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In the present document, modal verbs have the following meanings:

shall indicates a mandatory requirement to do something

shall not indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

Should indicates a recommendation to do something

should not indicates a recommendation not to do something

may indicates permission to do something

need not indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

Can indicates that something is possible

cannot indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

Will indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

will not indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

might indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

might not indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

is (or any other verb in the indicative mood) indicates a statement of fact

is not (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

1 Scope

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

The 5G System stage 2 architecture and procedures are specified in 3GPP TS 23.501 [2], 3GPP TS 23.502 [3] and 3GPP TS 23.548 [14].

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] OpenAPI: "OpenAPI Specification Version 3.0.0", <https://spec.openapis.org/oas/v3.0.0>.
- [7] 3GPP TR 21.900: "Technical Specification Group working methods".
- [8] 3GPP TS 33.501: "Security architecture and procedures for 5G system".
- [9] IETF RFC 6749: "The OAuth 2.0 Authorization Framework".
- [10] 3GPP TS 29.510: "5G System; Network Function Repository Services; Stage 3".
- [11] IETF RFC 9113: "HTTP/2".
- [12] IETF RFC 8259: "The JavaScript Object Notation (JSON) Data Interchange Format".
- [13] IETF RFC 9457: "Problem Details for HTTP APIs".
- [14] 3GPP TS 23.548: "5G System Enhancements for Edge Computing; Stage 2".
- [15] IETF RFC 6902: "JavaScript Object Notation (JSON) Patch".
- [16] 3GPP TS 29.571: "5G System; Common Data Types for Service Based Interfaces; Stage 3".
- [17] Void.
- [18] IETF RFC 7871: "Client Subnet in DNS Queries".
- [19] 3GPP TS 23.003: "Numbering, addressing and identification".

3 Definitions, symbols 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].

One-Time DNS Rule: A DNS Rule that applies only once to a specific DNS message earlier buffered in the EASDF and reported to the SMF (see clause 5.2.3.2.4).

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].

BD AIT	Baseline DNS Action Information Template
BD MDT	Baseline DNS Message Detection Template
EASDF	Edge Application Server Discovery Function
ECS	EDNS Client Subnet
EDNS	Extension mechanisms for DNS
HR-SBO	Home Routed Session BreakOut
MDT	(DNS Query or DNS Response) Message Detection Template

4 Overview

4.1 Introduction

Within the 5GC, the EASDF offers services to the SMF via the Neasdf service based interface (see 3GPP TS 23.548 [14], 3GPP TS 23.501 [2] and 3GPP TS 23.502 [3]).

Figure 4.1-1 provides the reference model (in service based interface representation and in reference point representation), with focus on the EASDF and the scope of the present specification.

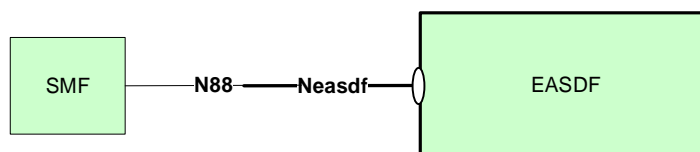


Figure 4.1-1: Reference model – EASDF

The functionalities supported by the EASDF are listed in clause 5.1.1 of 3GPP TS 23.548 [14].

In roaming scenarios, the V-EASDF offers service to the SMF in the VPLMN in both LBO roaming and HR with Session Breakout (HR-SBO) roaming scenarios (see clause 4.2 of 3GPP TS 23.548 [14]).

5 Services offered by the EASDF

5.1 Introduction

The EASDF offers to other NFs the following service:

Table 5.1-1: NF Service provided by EASDF

Service Name	Description	Example Consumer
Neasdf_DNSContext	This service enables the consumer to create, update and delete DNS context in EASDF, or subscribe to DNS message reporting from EASDF.	SMF, V-SMF
Neasdf_BaselineDNSPattern	This service enables the consumer to create, update and delete Baseline DNS pattern in EASDF.	SMF, V-SMF

The Neasdf_DNSContext service and Neasdf_BaselineDNSPattern service are specified in 3GPP TS 23.548 [14].

Table 5.1-2 summarizes the corresponding APIs defined for this specification.

Table 5.1-2: API Descriptions

Service Name	Clause	Description	OpenAPI Specification File	apiName	Annex
Neasdf_DNSContext	6.1	EASDF DNSContext Service	TS29556_Neasdf_DNSContext.yaml	neasdf-dnscontext	A.2
Neasdf_BaselineDNSPattern	6.2	EASDF BaselineDNSPattern Service	TS29556_Neasdf_BaselineDNSPattern.yaml	neasdf-baselinednspattern	A.3

5.2 Neasdf_DNSContext Service

5.2.1 Service Description

The Neasdf_DNSContext service operates on the DNS contexts. The EASDF is acting as NF Service Producer, while the SMF is the NF Service Consumer.

Following functionalities are provided by the Neasdf_DNSContext service:

- Create a DNS context in EASDF;
- Update a DNS context in EASDF;
- Delete a DNS context in EASDF;
- Enable the EASDF to report DNS signalling related information to the NF service consumer when receiving DNS Query or DNS Response.

The Neasdf_DNSContext service supports the following service operations.

Table 5.2.1-1: Service operations supported by the Neasdf_DNSContext service

Service Operations	Description	Operation Semantics	Example Consumer(s)
Create	Create a DNS context in EASDF.	Request/Response	SMF, V-SMF
Update	Update a DNS context in EASDF.	Request/Response	SMF, V-SMF
Delete	Delete a DNS context in EASDF.	Request/Response	SMF, V-SMF
Notify	EASDF reports DNS signalling related information to the NF service consumer when receiving DNS Query or DNS Response.	Subscribe/Notify	SMF, V-SMF

5.2.2 Service Operations

5.2.2.1 Introduction

See Table 5.2.1-1 for an overview of the service operations supported by the Neasdf_DNSContext service.

