**3GPP TSG-CT WG4 Meeting #107-eC4-216xyz**

**E-Meeting, 15th – 23rd November 2021 (was C4-216194)**

|  |
| --- |
| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **29.510** | **CR** | **0609** | **rev** | **1** | **Current version:** | **17.3.0** |  |
|  |
| *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)*.* |
|  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network |  | Core Network | **X** |

|  |
| --- |
|  |
| ***Title:***  | Group ranges in HSS Info |
|  |  |
| ***Source to WG:*** | Ericsson |
| ***Source to TSG:*** | CT4 |
|  |  |
| ***Work item code:*** | SBIProtoc17 |  | ***Date:*** | 2021-10-30 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-17 |
|  | *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 canbe 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:*** | At CT4#106-e, C4-215205 (CR #0041r2 to TS 29.563) was agreed, and it introduces the possibility for the UDM to request to the HSS the creation of subscripitons for a group of UEs (identified by its external group ID).This implies that the UDM needs to discover and select an HSS instance that supports such group of UEs. |
|  |  |
| ***Summary of change:*** | Introduce in the hssInfo data structure a new attribute to indicate the groups of UEs supported by a given HSS instance. |
|  |  |
| ***Consequences if not approved:*** | The UDM cannot discover the right HSS instance that can serve a given group of UEs. |
|  |  |
| ***Clauses affected:*** | 6.1.6.2.57, 6.2.3.2.3.1, A.2 |
|  |  |
|  | **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 backwards-compatible new features with impacts on the following APIs:- TS29510\_Nnrf\_NFManagement.yaml- TS29510\_Nnrf\_NFDiscovery.yaml |
|  |  |
| ***This CR's revision history:*** |  |

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

##### 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.(NOTE 1) |
| imsiRanges | array(ImsiRange) | O | 1..N | List of ranges of IMSIs whose profile data is available in the HSS instance (NOTE 1) |
| imsPrivateIdentityRanges | array(IdentityRange) | O | 1..N | List of ranges of IMS Private Identities whose profile data is available in the HSS instance (NOTE 1, NOTE 2) |
| imsPublicIdentityRanges | array(IdentityRange) | O | 1..N | List of ranges of IMS Public Identities whose profile data is available in the HSS instance (NOTE 1) |
| msisdnRanges | array(IdentityRange) | O | 1..N | List of ranges of MSISDNs whose profile data is available in the HSS instance (NOTE 1) |
| externalGroupIdentifiersRanges | array(IdentityRange) | O | 1..N | List of ranges of external group IDs that can be served by this HSS instance.If not provided, the HSS instance does not serve any external groups. |
| NOTE 1: If none of these parameters are provided, the HSS can serve any IMSI or IMS Private Identity or IMS Public Identity or MSISDN managed by the PLMN of the HSS instance. If "imsiRanges", "imsPrivateIdentityRanges", "imsPublicIdentityRanges" and "msisdnRanges" attributes are absent, and "groupId" is present, the IMSIs / IMS Private Identities / IMS Public Identities / MSISDNs served by this HSS instance is determined by the NRF.NOTE 2: In deployments where the users IMPIs are derived from their IMSIs (see 3GPP TS 23.003 [12], clause 13.3, the HSS shall only register imsiRanges in NRF. |

