##### 5.2.2.7.2 Subscription removal in the same PLMN

It is executed by deleting a given resource identified by a "subscriptionID". The operation is invoked by issuing a DELETE request on the URI representing the specific subscription received in the Location header field of the "201 Created" response received during a successful subscription (see clause 5.2.2.5).



Figure 5.2.2.7.2-1: Subscription removal in the same PLMN

1. The NF Service Consumer shall send a DELETE request to the resource URI representing the individual subscription. The request body shall be empty.

2a. On success, "204 No Content" shall be returned. The response body shall be empty.

2b. If the subscription, identified by the "subscriptionID", is not found in the list of active subscriptions in the NRF's database, the NRF shall return "404 Not Found" status code with the ProblemDetails IE providing details of the error.

##### 5.2.2.7.3 Subscription removal in a different PLMN

The subscription removal in a different PLMN is done by deleting a resource identified by a "subscriptionID", in the NRF of the Home PLMN.

For that, step 1 in clause 5.2.2.7.2 is executed (send a DELETE request to the NRF in the Serving PLMN); this request shall include the identity of the PLMN of the home NRF (MCC/MNC values) as a leading prefix of the susbcriptionID (see clause 5.2.2.5.3).

Then, steps 1-2 in Figure 5.2.2.7.3-1 are executed, between the NRF in the Serving PLMN and the NRF in the Home PLMN. In this step, the subscriptionID sent to the NRF in the Home PLMN shall not contain the identity of the PLMN (i.e., it shall be the same subscriptionID value as originally generated by the NRF in the Home PLMN). The NRF in the Home PLMN returns a status code with the result of the operation.

Finally, step 2 in clause 5.2.2.7.2 is executed; a status code is returned to the NF Service Consumer in Serving PLMN in accordance to the result received from NRF in Home PLMN.



Figure 5.2.2.7.3-1: Subscription removal in a different PLMN

1. The NF Service Consumer shall send a DELETE request to the resource URI representing the individual subscription. The request body shall be empty.

2a. On success, "204 No Content" shall be returned. The response body shall be empty.

2b. If the subscription, identified by the "subscriptionID", is not found in the list of active subscriptions in the NRF's database, the NRF shall return "404 Not Found" status code with the ProblemDetails IE providing details of the error.

#### 5.2.2.8 NFListRetrieval

##### 5.2.2.8.1 General

This service operation allows the retrieval of a list of NF Instances that are currently registered in NRF. The operation may apply to the whole set of registered NF instances or only to a subset of the NF instances, based on a given NF type and/or maximum number of NF instances to be returned.



Figure 5.2.2.8.1-1: NF instance list retrieval

1. The NF Service Consumer shall send an HTTP GET request to the resource URI "nf-instances" collection resource. The optional input filter criteria for the retrieval request shall be included in query parameters.

2a. On success, "200 OK" shall be returned. The response body shall contain the URI (conforming to the resource URI structure as described in clause 5.2.2.9.1) of each registered NF in the NRF that satisfy the retrieval filter criteria (e.g., all NF instances of the same NF type), or an empty list if there are no NFs to return in the query result (e.g., because there are no registered NFs in the NRF, or because there are no matching NFs of the type specified in the "nf-type" query parameter, currently registered in the NRF).

2b. If the NF Service Consumer is not allowed to retrieve the registered NF instances, the NRF shall return "403 Forbidden" status code.

If the NF Instance list retrieval fails at the NRF due to errors in the input data in the URI query parameters, the NRF shall return "400 Bad Request" status code with the ProblemDetails IE providing details of the error.

If the discovery request fails at the NRF due to NRF internal errors, the NRF shall return "500 Internal Server Error" status code with the ProblemDetails IE providing details of the error.

#### 5.2.2.9 NFProfileRetrieval

##### 5.2.2.9.1 General

This service operation allows the retrieval of the NF profile of a given NF instance currently registered in NRF.



Figure 5.2.2.9.1-1: NF profile retrieval

1. The NF Service Consumer shall send an HTTP GET request to the resource URI "nf-instances/{nfInstanceId}".

2a. On success, "200 OK" shall be returned. The response body shall contain the NF profile of the NF instance identified in the request.

2b. If the NF Service Consumer is not allowed to retrieve the NF profile of this specific registered NF instance, the NRF shall return "403 Forbidden" status code.

If the NF Profile retrieval fails at the NRF due to NRF internal errors, the NRF shall return "500 Internal Server Error" status code with the ProblemDetails IE providing details of the error.

## 5.3 Nnrf\_NFDiscovery Service

### 5.3.1 Service Description

The Nnrf\_NFDiscovery service allows a Network Function Instance to discover services offered by other Network Function Instances, by querying the local NRF.

It also allows an NRF in a PLMN to re-issue a discovery request towards an NRF in another PLMN (e.g., the HPLMN of a certain UE).

### 5.3.2 Service Operations

#### 5.3.2.1 Introduction

The service operations defined for the Nnrf\_NFDiscovery service are as follows:

- NFDiscover: It provides to the NF service consumer the IP address(es) or FQDN of the NF Instance(s) or NF Service(s) matching certain input criteria.

The NFDiscover operation can be invoked by an NF Service Consumer (i.e., "source NF") requesting to discover NF instances (i.e., "target NFs") located in the same PLMN, or in a different PLMN.

In the description of these operations in clause 5.3.2.2, when the NF instances are located in the same PLMN, both source NF and target NFs are said to be located in the "Serving PLMN" but, in the general case, the functionality is not restricted to the PLMN that is serving a given UE, and it shall be applicable as well to any scenario in which source NF and target NFs belong to the same PLMN.

When source NF and target NFs are located in different PLMNs, the source NF is said to be in the "Serving PLMN", and the target NFs (and the NRF where they are registered) are said to be in the "Home PLMN", similarly to the scenarios described in 3GPP TS 23.502 [3], but the functionality shall be equally applicable to any scenario between any pair of PLMNs (e.g. with the source NF in the Home PLMN and the target NF in the Serving PLMN).

#### 5.3.2.2 NFDiscover

##### 5.3.2.2.1 General

This service operation discovers the set of NF Instances (and their associated NF Service Instances), represented by their NF Profile, that are currently registered in NRF and satisfy a number of input query parameters.

Before a service consumer invokes this service operation, it shall consider if it is possible to reuse the results from a previous searching (service discovery).

The service consumer should reuse the previous result if input query parameters in the new service discovery request are the same as used for the previous search and the validity period of the result is not expired.

The service consumer may consider reusing the previous result if the attributes as required for the new query is also part of NF profile of the candidates NFs from a previous query. In such case, when the results of a previous query are reused, the service consumer need consider that the results, e.g. in terms of the number of discovered NFs, can be different than the potential results obtained after performing a new query.

##### 5.3.2.2.2 Service Discovery in the same PLMN

This service operation is executed by querying the "nf-instances" resource. The request is sent to an NRF in the same PLMN of the NF Service Consumer.



Figure 5.3.2.2.2-1: Service Discovery Request in the same PLMN

1. The NF Service Consumer shall send an HTTP GET request to the resource URI "nf-instances" collection resource. The input filter criteria for the discovery request shall be included in query parameters.

2a. On success, "200 OK" shall be returned. The response body shall contain a validity period, during which the search result can be cached by the NF Service Consumer, and an array of NF Profile objects, that satisfy the search filter criteria (e.g., all NF Instances offering a certain NF Service name).

2b. If the NF Service Consumer is not allowed to discover the NF services for the requested NF type provided in the query parameters, the NRF shall return "403 Forbidden" response.

If the discovery request fails at the NRF due to errors in the input data in the URI query parameters, the NRF shall return "400 Bad Request" status code with the ProblemDetails IE providing details of the error.

If the discovery request fails at the NRF due to NRF internal errors, the NRF shall return "500 Internal Server Error" status code with the ProblemDetails IE providing details of the error.

The NF Profile objects returned in a successful result shall contain generic data of each NF Instance, applicable to any NF type, and it may also contain NF-specific data, for those NF Instances belonging to a specific type (e.g., the attribute "udrInfo" is typically present in the NF Profile when the type of the NF Instance takes the value "UDR"). In addition, the attribute "customInfo", may be present in the NF Profile for those NF Instances with custom NF types.

For those NF Instances, the "customInfo" attribute shall be returned by NRF, if available, as part of the NF Profiles returned in the discovery response.

The NRF shall also include, in the returned NF Profile objects, the Vendor-Specific attributes (see 3GPP TS 29.500 [4], clause 6.6.3) that may have been provided by the registered NF Instances.

##### 5.3.2.2.3 Service Discovery in a different PLMN

The service discovery in a different PLMN is done by querying the "nf-instances" resource in the NRF of the Home PLMN.

For that, step 1 in clause 5.3.2.2.2 is executed (send a GET request to the NRF in the Serving PLMN); this request shall include the identity of the PLMN of the home NRF in a query parameter of the URI.

Then, steps 1-2 in Figure 5.3.2.2.3-1 are executed, between the NRF in the Serving PLMN and the NRF in the Home PLMN. In this step, the presence of the PLMN ID of the Home NRF in the query parameter of the URI is not required. The NRF in the Home PLMN returns a status code with the result of the operation. The NRF in the Serving PLMN shall be configured with a telescopic FQDN (see 3GPP TS 23.003 [12] and 3GPP TS 29.500 [4]) of the NRF in the Home PLMN.

NOTE: This is required for the NRF in the serving PLMN to route the NF discovery request to the NRF in the HPLMN through a SEPP in the serving PLMN and the SEPP to terminate the TLS connection with a wildcard certificate.

Finally, step 2 in clause 5.3.2.2.2 is executed; a status code is returned to the NF Service Consumer in Serving PLMN in accordance to the result received from NRF in Home PLMN.



Figure 5.3.2.2.3-1: Service Discovery in a different PLMN

Steps 1 and 2 are similar to steps 1 and 2 in Figure 5.3.2.2.2-1, by replacing the originator of the service invocation with the NRF in Serving PLMN, and the recipient of the service invocation with the NRF in the Home PLMN.

##### 5.3.2.2.4 Service Discovery with intermediate redirecting NRF

When multiple NRFs are deployed in one PLMN, one NRF may query the "nf-instances" resource in a different NRF so as to fulfil the service discovery request from a NF service consumer. The query between these two NRFs is redirected by a third NRF.



Figure 5.3.2.2.4-1: Service Discovery with intermediate redirecting NRF

1. NRF-1 receives a service discovery request but does not have the information to fulfil the request. Then NRF-1 sends the service discovery request to a pre-configured NRF-2.

2a. Upon receiving a service discovery request, based on the information contained in the service discovery request (e.g. the "supi" query parameter in the URI) and locally stored information NRF-2 shall identify the next hop NRF (see clause 5.2.2.2.3), and redirect the service discovery request by returning HTTP 307 Temporary Redirect response. The locally stored information in NRF-2 may:

a) be preconfigured; or

b) registered by other NRFs (see clause 5.2.2.2.3).

The 307 Temporary Redirect response shall contain a Location header field, the host part of the URI in the Location header field represents NRF-3.

2b. if NRF-2 does not have enough information to redirect the service discovery request, then it responds with 404 Not Found, and the rest of the steps are omitted.

3. Upon receiving 307 Temporary Redirect response, NRF-1 sends the service discovery request to NRF-3 by using the URI contained in the Location header field of the 307 Temporary Redirect response.

4a. Upon success, NRF-3 returns the search result.

4b. If the NF Service Consumer is not allowed to discover the NF services for the requested NF type provided in the query parameters, the NRF shall return "403 Forbidden" response.

If the discovery request fails at the NRF due to errors in the input data in the URI query parameters, the NRF shall return "400 Bad Request" status code with the ProblemDetails IE providing details of the error.

If the discovery request fails at the NRF due to NRF internal errors, the NRF shall return "500 Internal Server Error" status code with the ProblemDetails IE providing details of the error.

##### 5.3.2.2.5 Service Discovery with intermediate forwarding NRF

When multiple NRFs are deployed in one PLMN, one NRF may query the "nf-instances" resource in a different NRF so as to fulfil the service discovery request from a NF service consumer. The query between these two NRFs is forwarded by a third NRF.



Figure 5.3.2.2.5-1: Service Discovery with intermediate forwarding NRF

1. NRF-1 receives a service discovery request but does not have the information to fulfil the request. Then NRF-1 sends the service discovery request to a pre-configured NRF-2.

2a. Upon receiving a service discovery request, based on the information contained in the service discovery request (e.g. the "supi" query parameter in the URI) and locally stored information, NRF-2 shall identify the next hop NRF (see clause 5.2.2.2.3), and forward the service discovery request to that NRF (i.e. NRF-3 in this example), by replacing the originator of the service invocation with NRF-2, and the recipient of the service invocation with NRF-3. The locally stored information in NRF-2 may:

a) be preconfigured; or

b) registered by other NRFs (see clause 5.2.2.2.3).

2b. if NRF-2 does not have enough information to forward the service discovery request, then it responds with 404 Not Found, and the rest of the steps are omitted.

3a. Upon success, NRF-3 returns the search result.

3b. If the NF Service Consumer is not allowed to discover the NF services for the requested NF type provided in the query parameters, the NRF shall return "403 Forbidden" response.

If the discovery request fails at the NRF due to errors in the input data in the URI query parameters, the NRF shall return "400 Bad Request" status code with the ProblemDetails IE providing details of the error.

If the discovery request fails at the NRF due to NRF internal errors, the NRF shall return "500 Internal Server Error" status code with the ProblemDetails IE providing details of the error.

4a. NRF-2 forwards the success response to NRF-1.

4b. NRF-2 forwards the error response to NRF-1.

NOTE: It is not assumed that there can only be two NRF hierarchies, i.e. the NRF-3 can go on to forward the service discovery request to another NRF.

## 5.4 Nnrf\_AccessToken Service

### 5.4.1 Service Description

The NRF offers an Nnrf\_AccessToken service (used for OAuth2 authorization, see IETF RFC 6749 [16]), following the "Client Credentials" authorization grant, as specified in 3GPP TS 33.501 [15]. It exposes a "Token Endpoint" where the Access Token Request service can be requested by NF Service Consumers.

### 5.4.2 Service Operations

#### 5.4.2.1 Introduction

The services operations defined for the Nnrf\_AccessToken service are as follows:

- Access Token Request (i.e. Nnrf\_AccessToken\_Get)

#### 5.4.2.2 Get (Access Token Request)

##### 5.4.2.2.1 General

This service operation is used by an NF Service Consumer to request an OAuth2 access token from the authorization server (NRF).



Figure 5.4.2.2.1-1: Access Token Request

1. The NF Service Consumer shall send a POST request to the "Token Endpoint", as described in IETF RFC 6749 [16], clause 3.2. The "Token Endpoint" URI shall be:

{nrfApiRoot}/oauth2/token

where {nrfApiRoot} represents the concatenation of the "scheme" and "authority" components of the NRF, as defined in IETF RFC 3986 [17].  
  
The OAuth 2.0 Access Token Request includes in the body of the HTTP POST request shall contain:

- An OAuth2 grant type set to "client\_credentials";

- The "scope" parameter indicating the names of the NF Services that the NF Service Consumer is trying to access (i.e., the expected NF service names);

- The NF Instance Id of the the NF Service Consumer requesting the OAuth2.0 access token;

- NF type of the NF Service Consumer, if this is an access token request not for a specific NF Service Producer;

- NF type of the expected NF Service Producer, if this is an access token request not for a specific NF Service Producer;

- The NF Instance Id of the expected NF Service Producer, if this is an access token request for a specific NF Service Producer;

- Home and Serving PLMN IDs, if this is an access token request for use in roaming scenarios (see clause 13.4.1.2 of 3GPP TS 33.501 [15]).

The NF Service Consumer shall use TLS for mutual authentication with the NRF in order to access this endpoint, if the PLMN uses protection at the transport layer. Otherwise the NF Service Consumer shall use NDS or physical security to mutually authenticate with the NRF as specified in clause 13.3.1 of 3GPP TS 33.501 [15].

2. On success, "200 OK" shall be returned, the payload body of the POST response shall contain the requested access token and the token type set to value "Bearer". The response in addition:

- should contain the expiration time for the token as indicated in IETF RFC 6749 [16] unless the expiration time of the token is made available by other means (e.g. deployment-specific documentation); and

- shall contain the NF service name(s) of the requested NF service producer(s), if it is different from the scope included in the access token request (see IETF RFC 6749 [16]).

The access token shall be a JSON Web Token (JWT) as specified in IETF RFC 7519 [25]. The access token returned by the NRF shall include the claims encoded as a JSON object as specified in clause 6.3.5.2.4 and then digitally signed using JWS as specified in IETF RFC 7515 [24] and in clause 13.4.1 of 3GPP TS 33.501 [15].

The digitally signed access token shall be converted to the JWS Compact Serialization encoding as a string as specified in clause 7.1 of IETF RFC 7515 [24].

If the access token request fails at the NRF, the NRF shall return "400 Bad Request" status code, including in the response payload a JSON object that provides details about the specific error that occurred.

##### 5.4.2.2.2 Access Token request with intermediate forwarding NRF

When multiple NRFs are deployed in one PLMN, one NRF may request an OAuth2 access token to a different NRF so as to fulfil the Access Token Request from a NF service consumer. The acces token request between these two NRFs is forwarded by a third NRF in this case.

For this, step 1 in clause 5.4.2.2.1 is executed (send a POST request to NRF-1 in the Serving PLMN); this request shall include the OAuth 2.0 Access Token Request in the request body.

Then, steps 1-4 in Figure 5.4.2.2.2-1 hereinafter are executed between NRF-1in Serving PLMN, NRF-2 in Serving PLMN and NRF-3 in Serving PLMN.

Finally, step 2 in clause 5.4.2.2.1 is executed, the Access Token Response containing the requested access token, the token type and additional attributes shall be sent to the NF Service Consumer.



Figure 5.4.2.2.2-1: Access Token Request with intermediate forwarding NRF

1. NRF-1 receives an Access token request but does not have the information to fulfil the request. Then NRF-1 sends the Access token request to a pre-configured NRF-2.

2a. Upon reception of the Access token request and based on the information contained in the Acces token request and locally stored information, NRF-2 shall identify the next hop NRF (see clause 5.2.2.2.3), and forward the Access token request to that NRF (i.e. NRF-3 in this example) by replacing the originator of the service invocation with NRF-2, and the recipient of the service invocation with NRF-3. The locally stored information in NRF-2 may:

a) be preconfigured; or

b) registered by other NRFs (see clause 5.2.2.2.3).

2b. if NRF-2 does not have enough information to forward the Access token request, then it responds with 404 Not Found, and the rest of the steps are omitted.

3a. Upon success, NRF-3 shall return a "200 OK" status code, including in the response payload the Access token response containing the requested access token, the token type and additional attributes.

3b. Upon failure, NRF-3 shall return "400 Bad Request" status code, including in the response payload a JSON object that provides details about the specific error(s) that occurred.

4a. NRF-2 forwards the success response to NRF-1.

4b. NRF-2 forwards the error response to NRF-2.

NOTE: It is not assumed that there can only be two NRF hierarchies, i.e. the NRF-3 can go on and forward the Access token request request to another NRF.

##### 5.4.2.2.3 Access Token request with intermediate redirecting NRF

When multiple NRFs are deployed in one PLMN, one NRF may request an OAuth2 access token to a different NRF so as to fulfil the Access Token Request from a NF service consumer. The acces token request between these two NRFs is redirected by a third NRF in this case.

For this, step 1 in clause 5.4.2.2.1 is executed (send a POST request to NRF-1 in the Serving PLMN); this request shall include the OAuth 2.0 Access Token Request in the request body

Then, steps 1-4 in Figure 5.4.2.2.3-1 hereinafter are executed between NRF-1in Serving PLMN, NRF-2 in Serving PLMN and NRF-3 in Serving PLMN.

Finally, step 2 in clause 5.4.2.2.1 is executed, the Access token response containing the requested access token, the token type and additional attributes shall be sent to the NF Service Consumer.



Figure 5.4.2.2.3-1: Access Token Request with intermediate redirecting NRF

1. NRF-1 receives an Access token request but does not have the information to fulfil the request. Then NRF-1 sends the Access token request to a pre-configured NRF-2.

2a. Upon reception of the Access token requestand based on the information contained in the Acces token request and locally stored information, NRF-2 shall identify the next hop NRF (see clause 5.2.2.2.3), and redirect the Access token request by returning HTTP "307 Temporary Redirect" response. The locally stored information in NRF-2 may:

a) be preconfigured; or

b) registered by other NRFs (see clause 5.2.2.2.3).

The "307 Temporary Redirect" response shall contain a Location header field, the host part of the URI in the Location header field represents NRF-3.

2b. if NRF-2 does not have enough information to forward the Access token request, then it responds with "404 Not Found", and the rest of the steps are omitted.

3. Upon reception of "307 Temporary Redirect" response, NRF-1 sends the Acces token request to NRF-3 by using the URI contained in the Location header field of the "307 Temporary Redirect" response.

4a. Upon success, NRF-3shall return a "200 OK" status code including in the response payload the Access token response containing the requested access token, the token type and additional attributes.

4b. Upon failure, the NRF-3 shall return "400 Bad Request" status code, including in the response payload a JSON object that provides details about the specific error(s) that occurred.

## 5.5 Nnrf\_Bootstrapping Service

### 5.5.1 Service Description

The NRF offers a Nnrf\_Bootstrapping service to let NF Service Consumers of the NRF know about the services endpoints it supports, by using a version-independent URI endpoint that does not need to be discovered by using a Discovery service.

This service shall be used in inter-PLMN scenarios where the NRF in a PLMN-A needs to invoke services from an NRF in PLMN-B, when there is no pre-configured information indicating the version of the services deployed in PLMN-B.

This service may also be used in intra-PLMN scenarios, to avoid configuring statically in the different NFs information about the service versions deployed in the NRF to be used by those NFs.

### 5.5.2 Service Operations

#### 5.5.2.1 Introduction

The services operations defined for the Nnrf\_Bootstrapping service are as follows:

- Nnrf\_Bootstrapping\_Get

#### 5.5.2.2 Get

##### 5.5.2.2.1 General

This service operation is used by an NF Service Consumer to request bootstrapping information from the NRF.



Figure 5.5.2.2.1-1: Bootstrapping Request

1. The NF Service Consumer shall send a GET request to the "Bootstrapping Endpoint", as described in 3GPP TS 23.003 [12], clause x.y. The "Bootstrapping Endpoint" URI shall be:

{nrfApiRoot}/boostrapping

where {nrfApiRoot} represents the concatenation of the "scheme" and "authority" components of the NRF, as defined in IETF RFC 3986 [17].

2. On success, "200 OK" shall be returned, the payload body of the GET response shall contain the requested bootstrapping information.

EXAMPLE:

GET https://nrf.example.com/bootstrapping

Accept: application/3gppHal+json

HTTP/2 200 OK

Content-Type: application/3gppHal+json

{

"status": "OPERATIVE",

"\_links": {

"self": {

"href": "https://nrf.example.com/bootstrapping"

},

"manage": {

"href": "https://nrf.example.com/nnrf-nfm/v1/nf-instances"

},

"subscribe": {

"href": "https://nrf.example.com/nnrf-nfm/v1/subscriptions"

},

"discover": {

"href": "https://nrf.example.com/nnrf-disc/v1/nf-instances"

},

"authorize": {

"href": "https://nrf.example.com/oauth2/token"

}

}

}

# 6 API Definitions

## 6.1 Nnrf\_NFManagement Service API

### 6.1.1 API URI

URIs of this API shall have the following root:

{apiRoot}/{apiName}/{apiVersion}/

where "apiRoot" is defined in clause 4.4.1 of 3GPP TS 29.501 [5], the "apiName" shall be set to "nnrf-nfm" and the "apiVersion" shall be set to "v1" for the current version of this specification.

### 6.1.2 Usage of HTTP

#### 6.1.2.1 General

HTTP/2, as defined in IETF RFC 7540 [9], shall be used as specified in clause 5 of 3GPP TS 29.500 [4].

HTTP/2 shall be transported as specified in clause 5.3 of 3GPP TS 29.500 [4].

HTTP messages and bodies for the Nnrf\_NFManagement service shall comply with the OpenAPI [10] specification contained in Annex A.

#### 6.1.2.2 HTTP Standard Headers

##### 6.1.2.2.1 General

The mandatory standard HTTP headers as specified in clause 5.2.2.2 of 3GPP TS 29.500 [4] shall be supported.

##### 6.1.2.2.2 Content type

The following content types shall be supported:

- JSON, as defined in IETF RFC 8259 [22], shall be used as content type of the HTTP bodies specified in the present specification as indicated in clause 5.4 of 3GPP TS 29.500 [4].

- The Problem Details JSON Object (IETF RFC 7807 [11]). The use of the Problem Details JSON object in a HTTP response body shall be signalled by the content type "application/problem+json".

- JSON Patch (IETF RFC 6902 [13]). The use of the JSON Patch format in a HTTP request body shall be signalled by the content type "application/json-patch+json".

- The 3GPP hypermedia format as defined in 3GPP TS 29.501 [5]. The use of the 3GPP hypermedia format in a HTTP response body shall be signalled by the content type "application/3gppHal+json".

##### 6.1.2.2.3 Accept-Encoding

The NRF should support gzip coding (see IETF RFC 1952 [30]) in HTTP requests and responses and indicate so in the Accept-Encoding header, as described in clause 6.9 of 3GPP TS 29.500 [4].

#### 6.1.2.3 HTTP custom headers

##### 6.1.2.3.1 General

In this release of this specification, no custom headers specific to the Nnrf\_NFManagement service are defined. For 3GPP specific HTTP custom headers used across all service-based interfaces, see clause 5.2.3 of 3GPP TS 29.500 [4].

### 6.1.3 Resources

#### 6.1.3.1 Overview

The structure of the Resource URIs of the NFManagement service is shown in figure 6.1.3.1-1.



Figure 6.1.3.1-1: Resource URI structure of the NFManagement API

Table 6.1.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 6.1.3.1-1: Resources and methods overview

|  |  |  |  |
| --- | --- | --- | --- |
| Resource name | Resource URI | HTTP method or custom operation | Description |
| nf-instances  (Store) | {apiRoot}/nnrf-nfm/v1/nf-instances | GET | Read a collection of NF Instances. |
| OPTIONS | Discover the communication options supported by the NRF for this resource. |
| nf-instance  (Document) | {apiRoot}/nnrf-nfm/v1/nf-instances/{nfInstanceID} | GET | Read the profile of a given NF Instance. |
| PUT | Register in NRF a new NF Instance, or replace the profile of an existing NF Instance, by providing an NF profile. |
| PATCH | Modify the NF profile of an existing NF Instance. |
| DELETE | Deregister from NRF a given NF Instance. |
| subscriptions  (Collection) | {apiRoot}/nnrf-nfm/v1/subscriptions | POST | Creates a new subscription in NRF to newly registered NF Instances. |
| subscription  (Document) | {apiRoot}/nnrf-nfm/v1/subscriptions/{subscriptionID} | PATCH | Updates an existing subscription in NRF. |
| DELETE | Deletes an existing subscription from NRF. |
| Notification Callback | {nfStatusNotificationUri} | POST | Notify about newly created NF Instances, or about changes of the profile of a given NF Instance. |

#### 6.1.3.2 Resource: nf-instances (Store)

##### 6.1.3.2.1 Description

This resource represents a collection of the different NF instances registered in the NRF.

This resource is modelled as the Store resource archetype (see clause C.3 of 3GPP TS 29.501 [5]).

##### 6.1.3.2.2 Resource Definition

Resource URI: **{apiRoot}/nnrf-nfm/v1/nf-instances**

This resource shall support the resource URI variables defined in table 6.1.3.2.2-1.

Table 6.1.3.2.2-1: Resource URI variables for this resource

|  |  |
| --- | --- |
| Name | Definition |
| apiRoot | See clause 6.1.1 |

##### 6.1.3.2.3 Resource Standard Methods

###### 6.1.3.2.3.1 GET

This method retrieves a list of all NF instances currently registered in the NRF. This method shall support the URI query parameters specified in table 6.1.3.2.3.1-1.

Table 6.1.3.2.3.1-1: URI query parameters supported by the GET method on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| nf-type | NFType | O | 0..1 | The type of NF to restrict the list of returned NF Instances. |
| limit | integer | O | 0..1 | Maximum number of items to be returned in this query. |

This method shall support the request data structures specified in table 6.1.3.2.3.1-2 and the response data structures and response codes specified in table 6.1.3.2.3.1-3.

Table 6.1.3.2.3.1-2: Data structures supported by the GET Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| n/a |  |  |  |

Table 6.1.3.2.3.1-3: Data structures supported by the GET Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| UriList | M | 1 | 200 OK | The response body contains a "\_links" object containing the URI of each registered NF in the NRF, or an empty object if there are no NFs to return in the query result (e.g., because there are no registered NFs in the NRF, or because there are no matching NFs of the type specified in the "nf-type" query parameter, currently registered in the NRF). |
| NOTE: The mandatory HTTP error status codes for the GET method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] other than those specified in the table above also apply, with a ProblemDetails data type (see clause 5.2.7 of 3GPP TS 29.500 [4]). | | | | |

###### 6.1.3.2.3.2 OPTIONS

This method queries the communication options supported by the NRF (see clause 6.9 of 3GPP TS 29.500 [4]). This method shall support the URI query parameters specified in table 6.1.3.2.3.2-1.

Table 6.1.3.2.3.2-1: URI query parameters supported by the OPTIONS method on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| n/a |  |  |  |  |

This method shall support the request data structures specified in table 6.1.3.2.3.2-2 and the response data structures and response codes specified in table 6.1.3.2.3.2-3.

Table 6.1.3.2.3.2-2: Data structures supported by the OPTIONS Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| n/a |  |  |  |

Table 6.1.3.2.3.2-3: Data structures supported by the OPTIONS Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| n/a | M | 1 | 200 OK |  |
| ProblemDetails | M | 1 | 405 Method Not Allowed |  |
| ProblemDetails | M | 1 | 501 Not Implemented |  |
| NOTE: The mandatory HTTP error status codes for the OPTIONS method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] other than those specified in the table above also apply, with a ProblemDetails data type (see clause 5.2.7 of 3GPP TS 29.500 [4]). | | | | |

##### 6.1.3.2.4 Resource Custom Operations

There are no resource custom operations for the Nnrf\_NFManagement service in this release of the specification.

#### 6.1.3.3 Resource: nf-instance (Document)

##### 6.1.3.3.1 Description

This resource represents a single NF instance.

##### 6.1.3.3.2 Resource Definition

Resource URI: **{apiRoot}/nnrf-nfm/v1/nf-instances/{nfInstanceID}**

This resource shall support the resource URI variables defined in table 6.1.3.3.2-1.

Table 6.1.3.3.2-1: Resource URI variables for this resource

|  |  |
| --- | --- |
| Name | Definition |
| apiRoot | See clause 6.1.1 |
| nfInstanceID | Represents a specific NF Instance |

##### 6.1.3.3.3 Resource Standard Methods

###### 6.1.3.3.3.1 GET

This method retrieves the NF Profile of a given NF instance.

This method shall support the URI query parameters specified in table 6.1.3.3.3.1-1.

Table 6.1.3.3.3.1-1: URI query parameters supported by the GET method on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| n/a |  |  |  |  |

This method shall support the request data structures specified in table 6.1.3.3.3.1-2 and the response data structures and response codes specified in table 6.1.3.3.3.1-3.

Table 6.1.3.3.3.1-2: Data structures supported by the GET Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| n/a |  |  |  |

Table 6.1.3.3.3.1-3: Data structures supported by the GET Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| NFProfile | M | 1 | 200 OK | The response body contains the profile of a given NF Instance. |
| NOTE: The mandatory HTTP error status codes for the GET method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] other than those specified in the table above also apply, with a ProblemDetails data type (see clause 5.2.7 of 3GPP TS 29.500 [4]). | | | | |

###### 6.1.3.3.3.2 PUT

This method registers a new NF instance in the NRF, or replaces completely an existing NF instance.

This method shall support the URI query parameters specified in table 6.1.3.3.3.2-1.

Table 6.1.3.3.3.2-1: URI query parameters supported by the PUT method on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| n/a |  |  |  |  |

This method shall support the request data structures specified in table 6.1.3.3.3.2-2 and the response data structures and response codes specified in table 6.1.3.3.3.2-3.

Table 6.1.3.3.3.2-2: Data structures supported by the PUT Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| NFProfile | M | 1 | Profile of the NF Instance to be registered, or completely replaced, in NRF. |

Table 6.1.3.3.3.2-3: Data structures supported by the PUT Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| NFProfile | M | 1 | 200 OK | This case represents the successful replacement of an existing NF Instance profile.  Upon success, a response body is returned containing the replaced profile of the NF Instance. |
| NFProfile | M | 1 | 201 Created | This case represents the successful registration of a new NF Instance.  Upon success, a response body is returned containing the newly created NF Instance profile; also, the HTTP response shall include a "Location" HTTP header that contains the resource URI of the created NF Instance. |
| NOTE: The mandatory HTTP error status codes for the PUT method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] other than those specified in the table above also apply, with a ProblemDetails data type (see clause 5.2.7 of 3GPP TS 29.500 [4]). | | | | |

###### 6.1.3.3.3.3 PATCH

This method updates partially the profile of a given NF instance.

This method shall support the URI query parameters specified in table 6.1.3.3.3.3-1.

Table 6.1.3.3.3.3-1: URI query parameters supported by the PATCH method on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| n/a |  |  |  |  |

This method shall support the request data structures specified in table 6.1.3.3.3.3-2 and the response data structures and response codes specified in table 6.1.3.3.3.3-3.

Table 6.1.3.3.3.3-2: Data structures supported by the PATCH Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| PatchDocument | M | 1 | It contains the list of changes to be made to the profile of the NF Instance, according to the JSON PATCH format specified in IETF RFC 6902 [13]. |

Table 6.1.3.3.3.3-3: Data structures supported by the PATCH Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| NFProfile | M | 1 | 200 OK | Upon success, a response body is returned containing the updated profile of the NF Instance. |
| n/a |  |  | 204 No Content | Successful response sent when there is no need to provide a full updated profile of the NF Instance (e.g., in the Heart-Beat operation response described in clause 5.2.2.3.2). |
| NOTE: The mandatory HTTP error status codes for the PATCH method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] other than those specified in the table above also apply, with a ProblemDetails data type (see clause 5.2.7 of 3GPP TS 29.500 [4]). | | | | |

###### 6.1.3.3.3.4 DELETE

This method deregisters an existing NF instance from the NRF.

This method shall support the URI query parameters specified in table 6.1.3.3.3.4-1.

Table 6.1.3.3.3.4-1: URI query parameters supported by the DELETE method on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| n/a |  |  |  |  |

This method shall support the request data structures specified in table 6.1.3.3.3.4-2 and the response data structures and response codes specified in table 6.1.3.3.3.4-3.

Table 6.1.3.3.3.4-2: Data structures supported by the DELETE Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| n/a |  |  |  |

Table 6.1.3.3.3.4-3: Data structures supported by the DELETE Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| n/a |  |  | 204 No Content |  |
| NOTE: The mandatory HTTP error status codes for the DELETE method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] other than those specified in the table above also apply, with a ProblemDetails data type (see clause 5.2.7 of 3GPP TS 29.500 [4]). | | | | |

#### 6.1.3.4 Resource: subscriptions (Collection)

##### 6.1.3.4.1 Description

This resource represents a collection of subscriptions of NF Instances to newly registered NF Instances.

##### 6.1.3.4.2 Resource Definition

Resource URI: **{apiRoot}/nnrf-nfm/v1/subscriptions**

This resource shall support the resource URI variables defined in table 6.1.3.4.2-1.

Table 6.1.3.4.2-1: Resource URI variables for this resource

|  |  |
| --- | --- |
| Name | Definition |
| apiRoot | See clause 6.1.1 |

##### 6.1.3.4.3 Resource Standard Methods

###### 6.1.3.4.3.1 POST

This method creates a new subscription. This method shall support the URI query parameters specified in table 6.1.3.4.3.1-1.

Table 6.1.3.4.3.1-1: URI query parameters supported by the POST method on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| n/a |  |  |  |  |

This method shall support the request data structures specified in table 6.1.3.4.3.1-2 and the response data structures and response codes specified in table 6.1.3.4.3.1-3.

Table 6.1.3.4.3.1-2: Data structures supported by the POST Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| SubscriptionData | M | 1 | The request body contains the input parameters for the subscription. These parameters include, e.g.:  - Target NF type  - Target Service Name  - Callback URI of the Requester NF |

Table 6.1.3.4.3.1-3: Data structures supported by the POST Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| SubscriptionData | M | 1 | 201 Created | This case represents the successful creation of a subscription.  Upon success, the HTTP response shall include a "Location" HTTP header that contains the resource URI of the created resource. |
| NOTE: The mandatory HTTP error status codes for the PUT method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] other than those specified in the table above also apply, with a ProblemDetails data type (see clause 5.2.7 of 3GPP TS 29.500 [4]). | | | | |

#### 6.1.3.5 Resource: subscription (Document)

##### 6.1.3.5.1 Description

This resource represents an individual subscription of a given NF Instance to newly registered NF Instances.