5.2.2.2 Create

5.2.2.2.1 General

The Create service operation shall be used to create an individual DNS context for a given PDU Session in the EASDF.

It is used in the following procedures:

- EAS Discovery Procedure with EASDF (see clause 6.2.3.2.2 of 3GPP TS 23.548 [14]); and
- EAS Discovery Procedure with V-EASDF for HR-SBO (see clauses 6.7.2.2 and 6.7.2.3) of 3GPP TS 23.548 [14].

There shall be only one individual DNS context created in an EASDF per PDU session.

The NF Service Consumer (e.g. SMF) shall create a DNS context by using the HTTP POST method as shown in Figure 5.2.2.2.1-1.

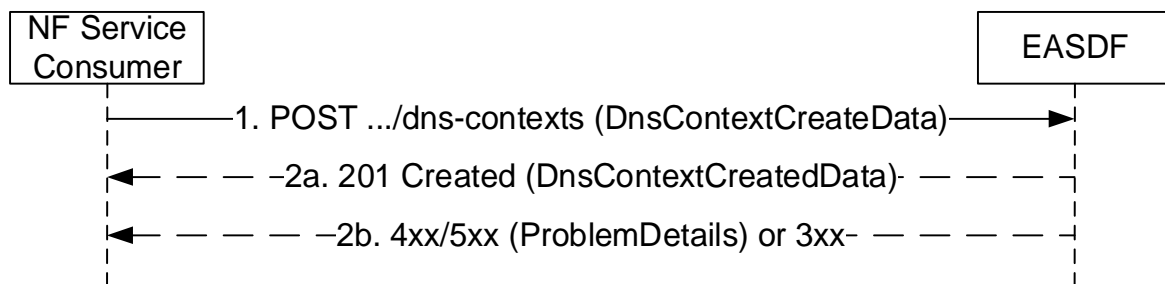


Figure 5.2.2.2.1-1: DNS context creation

1. The NF Service Consumer shall send a POST request to the resource representing the DNS contexts collection resource of the EASDF. The content of the POST request shall contain:
 - the UE IP address, S-NSSAI and the DNN of the related PDU session;
 - a notification URI for receiving DNS context related event notifications, if notifications are requested;
 - one or more DNS rules.

In addition, for a DNS context creation in the V-EASDF for HR-SBO in VPLMN:

- the UE IP address shall be set to an unspecified address, i.e. to the IPv4 address 0.0.0.0, or the IPv6 address ::/128, if the IP address of the UE's PDU session is not known yet, or to a mapped address (when using UE source IP address mapping at the Local PSA-UPF);
- the S-NSSAI shall correspond to the VPLMN S-NSSAI value; and
- the content of the POST request shall contain the HPLMN ID.

The payload body of the POST request may further contain:

- N6 traffic routing information that may contain the IP address and optional port number of the Local PSA-UPF, for HR-SBO in VPLMN, when using N6 tunneling between the L-PSA and V-EASDF, to disambiguate the DNS traffic using a private UE IP address from a certain HPLMN using a specific L-PSA UPF address of the N6 tunnel between the Local PSA-UPF and the V-EASDF.

2a. On success, a "201 Created" response shall be returned with the "Location" header containing the URI of the created resource.

The POST response body shall include:

- the IP address of the EASDF (to be sent by the SMF to the UE).

2b. On failure, or redirection, one of the HTTP status code listed in Table 6.1.3.2.3.1-3 shall be returned.

5.2.2.3 Update

5.2.2.3.1 General

The Update service operation shall be used to update an individual DNS context previously created in the EASDF. The update operation may apply to the whole DNS context (complete replacement of the data of the existing DNS context by new data), or it may apply to modify a subset of the parameters of the DNS context.

It is used in the following procedures:

- EAS Discovery Procedure with EASDF (see clause 6.2.3.2.2 of 3GPP TS 23.548 [14]); and
- EAS Discovery Procedure with V-EASDF for HR-SBO (see clauses 6.7.2.2 and 6.7.2.3) of 3GPP TS 23.548 [14].

To perform a partial update of the DNS context of a given DNS context Id, the NF Service Consumer shall issue an HTTP PATCH request, as shown in Figure 5.2.2.3.1-1. This partial update shall be used to add, delete and/or replace individual parameters of the DNS context.

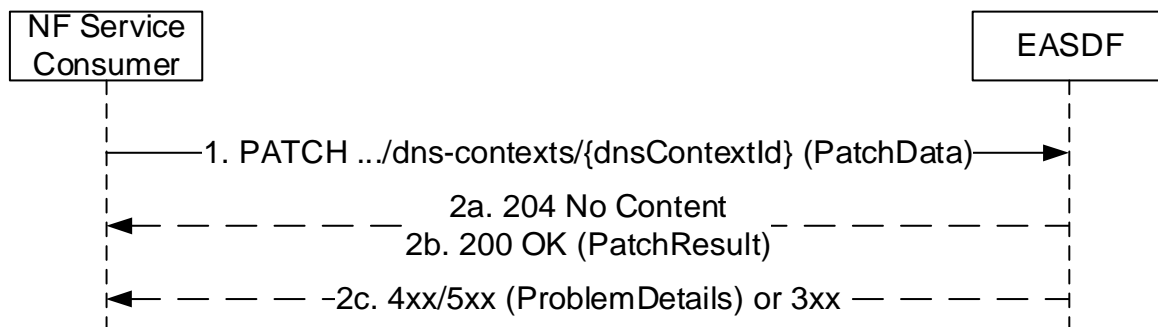


Figure 5.2.2.3.1-1: DNS context Partial Update

1. The NF Service Consumer (e.g. SMF) shall send a PATCH request to the resource URI representing the individual DNS context, identified by the {dnsContextId}. The content of the PATCH request shall contain the list of operations (add/delete/replace) to be applied to parameters in the individual DNS context.
- 2a. On success, if all the modification instructions in the PATCH request have been implemented, "204 No Content" shall be returned.