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

###### 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 target NF being discovered. |  |
| requester-nf-type | NFType | M | 1 | This IE shall contain the NF type of the Requester NF 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 Requester NF.  | 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 services returned by the NRF (inside the nfServices or nfServiceList attributes) in each matching NFProfile shall be those services whose service name matches one of the service names included in this list.If not included, the NRF shall not filter based on service name.This array shall contain unique items.Example:NF1 supports services: A, B, CNF2 supports services: C, D, ENF3 supports services: A, C, ENF4 supports services: B, C, DConsumer asks for service-names = [A, E]NRF returns:NF1 containing service ANF2 containing service ENF3 containing services A, ENF4 is not returned |  |
| requester-nf-instance-fqdn | Fqdn | O | 0..1 | This IE may be present for an NF discovery request within the same PLMN as the NRF.If included, this IE shall contain the FQDN of the Requester NF 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.This IE shall be ignored by the NRF if it is received from a requester NF belonging to a different PLMN.(NOTE 12) |  |
| 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.This IE shall also be included in SNPN scenarios, when the entity owning the subscription, the Credentials Holder (see clause 5.30.2.9 in 3GPP TS 23.501 [2]) is a PLMN.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. (NOTE 12) |  |
| requester-snpn-list | array(PlmnIdNid) | C | 1..N | This IE shall be included when the Requester NF belongs to one or several SNPNs, and NF services of a specific SNPN need to be discovered.When present, this IE shall contain the SNPN ID(s) of the requester NF.The NRF shall use this to return only those NF profiles of NF Instances allowing to be discovered from the SNPNs identified by this IE, according to the "allowedSnpns" list in the NF Profile and NF Service (see clauses 6.1.6.2.2 and 6.1.6.2.3). | Query-Params-Ext2 |
| 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 Requester NF has previously received such API URI to be used for service discovery (e.g., from the NSSF in the home PLMN as specified in clause 6.1.6.2.11 of 3GPP TS 29.531 [42]). |  |
| snssais | array(Snssai) | O | 1..N | If included, this IE shall contain the list of S-NSSAIs that are served by the NF (Service) Instances being discovered. The NRF shall return those NF profiles/NF services of NF (Service) Instances that have at least one of the S-NSSAIs in this list. The S-NSSAIs included in the NF profiles/NF services of NF (Service) Instances returned by the NRF shall be an interclause of the S-NSSAIs requested and the S-NSSAIs supported by those NF (Service) Instances. (NOTE 10)When the NF Profile of the NF Instances being discovered has defined the list of supported S-NSSAIs in the "perPlmnSnssaiList", the discovered NF Instances shall be those having any of the S-NSSAIs included in this "snssais" parameter in any of the PLMNs included in the "target-plmn-list" attribute, if present; if the "target-plmn-list" is not included, the NRF shall assume that the discovery request is for any of the PLMNs it supports. |  |
| requester-snssais | array(Snssai) | O | 1..N | If included, this IE shall contain the list of S-NSSAI of the requester NF. If this IE is included in a service discovery in a different PLMN, the requester NF shall provide S-NSSAI values of the target PLMN, that correspond to the S-NSSAI values of the requester NF.The NRF shall use this to return only those NF profiles of NF Instances allowing to be discovered from at least one network slice 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). (NOTE 12) |  |
| 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 S-NSSAI supported in any of the PLMNs 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). |  |
| requester-plmn-specific-snssai-list | array(PlmnSnssai) | O | 1..N | If included, this IE shall contain the list of S-NSSAI of the requester NF, for each of the PLMNs it supports. The NRF shall use this to return only those NF profiles of NF Instances allowing to be discovered from at least one network slice identified by this IE, according to the "allowedNssais" and "allowedPlmns" attributes in the NF Profile and NF Service (see clause 6.1.6.2.2 and 6.1.6.2.3). (NOTE 12) | Query-Params-Ext3 |
| 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", "UPF", "EASDF", "TSCTSF" or "MB-SMF".The DNN shall contain the Network Identifier and it may additionally contain an Operator Identifier. (NOTE 11).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 or P-CSCF 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 or P-CSCF 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 used by the AMF to find the combined SMF/PGW-C. |  |