##### 6.1.3.5.2 Resource Definition

Resource URI: **{apiRoot}/nnrf-nfm/v1/subscriptions/{subscriptionID}**

This resource shall support the resource URI variables defined in table 6.1.3.5.2-1.

Table 6.1.3.5.2-1: Resource URI variables for this resource

|  |  |
| --- | --- |
| Name | Definition |
| apiRoot | See clause 6.1.1 |
| subscriptionID | Represents a specific subscription |

##### 6.1.3.5.3 Resource Standard Methods

###### 6.1.3.5.3.1 DELETE

This method terminates an existing subscription. This method shall support the URI query parameters specified in table 6.1.3.5.3.1-1.

Table 6.1.3.5.3.1-1: URI query parameters supported by the DELETE method on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| n/a |  |  |  |  |

This method shall support the request data structures specified in table 6.1.3.5.3.1-2 and the response data structures and response codes specified in table 6.1.3.5.3.1-3.

Table 6.1.3.5.3.1-2: Data structures supported by the DELETE Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| n/a |  |  |  |

Table 6.1.3.5.3.1-3: Data structures supported by the DELETE Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| n/a |  |  | 204 No Content |  |
| NOTE: The mandatory HTTP error status codes for the PUT method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] other than those specified in the table above also apply, with a ProblemDetails data type (see clause 5.2.7 of 3GPP TS 29.500 [4]). | | | | |

###### 6.1.3.5.3.2 PATCH

This method updates an existing subscription. This method shall support the URI query parameters specified in table 6.1.3.5.3.2-1.

Table 6.1.3.5.3.2-1: URI query parameters supported by the PATCH method on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| n/a |  |  |  |  |

This method shall support the request data structures specified in table 6.1.3.5.3.2-2 and the response data structures and response codes specified in table 6.1.3.5.3.2-3.

Table 6.1.3.5.3.2-2: Data structures supported by the PATCH Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| array(PatchItem) | M | 1..N | It contains the list of changes to be made to the profile of the NF Instance, according to the JSON PATCH format specified in IETF RFC 6902 [13]. |

Table 6.1.3.5.3.2-3: Data structures supported by the PATCH Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| SubscriptionData | M | 1 | 200 OK |  |
| n/a |  |  | 204 No Content |  |

### 6.1.4 Custom Operations without associated resources

There are no custom operations defined without any associated resources for the Nnrf\_NFManagement service in this release of the specification.

### 6.1.5 Notifications

#### 6.1.5.1 General

This clause specifies the notifications provided by the Nnrf\_NFManagement service.

The delivery of notifications shall be supported as specified in clause 6.2 of 3GPP TS 29.500 [4] for Server-initiated communication.

Table 6.1.5.1-1: Notifications overview

|  |  |  |  |
| --- | --- | --- | --- |
| Notification | Resource URI | HTTP method or custom operation | Description  (service operation) |
| NF Instance Status Notification | {nfStatusNotificationUri}  (NF Service Consumer provided callback reference) | POST | Notify about registrations / deregistrations or profile changes of NF Instances |

#### 6.1.5.2 NF Instance Status Notification

##### 6.1.5.2.1 Description

The NF Service Consumer provides a callback URI for getting notified about NF Instances status events, the NRF shall notify the NF Service Consumer, when the conditions specified in the subscription are met.

##### 6.1.5.2.2 Notification Definition

The POST method shall be used for NF Instance Status notification and the URI shall be the callback reference provided by the NF Service Consumer during the subscription to this notification.

Resource URI: **{nfStatusNotificationUri}**

Support of URI query parameters is specified in table 6.1.5.2.2-1.

Table 6.1.5.2.2-1: URI query parameters supported by the POST method

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| n/a |  |  |  |  |

Support of request data structures is specified in table 6.1.5.2.2-2, and support of response data structures and response codes is specified in table 6.1.5.2-3.

Table 6.1.5.2.2-2: Data structures supported by the POST Request Body

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| NotificationData | M | 1 | Representation of the NF Instance status notification. |

Table 6.1.5.2.2-3: Data structures supported by the POST Response Body

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| N/A |  |  | 204 No Content | This case represents a successful notification of the NF Instance status event. |
| NOTE: The mandatory HTTP error status codes for the PUT method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] other than those specified in the table above also apply, with a ProblemDetails data type (see clause 5.2.7 of 3GPP TS 29.500 [4]). | | | | |

### 6.1.6 Data Model

#### 6.1.6.1 General

This clause specifies the application data model supported by the API.

Table 6.1.6.1-1 specifies the data types defined for the Nnrf service based interface protocol.

Table 6.1.6.1-1: Nnrf\_NFManagement specific Data Types

|  |  |  |
| --- | --- | --- |
| Data type | Clause defined | Description |
| NFProfile | 6.1.6.2.2 |  |
| NFService | 6.1.6.2.3 |  |
| DefaultNotificationSubscription | 6.1.6.2.4 | Data structure for specifying the notifications the NF service subscribes by default along with callback URI. |
| IpEndPoint | 6.1.6.2.5 |  |
| UdrInfo | 6.1.6.2.6 |  |
| UdmInfo | 6.1.6.2.7 |  |
| AusfInfo | 6.1.6.2.8 |  |
| SupiRange | 6.1.6.2.9 |  |
| IdentityRange | 6.1.6.2.10 |  |
| AmfInfo | 6.1.6.2.11 |  |
| SmfInfo | 6.1.6.2.12 |  |
| UpfInfo | 6.1.6.2.13 | Information related to UPF |
| SnssaiUpfInfoItem | 6.1.6.2.14 |  |
| DnnUpfInfoItem | 6.1.6.2.15 |  |
| SubscriptionData | 6.1.6.2.16 |  |
| NotificationData | 6.1.6.2.17 |  |
| NFServiceVersion | 6.1.6.2.19 | Contains the version details of an NF service. |
| PcfInfo | 6.1.6.2.20 |  |
| BsfInfo | 6.1.6.2.21 |  |
| Ipv4AddressRange | 6.1.6.2.22 |  |
| Ipv6PrefixRange | 6.1.6.2.23 |  |
| InterfaceUpfInfoItem | 6.1.6.2.24 |  |
| UriList | 6.1.6.2.25 |  |
| N2InterfaceAmfInfo | 6.1.6.2.26 | AMF N2 interface information |
| TaiRange | 6.1.6.2.27 |  |
| TacRange | 6.1.6.2.28 |  |
| SnssaiSmfInfoItem | 6.1.6.2.29 |  |
| DnnSmfInfoItem | 6.1.6.2.30 |  |
| NrfInfo | 6.1.6.2.31 |  |
| ChfInfo | 6.1.6.2.32 |  |
| ChfServiceInfo | 6.1.6.2.33 |  |
| PlmnRange | 6.1.6.2.34 |  |
| SubscrCond | 6.1.6.2.35 |  |
| NfInstanceIdCond | 6.1.6.2.36 |  |
| NfTypeCond | 6.1.6.2.37 |  |
| ServiceNameCond | 6.1.6.2.38 |  |
| AmfCond | 6.1.6.2.39 |  |
| GuamiListCond | 6.1.6.2.40 |  |
| NetworkSliceCond | 6.1.6.2.41 |  |
| NfGroupCond | 6.1.6.2.42 |  |
| NotifCondition | 6.1.6.2.43 |  |
| PlmnSnssai | 6.1.6.2.44 |  |
| NwdafInfo | 6.1.6.2.45 |  |
| LmfInfo | 6.1.6.2.46 |  |
| GmlcInfo | 6.1.6.2.47 |  |
| NefInfo | 6.1.6.2.48 |  |
| PfdData | 6.1.6.2.49 |  |
| AfEventExposureData | 6.1.6.2.50 |  |
| WAgfInfo | 6.1.6.2.51 |  |
| TngfInfo | 6.1.6.2.52 |  |
| PcscfInfo | 6.1.6.2.53 |  |
| NfSetCond | 6.1.6.2.54 |  |
| NfServiceSetCond | 6.1.6.2.55 |  |
| NfInfo | 6.1.6.2.56 |  |
| HssInfo | 6.1.6.2.57 |  |
| ImsiRange | 6.1.6.2.58 |  |
| InternalGroupIdRange | 6.1.6.2.59 |  |
| Fqdn | 6.1.6.3.2 |  |
| NefId | 6.1.6.3.2 |  |
| NFType | 6.1.6.3.3 |  |
| NotificationType | 6.1.6.3.4 |  |
| TransportProtocol | 6.1.6.3.5 |  |
| NotificationEventType | 6.1.6.3.6 |  |
| NFStatus | 6.1.6.3.7 |  |
| DataSetId | 6.1.6.3.8 |  |
| UPInterfaceType | 6.1.6.3.9 |  |
| ServiceName | 6.1.6.3.11 |  |
| NFServiceStatus | 6.1.6.3.12 |  |

Table 6.1.6.1-2 specifies data types re-used by the Nnrf service based interface protocol from other specifications, including a reference to their respective specifications and when needed, a short description of their use within the Nnrf service based interface.

Table 6.1.6.1-2: Nnrf\_NFManagement re-used Data Types

|  |  |  |
| --- | --- | --- |
| Data type | Reference | Comments |
| N1MessageClass | 3GPP 29.518 [6] | The N1 message type |
| N2InformationClass | 3GPP 29.518 [6] | The N2 information type |
| IPv4Addr | 3GPP TS 29.571 [7] |  |
| IPv6Addr | 3GPP TS 29.571 [7] |  |
| IPv6Prefix | 3GPP TS 29.571 [7] |  |
| Uri | 3GPP TS 29.571 [7] |  |
| Dnn | 3GPP TS 29.571 [7] |  |
| SupportedFeatures | 3GPP TS 29.571 [7] |  |
| Snssai | 3GPP TS 29.571 [7] |  |
| PlmnId | 3GPP TS 29.571 [7] |  |
| Guami | 3GPP TS 29.571 [7] |  |
| Tai | 3GPP TS 29.571 [7] |  |
| NfInstanceId | 3GPP TS 29.571 [7] |  |
| LinksValueSchema | 3GPP TS 29.571 [7] | 3GPP Hypermedia link |
| UriScheme | 3GPP TS 29.571 [7] |  |
| AmfName | 3GPP TS 29.571 [7] |  |
| DateTime | 3GPP TS 29.571 [7] |  |
| Dnai | 3GPP TS 29.571 [7] |  |
| ChangeItem | 3GPP TS 29.571 [7] |  |
| DiameterIdentity | 3GPP TS 29.571 [7] |  |
| AccessType | 3GPP TS 29.571 [7] |  |
| NfGroupId | 3GPP TS 29.571 [7] | Network Function Group Id |
| AmfRegionId | 3GPP TS 29.571 [7] |  |
| AmfSetId | 3GPP TS 29.571 [7] |  |
| PduSessionType | 3GPP TS 29.571 [7] |  |
| AtsssCapability | 3GPP TS 29.571 [7] | Capability to support procedures related to Access Traffic Steering, Switching, Splitting. |
| Nid | 3GPP TS 29.571 [7] |  |
| PlmnIdNid | 3GPP TS 29.571 [7] |  |
| NfSetId | 3GPP TS 29.571 [7] | NF Set ID (see clause 28.10 of 3GPP TS 23.003 [12]) |
| NfServiceSetId | 3GPP TS 29.571 [7] | NF Service Set ID (see clause 28.11 of 3GPP TS 23.003 [12]) |
| GroupId | 3GPP TS 29.571 [7] | Internal Group Identifier |
| EventId | 3GPP TS 29.520 [32] | Defined in Nnwdaf\_AnalyticsInfo API. |
| NwdafEvent | 3GPP TS 29.520 [32] | Defined in Nnwdaf\_EventsSubscription API. |
| ExternalClientType | 3GPP TS 29.572 [33] |  |
| AfEvent | 3GPP TS 29.517 [35] | Defined in Naf\_EventExposure API |

#### 6.1.6.2 Structured data types

##### 6.1.6.2.1 Introduction

This clause defines the structures to be used in resource representations.

##### 6.1.6.2.2 Type: NFProfile

Table 6.1.6.2.2-1: Definition of type NFProfile

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| nfInstanceId | NfInstanceId | M | 1 | Unique identity of the NF Instance. |
| nfType | NFType | M | 1 | Type of Network Function |
| nfStatus | NFStatus | M | 1 | Status of the NF Instance (NOTE 5) |
| nfInstanceName | string | O | 0..1 | Human readable name of the NF Instance |
| heartBeatTimer | integer | C | 0..1 | Time in seconds expected between 2 consecutive heart-beat messages from an NF Instance to the NRF.  It may be included in the registration request. When present in the request it shall contain the heartbeat time proposed by the NF service consumer.  It shall be included in responses from NRF to registration requests (PUT) or in NF profile updates (PUT or PATCH). If the proposed heartbeat time is acceptable by the NRF based on the local configuration, it shall use the same value as in the registration request; otherwise the NRF shall override the value using a preconfigured value. |
| plmnList | array(PlmnId) | C | 1..N | PLMN(s) of the Network Function (NOTE 7).  This IE shall be present if this information is available for the NF.  If not provided, PLMN ID(s) of the PLMN of the NRF are assumed for the NF. |
| snpnList | array(PlmnIdNid) | C | 1..N | SNPN(s) of the Network Function.  This IE shall be present if the NF pertains to one or more SNPNs. |
| sNssais | array(Snssai) | O | 1..N | S-NSSAIs of the Network Function.  If not provided, the NF can serve any S-NSSAI.  When present this IE represents the list of S-NSSAIs supported in all the PLMNs listed in the plmnList IE. |
| perPlmnSnssaiList | array(PlmnSnssai) | O | 1..N | This IE may be included when the list of S-NSSAIs supported by the NF for each PLMN it is supporting is different. When present, this IE shall include the S-NSSAIs supported by the Network Function for each PLMN supported by the Network Function. When present, this IE shall override sNssais IE. (NOTE 9) |
| nsiList | array(string) | O | 1..N | NSI identities of the Network Function.  If not provided, the NF can serve any NSI. |
| fqdn | Fqdn | C | 0..1 | FQDN of the Network Function (NOTE 1) (NOTE 2). For AMF, the FQDN registered with the NRF shall be that of the AMF Name (see 3GPP 23.003 [12] clause 28.3.2.5). |
| interPlmnFqdn | Fqdn | C | 0..1 | If the NF needs to be discoverable by other NFs in a different PLMN, then an FQDN that is used for inter-PLMN routing as specified in 3GPP 23.003 [12] shall be registered with the NRF (NOTE 8).  A change of this attribute shall result in triggering a "NF\_PROFILE\_CHANGED" notification from NRF towards subscribing NFs located in a different PLMN, but the new value shall be notified as a change of the "fqdn" attribute. |
| ipv4Addresses | array(Ipv4Addr) | C | 1..N | IPv4 address(es) of the Network Function (NOTE 1) (NOTE 2) |
| ipv6Addresses | array(Ipv6Addr) | C | 1..N | IPv6 address(es) of the Network Function (NOTE 1) (NOTE 2) |
| allowedPlmns | array(PlmnId) | O | 1..N | PLMNs allowed to access the NF instance.  If not provided, any PLMN is allowed to access the NF.  A change of this attribute shall not trigger a "NF\_PROFILE\_CHANGED" notification from NRF, and this attribute shall not be included in profile change notifications to subscribed NFs. |
| allowedSnpns | array(PlmnIdNid) | O | 1..N | SNPNs allowed to access the NF instance.  If this attribute is present in the NFService and in the NF profile, the attribute from the NFService shall prevail.  The absence of this attribute in both the NFService and in the NF profile indicates that no SNPN, other than the SNPN(s) registered in the snpnList attribute of the NF Profile, is allowed to access the service instance.  A change of this attribute shall not trigger a "NF\_PROFILE\_CHANGED" notification from NRF, and this attribute shall not be included in profile change notifications to subscribed NFs. |
| allowedNfTypes | array(NFType) | O | 1..N | Type of the NFs allowed to access the NF instance.  If not provided, any NF type is allowed to access the NF.  A change of this attribute shall not trigger a "NF\_PROFILE\_CHANGED" notification from NRF, and this attribute shall not be included in profile change notifications to subscribed NFs. |
| allowedNfDomains | array(string) | O | 1..N | Pattern (regular expression according to the ECMA-262 dialect [8]) representing the NF domain names allowed to access the NF instance.  If not provided, any NF domain is allowed to access the NF.  A change of this attribute shall not trigger a "NF\_PROFILE\_CHANGED" notification from NRF, and this attribute shall not be included in profile change notifications to subscribed NFs. |
| allowedNssais | array(Snssai) | O | 1..N | S-NSSAI of the allowed slices to access the NF instance.  If not provided, any slice is allowed to access the NF.  A change of this attribute shall not trigger a "NF\_PROFILE\_CHANGED" notification from NRF, and this attribute shall not be included in profile change notifications to subscribed NFs. |
| priority | integer | O | 0..1 | Priority (relative to other NFs of the same type) in the range of 0-65535, to be used for NF selection; lower values indicate a higher priority. Priority may or may not be present in the nfServiceList parameters, xxxInfo parameters and in this attribute. Priority in the nfServiceList has precedence over the priority in this attribute, which has precedence over the priority in xxxInfo parameter. (NOTE 4).  The NRF may overwrite the received priority value when exposing an NFProfile with the Nnrf\_NFDiscovery service. |
| capacity | integer | O | 0..1 | Static capacity information in the range of 0-65535, expressed as a weight relative to other NF instances of the same type; if capacity is also present in the nfServiceList parameters, those will have precedence over this value. (NOTE 4). |
| load | integer | O | 0..1 | Dynamic load information, ranged from 0 to 100, indicates the current load percentage of the NF. |
| locality | string | O | 0..1 | Operator defined information about the location of the NF instance (e.g. geographic location, data center) (NOTE 3) |
| udrInfo | UdrInfo | O | 0..1 | Specific data for the UDR (ranges of SUPI, group ID …) |
| udrInfoExt | array(UdrInfo) | O | 1..N | Multiple entries of UdrInfo. This attribute provides additional information to the udrInfo. udrInfoExt may be present even if the udrInfo is absent. |
| udmInfo | UdmInfo | O | 0..1 | Specific data for the UDM (ranges of SUPI, group ID…) |
| udmInfoExt | array(UdmInfo) | O | 1..N | Multiple entries of UdmInfo. This attribute provides additional information to the udmInfo. udmInfoExt may be present even if the udmInfo is absent. |
| ausfInfo | AusfInfo | O | 0..1 | Specific data for the AUSF (ranges of SUPI, group ID…) |
| ausfInfoExt | array(AusfInfo) | O | 1..N | Multiple entries of AusfInfo. This attribute provides additional information to the ausfInfo. ausfInfoExt may be present even if the ausfInfo is absent. |
| amfInfo | AmfInfo | O | 0..1 | Specific data for the AMF (AMF Set ID, …) |
| amfInfoExt | array(AmfInfo) | O | 1..N | Multiple entries of AmfInfo. This attribute provides additional information to the amfInfo. amfInfoExt may be present even if the amfInfo is absent. |
| smfInfo | SmfInfo | O | 0..1 | Specific data for the SMF (DNN's, …).  (NOTE 12) |
| smfInfoExt | array(SmfInfo) | O | 1..N | Multiple entries of SmfInfo. This attribute provides additional information to the smfInfo. smfInfoExt may be present even if the smfInfo is absent.  (NOTE 12) |
| upfInfo | UpfInfo | O | 0..1 | Specific data for the UPF (S-NSSAI, DNN, SMF serving area, interface…) |
| upfInfoExt | array(UpfInfo) | O | 1..N | Multiple entries of UpfInfo. This attribute provides additional information to the upfInfo. upfInfoExt may be present even if the upfInfo is absent. |
| pcfInfo | PcfInfo | O | 0..1 | Specific data for the PCF |
| pcfInfoExt | array(PcfInfo) | O | 1..N | Multiple entries of PcfInfo. This attribute provides additional information to the pcfInfo. pcfInfoExt may be present even if the pcfInfo is absent. |
| bsfInfo | BsfInfo | O | 0..1 | Specific data for the BSF |
| bsfInfoExt | array(BsfInfo) | O | 1..N | Multiple entries of BsfInfo. This attribute provides additional information to the bsfInfo. bsfInfoExt may be present even if the bsfInfo is absent. |
| chfInfo | ChfInfo | O | 0..1 | Specific data for the CHF |
| chfInfoExt | array(ChfInfo) | O | 1..N | Multiple entries of ChfInfo. This attribute provides additional information to the chfInfo. chfInfoExt may be present even if the chfInfo is absent. |
| nefInfo | NefInfo | O | 0..1 | Specific data for the NEF |
| nrfInfo | NrfInfo | O | 0..1 | Specific data for the NRF |
| nwdafInfo | NwdafInfo | O | 0..1 | Specific data for the NWDAF. |
| pcscfInfo | array(PcscfInfo) | O | 1..N | Specific data for the P-CSCF.  (NOTE 11) |
| hssInfo | array(HssInfo) | O | 1..N | Specific data for the HSS. |
| customInfo | object | O | 0..1 | Specific data for custom Network Functions |
| recoveryTime | DateTime | O | 0..1 | Timestamp when the NF was (re)started (NOTE 5) (NOTE 6) |
| nfServicePersistence | boolean | O | 0..1 | If present, and set to true, it indicates that the different service instances of a same NF Service in this NF instance, supporting a same API version, are capable to persist their resource state in shared storage and therefore these resources are available after a new NF service instance supporting the same API version is selected by a NF Service Consumer (see 3GPP 23.527 [27]).  Otherwise, it indicates that the NF Service Instances of a same NF Service are not capable to share resource state inside the NF Instance. |
| nfServices | array(NFService) | O | 1..N | List of NF Service Instances. It shall include the services produced by the NF that can be discovered by other NFs, if any. |
| nfProfileChangesSupportInd | boolean | O | 0..1 | NF Profile Changes Support Indicator.  See Annex B.  This IE may be present in the NFRegister or NFUpdate (NF Profile Complete Replacement) request and shall be absent in the response.  true: the NF Service Consumer supports receiving NF Profile Changes in the response.  false (default): the NF Service Consumer does not support receiving NF Profile Changes in the response.  Write-Only: true |
| nfProfileChangesInd | boolean | O | 0..1 | NF Profile Changes Indicator.  See Annex B.  This IE shall be absent in the request to the NRF and may be included by the NRF in NFRegister or NFUpdate (NF Profile Complete Replacement) response.  true: the NF Profile contains NF Profile changes.  false (default): complete NF Profile.  Read-Only: true |
| defaultNotificationSubscriptions | array(DefaultNotificationSubscription) | O | 1..N | Notification endpoints for different notification types.  (NOTE 10) |
| lmfInfo | LmfInfo | O | 0..1 | Specific data for the LMF |
| gmlcInfo | GmlcInfo | O | 0..1 | Specific data for the GMLC |
| nfSetIdList | array(NfSetId) | O | 1..N | NF Set ID defined in clause 28.10 of 3GPP TS 23.003 [12].  At most one NF Set ID shall be indicated per PLMN of the NF. |
| servingScope | array(string) | O | 1..N | The served area(s) of the NF instance.  The absence of this attribute does not imply that the NF instance can serve every area in the PLMN.  (NOTE 13) |
| NOTE 1: At least one of the addressing parameters (fqdn, ipv4address or ipv6adress) shall be included in the NF Profile. If the NF supports the NF services with "https" URI scheme (i.e use of TLS is mandatory), then the FQDN shall be provided in the NF Profile or the NF Service profile (see clause 6.1.6.2.3). See NOTE 1 of Table 6.1.6.2.3-1 for the use of these parameters. If multiple ipv4 addresses and/or ipv6 addresses are included in the NF Profile, the NF Service Consumer of the discovery service shall select one of these addresses randomly, unless operator defined local policy of IP address selection, in order to avoid overload for a specific ipv4 address and/or ipv6 address.  NOTE 2: If the type of Network Function is UPF, the addressing information is for the UPF N4 interface.  NOTE 3: A requester NF may use this information to select a NF instance (e.g. a NF instance preferably located in the same data center).  NOTE 4: The capacity and priority parameters, if present, are used for NF selection and load balancing. The priority and capacity attributes shall be used for NF selection in the same way that priority and weight are used for server selection as defined in IETF RFC 2782 [23].  NOTE 5: The NRF shall notify NFs subscribed to receiving notifications of changes of the NF profile, if the NF recoveryTime or the nfStatus is changed. See clause 6.2 of 3GPP 23.527 [27].  NOTE 6: A requester NF may consider that all the resources created in the NF before the NF recovery time have been lost. This may be used to detect a restart of a NF and to trigger appropriate actions, e.g. release local resources. See clause 6.2 of 3GPP 23.527 [27].  NOTE 7: A NF may register multiple PLMN IDs in its profile within a PLMN comprising multiple PLMN IDs. If so, all the attributes of the NF Profile shall apply to each PLMN ID registered in the plmnList. As an exception, attributes including a PLMN ID, e.g. IMSI-based SUPI ranges, TAIs and GUAMIs, are specific to one PLMN ID and the NF may register in its profile multiple occurrences of such attributes for different PLMN IDs (e.g. the UDM may register in its profile SUPI ranges for different PLMN IDs).  NOTE 8: Other NFs are in a different PLMN if they belong to none of the PLMN ID(s) configured for the PLMN of the NRF.  NOTE 9: This is for the use case where an NF (e.g. AMF) supports multiple PLMNs and the slices supported in each PLMN are different. See clause 9.2.6.2 of 3GPP TS 38.413 [29].  NOTE 10: If notification endpoints are present both in the profile of the NF instance (NFProfile) and in some of its NF Services (NFService) for a same notification type, the notification endpoint(s) of the NF Services shall be used for this notification type.  NOTE 11: The absence of the pcscfInfo attribute in a P-CSCF profile indicates that the P-CSCF can be selected for any DNN and Access Type.  NOTE 12: The absence of both the smfInfo and smfInfoExt attributes in an SMF profile indicates that the SMF can be selected for any S-NSSAI, DNN, TAI and access type.  NOTE 13: The servingScope attribute may indicate geographical areas, It may be used e.g. to discover and select NFs in centralized Data Centers that are expected to serve users located in specific region(s) or province(s). It may also be used to reduce the large configuration of TAIs in the NF instances. | | | | |

##### 6.1.6.2.3 Type: NFService

Table 6.1.6.2.3-1: Definition of type NFService

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| serviceInstanceId | string | M | 1 | Unique ID of the service instance within a given NF Instance |
| serviceName | ServiceName | M | 1 | Name of the service instance (e.g. "nudm-sdm") |
| versions | array(NFServiceVersion) | M | 1..N | The API versions supported by the NF Service and if available, the corresponding retirement date of the NF Service.  The different array elements shall have distinct unique values for "apiVersionInUri", and consequently, the values of "apiFullVersion" shall have a unique first digit version number. |
| scheme | UriScheme | M | 1 | URI scheme (e.g. "http", "https") |
| nfServiceStatus | NFServiceStatus | M | 1 | Status of the NF Service Instance (NOTE 3) |
| fqdn | Fqdn | O | 0..1 | FQDN of the NF Service Instance (NOTE 1) (NOTE 8) |
| interPlmnFqdn | Fqdn | O | 0..1 | If the NF service needs to be discoverable by other NFs in a different PLMN, then an FQDN that is used for inter PLMN routing as specified in 3GPP 23.003 [12] may be registered with the NRF (NOTE 1) (NOTE 6).  A change of this attribute shall result in triggering a "NF\_PROFILE\_CHANGED" notification from NRF towards subscribing NFs located in a different PLMN, but the new value shall be notified as a change of the "fqdn" attribute. |
| ipEndPoints | array(IpEndPoint) | O | 1..N | IP address(es) and port information of the Network Function (including IPv4 and/or IPv6 address) where the service is listening for incoming service requests (NOTE 1) (NOTE 7). |
| apiPrefix | string | O | 0..1 | Optional path segment(s) used to construct the {apiRoot} variable of the different API URIs, as described in 3GPP 29.501 [5], clause 4.4.1 |
| defaultNotificationSubscriptions | array(DefaultNotificationSubscription) | O | 1..N | Notification endpoints for different notification types. |
| allowedPlmns | array(PlmnId) | O | 1..N | PLMNs allowed to access the service instance (NOTE 5).  The absence of this attribute indicates that any PLMN is allowed to access the service instance.  When included, the allowedPlmns attribute needs not include the PLMN ID(s) registered in the plmnList attribute of the NF Profile, i.e. the PLMN ID(s) registered in the NF Profile shall be considered to be allowed to access the service instance.  A change of this attribute shall not trigger a "NF\_PROFILE\_CHANGED" notification from NRF, and this attribute shall not be included in profile change notifications to subscribed NFs. |
| allowedSnpns | array(PlmnIdNid) | O | 1..N | SNPNs allowed to access the service instance.  If this attribute is present in the NFService and in the NF profile, the attribute from the NFService shall prevail.  The absence of this attribute in both the NFService and in the NF profile indicates that no SNPN, other than the SNPN(s) registered in the snpnList attribute of the NF Profile, is allowed to access the service instance.  When included, the allowedSnpns attribute needs not include the PLMN ID/NID(s) registered in the snpnList attribute of the NF Profile, i.e. the SNPNs registered in the NF Profile shall be considered to be allowed to access the service instance.  A change of this attribute shall not trigger a "NF\_PROFILE\_CHANGED" notification from NRF, and this attribute shall not be included in profile change notifications to subscribed NFs. |
| allowedNfTypes | array(NFType) | O | 1..N | Type of the NFs allowed to access the service instance (NOTE 5).  The absence of this attribute indicates that any NF type is allowed to access the service instance.  A change of this attribute shall not trigger a "NF\_PROFILE\_CHANGED" notification from NRF, and this attribute shall not be included in profile change notifications to subscribed NFs. |
| allowedNfDomains | array(string) | O | 1..N | Pattern (regular expression according to the ECMA-262 dialect [8]) representing the NF domain names allowed to access the service instance (NOTE 5).  The absence of this attribute indicates that any NF domain is allowed to access the service instance.  A change of this attribute shall not trigger a "NF\_PROFILE\_CHANGED" notification from NRF, and this attribute shall not be included in profile change notifications to subscribed NFs. |
| allowedNssais | array(Snssai) | O | 1..N | S-NSSAI of the allowed slices to access the service instance (NOTE 5).  The absence of this attribute indicates that any slice is allowed to access the service instance.  A change of this attribute shall not trigger a "NF\_PROFILE\_CHANGED" notification from NRF, and this attribute shall not be included in profile change notifications to subscribed NFs. |
| priority | integer | O | 0..1 | Priority (relative to other services of the same type) in the range of 0-65535, to be used for NF Service selection; lower values indicate a higher priority. (NOTE 2).  The NRF may overwrite the received priority value when exposing an NFProfile with the Nnrf\_NFDiscovery service. |
| capacity | integer | O | 0..1 | Static capacity information in the range of 0-65535, expressed as a weight relative to other services of the same type. (NOTE 2). |
| load | integer | O | 0..1 | Dynamic load information, ranged from 0 to 100, indicates the current load percentage of the NF Service. |
| recoveryTime | DateTime | O | 0..1 | Timestamp when the NF service was (re)started (NOTE 3) (NOTE 4) |
| chfServiceInfo | ChfServiceInfo | O | 0..1 | Specific data for a CHF service instance |
| supportedFeatures | SupportedFeatures | O | 0..1 | Supported Features of the NF Service instance |
| nfServiceSetIdList | array(NfServiceSetId) | O | 1..N | NF Service Set ID (see clause 28.11 of 3GPP TS 23.003 [12])  At most one NF Service Set ID shall be indicated per PLMN of the NF. |
| NOTE 1: The NF Service Consumer will construct the API URIs of the service using:  - for intra-PLMN signalling: the FQDN and IP addresses related attributes present in the NF Service Profile, if any, otherwise the FQDN and IP addresses related attributes present in the NF Profile.  - for inter-PLMN signalling: the interPlmnFqdn present in the NF Service Profile, if any, otherwise the interPlmnFqdn present in the NF Profile.  See Table 6.2.6.2.4-1.  NOTE 2: The capacity and priority parameters, if present, are used for NF selection and load balancing. The priority and capacity attributes shall be used for NF selection in the same way that priority and weight are used for server selection as defined in IETF RFC 2782 [23].  NOTE 3: The NRF shall notify NFs subscribed to receiving notifications of changes of the NF profile, if the recoveryTime or the nfServiceStatus is changed. See clause 6.2 of 3GPP 23.527 [27].  NOTE 4: A requester NF subscribed to NF status changes may consider that all the resources created in the NF service before the NF service recovery time have been lost. This may be used to detect a restart of a NF service and to trigger appropriate actions, e.g. release local resources. See clause 6.2 of 3GPP 23.527 [27].  NOTE 5: If this attribute is present in the NFService and in the NF profile, the attribute from the NFService shall prevail. The absence of this attribute in the NFService and in the NFProfile indicates that there is no corresponding restriction to access the service instance. If this attribute is absent in the NF Service, but it is present in the NF Profile, the attribute from the NF Profile shall be applied.  NOTE 6: Other NFs are in a different PLMN if they belong to none of the PLMN ID(s) configured for the PLMN of the NRF.  NOTE 7: If multiple ipv4 addresses and/or ipv6 addresses are included in the NF Service, the NF Service Consumer of the discovery service shall select one of these addresses randomly, unless operator defined local policy of IP address selection, in order to avoid overload for a specific ipv4 address and/or ipv6 address.  NOTE 8: If the URI scheme registered for the NF service is "https" then FQDN shall be provided in the NF Service profile or in NF Profile (see clause 6.1.6.2.2). | | | | |

##### 6.1.6.2.4 Type: DefaultNotificationSubscription

Table 6.1.6.2.4-1: Definition of type DefaultNotificationSubscription

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| notificationType | NotificationType | M | 1 | Type of notification for which the corresponding callback URI is provided. |
| callbackUri | Uri | M | 1 | This attribute contains a default notification endpoint to be used by a NF Service Producer towards an NF Service Consumer that has not registered explicitly a callback URI in the NF Service Producer (e.g. as a result of an implicit subscription). |
| n1MessageClass | N1MessageClass | C | 0..1 | If the notification type is N1\_MESSAGES, this IE shall be present and shall identify the class of N1 messages to be notified. |
| n2InformationClass | N2InformationClass | C | 0..1 | If the notification type is N2\_INFORMATION, this IE shall be present and shall identify the class of N2 information to be notified. |

##### 6.1.6.2.5 Type: IpEndPoint

Table 6.1.6.2.5-1: Definition of type IpEndPoint

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| ipv4Address | Ipv4Addr | C | 0..1 | IPv4 address (NOTE 1) |
| ipv6Address | Ipv6Addr | C | 0..1 | IPv6 address (NOTE 1) |
| transport | TransportProtocol | O | 0..1 | Transport protocol |
| port | integer | O | 0..1 | Port number (NOTE 2) |
| NOTE 1: At most one occurrence of either ipv4Address or ipv6Address shall be included in this data structure.  NOTE 2: If the port number is absent from the ipEndPoints attribute, the NF service consumer shall use the default HTTP port number, i.e. TCP port 80 for "http" URIs or TCP port 443 for "https" URIs as specified in IETF RFC 7540 [9] when invoking the service. | | | | |

##### 6.1.6.2.6 Type: UdrInfo

Table 6.1.6.2.6-1: Definition of type UdrInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| groupId | NfGroupId | O | 0..1 | Identity of the UDR group that is served by the UDR instance.  If not provided, the UDR instance does not pertain to any UDR group. |
| supiRanges | array(SupiRange) | O | 1..N | List of ranges of SUPI's whose profile data is available in the UDR instance (NOTE 1) |
| gpsiRanges | array(IdentityRange) | O | 1..N | List of ranges of GPSIs whose profile data is available in the UDR instance (NOTE 1) |
| externalGroupIdentifiersRanges | array(IdentityRange) | O | 1..N | List of ranges of external groups whose profile data is available in the UDR instance (NOTE 1) |
| supportedDataSets | array(DataSetId) | O | 1..N | List of supported data sets in the UDR instance.  If not provided, the UDR supports all data sets. |
| NOTE 1: If none of these parameters is provided, the UDR can serve any external group and any SUPI or GPSI. | | | | |