2b. If some of the modification instructions for unknown attribute(s) in the PATCH request have been ignored, the EASDF shall respond with "200 OK" with the response body containing PatchResult, as specified in clause 5.2.7.2 of 3GPP TS 29.500 [4].

2c. On failure or redirection, one of the HTTP status code listed in Table 6.1.3.3.3.2-3 shall be returned.

To perform a complete replacement of the data of the DNS context of a given DNS context Id, the NF Service Consumer shall issue an HTTP PUT request, as shown in Figure 5.2.2.3.1-2:

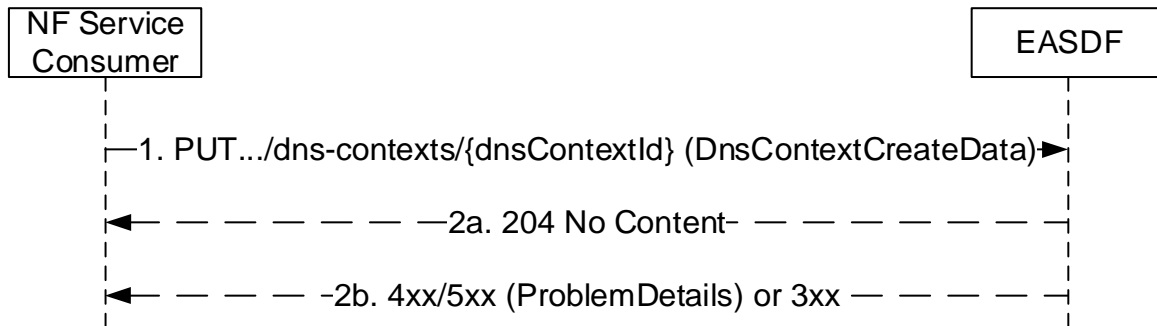


Figure 5.2.2.3.1-2: DNS context Complete Replacement

1. The NF service consumer (e.g. SMF) shall send a PUT request to the resource URI representing the individual DNS context, identified by the {dnsContextId}. The content of the PUT request shall contain a representation of the individual DNS context to be completely replaced in the EASDF.

2a. On success, "204 No Content" shall be returned.

2b. On failure or redirection, one of the HTTP status code listed in Table 6.1.3.3.3.3 shall be returned.

For HR-SBO in VPLMN, if the V-SMF has created the DNS context with an unspecified UE IP address, the V-SMF shall use either of the procedures above including the UE IP address assigned by the HPLMN to complete the configuration of the context in the V-EASDF.

5.2.2.4 Delete

5.2.2.4.1 General

The Delete Service operation shall be used by the NF service consumer (e.g. SMF) to delete the individual DNS context in the EASDF.

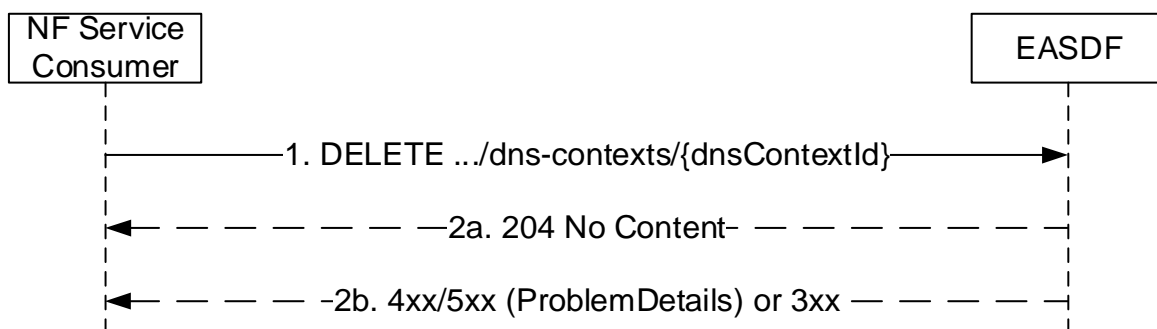


Figure 5.2.2.4.1-1: DNS context deletion

1. The NF Service Consumer (e.g. SMF) shall send a DELETE request to delete the individual DNS context represented by the {dnsContextId}. The request body shall be empty.

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

2b. On failure or redirection, one of the HTTP status code listed in Table 6.1.3.3.3.1-3 shall be returned.

5.2.2.5 Notify

5.2.2.5.1 General

The Notify service operation shall be used to notify the NF Service Consumer (e.g. SMF or V-SMF) about a DNS context related event, e.g. if a received DNS Query message or DNS response message matches a DNS detection template of an DNS rule and the associated action requires to report the message to the NF service producer.

It is used in the following procedures:

- EAS Discovery Procedure with EASDF (see clause 6.2.3.2.2 of 3GPP TS 23.548 [14]); and
- EAS Discovery Procedure with V-EASDF for HR-SBO (see clauses 6.7.2.2 and 6.7.2.3) of 3GPP TS 23.548 [14].