| pgw-ip | IpAddr | O | 0..1 | If included, this IE shall contain the PGW IP Address used by the AMF to find the combined SMF/PGW-C. | Query-SBIProtoc17 |
| 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", "UDR", "HSS" or "TSCTSF". |  |
| 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".The NRF shall return those NEF instances which can provide the PFDs for at least one of the provided application identifiers, or for at least one of the provided application function identifiers. | 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 TS 23.003 [12]) to an AUSF, AAnF and UDM instance capable to serve the subscriber. May be included if the target NF type is "AUSF", "AANF" or "UDM".Pattern: "^[0-9]{1,4}$" |  |
| 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", "AUSF" or "CHF". |  |
| 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", "SMF", "EASDF" or "NEF". |  |
| 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. 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.Minimum: 1 | 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 |
| max-payload-size-ext | 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.This query parameter is used when the consumer supports payload size bigger than 2 million octets.Default: 124 | Query-Params-Ext2 |
| 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 |
| lmf-id | LMFIdentification | O | 0..1 | When present, this IE shall contain LMF identification to be discovered.This may be included if the target NF type is "LMF". | Query-Params-Ext2 |
| an-node-type | AnNodeType | O | 0..1 | If included, this IE shall contain the AN Node type which is required to be supported by the target Network Function (i.e. LMF). | Query-Params-Ext2 |
| rat-type | RatType | O | 0..1 | If included, this IE shall contain the RAT type which is required to be supported by the target Network Function (i.e. LMF). | 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.This IE shall also be included in SNPN scenarios, when the entity owning the subscription, the Credentials Holder (see clause 5.30.2.9 in 3GPP TS 23.501 [2]) is an SNPN. | 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 |
| twif-info | TwifInfo | O | 0..1 | If included, this IE shall contain the TWIF identifiers of N3 terminations which is received by the SMF to find the combined TWIF/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 28.12 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 28.13 of 3GPP TS 23.003 [12]) of the NF service instances being discovered.If this IE is provided together with the target-nf-set-id IE, the NRF shall return service instances of the NF Service Set indicated in the request and should additionally return equivalent ones, if any. | 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 |
| n1-msg-class | N1MessageClass | O | 0..1 | This IE may be included when "notification-type" IE is present with value "N1\_MESSAGES".When included, this IE shall contain the N1 message class 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 n1-msg-class parameter.(NOTE 9) | Query-Params-Ext3 |
| n2-info-class | N2InformationClass | O | 0..1 | This IE may be included when "notification-type" IE is present with value "N2\_INFORMATION".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 n2-info-class parameter.(NOTE 9) | Query-Params-Ext3 |
| 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.(NOTE 18) | 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 |
| ims-private-identity | string | O | 0..1 | If included, this IE shall contain the IMS Private Identity of the requester UE to search for an appropriate NF. IMS Private Identity may be included if the target NF type is "HSS". | Query-Params-Ext3 |
| ims-public-identity | string | O | 0..1 | If included, this IE shall contain the IMS Public Identity of the requester UE to search for an appropriate NF. IMS Public Identity may be included if the target NF type is "HSS". | Query-Params-Ext3 |
| msisdn | string | O | 0..1 | If included, this IE shall contain the MSISDN of the requester UE to search for an appropriate NF. IMS Public Identity may be included if the target NF type is "HSS". | Query-Params-Ext3 |
| 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. The NRF may return additional NFs in the response not matching the preferred API versions, e.g. if no NF profile is found matching the preferred-api-versions.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 |
| v2x-support-ind | boolean | O | 0..1 | When present, this IE indicates whether a PCF supporting V2X Policy/Parameter provisioning needs to be discovered.true: a PCF supporting V2X Policy/Parameter provisioning is requested to be discovered;false: a PCF not supporting V2X Policy/Parameter provisioning is requested to be discovered. | Query-Params-Ext2 |
| redundant-gtpu | boolean | O | 0..1 | When present, this IE indicates whether a UPF supporting redundant GTP-U path needs to be discovered.true: a UPF supporting redundant GTP-U path is requested to be discovered;false: a UPF not supporting redundant GTP-U path is requested to be discovered. | Query-Params-Ext2 |