##### 6.1.6.2.7 Type: UdmInfo

Table 6.1.6.2.7-1: Definition of type UdmInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| groupId | NfGroupId | O | 0..1 | Identity of the UDM group that is served by the UDM instance.  If not provided, the UDM instance does not pertain to any UDM group. |
| supiRanges | array(SupiRange) | O | 1..N | List of ranges of SUPIs whose profile data is available in the UDM instance (NOTE 1) |
| gpsiRanges | array(IdentityRange) | O | 1..N | List of ranges of GPSIs whose profile data is available in the UDM instance (NOTE 1) |
| externalGroupIdentifiersRanges | array(IdentityRange) | O | 1..N | List of ranges of external groups whose profile data is available in the UDM instance (NOTE 1) |
| routingIndicators | array(string) | O | 1..N | List of Routing Indicator information that allows to route network signalling with SUCI (see 3GPP 23.003 [12]) to the UDM instance.  If not provided, the UDM can serve any Routing Indicator.  Pattern: '^[0-9]{1,4}$' |
| internalGroupIdentifiersRanges | array(InternalGroupIdRange) | O | 1..N | List of ranges of Internal Group Identifiers whose profile data is available in the UDM instance.  If not provided, it does not imply that the UDM supports all internal groups. |
| NOTE 1: If none of these parameters is provided, the UDM can serve any external group and any SUPI or GPSI. | | | | |

##### 6.1.6.2.8 Type: AusfInfo

Table 6.1.6.2.8-1: Definition of type AusfInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| groupId | NfGroupId | O | 0..1 | Identity of the AUSF group.  If not provided, the AUSF instance does not pertain to any AUSF group. |
| supiRanges | array(SupiRange) | O | 1..N | List of ranges of SUPIs that can be served by the AUSF instance. If not provided, the AUSF can serve any SUPI. |
| routingIndicators | array(string) | O | 1..N | List of Routing Indicator information that allows to route network signalling with SUCI (see 3GPP 23.003 [12]) to the AUSF instance.  If not provided, the AUSF can serve any Routing Indicator.  Pattern: '^[0-9]{1,4}$' |

##### 6.1.6.2.9 Type: SupiRange

Table 6.1.6.2.9-1: Definition of type SupiRange

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| start | string | O | 0..1 | First value identifying the start of a SUPI range, to be used when the range of SUPI's can be represented as a numeric range (e.g., IMSI ranges). This string shall consist only of digits.  Pattern: "^[0-9]+$" |
| end | string | O | 0..1 | Last value identifying the end of a SUPI range, to be used when the range of SUPI's can be represented as a numeric range (e.g. IMSI ranges). This string shall consist only of digits.  Pattern: "^[0-9]+$" |
| pattern | string | O | 0..1 | Pattern (regular expression according to the ECMA-262 dialect [8]) representing the set of SUPI's belonging to this range. A SUPI value is considered part of the range if and only if the SUPI string fully matches the regular expression. |
| NOTE: Either the start and end attributes, or the pattern attribute, shall be present. | | | | |

EXAMPLE 1: IMSI range. From: 123 45 6789040000 To: 123 45 6789059999 (i.e., 20,000 IMSI numbers)  
JSON: { "start": "123456789040000", "end": "123456789059999" }

EXAMPLE 2: IMSI range. From: 123 45 6789040000 To: 123 45 6789049999 (i.e., 10,000 IMSI numbers)  
JSON: { "pattern": "^imsi-12345678904[0-9]{4}$" }, or  
JSON: { "start": "123456789040000", "end": "123456789049999" }

EXAMPLE 3: NAI range. "[smartmeter-*{factoryID}*@company.com](mailto:smartmeter-%7bfactoryID%7d@company.com)" where "*{factoryID}*" can be any string.  
JSON: { "pattern": "[^nai-smartmeter-.+@company\.com$](mailto:%5enai-smartmeter-.+@gascompany\.com$)" }

##### 6.1.6.2.10 Type: IdentityRange

Table 6.1.6.2.10-1: Definition of type IdentityRange

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| start | string | O | 0..1 | First value identifying the start of an identity range, to be used when the range of identities can be represented as a numeric range (e.g., MSISDN ranges). This string shall consist only of digits.  Pattern: "^[0-9]+$" |
| end | string | O | 0..1 | Last value identifying the end of an identity range, to be used when the range of identities can be represented as a numeric range (e.g. MSISDN ranges). This string shall consist only of digits.  Pattern: "^[0-9]+$" |
| pattern | String | O | 0..1 | Pattern (regular expression according to the ECMA-262 dialect [8]) representing the set of identities belonging to this range. An identity value is considered part of the range if and only if the identity string fully matches the regular expression. To be used when identity is External Identifier or External Group Identifier or MSISDN. |
| NOTE: Either the start and end attributes, or the pattern attribute, shall be present. | | | | |

##### 6.1.6.2.11 Type: AmfInfo

Table 6.1.6.2.11-1: Definition of type AmfInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| amfRegionId | AmfRegionId | M | 1 | AMF region identifier |
| amfSetId | AmfSetId | M | 1 | AMF set identifier. |
| guamiList | array(Guami) | M | 1..N | List of supported GUAMIs |
| taiList | array(Tai) | O | 1..N | The list of TAIs the AMF can serve. It may contain the non-3GPP access TAI. The absence of this attribute and the taiRangeList attribute indicate that the AMF can be selected for any TAI in the serving network. |
| taiRangeList | array(TaiRange) | O | 1..N | The range of TAIs the AMF can serve. The absence of this attribute and the taiList attribute indicate that the AMF can be selected for any TAI in the serving network. |
| backupInfoAmfFailure | array(Guami) | O | 1..N | List of GUAMIs for which the AMF acts as a backup for AMF failure |
| backupInfoAmfRemoval | array(Guami) | O | 1..N | List of GUAMIs for which the AMF acts as a backup for planned AMF removal |
| n2InterfaceAmfInfo | N2InterfaceAmfInfo | O | 0..1 | N2 interface information of the AMF. This information needs not be sent in NF Discovery responses. It may be used by the NRF to update the DNS for AMF discovery by the 5G Access Network. The procedures for updating the DNS are out of scope of this specification. |

The "backupInfoAmfFailure" attribute and "backupInfoAmfRemoval" attribute indicates the GUAMIs for which the AMF can act as Backup, when the serving AMF has failed or under planned removal.

EXAMPLE:

When AMF-A, AMF-B and AMF-C registered their NF profiles for PLMN (e.g. MCC = 234, MNC = 15) as following:

AMF-A NF Profile:

{

"amfInfo": {

"guamiList": [{ "plmnId": { "mcc": "234", "mnc": "15" }, "amfId": "000001"}],

"backupInfoAmfFailure": [{ "plmnId": { "mcc": "234", "mnc": "15" }, "amfId": "000003"}]

}

}

AMF-B NF Profile:

{

"amfInfo": {

"guamiList": [{ "plmnId": { "mcc": "234", "mnc": "15" }, "amfId": "000002"}],

"backupInfoAmfRemoval": [{ "plmnId": { "mcc": "234", "mnc": "15" }, "amfId": "000003"}]

}

}

AMF-C NF Profile:

{

"amfInfo": {

"guamiList": [{ "plmnId": { "mcc": "234", "mnc": "15" }, "amfId": "000003"}]

}

}

When one NF consumer queries NRF with a GUAMI served by AMF-C (i.e. {"plmnId":{"mcc":"234","mnc": "15"},"amfId":"000003"}), then

- if the NRF detects the AMF-C has failed, e.g. using heartbeat, the NRF shall return AMF-A instance as backup AMF; or

- if the NRF detects AMF-C has entered planned removal, i.e. received a de-registration request from AMF-C, the NRF shall return AMF-B instance as backup AMF.

##### 6.1.6.2.12 Type: SmfInfo

Table 6.1.6.2.12-1: Definition of type SmfInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| sNssaiSmfInfoList | array(sNssaiSmfInfoItem) | M | 1..N | List of parameters supported by the SMF per S-NSSAI (NOTE 1). |
| taiList | array(Tai) | O | 1..N | The list of TAIs the SMF can serve. It may contain the non-3GPP access TAI. The absence of this attribute and the taiRangeList attribute indicate that the SMF can be selected for any TAI in the serving network. |
| taiRangeList | array(TaiRange) | O | 1..N | The range of TAIs the SMF can serve. It may contain the non-3GPP access' TAI. The absence of this attribute and the taiList attribute indicate that the SMF can be selected for any TAI in the serving network. |
| pgwFqdn | Fqdn | O | 0..1 | The FQDN of the PGW if the SMF is a combined SMF/PGW-C. |
| accessType | array(AccessType) | C | 1..2 | If included, this IE shall contain the access type (3GPP\_ACCESS and/or NON\_3GPP\_ACCESS) supported by the SMF.  If not included, it shall be assumed the both access types are supported. |
| priority | integer | O | 0..1 | Priority (relative to other NFs of the same type) in the range of 0-65535, to be used for NF selection for a service request matching the attributes of the SmfInfo; lower values indicate a higher priority.  See the precedence rules in the description of the priority attribute in NFProfile, if Priority is also present in the nfServiceList parameters or in NFProfile.  The NRF may overwrite the received priority value when exposing an NFProfile with the Nnrf\_NFDiscovery service.  (NOTE 2) |
| NOTE 1: If this S-NSSAIs is present in the SmfInfo and in the NFprofile, the S-NSSAIs from the SmfInfo shall prevail.  NOTE 2: An SMF profile may e.g. contain multiple SmfInfo entries, with each entry containing a different list of TAIs and a different priority, to differentiate the priority to select the SMF based on the user location. The priority in SmfInfo has the least precedence, i.e. it applies between SMFs or SMF Services with the same priority. | | | | |

##### 6.1.6.2.13 Type: UpfInfo

Table 6.1.6.2.13-1: Definition of type UpfInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| sNssaiUpfInfoList | array(SnssaiUpfInfoItem) | M | 1..N | List of parameters supported by the UPF per S-NSSAI (NOTE 1) |
| smfServingArea | array(string) | O | 1..N | The SMF service area(s) the UPF can serve.  If not provided, the UPF can serve any SMF service area. |
| interfaceUpfInfoList | array(InterfaceUpfInfoItem) | O | 1..N | List of User Plane interfaces configured on the UPF. When this IE is provided in the NF Discovery response, the NF Service Consumer (e.g. SMF) may use this information for UPF selection. |
| iwkEpsInd | boolean | O | 0..1 | Indicates whether interworking with EPS is supported by the UPF.  true: Supported false (default): Not Supported |
| pduSessionTypes | array(PduSessionType) | O | 1..N | List of PDU session type(s) supported by the UPF. The absence of this attribute indicates that the UPF can be selected for any PDU session type. |
| atsssCapability | AtsssCapability | C | 0..1 | If present, this IE shall indicate the ATSSS capability of the UPF.  If not present, the UPF shall be regarded with no ATSSS capability. |
| ueIpAddrInd | boolean | O | 0..1 | Indicates whether the UPF supports allocating UE IP addresses/prefixes.  true: supported false (default): not supported |
| taiList | array(Tai) | O | 1..N | The list of TAIs the UPF can serve. It may contain the non-3GPP access TAI.  If not provided, the UPF can serve the whole SMF service area defined by the smfServingArea attribute. |
| wAgfInfo | WAgfInfo | C | 0..1 | If present, this IE shall indicate that the UPF is collocated with W-AGF.  If not present, the UPF is not collocated with W-AGF. |
| tngfInfo | TngfInfo | C | 0..1 | If present, this IE shall indicate that the UPF is collocated with TNGF.  If not present, the UPF is not collocated with TNGF. |
| priority | integer | O | 0..1 | Priority (relative to other NFs of the same type) in the range of 0-65535, to be used for NF selection for a service request matching the attributes of the UpfInfo; lower values indicate a higher priority.  See the precedence rules in the description of the priority attribute in NFProfile, if Priority is also present in NFProfile.  The NRF may overwrite the received priority value when exposing an NFProfile with the Nnrf\_NFDiscovery service.  (NOTE 2) |
| NOTE 1: If this S-NSSAIs is present in the UpfInfo and in the NFprofile, the S-NSSAIs from the UpfInfo shall prevail.  NOTE 2: An UPF profile may e.g. contain multiple UpfInfo entries, with each entry containing a different list of TAIs and a different priority, to differentiate the priority to select the UPF based on the user location. The priority in UpfInfo has the least precedence, i.e. it applies between UPFs with the same priority. | | | | |

##### 6.1.6.2.14 Type: SnssaiUpfInfoItem

Table 6.1.6.2.14-1: Definition of type SnssaiUpfInfoItem

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| sNssai | Snssai | M | 1 | Supported S-NSSAI |
| dnnUpfInfoList | array(DnnUpfInfoItem) | M | 1..N | List of parameters supported by the UPF per DNN |

##### 6.1.6.2.15 Type: DnnUpfInfoItem

Table 6.1.6.2.15-1: Definition of type DnnUpfInfoItem

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| dnn | Dnn | M | 1 | Supported DNN |
| dnaiList | array(Dnai) | O | 1..N | List of Data network access identifiers supported by the UPF for this DNN. The absence of this attribute indicates that the UPF can be selected for this DNN for any DNAI. |
| pduSessionTypes | array(PduSessionType) | O | 1..N | List of PDU session type(s) supported by the UPF for a specific DNN. The absence of this attribute indicates that the UPF can be selected for this DNN for any PDU session type supported by the UPF (see clause 6.1.6.2.13). |
| ipv4AddressRanges | array(Ipv4AddressRange) | O | 1..N | List of ranges of IPv4 addresses handled by UPF. (NOTE 1) |
| ipv6PrefixRanges | array(Ipv6PrefixRange) | O | 1..N | List of ranges of IPv6 prefixes handled by the UPF. (NOTE 1) |
| NOTE 1: The list of ranges of IPv4/v6 address may be used by the SMF to select a UPF which supports a UE static IP address received in user subscription. | | | | |

##### 6.1.6.2.16 Type: SubscriptionData

Table 6.1.6.2.16-1: Definition of type SubscriptionData

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| nfStatusNotificationUri | Uri | M | 1 | Callback URI where the NF Service Consumer will receive the notifications from NRF. |
| reqNfInstanceId | NfInstanceId | O | 0..1 | If present, this IE shall contain the NF instance id of the NF service consumer. |
| subscrCond | SubscrCond | O | 0..1 | If present, this attributed shall contain the conditions identifying the set of NF Instances whose status is requested to be monitored. If this attribute is not present, it means that the NF Service Consumer requests a subscription to all NFs in the NRF (NOTE 1). |
| subscriptionId | string | C | 0..1 | Subscription ID for the newly created resource. This parameter shall be absent in the request to the NRF and shall be included by NRF in the response to the subscription creation request.  Read-Only: true |
| validityTime | DateTime | C | 0..1 | Time instant after which the subscription becomes invalid. This parameter may be sent by the client, as a hint to the server, but it shall be always sent back by the server (regardless of the presence of the attribute in the request) in the response to the subscription creation request. |
| reqNotifEvents | array(NotificationEventType) | O | 1..N | If present, this attribute shall contain the list of event types that the NF Service Consumer is interested in receiving.  If this attribute is not present, it means that notifications for all event types are requested. |
| reqNfType | NFType | O | 0..1 | If included, this IE shall contain the NF type of the NF Service Consumer that is requesting the creation of the subscription. The NRF shall use it for authorizing the request, in the same way as the "requester-nf-type" is used in the NF Discovery service (see Table 6.2.3.2.3.1-1).  When the subscription is for a set of NF Instances, the subscription may be accepted by NRF, but it shall only generate notifications from NF Instances whose authorization parameters allow the NF Service Consumer to access their services (NOTE 2). |
| reqNfFqdn | Fqdn | O | 0..1 | If included, this IE shall contain the FQDN of the NF Service Consumer that is requesting the creation of the subscription. The NRF shall use it for authorizing the request, in the same way as the "requester-nf-instance-fqdn" is used in the NF Discovery service (see Table 6.2.3.2.3.1-1).  When the subscription is for a set of NF Instances, the subscription may be accepted by NRF, but it shall only generate notifications from NF Instances whose authorization parameters allow the NF Service Consumer to access their services (NOTE 2). |
| reqSnssais | array(Snssai) | O | 0..1 | If included, this IE shall contain the list of S-NSSAIs of the NF Service Consumer that is requesting the creation of the subscription. The NRF shall use it for authorizing the request, in the same way as the "requester-snssais" is used in the NF Discovery service (see Table 6.2.3.2.3.1-1).  When the subscription is for a set of NF Instances, the subscription may be accepted by NRF, but it shall only generate notifications from NF Instances whose authorization parameters allow the NF Service Consumer to access their services (NOTE 2). |
| plmnId | PlmnId | O | 0..1 | If present, this attribute contains the target PLMN ID of the NF Instance(s) whose status is requested to be monitored. |
| nid | Nid | O | 0..1 | If present, this attribute contains the target NID that, together with the plmnId attribute, identifies the SNPN of the NF Instance(s) whose status is requested to be monitored. |
| notifCondition | NotifCondition | O | 0..1 | If present, this attribute contains the conditions that trigger a notification from NRF; this attribute shall only be present if the NF Service Consumer has subscribed to changes on the NF Profile (i.e., reqNotifEvents contains the value "NF\_PROFILE\_CHANGED", or reqNotifEvents attribute is absent) (NOTE 3).  If this attribute is absent, it means that the NF Service Consumer does not indicate any restriction, or condition, on which attributes of the NF Profile shall trigger a notification from NRF. |
| reqPlmnList | array(PlmnId) | C | 1..N | This IE shall be included when subscribing to NF services in a different PLMN. When included, this IE shall contain the PLMN ID(s) of the requester NF. |
| NOTE 1: The "subscription to all NFs" may be quite demanding in terms of resources in NRF and also in terms of network traffic of the resulting notifications, so it should be authorized by NRF under very strict policies (e.g. only to a specific requesting NF, as indicated by reqNfType and reqNfFqdn attributes).  NOTE 2: The authorization parameters in NF Profile are those used by NRF to determine whether a given NF Instance / NF Service Instance can be discovered by an NF Service Consumer in order to consume its offered services (e.g. "allowedNfTypes", "allowedNfDomains", etc.).  NOTE 3: The subscription to load changes may be quite demanding in terms of network traffic of the resulting notifications, thus it may be limited by the NRF via appropriate configuration (e.g. granularity threshold) | | | | |

##### 6.1.6.2.17 Type: NotificationData

Table 6.1.6.2.17-1: Definition of type NotificationData

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| event | NotificationEventType | M | 1 | Notification type. It shall take the values "NF\_REGISTERED", "NF\_DEREGISTERED" OR "NF\_PROFILE\_CHANGED". |
| nfInstanceUri | Uri | M | 1 | Uri of the NF Instance (see clause 6.1.3.3.2) associated to the notification event. |
| nfProfile | NFProfile | C | 0..1 | New NF Profile or Updated NF Profile; it shall be present when the notification type is "NF\_REGISTERED" or "NF\_PROFILE\_CHANGED". |
| profileChanges | array(ChangeItem) | C | 1..N | List of changes on the profile of the NF Instance associated to the notification event; it may be present when the notification type is "NF\_PROFILE\_CHANGED" (see NOTE 1). |
| NOTE 1: If "event" attribute takes the value "NF\_PROFILE\_CHANGED", then either "nfProfile" or "profileChanges" attributes shall be present, but not both. | | | | |

EXAMPLE: Notification payload sent from NRF when an NF Instance has changed its profile by updating the value of the "recoveryTime" attribute of its NF Profile, and updated the TCP port of the first NF Service Instance:

{

"event": "NF\_PROFILE\_CHANGED",

"nfInstanceUri": ".../nf-instances/4947a69a-f61b-4bc1-b9da-47c9c5d14b64",

"profileChanges": [

{

"op": "REPLACE",

"path": "/recoveryTime",

"newValue": "2018-12-30T23:20:50Z"

},

{

"op": "REPLACE",

"path": "/nfServices/0/ipEndPoints/0/port",

"newValue": 8080

}

]

}

##### 6.1.6.2.18 Void

##### 6.1.6.2.19 Type: NFServiceVersion

Table 6.1.6.2.19-1: Definition of type NFServiceVersion

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| apiVersionInUri | string | M | 1 | Version of the service instance to be used in the URI for accessing the API (e.g. "v1"). |
| apiFullVersion | string | M | 1 | Full version number of the API as specified in clause 4.3.1 of 3GPP 29.501 [5]. |
| expiry | DateTime | O | 0..1 | Expiry date and time of the NF service. This represents the planned retirement date as specified in clause 4.3.1.5 of 3GPP 29.501 [5]. |

##### 6.1.6.2.20 Type: PcfInfo

Table 6.1.6.2.20-1: Definition of type PcfInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| groupId | NfGroupId | O | 0..1 | Identity of the PCF group that is served by the PCF instance.  If not provided, the PCF instance does not pertain to any PCF group. |
| dnnList | array(Dnn) | O | 1..N | DNNs supported by the PCF.  If not provided, the PCF can serve any DNN. |
| supiRanges | array(SupiRange) | O | 1..N | List of ranges of SUPIs that can be served by the PCF instance. If not provided, the PCF can serve any SUPI. |
| gpsiRanges | array(IdentityRange) | O | 1..N | List of ranges of GPSIs that can be served by the PCF instance. If not provided, the PCF can serve any GPSI. |
| rxDiamHost | DiameterIdentity | C | 0..1 | This IE shall be present if the PCF supports Rx interface.  When present, this IE shall indicate the Diameter host of the Rx interface for the PCF. |
| rxDiamRealm | DiameterIdentity | C | 0..1 | This IE shall be present if the PCF supports Rx interface.  When present, this IE shall indicate the Diameter realm of the Rx interface for the PCF. |

##### 6.1.6.2.21 Type: BsfInfo

Table 6.1.6.2.21-1: Definition of type BsfInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| ipv4AddressRanges | array(Ipv4AddressRange) | O | 1..N | List of ranges of IPv4 addresses handled by BSF.  If not provided, the BSF can serve any IPv4 address. |
| dnnList | array(Dnn) | O | 1..N | List of DNNs handled by the BSF  If not provided, the BSF can serve any DNN. |
| ipDomainList | array(string) | O | 1..N | List of IPv4 address domains, as described in clause 6.2 of 3GPP 29.513 [28], handled by the BSF.  If not provided, the BSF can serve any IP domain. |
| ipv6PrefixRanges | array(Ipv6PrefixRange) | O | 1..N | List of ranges of IPv6 prefixes handled by the BSF.  If not provided, the BSF can serve any IPv6 prefix. |

##### 6.1.6.2.22 Type: Ipv4AddressRange

Table 6.1.6.2.22-1: Definition of type IPv4AddressRange

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| start | Ipv4Addr | M | 1 | First value identifying the start of an IPv4 address range |
| end | Ipv4Addr | M | 1 | Last value identifying the end of an IPv4 address range |

##### 6.1.6.2.23 Type: Ipv6PrefixRange

Table 6.1.6.2.23-1: Definition of type IPv6PrefixRange

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| start | Ipv6Prefix | M | 1 | First value identifying the start of an IPv6 prefix range |
| end | Ipv6Prefix | M | 1 | Last value identifying the end of an IPv6 prefix range |

##### 6.1.6.2.24 Type: InterfaceUpfInfoItem

Table 6.1.6.2.24-1: Definition of type InterfaceUpfInfoItem

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| interfaceType | UPInterfaceType | M | 1 | User Plane interface type |
| ipv4EndpointAddresses | array(Ipv4Addr) | C | 1..N | Available endpoint IPv4 address(es) of the User Plane interface (NOTE 1) |
| ipv6EndpointAddresses | array(Ipv6Addr) | C | 1..N | Available endpoint IPv6 address(es) of the User Plane interface (NOTE 1) |
| endpointFqdn | Fqdn | C | 0..1 | FQDN of available endpoint of the User Plane interface (NOTE 1) |
| networkInstance | string | O | 0..1 | Network Instance (See 3GPP 29.244 [21]) associated to the User Plane interface |
| NOTE 1: At least one of the addressing parameters (ipv4address, ipv6adress or endpointFqdn) shall be included in the InterfaceUpfInfoItem. | | | | |

##### 6.1.6.2.25 Type: UriList

Table 6.1.6.2.25-1: Definition of type UriList

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| \_links | map(LinksValueSchema) | O | 1..N | See clause 4.9.4 of 3GPP TS 29.501 [5] for the description of the members. |

##### 6.1.6.2.26 Type: N2InterfaceAmfInfo

Table 6.1.6.2.26-1: Definition of type N2InterfaceAmfInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| ipv4EndpointAddress | array(Ipv4Addr) | C | 1..N | Available AMF endpoint IPv4 address(es) for N2 (see NOTE 1) |
| ipv6EndpointAddress | array(Ipv6Addr) | C | 1..N | Available AMF endpoint IPv6 address(es) for N2 (see NOTE 1) |
| amfName | AmfName | O | 0..1 | AMF Name |
| NOTE 1: At least one of the addressing parameters (ipv4address or ipv6adress) shall be included. | | | | |

##### 6.1.6.2.27 Type: TaiRange

Table 6.1.6.2.27-1: Definition of type TaiRange

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| plmnId | PlmnId | M | 1 | PLMN ID related to the TacRange. |
| tacRangeList | array(TacRange) | M | 1..N | The range of the TACs |
| nid | Nid | O | 0..1 | NID related to the TacRange, for an SNPN |

##### 6.1.6.2.28 Type: TacRange

Table 6.1.6.2.28-1: Definition of type TacRange

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| start | string | O | 0..1 | First value identifying the start of a TAC range, to be used when the range of TAC's can be represented as a hexadecimal range (e.g., TAC ranges). 3-octet string identifying a tracking area code, each character in the string shall take a value of "0" to "9" or "A" to "F" and shall represent 4 bits. The most significant character representing the 4 most significant bits of the TAC shall appear first in the string, and the character representing the 4 least significant bit of the TAC shall appear last in the string.  Pattern: "^([A-Fa-f0-9]{4}|[A-Fa-f0-9]{6}$)" |
| end | string | O | 0..1 | Last value identifying the end of a TAC range, to be used when the range of TAC's can be represented as a hexadecimal range (e.g. TAC ranges). 3-octet string identifying a tracking area code, each character in the string shall take a value of "0" to "9" or "A" to "F" and shall represent 4 bits. The most significant character representing the 4 most significant bits of the TAC shall appear first in the string, and the character representing the 4 least significant bit of the TAC shall appear last in the string.  Pattern: "^([A-Fa-f0-9]{4}|[A-Fa-f0-9]{6})$" |
| pattern | string | O | 0..1 | Pattern (regular expression according to the ECMA-262 dialect [8]) representing the set of TAC's belonging to this range. A TAC value is considered part of the range if and only if the TAC string fully matches the regular expression. |
| NOTE: Either the start and end attributes, or the pattern attribute, shall be present. | | | | |

EXAMPLE 1: TAC range. From: 543000 To: 5433E7 (i.e., 1000 TAC numbers)  
JSON: { "start": "543000", "end": "5433E7" }

EXAMPLE 2: TAC range. From: 54E000 To: 54EFFF (i.e., 4096 TAC numbers)  
JSON: { "pattern": "^54E[0-9a-fA-F]{3}$" }, or  
JSON: { "start": "54E000", "end": "54EFFF" }

##### 6.1.6.2.29 Type: SnssaiSmfInfoItem

Table 6.1.6.2.29-1: Definition of type SnssaiSmfInfoItem

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| sNssai | Snssai | M | 1 | Supported S-NSSAI |
| dnnSmfInfoList | array(DnnSmfInfoItem) | M | 1..N | List of parameters supported by the SMF per DNN |

##### 6.1.6.2.30 Type: DnnSmfInfoItem

Table 6.1.6.2.30-1: Definition of type DnnSmfInfoItem

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| dnn | Dnn | M | 1 | Supported DNN |

##### 6.1.6.2.31 Type: NrfInfo

Table 6.1.6.2.31-1: Definition of type NrfInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| servedUdrInfo | map(UdrInfo) | O | 1..N | This attribute contains all the udrInfo attributes locally configured in the NRF or the NRF received during NF registration. The key of the map is the nfInstanceId of which the udrInfo belongs to. |
| servedUdmInfo | map(UdmInfo) | O | 1..N | This attribute contains all the udmInfo attributes locally configured in the NRF or the NRF received during NF registration. The key of the map is the nfInstanceId of which the udmInfo belongs to. |
| servedAusfInfo | map(AusfInfo) | O | 1..N | This attribute contains all the ausfInfo attributes locally configured in the NRF or the NRF received during NF registration. The key of the map is the nfInstanceId of which the ausfInfo belongs to. |
| servedAmfInfo | map(AmfInfo) | O | 1..N | This attribute contains all the amfInfo attributes locally configured in the NRF or the NRF received during NF registration. The key of the map is the nfInstanceId of which the amfInfo belongs to. |
| servedSmfInfo | map(SmfInfo) | O | 1..N | This attribute contains all the smfInfo attributes locally configured in the NRF or the NRF received during NF registration. The key of the map is the nfInstanceId of which the smfInfo belongs to. |
| servedUpfInfo | map(UpfInfo) | O | 1..N | This attribute contains all the upfInfo attributes locally configured in the NRF or the NRF received during NF registration. The key of the map is the nfInstanceId of which the upfInfo belongs to. |
| servedPcfInfo | map(PcfInfo) | O | 1..N | This attribute contains all the pcfInfo attributes locally configured in the NRF or the NRF received during NF registration. The key of the map is the nfInstanceId of which the pcfInfo belongs to. |
| servedBsfInfo | map(BsfInfo) | O | 1..N | This attribute contains all the bsfInfo attributes locally configured in the NRF or the NRF received during NF registration. The key of the map is the nfInstanceId of which the bsfInfo belongs to. |
| servedChfInfo | map(ChfInfo) | O | 1..N | This attribute contains all the chfInfo attributes locally configured in the NRF or the NRF received during NF registration. The key of the map is the nfInstanceId of which the chfInfo belongs to. |
| servedNefInfo | map(NefInfo) | O | 1..N | This attribute contains all the nefInfo attributes locally configured in the NRF or the NRF received during NF registration. The key of the map is the nfInstanceId of which the nefInfo belongs to. |
| servedNwdafInfo | map(NwdafInfo) | O | 1..N | This attribute contains all the nwdafInfo attributes locally configured in the NRF or the NRF received during NF registration. The key of the map is the nfInstanceId of which the nwdafInfo belongs to. |
| servedPcscfInfo | map(PcscfInfo) | O | 1..N | This attribute contains all the pcscfInfo attributes locally configured in the NRF or the NRF received during NF registration. The key of the map is the nfInstanceId of which the pcscfInfo belongs to. |
| servedGmlcInfo | map(GmlcInfo) | O | 1..N | This attribute contains all the gmlcInfo attributes locally configured in the NRF or the NRF received during NF registration. The key of the map is the nfInstanceId of which the gmlcInfo belongs to. |
| servedLmfInfo | map(LmfInfo) | O | 1..N | This attribute contains all the lmfInfo attributes locally configured in the NRF or the NRF received during NF registration. The key of the map is the nfInstanceId of which the lmfInfo belongs to. |
| servedNfInfo | map(NfInfo) | O | 1..N | This attribute contains information of other NFs without corresponding NF type specific Info extensions locally configured in the NRF or the NRF received during NF registration. The key of the map is the nfInstanceId of the NF. |
| servedHssInfo | map(HssInfo) | O | 1..N | This attribute contains all the hssInfo attributes locally configured in the NRF or the NRF received during NF registration. The key of the map is the nfInstanceId of which the hssInfo belongs to. |
| NOTE: The absence of these parameters means the NRF is able to serve any NF discovery request. | | | | |

##### 6.1.6.2.32 Type: ChfInfo

Table 6.1.6.2.32-1: Definition of type ChfInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| supiRangeList | array(SupiRange) | O | 1..N | List of ranges of SUPIs that can be served by the CHF instance. If not provided, the CHF can serve any SUPI. |
| gpsiRangeList | array(IdentityRange) | O | 1..N | List of ranges of GPSI that can be served by the CHF instance. If not provided, the CHF can serve any GPSI. |
| plmnRangeList | array(PlmnRange) | O | 1..N | List of ranges of PLMNs (including the PLMN IDs of the CHF instance) that can be served by the CHF instance. If not provided, the CHF can serve any PLMN. |

##### 6.1.6.2.33 Type: ChfServiceInfo

Table 6.1.6.2.33-1: Definition of type ChfServiceInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| primaryChfServiceInstance | string | C | 0..1 | This IE shall be present if the CHF service instance serves as a secondary CHF instance of another primary CHF service instance. When present, it shall be set to the serviceInstanceId of the primary CHF service instance.  This IE shall be absent if the secondaryChfServiceInstance is present. |
| secondaryChfServiceInstance | string | C | 0..1 | This IE shall be present if the CHF service instance serves as a primary CHF instance of another secondary CHF service instance. When present, it shall be set to the serviceInstanceId of the secondary CHF service instance.  This IE shall be absent if the primaryChfServiceInstance is present. |

##### 6.1.6.2.34 Type: PlmnRange

Table 6.1.6.2.34-1: Definition of type PlmnRange

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| start | string | O | 0..1 | First value identifying the start of a PLMN range.  The string shall be encoded as follows:  <MCC><MNC>  Pattern: '^[0-9]{3}[0-9]{2,3}$' |
| end | string | O | 0..1 | Last value identifying the end of a PLMN range.  The string shall be encoded as follows:  <MCC><MNC>  Pattern: '^[0-9]{3}[0-9]{2,3}$' |
| pattern | string | O | 0..1 | Pattern (regular expression according to the ECMA-262 dialect [8]) representing the set of PLMNs belonging to this range. A PLMN value is considered part of the range if and only if the PLMN string (formatted as <MCC><MNC>) fully matches the regular expression. |
| NOTE: Either the start and end attributes, or the pattern attribute, shall be present. | | | | |

EXAMPLE 1: PLMN range. MCC 123, any MNC   
JSON: { "start": "12300", "end": "123999" }

EXAMPLE 2: PLMN range. MCC 123, MNC within range 45 to 49   
JSON: { "pattern": "^1234[5-9]$" }, or  
JSON: { "start": "12345", "end": "12349" }

EXAMPLE 3: PLMN range. MCC within range 123 to 257, any MNC  
JSON: { "start": "12300", "end": "257999" }

##### 6.1.6.2.35 Type: SubscrCond

Table 6.1.6.2.35-1: Definition of type SubscrCond as a list of mutually exclusive alternatives

|  |  |  |
| --- | --- | --- |
| Data type | Cardinality | Description |
| NfInstanceIdCond | 1 | Subscription to a given NF Instance |
| NfTypeCond | 1 | Subscription to a set of NF Instances, identified by their NF Type |
| ServiceNameCond | 1 | Subscription to a set of NF Instances that offer a certain service name |
| AmfCond | 1 | Subscription to a set of NF Instances (AMFs), belonging to a certain AMF Set and/or belonging to a certain AMF Region. |
| GuamiListCond | 1 | Subscription to a set of NF Instances (AMFs), identified by their Guamis. |
| NetworkSliceCond | 1 | Subscription to a set of NF Instances, identified by S-NSSAI(s) and NSI ID(s). |
| NfGroupCond | 1 | Subscription to a set of NF Instances, identified by a NF (UDM, AUSF or UDR) Group Identity. |
| nfSetCond | 1 | Subscription to a set of NF Instances belonging to a certain NF Set. |
| nfServiceSetCond | 1 | Subscription to a set of NF Service Instances belonging to a certain NF Service Set. |

##### 6.1.6.2.36 Type: NfInstanceCond

Table 6.1.6.2.36-1: Definition of type NfInstanceCond

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| nfInstanceId | NfInstanceId | M | 1 | NF Instance ID of the NF Instance whose status is requested to be monitored. |

##### 6.1.6.2.37 Type: NfTypeCond

Table 6.1.6.2.37-1: Definition of type NfTypeCond

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| nfType | NFType | M | 1 | NF type of the NF Instances whose status is requested to be monitored. |
| NOTE: This type shall not contain the attribute "nfGroupId", to avoid that this type has a matching definition with "NfGroupCond" type. | | | | |

##### 6.1.6.2.38 Type: ServiceNameCond

Table 6.1.6.2.38-1: Definition of type ServiceNameCond

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| serviceName | ServiceName | M | 1 | Service name offered by the NF Instances whose status is requested to be monitored. |

##### 6.1.6.2.39 Type: AmfCond

Table 6.1.6.2.39-1: Definition of type AmfCond

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| amfSetId | AmfSetId | C | 1 | AMF Set ID of the NF Instances (AMF) whose status is requested to be monitored. |
| amfRegionId | AmfRegionId | C | 1 | AMF Region ID of the NF Instances (AMF) whose status is requested to be monitored. |
| NOTE 1: At least amfSetId or amfRegionId shall be present; if both the amfRegionId and amfSetId attributes are present in the SubscriptionData, this indicates a subscription for notifications satisfying both attributes (i.e. notifications for NFs from that amfRegionId and amfSetId).  NOTE 2: The PLMN ID (or PLMN ID and NID) of the AMF Region and AMF Set of the NF Instances (AMF) whose status is requested to be monitored may be indicated in the plmnId attribute (or plmnid and nid attributes) in the SubscriptionData. | | | | |

##### 6.1.6.2.40 Type: GuamiListCond

Table 6.1.6.2.40-1: Definition of type GuamiListCond

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| guamiList | array(Guami) | M | 1..N | Guamis of the NF Instances (AMFs) whose status is requested to be monitored. |

##### 6.1.6.2.41 Type: NetworkSliceCond

Table 6.1.6.2.41-1: Definition of type NetworkSliceCond

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| snssaiList | array(Snssai) | M | 1..N | S -NSSAIs of the NF Instances whose status is requested to be monitored. |
| nsiList | array(string) | O | 1..N | NSI IDs of the NF Instances whose status is requested to be monitored. |

##### 6.1.6.2.42 Type: NfGroupCond

Table 6.1.6.2.42-1: Definition of type NfGroupCond

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| nfType | string | M | 1 | NF type (UDM, AUSF, PCF or UDR) of the NF Instances whose status is requested to be monitored. |
| nfGroupId | NfGroupId | M | 1 | Group ID of the NF Instances whose status is requested to be monitored. |

##### 6.1.6.2.43 Type: NotifCondition

Table 6.1.6.2.43-1: Definition of type NotifCondition

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| monitoredAttributes | array(string) | C | 1..N | List of JSON Pointers of attributes in the NF Profile.  If this attribute is present, the NRF shall send notification only for changes in the attributes included in this list (see NOTE 1). |
| unmonitoredAttributes | array(string) | C | 1..N | List of JSON Pointers of attributes in the NF Profile.  If this attribute is present, the NRF shall send notification for changes on any attribute, except for those included in this list (see NOTE 1). |
| NOTE 1: Attributes "monitoredAttributes" and "unmonitoredAttributes" shall not be included simultaneously | | | | |

EXAMPLE 1: The following JSON object would represent a monitoring condition where the client requests to be notified of all changes on the NF Profile, except "load" attribute.