The EASDF shall send an HTTP POST request targeting the DNS context notification URI provided by the NF Service Consumer in the Create or Update service operation (see clause 5.2.2.2.1). See also Figure 5.2.2.5.1-1.

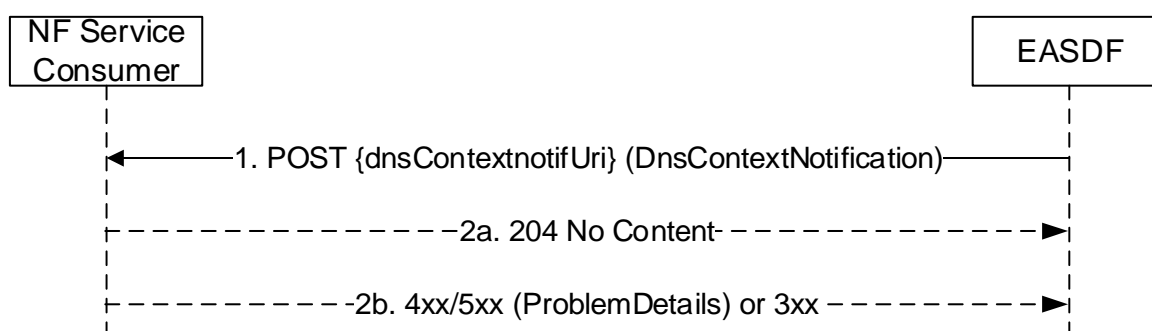


Figure 5.2.2.5.1-1: DNS Context Notify

1. The EASDF shall send a HTTP POST request to the DNS context notification URI, and the content of the POST request shall contain a DnsContextNotification data structure, with the DNS message report that was subscribed by the NF Service Consumer.
- 2a. On success, "204 No Content" shall be returned and the content of the POST response shall be empty.
- 2b. On failure or redirection, one of the HTTP status code listed in Table 6.1.5.2.3.1-3 shall be returned.

If the EASDF receives a "404 Not Found" response with the application error "DNS_CONTEXT_NOT_FOUND", the EASDF should consider that the DNS context is no longer valid and delete the DNS context.

The EASDF should not keep on sending notification requests to an NF service consumer and may consider that the DNS context is no longer valid and delete the DNS context, if it receives one or more "404 Not Found" responses without an application error or with other application errors.

5.2.3 DNS messages processing by EASDF

5.2.3.1 Introduction

This clause specifies how the EASDF shall process DNS messages according to the instructions received from the SMF.

5.2.3.2 DNS message processing model

5.2.3.2.1 DNS Context

The SMF shall control how the EASDF processes DNS messages received for a particular UE's PDU session by creating one single DNS context per PDU session including the following information:

- the UE IP address, S-NSSAI and DNN of the PDU session;
- the H-PLMN ID for a PDU session supporting HR-SBO in VPLMN; and
- one or more DNS rules.

There shall be at most one DNS context created in the EASDF with the same UE IP address, S-NSSAI and DNN, and for HR-SBO in VPLMN, in addition with the same H-PLMN ID. If the EASDF receives a request to create a DNS context for which another DNS context already exists with the same UE IP address, S-NSSAI and DNN, and for HR-SBO in VPLMN, in addition with the same H-PLMN ID, the EASDF shall proceed with creating the DNS context and shall delete the earlier existing DNS context with the same UE IP address, S-NSSAI and DNN, and for HR-SBO in VPLMN, in addition with the same H-PLMN ID.

As an exception, for HR-SBO in VPLMN, several DNS contexts may be created in the V-EASDF with an unspecified UE IP address and the same S-NSSAI, DNN and H-PLMN ID (see clause 5.2.2.2.1). The V-EASDF shall support creating such DNS contexts without deleting earlier DNS contexts with the same unspecified UE IP address, S-NSSAI, DNN and H-PLMN ID.

5.2.3.2.2 DNS Rule

A DNS rule shall apply either to DNS Query messages or DNS Response messages. A DNS rule shall contain:

- the DNS Rule ID uniquely identifying the DNS rule within the DNS context, for a DNS rule other than a One-Time DNS rule;
- precedence information, indicating the order in which the EASDF shall attempt to match DNS messages against all the DNS rules provisioned in the DNS context, for a DNS rule other than a One-Time DNS rule;
- for a DNS rule provisioned for DNS Query messages:
 - for a DNS rule other than a One-Time DNS rule:
 - at least one DNS Query Message Detection Template (MDT) or Baseline DNS Query Message Detection Template (BD MDT) ID referring to a BD MDT provisioned in a baseline DNS pattern; such a DNS rule may contain one or more DNS Query MDTs and/or BD MDT IDs referring to BD MDTs provisioned in one or more baseline DNS patterns; or
 - for a One-Time DNS rule:
 - the DNS message identifier uniquely identifying the DNS message buffered in the EASDF;
- for a DNS rule provisioned for DNS Response messages:
 - for a DNS rule other than a One-Time DNS rule:
 - at least one DNS Response MDT or Baseline DNS Response MDT ID referring to a BD MDT provisioned in a baseline DNS pattern; a DNS rule may contain one or more DNS Response MDTs and/or BD MDT IDs referring to BD MDTs provisioned in one or more baseline DNS patterns;
 - for a One-Time DNS rule:
 - the DNS message identifier uniquely identifying the DNS message buffered in the EASDF;
- a list of actions to apply to all DNS messages matching at least one DNS MDT of the DNS rule or one BD MDT referred by the DNS rule.