| redundant-transport | boolean | O | 0..1 | When present, this IE indicates whether a UPF supporting redundant transport path on the transport layer in the corresponding network slice needs to be discovered.true: a UPF supporting redundant transport path on the transport layer is requested to be discovered;false: a UPF not supporting redundant transport path on the transport layer is requested to be discovered.If the Snssai(s) are also included, the UPF supporting redundant transport path on the transport layer shall be available in the network slice(s) identified by the Snssai(s). | Query-Params-Ext2 |
| ipups | boolean | O | 0..1 | When present, this IE indicates whether a UPF which is configured for IPUPS is requested to be discovered.true: a UPF which is configured for IPUPS is requested to be discovered;false: a UPF which is not configured for IPUPS is requested to be discovered. | Query-Params-Ext2 |
| scp-domain-list | array(string) | O | 1..N | When present, this IE shall contain the SCP domain(s) the target NF, SCP or SEPP belongs to. The NRF shall return NF, SCP or SEPP profiles that belong to all the SCP domains provided in this list.  | Query-Params-Ext2 |
| address-domain | Fqdn | O | 0..1 | If included, this IE shall contain the address domain that shall be reachable through the SCP. This IE may be included when the target NF type is "SCP". | Query-Params-Ext2 |
| ipv4-addr | Ipv4Addr | O | 0..1 | If included, this IE shall contain the IPv4 address that shall be reachable through the SCP. This IE may be included when the target NF type is "SCP". | Query-Params-Ext2 |
| ipv6-prefix | Ipv6Prefix | O | 0..1 | If included, this IE shall contain the IPv6 prefix that shall be reachable through the SCP. This IE may be included when the target NF type is "SCP". | Query-Params-Ext2 |
| served-nf-set-id | NfSetId | O | 0..1 | When present, this IE shall contain the NF Set ID that shall be reachable through the SCP. This IE may be included when the target NF type is "SCP". | Query-Params-Ext2 |
| remote-plmn-id | PlmnId | O | 0..1 | If included, this IE shall contain the remote PLMN ID that shall be reachable through the SCP or SEPP. This IE may be included when the target NF type is "SCP" or "SEPP". | Query-Params-Ext2 |
| data-forwarding | boolean | O | 0..1 | This may be included if the target NF type is "UPF". (NOTE 13)When present, the IE indicates whether UPF(s) configured for data forwarding needs to be discovered.true: UPF(s) configured for data forwarding is requested to be discovered;false: UPF(s) not configured for data forwarding is requested to be discovered. | Query-Params-Ext2 |
| preferred-full-plmn | boolean | O | 0..1 | When present, the NRF shall prefer NF profile(s) that can serve the full PLMN (i.e. can serve any TAI in the PLMN), or the NRF shall return other NF profiles if no NF profile serving the full PLMN is found:- true: NF instance(s) serving the full PLMN is preferred;- false: NF instance(s) serving the full PLMN is not preferred.(NOTE 14) | Query-Params-Ext2 |
| requester-features | SupportedFeatures | C | 0..1 | Nnrf\_NFDiscovery features supported by the Requester NF that is invoking the Nnrf\_NFDiscovery service.This IE shall be included if at least one feature is supported by the Requester NF. |  |
| realm-id | string | O | 0..1 | May be included if the target NF type is "UDSF". If included, this IE shall contain the realm-id for which a UDSF shall be discovered. | Query-Params-Ext4 |
| storage-id | string | O | 0..1 | May be included if the target NF type is "UDSF" and realm-id is included. If included, this IE shall contain the storage-id for the realm-id indicated in the realm-id IE for which a UDSF shall be discovered. | Query-Params-Ext4 |
| vsmf-support-ind | boolean | O | 0..1 | If included, this IE shall indicate that target SMF(s) that support V-SMF Capability are preferred.This IE may be included when the target NF type is "SMF".(NOTE 15) | Query-Param-vSmf-Capability |
| nrf-disc-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 NRF holding the NF Profile.It shall be included if:- the target-nf-instance-id is present;- the NF Service Consumer has previously received such API URI in an earlier NF service discovery, i.e. if the target NF instance was provided in the nfInstanceList attribute in SearchResult (see clause 6.2.6.2.2) and the nrfDiscApiUri attribute was present in the NfInstanceInfo (see clause 6.2.6.2.x); and- the service discovery request is addressed to a different NRF than the NRF holding the NF profile. | Enh-NF-Discovery |
