**3GPP TSG-CT WG4 Meeting #104-eC4-213031**

**E-Meeting, 19th – 28th May 2021**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **29.510** | **CR** | **0516** | **rev** | **1** | **Current version:** | **16.7.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network |  | Core Network | **X** |

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|  | | | | | | | | | | |
| ***Title:*** | Nested cardinality | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | China Mobile, China Southern Power Grid | | | | | | | | | |
| ***Source to TSG:*** | CT4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | SBIProtoc16 | | | | |  | ***Date:*** | | | 2021-05-19 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | F |  | | | | | ***Release:*** | | | Rel-16 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | The cardinality for the nested data type is not precisely described. See discussion paper in C4-213028. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | To introduce nested cardinality | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Unclear data type definition leads to interoperability issue. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 6.1.6.2.3, 6.1.6.2.31, 6.1.6.2.63, 6.2.6.2.4, A.2, A.3 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | | This CR introduces backward compatible corrections to Nnrf\_NFManagement and Nnrf\_NFDiscovery APIs. | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

**\*\*\*\*\*\*\***

\* \* \* First Change \* \* \* \*

##### 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) (NOTE 12) |
| 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.  This attribute shall not be included in profile change notifications to subscribed NFs. (NOTE 13) |
| 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.  This attribute shall not be included in profile change notifications to subscribed NFs. (NOTE 13) |
| 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.  This attribute shall not be included in profile change notifications to subscribed NFs. (NOTE 13) |
| allowedNfDomains | array(string) | O | 1..N | Pattern (regular expression according to the ECMA-262 dialect [8]) representing the NF domain names within the PLMN of the NRF 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.  This attribute shall not be included in profile change notifications to subscribed NFs. (NOTE 13) |
| allowedNssais | array(ExtSnssai) | 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.  This attribute shall not be included in profile change notifications to subscribed NFs. (NOTE 13) |
| allowedOperationsPerNfType | map(array(string)) | O | 1..N(1..M) | Map of allowed operations on resources for each type of NF; the key of the map is the NF Type, and the value is an array of scopes.  The scopes shall be any of those defined in the API that defines the current service (identified by the "serviceName" attribute).  (NOTE 11) |
| allowedOperationsPerNfInstance | map(array(string)) | O | 1..N(1..M) | Map of allowed operations on resources for a given NF Instance; the key of the map is the NF Instance Id, and the value is an array of scopes.  The scopes shall be any of those defined in the API that defines the current service (identified by the "serviceName" attribute).  (NOTE 11) |
| 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. |
| loadTimeStamp | DateTime | O | 0..1 | It indicates the point in time in which the latest load information (sent by the NF in the "load" attribute of the NF Service) was generated at the NF Service Instance.  If the NF did not provide a timestamp, the NRF should set it to the instant when the NRF received the message where the NF provided the latest load information. |
| recoveryTime | DateTime | O | 0..1 | Timestamp when the NF service was (re)started (NOTE 3) (NOTE 4) |
| supportedFeatures | SupportedFeatures | O | 0..1 | Supported Features of the NF Service instance |
| nfServiceSetIdList | array(NfServiceSetId) | C | 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.  This information shall be present if available. |
| sNssais | array(ExtSnssai) | O | 1..N | S-NSSAIs of the NF Service. This may be a subset of the S-NSSAIs supported by the NF (see sNssais attribute in NFProfile).  When present, this IE shall represent the list of S-NSSAIs supported by the NF Service in all the PLMNs listed in the plmnList IE and it shall prevail over the list of S-NSSAIs supported by the NF instance. |
| perPlmnSnssaiList | array(PlmnSnssai) | O | 1..N | S-NSSAIs of the NF Service per PLMN. This may be a subset of the S-NSSAIs supported per PLMN by the NF (see perPlmnSnssaiList attribute in NFProfile).  This IE may be included when the list of S-NSSAIs supported by the NF Service for each PLMN it is supporting is different. When present, this IE shall include the S-NSSAIs supported by the NF Service for each PLMN and it shall prevail over the list of S-NSSAIs supported per PLMN by the NF instance. When present, this IE shall override the sNssais IE. (NOTE 9) |
| vendorId | VendorId | O | 0..1 | Vendor ID of the NF Service instance, according to the IANA-assigned "SMI Network Management Private Enterprise Codes" [38]. |
| supportedVendorSpecificFeatures | map(array(VendorSpecificFeature)) | O | 1..N(1..M) | Map of Vendor-Specific features, where the key of the map is the IANA-assigned "SMI Network Management Private Enterprise Codes" [38].  The value of each entry of the map shall be a list (array) of VendorSpecificFeature objects.  (NOTE 10) |
| oauth2Required | boolean | O | 0..1 | It indicates whether the NF Service Instance requires Oauth2-based authorization.  Absence of this IE means that the NF Service Producer has not provided any indication about its usage of Oauth2 for authorization. |
| 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).  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: When present, this attribute allows the NF Service Consumer to determine which vendor-specific extensions are supported in a given NF Service Producer in order to include, or not, the vendor-specific attributes (see 3GPP TS 29.500 [4] clause 6.6.3) required for a given feature in subsequent service requests towards a certain service instance of the NF Service Producer.  NOTE 11: These attributes are used in order to determine whether a given resource/operation-level scope shall be granted to an NF Service Consumer that requested an Oauth2 access token with a specific scope; the NRF shall only grant such scope in the access token, if the scope is present in either "allowedOperationsPerNfType", for the specific NF type of the NF Service Consumer, or in "allowedOperationsPerNfInstance", for the specific instance ID of the NF Service Consumer.  NOTE 12: The nfServiceStatus also indicate the Status of the NF service instance as NF Service Consumer for notification delivery. When a notification is to be delivered to the NF service instance and the NF Service Producer (or SCP) has been aware that the NF service instance is not operative from the nfServiceStatus in the NF profile, the NF Service producer (or SCP) shall reselect another NF Service Consumer as target if possible, e.g. using binding indication or discovery factors previously provided for the notification. When selecting or reselecting an NF Service Consumer for notification delivery, not operative NF (service) instances shall not be selected as target.  NOTE 13: A change of this attribute shall trigger a "NF\_PROFILE\_CHANGED" notification from NRF, if the change of the NF Profile results in that the NF Instance starts or stops being authorized to be accessed by an NF having subscribed to be notified about NF profile changes. | | | | |