See clauses 5.2.3.5 and 5.2.3.2.4 for the description of baseline DNS patterns and One-Time DNS rules respectively.

Figure 5.2.3.2-1 provides an overview of DNS contexts, DNS rules (other than One-Time DNS rules) and baseline DNS patterns, depicting one DNS context created with N DNS rules, some of them referring to baseline DNS patterns.

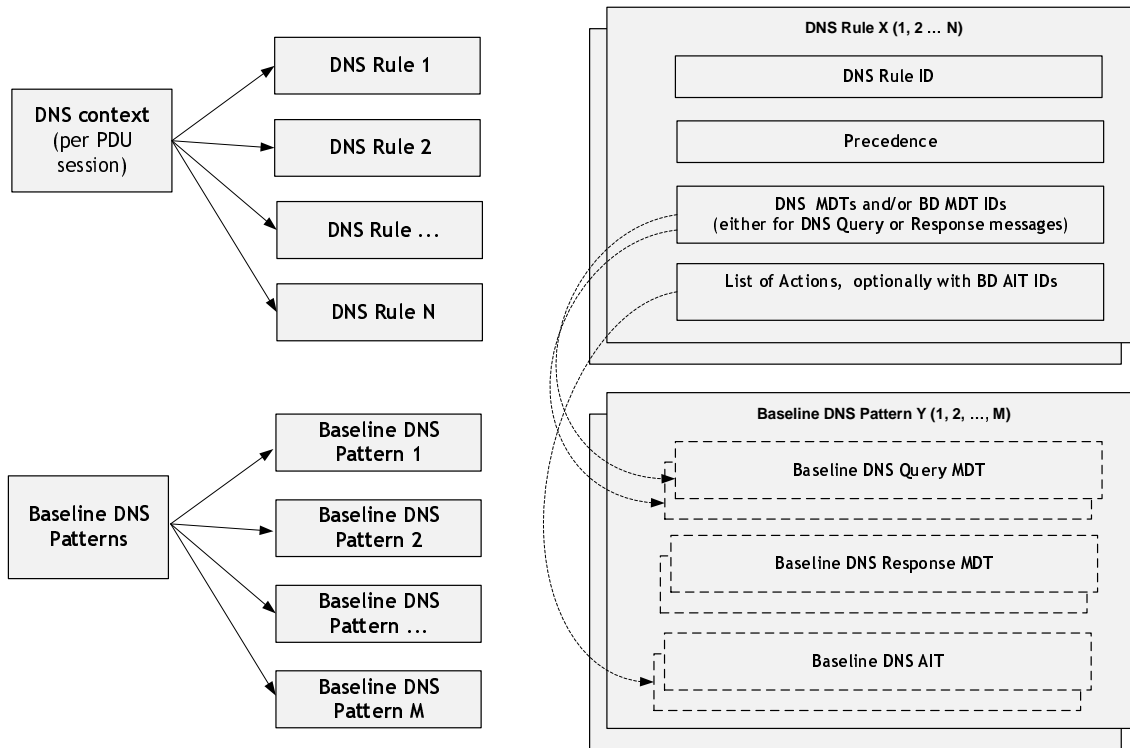


Figure 5.2.3.2-1: Overview of DNS contexts, DNS rules and Baseline DNS Patterns

5.2.3.2.3 Processing flow for incoming DNS messages

Upon receipt of a DNS message, the EASDF shall first identify the DNS context corresponding to the DNS message as follows:

- for DNS Query message: by using the source IP address of the DNS Query message and by matching it with the UE IP address provisioned in the DNS Query MDTs if any or with the UE IP address provisioned in the DNS context; and
- for a DNS Response message: by matching the DNS response with the DNS Query (either by the EASDF assigning a specific Transaction ID when forwarding the DNS Query message and by matching the Transaction ID in the DNS Query and DNS Response, or by the EASDF using a unique couple of source IP address and UDP port per DNS context when forwarding the DNS Query message and by matching the DNS Response message using the destination IP address and UDP port) and by retrieving the DNS context that is associated with the DNS query.

NOTE 1: The EASDF has direct user plane connectivity (i.e., without any NAT) with the PSA UPF over N6 for the transmission of DNS signalling exchanged with the UE. The deployment of a NAT between EASDF and PSA UPF is not supported.

The following options may be used to support DNS contexts with the same (private) UE IP address from different S-NSSAI and DNNs:

- the EASDF may associate a specific EASDF address with a specific S-NSSAI and DNN and provide this address to the SMF during the creation of a DNS context associated with this S-NSSAI and DNN. If so, the EASDF shall also use the destination IP address of DNS Query messages to identify the DNS context matching an incoming DNS request;
- the SMF may set the UE IP address to a mapped N6 address, when using UE source IP address mapping at the Local PSA-UPF;
- the SMF may provide N6 traffic routing information (in the DNS context information) that may contain the IP address and optional port number of the Local PSA-UPF, for HR-SBO in VPLMN, when using N6 tunneling

between the L-PSA and V-EASDF. If so, the V-EASDF shall also use the N6 traffic routing information of DNS Query messages to identify the DNS context matching an incoming DNS request.

To support DNS contexts with the same (private) UE IP address from different PLMNs and from different S-NSSAI and DNNs, the V-EASDF may associate a specific V-EASDF address with a specific HPLMN ID, S-NSSAI and DNN and provide this address to the V-SMF during the creation of a DNS context associated with this HPLMN ID, S-NSSAI and DNN. If so, the V-EASDF shall also use the destination IP address of DNS Query messages to identify the DNS context matching an incoming DNS request.