| preferred-vendor-specific-features | map(map(array(VendorSpecificFeature))) | O | 1..N(1..M(1..L)) | When present, this IE indicates the list of preferred vendor-specific features supported by the target Network Function, as defined by the supportedVendorSpecificFeatures attribute in NFService (see clauses 6.1.6.2.3 and 6.2.6.2.4). NF profiles that support all the preferred features, or by default, NF profiles that contain at least one service supporting the preferred features, should be preferentially returned in the response; NF profiles in the response may not support the preferred features.The key of the external map is the ServiceName (see clause 6.1.6.3.11) for which the preferred vendor-specific features is indicated. Each element carries the preferred vendor-specific features for the service indicated by the key.The key of the internal map is the IANA-assigned "SMI Network Management Private Enterprise Codes" [38]. The string used as key of the internal map shall contain 6 decimal digits; if the SMI code has less than 6 digits, it shall be padded with leading digits "0" to complete a 6-digit string value.The value of each entry of the map shall be a list (array) of VendorSpecificFeature objects.The NF profiles returned by the NRF shall include the full list of vendor-specific-features and not just the interclause of supported and preferred vendor-specific features. | Query-SBIProtoc17 |
| preferred-vendor-specific-nf-features | map(array(VendorSpecificFeature)) | O | 1..N(1..M) | When present, this IE indicates the list of preferred vendor-specific features supported by the target Network Function, as defined by the supportedVendorSpecificFeatures attribute in NF profile (see clause 6.1.6.2.2 and 6.2.6.2.3). NF profiles that support all the preferred features should be preferentially returned in the response. NF profiles in the response may not support the preferred features.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.The NF profiles returned by the NRF shall include the full list of vendor-specific features and not just the interclause of supported and preferred vendor-specific features. | Query-SBIProtoc17 |
| required-pfcp-features | string | O | 0..1 | List of features required to be supported by the target UPF (when selecting a UPF), encoded as defined for the supportedPfcpFeatures attribute in UpfInfo (see clause 6.1.6.2.13).(NOTE 16) | Query-Upf-Pfcp |
| home-pub-key-id | integer | O | 0..1 | When present, this IE shall indicate the Home Network Public Key ID which shall be able to be served by the NF instance.May be included if the target NF type is "AUSF" or "UDM". (NOTE 17) | Query-SBIProtoc17 |
| prose-support-ind | boolean | O | 0..1 | When present, this IE indicates whether supporting ProSe capability by PCF needs to be discovered.true: a PCF supporting ProSe capability is requested to be discovered;false: a PCF not ProSe capability is requested to be discovered. | Query-5G-ProSe |
| analytics-aggregation-ind | boolean | O | 0..1 | If included, this IE shall contain the analytics aggregation capability indication of the NF being discovered. This IE may be included when the target NF type is "NWDAF". | Query-eNA-PH2 |
| analytics-metadata-prov-ind | boolean | O | 0..1 | If included, this IE shall contain the analytics metadata provisioning capability indication of the NF being discovered. This IE may be included when the target NF type is "NWDAF". | Query-eNA-PH2 |
| serving-nf-set-id | NfSetId | O | 0..1 | When present, this IE shall contain the NF Set ID that is served by the DCCF, NWDAF or MFAF. This IE may be included when the target NF type is "DCCF" or "NWDAF" or "MFAF". | Query-eNA-PH2 |
| serving-nf-type | NFType | O | 0..1 | When present, this IE shall contain the NF type that is served by the DCCF, NWDAF or MFAF. This IE may be included when the target NF type is "DCCF" or "NWDAF" or "MFAF". | Query-eNA-PH2 |
| ml-analytics-id-list | array(NwdafEvent) | O | 1..N | If present, this attribute shall contain the list of analytics Id(s) requested to be supported by the Nnwdaf\_MLModelProvision Service, the NRF shall return NF which support all the requested analytics Id(s). | Query-eNA-PH2 |
| nsacf-serving-area | string | O | 0..1 | If included, this IE shall contain the serving area of the NSACF. It may be included if the target NF type is "NSACF". | NSAC |
| nsacf-capability | NsacfCapability | O | 0..1 | When present, this IE indicates the service capability that the target NSACF needs to support. | NSAC |
| mbs-session-id-list | array(MbsSessionId) | O | 0..1 | This IE may be present if the target NF type is "MB-SMF".When present, it shall contain the list of MBS Session ID(s) for which MB-SMF(s) are to be discovered.When present, for each mbs-session-id in the list, the NRF shall determine whether an MB-SMF supporting the mbs-session-id and complying with the other query parameters (if any) exists. An MB-SMF shall be considered to support the mbs-session-id if: - the mbs-session-id contains a TMGI that is part of a TMGI range (see tmgiRangeList attribute in clause 6.1.6.2.85) registered by the MB-SMF and, if the tai query parameter is present:- if the TAI indicated in the tai query parameter can be served by the MB-SMF (see taiList and taiRangeList