\* \* \* Next Change \* \* \* \*

##### 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. |
| servedUdrInfoList | map(map(UdrInfo)) | O | 1..N(1..M) | This attribute contains the udrInfoList attribute locally configured in the NRF or that the NRF received during NF registration. The key of the map is the nfInstanceId to which the map entry 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. |
| servedUdmInfoList | map(map(UdmInfo)) | O | 1..N(1..M) | This attribute contains the udmInfoList attribute locally configured in the NRF or that the NRF received during NF registration. The key of the map is the nfInstanceId to which the map entry 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. |
| servedAusfInfoList | map(map(AusfInfo)) | O | 1..N(1..M) | This attribute contains the ausfInfoList attribute locally configured in the NRF or that the NRF received during NF registration. The key of the map is the nfInstanceId to which the map entry 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. |
| servedAmfInfoList | map(map(AmfInfo)) | O | 1..N(1..M) | This attribute contains the amfInfoList attribute locally configured in the NRF or that the NRF received during NF registration. The key of the map is the nfInstanceId to which the map entry 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. |
| servedSmfInfoList | map(map(SmfInfo)) | O | 1..N(1..M) | This attribute contains the smfInfoList attribute locally configured in the NRF or that the NRF received during NF registration. The key of the map is the nfInstanceId to which the map entry 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. |
| servedUpfInfoList | map(map(UpfInfo)) | O | 1..N(1..M) | This attribute contains the upfInfoList attribute locally configured in the NRF or that the NRF received during NF registration. The key of the map is the nfInstanceId to which the map entry 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. |
| servedPcfInfoList | map(map(PcfInfo)) | O | 1..N(1..M) | This attribute contains the pcfInfoList attribute locally configured in the NRF or that the NRF received during NF registration. The key of the map is the nfInstanceId to which the map entry 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. |
| servedBsfInfoList | map(map(BsfInfo)) | O | 1..N(1..M) | This attribute contains the bsfInfoList attribute locally configured in the NRF or that the NRF received during NF registration. The key of the map is the nfInstanceId to which the map entry 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. |
| servedChfInfoList | map(map(ChfInfo)) | O | 1..N(1..M) | This attribute contains the chfInfoList attribute locally configured in the NRF or that the NRF received during NF registration. The key of the map is the nfInstanceId to which the map entry 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. |
| servedPcscfInfoList | map(map(PcscfInfo)) | O | 1..N(1..M) | 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 to which the map entry 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. |
| servedHssInfoList | map(map(HssInfo)) | O | 1..N(1..M) | 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 to which the map entry belongs to. |
| servedUdsfInfo | map(UdsfInfo) | O | 1..N | This attribute contains all the udsfInfo attributes locally configured in the NRF or the NRF received during NF registration. The key of the map is the nfInstanceId to which the map entry belongs to. |
| servedUdsfInfoList | map(map(UdsfInfo)) | O | 1..N(1..M) | This attribute contains the udsfInfoList attribute locally configured in the NRF or that the NRF received during NF registration. The key of the map is the nfInstanceId to which the map entry belongs to. |
| servedScpInfoList | map(ScpInfo) | O | 1..N | This attribute contains the scpInfo attribute locally configured in the NRF or that the NRF received during SCP registration. The key of the map is the nfInstanceId to which the scpInfo belongs to. |
| NOTE: The absence of these parameters means the NRF is able to serve any NF discovery request. | | | | |