{

"unmonitoredAttributes": [ "/load" ]

}

EXAMPLE 2: The following JSON object would represent a monitoring condition where the client requests to be notified only of changes on attribute "nfStatus":

{

"monitoredAttributes": [ "/nfStatus" ]

}

##### 6.1.6.2.44 Type: PlmnSnssai

Table 6.1.6.2.44-1: Definition of type PlmnSnssai

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| plmnId | PlmnId | M | 1 | PLMN ID for which list of supported S-NSSAI(s) is provided. |
| sNssaiList | array(Snssai) | M | 1..N | The specific list of S-NSSAIs supported by the given PLMN or SNPN. |
| nid | Nid | O | 0..1 | NID for which list of supported S-NSSAI(s) is provided. |

##### 6.1.6.2.45 Type: NwdafInfo

Table 6.1.6.2.45-1: Definition of type NwdafInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| eventIds | array(EventId) | C | 1..N | EventId(s) supported by the Nnwdaf\_AnalyticsInfo service, if none are provided the NWDAF can serve any eventId. |
| nwdafEvents | array(NwdafEvent) | C | 1..N | Event(s) supported by the Nnwdaf\_EventsSubscription service, if none are provided the NWDAF can serve any nwdafEvent. |
| taiList | array(Tai) | O | 1..N | The list of TAIs the NWDAF can serve. It may contain the non-3GPP access TAI. The absence of this attribute and the taiRangeList attribute indicate that the NWDAF can be selected for any TAI in the serving network. |
| taiRangeList | array(TaiRange) | O | 1..N | The range of TAIs the NWDAF can serve. The absence of this attribute and the taiList attribute indicate that the NWDAF can be selected for any TAI in the serving network. |

##### 6.1.6.2.46 Type: LmfInfo

Table 6.1.6.2.46-1: Definition of type LmfInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| servingClientTypes | array(ExternalClientType) | C | 1..N | This IE shall be present if the LMF is dedicated to serve the listed external client type(s), e.g. emergency client. The NRF should only include this LMF instance to NF discovery with "client-type" query parameter indicating one of the external client types in the list.  Absence of this IE means the LMF is not dedicated to serve specific client types. |

##### 6.1.6.2.47 Type: GmlcInfo

Table 6.1.6.2.47-1: Definition of type GmlcInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| servingClientTypes | array(ExternalClientType) | C | 1..N | This IE shall be present if the GMLC is dedicated to serve the listed external client type(s), e.g. emergency client. The NRF should only include this GMLC instance to NF discovery with "client-type" query parameter indicating one of the external client types in the list.  Absence of this IE means the GMLC is not dedicated to serve specific client types. |

##### 6.1.6.2.48 Type: NefInfo

Table 6.1.6.2.48-1: Definition of type NefInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| nefId | NefId | C | 0..1 | This IE shall be present and contain the NEF ID of the NEF if NIDD service is supported. |
| pfdData | PfdData | O | 0..1 | PFD data. The NRF shall return the NEF profiles that have at least one nnef-pfdmanagement service matching the application identifiers and/or application function identifiers in the corresponding identifier list.  If not included, the NRF shall return all the application identifiers and/or application function identifiers registered in the NEF profile. |
| afEeData | AfEventExposureData | O | 0..1 | The AF provided event exposure data. The NEF registers such information in the NRF on behave of the AF. |

##### 6.1.6.2.49 Type: PfdData

Table 6.1.6.2.49-1: Definition of type PfdData

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| appIds | array(string) | O | 1..N | List of internal application identifiers of the managed PFDs. |
| afIds | array(string) | O | 1..N | List of application function identifiers of the managed PFDs. |

##### 6.1.6.2.50 Type: AfEventExposureData

Table 6.1.6.2.50-1: Definition of type AfEventExposureData

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| afEvents | array(AfEvent) | M | 1..N | AF Event(s) exposed by the NEF after registration of the AF(s) at the NEF. |
| afId | array(string) | O | 1..N | Associated AF identifications to the AfEvents. The absence of this attribute indicate that the NEF can be selected for any AF. |
| appIds | array(string) | O | 1..N | The list of Application ID(s) the AF(s) connected to the NEF supports. The absence of this attribute indicate that the NEF can be selected for any Application. |

##### 6.1.6.2.51 Type: WAgfInfo

Table 6.1.6.2.51-1: Definition of type WAgfInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| ipv4EndpointAddresses | array(Ipv4Addr) | C | 1..N | Available endpoint IPv4 address(es) of the N3 terminations (NOTE 1). |
| ipv6EndpointAddresses | array(Ipv6Addr) | C | 1..N | Available endpoint IPv6 address(es) of the N3 terminations (NOTE 1). |
| endpointFqdn | Fqdn | C | 0..1 | Available endpoint FQDN of the N3 terminations (NOTE 1). |
| NOTE 1: At least one of the addressing parameters (ipv4address, ipv6adress or endpointFqdn) shall be included in the WAgfInfo. | | | | |

##### 6.1.6.2.52 Type: TngfInfo

Table 6.1.6.2.52-1: Definition of type TngfInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| ipv4EndpointAddresses | array(Ipv4Addr) | C | 1..N | Available endpoint IPv4 address(es) of the N3 terminations (NOTE 1). |
| ipv6EndpointAddresses | array(Ipv6Addr) | C | 1..N | Available endpoint IPv6 address(es) of the N3 terminations (NOTE 1). |
| endpointFqdn | Fqdn | C | 0..1 | Available endpoint FQDN of the N3 terminations (NOTE 1). |
| NOTE 1: At least one of the addressing parameters (ipv4address, ipv6adress or endpointFqdn) shall be included in the TngfInfo. | | | | |

##### 6.1.6.2.53 Type: PcscfInfo

Table 6.1.6.2.53-1: Definition of type PcscfInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| accessType | array(AccessType) | C | 1..N | If included, this IE shall contain the access type (3GPP\_ACCESS and/or NON\_3GPP\_ACCESS) supported by the P-CSCF.  If not included, it shall be assumed that all access types are supported. |
| dnnList | array(Dnn) | O | 1..N | DNNs supported by the P-CSCF.  If not provided, the P-CSCF can serve any DNN. |

##### 6.1.6.2.54 Type: NfSetCond

Table 6.1.6.2.54-1: Definition of type NfSetCond

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| nfSetId | NfSetId | M | 1 | NF Set ID (see clause 28.10 of 3GPP TS 23.003 [12]) of NF Instances whose status is requested to be monitored. |

##### 6.1.6.2.55 Type: NfServiceSetCond

Table 6.1.6.2.55-1: Definition of type NfServiceSetCond

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| nfServiceSetId | NfServiceSetId | M | 1 | NF Service Set ID (see clause 28.11 of 3GPP TS 23.003 [12]) of NF service instances whose status is requested to be monitored. |

##### 6.1.6.2.56 Type: NfInfo

Table 6.1.6.2.56-1: Definition of type NfInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| nfType | NFType | M | 1 | This IE shall indicate the type of the NF. |

##### 6.1.6.2.57 Type: HssInfo

Table 6.1.6.2.57-1: Definition of type HssInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| groupId | NfGroupId | O | 0..1 | Identity of the HSS group that is served by the HSS instance.  If not provided, the HSS instance does not pertain to any HSS group. |
| imsiRanges | array(ImsiRange) | O | 1..N | List of ranges of IMSIs whose profile data is available in the HSS instance (NOTE 1) |
| NOTE 1: If none of these parameters is provided, the HSS can serve any group and any IMSI. | | | | |

##### 6.1.6.2.58 Type: ImsiRange

Table 6.1.6.2.58-1: Definition of type ImsiRange

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| start | string | O | 0..1 | First value identifying the start of a IMSI range.  Pattern: "^[0-9]+$" |
| end | string | O | 0..1 | Last value identifying the end of a IMSI range.  Pattern: "^[0-9]+$" |
| pattern | string | O | 0..1 | Pattern (regular expression according to the ECMA-262 dialect [8]) representing the set of IMSIs belonging to this range. An IMSI value is considered part of the range if and only if the IMSI string fully matches the regular expression. |
| NOTE: Either the start and end attributes, or the pattern attribute, shall be present. | | | | |

##### 6.1.6.2.59 Type: InternalGroupIdRange

Table 6.1.6.2.59-1: Definition of type InternalGroupIdRange

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| start | GroupId | O | 0..1 | First value identifying the start of an identity range, to be used when the range of identities can be represented as a consecutive numeric range. |
| end | GroupId | O | 0..1 | Last value identifying the end of an identity range, to be used when the range of identities can be represented as a consecutive numeric range. |
| pattern | string | O | 0..1 | Pattern (regular expression according to the ECMA-262 dialect [8]) representing the set of identities belonging to this range. An identity value is considered part of the range if and only if the identity string fully matches the regular expression. |
| NOTE: Either the start and end attributes, or the pattern attribute, shall be present. | | | | |

#### 6.1.6.3 Simple data types and enumerations

##### 6.1.6.3.1 Introduction

This clause defines simple data types and enumerations that can be referenced from data structures defined in the previous clauses.

##### 6.1.6.3.2 Simple data types

The simple data types defined in table 6.1.6.3.2-1 shall be supported.

Table 6.1.6.3.2-1: Simple data types

|  |  |  |
| --- | --- | --- |
| Type Name | Type Definition | Description |
| Fqdn | string | FQDN (Fully Qualified Domain Name) |
| NefId | string | The NEF ID as specified in clause 4.25.2 of 3GPP TS 23.502 [3].  For combined SCEF+NEF, the NEF ID shall contain the SCEF ID encoded as specified in clause 8.4.5 of 3GPP TS 29.336 [37]. |

##### 6.1.6.3.3 Enumeration: NFType

The enumeration NFType represents the different types of Network Functions that can be found in the 5GC.

Table 6.1.6.3.3-1: Enumeration NFType

|  |  |
| --- | --- |
| Enumeration value | Description |
| "NRF" | Network Function: NRF |
| "UDM" | Network Function: UDM |
| "AMF" | Network Function: AMF |
| "SMF" | Network Function: SMF |
| "AUSF" | Network Function: AUSF |
| "NEF" | Network Function: NEF |
| "PCF" | Network Function: PCF |
| "SMSF" | Network Function: SMSF |
| "NSSF" | Network Function: NSSF |
| "UDR" | Network Function: UDR |
| "LMF" | Network Function: LMF |
| "GMLC" | Network Function: GMLC |
| "5G\_EIR" | Network Function: 5G-EIR |
| "SEPP" | Network Function: SEPP |
| "UPF" | Network Function: UPF |
| "N3IWF" | Network Function: N3IWF |
| "AF" | Network Function: AF |
| "UDSF" | Network Function: UDSF |
| "BSF" | Network Function: BSF |
| "CHF" | Network Function: CHF |
| "NWDAF" | Network Function: NWDAF |
| "PCSCF" | Network Function: P-CSCF |
| "CBCF" | Network Function: CBCF |
| "UCMF" | Network Function: UCMF |
| "HSS" | Network Function: HSS |

##### 6.1.6.3.4 Enumeration: NotificationType

Table 6.1.6.3.4-1: Enumeration NotificationType

|  |  |
| --- | --- |
| Enumeration value | Description |
| "N1\_MESSAGES" | Notification of N1 messages |
| "N2\_INFORMATION" | Notification of N2 information |
| "LOCATION\_NOTIFICATION" | Notification of Location Information by AMF towards NF Service Consumers (e.g GMLC) |
| "DATA\_REMOVAL\_NOTIFICATION" | Notification of Data Removal by UDR (e.g., removal of UE registration data upon subscription withdrawal) |
| "DATA\_CHANGE\_NOTIFICATION" | Notification of Data Changes by UDR |
| "LOCATION\_UPDATE\_NOTIFICATION" | Notification of UE Location Information Update by GMLC towards NF Service Consumers (e.g. NEF), during MO\_LR procedure. |

##### 6.1.6.3.5 Enumeration: TransportProtocol

Table 6.1.6.3.5-1: Enumeration TransportProtocol

|  |  |
| --- | --- |
| Enumeration value | Description |
| "TCP" | Transport protocol: TCP |

##### 6.1.6.3.6 Enumeration: NotificationEventType

Table 6.1.6.3.6-1: Enumeration NotificationEventType

|  |  |
| --- | --- |
| Enumeration value | Description |
| "NF\_REGISTERED" | The NF Instance has been registered in NRF |
| "NF\_DEREGISTERED" | The NF Instance has been deregistered from NRF |
| "NF\_PROFILE\_CHANGED" | The profile of the NF Instance has been modified |

##### 6.1.6.3.7 Enumeration: NFStatus

Table 6.1.6.3.7-1: Enumeration NFStatus

|  |  |
| --- | --- |
| Enumeration value | Description |
| "REGISTERED" | The NF Instance is registered in NRF and can be discovered by other NFs. |
| "SUSPENDED" | The NF Instance is registered in NRF but it is not operative and cannot be discovered by other NFs.  This status may result from a NF Heart-Beat failure (see clause 5.2.2.3.2) or a NF failure and may trigger restoration procedures (see clause 6.2 of 3GPP 23.527 [27]). |
| "UNDISCOVERABLE" | The NF instance is registered in NRF, is operative but cannot be discovered by other NFs.  This status may be set by the NF e.g. in shutting down scenarios where the NF is still able to process requests for existing resources or sessions but cannot accept new resource creation or session establishment. |

##### 6.1.6.3.8 Enumeration: DataSetId

The enumeration DataSetId represents the different types of data sets supported by an UDR instance.

Table 6.1.6.3.8-1: Enumeration DataSetId

|  |  |
| --- | --- |
| Enumeration value | Description |
| "SUBSCRIPTION" | Data set: Subscription data |
| "POLICY" | Data set: Policy data |
| "EXPOSURE" | Data set: Structured data for exposure |
| "APPLICATION" | Data set: Application data |

##### 6.1.6.3.9 Enumeration: UPInterfaceType

Table 6.1.6.3.9-1: Enumeration UPInterfaceType

|  |  |
| --- | --- |
| Enumeration value | Description |
| "N3" | User Plane Interface: N3 |
| "N6" | User Plane Interface: N6 |
| "N9" | User Plane Interface: N9 |

##### 6.1.6.3.10 Relation Types

###### 6.1.6.3.10.1 General

This clause describes the possible relation types defined within NRF API. See clause 4.7.5.2 of 3GPP TS 29.501 [5] for the description of the relation types.

Table 6.1.6.3.10.1-1: supported registered relation types

|  |
| --- |
| Relation Name |
| self |
| item |

##### 6.1.6.3.11 Enumeration: ServiceName

Table 6.1.6.3.11-1: Enumeration ServiceName

|  |  |
| --- | --- |
| Enumeration value | Description |
| "nnrf-nfm" | Nnrf\_NFManagement Service offered by the NRF |
| "nnrf-disc" | Nnrf\_NFDiscovery Service offered by the NRF |
| "nudm-sdm" | Nudm\_SubscriberDataManagement Service offered by the UDM |
| "nudm-uecm" | Nudm\_UEContextManagement Service offered by the UDM |
| "nudm-ueau" | Nudm\_UEAuthentication Service offered by the UDM |
| "nudm-ee" | Nudm\_EventExposure Service offered by the UDM |
| "nudm-pp" | Nudm\_ParameterProvision Service offered by the UDM |
| "nudm-niddau" | Nudm\_NIDDAuthorization Service offered by the UDM |
| "nudm-mt" | Nudm\_MT Service offered by the UDM |
| "namf-comm" | Namf\_Communication Service offered by the AMF |
| "namf-evts" | Namf\_EventExposure Service offered by the AMF |
| "namf-mt" | Namf\_MT Service offered by the AMF |
| "namf-loc" | Namf\_Location Service offered by the AMF |
| "nsmf-pdusession" | Nsmf\_PDUSession Service offered by the SMF |
| "nsmf-event-exposure" | Nsmf\_EventExposure Service offered by the SMF |
| "nausf-auth" | Nausf\_UEAuthentication Service offered by the AUSF |
| "nausf-sorprotection" | Nausf\_SoRProtection Service offered by the AUSF |
| "nausf-upuprotection" | Nausf\_UPUProtection Service offered by the AUSF |
| "nnef-pfdmanagement" | Nnef\_PFDManagement offered by the NEF |
| "npcf-am-policy-control" | Npcf\_AMPolicyControl Service offered by the PCF |
| "npcf-smpolicycontrol" | Npcf\_SMPolicyControl Service offered by the PCF |
| "npcf-policyauthorization" | Npcf\_PolicyAuthorization Service offered by the PCF |
| "npcf-bdtpolicycontrol" | Npcf\_BDTPolicyControl Service offered by the PCF |
| "npcf-eventexposure" | Npcf\_EventExposure Service offered by the PCF |
| "npcf-ue-policy-control" | Npcf\_UEPolicyControl Service offered by the PCF |
| "nsmsf-sms" | Nsmsf\_SMService Service offered by the SMSF |
| "nnssf-nsselection" | Nnssf\_NSSelection Service offered by the NSSF |
| "nnssf-nssaiavailability" | Nnssf\_NSSAIAvailability Service offered by the NSSF |
| "nudr-dr" | Nudr\_DataRepository Service offered by the UDR |
| "nlmf-loc" | Nlmf\_Location Service offered by the LMF |
| "n5g-eir-eic" | N5g-eir\_EquipmentIdentityCheck Service offered by the 5G-EIR |
| "nbsf-management" | Nbsf\_Management Service offered by the BSF |
| "nchf-spendinglimitcontrol" | Nchf\_SpendingLimitControl Service offered by the CHF |
| "nchf-convergedcharging" | Nchf\_Converged\_Charging Service offered by the CHF |
| "nnwdaf-eventssubscription" | Nnwdaf\_EventsSubscription Service offered by the NWDAF (This corresponds to Nnwdaf\_AnalyticsSubscription Service defined in stage-2 specifications) |
| "nnwdaf-analyticsinfo" | Nnwdaf\_AnalyticsInfo Service offered by the NWDAF |
| "ngmlc-loc" | Ngmlc\_Location Service offered by GMLC |
| "nucmf-provisioning" | Nucmf\_Provisioning Service offered by UCMF |
| "nucmf-uecapabilitymanagement" | Nucmf\_UECapabilityManagement Service offered by UCMF |
| "nhss-sdm" | Nhss\_SubscriberDataManagement Service offered by the HSS |
| "nhss-uecm" | Nhss\_UEContextManagement Service offered by the HSS |
| "nhss-ueau" | Nhss\_UEAuthentication Service offered by the HSS |
| NOTE: The services defined in this table are those defined by 3GPP NFs in 5GC; however, in order to support custom services offered by standard and custom NFs, the NRF shall also accept the registration of NF Services with other service names. | |

##### 6.1.6.3.12 Enumeration: NFServiceStatus

Table 6.1.6.3.12-1: Enumeration NFServiceStatus

|  |  |
| --- | --- |
| Enumeration value | Description |
| "REGISTERED" | The NF Service Instance is registered in NRF and can be discovered by other NFs. |
| "SUSPENDED" | The NF Service Instance is registered in NRF but it is not operative and cannot be discovered by other NFs.  This status may result from a NF Service failure and may trigger restoration procedures (see clause 6.2 of 3GPP 23.527 [27]). |
| "UNDISCOVERABLE" | The NF Service instance is registered in NRF, is operative but cannot be discovered by other NFs.  This status may be set by the NF e.g. in shutting down scenarios where the NF service is still able to process requests for existing resources or sessions but cannot accept new resource creation or session establishment. |

### 6.1.7 Error Handling

#### 6.1.7.1 General

HTTP error handling shall be supported as specified in clause 5.2.4 of 3GPP TS 29.500 [4].

#### 6.1.7.2 Protocol Errors

Protocol errors handling shall be supported as specified in clause 5.2.7 of 3GPP TS 29.500 [4].

#### 6.1.7.3 Application Errors

The application errors defined for the Nnrf\_NFManagement service are listed in Table 6.1.7.3-1.

Table 6.1.7.3-1: Application errors

|  |  |  |
| --- | --- | --- |
| Application Error | HTTP status code | Description |
|  |  |  |

### 6.1.8 Security

As indicated in 3GPP TS 33.501 [15], the access to the Nnrf\_NFManagement API may be authorized by means of the OAuth2 protocol (see IETF RFC 6749 [16]), using the "Client Credentials" authorization grant, where the NRF plays the role of the authorization server.

If Oauth2 authorization is used, an NF Service Consumer, prior to consuming services offered by the Nnrf\_NFManagement API, shall obtain a "token" from the authorization server, by invoking the Access Token Request service, as described in clause 5.4.2.2.

NOTE: When multiple NRFs are deployed in a network, the NRF used as authorization server is the same NRF where the Nnrf\_NFManagement service is invoked by the NF Service Producer.

The Nnrf\_NFManagement API defines scopes for OAuth2 authorization as specified in 3GPP TS 33.501 [15]; it defines a single scope consisting on the name of the service (i.e., "nnrf-nfm"), and it does not define any additional scopes at resource or operation level.

## 6.2 Nnrf\_NFDiscovery Service API

### 6.2.1 API URI

URIs of this API shall have the following root:

{apiRoot}/{apiName}/{apiVersion}/

where "apiRoot" is defined in clause 4.4.1 of 3GPP TS 29.501 [5], the "apiName" shall be set to "nnrf-disc" and the "apiVersion" shall be set to "v1" for the current version of this specification.

### 6.2.2 Usage of HTTP

#### 6.2.2.1 General

HTTP/2, as defined in IETF RFC 7540 [9], shall be used as specified in clause 5 of 3GPP TS 29.500 [4].

HTTP/2 shall be transported as specified in clause 5.3 of 3GPP TS 29.500 [4].

HTTP messages and bodies for the Nnrf\_NFDiscovery service shall comply with the OpenAPI [10] specification contained in Annex A.

#### 6.2.2.2 HTTP Standard Headers

##### 6.2.2.2.1 General

The mandatory standard HTTP headers as specified in clause 5.2.2.2 of 3GPP TS 29.500 [4] shall be supported.

##### 6.2.2.2.2 Content type

The following content types shall be supported:

- The JSON format (IETF RFC 8259 [22]). The use of the JSON format shall be signalled by the content type "application/json". See also clause 5.4 of 3GPP TS 29.500 [4].

- The Problem Details JSON Object (IETF RFC 7807 [11]). The use of the Problem Details JSON object in a HTTP response body shall be signalled by the content type "application/problem+json".

##### 6.2.2.2.3 Cache-Control

A "Cache-Control" header should be included in HTTP responses, as described in IETF RFC 7234 [20], clause 5.2. It shall contain a "max-age" value, indicating the amount of time in seconds after which the received response is considered stale; this value shall be the same as the content of the "validityPeriod" element described in clause 6.2.6.2.2.

##### 6.2.2.2.4 ETag

An "ETag" (entity-tag) header should be included in HTTP responses, as described in IETF RFC 7232 [19], clause 2.3. It shall contain a server-generated strong validator, that allows further matching of this value (included in subsequent client requests) with a given resource representation stored in the server or in a cache.

##### 6.2.2.2.5 If-None-Match

An NF Service Consumer should issue conditional GET request towards NRF, by including an If-None-Match header in HTTP requests, as described in IETF RFC 7232 [19], clause 3.2, containing one or several entity tags received in previous responses for the same resource.

#### 6.2.2.3 HTTP custom headers

##### 6.2.2.3.1 General

In this release of this specification, no custom headers specific to the Nnrf\_NFDiscovery service are defined. For 3GPP specific HTTP custom headers used across all service-based interfaces, see clause 5.2.3 of 3GPP TS 29.500 [4].

### 6.2.3 Resources

#### 6.2.3.1 Overview

The structure of the Resource URIs of the NFDiscovery service is shown in figure 6.2.3.1-1.



Figure 6.2.3.1-1: Resource URI structure of the NFDiscovery API

Table 6.2.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 6.2.3.1-1: Resources and methods overview

|  |  |  |  |
| --- | --- | --- | --- |
| Resource name | Resource URI | HTTP method or custom operation | Description |
| nf-instances  (Store) | {apiRoot}/nnrf-disc/v1/nf-instances | GET | Retrieve a collection of NF Instances according to certain filter criteria. |
| Stored Search (Document) | {apiRoot}/nnrf-disc/v1/searches/{searchId} | GET | Retrieve a collection of NF Instances, previously stored by NRF as a consequence of a prior search result. |
| Complete Stored Search (Document) | {apiRoot}/nnrf-disc/v1/searches/{searchId}/complete | GET | Retrieve a collection of NF Instances, previously stored by NRF as a consequence of a prior search result, without applying any client restriction on the number of instances (e.g. "limit" or "max-payload-size" query parameters). |

#### 6.2.3.2 Resource: nf-instances (Store)

##### 6.2.3.2.1 Description

This resource represents a collection of the different NF instances registered in the NRF.

This resource is modelled as the Store resource archetype (see clause C.3 of 3GPP TS 29.501 [5]).

##### 6.2.3.2.2 Resource Definition

Resource URI: **{apiRoot}/nnrf-disc/v1/nf-instances**

This resource shall support the resource URI variables defined in table 6.1.3.2.2-1.

Table 6.2.3.2.2-1: Resource URI variables for this resource

|  |  |
| --- | --- |
| Name | Definition |
| apiRoot | See clause 6.1.1 |

##### 6.2.3.2.3 Resource Standard Methods

###### 6.2.3.2.3.1 GET

This operation retrieves a list of NF Instances, and their offered services, currently registered in the NRF, satisfying a number of filter criteria, such as those NF Instances offering a certain service name, or those NF Instances of a given NF type (e.g., AMF).

Table 6.2.3.2.3.1-1: URI query parameters supported by the GET method on this resource