A DNS context containing an unspecified UE IP address shall be considered to never match any DNS Query message.

If there is no DNS context matching a DNS Query or Response message, the EASDF should forward the DNS Query message towards a preconfigured DNS server and the DNS response towards the UE.

After finding the DNS context, the EASDF shall look up for a DNS rule matching the DNS message, among all DNS rules provisioned in the DNS Context, starting with the DNS rules with the highest precedence and continuing then with DNS rules with a lower precedence, in decreasing order of precedence. If there is no DNS rule matching the DNS message, the EASDF should forward the DNS Query message towards a preconfigured DNS server/resolver for resolution.

NOTE 2: The SMF can provision in the DNS context a DNS rule with the lowest precedence and with a DNS Query MDT or a DNS Response MDT containing a wildcard FQDN, such as to associate a default behavior to all DNS messages not matching any other DNS rule, e.g. forward DNS Query messages to a specific DNS Server.

After having found a matching DNS rule, the EASDF shall stop looking up for other DNS rules and shall apply the list of actions provisioned in the matching DNS rule.

A DNS message matches a DNS rule if it matches at least one MDT of the DNS Rule or one BD MDT referred by the DNS rule.

The DNS message processing models for DNS Query and DNS Response are depicted in Figure 5.2.3.2-2 and 5.2.3.2-3 respectively.

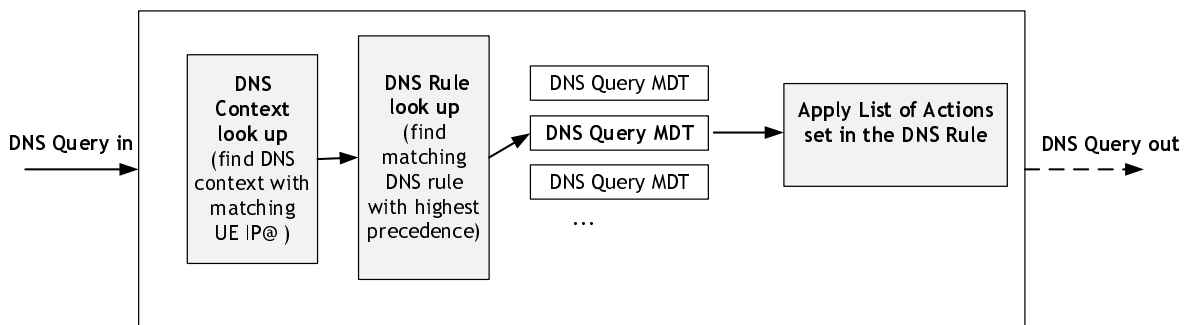


Figure 5.2.3.2-2: DNS Query processing flow in the EASDF

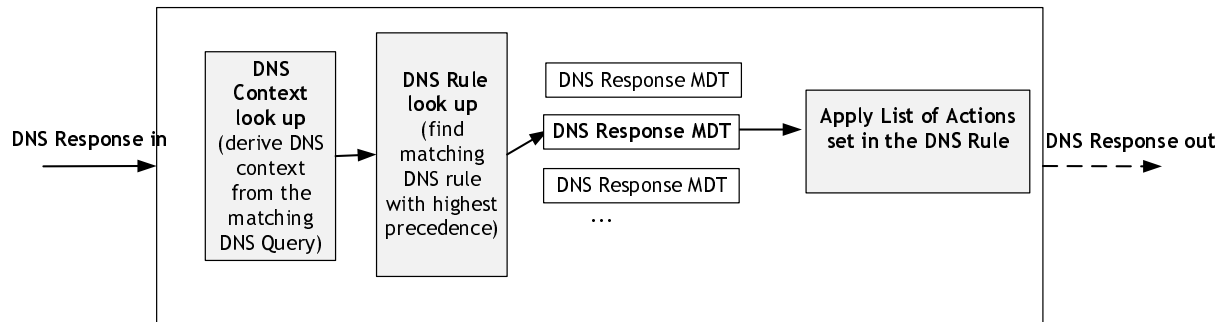


Figure 5.2.3.2-3: DNS Response processing flow in the EASDF

5.2.3.2.4 Processing of a One-Time DNS Rule applicable to a specific DNS message earlier buffered in the EASDF

The SMF may instruct the EASDF to apply certain actions (e.g. forward, drop or respond to a DNS message, or send another DNS Query message) to a specific DNS message, that has been earlier buffered in the EASDF and reported to the SMF, by creating a new DNS rule in the DNS context that includes:

- the DNS message identifier uniquely identifying the DNS message within the DNS context, as reported earlier by the EASDF in the DNSContext Notify request; and
- the requested actions to apply to the DNS message.

Such a DNS rule shall not contain any DNS Rule ID, precedence, MBT nor BD MDT.

Upon receipt of an DNSContext Update request that creates such a DNS rule, the EASDF shall apply the requested actions to the specific DNS message identified by the DNS message identifier and then delete the DNS Rule. If there is no buffered DNS message corresponding to the DNS message identifier received in the DNS rule, the EASDF shall reject the request with an error.

NOTE: A DNS rule that includes a DNS message identifier is referred as a "One-Time" DNS rule throughout this specification since the DNS rule is applied only once for the indicated DNS message and the DNS rule is not further stored by the EASDF.

5.2.3.3 DNS Message Detection Template

5.2.3.3.1 General

The contents of a DNS Query MDT or a DNS Response MDT may be provisioned directly in a DNS rule itself or in a BD MDT provisioned in a baseline DNS pattern. In the latter case, a DNS rule may refer to one or more BD MDTs (that are all either DNS Query MDTs or DNS Response MDTs) of one or more baseline DNS patterns by referencing the BD MDT IDs of the BD MDTs of the baseline DNS patterns.