attributes in clause 6.1.6.2.85);or- the mbs-session-id contains a TMGI or an SSM address, that is part of the list of MBS sessions currently served by the MB-SMF (see mbsSessionList attribute in clause 6.1.6.2.85) and, if the tai query parameter is present and the MBS session is registered with an MBS Service Area (see mbsServiceArea in clause 6.1.6.2.90):- if the TAI indicated in the tai query parameter is supported by the MBS Service Area of the MBS session.If so, the NRF shall return the profile of this MB-SMF. If no MB-SMF supporting the mbs-session-id and complying with the other query parameters exists, the NRF shall return MB-SMF profiles based on the other query parameters, e.g. profiles of MB-SMF(s) that can serve the TAI indicated in the tai query parameters.See clause 7.1.2 of 3GPP TS 23.247 [43]. | Query-MBS |
| 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 Requester NF (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 notification type of a notification request (see clause 6.10.3.3 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-NSSAI value in the NF Profile or NF Service 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).NOTE 11: The dnn query parameter shall be considered as matching a DNN attribute in the NF Profile of a given NF Instance if: - both contain the same Network Identifier and Operator Identifier; - both contain the same Network Identifier and none contains an Operator Identifier; - the dnn query parameter contains the Network Identifier only, the DNN value in the NF Profile contains both the Network Identifier and Operator Identifier, and both contain the same Network Identifier; or- the dnn query parameter contains both the Network Identifier and Operator Identifier, the DNN value in the NF Profile contains the Network Identifier only, both contain the same Network Identifier and the Operator Identifier matches one PLMN of the NF (i.e. plmnList of the NF Profile).NOTE 12: Based on operator's policies, a discovery request not including the requester's information necessary to validate the authorization parameters in NF Profiles may be rejected or accepted but with only returning in the discovery response NF Instances whose authorization parameters allow any NF Service Consumer to access their services. 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 13: Different UPF instances for data forwarding may be configured in the network e.g. for different serving areas. The SMF may use this query parameter together with others (like SMF Serving Area or TAI) in discovery to select the UPF candidate for data forwarding.NOTE 14: For HR roaming, if the V-PLMN requires Deployments Topologies with specific SMF Service Areas (DTSSA) but no H-SMF can be selected supporting V-SMF change, AMF may use this query parameter to select a V-SMF serving the full VPLMN if available.NOTE 15: The AMF may perform discovery with this parameter to find V-SMF(s), and the NRF shall return the SMF profiles that explicitly indicated support of V-SMF capability. When performing discovery, the AMF shall use other query parameters together with this IE to ensure the required configurations and/or features are supported by the V-SMF, e.g. required Slice for the PDU session, support of DTSSA feature if V-SMF change is required for PDU Session, etc. If no SMF instances that explicitly indicated support of V-SMF capability can be matched for the discovery, the NRF shall return matched SMF instances not indicating support of V-SMF capability explicitly, i.e. the SMF instances not registered vsmfSupportInd IE in the NF profile but matched to the rest query parameters, if available.NOTE 16: When required-pfcp-features is used as query parameter, the NRF shall return a list of candidate UPFs supporting all the required PFCP features. The NRF may also return UPF profiles not including the "SupportedPfcpFeatures" attribute (e.g. pre-Rel-17 UPFs) but matching the other query parameters. The NF Service Consumer, e.g. a SMF, when using required-pfcp-features as query parameter, shall also include the query parameter corresponding to the UPF features (atsss-capability, upf-ue-ip-addr-ind, redundant-gtpu) which correspond to the PFCP feature flags MPTCP and ATSSS\_LL, UEIP, and RTTL respectively, if the corresponding PFCP feature is required. For example an SMF, that wishes to select a UPF supporting UE IP Address Allocation by the UP function, shall set the UEIP flag to "1" in the required-pfcp-features and also include the upf-ue-ip-addr-ind parameter set to "true".NOTE 17: This may only be used by the HPLMN in roaming scenarios in this release of the specification, i.e. an AMF in a visited network does not use the Home Network Public Key ID for AUSF/UDM selection.NOTE 18: The NF service consumer may derive the serving scope from e.g. the TAI of the UE, using local configuration. This parameter may be used to discover any NF that registers to the NRF, e.g. a 5GC NF or a P-CSCF. |