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description | Applicability |
| target-nf-type | NFType | M | 1 | This IE shall contain the NF type of the NF Service Producer being discovered. |  |
| requester-nf-type | NFType | M | 1 | This IE shall contain the NF type of the NF Service Consumer that is invoking the Nnrf\_NFDiscovery service. |  |
| requester-nf-instance-id | NfInstanceId | O | 0..1 | If included, this IE shall contain the NF instance id of the NF service consumer. | Query-Params-Ext2 |
| service-names | array(ServiceName) | O | 1..N | If included, this IE shall contain an array of service names for which the NRF is queried to provide the list of NF profiles. The NRF shall return the NF profiles that have at least one NF service matching the NF service names in this list. The NF service names returned by the NRF shall be an interclause of the NF service names requested and the NF service names registered in the NF profile.  If not included, the NRF shall return all the NF service names registered in the NF profile. |  |
| requester-nf-instance-fqdn | Fqdn | O | 0..1 | If included, this IE shall contain the FQDN of the NF Service Consumer that is invoking the Nnrf\_NFDiscovery service.  The NRF shall use this to return only those NF profiles that include at least one NF service containing an entry in the "allowedNfDomains" list (see clause 6.1.6.2.3) that matches the domain of the requester NF. |  |
| target-plmn-list | array(PlmnId) | C | 1..N | This IE shall be included when NF services in a different PLMN, or NF services of specific PLMN ID(s) in a same PLMN comprising multiple PLMN IDs, need to be discovered. When included, this IE shall contain the PLMN ID of the target NF. If more than one PLMN ID is included, NFs from any PLMN ID present in the list matches the query parameter.  For inter-PLMN service discovery, at most 1 PLMN ID shall be included in the list; it shall be included in the service discovery from the NF in the source PLMN sent to the NRF in the same PLMN, while it may be absent in the service discovery request sent from the source NRF to the target NRF. In such case, if the NRF receives more than 1 PLMN ID, it shall only consider the first element of the array, and ignore the rest. |  |
| requester-plmn-list | array(PlmnId) | C | 1..N | This IE shall be included when NF services in a different PLMN need to be discovered. When included, this IE shall contain the PLMN ID(s) of the requester NF. |  |
| target-nf-instance-id | NfInstanceId | O | 0..1 | Identity of the NF instance being discovered. |  |
| target-nf-fqdn | Fqdn | O | 0..1 | FQDN of the target NF instance being discovered. |  |
| hnrf-uri | Uri | C | 0..1 | If included, this IE shall contain the API URI of the NFDiscovery Service (see clause 6.2.1) of the home NRF. It shall be included if the NF Service Consumer has previously received such API URI to be used for service discovery (e.g., from the NSSF in the home PLMN). |  |
| snssais | array(Snssai) | O | 1..N | If included, this IE shall contain the list of S-NSSAIs that are served by the NF Instances being discovered. The NRF shall return those NF profiles of NF Instances that have at least one of the S-NSSAIs in this list. The S-NSSAIs included in the NF profiles of NF Instances returned by the NRF shall be an interclause of the S-NSSAIs requested and the S-NSSAIs supported by those NF Instances. (NOTE 10). |  |
| requester-snssais | array(Snssai) | O | 1..N | If included, this IE shall contain the list of S-NSSAI of the requester NF. The NRF shall use this to return only those NF profiles of NF Instances allowing to be discovered from the slice(s) identified by this IE, according to the "allowedNssais" list in the NF Profile and NF Service (see clause 6.1.6.2.2 and 6.1.6.2.3). |  |
| plmn-specific-snssai-list | array(PlmnSnssai) | O | 1..N | If included, this IE shall contain the list of S-NSSAI that are served by the NF service being discovered for the corresponding PLMN provided. The NRF shall use this to identify the NF services that have registered their support for the S-NSSAIs for the corresponding PLMN given. The NRF shall return the NF profiles that have at least one per PLMN S-NSSAI entry matching the PLMN specific S-NSSAIs provided in this list. The per PLMN list of S-NSSAIs included in the NF profile returned by the NRF shall be an interclause of the list requested and the list registered in the NF profile. (NOTE 10). |  |
| nsi-list | array(string) | O | 1..N | If included, this IE shall contain the list of NSI IDs that are served by the services being discovered. |  |
| dnn | Dnn | O | 0..1 | If included, this IE shall contain the DNN for which NF services serving that DNN is discovered. DNN may be included if the target NF type is e.g. "BSF", "SMF", "PCF", "PCSCF" or "UPF".  If the Snssai(s) are also included, the NF services serving the DNN shall be available in the network slice(s) identified by the Snssai(s). |  |
| smf-serving-area | string | O | 0..1 | If included, this IE shall contain the serving area of the SMF. It may be included if the target NF type is "UPF". |  |
| tai | Tai | O | 0..1 | Tracking Area Identity. |  |
| amf-region-id | AmfRegionId | O | 0..1 | AMF Region Identity. |  |
| amf-set-id | AmfSetId | O | 0..1 | AMF Set Identity. |  |
| guami | Guami | O | 0..1 | Guami used to search for an appropriate AMF.  (NOTE 1) |  |
| supi | Supi | O | 0..1 | If included, this IE shall contain the SUPI of the requester UE to search for an appropriate NF. SUPI may be included if the target NF type is e.g. "PCF", "CHF", "AUSF", "UDM" or "UDR". |  |
| ue-ipv4-address | Ipv4Addr | O | 0..1 | The IPv4 address of the UE for which a BSF needs to be discovered. |  |
| ip-domain | string | O | 0..1 | The IPv4 address domain of the UE for which a BSF needs to be discovered. |  |
| ue-ipv6-prefix | Ipv6Prefix | O | 0..1 | The IPv6 prefix of the UE for which a BSF needs to be discovered. |  |
| pgw-ind | boolean | O | 0..1 | When present, this IE indicates whether a combined SMF/PGW-C or a standalone SMF needs to be discovered.  true: A combined SMF/PGW-C is requested to be discovered; false: A standalone SMF is requested to be discovered. (See NOTE 2) |  |
| pgw | Fqdn | O | 0..1 | If included, this IE shall contain the PGW FQDN which is received by the AMF from the MME to find the combined SMF/PGW. |  |
| gpsi | Gpsi | O | 0..1 | If included, this IE shall contain the GPSI of the requester UE to search for an appropriate NF. GPSI may be included if the target NF type is "CHF", "PCF", "UDM" or "UDR". |  |
| external-group-identity | ExtGroupId | O | 0..1 | If included, this IE shall contain the external group identifier of the requester UE to search for an appropriate NF. This may be included if the target NF type is "UDM" or "UDR". |  |
| pfd-data | PfdData | O | 0..1 | When present, this IE shall contain the application identifiers and/or application function identifiers in PFD management. This may be included if the target NF type is "NEF". | Query-Params-Ext2 |
| data-set | DataSetId | O | 0..1 | Indicates the data set to be supported by the NF to be discovered. May be included if the target NF type is "UDR". |  |
| routing-indicator | string | O | 0..1 | Routing Indicator information that allows to route network signalling with SUCI (see 3GPP 23.003 [12]) to an AUSF and UDM instance capable to serve the subscriber. May be included if the target NF type is "AUSF" or "UDM". |  |
| group-id-list | array(NfGroupId) | O | 1..N | Identity of the group(s) of the NFs of the target NF type to be discovered. May be included if the target NF type is "UDR", "UDM", "HSS", "PCF" or "AUSF". |  |
| dnai-list | array(Dnai) | O | 1..N | If included, this IE shall contain the Data network access identifiers. It may be included if the target NF type is "UPF". |  |
| upf-iwk-eps-ind | boolean | O | 0..1 | When present, this IE indicates whether a UPF supporting interworking with EPS needs to be discovered.  true: A UPF supporting interworking with EPS is requested to be discovered; false: A UPF not supporting interworking with EPS is requested to be discovered. (NOTE 3) |  |
| chf-supported-plmn | PlmnId | O | 0..1 | If included, this IE shall contain the PLMN ID that a CHF supports (i.e., in the PlmnRange of ChfInfo attribute in the NFProfile). This IE may be included when the target NF type is "CHF". |  |
| preferred-locality | string | O | 0..1 | Preferred target NF location (e.g. geographic location, data center).  When present, the NRF shall prefer NF profiles with a locality attribute that matches the preferred-locality.  The NRF may return additional NFs in the response not matching the preferred target NF location, e.g. if no NF profile is found matching the preferred target NF location.  The NRF should set a lower priority for any additional NFs on the response not matching the preferred target NF location than those matching the preferred target NF location.  (NOTE 6) |  |
| access-type | AccessType | C | 0..1 | If included, this IE shall contain the Access type which is required to be supported by the target Network Function (i.e. SMF). |  |
| supported-features | SupportedFeatures | O | 0..1 | List of features required to be supported by the target Network Function.  This IE may be present only if the service-names attribute is present and if it contains a single service-name, or if the target Network Function does not support any service. It shall be ignored by the NRF otherwise.  (NOTE 4) |  |
| required-features | array(SupportedFeatures) | O | 1..N | List of features required to be supported by the target Network Function, as defined by the supportedFeatures attribute in NFService (see clauses 6.1.6.2.3 and 6.2.6.2.4).  This IE may be present only if the service-names attribute is present.  When present, the required-features attribute shall contain as many entries as the number of entries in the service-names attribute. The nth entry in the required-features attribute shall correspond to the nth entry in the service-names attribute. An entry corresponding to a service for which no specific feature is required shall be encoded as "0". | Query-Params-Ext1 |
| complex-query | ComplexQuery | O | 0..1 | This query parameter is used to override the default logical relationship of query parameters. | Complex-Query |
| limit | integer | O | 0..1 | Maximum number of NFProfiles to be returned in the response. | Query-Params-Ext1 |
| max-payload-size | integer | O | 0..1 | Maximum payload size (before compression, if any) of the response, expressed in kilo octets.  When present, the NRF shall limit the number of NF profiles returned in the response such as to not exceed the maximum payload size indicated in the request.  Default = 124. Maximum = 2000 (i.e. 2 Mo). | Query-Params-Ext1 |
| pdu-session-types | array(PduSessionType) | O | 1..N | List of the PDU session type (s) requested to be supported by the target Network Function (i.e UPF). | Query-Params-Ext1 |
| event-id-list | array(EventId) | O | 1..N | If present, this attribute shall contain the list of events requested to be supported by the Nnwdaf AnalyticsInfo Service, the NRF shall return NF which support all the requested events. | Query-Param-Analytics |
| nwdaf-event-list | array(NwdafEvent) | O | 1..N | If present, this attribute shall contain the list of events requested to be supported by the Nnwdaf\_EventsSubscription service, the NRF shall return NF which support all the requested events. | Query-Param-Analytics |
| atsss-capability | AtsssCapability | O | 0..1 | When present, this IE indicates the ATSSS capability of the target UPF needs to be supported. | MAPDU |
| upf-ue-ip-addr-ind | boolean | O | 0..1 | When present, this IE indicates whether a UPF supporting allocating UE IP addresses/prefixes needs to be discovered.  true: a UPF supporting UE IP addresses/prefixes allocation is requested to be discovered; false: a UPF not supporting UE IP addresses/prefixes allocation is requested to be discovered. | Query-Params-Ext2 |
| client-type | ExternalClientType | O | 0..1 | When present, this IE indicates that NF(s) dedicatedly serving the specified Client Type needs to be discovered. This IE may be included when target NF Type is "LMF" and "GMLC".  If no NF profile is found dedicately serving the requested client type, the NRF may return NF(s) not dedicatedly serving the request client type in the response. | Query-Params-Ext2 |
| target-snpn | PlmnIdNid | C | 0..1 | This IE shall be included when NF services of a specific SNPN need to be discovered. When included, this IE shall contain the PLMN ID and NID of the target NF. | Query-Params-Ext2 |
| af-ee-data | AfEventExposureData | O | 0..1 | When present, this shall contain the application events, and optionally application function identifiers, application identifiers of the AF(s). This may be included if the target NF type is "NEF". | Query-Params-Ext2 |
| w-agf-info | WAgfInfo | O | 0..1 | If included, this IE shall contain the W-AGF identifiers of N3 terminations which is received by the SMF to find the combined W-AGF/UPF. | Query-Params-Ext2 |
| tngf-info | TngfInfo | O | 0..1 | If included, this IE shall contain the TNGF identifiers of N3 terminations which is received by the SMF to find the combined TNGF/UPF. | Query-Params-Ext2 |
| target-nf-set-id | NfSetId | O | 0..1 | When present, this IE shall contain the target NF Set ID (as defined in clause 28.10 of 3GPP TS 23.003 [12]) of the NF instances being discovered. | Query-Params-Ext2 |
| target-nf-service-set-id | NfServiceSetId | O | 0..1 | When present, this IE shall contain the target NF Service Set ID (as defined in clause 28.11 of 3GPP TS 23.003 [12]) of the NF service instances being discovered. | Query-Params-Ext2 |
| preferred-tai | Tai | O | 0..1 | When present, the NRF shall prefer NF profiles that can serve the TAI, or the NRF shall return NF profiles not matching the TAI if no NF profile is found matching the TAI.  (NOTE 5) | Query-Params-Ext2 |
| nef-id | NefId | O | 0..1 | When present, this IE shall contain the NEF ID of the NEF to be discovered. This may be included if the target NF type is "NEF". (NOTE 7) | Query-Params-Ext2 |
| preferred-nf-instances | array(NfInstanceId) | O | 1..N | When present, this IE shall contain a list of preferred candidate NF instance IDs. (NOTE 8) | Query-Params-Ext2 |
| notification-type | NotificationType | O | 0..1 | If included, this IE shall contain the notification type of default notification subscriptions that shall be registered in the NFProfile or NFService of the NF Instances being discovered. The NF profiles returned by the NRF shall contain all the registered default notification subscriptions, including the one corresponding to the notification-type parameter.  (NOTE 9) | Query-Params-Ext2 |
| serving-scope | array(string) | O | 1..N | If present, this attribute shall contain the list of areas that can be served by the NF instances to be discovered. The NRF shall return NF profiles of NFs which can serve all the areas requested in this query parameter. | Query-Params-Ext2 |
| imsi | string | O | 0..1 | If included, this IE shall contain the IMSI of the requester UE to search for an appropriate NF. IMSI may be included if the target NF type is "HSS".  pattern: "[0-9]{5,15}" | Query-Params-Ext2 |
| internal-group-identity | GroupId | O | 0..1 | If included, this IE shall contain the internal group identifier of the UE to search for an appropriate NF. This may be included if the target NF type is "UDM" | Query-Params-Ext2 |
| preferred-api-versions | map(string) | O | 1..N | When present, this IE indicates the preferred API version of the services that are supported by the target NF instances. The key of the map is the ServiceName (see clause 6.1.6.3.11) for which the preferred API version is indicated. Each element carries the API Version Indication for the service indicated by the key.  An API Version Indication is a string formatted as {operator}+{API Version}.  The following operators shall be supported:  "=" match a version equals to the version value indicated.  ">" match any version greater than the version value indicated  ">=" match any version greater than or equal to the version value indicated  "<" match any version less than the version value indicated  "<=" match any version less than or equal to the version value indicated  "^" match any version compatible with the version indicated, i.e. any version with the same major version as the version indicated.  Precedence between versions is identified by comparing the Major, Minor, and Patch version fields numerically, from left to right.  If no operator or an unknown operator is provided in API Version Indication, "=" operator is applied.  Example of API Version Indication:  Case1: "=1.2.4.operator-ext" or "1.2.4.operator-ext" means matching the service with API version "1.2.4.operator-ext"  Case2: ">1.2.4" means matching the service with API versions greater than "1.2.4"  Case3: "^2.3.0" or "^2" means matching the service with all API versions with major version "2". | Query-Params-Ext2 |
| NOTE 1: If this parameter is present and no AMF supporting the requested GUAMI is available due to AMF Failure or planned AMF removal, the NRF shall return in the response AMF instances acting as a backup for AMF failure or planned AMF removal respectively for this GUAMI (see clause 6.1.6.2.11). The NRF can detect if an AMF has failed, using the Heartbeat procedure. The NRF will receive a de-registration request from an AMF performing a planned removal.  NOTE 2: If the combined SMF/PGW-C is requested to be discovered, the NRF shall return in the response the SMF instances registered with the SmfInfo containing pgwFqdn.  NOTE 3: If a UPF supporting interworking with EPS is requested to be discovered, the NRF shall return in the response the UPF instances registered with the upfInfo containing iwkEpsInd set to true.  NOTE 4: This attribute has a different semantic than what is defined in clause 6.6.2 of 3GPP TS 29.500 [4], i.e. it is not used to signal optional features of the Nnrf\_NFDiscovery Service API supported by the requester NF.  NOTE 5: The AMF may perform the SMF discovery based on the dnn, snssais and preferred-tai during a PDU session establishment procedure, and the NRF shall return the SMF profiles matching all if possible, or the SMF profiles only matching dnn and snssais. If the SMF profiles only matching dnn and snssais are returned, the AMF shall insert an I-SMF. An SMF may also perform a UPF discovery using this parameter.  NOTE 6: The SMF may select the P-CSCF close to the UPF by setting the preferred-locality to the value of the locality of the UPF.  NOTE 7: During EPS to 5GS idle mobility procedure, the NF service consumer (i.e. SMF) discovers the anchor NEF for NIDD using the SCEF ID received from EPS as the value of the NEF ID, as specified in clause 4.11.1.3.3 of 3GPP TS 23.502 [3].  NOTE 8: The service consumer may include a list of preferred-nf-instance-ids in the query. If so, the NRF shall first check if the NF profiles of the preferred NF instances match the other query parameters, and if so, then the NRF shall return the corresponding NF profiles; otherwise, the NRF shall return a list of candidate NF profiles matching the query parameters other than the preferred-nf-instance-ids. For example, the target AMF may set this query parameter to the SMF Instance ID and I-SMF Instance ID during an inter AMF mobility procedure to select an I-SMF.  NOTE 9: This parameter may be used by the SCP (with other query parameters) to discover and select a NF service consumer with a default notification subscription supporting the notication type of a notification request (see clause 6.10.3.x of 3GPP TS 29.500 [4]).  NOTE 10: An S-NSSAI value used in discovery request query parameters shall be considered as matching the S-NSAAI value in the NF Profile of a given NF Instance if both the SST and SD components are identical (i.e. an S-NSSAI value where SD is absent, shall not be considered as matching an S-NSSAI where SD is present, regardless if SST is equal in both). | | | | | |

The default logical relationship among the query parameters is logical "AND", i.e. all the provided query parameters shall be matched, with the exception of the "preferred-locality" or the "preferred-nf-instances" query (see Table 6.2.3.2.3.1-1).

The NRF may support the Complex query expression as defined in 3GPP TS 29.501 [5] for the NF Discovery service. If the "complexQuery" query parameter is included, then the logical relationship among the query parameters contained in "complexQuery" query parameter is as defined in 3GPP TS 29.571 [7].

A NRF not supporting Complex query expression shall reject a NF service discovery request including a complexQuery parameter, with a ProblemDetails IE including the cause attribute set to INVALID\_QUERY\_PARAM and the invalidParams attribute indicating the complexQuery parameter.

This method shall support the request data structures specified in table 6.1.3.2.3.1-2 and the response data structures and response codes specified in table 6.1.3.2.3.1-3.

Table 6.2.3.2.3.1-2: Data structures supported by the GET Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| n/a |  |  |  |

Table 6.2.3.2.3.1-3: Data structures supported by the GET Response Body on this resource

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Data type | P | | Cardinality | Response  codes | Description |
| SearchResult | M | | 1 | 200 OK | The response body contains the result of the search over the list of registered NF Instances. |
| n/a |  | |  | 307 Temporary Redirect | The response shall be used when the intermediate NRF redirects the service discovery request.  The NRF shall include in this response a Location header field containing a URI pointing to the resource located on the redirect target NRF. |
| ProblemDetails | M | | 1 | 400 Bad Request | The response body contains the error reason of the request message.  If the query parameter used to match the authorization parameter is required but not provided in the NF discovery request, the "cause" attribute shall be set to "MANDATORY\_QUERY\_PARAM\_MISSING", and the missing query parameter shall be indicated. |
| ProblemDetails | | M | 1 | 403 Forbidden | This response shall be returned if the NF Service Consumer is not allowed to discover the NF Service(s) being queried. |
| ProblemDetails | | M | 1 | 404 Not Found | This response shall be returned if the requested resource URI is not found in the server.  It may also be sent in hierarchical NRF deployments when the NRF needs to forward/redirect the request to another NRF but lacks information in the request to do so; similarly, the NRF shall return this response code when it is received from the upstream NRF. |
| ProblemDetails | M | | 1 | 500 Internal Server Error | The response body contains the error reason of the request message. |

##### 6.2.3.2.4 Resource Custom Operations

There are no resource custom operations for the Nnrf\_NFDiscovery service in this release of the specification.

#### 6.2.3.3 Resource: Stored Search (Document)

##### 6.2.3.3.1 Description

This resource represents a search result (i.e. a number of discovered NF Instances), stored by NRF as a consequence of a prior search result.

This resource is modelled as the Document resource archetype (see clause C.3 of 3GPP TS 29.501 [5]).

##### 6.2.3.3.2 Resource Definition

Resource URI: **{apiRoot}/nnrf-disc/v1/searches/{searchId}**

This resource shall support the resource URI variables defined in table 6.2.3.3.2-1.

Table 6.2.3.3.2-1: Resource URI variables for this resource

|  |  |
| --- | --- |
| Name | Definition |
| apiRoot | See clause 6.1.1 |
| searchId | Identifier of a stored search result, returned by NRF to the NF Consumer in the original response to the NF Discovery GET operation (see clause 6.2.6.2.2). |

###### 6.2.3.3.2.1 GET

This method retrieves the NF Instances corresponding to a given stored search result.

This method shall support the URI query parameters specified in table 6.2.3.3.2.1-1.

Table 6.2.3.3.2.1-1: URI query parameters supported by the GET method on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| n/a |  |  |  |  |

This method shall support the request data structures specified in table 6.2.3.3.2.1-2 and the response data structures and response codes specified in table 6.2.3.3.2.1-3.

Table 6.2.3.3.2.1-2: Data structures supported by the GET Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| n/a |  |  |  |

Table 6.2.3.3.2.1-3: Data structures supported by the GET Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| StoredSearchResult | M | 1 | 200 OK | The response body contains the NF Instances corresponding to a given stored search result. |
| NOTE: The mandatory HTTP error status codes for the GET method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] other than those specified in the table above also apply, with a ProblemDetails data type (see clause 5.2.7 of 3GPP TS 29.500 [4]). | | | | |

#### 6.2.3.4 Resource: Complete Stored Search (Document)

##### 6.2.3.4.1 Description

This resource represents a complete search result (i.e. a number of discovered NF Instances), stored by NRF as a consequence of a prior search result, but without applying any client restrictions in terms of the number of instances to be returned (i.e. "limit" or "max-payload-size" query parameters).

This resource is modelled as the Document resource archetype (see clause C.3 of 3GPP TS 29.501 [5]).

##### 6.2.3.4.2 Resource Definition

Resource URI: **{apiRoot}/nnrf-disc/v1/searches/{searchId}/complete**

This resource shall support the resource URI variables defined in table 6.2.3.4.2-1.

Table 6.2.3.4.2-1: Resource URI variables for this resource

|  |  |
| --- | --- |
| Name | Definition |
| apiRoot | See clause 6.1.1 |
| searchId | Identifier of a stored search result, returned by NRF to the NF Consumer in the original response to the NF Discovery GET operation (see clause 6.2.6.2.2). |

###### 6.2.3.4.2.1 GET

This method retrieves the NF Instances corresponding to a given stored search result.

This method shall support the URI query parameters specified in table 6.2.3.4.2.1-1.

Table 6.2.3.4.2.1-1: URI query parameters supported by the GET method on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| n/a |  |  |  |  |

This method shall support the request data structures specified in table 6.2.3.4.2.1-2 and the response data structures and response codes specified in table 6.2.3.4.3.1-3.

Table 6.2.3.4.2.1-2: Data structures supported by the GET Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| n/a |  |  |  |

Table 6.2.3.4.2.1-3: Data structures supported by the GET Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| StoredSearchResult | M | 1 | 200 OK | The response body contains the NF Instances corresponding to a given stored search result, but without applying any client restrictions in terms of the number of instances to be returned (i.e. "limit" or "max-payload-size" query parameters). |
| NOTE: The mandatory HTTP error status codes for the GET method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] other than those specified in the table above also apply, with a ProblemDetails data type (see clause 5.2.7 of 3GPP TS 29.500 [4]). | | | | |

### 6.2.4 Custom Operations without associated resources

There are no custom operations defined without any associated resources for the Nnrf\_NFDiscovery service in this release of this specification.

### 6.2.5 Notifications

There are no notifications defined for the Nnrf\_NFDiscovery service in this release of the specification.

### 6.2.6 Data Model

#### 6.2.6.1 General

This clause specifies the application data model supported by the API.

Table 6.2.6.1-1 specifies the data types defined for the Nnrf service based interface protocol.

Table 6.2.6.1-1: Nnrf\_NFDiscovery specific Data Types

|  |  |  |
| --- | --- | --- |
| Data type | Clause defined | Description |
| SearchResult | 6.2.6.2.2 |  |
| NFProfile | 6.2.6.2.3 |  |
| NFService | 6.2.6.2.4 |  |
| StoredSearchResult | 6.2.6.2.5 |  |
| PreferredSearch | 6.2.6.2.6 |  |

Table 6.2.6.1-2 specifies data types re-used by the Nnrf service based interface protocol from other specifications, including a reference to their respective specifications and when needed, a short description of their use within the Nnrf service based interface.

Table 6.2.6.1-2: Nnrf\_NFDiscovery re-used Data Types

|  |  |  |
| --- | --- | --- |
| Data type | Reference | Comments |
| Snssai | 3GPP TS 29.571 [7] |  |
| PlmnId | 3GPP TS 29.571 [7] |  |
| Dnn | 3GPP TS 29.571 [7] |  |
| Tai | 3GPP TS 29.571 [7] |  |
| SupportedFeatures | 3GPP TS 29.571 [7] |  |
| NfInstanceId | 3GPP TS 29.571 [7] |  |
| Uri | 3GPP TS 29.571 [7] |  |
| Gpsi | 3GPP TS 29.571 [7] |  |
| GroupId | 3GPP TS 29.571 [7] |  |
| Guami | 3GPP TS 29.571 [7] |  |
| IPv4Addr | 3GPP TS 29.571 [7] |  |
| IPv6Addr | 3GPP TS 29.571 [7] |  |
| UriScheme | 3GPP TS 29.571 [7] |  |
| Dnai | 3GPP TS 29.571 [7] |  |
| NfGroupId | 3GPP TS 29.571 [7] | Identifier of a NF Group |
| PduSessionType | 3GPP TS 29.571 [7] |  |
| AtsssCapability | 3GPP TS 29.571 [7] |  |
| PlmnIdNid | 3GPP TS 29.571 [7] |  |
| NfSetId | 3GPP TS 29.571 [7] |  |
| NfServiceSetId | 3GPP TS 29.571 [7] |  |
| EventId | 3GPP TS 29.520 [32] | Defined in Nnwdaf\_AnalyticsInfo API. |
| NwdafEvent | 3GPP TS 29.520 [32] | Defined in Nnwdaf\_EventsSubscription API. |
| ExtGroupId | 3GPP TS 29.503 [36] |  |
| DefaultNotificationSubscription | 3GPP TS 29.510 | See clause 6.1.6.2.4 |
| IPEndPoint | 3GPP TS 29.510 | See clause 6.1.6.2.5 |
| NFType | 3GPP TS 29.510 | See clause 6.1.6.3.3 |
| UdrInfo | 3GPP TS 29.510 | See clause 6.1.6.2.6 |
| UdmInfo | 3GPP TS 29.510 | See clause 6.1.6.2.7 |
| AusfInfo | 3GPP TS 29.510 | See clause 6.1.6.2.8 |
| SupiRange | 3GPP TS 29.510 | See clause 6.1.6.2.9 |
| AmfInfo | 3GPP TS 29.510 | See clause 6.1.6.2.11 |
| SmfInfo | 3GPP TS 29.510 | See clause 6.1.6.2.12 |
| UpfInfo | 3GPP TS 29.510 | See clause 6.1.6.2.13 |
| PcfInfo | 3GPP TS 29.510 | See clause 6.1.6.2.20 |
| BsfInfo | 3GPP TS 29.510 | See clause 6.1.6.2.21 |
| ChfInfo | 3GPP TS 29.510 | See clause 6.1.6.2.32 |
| ChfServiceInfo | 3GPP TS 29.510 | See clause 6.1.6.2.33 |
| NFServiceVersion | 3GPP TS 29.510 | See clause 6.1.6.2.19 |
| PlmnSnssai | 3GPP TS 29.510 | See clause 6.1.6.2.44 |
| NwdafInfo | 3GPP TS 29.510 | See clause 6.1.6.2.45 |
| NFStatus | 3GPP TS 29.510 | See clause 6.1.6.3.7 |
| DataSetId | 3GPP TS 29.510 | See clause 6.1.6.3.8 |
| ServiceName | 3GPP TS 29.510 | See clause 6.1.6.3.11 |
| NFServiceStatus | 3GPP TS 29.510 | See clause 6.1.6.3.12 |
| LmfInfo | 3GPP TS 29.510 | See clause 6.1.6.2.46 |
| GmlcInfo | 3GPP TS 29.510 | See clause 6.1.6.2.47 |
| NefInfo | 3GPP TS 29.510 | See clause 6.1.6.2.48 |
| PfdData | 3GPP TS 29.510 | See clause 6.1.6.2.49 |
| AfEventExposureData | 3GPP TS 29.510 | See clause 6.1.6.2.50 |
| PcscfInfo | 3GPP TS 29.510 | See clause 6.1.6.2.53 |
| HssInfo | 3GPP TS 29.510 | See clause 6.1.6.2.57 |
| ImsiRange | 3GPP TS 29.510 | See clause 6.1.6.2.58 |
| NefId | 3GPP TS 29.510 | See clause 6.1.6.3 |

#### 6.2.6.2 Structured data types

##### 6.2.6.2.1 Introduction

This clause defines the structures to be used in resource representations.

##### 6.2.6.2.2 Type: SearchResult

Table 6.2.6.2.2-1: Definition of type SearchResult

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| validityPeriod | integer | M | 1 | It shall contain the time in seconds during which the discovery result is considered valid and can be cached by the NF Service Consumer. This value shall be the same as the value contained in the "max-age" parameter of the "Cache-Control" header field sent in the HTTP response. |
| nfInstances | array(NFProfile) | M | 0..N | It shall contain an array of NF Instance profiles, matching the search criteria indicated by the query parameters of the discovery request. An empty array means there is no NF instance that can match the search criteria. |
| searchId | string | O | 0..1 | This IE may be present if the NRF stores the result of the current service discovery response in a given URL (server-side caching), to make it available in the future to NF Service Consumers without having to compute the whole search process again. |
| numNfInstComplete | Uint32 | O | 0..1 | This IE may be present when the total number of NF Instances found by NRF, as the result of the service discovery process, is higher than the actual number of NF Instances included in the attribute nfInstances of the SearchResult object. This may happen due to the NF Service Consumer including in the discovery request parameters such as "limit" or "max-payload-size". |
| preferredSearch | PreferredSearch | C | 0..1 | This IE shall be present to indicate whether the returned NFProfiles match the preferred query parameters, if the discovery request contain any of the query parameter defined in the PreferredSearch data type. |
| nrfSupportedFeatures | SupportedFeatures | C | 0..1 | Features supported by the NRF for the NFDiscovery service (see clause 6.2.9).  This IE should be present if the NRF supports at least one feature. |

##### 6.2.6.2.3 Type: NFProfile

Table 6.2.6.2.3-1: Definition of type NFProfile

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| nfInstanceId | NfInstanceId | M | 1 | Unique identity of the NF Instance. |
| nfType | NFType | M | 1 | Type of Network Function |
| nfStatus | NFStatus | M | 1 | Status of the NF Instance |
| nfInstanceName | string | O | 0..1 | Human readable name of the NF Instance |
| plmnList | array(PlmnId) | C | 1..N | PLMN(s) of the Network Function (NOTE 5). This IE shall be present if this information is available for the NF. If this information was not provided by the NF during registration, the NRF should return the list of PLMN ID(s) of the PLMN of the NRF. If this IE is absent in the response, PLMN ID(s) of the PLMN of the NRF are assumed for the NF. |
| sNssais | array(Snssai) | O | 1..N | S-NSSAIs of the Network Function.  If not provided, the NF can serve any S-NSSAI. |
| perPlmnSnssaiList | array(PlmnSnssai) | O | 1..N | The per-PLMN list of S-NSSAI(s) supported by the Network Function. |
| nsiList | array(string) | O | 1..N | List of NSIs of the Network Function.  If not provided, the NF can serve any NSI. |
| fqdn | Fqdn | C | 0..1 | FQDN of the Network Function (NOTE 1, NOTE 3) |
| ipv4Addresses | array(Ipv4Addr) | C | 1..N | IPv4 address(es) of the Network Function (NOTE 1) |
| ipv6Addresses | array(Ipv6Addr) | C | 1..N | IPv6 address(es) of the Network Function (NOTE 1) |
| capacity | integer | O | 0..1 | Static capacity information in the range of 0-65535, expressed as a weight relative to other NF instances of the same type; if capacity is also present in the nfServiceList parameters, those will have precedence over this value. (See NOTE 2) |
| load | integer | O | 0..1 | Latest known load information of the NF ranged from 0 to 100 in percentage (See NOTE 4) |
| locality | string | O | 0..1 | Operator defined information about the location of the NF instance (e.g. geographic location, data center) |
| priority | integer | O | 0..1 | Priority (relative to other NFs of the same type) in the range of 0-65535, to be used for NF selection; lower values indicate a higher priority. Priority may or may not be present in the nfServiceList parameters, xxxInfo parameters and in this attribute. Priority in the nfServiceList has precedence over the priority in this attribute, which has precedence over the priority in xxxInfo parameter.  (NOTE 2) |
| udrInfo | UdrInfo | O | 0..1 | Specific data for the UDR (ranges of SUPI, …) |
| udrInfoExt | array(UdrInfo) | O | 1..N | Multiple entries of UdrInfo. This attribute provides additional information to the udrInfo. udrInfoExt may be present even if the udrInfo is absent. |
| udmInfo | UdmInfo | O | 0..1 | Specific data for the UDM |
| udmInfoExt | array(UdmInfo) | O | 1..N | Multiple entries of UdmInfo. This attribute provides additional information to the udmInfo. udmInfoExt may be present even if the udmInfo is absent. |
| ausfInfo | AusfInfo | O | 0..1 | Specific data for the AUSF |
| ausfInfoExt | array(AusfInfo) | O | 1..N | Multiple entries of AusfInfo. This attribute provides additional information to the ausfInfo. ausfInfoExt may be present even if the ausfInfo is absent. |
| amfInfo | AmfInfo | O | 0..1 | Specific data for the AMF (AMF Set ID, …) |
| amfInfoExt | array(AmfInfo) | O | 1..N | Multiple entries of AmfInfo. This attribute provides additional information to the amfInfo. amfInfoExt may be present even if the amfInfo is absent. |
| smfInfo | smfInfo | O | 0..1 | Specific data for the SMF (DNN's, …).  (NOTE 8) |
| smfInfoExt | array(SmfInfo) | O | 1..N | Multiple entries of SmfInfo. This attribute provides additional information to the smfInfo. smfInfoExt may be present even if the smfInfo is absent.  (NOTE 8) |
| upfInfo | UpfInfo | O | 0..1 | Specific data for the UPF (S-NSSAI, DNN, SMF serving area, …) |
| upfInfoExt | array(UpfInfo) | O | 1..N | Multiple entries of UpfInfo. This attribute provides additional information to the upfInfo. upfInfoExt may be present even if the upfInfo is absent. |
| pcfInfo | PcfInfo | O | 0..1 | Specific data for the PCF |
| pcfInfoExt | array(PcfInfo) | O | 1..N | Multiple entries of PcfInfo. This attribute provides additional information to the pcfInfo. pcfInfoExt may be present even if the pcfInfo is absent. |
| bsfInfo | BsfInfo | O | 0..1 | Specific data for the BSF |
| bsfInfoExt | array(BsfInfo) | O | 1..N | Multiple entries of BsfInfo. This attribute provides additional information to the bsfInfo. bsfInfoExt may be present even if the bsfInfo is absent. |
| chfInfo | ChfInfo | O | 0..1 | Specific data for the CHF |
| chfInfoExt | array(ChfInfo) | O | 1..N | Multiple entries of ChfInfo. This attribute provides additional information to the chfInfo. chfInfoExt may be present even if the chfInfo is absent. |
| nefInfo | NefInfo | O | 0..1 | Specific data for the NEF |
| nwdafInfo | NwdafInfo | O | 0..1 | Specific data for the NWDAF |
| pcscfInfo | array(PcscfInfo) | O | 1..N | Specific data for the P-CSCF.  (NOTE 7) |
| hssInfo | array(HssInfo) | O | 1..N | Specific data for the HSS. |
| customInfo | object | O | 0..1 | Specific data for custom Network Functions |
| recoveryTime | DateTime | O | 0..1 | Timestamp when the NF was (re)started |
| nfServicePersistence | boolean | O | 0..1 | If present, and set to true, it indicates that the different service instances of a same NF Service in the NF instance, supporting a same API version, are capable to persist their resource state in shared storage and therefore these resources are available after a new NF service instance supporting the same API version is selected by a NF Service Consumer (see 3GPP 23.527 [27]).  Otherwise, it indicates that the NF Service Instances of a same NF Service are not capable to share resource state inside the NF Instance. |
| nfServices | array(NFService) | O | 1..N | List of NF Service Instances |
| defaultNotificationSubscriptions | array(DefaultNotificationSubscription) | O | 1..N | Notification endpoints for different notification types.  (NOTE 6) |
| lmfInfo | LmfInfo | O | 0..1 | Specific data for the LMF |
| gmlcInfo | GmlcInfo | O | 0..1 | Specific data for the GMLC |
| snpnList | array(PlmnIdNid) | C | 1..N | SNPN(s) of the Network Function.  This IE shall be present if the NF pertains to one or more SNPNs. |
| nfSetIdList | array(NfSetId) | O | 1..N | NF Set ID defined in clause 28.10 of 3GPP TS 23.003 [12].  At most one NF Set ID shall be indicated per PLMN of the NF. |
| servingScope | array(string) | O | 1..N | The served area(s) of the NF instance.  The absence of this attribute does not imply the NF instance can serve every area. |
| NOTE 1: At least one of the addressing parameters (fqdn, ipv4address or ipv6adress) shall be included in the NF Profile. See NOTE 1 of Table 6.2.6.2.4-1 for the use of these parameters. If multiple ipv4 addresses and/or ipv6 addresses are included in the NF Profile, the NF Service Consumer shall select one of these addresses randomly, unless operator defined local policy of IP address selection, in order to avoid overload for a specific ipv4 address and/or ipv6 address.  NOTE 2: The capacity and priority parameters, if present, are used for NF selection and load balancing. The priority and capacity attributes shall be used for NF selection in the same way that priority and weight are used for server selection as defined in IETF RFC 2782 [23].  NOTE 3: If the requester-plmn in the query parameter is different from the PLMN of the discovered NF, then the fqdn attribute value shall contain the interPlmnFqdn value registered by the NF during NF registration (see clause 6.1.6.2.2). The requester-plmn is different from the PLMN of the discovered NF if it belongs to none of the PLMN ID(s) configured for the PLMN of the NRF.  NOTE 4: The usage of the load parameter by the NF service consumer is implementation specific, e.g. be used for NF selection and load balancing, together with other parameters.  NOTE 5: An NF may register multiple PLMN IDs in its profile within a PLMN comprising multiple PLMN IDs. If so, all the attributes of the NF Profile shall apply to each PLMN ID registered in the plmnList. As an exception, attributes including a PLMN ID, e.g. IMSI-based SUPI ranges, TAIs and GUAMIs, are specific to one PLMN ID and the NF may register in its profile multiple occurrences of such attributes for different PLMN IDs (e.g. the UDM may register in its profile SUPI ranges for different PLMN IDs).  NOTE 6: If notification endpoints are present both in the profile of the NF instance (NFProfile) and in some of its NF Services (NFService) for a same notification type, the notification endpoint(s) of the NF Services shall be used for this notification type.  NOTE 7: The absence of the pcscfInfo attribute in a P-CSCF profile indicates that the P-CSCF can be selected for any DNN and Access Type.  NOTE 8: The absence of both the smfInfo and smfInfoExt attributes in an SMF profile indicates that the SMF can be selected for any S-NSSAI, DNN, TAI and access type. | | | | |

##### 6.2.6.2.4 Type: NFService

Table 6.2.6.2.4-1: Definition of type NFService

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| serviceInstanceId | string | M | 1 | Unique ID of the service instance within a given NF Instance |
| serviceName | ServiceName | M | 1 | Name of the service instance (e.g. "udm-sdm") |
| versions | array(NFServiceVersion) | M | 1..N | The API versions supported by the NF Service and if available, the corresponding retirement date of the NF Service.  The different array elements shall have distinct unique values for "apiVersionInUri", and consequently, the values of "apiFullVersion" shall have a unique first digit version number. |
| scheme | UriScheme | M | 1 | URI scheme (e.g. "http", "https") |
| nfServiceStatus | NFServiceStatus | M | 1 | Status of the NF Service Instance |
| fqdn | string | O | 0..1 | FQDN of the NF Service Instance (see NOTE 1, NOTE 3) |
| ipEndPoints | array(IpEndPoint) | O | 1..N | IP address(es) and port information of the Network Function (including IPv4 and/or IPv6 address) where the service is listening for incoming service requests (see NOTE 1, NOTE 5, NOTE 6) |
| apiPrefix | string | O | 0..1 | Optional path segment(s) used to construct the {apiRoot} variable of the different API URIs, as described in 3GPP 29.501 [5], clause 4.4.1 (optional deployment-specific string that starts with a "/" character) |
| defaultNotificationSubscriptions | array(DefaultNotificationSubscription) | O | 1..N | Notification endpoints for different notification types. |
| capacity | integer | O | 0..1 | Static capacity information in the range of 0-65535, expressed as a weight relative to other services of the same type. (See NOTE 2) |
| load | integer | O | 0..1 | Latest known load information of the NF Service, ranged from 0 to 100 in percentage. (See NOTE 4) |
| priority | integer | O | 0..1 | Priority (relative to other services of the same type) in the range of 0-65535, to be used for NF Service selection; lower values indicate a higher priority. (See NOTE 2) |
| recoveryTime | DateTime | O | 0..1 | Timestamp when the NF service was (re)started |
| chfServiceInfo | ChfServicefInfo | O | 0..1 | Specific data for the CHF service instance |
| supportedFeatures | SupportedFeatures | O | 0..1 | Supported Features of the NF Service instance |
| nfServiceSetIdList | array(NfServiceSetId) | O | 1..N | NF Service Set ID (see clause 28.11 of 3GPP TS 23.003 [12])  At most one NF Service Set ID shall be indicated per PLMN of the NF. |
| NOTE 1: The NF Service Consumer shall construct the API URIs of the service using:  - for intra-PLMN signalling: the FQDN and IP addresses related attributes present in the NF Service Profile, if any, otherwise the FQDN and IP addresses related attributes present in the NF Profile.  - for inter-PLMN signalling: the FQDN present in the NF Service Profile, if any, otherwise the FQDN present in the NF Profile (see NOTE 3).  NOTE 2: The capacity and priority parameters, if present, are used for service selection and load balancing. The priority and capacity attributes shall be used for NF selection in the same way that priority and weight are used for server selection as defined in IETF RFC 2782 [23].  NOTE 3: If the requester-plmn in the query parameter is different from the PLMN of the discovered NF Service, then the fqdn attribute value, if included shall contain the interPlmnFqdn value registered by the NF Service during NF registration (see clause 6.1.6.2.3). The requester-plmn is different from the PLMN of the discovered NF Service if it belongs to none of the PLMN ID(s) configured for the PLMN of the NRF.  NOTE 4: The usage of the load parameter by the NF service consumer is implementation specific, e.g. be used for NF service selection and load balancing, together with other parameters.  NOTE 5: If the ipEndPoints attribute is absent in the NF Service and NF Profile, the NF service consumer shall use the fqdn attribute value for DNS query and if the NF service consumer does not receive a port number during the DNS query it shall use the default HTTP port number, i.e. TCP port 80 for "http" URIs or TCP port 443 for "https" URIs as specified in IETF RFC 7540 [9] when invoking the service.  NOTE 6: If multiple ipv4 addresses and/or ipv6 addresses are included in the NF Service, the NF Service Consumer shall select one of these addresses randomly, unless operator defined local policy of IP address selection, in order to avoid overload for a specific ipv4 address and/or ipv6 address. | | | | |

##### 6.2.6.2.5 Type: StoredSearchResult

Table 6.2.6.2.5-1: Definition of type StoredSearchResult

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| nfInstances | array(NFProfile) | M | 0..N | An array of NF Instances corresponding to a given stored search result. |

##### 6.2.6.2.6 Type: PreferredSearch

Table 6.2.6.2.6-1: Definition of type PreferredSearch

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| preferredTaiMatchInd | boolean | C | 0..1 | Indicates whether the returned NFProfiles match the query parameter preferred-tai.  true: Match false (default): Not Match |

#### 6.2.6.3 Simple data types and enumerations

##### 6.2.6.3.1 Introduction

This clause defines simple data types and enumerations that can be referenced from data structures defined in the previous clauses.

##### 6.2.6.3.2 Simple data types

The simple data types defined in table 6.2.6.3.2-1 shall be supported.