The following clauses define the contents of DNS Query MDTs and DNS Response MDTs, provisioned in a DNS rule or in a BD MDT.

5.2.3.3.2 DNS Query MDT

A DNS Query Message Detection Template may include:

- a UE IP address;
- a list of FQDN ranges or a wildcard FQDN representing "any FQDN" (see clauses 6.1.6.2.5 and 6.1.6.2.6).

A UE IP address may only be provisioned in a DNS Query MDT, i.e. it cannot be provisioned in a Baseline DNS MDT. However, a DNS rule may be provisioned with a reference to one or more Baseline DNS Query MDTs together with a UE IP address (see clause 6.1.6.2.20), in which case the referenced Baseline DNS Query MDTs shall be matched for the specific UE IP address.

When present in a DNS Query MDT, or together with the reference to a Baseline DNS Query MDT, the UE IP address shall be used for matching the DNS Query message with the related DNS rule (see clause 5.2.3.2). Otherwise, the UE IP address provisioned in the DNS context shall be used.

FQDNs shall be matched against the Query Domain Name of DNS Query messages.

5.2.3.3.3 DNS Response MDT

A DNS Response Message Detection Template may include:

- a list of FQDN ranges or a wildcard FQDN representing "any FQDN";
- a list of EAS IP addresses ranges; and/or
- the source IP address(es) of the DNS Server (applicable to V-SMF and V-EASDF only, for HR-SBO).

FQDNs shall be matched against the Domain Names in the Answers of DNS Response messages.

EAS IP addresses ranges shall be matched against the IP addresses returned in the Answers of DNS Response messages.

5.2.3.4 Actions applicable to DNS message

5.2.3.4.1 General

Each DNS rule shall be provisioned with the list of actions to apply to all DNS messages matching the DNS rule.

The SMF may request the EASDF to apply one or more of the following actions:

- 1) REPORT DNS message content to the SMF.

The SMF may further request the EASDF to send a report only once to the SMF, i.e. only when a first DNS message matches any MDT of the DNS rule. If so, the EASDF shall skip this action (i.e. report to SMF) for any subsequent DNS message matching the DNS rule.

The SMF may further request the EASDF to reset the reporting-once indication, in which case the EASDF shall send (only) one more report at the next DNS message that matches the DNS rule.

- 2) BUFFER DNS message.
- 3) FORWARD DNS message.

The SMF may further request the EASDF to set the destination IP address of the DNS Query message to a specific DNS Server address. The DNS Server address may either be included in the DNS rule or in a Baseline DNS Action Information Template (BD AIT); in the latter case, the DNS rule shall refer to the corresponding BD AIT ID. If no DNS Server address is provided by the SMF, the EASDF shall forward the DNS message to a locally pre-configured DNS server/resolver.

The SMF may request the EASDF to build an EDNS Client Subnet (ECS) option to be included in the DNS Query message as defined in IETF RFC 7871 [18], or to be used for replacing the ECS option if an ECS option is received in the DNS Query message from the UE. The information for the EASDF to build the ECS option may either be included in the DNS rule or in a Baseline DNS Action Information Template (BD AIT); in the latter case, the DNS rule shall refer to the corresponding BD AIT ID.

When forwarding a DNS Query message, if the SMF did not request the EASDF to build an ECS option, the EASDF shall remove the ECS option received from the UE in the DNS Query, if any.

When forwarding a DNS Response message to the UE, based on configuration, the EASDF shall either remove any received ECS option or, if an ECS option was received in the DNS Query from the UE, replace it with the latter ECS option.

- 4) DISCARD DNS message.
- 5) RESPOND to DNS Query message.

If both the SMF and the EASDF support the CEASD feature (see clause 6.1.8), the SMF may instruct the EASDF to build a DNS Response message to a DNS Query message and to send it to the UE by setting the `applyAction` to the value "RESPOND", e.g. when a set of UEs shall use the same EAS (see clause 6.2.3.2.5 of 3GPP TS 23.548 [14]). When requesting so, the SMF shall indicate to the EASDF the EAS IP address(es) that the DNS response shall contain.

Upon receipt of such a request, the EASDF shall build a DNS Response message to the DNS Query message, that includes the EAS IP address(es) indicated by the SMF and send it to the UE.

6) SEND ANOTHER DNS Query message.

The V-SMF may instruct the V-EASDF to send another DNS Query message to another DNS server, upon receiving a DNS Response message. If so, the V-EASDF shall drop the DNS Response message earlier received and send a new DNS Query message to the other DNS server, with the same FQDN as sent in the original DNS Query message. The behavior specified above for the "FORWARD DNS message" action shall also apply to the "SEND ANOTHER DNS QUERY" action, e.g. for the setting of the destination IP address of the new DNS Query message and the possible inclusion or removal of the ECS option.

This action may be used by the V-SMF to request the V-EASDF to send another DNS Query message to the DNS server of the HPLMN, when the VPLMN Specific Offloading Information does not include FQDN ranges and the EAS IP address received from the DNS server used by the VPLMN is not part of the IP addresses ranges authorized in the VPLMN Offloading Information (see clause 6.7.2.3 of 3GPP TS 23.548 [14]).

NOTE 1: The V-SMF can instruct the V-EASDF to send another DNS Query message by provisioning a One-Time DNS rule (see clause 5.2.3.2.4) with the DNS message identifier of the DNS Response buffered and reported to the V-SMF, or alternatively by provisioning a (generic) DNS rule with a lower precedence for DNS Responses with any EAS IP address received from a DNS Server used by the VPLMN.