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", "preferred-nf-instances", "preferred-tai", "preferred-api-versions", "preferred-full-plmn" and "mbs-session-id" query parameters (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 | Responsecodes | Description |
| SearchResult | M | 1 | 200 OK | The response body contains the result of the search over the list of registered NF Instances. |
| RedirectResponse | O | 0..1 | 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.If an SCP redirects the message to another SCP then the location header field shall contain the same URI or a different URI pointing to the endpoint of the NF service producer to which the request should be sent. |
| ProblemDetails | O | 0..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 | O | 0..1 | 403 Forbidden | This response shall be returned if the Requester NF is not allowed to discover the NF Service(s) being queried. |
| ProblemDetails | O | 0..1 | 404 Not Found | This response shall be returned if the requested resource URI as defined in clause 6.2.3.2.2 (query parameter not considered) 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 | O | 0..1 | 500 Internal Server Error | The response body contains the error reason of the request message. |

Table 6.2.3.2.3.1-4: Headers supported by the GET method on this endpoint

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| If-None-Match | string | C | 0..1 | Validator for conditional requests, as described in IETF RFC 7232 [19], clause 3.2 |

Table 6.2.3.2.3.1-5: Headers supported by the 200 Response Code on this endpoint

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| Cache-Control | string | C | 0..1 | Cache-Control containing max-age, described in IETF RFC 7234 [20], clause 5.2 |
| ETag | string | C | 0..1 | Entity Tag containing a strong validator, described in IETF RFC 7232 [19], clause 2.3 |

Table 6.2.3.2.3.1-6: Headers supported by the 307 Response Code on this endpoint

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Data type | P | Cardinality | Description |
| Location | string | M | 1 | The URI pointing to the resource located on the redirect target NRF |

Table 6.2.3.2.3.1-7: Links supported by the 200 Response Code on this endpoint

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Resource name | HTTP method or custom operation | Parameters table | Description |
| search | Stored Search (Document) | GET | 6.2.3.2.3.1-8 | The 'searchId' parameter returned in the response can be used as the 'searchId' parameter in the GET request to '/searches/{searchId}' |
| completeSearch | Complete Stored Search (Document) | GET | 6.2.3.2.3.1-9 | The 'searchId' parameter returned in the response can be used as the 'searchId' parameter in the GET request to '/searches/{searchId}/complete' |

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

## A.2 Nnrf\_NFManagement API

*(... text not shown for clarity ...)*

 HssInfo:

 description: Information of an HSS NF Instance

 type: object

 properties:

 groupId:

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

 imsiRanges:

 type: array

 items:

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

 minItems: 1

 imsPrivateIdentityRanges:

 type: array

 items:

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

 minItems: 1

 imsPublicIdentityRanges:

 type: array

 items:

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

 minItems: 1

 msisdnRanges:

 type: array

 items:

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

 minItems: 1

 externalGroupIdentifiersRanges:

 type: array

 items:

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

 minItems: 1

*(... text not shown for clarity ...)*

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