Table 6.2.6.3.2-1: Simple data types

|  |  |  |
| --- | --- | --- |
| Type Name | Type Definition | Description |
|  |  |  |

### 6.2.7 Error Handling

#### 6.2.7.1 General

HTTP error handling shall be supported as specified in clause 5.2.4 of 3GPP TS 29.500 [4].

#### 6.2.7.2 Protocol Errors

Protocol errors handling shall be supported as specified in clause 5.2.7 of 3GPP TS 29.500 [4].

#### 6.2.7.3 Application Errors

The application errors defined for the Nnrf\_NFDiscovery service are listed in Table 6.2.7.3-1.

Table 6.2.7.3-1: Application errors

|  |  |  |
| --- | --- | --- |
| Application Error | HTTP status code | Description |
|  |  |  |

### 6.2.8 Security

As indicated in 3GPP TS 33.501 [15], the access to the Nnrf\_NFDiscovery API may be authorized by means of the OAuth2 protocol (see IETF RFC 6749 [16]), using the "Client Credentials" authorization grant, where the NRF plays the role of the authorization server.

If Oauth2 authorization is used, an NF Service Consumer, prior to consuming services offered by the Nnrf\_NFDiscovery API, shall obtain a "token" from the authorization server, by invoking the Access Token Request service, as described in clause 5.4.2.2.

NOTE: When multiple NRFs are deployed in a network, the NRF used as authorization server is the same NRF where the Nnrf\_NFDiscovery service is invoked by the NF Service Consumer.

The Nnrf\_NFDiscovery API defines scopes for OAuth2 authorization as specified in 3GPP TS 33.501 [15]; it defines a single scope consisting on the name of the service (i.e., "nnrf-disc"), and it does not define any additional scopes at resource or operation level.

### 6.2.9 Features supported by the NFDiscovery service

The syntax of the supportedFeatures attribute is defined in clause 5.2.2 of 3GPP TS 29.571 [7].

The following features are defined for the Nnrf\_NFDiscovery service.

Table 6.2.9-1: Features of supportedFeatures attribute used by Nnrf\_NFDiscovery service

|  |  |  |
| --- | --- | --- |
| Feature Number | Feature | Description |
| 1 | Complex-Query | Support of Complex Query expression (see clause 6.2.3.2.3.1) |
| 2 | Query-Params-Ext1 | Support of the following query parameters:  - limit  - max-payload-size  - required-features  - pdu-session-types |
| 3 | Query-Param-Analytics | Support of the query parameters for Analytics identifier:  - event-id-list  - nwdaf-event-list |
| 4 | MAPDU | This feature indicates whether the NRF supports selection of UPF with ATSSS capability. |
| 5 | Query-Params-Ext2 | Support of the following query parameters:  - requester-nf-instance-id  - upf-ue-ip-addr-ind  - pfd-data  - target-snpn  - af-ee-data  - w-agf-info  - tngf-info  - target-nf-set-id  - target-nf-service-set-id  - preferred-tai  - nef-id  - preferred-nf-instances  - notification-type  - serving-scope  - internal-group-identity  - preferred-api-versions |
| Feature number: The order number of the feature within the supportedFeatures attribute (starting with 1).  Feature: A short name that can be used to refer to the bit and to the feature.  Description: A clear textual description of the feature. | | |

## 6.3 Nnrf\_AccessToken Service API

### 6.3.1 General

This API reuses the API endpoints and input / output parameters specified in IETF RFC 6749 [16] as a custom operation without resources. Hence this clause does not follow the 3GPP API specification guidelines described in 3GPP TS 29.501 [5].

### 6.3.2 API URI

URIs of this API shall have the following root:

{nrfApiRoot}/oauth2/

where {nrfApiRoot} represents the concatenation of the "scheme" and "authority" components of the NRF, as defined in IETF RFC 3986 [17].

### 6.3.3 Usage of HTTP

#### 6.3.3.1 General

HTTP/2, as defined in IETF RFC 7540 [9], shall be used as specified in clause 5 of 3GPP TS 29.500 [4].

HTTP/2 shall be transported as specified in clause 5.3 of 3GPP TS 29.500 [4].

HTTP messages and bodies this API shall comply with the OpenAPI [10] specification contained in Annex A.

#### 6.3.3.2 HTTP standard headers

##### 6.3.3.2.1 General

The HTTP headers as specified in clause 4.4 of IETF RFC 6749 [16] shall be supported, with the exception that there shall not be "Authorization" HTTP request header in the access token request.

##### 6.3.3.2.2 Content type

The following content types shall be supported:

- The x-www-form-urlencoded format (see clause 17.13.4.1 of W3C HTML 4.01 Specification [26]). The use of the x-www-form-urlencoded format shall be signalled by the content type "application/x-www-form-urlencoded".

- The JSON format (IETF RFC 8259 [22]). The use of the JSON format shall be signalled by the content type "application/json". See also clause 5.4 of 3GPP TS 29.500 [4].

#### 6.3.3.3 HTTP custom headers

##### 6.3.3.3.1 General

In this release of this specification, no custom headers specific to the OAuth2.0 Authorization Service API are defined. For 3GPP specific HTTP custom headers used across all service-based interfaces, see clause 5.2.3 of 3GPP TS 29.500 [4].

### 6.3.4 Custom Operation without Associated Resources

#### 6.3.4.1 Overview

The /token endpoint as specified in IETF RFC 6749 [16] shall be supported. The "token endpoint" URI shall be:

{nrfApiRoot}/oauth2/token

where {nrfApiRoot} is defined in clause 6.3.2.

Table 6.3.4.1-1 provides an overview of the endpoints and applicable HTTP methods.

Table 6.3.4.1-1: Custom operations without associated resources

|  |  |  |
| --- | --- | --- |
| Custom operation URI | Mapped HTTP method | Description |
| {nrfApiRoot}/oauth2/token | POST | Access token request for obtaining OAuth2.0 access token. This operation maps to Nnrf\_AccessToken\_Get service operation. |

#### 6.3.4.2 Operation: Get (Access Token Request)

##### 6.3.4.2.1 Description

This custom operation represents the process for issuing the OAuth2.0 access token.

##### 6.3.4.2.2 Operation Definition

This operation returns an OAuth 2.0 access token based on the input parameters provided. This custom operation shall use the HTTP POST method.

This method shall support the request data structures specified in table 6.3.4.2.2-1 and the response data structures and response codes specified in table 6.3.4.2.2-2. The data structure used for the POST request body shall be using x-www-urlencoded format as specified in clause 17.13.4.1 of W3C HTML 4.01 Specification [26].

Table 6.3.4.2.2-1: Data structures supported by the POST Request Body on this endpoint

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| AccessTokenReq | M | 1 | This IE shall contain the request information for the access token request. |

Table 6.3.4.2.2-2: Data structures supported by the POST Response Body on this endpoint

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| AccessTokenRsp | M | 1 | 200 OK | This IE shall contain the access token response information. |
| AccessTokenErr | M | 1 | 400 Bad Request | See IETF RFC 6749 [16] clause 5.2. |

### 6.3.5 Data Model

#### 6.3.5.1 General

This clause specifies the application data model supported by the API.

Table 6.3.5.1-1 specifies the data types defined for the OAuth 2.0 Authorization Service API. The AccessTokenReq data structure shall be converted to the content type "application/x-www-urlencoded" when the OAuth 2.0 Access Token Request is invoked.

Table 6.3.5.1-1: OAuth 2.0 Authorization service specific Data Types

|  |  |  |
| --- | --- | --- |
| Data type | Clause defined | Description |
| AccessTokenReq | 6.3.5.2.2 | Data type for carrying information related to access token request. |
| AccessTokenRsp | 6.3.5.2.3 | Data type for carrying information related to access token response. |
| AccessTokenClaims | 6.3.5.2.4 | The claims data structure for the access token. |
| Audience | 6.3.5.4.1 | Data type for the audience of the access token. |

Table 6.3.5.1-2 specifies data types re-used by the OAuth 2.0 Authorization service from other specifications, including a reference to their respective specifications and when needed, a short description of their use.

Table 6.3.5.1-2: OAuth 2.0 Authorization service re-used Data Types

|  |  |  |
| --- | --- | --- |
| Data type | Reference | Comments |
| NfInstanceId | 3GPP TS 29.571 [7] |  |
| PlmnId | 3GPP TS 29.571 [7] | PLMN ID |
| NFType | 3GPP TS 29.510 | See clause 6.1.6.3.3 |
| Snssai | 3GPP TS 29.571 [7] |  |

#### 6.3.5.2 Structured data types

##### 6.3.5.2.1 Introduction

This clause defines the structures to be used in the APIs.

##### 6.3.5.2.2 Type: AccessTokenReq

Table 6.3.5.2.2-1: Definition of type AccessTokenReq

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| grant\_type | GrantType | M | 1 | This IE shall contain the grant type as "client\_credentials" |
| nfInstanceId | NfInstanceId | M | 1 | This IE shall contain the NF instance id of the NF service consumer. |
| nfType | NFType | C | 0..1 | This IE shall be included when the access token request is for an NF type and not for a specific NF / NF service instance. When present, this IE shall contain the NF type of the NF service consumer. |
| targetNfType | NFType | C | 0..1 | This IE shall be included when the access token request is for an NF type and not for a specific NF / NF service instance. When present, this IE shall contain the NF type of the NF service producer. |
| scope | string | M | 1 | This IE shall contain the NF service name(s) of the NF service producer(s), separated by whitespaces, as described in IETF RFC 6749 [16], clause 3.3.  The service name(s) included in this attribute shall be any of the services defined in the ServiceName enumerated type (see clause 6.1.6.3.11).  pattern: '^([a-zA-Z0-9\_-]+)( [a-zA-Z0-9\_-]+)\*$'  See NOTE 2. |
| targetNfInstanceId | NfInstanceId | C | 0..1 | This IE shall be included, if available and if it is an access token request for a specific NF Service Producer. When present this IE shall contain the NF Instance ID of the specific NF Service Producer for which the access token is requested. |
| requesterPlmn | PlmnId | C | 0..1 | This IE shall be included when the NF service consumer in one PLMN requests a service access authorization for an NF service producer from a different PLMN.  When present, this IE shall contain the PLMN ID of the requester NF service consumer. |
| targetPlmn | PlmnId | C | 0..1 | This IE shall be included when the NF service consumer in one PLMN requests a service access authorization for an NF service producer from a different PLMN.  When present, this IE shall contain the PLMN ID of the target PLMN (i.e., PLMN ID of the NF service producer). |
| targetSnssaiList | array(Snssai) | O | 1..N | This IE may be included during an access token request for an NF type and not for a specific NF / NF service instance. When present, this IE shall contain the list of S-NSSAIs of the NF Service Producer. |
| targetNsiList | array(string) | O | 1..N | This IE may be included during an access token request for an NF type and not for a specific NF / NF service instance. When present, this IE shall contain the list of NSIs of the NF Service Producer. |
| NOTE 1: This data structure shall not be treated as a JSON object. It shall be treated as a key, value pair data structure to be encoded using x-www-urlencoded format as specified in clause 17.13.4.1 of W3C HTML 4.01 Specification [26].  NOTE 2: Though scope attribute is optional as per IETF RFC 6749 [16], it is mandatory for 3GPP as per 3GPP TS 33.501 [15]. | | | | |

##### 6.3.5.2.3 Type: AccessTokenRsp

Table 6.3.5.2.3-1: Definition of type AccessTokenRsp

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| access\_token | string | M | 1 | This IE shall contain JWS Compact Serialized representation of the JWS signed JSON object containing AccessTokenClaims (see clause 6.3.5.2.4). |
| token\_type | string | M | 1 | This IE shall contain the token type, set to value "Bearer". |
| expires\_in | integer | C | 0..1 | This IE when present shall contain the number of seconds after which the access token is considered to be expired.  As indicated in IETF RFC 6749 [16], this attribute should be included, unless the expiration time of the token is made available by other means (e.g. deployment-specific documentation). |
| scope | string | C | 0..1 | This IE when present shall contain the NF service name(s) of the NF service producer(s), separated by whitespaces, as described in IETF RFC 6749 [16], clause 3.3.  The service name(s) included in this attribute shall be any of the services defined in the ServiceName enumerated type (see clause 6.1.6.3.11).  As indicated in IETF RFC 6749 [16], this attribute shall be present if it is different than the scope included in the access token request; if it is the same as the requested scope, this attribute may be absent.  pattern: '^([a-zA-Z0-9\_-]+)( [a-zA-Z0-9\_-]+)\*$' |

##### 6.3.5.2.4 Type: AccessTokenClaims

Table 6.3.5.2.4-1: Definition of type AccessTokenClaims

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| iss | NfInstanceId | M | 1 | This IE shall contain NF instance id of the NRF. , corresponding to the standard "Issuer" claim described in IETF RFC 7519 [25], clause 4.1.1 |
| sub | NfInstanceId | M | 1 | This IE shall contain the NF instance ID of the NF service consumer, corresponding to the standard "Subject" claim described in IETF RFC 7519 [25], clause 4.1.2. |
| aud | Audience | M | 1 | This IE shall contain the NF service producer's NF instance ID(s) (if the exact NF instance(s) of the NF service producer is known) or the NF type of NF service producers for which the claim is applicable, corresponding to the standard "Audience" claim described in IETF RFC 7519 [25], clause 4.1.3. |
| scope | string | M | 1 | This IE shall contain the name of the NF services for which the access\_token is authorized for use; this claim corresponds to a private claim, as described in IETF RFC 7519 [25], clause 4.3.  pattern: '^([a-zA-Z0-9\_-]+)( [a-zA-Z0-9\_-]+)\*$' |
| exp | integer | M | 1 | This IE shall contain the expiration time after which the access\_token is considered to be expired, corresponding to the standard "Expiration Time" claim described in IETF RFC 7519 [25], clause 4.1.4. |
| consumerPlmnId | PlmnId | C | 0..1 | This IE shall be included if the NRF supports providing PLMN ID of the NF service consumer in the access token claims, to be interpreted for subject (sub IE), as specified in clause 13.4.1.2 of 3GPP TS 33.501 [15]. If an NF service producer that receives this IE in the token included in the authorization header does not understand this IE, it shall be ignored. |
| producerPlmnId | PlmnId | C | 0..1 | This IE shall be included if the NRF supports providing PLMN ID of the NF service producer in the access token claims, to be interpretted for audience (aud IE), as specified in clause 13.4.1.2 of 3GPP TS 33.501 [15]. If an NF service producer that receives this IE in the token included in the authorization header does not understand this IE, it shall be ignored. |
| producerSnssaiList | array(Snssai) | O | 1..N | This IE may be included if the NRF supports providing list of S-NSSAIs of the NF service producer in the access token claims. If an NF service producer that receives this IE in the token included in the authorization header does not understand this IE, it shall be ignored. |
| producerNsiList | array(string) | O | 1..N | This IE may be included if the NRF supports providing list of NSIs of the NF service producer in the access token claims. If an NF service producer that receives this IE in the token included in the authorization header does not understand this IE, it shall be ignored. |

#### 6.3.5.3 Simple data types and enumerations

##### 6.3.5.3.1 Introduction

This clause defines simple data types and enumerations that can be referenced from data structures defined in the previous clauses.

##### 6.3.5.3.2 Simple data types

There are no specific simple data types defined in this version of this API. For the re-used data types from other specifications see clause 6.3.5.1

##### 6.3.5.3.3 Enumeration: GrantType

Table 6.3.5.3.3-1: Enumeration GrantType

|  |  |
| --- | --- |
| Enumeration value | Description |
| "client\_credentials" | Represents the Client Credentials grant type. |

#### 6.3.5.4 Data types describing alternative data types or combinations of data types

##### 6.3.5.4.1 Type: Audience

Table 6.3.5.4.1-1: Definition of type Audience as a list of "non-exclusive alternatives"

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | Cardinality | Description | Applicability |
| NFType | 1 | NF type |  |
| array(NfInstanceId) | 1..N | Array of NF Instance Ids |  |

## 6.4 Nnrf\_Bootstrapping Service API

### 6.4.1 API URI

URIs of this API shall have the following root:

{nrfApiRoot}

where {nrfApiRoot} represents the concatenation of the "scheme" and "authority" components of the NRF, as defined in IETF RFC 3986 [17].

### 6.4.2 Usage of HTTP

#### 6.4.2.1 General

HTTP/2, as defined in IETF RFC 7540 [9], shall be used as specified in clause 5 of 3GPP TS 29.500 [4].

HTTP/2 shall be transported as specified in clause 5.3 of 3GPP TS 29.500 [4].

HTTP messages and bodies this API shall comply with the OpenAPI [10] specification contained in Annex A.

#### 6.4.2.2 HTTP standard headers

##### 6.4.2.2.1 General

The HTTP headers as specified in clause 4.4 of IETF RFC 6749 [16] shall be supported, with the exception that there shall not be "Authorization" HTTP request header in the access token request.

##### 6.4.2.2.2 Content type

The following content types shall be supported:

- The JSON format (IETF RFC 8259 [22]). The use of the JSON format shall be signalled by the content type "application/json". See also clause 5.4 of 3GPP TS 29.500 [4].

- The Problem Details JSON Object (IETF RFC 7807 [11]). The use of the Problem Details JSON object in a HTTP response body shall be signalled by the content type "application/problem+json".

- The 3GPP hypermedia format as defined in 3GPP TS 29.501 [5]. The use of the 3GPP hypermedia format in a HTTP response body shall be signalled by the content type "application/3gppHal+json".

#### 6.4.2.3 HTTP custom headers

##### 6.4.2.3.1 General

### In this release of this specification, no custom headers specific to the Nnrf\_Bootstrapping Service API are defined. For 3GPP specific HTTP custom headers used across all service-based interfaces, see clause 5.2.3 of 3GPP TS 29.500 [4].6.4.3 Resources

#### 6.4.3.1 Overview

The structure of the Resource URIs of the Nnrf\_Bootstrapping service is shown in figure 6.4.3.1-1.



Figure 6.4.3.1-1: Resource URI structure of the Nnrf\_Bootstrapping API

Table 6.4.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 6.4.3.1-1: Resources and methods overview

|  |  |  |  |
| --- | --- | --- | --- |
| Resource name | Resource URI | HTTP method or custom operation | Description |
| Bootstrapping  (Document) | {nrfApiRoot}/bootstrapping | GET | Retrieve a collection of links pointing to other services exposed by NRF. |

#### 6.4.3.2 Resource: Bootstrapping (Document)

##### 6.4.3.2.1 Description

This resource represents a collection of links pointing to other services exposed by NRF.

This resource is modelled as the Document resource archetype (see clause C.3 of 3GPP TS 29.501 [5]).

##### 6.4.3.2.2 Resource Definition

Resource URI: **{nrfApiRoot}/bootstrapping**

This resource shall support the resource URI variables defined in table 6.4.3.2.2-1.

Table 6.4.3.2.2-1: Resource URI variables for this resource

|  |  |
| --- | --- |
| Name | Definition |
| nrfApiRoot | See clause 6.4.1 |

##### 6.4.3.2.3 Resource Standard Methods

###### 6.4.3.2.3.1 GET

This method retrieves a list of links pointing to other services exposed by NRF. This method shall support the URI query parameters specified in table 6.4.3.2.3.1-1.

Table 6.4.3.2.3.1-1: URI query parameters supported by the GET method on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| n/a | n/a |  |  |  |

This method shall support the request data structures specified in table 6.4.3.2.3.1-2 and the response data structures and response codes specified in table 6.4.3.2.3.1-3.

Table 6.4.3.2.3.1-2: Data structures supported by the GET Request Body on this resource

|  |  |  |  |
| --- | --- | --- | --- |
| Data type | P | Cardinality | Description |
| n/a |  |  |  |

Table 6.4.3.2.3.1-3: Data structures supported by the GET Response Body on this resource

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data type | P | Cardinality | Response  codes | Description |
| BootstrappingInfo | M | 1 | 200 OK | The response body contains a "\_links" object containing the URI of each service exposed by the NRF. |
| NOTE: The mandatory HTTP error status codes for the GET method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] other than those specified in the table above also apply, with a ProblemDetails data type (see clause 5.2.7 of 3GPP TS 29.500 [4]). | | | | |

### 6.4.4 Custom Operations without associated resources

There are no custom operations defined without any associated resources for the Nnrf\_Bootstrapping service in this release of the specification.

### 6.4.5 Notifications

### There are no notifications defined for the Nnrf\_Bootstrapping service in this release of the specification.6.4.6 Data Model

#### 6.4.6.1 General

This clause specifies the application data model supported by the API.

Table 6.4.6.1-1 specifies the data types defined for the Nnrf\_Bootstrapping service-based interface protocol.

Table 6.4.6.1-1: Nnrf\_Bootstrapping specific Data Types

|  |  |  |
| --- | --- | --- |
| Data type | Clause defined | Description |
| BootstrappingInfo | 6.4.6.2.2 |  |

Table 6.4.6.1-2 specifies data types re-used by the Nnrf\_Bootstrapping service-based interface protocol from other specifications, including a reference to their respective specifications and when needed, a short description of their use within the Nnrf service-based interface.

Table 6.4.6.1-2: Nnrf\_Bootstrapping re-used Data Types

|  |  |  |
| --- | --- | --- |
| Data type | Reference | Comments |
| LinksValueSchema | 3GPP TS 29.571 [7] | 3GPP Hypermedia link |
| ProblemDetails | 3GPP TS 29.571 [7] |  |

#### 6.4.6.2 Structured data types

##### 6.4.6.2.1 Introduction

This clause defines the structures to be used in resource representations.

##### 6.4.6.2.2 Type: BootstrappingInfo

Table 6.4.6.2.2-1: Definition of type BootstrappingInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| status | Status | O | 0..1 | Status of the NRF (operative, non-operative, ...) |
| \_links | map(LinksValueSchema) | M | 1..N | Map of LinksValueSchema objects, where the keys are the link relations, as described in Table 6.4.6.3.3.1-1, and the values are objects containing an "href" attribute, whose value is an absolute URI corresponding to each link relation. |

#### 6.4.6.3 Simple data types and enumerations

##### 6.4.6.3.1 Introduction

This clause defines simple data types and enumerations that can be referenced from data structures defined in the previous clauses.

##### 6.4.6.3.2 Enumeration: Status

Table 6.4.6.3.2-1: Enumeration Status

|  |  |
| --- | --- |
| Enumeration value | Description |
| "OPERATIVE" | The NRF is operative |
| "NON\_OPERATIVE" | The NRF is not operative |

##### 6.4.6.3.3 Relation Types

###### 6.4.6.3.3.1 General

This clause describes the possible relation types defined within NRF API. See clause 4.7.5.2 of 3GPP TS 29.501 [5] for the description of the relation types.

Table 6.4.6.3.3.1-1: supported registered relation types

|  |  |
| --- | --- |
| Relation Name | Description |
| self | The "href" attribute of the object associated to this relation type contains the URI of the same resource returned in the response body (i.e. the "bootstrapping" resource). |
| manage | The "href" attribute of the object associated to this relation type contains the URI of the resource used in the Nnrf\_NFManagement API to register/deregister/update NF Instances profiles in the NRF (i.e. the "nf-instances" store resource). |
| subscribe | The "href" attribute of the object associated to this relation type contains the URI of the resource used in the Nnrf\_NFManagement API to manage subscriptions to the NRF (i.e. the "subscriptions" collection resource). |
| discover | The "href" attribute of the object associated to this relation type contains the URI of the resource used in the Nnrf\_NFManagement API (i.e. the "subscriptions" collection resource). |
| authorize | The "href" attribute of the object associated to this relation type contains the URI of the Oauth2 Access Token Request endpoint, used to request authorization to other APIs in the 5G Core Network. |

Annex A (normative): OpenAPI specification

## A.1 General

This Annex specifies the formal definition of the Nnrf Service API(s). It consists of OpenAPI 3.0.0 specifications, in YAML format.

This Annex takes precedence when being discrepant to other parts of the specification with respect to the encoding of information elements and methods within the API(s).

NOTE 1: The semantics and procedures, as well as conditions, e.g. for the applicability and allowed combinations of attributes or values, not expressed in the OpenAPI definitions but defined in other parts of the specification also apply.

Informative copies of the OpenAPI specification files contained in this 3GPP Technical Specification are available on the public 3GPP file server in the following locations (see clause 5B of the 3GPP TR 21.900 [31] for further information):

- [https://www.3gpp.org/ftp/Specs/archive/OpenAPI/<Release>/](https://www.3gpp.org/ftp/Specs/archive/OpenAPI/%3cRelease%3e/), and

- [https://www.3gpp.org/ftp/Specs/<Plenary>/<Release>/OpenAPI/](https://www.3gpp.org/ftp/Specs/%3cPlenary%3e/%3cRelease%3e/OpenAPI/).

NOTE 2: To fetch the OpenAPI specification file after CT#83 plenary meeting for Release 15 in the above links <Plenary> must be replaced with the date the CT Plenary occurs, in the form of year-month (yyyy-mm), e.g. for CT#83 meeting <Plenary> must be replaced with value "2019-03" and <Release> must be replaced with value "Rel-15".

## A.2 Nnrf\_NFManagement API

openapi: 3.0.0

info:

version: '1.1.0.alpha-3'

title: 'NRF NFManagement Service'

description: |

NRF NFManagement Service.

© 2019, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).

All rights reserved.

externalDocs:

description: 3GPP TS 29.510 V16.2.0; 5G System; Network Function Repository Services; Stage 3

url: 'http://www.3gpp.org/ftp/Specs/archive/29\_series/29.510/'

servers:

- url: '{apiRoot}/nnrf-nfm/v1'

variables:

apiRoot:

default: https://example.com

description: apiRoot as defined in clause 4.4 of 3GPP TS 29.501

security:

- {}

- oAuth2ClientCredentials:

- nnrf-nfm

paths:

/nf-instances:

get:

summary: Retrieves a collection of NF Instances

operationId: GetNFInstances

tags:

- NF Instances (Store)

parameters:

- name: nf-type

in: query

description: Type of NF

required: false

schema:

$ref: '#/components/schemas/NFType'

- name: limit

in: query

description: How many items to return at one time

required: false

schema:

type: integer

responses:

'200':

description: Expected response to a valid request

content:

application/3gppHal+json:

schema:

type: object

properties:

\_links:

type: object

description: 'List of the URI of NF instances. It has two members whose names are item and self. The item one contains an array of URIs.'

additionalProperties:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/LinksValueSchema'

minProperties: 1

'400':

$ref: 'TS29571\_CommonData.yaml#/components/responses/400'

'401':

$ref: 'TS29571\_CommonData.yaml#/components/responses/401'

'403':

$ref: 'TS29571\_CommonData.yaml#/components/responses/403'

'404':

$ref: 'TS29571\_CommonData.yaml#/components/responses/404'

'406':

$ref: 'TS29571\_CommonData.yaml#/components/responses/406'

'411':

$ref: 'TS29571\_CommonData.yaml#/components/responses/411'

'413':

$ref: 'TS29571\_CommonData.yaml#/components/responses/413'

'415':

$ref: 'TS29571\_CommonData.yaml#/components/responses/415'

'429':

$ref: 'TS29571\_CommonData.yaml#/components/responses/429'

'500':

$ref: 'TS29571\_CommonData.yaml#/components/responses/500'

'501':

$ref: 'TS29571\_CommonData.yaml#/components/responses/501'

'503':

$ref: 'TS29571\_CommonData.yaml#/components/responses/503'

default:

$ref: 'TS29571\_CommonData.yaml#/components/responses/default'

options:

summary: Discover communication options supported by NRF for NF Instances

operationId: OptionsNFInstances

tags:

- NF Instances (Store)

responses:

'200':

description: OK

headers:

Accept-Encoding:

description: Accept-Encoding, described in IETF RFC 7694

schema:

type: string

'400':

$ref: 'TS29571\_CommonData.yaml#/components/responses/400'

'401':

$ref: 'TS29571\_CommonData.yaml#/components/responses/401'

'403':

$ref: 'TS29571\_CommonData.yaml#/components/responses/403'

'404':

$ref: 'TS29571\_CommonData.yaml#/components/responses/404'

'405':

$ref: 'TS29571\_CommonData.yaml#/components/responses/405'

'429':

$ref: 'TS29571\_CommonData.yaml#/components/responses/429'

'500':

$ref: 'TS29571\_CommonData.yaml#/components/responses/500'

'501':

$ref: 'TS29571\_CommonData.yaml#/components/responses/501'

'503':

$ref: 'TS29571\_CommonData.yaml#/components/responses/503'

default:

$ref: 'TS29571\_CommonData.yaml#/components/responses/default'

/nf-instances/{nfInstanceID}:

get:

summary: Read the profile of a given NF Instance

operationId: GetNFInstance

tags:

- NF Instance ID (Document)

parameters:

- name: nfInstanceID

in: path

description: Unique ID of the NF Instance

required: true

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfInstanceId'

responses:

'200':

description: Expected response to a valid request

content:

application/json:

schema:

$ref: '#/components/schemas/NFProfile'

'400':

$ref: 'TS29571\_CommonData.yaml#/components/responses/400'

'401':

$ref: 'TS29571\_CommonData.yaml#/components/responses/401'

'403':

$ref: 'TS29571\_CommonData.yaml#/components/responses/403'

'404':

$ref: 'TS29571\_CommonData.yaml#/components/responses/404'

'406':

$ref: 'TS29571\_CommonData.yaml#/components/responses/406'

'411':

$ref: 'TS29571\_CommonData.yaml#/components/responses/411'

'413':

$ref: 'TS29571\_CommonData.yaml#/components/responses/413'

'415':

$ref: 'TS29571\_CommonData.yaml#/components/responses/415'

'429':

$ref: 'TS29571\_CommonData.yaml#/components/responses/429'

'500':

$ref: 'TS29571\_CommonData.yaml#/components/responses/500'

'501':

$ref: 'TS29571\_CommonData.yaml#/components/responses/501'

'503':

$ref: 'TS29571\_CommonData.yaml#/components/responses/503'

default:

$ref: 'TS29571\_CommonData.yaml#/components/responses/default'

put:

summary: Register a new NF Instance

operationId: RegisterNFInstance

tags:

- NF Instance ID (Document)

parameters:

- name: nfInstanceID

in: path

required: true

description: Unique ID of the NF Instance to register

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfInstanceId'

- name: Content-Encoding

in: header

description: Content-Encoding, described in IETF RFC 7231

schema:

type: string

requestBody:

content:

application/json:

schema:

$ref: '#/components/schemas/NFProfile'

required: true

responses:

'200':

description: OK (Profile Replacement)

content:

application/json:

schema:

$ref: '#/components/schemas/NFProfile'

headers:

Accept-Encoding:

description: Accept-Encoding, described in IETF RFC 7694

schema:

type: string

'201':

description: Expected response to a valid request

content:

application/json:

schema:

$ref: '#/components/schemas/NFProfile'

headers:

Location:

description: 'Contains the URI of the newly created resource, according to the structure: {apiRoot}/nnrf-nfm/v1/nf-instances/{nfInstanceId}'

required: true

schema:

type: string

Accept-Encoding:

description: Accept-Encoding, described in IETF RFC 7694

schema:

type: string

'400':

$ref: 'TS29571\_CommonData.yaml#/components/responses/400'

'401':

$ref: 'TS29571\_CommonData.yaml#/components/responses/401'

'403':

$ref: 'TS29571\_CommonData.yaml#/components/responses/403'

'404':

$ref: 'TS29571\_CommonData.yaml#/components/responses/404'

'411':

$ref: 'TS29571\_CommonData.yaml#/components/responses/411'

'413':

$ref: 'TS29571\_CommonData.yaml#/components/responses/413'

'415':

$ref: 'TS29571\_CommonData.yaml#/components/responses/415'

'429':

$ref: 'TS29571\_CommonData.yaml#/components/responses/429'

'500':

$ref: 'TS29571\_CommonData.yaml#/components/responses/500'

'501':

$ref: 'TS29571\_CommonData.yaml#/components/responses/501'

'503':

$ref: 'TS29571\_CommonData.yaml#/components/responses/503'

default:

$ref: 'TS29571\_CommonData.yaml#/components/responses/default'

patch:

summary: Update NF Instance profile

operationId: UpdateNFInstance

tags:

- NF Instance ID (Document)

parameters:

- name: nfInstanceID

in: path

required: true

description: Unique ID of the NF Instance to update

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfInstanceId'

requestBody:

content:

application/json-patch+json:

schema:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PatchItem'

minItems: 1

required: true

responses:

'200':

description: Expected response to a valid request

content:

application/json:

schema:

$ref: '#/components/schemas/NFProfile'

'204':

description: Expected response with empty body

'400':

$ref: 'TS29571\_CommonData.yaml#/components/responses/400'

'403':

$ref: 'TS29571\_CommonData.yaml#/components/responses/403'

'404':

$ref: 'TS29571\_CommonData.yaml#/components/responses/404'

'411':

$ref: 'TS29571\_CommonData.yaml#/components/responses/411'

'413':

$ref: 'TS29571\_CommonData.yaml#/components/responses/413'

'415':

$ref: 'TS29571\_CommonData.yaml#/components/responses/415'

'429':

$ref: 'TS29571\_CommonData.yaml#/components/responses/429'

'500':

$ref: 'TS29571\_CommonData.yaml#/components/responses/500'

'501':

$ref: 'TS29571\_CommonData.yaml#/components/responses/501'

'503':

$ref: 'TS29571\_CommonData.yaml#/components/responses/503'

default:

$ref: 'TS29571\_CommonData.yaml#/components/responses/default'

delete:

summary: Deregisters a given NF Instance

operationId: DeregisterNFInstance

tags:

- NF Instance ID (Document)

parameters:

- name: nfInstanceID

in: path

required: true

description: Unique ID of the NF Instance to deregister

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfInstanceId'

responses:

'204':

description: Expected response to a successful deregistration

'400':

$ref: 'TS29571\_CommonData.yaml#/components/responses/400'

'401':

$ref: 'TS29571\_CommonData.yaml#/components/responses/401'

'403':

$ref: 'TS29571\_CommonData.yaml#/components/responses/403'

'404':

$ref: 'TS29571\_CommonData.yaml#/components/responses/404'

'411':

$ref: 'TS29571\_CommonData.yaml#/components/responses/411'

'429':

$ref: 'TS29571\_CommonData.yaml#/components/responses/429'

'500':

$ref: 'TS29571\_CommonData.yaml#/components/responses/500'

'501':

$ref: 'TS29571\_CommonData.yaml#/components/responses/501'

'503':

$ref: 'TS29571\_CommonData.yaml#/components/responses/503'

default:

$ref: 'TS29571\_CommonData.yaml#/components/responses/default'

/subscriptions:

post:

summary: Create a new subscription

operationId: CreateSubscription

tags:

- Subscriptions (Collection)

requestBody:

content:

application/json:

schema:

$ref: '#/components/schemas/SubscriptionData'

required: true

responses:

'201':

description: Expected response to a valid request

content:

application/json:

schema:

$ref: '#/components/schemas/SubscriptionData'

headers:

Location:

description: 'Contains the URI of the newly created resource, according to the structure: {apiRoot}/nnrf-nfm/v1/subscriptions/{subscriptionId}'

required: true

schema:

type: string

'400':

$ref: 'TS29571\_CommonData.yaml#/components/responses/400'

'401':

$ref: 'TS29571\_CommonData.yaml#/components/responses/401'

'403':

$ref: 'TS29571\_CommonData.yaml#/components/responses/403'

'404':

$ref: 'TS29571\_CommonData.yaml#/components/responses/404'

'411':

$ref: 'TS29571\_CommonData.yaml#/components/responses/411'

'413':

$ref: 'TS29571\_CommonData.yaml#/components/responses/413'

'415':

$ref: 'TS29571\_CommonData.yaml#/components/responses/415'

'429':

$ref: 'TS29571\_CommonData.yaml#/components/responses/429'

'500':

$ref: 'TS29571\_CommonData.yaml#/components/responses/500'

'501':

$ref: 'TS29571\_CommonData.yaml#/components/responses/501'

'503':

$ref: 'TS29571\_CommonData.yaml#/components/responses/503'

default:

$ref: 'TS29571\_CommonData.yaml#/components/responses/default'

callbacks:

onNFStatusEvent:

'{$request.body#/nfStatusNotificationUri}':

post:

requestBody:

description: Notification Payload

content:

application/json:

schema:

$ref: '#/components/schemas/NotificationData'

responses:

'204':

description: Expected response to a successful callback processing

'400':

$ref: 'TS29571\_CommonData.yaml#/components/responses/400'

'401':

$ref: 'TS29571\_CommonData.yaml#/components/responses/401'

'403':

$ref: 'TS29571\_CommonData.yaml#/components/responses/403'

'404':

$ref: 'TS29571\_CommonData.yaml#/components/responses/404'

'411':

$ref: 'TS29571\_CommonData.yaml#/components/responses/411'