\* \* \* Next Change \* \* \* \*

##### 6.1.6.2.63 Type: UdsfInfo

Table 6.1.6.2.63-1: Definition of type UdsfInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description |
| groupId | NfGroupId | O | 0..1 | Identity of the UDSF group that is served by the UDSF instance.  If not provided, the UDSF instance does not pertain to any UDSF group. |
| supiRanges | array(SupiRange) | O | 1..N | List of ranges of SUPIs whose profile data is available in the UDSF instance (NOTE 1) |
| storageIdRanges | map(array(IdentityRange)) | C | 1..N(1..M) | A map (list of key-value pairs) where realmId serves as key and each value in the map is an array of IdentityRanges. Each IdentityRange is a range of storageIds. A UDSF complying with this version of the specification shall include this IE.  Absence indicates that the UDSF's supported realms and storages are determined by the UDSF's consumer by other means such as local provisioning. |
| NOTE 1: If this parameter is not provided, then the UDSF can serve any SUPI range. | | | | |

\* \* \* Next Change \* \* \* \*

##### 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 | Fqdn | 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 within the range 0 to 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, within the range 0 to 100 in percentage. (See NOTE 4) |
| loadTimeStamp | DateTime | O | 0..1 | It indicates the point in time in which the latest load information of the NF Service Instance was sent from the NF to the NRF. |
| priority | integer | O | 0..1 | Priority (relative to other services of the same type) within the range 0 to 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 |
| supportedFeatures | SupportedFeatures | O | 0..1 | Supported Features of the NF Service instance |
| nfServiceSetIdList | array(NfServiceSetId) | C | 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.  This information shall be present if available. |
| sNssais | array(ExtSnssai) | O | 1..N | S-NSSAIs of the NF Service. This may be a subset of the S-NSSAIs supported by the NF (see sNssais attribute in NFProfile).  When present, this IE represents the list of S-NSSAIs supported by the NF Service in all the PLMNs listed in the plmnList IE. |
| perPlmnSnssaiList | array(PlmnSnssai) | O | 1..N | S-NSSAIs of the NF Service per PLMN. This may be a subset of the S-NSSAIs supported per PLMN by the NF (see perPlmnSnssaiList attribute in NFProfile).  This IE may be included when the list of S-NSSAIs supported by the NF Service for each PLMN it is supporting is different. When present, this IE shall include the S-NSSAIs supported by the NF Service for each PLMN. When present, this IE shall override the sNssais IE. |
| vendorId | VendorId | O | 0..1 | Vendor ID of the NF Service instance, according to the IANA-assigned "SMI Network Management Private Enterprise Codes" [38]. |
| supportedVendorSpecificFeatures | map(array(VendorSpecificFeature) | O | 1..N(1..M) | Map of Vendor-Specific features, where the key of the map is the IANA-assigned "SMI Network Management Private Enterprise Codes" [38].  The value of each entry of the map shall be a list (array) of VendorSpecificFeature objects.  (NOTE 7) |
| oauth2Required | boolean | O | 0..1 | It indicates whether the NF Instance requires Oauth2-based authorization.  Absence of this IE means that the NF Service Producer has not provided any indication about its usage of Oauth2 for authorization. |
| allowedOperationsPerNfType | map(array(string)) | O | 1..N(1..M) | Map of allowed operations on resources for each type of NF; the key of the map is the NF Type, and the value is an array of scopes.  The scopes shall be any of those defined in the API that defines the current service (identified by the "serviceName" attribute).  (NOTE 8) |
| allowedOperationsPerNfInstance | map(array(string)) | O | 1..N(1..M) | Map of allowed operations on resources for a given NF Instance; the key of the map is the NF Instance Id, and the value is an array of scopes.  The scopes shall be any of those defined in the API that defines the current service (identified by the "serviceName" attribute).  (NOTE 8) |
| 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 NF Service Consumer, based on the FQDN and IP address related attributes of the NFProfile and NFService, determines that it needs to use an FQDN to establish the HTTP connection with the NF Service Producer, it shall use such FQDN for DNS query and, in absence of any port information in the ipEndPoints attribute of the NF Service, 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.  NOTE 7: When present, this attribute allows the NF Service Consumer to determine which vendor-specific extensions are supported in a given NF Service Producer in order to include, or not, the vendor-specific attributes (see 3GPP TS 29.500 [4] clause 6.6.3) required for a given feature in subsequent service requests towards a certain service instance of the NF Service Producer.  NOTE 8: These attributes are used by the NF Service Consumer in order to discover the additional scopes (resource/operation-level scopes) that might be required to invoke a certain service operation, based on the authorization information registered in NRF by the NF Service Producer in its NF profile. | | | | |