'413':

$ref: 'TS29571\_CommonData.yaml#/components/responses/413'

'415':

$ref: 'TS29571\_CommonData.yaml#/components/responses/415'

'429':

$ref: 'TS29571\_CommonData.yaml#/components/responses/429'

'500':

$ref: 'TS29571\_CommonData.yaml#/components/responses/500'

'501':

$ref: 'TS29571\_CommonData.yaml#/components/responses/501'

'503':

$ref: 'TS29571\_CommonData.yaml#/components/responses/503'

default:

$ref: 'TS29571\_CommonData.yaml#/components/responses/default'

/subscriptions/{subscriptionID}:

patch:

summary: Updates a subscription

operationId: UpdateSubscription

tags:

- Subscription ID (Document)

parameters:

- name: subscriptionID

in: path

required: true

description: Unique ID of the subscription to update

schema:

type: string

pattern: '^([0-9]{5,6}-)?[^-]+$'

requestBody:

content:

application/json-patch+json:

schema:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PatchItem'

required: true

responses:

'200':

description: Expected response to a valid request

content:

application/json:

schema:

$ref: '#/components/schemas/SubscriptionData'

'204':

description: No Content

'400':

$ref: 'TS29571\_CommonData.yaml#/components/responses/400'

'403':

$ref: 'TS29571\_CommonData.yaml#/components/responses/403'

'404':

$ref: 'TS29571\_CommonData.yaml#/components/responses/404'

'411':

$ref: 'TS29571\_CommonData.yaml#/components/responses/411'

'413':

$ref: 'TS29571\_CommonData.yaml#/components/responses/413'

'415':

$ref: 'TS29571\_CommonData.yaml#/components/responses/415'

'429':

$ref: 'TS29571\_CommonData.yaml#/components/responses/429'

'500':

$ref: 'TS29571\_CommonData.yaml#/components/responses/500'

'501':

$ref: 'TS29571\_CommonData.yaml#/components/responses/501'

'503':

$ref: 'TS29571\_CommonData.yaml#/components/responses/503'

default:

$ref: 'TS29571\_CommonData.yaml#/components/responses/default'

delete:

summary: Deletes a subscription

operationId: RemoveSubscription

tags:

- Subscription ID (Document)

parameters:

- name: subscriptionID

in: path

required: true

description: Unique ID of the subscription to remove

schema:

type: string

pattern: '^([0-9]{5,6}-)?[^-]+$'

responses:

'204':

description: Expected response to a successful subscription removal

'400':

$ref: 'TS29571\_CommonData.yaml#/components/responses/400'

'401':

$ref: 'TS29571\_CommonData.yaml#/components/responses/401'

'403':

$ref: 'TS29571\_CommonData.yaml#/components/responses/403'

'404':

$ref: 'TS29571\_CommonData.yaml#/components/responses/404'

'411':

$ref: 'TS29571\_CommonData.yaml#/components/responses/411'

'413':

$ref: 'TS29571\_CommonData.yaml#/components/responses/413'

'415':

$ref: 'TS29571\_CommonData.yaml#/components/responses/415'

'429':

$ref: 'TS29571\_CommonData.yaml#/components/responses/429'

'500':

$ref: 'TS29571\_CommonData.yaml#/components/responses/500'

'501':

$ref: 'TS29571\_CommonData.yaml#/components/responses/501'

'503':

$ref: 'TS29571\_CommonData.yaml#/components/responses/503'

default:

$ref: 'TS29571\_CommonData.yaml#/components/responses/default'

components:

securitySchemes:

oAuth2ClientCredentials:

type: oauth2

flows:

clientCredentials:

tokenUrl: '/oauth2/token'

scopes:

nnrf-nfm: Access to the Nnrf\_NFManagement API

schemas:

NFProfile:

type: object

required:

- nfInstanceId

- nfType

- nfStatus

anyOf:

- required: [ fqdn ]

- required: [ ipv4Addresses ]

- required: [ ipv6Addresses ]

properties:

nfInstanceId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfInstanceId'

nfInstanceName:

type: string

nfType:

$ref: '#/components/schemas/NFType'

nfStatus:

$ref: '#/components/schemas/NFStatus'

heartBeatTimer:

type: integer

plmnList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnId'

minItems: 1

snpnList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnIdNid'

minItems: 1

sNssais:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Snssai'

minItems: 1

perPlmnSnssaiList:

type: array

items:

$ref: '#/components/schemas/PlmnSnssai'

minItems: 1

nsiList:

type: array

items:

type: string

minItems: 1

fqdn:

$ref: '#/components/schemas/Fqdn'

interPlmnFqdn:

$ref: '#/components/schemas/Fqdn'

ipv4Addresses:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv4Addr'

minItems: 1

ipv6Addresses:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv6Addr'

minItems: 1

allowedPlmns:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnId'

minItems: 1

allowedSnpns:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnIdNid'

minItems: 1

allowedNfTypes:

type: array

items:

$ref: '#/components/schemas/NFType'

minItems: 1

allowedNfDomains:

type: array

items:

type: string

minItems: 1

allowedNssais:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Snssai'

minItems: 1

priority:

type: integer

minimum: 0

maximum: 65535

capacity:

type: integer

minimum: 0

maximum: 65535

load:

type: integer

minimum: 0

maximum: 100

locality:

type: string

udrInfo:

$ref: '#/components/schemas/UdrInfo'

udrInfoExt:

type: array

items:

$ref: '#/components/schemas/UdrInfo'

minItems: 1

udmInfo:

$ref: '#/components/schemas/UdmInfo'

udmInfoExt:

type: array

items:

$ref: '#/components/schemas/UdmInfo'

minItems: 1

ausfInfo:

$ref: '#/components/schemas/AusfInfo'

ausfInfoExt:

type: array

items:

$ref: '#/components/schemas/AusfInfo'

minItems: 1

amfInfo:

$ref: '#/components/schemas/AmfInfo'

amfInfoExt:

type: array

items:

$ref: '#/components/schemas/AmfInfo'

minItems: 1

smfInfo:

$ref: '#/components/schemas/SmfInfo'

smfInfoExt:

type: array

items:

$ref: '#/components/schemas/SmfInfo'

minItems: 1

upfInfo:

$ref: '#/components/schemas/UpfInfo'

upfInfoExt:

type: array

items:

$ref: '#/components/schemas/UpfInfo'

minItems: 1

pcfInfo:

$ref: '#/components/schemas/PcfInfo'

pcfInfoExt:

type: array

items:

$ref: '#/components/schemas/PcfInfo'

minItems: 1

bsfInfo:

$ref: '#/components/schemas/BsfInfo'

bsfInfoExt:

type: array

items:

$ref: '#/components/schemas/BsfInfo'

minItems: 1

chfInfo:

$ref: '#/components/schemas/ChfInfo'

chfInfoExt:

type: array

items:

$ref: '#/components/schemas/ChfInfo'

minItems: 1

nefInfo:

$ref: '#/components/schemas/NefInfo'

nrfInfo:

$ref: '#/components/schemas/NrfInfo'

nwdafInfo:

$ref: '#/components/schemas/NwdafInfo'

pcscfInfo:

type: array

items:

$ref: '#/components/schemas/PcscfInfo'

minItems: 1

hssInfo:

type: array

items:

$ref: '#/components/schemas/HssInfo'

minItems: 1

customInfo:

type: object

recoveryTime:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/DateTime'

nfServicePersistence:

type: boolean

default: false

nfServices:

type: array

items:

$ref: '#/components/schemas/NFService'

minItems: 1

nfProfileChangesSupportInd:

type: boolean

default: false

writeOnly: true

nfProfileChangesInd:

type: boolean

default: false

readOnly: true

defaultNotificationSubscriptions:

type: array

items:

$ref: '#/components/schemas/DefaultNotificationSubscription'

lmfInfo:

$ref: '#/components/schemas/LmfInfo'

gmlcInfo:

$ref: '#/components/schemas/GmlcInfo'

nfSetIdList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfSetId'

minItems: 1

servingScope:

type: array

items:

type: string

minItems: 1

NFService:

type: object

required:

- serviceInstanceId

- serviceName

- versions

- scheme

- nfServiceStatus

properties:

serviceInstanceId:

type: string

serviceName:

$ref: '#/components/schemas/ServiceName'

versions:

type: array

items:

$ref: '#/components/schemas/NFServiceVersion'

minItems: 1

scheme:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/UriScheme'

nfServiceStatus:

$ref: '#/components/schemas/NFServiceStatus'

fqdn:

$ref: '#/components/schemas/Fqdn'

interPlmnFqdn:

$ref: '#/components/schemas/Fqdn'

ipEndPoints:

type: array

items:

$ref: '#/components/schemas/IpEndPoint'

minItems: 1

apiPrefix:

type: string

defaultNotificationSubscriptions:

type: array

items:

$ref: '#/components/schemas/DefaultNotificationSubscription'

minItems: 1

allowedPlmns:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnId'

minItems: 1

allowedSnpns:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnIdNid'

minItems: 1

allowedNfTypes:

type: array

items:

$ref: '#/components/schemas/NFType'

minItems: 1

allowedNfDomains:

type: array

items:

type: string

minItems: 1

allowedNssais:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Snssai'

minItems: 1

priority:

type: integer

minimum: 0

maximum: 65535

capacity:

type: integer

minimum: 0

maximum: 65535

load:

type: integer

minimum: 0

maximum: 100

recoveryTime:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/DateTime'

chfServiceInfo:

$ref: '#/components/schemas/ChfServiceInfo'

supportedFeatures:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/SupportedFeatures'

nfServiceSetIdList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfServiceSetId'

minItems: 1

NFType:

anyOf:

- type: string

enum:

- NRF

- UDM

- AMF

- SMF

- AUSF

- NEF

- PCF

- SMSF

- NSSF

- UDR

- LMF

- GMLC

- 5G\_EIR

- SEPP

- UPF

- N3IWF

- AF

- UDSF

- BSF

- CHF

- NWDAF

- PCSCF

- CBCF

- HSS

- UCMF

- type: string

Fqdn:

type: string

NefId:

type: string

IpEndPoint:

type: object

properties:

ipv4Address:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv4Addr'

ipv6Address:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv6Addr'

transport:

$ref: '#/components/schemas/TransportProtocol'

port:

type: integer

minimum: 0

maximum: 65535

SubscriptionData:

type: object

required:

- nfStatusNotificationUri

- subscriptionId

properties:

nfStatusNotificationUri:

type: string

reqNfInstanceId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfInstanceId'

subscrCond:

oneOf:

- $ref: '#/components/schemas/NfInstanceIdCond'

- $ref: '#/components/schemas/NfTypeCond'

- $ref: '#/components/schemas/ServiceNameCond'

- $ref: '#/components/schemas/AmfCond'

- $ref: '#/components/schemas/GuamiListCond'

- $ref: '#/components/schemas/NetworkSliceCond'

- $ref: '#/components/schemas/NfGroupCond'

- $ref: '#/components/schemas/NfSetCond'

- $ref: '#/components/schemas/NfServiceSetCond'

subscriptionId:

type: string

pattern: '^([0-9]{5,6}-)?[^-]+$'

readOnly: true

validityTime:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/DateTime'

reqNotifEvents:

type: array

items:

$ref: '#/components/schemas/NotificationEventType'

minItems: 1

plmnId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnId'

nid:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Nid'

notifCondition:

$ref: '#/components/schemas/NotifCondition'

reqNfType:

$ref: '#/components/schemas/NFType'

reqNfFqdn:

$ref: '#/components/schemas/Fqdn'

reqSnssais:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Snssai'

minItems: 1

reqPlmnList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnId'

minItems: 1

NfInstanceIdCond:

type: object

required:

- nfInstanceId

properties:

nfInstanceId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfInstanceId'

NfTypeCond:

type: object

required:

- nfType

not:

required: [ nfGroupId ]

properties:

nfType:

$ref: '#/components/schemas/NFType'

ServiceNameCond:

type: object

required:

- serviceName

properties:

serviceName:

$ref: '#/components/schemas/ServiceName'

AmfCond:

type: object

anyOf:

- required: [ amfSetId ]

- required: [ amfRegionId ]

properties:

amfSetId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/AmfSetId'

amfRegionId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/AmfRegionId'

GuamiListCond:

type: object

required:

- guamiList

properties:

guamiList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Guami'

NetworkSliceCond:

type: object

required:

- snssaiList

properties:

snssaiList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Snssai'

nsiList:

type: array

items:

type: string

NfGroupCond:

type: object

required:

- nfType

- nfGroupId

properties:

nfType:

type: string

enum:

- UDM

- AUSF

- UDR

- PCF

nfGroupId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfGroupId'

NotifCondition:

type: object

not:

required: [ monitoredAttributes, unmonitoredAttributes ]

properties:

monitoredAttributes:

type: array

items:

type: string

minItems: 1

unmonitoredAttributes:

type: array

items:

type: string

minItems: 1

UdrInfo:

type: object

properties:

groupId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfGroupId'

supiRanges:

type: array

items:

$ref: '#/components/schemas/SupiRange'

minItems: 1

gpsiRanges:

type: array

items:

$ref: '#/components/schemas/IdentityRange'

minItems: 1

externalGroupIdentifiersRanges:

type: array

items:

$ref: '#/components/schemas/IdentityRange'

minItems: 1

supportedDataSets:

type: array

items:

$ref: '#/components/schemas/DataSetId'

minItems: 1

SupiRange:

type: object

properties:

start:

type: string

pattern: '^[0-9]+$'

end:

type: string

pattern: '^[0-9]+$'

pattern:

type: string

IdentityRange:

type: object

properties:

start:

type: string

pattern: '^[0-9]+$'

end:

type: string

pattern: '^[0-9]+$'

pattern:

type: string

InternalGroupIdRange:

type: object

properties:

start:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/GroupId'

end:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/GroupId'

pattern:

type: string

DataSetId:

anyOf:

- type: string

enum:

- SUBSCRIPTION

- POLICY

- EXPOSURE

- APPLICATION

- type: string

UdmInfo:

type: object

properties:

groupId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfGroupId'

supiRanges:

type: array

items:

$ref: '#/components/schemas/SupiRange'

minItems: 1

gpsiRanges:

type: array

items:

$ref: '#/components/schemas/IdentityRange'

minItems: 1

externalGroupIdentifiersRanges:

type: array

items:

$ref: '#/components/schemas/IdentityRange'

minItems: 1

routingIndicators:

type: array

items:

type: string

pattern: '^[0-9]{1,4}$'

minItems: 1

internalGroupIdentifiersRanges:

type: array

items:

$ref: '#/components/schemas/InternalGroupIdRange'

minItems: 1

AusfInfo:

type: object

properties:

groupId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfGroupId'

supiRanges:

type: array

items:

$ref: '#/components/schemas/SupiRange'

minItems: 1

routingIndicators:

type: array

items:

type: string

pattern: '^[0-9]{1,4}$'

minItems: 1

AmfInfo:

type: object

required:

- amfSetId

- amfRegionId

- guamiList

properties:

amfSetId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/AmfSetId'

amfRegionId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/AmfRegionId'

guamiList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Guami'

minItems: 1

taiList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Tai'

minItems: 1

taiRangeList:

type: array

items:

$ref: '#/components/schemas/TaiRange'

minItems: 1

backupInfoAmfFailure:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Guami'

minItems: 1

backupInfoAmfRemoval:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Guami'

minItems: 1

n2InterfaceAmfInfo:

$ref: '#/components/schemas/N2InterfaceAmfInfo'

SmfInfo:

type: object

required:

- sNssaiSmfInfoList

properties:

sNssaiSmfInfoList:

type: array

items:

$ref: '#/components/schemas/SnssaiSmfInfoItem'

minItems: 1

taiList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Tai'

minItems: 1

taiRangeList:

type: array

items:

$ref: '#/components/schemas/TaiRange'

minItems: 1

pgwFqdn:

$ref: '#/components/schemas/Fqdn'

accessType:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/AccessType'

minItems: 1

priority:

type: integer

minimum: 0

maximum: 65535

SnssaiSmfInfoItem:

type: object

required:

- sNssai

- dnnSmfInfoList

properties:

sNssai:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Snssai'

dnnSmfInfoList:

type: array

items:

$ref: '#/components/schemas/DnnSmfInfoItem'

minItems: 1

DnnSmfInfoItem:

type: object

required:

- dnn

properties:

dnn:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Dnn'

UpfInfo:

type: object

required:

- sNssaiUpfInfoList

properties:

sNssaiUpfInfoList:

type: array

items:

$ref: '#/components/schemas/SnssaiUpfInfoItem'

minItems: 1

smfServingArea:

type: array

items:

type: string

minItems: 1

interfaceUpfInfoList:

type: array

items:

$ref: '#/components/schemas/InterfaceUpfInfoItem'

minItems: 1

iwkEpsInd:

type: boolean

default: false

pduSessionTypes:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PduSessionType'

minItems: 1

atsssCapability:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/AtsssCapability'

ueIpAddrInd:

type: boolean

default: false

taiList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Tai'

minItems: 1

wAgfInfo:

$ref: '#/components/schemas/WAgfInfo'

tngfInfo:

$ref: '#/components/schemas/TngfInfo'

priority:

type: integer

minimum: 0

maximum: 65535

SnssaiUpfInfoItem:

type: object

required:

- sNssai

- dnnUpfInfoList

properties:

sNssai:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Snssai'

dnnUpfInfoList:

type: array

items:

$ref: '#/components/schemas/DnnUpfInfoItem'

minItems: 1

DnnUpfInfoItem:

type: object

required:

- dnn

properties:

dnn:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Dnn'

dnaiList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Dnai'

minItems: 1

pduSessionTypes:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PduSessionType'

minItems: 1

ipv4AddressRanges:

type: array

items:

$ref: '#/components/schemas/Ipv4AddressRange'

minItems: 1

ipv6PrefixRanges:

type: array

items:

$ref: '#/components/schemas/Ipv6PrefixRange'

minItems: 1

InterfaceUpfInfoItem:

type: object

required:

- interfaceType

properties:

interfaceType:

$ref: '#/components/schemas/UPInterfaceType'

ipv4EndpointAddresses:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv4Addr'

minItems: 1

ipv6EndpointAddresses:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv6Addr'

minItems: 1

endpointFqdn:

$ref: '#/components/schemas/Fqdn'

networkInstance:

type: string

UPInterfaceType:

anyOf:

- type: string

enum:

- N3

- N6

- N9

- type: string

WAgfInfo:

type: object

properties:

ipv4EndpointAddresses:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv4Addr'

minItems: 1

ipv6EndpointAddresses:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv6Addr'

minItems: 1

endpointFqdn:

$ref: '#/components/schemas/Fqdn'

TngfInfo:

type: object

properties:

ipv4EndpointAddresses:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv4Addr'

minItems: 1

ipv6EndpointAddresses:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv6Addr'

minItems: 1

endpointFqdn:

$ref: '#/components/schemas/Fqdn'

PcfInfo:

type: object

properties:

groupId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfGroupId'

dnnList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Dnn'

minItems: 1

supiRanges:

type: array

items:

$ref: '#/components/schemas/SupiRange'

minItems: 1

gpsiRanges:

type: array

items:

$ref: '#/components/schemas/IdentityRange'

minItems: 1

rxDiamHost:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/DiameterIdentity'

rxDiamRealm:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/DiameterIdentity'

BsfInfo:

type: object

properties:

dnnList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Dnn'

minItems: 1

ipDomainList:

type: array

items:

type: string

minItems: 1

ipv4AddressRanges:

type: array

items:

$ref: '#/components/schemas/Ipv4AddressRange'

minItems: 1

ipv6PrefixRanges:

type: array

items:

$ref: '#/components/schemas/Ipv6PrefixRange'

minItems: 1

ChfInfo:

type: object

properties:

supiRangeList:

type: array

items:

$ref: '#/components/schemas/SupiRange'

minItems: 1

gpsiRangeList:

type: array

items:

$ref: '#/components/schemas/IdentityRange'

minItems: 1

plmnRangeList:

type: array

items:

$ref: '#/components/schemas/PlmnRange'

minItems: 1

Ipv4AddressRange:

type: object

properties:

start:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv4Addr'

end:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv4Addr'

Ipv6PrefixRange:

type: object

properties:

start:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv6Prefix'

end:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv6Prefix'

DefaultNotificationSubscription:

type: object

required:

- notificationType

- callbackUri

properties:

notificationType:

$ref: '#/components/schemas/NotificationType'

callbackUri:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Uri'

n1MessageClass:

$ref: 'TS29518\_Namf\_Communication.yaml#/components/schemas/N1MessageClass'

n2InformationClass:

$ref: 'TS29518\_Namf\_Communication.yaml#/components/schemas/N2InformationClass'

NfSetCond:

type: object

required:

- nfSetId

properties:

nfSetId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfSetId'

NfServiceSetCond:

type: object

required:

- nfServiceSetId

properties:

nfServiceSetId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfServiceSetId'

NotificationType:

anyOf:

- type: string

enum:

- N1\_MESSAGES

- N2\_INFORMATION

- LOCATION\_NOTIFICATION

- DATA\_REMOVAL\_NOTIFICATION

- DATA\_CHANGE\_NOTIFICATION

- LOCATION\_UPDATE\_NOTIFICATION

- type: string

TransportProtocol:

anyOf:

- type: string

enum:

- TCP

- type: string

NotificationEventType:

anyOf:

- type: string

enum:

- NF\_REGISTERED

- NF\_DEREGISTERED

- NF\_PROFILE\_CHANGED

- type: string

NotificationData:

type: object

required:

- event

- nfInstanceUri

allOf:

#

# Condition: If 'event' takes value 'NF\_PROFILE\_CHANGED',

# then either 'nfProfile' or 'profileChanges' (but not both) must be present

#

- anyOf:

- not:

properties:

event:

type: string

enum:

- NF\_PROFILE\_CHANGED

- oneOf:

- required: [ nfProfile ]

- required: [ profileChanges ]

#

# Condition: If 'event' takes value 'NF\_REGISTERED',

# then 'nfProfile' must be present

#

- anyOf:

- not:

properties:

event:

type: string

enum:

- NF\_REGISTERED

- required: [ nfProfile ]

properties:

event:

$ref: '#/components/schemas/NotificationEventType'

nfInstanceUri:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Uri'

nfProfile:

allOf:

- $ref: '#/components/schemas/NFProfile'

- not:

required: [ interPlmnFqdn ]

- not:

required: [ allowedPlmns ]

- not:

required: [ allowedNfTypes ]

- not:

required: [ allowedNfDomains ]

- not:

required: [ allowedNssais ]

- properties:

nfServices:

type: array

items:

allOf:

- $ref: '#/components/schemas/NFService'

- not:

required: [ interPlmnFqdn ]

- not:

required: [ allowedPlmns ]

- not:

required: [ allowedNfTypes ]

- not:

required: [ allowedNfDomains ]

- not:

required: [ allowedNssais ]

profileChanges:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/ChangeItem'

minItems: 1

NFStatus:

anyOf:

- type: string

enum:

- REGISTERED

- SUSPENDED

- UNDISCOVERABLE

- type: string

NFServiceVersion:

type: object

required:

- apiVersionInUri

- apiFullVersion

properties:

apiVersionInUri:

type: string

apiFullVersion:

type: string

expiry:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/DateTime'

ServiceName:

anyOf:

- type: string

enum:

- nnrf-nfm

- nnrf-disc

- nudm-sdm

- nudm-uecm

- nudm-ueau

- nudm-ee

- nudm-pp

- nudm-niddau

- nudm-mt

- namf-comm

- namf-evts

- namf-mt

- namf-loc

- nsmf-pdusession

- nsmf-event-exposure

- nausf-auth

- nausf-sorprotection

- nausf-upuprotection

- nnef-pfdmanagement

- npcf-am-policy-control

- npcf-smpolicycontrol

- npcf-policyauthorization

- npcf-bdtpolicycontrol

- npcf-eventexposure

- npcf-ue-policy-control

- nsmsf-sms

- nnssf-nsselection

- nnssf-nssaiavailability

- nudr-dr

- nlmf-loc

- n5g-eir-eic

- nbsf-management

- nchf-spendinglimitcontrol

- nchf-convergedcharging

- nnwdaf-eventssubscription

- nnwdaf-analyticsinfo

- ngmlc-loc

- nucmf-provisioning

- nucmf-uecapabilitymanagement

- nhss-sdm

- nhss-uecm

- nhss-ueau

- type: string

N2InterfaceAmfInfo:

type: object

properties:

ipv4EndpointAddress:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv4Addr'

minItems: 1

ipv6EndpointAddress:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv6Addr'

minItems: 1

amfName:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/AmfName'

NFServiceStatus:

anyOf:

- type: string

enum:

- REGISTERED

- SUSPENDED

- UNDISCOVERABLE

- type: string

TaiRange:

type: object

required:

- plmnId

- tacRangeList

properties:

plmnId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnId'

tacRangeList:

type: array

items:

$ref: '#/components/schemas/TacRange'

minItems: 1

nid:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Nid'

TacRange:

type: object

properties:

start:

type: string

pattern: '^([A-Fa-f0-9]{4}|[A-Fa-f0-9]{6})$'

end:

type: string

pattern: '^([A-Fa-f0-9]{4}|[A-Fa-f0-9]{6})$'

pattern:

type: string

ChfServiceInfo:

type: object

not:

required: [ primaryChfServiceInstance, secondaryChfServiceInstance ]

properties:

primaryChfServiceInstance:

type: string

secondaryChfServiceInstance:

type: string

PlmnRange:

type: object

properties:

start:

type: string

pattern: '^[0-9]{3}[0-9]{2,3}$'

end:

type: string

pattern: '^[0-9]{3}[0-9]{2,3}$'

pattern:

type: string

NrfInfo:

type: object

properties:

servedUdrInfo:

type: object

additionalProperties:

$ref: '#/components/schemas/UdrInfo'

minProperties: 1

servedUdmInfo:

type: object

additionalProperties:

$ref: '#/components/schemas/UdmInfo'

minProperties: 1

servedAusfInfo:

type: object

additionalProperties:

$ref: '#/components/schemas/AusfInfo'

minProperties: 1

servedAmfInfo:

type: object

additionalProperties:

$ref: '#/components/schemas/AmfInfo'

minProperties: 1

servedSmfInfo:

type: object

additionalProperties:

$ref: '#/components/schemas/SmfInfo'

minProperties: 1

servedUpfInfo:

type: object

additionalProperties:

$ref: '#/components/schemas/UpfInfo'

minProperties: 1

servedPcfInfo:

type: object

additionalProperties:

$ref: '#/components/schemas/PcfInfo'

minProperties: 1

servedBsfInfo:

type: object

additionalProperties:

$ref: '#/components/schemas/BsfInfo'

minProperties: 1

servedChfInfo:

type: object

additionalProperties:

$ref: '#/components/schemas/ChfInfo'

minProperties: 1

servedNefInfo:

type: object

additionalProperties:

$ref: '#/components/schemas/NefInfo'

minProperties: 1

servedNwdafInfo:

type: object

additionalProperties:

$ref: '#/components/schemas/NwdafInfo'

minProperties: 1

servedPcscfInfo:

type: object

additionalProperties:

$ref: '#/components/schemas/PcscfInfo'

minProperties: 1

servedGmlcInfo:

type: object

additionalProperties:

$ref: '#/components/schemas/GmlcInfo'

minProperties: 1

servedLmfInfo:

type: object

additionalProperties:

$ref: '#/components/schemas/LmfInfo'

minProperties: 1

servedNfInfo:

type: object

additionalProperties:

$ref: '#/components/schemas/NfInfo'

minProperties: 1

servedHssInfo:

type: object

additionalProperties:

$ref: '#/components/schemas/HssInfo'

minProperties: 1

PlmnSnssai:

type: object

required:

- plmnId

- sNssaiList

properties:

plmnId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnId'

sNssaiList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Snssai'

minItems: 1

nid:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Nid'

NefInfo:

type: object

properties:

nefId:

$ref: '#/components/schemas/NefId'

pfdData:

$ref: '#/components/schemas/PfdData'

afEeData:

$ref: '#/components/schemas/AfEventExposureData'

PfdData:

type: object

properties:

appIds:

type: array

items:

type: string

minItems: 1

afIds:

type: array

items:

type: string

minItems: 1

NwdafInfo:

type: object

properties:

eventIds:

type: array

items:

$ref: 'TS29520\_Nnwdaf\_AnalyticsInfo.yaml#/components/schemas/EventId'

minItems: 1

nwdafEvents:

type: array

items:

$ref: 'TS29520\_Nnwdaf\_EventsSubscription.yaml#/components/schemas/NwdafEvent'

minItems: 1

taiList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Tai'

minItems: 1

taiRangeList:

type: array

items:

$ref: '#/components/schemas/TaiRange'

minItems: 1

LmfInfo:

type: object

properties:

servingClientTypes:

type: array

items:

$ref: 'TS29572\_Nlmf\_Location.yaml#/components/schemas/ExternalClientType'

minItems: 1

GmlcInfo:

type: object

properties:

servingClientTypes:

type: array

items:

$ref: 'TS29572\_Nlmf\_Location.yaml#/components/schemas/ExternalClientType'

minItems: 1

AfEventExposureData:

type: object

required:

- afEvents

properties:

afEvents:

type: array

items:

$ref: 'TS29517\_Naf\_EventExposure.yaml#/components/schemas/AfEvent'

minItems: 1

afIds:

type: array

items:

type: string

minItems: 1

appIds:

type: array

items:

type: string

minItems: 1

PcscfInfo:

type: object

properties:

accessType:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/AccessType'

minItems: 1

dnnList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Dnn'

minItems: 1

NfInfo:

type: object

properties:

nfType:

$ref: '#/components/schemas/NFType'

HssInfo:

type: object

properties:

groupId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfGroupId'

imsRanges:

type: array

items:

$ref: '#/components/schemas/ImsiRange'

minItems: 1

ImsiRange:

type: object

properties:

start:

type: string

pattern: '^[0-9]+$'

end:

type: string

pattern: '^[0-9]+$'

pattern:

type: string

## A.3 Nnrf\_NFDiscovery API

openapi: 3.0.0

info:

version: '1.1.0.alpha-3'

title: 'NRF NFDiscovery Service'

description: |

NRF NFDiscovery Service.

© 2019, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).

All rights reserved.

externalDocs:

description: 3GPP TS 29.510 V16.2.0; 5G System; Network Function Repository Services; Stage 3

url: 'http://www.3gpp.org/ftp/Specs/archive/29\_series/29.510/'

servers:

- url: '{apiRoot}/nnrf-disc/v1'

variables:

apiRoot:

default: https://example.com

description: apiRoot as defined in clause 4.4 of 3GPP TS 29.501

security:

- {}

- oAuth2ClientCredentials:

- nnrf-disc

paths:

/nf-instances:

get:

summary: Search a collection of NF Instances

operationId: SearchNFInstances

tags:

- NF Instances (Store)

parameters:

- name: target-nf-type

in: query

description: Type of the target NF

required: true

schema:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/NFType'

- name: requester-nf-type

in: query

description: Type of the requester NF

required: true

schema:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/NFType'

- name: requester-nf-instance-id

in: query

description: NfInstanceId of the requester NF

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfInstanceId'

- name: service-names

in: query

description: Names of the services offered by the NF

schema:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/ServiceName'

minItems: 1

uniqueItems: true

style: form

explode: false

- name: requester-nf-instance-fqdn

in: query

description: FQDN of the requester NF

schema:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/Fqdn'

- name: target-plmn-list

in: query

description: Id of the PLMN of the target NF

content:

application/json:

schema:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnId'

minItems: 1

- name: requester-plmn-list

in: query

description: Id of the PLMN where the NF issuing the Discovery request is located

content:

application/json:

schema:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnId'

minItems: 1

- name: target-nf-instance-id

in: query

description: Identity of the NF instance being discovered

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfInstanceId'

- name: target-nf-fqdn

in: query

description: FQDN of the NF instance being discovered

schema:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/Fqdn'

- name: hnrf-uri

in: query

description: Uri of the home NRF

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Uri'

- name: snssais

in: query

description: Slice info of the target NF

content:

application/json:

schema:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Snssai'

minItems: 1

- name: requester-snssais

in: query

description: Slice info of the requester NF

content:

application/json:

schema:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Snssai'

minItems: 1

- name: plmn-specific-snssai-list

in: query

description: PLMN specific Slice info of the target NF

content:

application/json:

schema:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/PlmnSnssai'

minItems: 1

- name: dnn

in: query

description: Dnn supported by the BSF, SMF or UPF

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Dnn'

- name: nsi-list

in: query

description: NSI IDs that are served by the services being discovered

schema:

type: array

items:

type: string

minItems: 1

style: form

explode: false

- name: smf-serving-area

in: query

schema:

type: string

- name: tai

in: query

description: Tracking Area Identity

content:

application/json:

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Tai'

- name: amf-region-id

in: query

description: AMF Region Identity

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/AmfRegionId'

- name: amf-set-id

in: query

description: AMF Set Identity

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/AmfSetId'

- name: guami

in: query

description: Guami used to search for an appropriate AMF

content:

application/json:

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Guami'

- name: supi

in: query

description: SUPI of the user

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Supi'

- name: ue-ipv4-address

in: query

description: IPv4 address of the UE

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv4Addr'

- name: ip-domain

in: query

description: IP domain of the UE, which supported by BSF

schema:

type: string

- name: ue-ipv6-prefix

in: query

description: IPv6 prefix of the UE

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv6Prefix'

- name: pgw-ind

in: query

description: Combined PGW-C and SMF or a standalone SMF

schema:

type: boolean

- name: pgw

in: query

description: PGW FQDN of a combined PGW-C and SMF

schema:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/Fqdn'

- name: gpsi

in: query

description: GPSI of the user

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Gpsi'

- name: external-group-identity

in: query

description: external group identifier of the user

schema:

$ref: 'TS29503\_Nudm\_SDM.yaml#/components/schemas/ExtGroupId'

- name: internal-group-identity

in: query

description: internal group identifier of the user

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/GroupId'

- name: pfd-data

in: query

description: PFD data

content:

application/json:

schema:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/PfdData'

- name: data-set

in: query

description: data set supported by the NF

schema:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/DataSetId'

- name: routing-indicator

in: query

description: routing indicator in SUCI

schema:

type: string

pattern: '^[0-9]{1,4}$'

- name: group-id-list

in: query

description: Group IDs of the NFs being discovered

schema:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfGroupId'

minItems: 1

style: form

explode: false

- name: dnai-list

in: query

description: Data network access identifiers of the NFs being discovered

schema:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Dnai'

minItems: 1

style: form

explode: false

- name: pdu-session-types

in: query

description: list of PDU Session Type required to be supported by the target NF

schema:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PduSessionType'

minItems: 1

style: form

explode: false

- name: event-id-list

in: query

description: Analytics event(s) requested to be supported by the Nnwdaf\_AnalyticsInfo service

schema:

type: array

items:

$ref: 'TS29520\_Nnwdaf\_AnalyticsInfo.yaml#/components/schemas/EventId'

minItems: 1

style: form

explode: false

- name: nwdaf-event-list

in: query

description: Analytics event(s) requested to be supported by the Nnwdaf\_EventsSubscription service.

schema:

type: array

items:

$ref: 'TS29520\_Nnwdaf\_EventsSubscription.yaml#/components/schemas/NwdafEvent'

minItems: 1

style: form

explode: false

- name: supported-features

in: query

description: Features required to be supported by the target NF

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/SupportedFeatures'

- name: upf-iwk-eps-ind

in: query

description: UPF supporting interworking with EPS or not

schema:

type: boolean

- name: chf-supported-plmn

in: query

description: PLMN ID supported by a CHF

content:

application/json:

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnId'

- name: preferred-locality

in: query

description: preferred target NF location

schema:

type: string

- name: access-type

in: query

description: AccessType supported by the target NF

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/AccessType'

- name: limit

in: query

description: Maximum number of NFProfiles to return in the response

required: false

schema:

type: integer

minimum: 1

- name: required-features

in: query

description: Features required to be supported by the target NF

schema:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/SupportedFeatures'

minItems: 1

style: form

explode: false

- name: complex-query

in: query

description: the complex query condition expression

content:

application/json:

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/ComplexQuery'

- name: max-payload-size

in: query

description: Maximum payload size of the response expressed in kilo octets

required: false

schema:

type: integer

maximum: 2000

default: 124

- name: atsss-capability

in: query

description: ATSSS Capability

content:

application/json:

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/AtsssCapability'

- name: upf-ue-ip-addr-ind

in: query

description: UPF supporting allocating UE IP addresses/prefixes

schema:

type: boolean

- name: client-type

in: query

description: Requested client type served by the NF

content:

application/json:

schema:

$ref: 'TS29572\_Nlmf\_Location.yaml#/components/schemas/ExternalClientType'

- name: preferred-tai

in: query

description: preferred Tracking Area Identity

content:

application/json:

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Tai'

- name: preferred-nf-instances

in: query

description: preferred NF Instances

schema:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfInstanceId'

minItems: 1

style: form

explode: false

- name: If-None-Match

in: header

description: Validator for conditional requests, as described in IETF RFC 7232, 3.2

schema:

type: string

- name: target-snpn

in: query

description: Target SNPN Identity

content:

application/json:

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnIdNid'

- name: af-ee-data

in: query

description: NEF exposured by the AF

content:

application/json:

schema:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/AfEventExposureData'

- name: w-agf-info

in: query

description: UPF collocated with W-AGF

content:

application/json:

schema:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/WAgfInfo'

- name: tngf-info

in: query

description: UPF collocated with TNGF

content:

application/json:

schema:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/TngfInfo'

- name: target-nf-set-id

in: query

description: Target NF Set ID

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfSetId'

- name: target-nf-service-set-id

in: query

description: Target NF Service Set ID

schema:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfServiceSetId'

- name: nef-id

in: query

description: NEF ID

schema:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/NefId'

- name: notification-type

in: query

description: Notification Type

schema:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/NotificationType'

- name: serving-scope

in: query

description: areas that can be served by the target NF

schema:

type: array

items:

type: string

minItems: 1

style: form

explode: false

- name: imsi

in: query

description: IMSI of the requester UE to search for an appropriate NF (e.g. HSS)

schema:

type: string

- name: preferred-api-versions

in: query

description: Preferred API version of the services to be discovered

content:

application/json:

schema:

type: object

additionalProperties:

type: string

minProperties: 1

responses:

'200':

description: Expected response to a valid request

content:

application/json:

schema:

$ref: '#/components/schemas/SearchResult'

links:

search:

operationId: RetrieveStoredSearch

parameters:

searchId: $response.body#/searchId

description: >

The 'searchId' parameter returned in the response can be used as the

'searchId' parameter in the GET request to '/searches/{searchId}'

completeSearch:

operationId: RetrieveCompleteSearch

parameters:

searchId: $response.body#/searchId

description: >

The 'searchId' parameter returned in the response can be used as the

'searchId' parameter in the GET request to '/searches/{searchId}/complete'

headers:

Cache-Control:

description: Cache-Control containing max-age, described in IETF RFC 7234, 5.2

schema:

type: string

ETag:

description: Entity Tag containing a strong validator, described in IETF RFC 7232, 2.3

schema:

type: string

'307':

description: Temporary Redirect

headers:

Location:

description: 'The URI pointing to the resource located on the redirect target NRF'

required: true

schema:

type: string

'400':

$ref: 'TS29571\_CommonData.yaml#/components/responses/400'

'401':

$ref: 'TS29571\_CommonData.yaml#/components/responses/401'

'403':

$ref: 'TS29571\_CommonData.yaml#/components/responses/403'

'404':

$ref: 'TS29571\_CommonData.yaml#/components/responses/404'

'406':

$ref: 'TS29571\_CommonData.yaml#/components/responses/406'

'411':

$ref: 'TS29571\_CommonData.yaml#/components/responses/411'

'413':

$ref: 'TS29571\_CommonData.yaml#/components/responses/413'

'415':

$ref: 'TS29571\_CommonData.yaml#/components/responses/415'

'429':

$ref: 'TS29571\_CommonData.yaml#/components/responses/429'

'500':

$ref: 'TS29571\_CommonData.yaml#/components/responses/500'

'501':

$ref: 'TS29571\_CommonData.yaml#/components/responses/501'

'503':

$ref: 'TS29571\_CommonData.yaml#/components/responses/503'

default:

$ref: 'TS29571\_CommonData.yaml#/components/responses/default'

/searches/{searchId}:

get:

operationId: RetrieveStoredSearch

tags:

- Stored Search (Document)

parameters:

- $ref: '#/components/parameters/searchId'

responses:

'200':

$ref: '#/components/responses/200'

/searches/{searchId}/complete:

get:

operationId: RetrieveCompleteSearch

tags:

- Complete Stored Search (Document)

parameters:

- $ref: '#/components/parameters/searchId'

responses:

'200':

$ref: '#/components/responses/200'

components:

securitySchemes:

oAuth2ClientCredentials:

type: oauth2

flows:

clientCredentials:

tokenUrl: '/oauth2/token'

scopes:

nnrf-disc: Access to the Nnrf\_NFDiscovery API

parameters:

searchId:

name: searchId

in: path

description: Id of a stored search

required: true

schema:

type: string

responses:

'200':

description: Expected response to a valid request

content:

application/json:

schema:

$ref: '#/components/schemas/StoredSearchResult'

headers:

Cache-Control:

description: Cache-Control containing max-age, described in IETF RFC 7234, 5.2

schema:

type: string

ETag:

description: Entity Tag containing a strong validator, described in IETF RFC 7232, 2.3

schema:

type: string

schemas:

SearchResult:

type: object

required:

- nfInstances

properties:

validityPeriod:

type: integer

nfInstances:

type: array

items:

$ref: '#/components/schemas/NFProfile'

searchId:

type: string

numNfInstComplete:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Uint32'

preferredSearch:

$ref: '#/components/schemas/PreferredSearch'

nrfSupportedFeatures:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/SupportedFeatures'

StoredSearchResult:

type: object

required:

- nfInstances

properties:

nfInstances:

type: array

items:

$ref: '#/components/schemas/NFProfile'

NFProfile:

type: object

required:

- nfInstanceId

- nfType

- nfStatus

properties:

nfInstanceId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfInstanceId'

nfInstanceName:

type: string

nfType:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/NFType'

nfStatus:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/NFStatus'

plmnList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnId'

minItems: 1

sNssais:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Snssai'

minItems: 1

perPlmnSnssaiList:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/PlmnSnssai'

minItems: 1

nsiList:

type: array

items:

type: string

minItems: 1

fqdn:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/Fqdn'

ipv4Addresses:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv4Addr'

minItems: 1

ipv6Addresses:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Ipv6Addr'

minItems: 1

capacity:

type: integer

minimum: 0

maximum: 65535

load:

type: integer

minimum: 0

maximum: 100

locality:

type: string

priority:

type: integer

minimum: 0

maximum: 65535

udrInfo:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/UdrInfo'

udrInfoExt:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/UdrInfo'

minItems: 1

udmInfo:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/UdmInfo'

udmInfoExt:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/UdmInfo'

minItems: 1

ausfInfo:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/AusfInfo'

ausfInfoExt:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/AusfInfo'

minItems: 1

amfInfo:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/AmfInfo'

amfInfoExt:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/AmfInfo'

minItems: 1

smfInfo:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/SmfInfo'

smfInfoExt:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/SmfInfo'

minItems: 1

upfInfo:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/UpfInfo'

upfInfoExt:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/UpfInfo'

minItems: 1

pcfInfo:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/PcfInfo'

pcfInfoExt:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/PcfInfo'

minItems: 1

bsfInfo:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/BsfInfo'

bsfInfoExt:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/BsfInfo'

minItems: 1

chfInfo:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/ChfInfo'

chfInfoExt:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/ChfInfo'

minItems: 1

nwdafInfo:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/NwdafInfo'

nefInfo:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/NefInfo'

pcscfInfo:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/PcscfInfo'

minItems: 1

hssInfo:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/HssInfo'

minItems: 1

customInfo:

type: object

recoveryTime:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/DateTime'

nfServicePersistence:

type: boolean

default: false

nfServices:

type: array

items:

$ref: '#/components/schemas/NFService'

minItems: 1

defaultNotificationSubscriptions:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/DefaultNotificationSubscription'

lmfInfo:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/LmfInfo'

gmlcInfo:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/GmlcInfo'

snpnList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnIdNid'

minItems: 1

nfSetIdList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfSetId'

minItems: 1

servingScope:

type: array

items:

type: string

minItems: 1

NFService:

type: object

required:

- serviceInstanceId

- serviceName

- versions

- scheme

- nfServiceStatus

properties:

serviceInstanceId:

type: string

serviceName:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/ServiceName'

versions:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/NFServiceVersion'

minItems: 1

scheme:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/UriScheme'

nfServiceStatus:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/NFServiceStatus'

fqdn:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/Fqdn'

ipEndPoints:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/IpEndPoint'

minItems: 1

apiPrefix:

type: string

defaultNotificationSubscriptions:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/DefaultNotificationSubscription'

minItems: 1

capacity:

type: integer

minimum: 0

maximum: 65535

load:

type: integer

minimum: 0

maximum: 100

priority:

type: integer

minimum: 0

maximum: 65535

recoveryTime:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/DateTime'

chfServiceInfo:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/ChfServiceInfo'

supportedFeatures:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/SupportedFeatures'

nfServiceSetIdList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfServiceSetId'

minItems: 1

PreferredSearch:

type: object

properties:

preferredTaiMatchInd:

type: boolean

default: false

## A.4 Nnrf\_AccessToken API (NRF OAuth2 Authorization)

openapi: 3.0.0

info:

version: '1.1.0.alpha-2'

title: 'NRF OAuth2'

description: |

NRF OAuth2 Authorization.

© 2019, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).

All rights reserved.

externalDocs:

description: 3GPP TS 29.510 V16.2.0; 5G System; Network Function Repository Services; Stage 3

url: 'http://www.3gpp.org/ftp/Specs/archive/29\_series/29.510/'

paths:

/oauth2/token:

post:

summary: Access Token Request

operationId: AccessTokenRequest

tags:

- Access Token Request

requestBody:

content:

application/x-www-form-urlencoded:

schema:

$ref: '#/components/schemas/AccessTokenReq'

required: true

responses:

'200':

description: Successful Access Token Request

content:

application/json:

schema:

$ref: '#/components/schemas/AccessTokenRsp'

headers:

Cache-Control:

$ref: '#/components/headers/cache-control'

Pragma:

$ref: '#/components/headers/pragma'

'307':

description: Temporary Redirect

'400':

description: Error in the Access Token Request

content:

application/json:

schema:

$ref: '#/components/schemas/AccessTokenErr'

headers:

Cache-Control:

$ref: '#/components/headers/cache-control'

Pragma:

$ref: '#/components/headers/pragma'

'401':

$ref: 'TS29571\_CommonData.yaml#/components/responses/401'

'403':

$ref: 'TS29571\_CommonData.yaml#/components/responses/403'

'404':

$ref: 'TS29571\_CommonData.yaml#/components/responses/404'

'411':

$ref: 'TS29571\_CommonData.yaml#/components/responses/411'

'413':

$ref: 'TS29571\_CommonData.yaml#/components/responses/413'

'415':

$ref: 'TS29571\_CommonData.yaml#/components/responses/415'

'429':

$ref: 'TS29571\_CommonData.yaml#/components/responses/429'

'500':

$ref: 'TS29571\_CommonData.yaml#/components/responses/500'

'501':

$ref: 'TS29571\_CommonData.yaml#/components/responses/501'

'503':

$ref: 'TS29571\_CommonData.yaml#/components/responses/503'

default:

$ref: 'TS29571\_CommonData.yaml#/components/responses/default'

components:

headers:

cache-control:

required: true

schema:

type: string

enum:

- no-store

pragma:

required: true

schema:

type: string

enum:

- no-cache

schemas:

AccessTokenReq:

type: object

required:

- grant\_type

- nfInstanceId

- scope

properties:

grant\_type:

type: string

enum:

- client\_credentials

nfInstanceId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfInstanceId'

nfType:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/NFType'

targetNfType:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/NFType'

scope:

type: string

pattern: '^([a-zA-Z0-9\_-]+)( [a-zA-Z0-9\_-]+)\*$'

targetNfInstanceId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfInstanceId'

requesterPlmn:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnId'

targetPlmn:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnId'

targetSnssaiList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Snssai'

minItems: 1

targetNsiList:

type: array

items:

type: string

minItems: 1

AccessTokenRsp:

type: object

required:

- access\_token

- token\_type

properties:

access\_token:

type: string

description: JWS Compact Serialized representation of JWS signed JSON object (AccessTokenClaims)

token\_type:

type: string

enum:

- Bearer

expires\_in:

type: integer

scope:

type: string

pattern: '^([a-zA-Z0-9\_-]+)( [a-zA-Z0-9\_-]+)\*$'

AccessTokenClaims:

type: object

required:

- iss

- sub

- aud

- scope

- exp

properties:

iss:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfInstanceId'

sub:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfInstanceId'

aud:

anyOf:

- $ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/NFType'

- type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/NfInstanceId'

minItems: 1

scope:

type: string

pattern: '^([a-zA-Z0-9\_-]+)( [a-zA-Z0-9\_-]+)\*$'

exp:

type: integer

consumerPlmnId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnId'

producerPlmnId:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/PlmnId'

producerSnssaiList:

type: array

items:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/Snssai'

minItems: 1

producerNsiList:

type: array

items:

type: string

minItems: 1

AccessTokenErr:

type: object

required:

- error

properties:

error:

type: string

enum:

- invalid\_request

- invalid\_client

- invalid\_grant

- unauthorized\_client

- unsupported\_grant\_type

- invalid\_scope

error\_description:

type: string

error\_uri:

type: string

## A.5 Nnrf\_Bootstrapping API

openapi: 3.0.0

info:

version: '1.0.0.alpha-1'

title: 'NRF Bootstrapping'

description: |

NRF Bootstrapping.

© 2019, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).

All rights reserved.

externalDocs:

description: 3GPP TS 29.510 V16.2.0; 5G System; Network Function Repository Services; Stage 3

url: 'http://www.3gpp.org/ftp/Specs/archive/29\_series/29.510/'

paths:

/bootstrapping:

get:

summary: Bootstrapping Info Request

operationId: BootstrappingInfoRequest

tags:

- Bootstrapping Request

responses:

'200':

description: Successful Bootstrapping Request

content:

application/3gppHal+json:

schema:

$ref: '#/components/schemas/BootstrappingInfo'

'400':

$ref: 'TS29571\_CommonData.yaml#/components/responses/400'

'500':

$ref: 'TS29571\_CommonData.yaml#/components/responses/500'

default:

$ref: 'TS29571\_CommonData.yaml#/components/responses/default'

components:

schemas:

BootstrappingInfo:

type: object

required:

- \_links

properties:

status:

$ref: '#/components/schemas/Status'

\_links:

type: object

description: 'Map of link objects where the keys are the link relations defined in 3GPP TS 29.510 clause 6.4.6.3.3'

additionalProperties:

$ref: 'TS29571\_CommonData.yaml#/components/schemas/LinksValueSchema'

minProperties: 1

Status:

anyOf:

- type: string

enum:

- OPERATIVE

- NON\_OPERATIVE

- type: string

Annex B (normative): NF Profile changes in NFRegister and NFUpdate (NF Profile Complete Replacement) responses

## B.1 General

In the NFRegister and NFUpdate (NF Profile Complete Replacement) service operations, a NF Service Consumer may indicate to the NRF that it supports receiving NF Profile changes in the response from the NRF, by including the nfProfileChangesSupportInd attribute set to "true" in the NFProfile it registers to or replaces in the NRF.

The NRF may return NF Profile changes, instead of the complete NF Profile, in NFRegister or NFUpdate (NF Profile Complete Replacement) responses, if the NF Service Consumer indicated corresponding support in the request. When doing so, the NRF shall include in the NF Profile returned in the response:

- attributes that are mandatory to include in the NF Profile; if an optional IE is included (e.g. nfServices), attributes that are mandatory to include in this optional IE (e.g. serviceInstanceId) shall also be included;

- optional or conditional IEs that have been changed or added by the NRF; and

- the nfProfileChangesInd IE set to "true", indicating that the returned profile contains NF profile changes.

EXAMPLE 1: The NRF does not change the NF Profile received in the request.

The NRF response contains a NFProfile with just the following IEs:

- nfInstanceId, nfType, nfStatus; and

- nfProfileChangesInd IE set to "true".

EXAMPLE 2: The NRF modifies or adds the heartbeatTimer attribute to the NF Profile received in the request.

The NRF response contains a NFProfile with just the following IEs:

- nfInstanceId, nfType, nfStatus;

- heartbeatTimer with NRF chosen value;

- nfProfileChangesInd IE set to "true".

Annex C (informative): Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Date** | **Meeting** | **TDoc.** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New** |
| 2017-10 | CT4#80 | C4-175271 |  |  |  | Initial draft | 0.1.0 |
| 2017-10 | CT4#80 | C4-175395 |  |  |  | Incorporation of agreed pCRs from CT4#80: C4-175109, C4-175272, C4-175274, C4-175363 | 0.2.0 |
| 2017-12 | CT4#81 | C4-176438 |  |  |  | Incorporation of agreed pCRs from CT4#81: C4-176184, C4-176278, C4-176280, C4-176281, C4-176282 | 0.3.0 |
| 2018-01 | CT4#82 | C4-181392 |  |  |  | Incorporation of agreed pCRs from CT4#82: C4-181348, C4-181351 | 0.4.0 |
| 2018-03 | CT4#83 | C4-182435 |  |  |  | Incorporation of agreed pCRs from CT4#83: C4-182098, C4-182327, C4-182328, C4-182365, C4-182413 | 0.5.0 |
| 2018-04 | CT4#84 | C4-183517 |  |  |  | Incorporation of agreed pCRs from CT4#84: C4-183450, C4-183451, C4-183452, C4-183487, C4-183488, C4-183490, C4-183491 | 0.6.0 |
| 2018-05 | CT4#85 | C4-184625 |  |  |  | Incorporation of agreed pCRs from CT4#85: C4-184207,  C4-184208, C4-184280, C4-184466, C4-184469, C4-184478, C4-184517, C4-184519, C4-184545, C4-184595, C4-184596, C4-184597, C4-184600, C4-184615, C4-184616, C4-184626 | 0.7.0 |
| 2018-06 | CT#80 | CP-181105 |  |  |  | Presented for information and approval | 1.0.0 |
| 2018-06 | CT#80 |  |  |  |  | Approved in CT#80. | 15.0.0 |
| 2018-09 | CT#81 | CP-182012 | 0001 | 2 | F | Implementing the Indirect Delivery method for the GET method to retrieve NF instances | 15.1.0 |
| 2018-09 | CT#81 | CP-182093 | 0003 | 3 | F | Defining the range of the priority and capacity attributes and aligning their usage with SRV RFC 2782 | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0004 | - | F | Corrections to descriptions, references and SUPI parameter in Discovery Request | 15.1.0 |
| 2018-09 | CT#81 | CP-182047 | 0006 | 2 | F | SubscriptionData | 15.1.0 |
| 2018-09 | CT#81 | CP-182045 | 0008 | 2 | F | Error Cases | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0009 | 2 | F | Heart Beat Procedure | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0010 | 1 | B | Vendor-Specific NF Types | 15.1.0 |
| 2018-09 | CT#81 | CP-182044 | 0011 | 3 | F | Presence condition of service discovery query parameters | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0012 | 4 | F | Description of Inter-PLMN scenarios | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0013 | 1 | F | NF Service Versions | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0014 | 1 | B | Custom Headers | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0015 | 1 | F | Overall Clean-up | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0016 | - | F | Formatting of query parameters | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0017 | - | F | Editorial corrections | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0018 | 2 | F | Backup AMF | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0020 | 1 | B | NF Service Names | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0023 | - | F | CHF as service consumer | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0024 | 3 | B | Hierarchical NF discovery in recursion mode | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0025 | 2 | B | Hierarchical NF discovery in iteration mode | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0026 | - | F | Correction of Allowed NF Domains | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0027 | - | F | Correction of BsfInfo data type | 15.1.0 |
| 2018-09 | CT#81 | CP-182161 | 0028 | 1 | F | IPv6 Prefix for NF / NF Service Address | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0030 | 1 | B | NF Set Id | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0031 | 1 | F | URI Scheme | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0032 | 2 | B | NRF service registration | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0034 | 2 | F | Discovery of combined SMF and PGW-C | 15.1.0 |
| 2018-09 | CT#81 | CP-182163 | 0035 | 3 | F | Support TAI Range for AMF/SMF and SUPI Range for PCF | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0036 | 1 | F | SUPI Range for PCF | 15.1.0 |
| 2018-09 | CT#81 | CP-182164 | 0037 | 3 | F | Scope for OAuth 2.0 Access Token Request | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0039 | 1 | F | Corrections to NotificationData and "supi" parameter in Discovery Request | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0040 | 1 | F | Group ID in Discovery Request | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0041 | 1 | F | Registering multiple Routing Indicators | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0045 | - | F | Description of Structured data types | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0046 | 1 | F | Service names in Discovery Request | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0047 | 1 | F | Resource structure presentation | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0048 | - | B | Default Notifications for UDM | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0049 | - | F | Cell ID in Discovery Request | 15.1.0 |
| 2018-09 | CT#81 | CP-182046 | 0050 | 2 | F | NRF Subscription Data | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0051 | 1 | F | AMF Discovery by 5G-AN | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0052 | 1 | F | Detecting NF Failure and Restart using the NRF | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0053 | 2 | B | NRF Subscription Lifespan | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0054 | 1 | F | NRF servers clause in OpenAPI | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0056 | 2 | F | Default port number | 15.1.0 |
| 2018-09 | CT#81 | CP-182162 | 0057 | 1 | F | AMF Discovery Based on AMF Name | 15.1.0 |
| 2018-09 | CT#81 | CP-182060 | 0058 | - | F | API Version Update | 15.1.0 |
| 2018-12 | CT#82 | CP-183018 | 0060 | 4 | F | Heartbeat Timer | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0061 | 1 | F | Location Header | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0062 | 2 | F | NF Profile Addressing Parameters | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0063 | 1 | F | NRF Notifications | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0064 | - | F | Oauth2 Corrections | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0065 | 1 | F | Regular Expression Patterns | 15.2.0 |
| 2018-12 | CT#82 | CP-183183 | 0066 | 5 | F | Subscription Data | 15.2.0 |
| 2018-12 | CT#82 | CP-183147 | 0067 | 2 | F | UPF selection based on DNAI | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0068 | 5 | F | CHF registration and selection | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0069 | 1 | F | Clarify the NRF management functionality in the case of hierarchical NRFs | 15.2.0 |
| 2018-12 | CT#82 | CP-183149 | 0070 | 5 | F | OAuth2.0 Service Alignments and Corrections | 15.2.0 |
| 2018-12 | CT#82 | CP-183150 | 0071 | 1 | F | HTTP Basic Authentication For OAuth2.0 Access Token Request | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0072 | 1 | F | Multiple PLMNs support | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0075 | 2 | F | NFService attribute in NFProfile | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0076 | 1 | F | Corrections of ServiceName enumeration | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0077 | 4 | F | Indicating support of EPS interworking in UPF Profile | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0079 | 2 | F | Cardinality | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0081 | - | F | APIRoot Clarification | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0082 | 2 | F | Clarification on the reuse of the previous search results | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0083 | 1 | F | NF profile detail for hierarchical NRF | 15.2.0 |
| 2018-12 | CT#82 | CP-183235 | 0084 | 3 | F | Complex query | 15.2.0 |
| 2018-12 | CT#82 | CP-183152 | 0087 | 1 | F | SMF discovery based on S-NSSAI and DNN | 15.2.0 |
| 2018-12 | CT#82 | CP-183153 | 0088 | 2 | F | CHF discovery based on GPSI and SUPI | 15.2.0 |
| 2018-12 | CT#82 | CP-183146 | 0089 | 3 | F | Add access type in SMF selection | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0090 | 2 | F | Hierarchical subscription with intermediate forwarding NRF | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0091 | 2 | F | Hierarchical subscription with intermediate redirecting NRF | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0093 | 1 | F | Notifications for subscriptions via intermediate NRF | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0096 | 1 | F | DNN and IP Domain in BSF Info | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0097 | 1 | F | PCF Information | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0100 | - | F | NF Service FQDN | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0101 | - | F | NRF Corrections | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0102 | 1 | F | Notification Data | 15.2.0 |
| 2018-12 | CT#82 | CP-183181 | 0103 | 2 | F | NRF Oauth Scopes | 15.2.0 |
| 2018-12 | CT#82 | CP-183182 | 0104 | 1 | F | NRF Subscription Handling | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0105 | - | F | NF Profile Change Notification | 15.2.0 |
| 2018-12 | CT#82 | CP-183171 | 0107 | - | F | UDM Group ID | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0108 | 2 | F | Preferred target NF Location in Discovery Request | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0109 | 1 | F | Telescopic FQDN for HNRF | 15.2.0 |
| 2018-12 | CT#82 | CP-183184 | 0112 | 1 | F | Description of NF instances/NF profile retrieval | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0113 | - | F | Content of the Subscription to notification response | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0115 | - | F | Adding new services in ServiceName enumeration | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0116 | - | F | NF Profile Service Instances | 15.2.0 |
| 2018-12 | CT#82 | CP-183018 | 0117 | - | F | API Version | 15.2.0 |
| 2018-12 | CT#82 | CP-183180 | 0118 | 1 | F | ExternalDocs Update | 15.2.0 |
| 2019-03 | CT#83 | CP-190023 | 0119 | 1 | F | AmfRegionId and AmfSetId | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0120 | 1 | F | Interpretation of absence of IEs in NF Profile | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0121 | 1 | F | Usage of FQDN and IP address related attributes from NF / NF Service profiles | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0122 | 1 | F | AMF Region and AMF Set in PLMNs supporting multiple PLMN Ids | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0123 | 1 | F | Encoding of GUAMI query parameter in NFDiscover Request | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0124 | 1 | F | Status for operative NF (service) not discoverable by other NFs | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0126 | 1 | F | Limiting the number of NFProfiles returned in NFDiscover response | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0127 | 2 | F | Maximum payload size of NFDiscover Response | 15.3.0 |
| 2019-03 | CT#83 | CP-190155 | 0128 | 2 | F | NF Profile Changes in NF Register / NFUpdate Response | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0129 | 1 | F | supported-features query parameter of NFDiscover Request | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0130 | 1 | F | OpenAPI Corrections | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0132 | 1 | F | Oauth2 Token Claims | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0133 | 1 | F | Oauth2 Token Type | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0134 | 1 | F | Authorization Attributes of NF Profile | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0135 | 2 | F | Features of NF Discovery service | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0136 | - | F | Subscription Authorization for Sets of NFs | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0137 | 1 | F | S-NSSAI per PLMN | 15.3.0 |
| 2019-03 | CT#83 | CP-190059 | 0138 | 4 | F | UPF selection based on PDUSessionType | 15.3.0 |
| 2019-03 | CT#83 | CP-190163 | 0139 | 2 | F | Service Names in URI Query Parameters | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0140 | 1 | F | GMLC URI for Namf\_Location EventNotify | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0141 | 1 | F | Corrections on complex query | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0142 | 1 | F | NRF Notifications | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0143 | 1 | F | NRF Heart-Beat | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0144 | - | F | Addition of new Service Name | 15.3.0 |
| 2019-03 | CT#83 | CP-190023 | 0145 | - | F | API version update | 15.3.0 |
| 2019-06 | CT#84 | CP-191034 | 0146 | 3 | F | PLMN ID in Access Token Claims | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0147 | 1 | F | Content encodings supported in HTTP requests | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0156 | 3 | F | Correct the condition of the FQDN parameter of NFProfile and NFService | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0159 | 1 | F | NRF Service Description | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0161 | 1 | F | Slice Info in NRF | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0162 | 1 | F | Subscription Conditions | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0163 | 1 | F | Vendor-Specific IEs in NF Profile | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0165 | 2 | F | Target PLMN List in Inter-PLMN Service Discovery | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0167 | 2 | F | Storage of OpenAPI specification files | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0170 | - | F | Corrections on NFStatusUnSubscribe operation to take into account multiple NRFs | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0171 | 1 | F | Corrections on UpdateSubscription operation to take into account multiple NRFs | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0174 | 4 | F | Corrections on Nnrf\_AccessToken Service for multiple NRFs | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0176 | - | F | LowerCamel Correction in Data Structures | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0177 | - | F | Removal of Basic Authentication | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0178 | 1 | F | Location header in redirect response | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0185 | 2 | F | Add HTTP error codes in 29.510 | 15.4.0 |
| 2019-09 | CT#85 | CP-192108 | 0192 | 4 | F | Add selection mechanism for multiple IP addresses in NFProfile | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0194 | 2 | F | Add retrieval of the NF profile using the URI | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0195 | 1 | F | Add the update of subscription in a different PLMN | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0198 | 1 | F | PLMN-IDs in Discovery Response | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0202 | - | F | Copyright Note in YAML files | 15.4.0 |
| 2019-06 | CT#84 | CP-191034 | 0206 | - | F | 3GPP TS 29.510 API version update | 15.4.0 |
| 2019-06 | CT#84 | CP-191052 | 0148 | 7 | B | NWDAF Discovery and Selection | 16.0.0 |
| 2019-06 | CT#84 | CP-191057 | 0149 | 4 | B | Multiple entries of pcfInfo | 16.0.0 |
| 2019-06 | CT#84 | CP-191057 | 0150 | 3 | B | Multiple entries of bsfInfo | 16.0.0 |
| 2019-06 | CT#84 | CP-191057 | 0151 | 3 | B | Multiple entries of smfInfo | 16.0.0 |
| 2019-06 | CT#84 | CP-191051 | 0154 | 5 | B | ATSSS Capability for UPF Selection | 16.0.0 |
| 2019-06 | CT#84 | CP-191057 | 0175 | 1 | B | GPSI range in pcfInfo | 16.0.0 |
| 2019-06 | CT#84 | CP-191057 | 0180 | 2 | B | Multiple entries of xxxInfo (generalized) | 16.0.0 |
| 2019-06 | CT#84 | CP-191057 | 0186 | 2 | F | Add the name of NF Instance | 16.0.0 |
| 2019-06 | CT#84 | CP-191057 | 0187 | 3 | B | Add requester nfInstanceId parameter in NFStatusSubscribe and NFDiscovery operations | 16.0.0 |
| 2019-06 | CT#84 | CP-191034 | 0196 | 2 | F | Correct The subscription notification procedure under the exception case | 16.0.0 |
| 2019-06 | CT#84 | CP-191057 | 0199 | 1 | B | PCF Group ID | 16.0.0 |
| 2019-06 | CT#84 | CP-191057 | 0200 | 1 | B | Number of NF Instances | 16.0.0 |
| 2019-06 | CT#84 | CP-191050 | 0201 | 1 | B | NIDDAU Service Name | 16.0.0 |
| 2019-06 | CT#84 | CP-191054 | 0204 | 1 | B | UE IP address allocation by UPF | 16.0.0 |
| 2019-06 | CT#84 | CP-191048 | 0205 | - | B | 3GPP TS 29.510 API version update | 16.0.0 |
| 2019-09 | CT#85 | CP-192033 | 0207 | 3 | C | CBCF as Network Function | 16.1.0 |
| 2019-09 | CT#85 | CP-192127 | 0208 | 1 | F | callbackUri the same as nfStatusNotificationUri | 16.1.0 |
| 2019-09 | CT#85 | CP-192193 | 0210 | 1 | B | Extensions for I-SMF and I-UPF selection | 16.1.0 |
| 2019-09 | CT#85 | CP-192194 | 0211 | 2 | B | NF Set and NF Service Set | 16.1.0 |
| 2019-09 | CT#85 | CP-192034 | 0212 | 2 | B | Update NRF descriptions to support AF Available Data Registration as described in TS23.288 | 16.1.0 |
| 2019-09 | CT#85 | CP-192035 | 0213 | 3 | B | SMF Selection | 16.1.0 |
| 2019-09 | CT#85 | CP-192107 | 0215 | - | A | Expiration Time of AccessTokenClaims | 16.1.0 |
| 2019-09 | CT#85 | CP-192109 | 0217 | 1 | F | Requester PLMN ID in SubscriptionData | 16.1.0 |
| 2019-09 | CT#85 | CP-192127 | 0218 | - | F | Correct the conditions of the information included in the access token request | 16.1.0 |
| 2019-09 | CT#85 | CP-192107 | 0222 | - | A | Slice Information in Access Token Claims | 16.1.0 |
| 2019-09 | CT#85 | CP-192130 | 0223 | 1 | B | UPF collocated with W-AGF | 16.1.0 |
| 2019-09 | CT#85 | CP-192127 | 0224 | 2 | F | URI in Location header for subscription to NF Instances in a different PLMN | 16.1.0 |
| 2019-09 | CT#85 | CP-192249 | 0226 | 5 | A | Support of Static IP Address | 16.1.0 |
| 2019-09 | CT#85 | CP-192133 | 0228 | 1 | B | Network Identifier for Stand-alone Non-Public Networks | 16.1.0 |
| 2019-09 | CT#85 | CP-192127 | 0229 | 1 | F | SMF profile without the smfInfo attribute | 16.1.0 |
| 2019-09 | CT#85 | CP-192107 | 0231 | - | A | Authorization Attributes in NF Service | 16.1.0 |
| 2019-09 | CT#85 | CP-192123 | 0232 | - | B | Handling of authorization parameters | 16.1.0 |
| 2019-09 | CT#85 | CP-192136 | 0233 | 1 | B | P-CSCF Discovery | 16.1.0 |
| 2019-09 | CT#85 | CP-192123 | 0235 | - | B | GPSI support for PCF Query | 16.1.0 |
| 2019-09 | CT#85 | CP-192123 | 0236 | - | B | LMF and GMLC Info | 16.1.0 |
| 2019-09 | CT#85 | CP-192123 | 0238 | 1 | B | NEF discovery information for PFD | 16.1.0 |
| 2019-09 | CT#85 | CP-192135 | 0239 | - | B | Services invoked by NWDAF | 16.1.0 |
| 2019-09 | CT#85 | CP-192127 | 0240 | 1 | F | Regulation of load update notifications | 16.1.0 |
| 2019-09 | CT#85 | CP-192120 | 0242 | - | F | 3GPP TS 29.510 API version update | 16.1.0 |
| 2019-10 |  |  |  |  |  | Corrupted references fixed | 16.1.1 |
| 2019-12 | CT#86 | C-193063 | 0244 | - | B | Missing NFs information in NrfInfo | 16.2.0 |
| 2019-12 | CT#86 | C-193059 | 0245 | 2 | B | P-CSCF Discovery based on preferred-locality | 16.2.0 |
| 2019-12 | CT#86 | C-193049 | 0247 | 2 | B | NEF ID | 16.2.0 |
| 2019-12 | CT#86 | C-193042 | 0248 | - | F | ExternalDocs Section | 16.2.0 |
| 2019-12 | CT#86 | C-193036 | 0250 | 3 | F | Support of Static IP Address | 16.2.0 |
| 2019-12 | CT#86 | C-193063 | 0251 | 3 | B | NRF Bootstrapping | 16.2.0 |
| 2019-12 | CT#86 | C-193056 | 0252 | 3 | B | I-SMF selection in a mobility procedure | 16.2.0 |
| 2019-12 | CT#86 | C-193283 | 0253 | 3 | B | UCMF Registration in NRF | 16.2.0 |
| 2019-12 | CT#86 | C-193057 | 0254 | 1 | B | Handling of default notification subscriptions with Delegated Discovery | 16.2.0 |
| 2019-12 | CT#86 | C-193063 | 0255 | 1 | B | Support of different priorities in SMF/UPF profiles for different TAIs | 16.2.0 |
| 2019-12 | CT#86 | C-193031 | 0256 | 1 | A | External Group ID | 16.2.0 |
| 2019-12 | CT#86 | C-193053 | 0257 | 2 | B | Internal Group Identifier in UdmInfo | 16.2.0 |
| 2019-12 | CT#86 | C-193054 | 0258 | 1 | B | HSS Service Discovery | 16.2.0 |
| 2019-12 | CT#86 | C-193063 | 0259 | 1 | B | NF serving scope | 16.2.0 |
| 2019-12 | CT#86 | C-193031 | 0260 | 1 | A | S-NSSAI Discovery Parameter | 16.2.0 |
| 2019-12 | CT#86 | C-193063 | 0261 | 1 | F | NF discovery based on DNN | 16.2.0 |
| 2019-12 | CT#86 | C-193063 | 0262 | 1 | F | S-NSSAI for SMF or UPF selection | 16.2.0 |
| 2019-12 | CT#86 | C-193055 | 0264 | 2 | B | GMLC Location service | 16.2.0 |
| 2019-12 | CT#86 | C-193063 | 0265 | - | F | Error code 404 for Hierarchical NRFs | 16.2.0 |
| 2019-12 | CT#86 | C-193063 | 0266 | 3 | B | Preferred API Version | 16.2.0 |
| 2019-12 | CT#86 | C-193042 | 0267 | 3 | F | Clarification on Backup AMF Info | 16.2.0 |
| 2019-12 | CT#86 | C-193055 | 0269 | - | B | Location Update Notification Default Subscription | 16.2.0 |
| 2019-12 | CT#86 | C-193044 | 0273 | - | F | 3GPP TS 29.510 API version update | 16.2.0 |