\* \* \* Next Change \* \* \* \*

## A.2 Nnrf\_NFManagement API

\*\*\*\*\*\*\* skipped for clarity \*\*\*\*\*\*\*

NFService:

description: Information of a given NF Service Instance; it is part of the NFProfile of an NF Instance

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/ExtSnssai'

minItems: 1

allowedOperationsPerNfType:

type: object

additionalProperties:

type: array

items:

type: string

minItems: 1

minProperties: 1

allowedOperationsPerNfInstance:

type: object

additionalProperties:

type: array

items:

type: string

minItems: 1

minProperties: 1

priority:

type: integer

minimum: 0

maximum: 65535

capacity:

type: integer

minimum: 0

maximum: 65535

load:

type: integer

minimum: 0

maximum: 100

loadTimeStamp:

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

recoveryTime:

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

supportedFeatures:

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

nfServiceSetIdList:

type: array

items:

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

minItems: 1

sNssais:

type: array

items:

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

minItems: 1

perPlmnSnssaiList:

type: array

items:

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

minItems: 1

vendorId:

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

supportedVendorSpecificFeatures:

type: object

additionalProperties:

type: array

items:

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

minItems: 1

minProperties: 1

oauth2Required:

type: boolean

\*\*\*\*\*\*\* skipped for clarity \*\*\*\*\*\*\*

\* \* \* Next Change \* \* \* \*

## A.3 Nnrf\_NFDiscovery API

\*\*\*\*\*\*\* skipped for clarity \*\*\*\*\*\*\*

NFService:

description: Information of a given NF Service Instance; it is part of the NFProfile of an NF Instance discovered by the NRF

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

loadTimeStamp:

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

priority:

type: integer

minimum: 0

maximum: 65535

recoveryTime:

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

supportedFeatures:

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

nfServiceSetIdList:

type: array

items:

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

minItems: 1

sNssais:

type: array

items:

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

minItems: 1

perPlmnSnssaiList:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/PlmnSnssai'

minItems: 1

vendorId:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/VendorId'

supportedVendorSpecificFeatures:

type: object

additionalProperties:

type: array

items:

$ref: 'TS29510\_Nnrf\_NFManagement.yaml#/components/schemas/VendorSpecificFeature'

minItems: 1

minProperties: 1

oauth2Required:

type: boolean

allowedOperationsPerNfType:

type: object

additionalProperties:

type: array

items:

type: string

minItems: 1

minProperties: 1

allowedOperationsPerNfInstance:

type: object

additionalProperties:

type: array

items:

type: string

minItems: 1

minProperties: 1

PreferredSearch:

description: Contains information on whether the returned NFProfiles match the preferred query parameters

type: object

properties:

preferredTaiMatchInd:

type: boolean

default: false

preferredFullPlmnMatchInd:

type: boolean

default: false

preferredApiVersionsMatchInd:

type: boolean

otherApiVersionsInd:

type: boolean

preferredLocalityMatchInd:

type: boolean

default: false

otherLocalityInd:

type: boolean

default: false

\*\*\*\*\*\*\* skipped for clarity \*\*\*\*\*\*\*

\* \* \* End of Changes \* \* \* \*