NOTE 2: The V-SMF can instruct the V-EASDF to forward the DNS Response message received from the DNS Server of the HPLMN to the UE, by provisioning a One-Time DNS rule (see clause 5.2.3.2.4) with the DNS message identifier of the DNS Response buffered and reported to the V-SMF, or alternatively by provisioning a (generic) DNS rule with an even lower precedence for DNS Responses with any EAS IP address received from any DNS Server.

The SMF may change the list of actions associated to a DNS rule (other than a One-Time DNS rule), e.g. to replace the actions to REPORT and BUFFER DNS Query messages to the SMF by the action to FORWARD the DNS messages. In such a case, any earlier buffered DNS message (matching the DNS rule) and any further incoming DNS message shall be processed according to the new instructions received from the SMF, e.g. they shall all be forwarded. The SMF may alternatively request the EASDF to apply certain actions to a specific DNS message by creating a One-Time DNS rule as defined in clause 5.2.3.2.4.

5.2.3.4.2 Event reporting by EASDF

The EASDF shall send a report to the SMF:

- to report the contents of DNS (Query or Response) messages matching a DNS rule provisioned with the action to report the DNS message contents.

The EASDF shall send reports to the SMF as defined in clause 5.2.2.5. The notification request sent to the SMF may contain one or more reports, for DNS Query and/or DNS Response messages matching one or more DNS rules provisioned in the DNS context. For each report, the EASDF may provide a DNS message identifier uniquely identifying the DNS message reported to the SMF within the DNS context (see clause 5.2.3.2.4).

5.2.3.5 Baseline DNS Patterns

5.2.3.5.1 General

The SMF may create, modify or delete baseline DNS patterns in the EASDF using the `Neasdf_BaselineDnsPattern` service (see clause 5.3).

A baseline DNS pattern contains baseline DNS information that may apply to multiple PDU sessions, e.g. to all PDU sessions with a certain DNN and S-NSSAI.

A baseline DNS pattern may contain:

- one or several BD MDTs; and/or
- one or several BD AITs.

A baseline DNS pattern may contain BD MDTs for DNS Query messages and BD MDTs for DNS Response messages. One BD MDT shall be either a DNS Query MDT or a DNS Response MDT (see clause 5.2.3.3).

A BD AIT may include:

- one or more local DNS Server IP address(es); and/or
- ECS option information.

NOTE 1: Multiple DNS Server IP addresses can be provided for resiliency.

A BD MDT and a BD AIT shall be uniquely identified in the EASDF by the combination of the following information:

- the URI of the baseline DNS pattern in which the BD MDT or BD AIT is defined; the URI shall be chosen by the SMF when creating the baseline DNS pattern (see clause 6.2.3); and
- an MDT or AIT identifier (string) uniquely identifying the MDT or AIT within the baseline DNS pattern; this identifier shall be chosen by the SMF when creating the BD MDT or BD AIT.

The URI of a baseline DNS pattern shall be unique per SMF set, if an SMF set controls the EASDF, or unique per SMF otherwise.

NOTE 2: The URI of a baseline DNS pattern includes an identifier of the SMF or SMF set (see clause 6.2.3.1) and SMF implementation specific information. This ensures the uniqueness of the URI in the EASDF when several SMFs or SMF sets control the same EASDF. As an example, an SMF can encode the URI of the baseline DNS pattern and the MDT or AIT identifier to include the DNAI or a sequence number. The EASDF is not meant to understand the structure of this information.

When a BD MDT or BD AIT of a baseline DNS pattern is modified by the SMF, the modified BD MDT or BD AIT shall apply to all DNS rules of all DNS contexts referring to that BD MDT or BD AIT.

5.3 Neasdf_BaselineDNSPattern Service

5.3.1 Service Description

The Neasdf_BaselineDNSPattern service operates on the Baseline DNS patterns in EASDF, which contains the DNS base information that may apply to multiple PDU sessions, e.g. DNS Query and Response MDTs applicable to all PDU sessions with a certain DNN and S-NSSAI. The EASDF is acting as NF Service Producer, while the SMF is the NF Service Consumer.

Following functionalities are provided by the Neasdf_BaselineDNSPattern service:

- Create a Baseline DNS Pattern in EASDF;
- Update the Baseline DNS Pattern in EASDF;
- Delete the Baseline DNS Pattern in EASDF.

The Neasdf_BaselineDNSPattern service supports the following service operations.

Table 5.3.1-1: Service operations supported by the Neasdf_BaselineDNSPattern service

Service Operations	Description	Operation Semantics	Example Consumer(s)
Create	Create a Baseline DNS Pattern in EASDF.	Request/Response	SMF, V-SMF
Update	Update the Baseline DNS Pattern in EASDF.	Request/Response	SMF, V-SMF
Delete	Delete the Baseline DNS Pattern in EASDF.	Request/Response	SMF, V-SMF

5.3.2 Service Operations

5.3.2.1 Introduction

See Table 5.3.1-1 for an overview of the service operations supported by the Neasdf_BaselineDNSPattern service.

5.3.2.2 Create

5.3.2.2.1 General

The Create service operation shall be used to create the Baseline DNS Pattern in the EASDF.

It is used in the following procedures:

- BaselineDNSPattern management in the EASDF procedure (see clause 6.2.3.4.4 of 3GPP TS 23.548 [14]).

The NF Service Consumer (e.g. SMF) shall create the Baseline DNS Pattern by using the HTTP PUT method as shown in Figure 5.3.2.2.1-1.

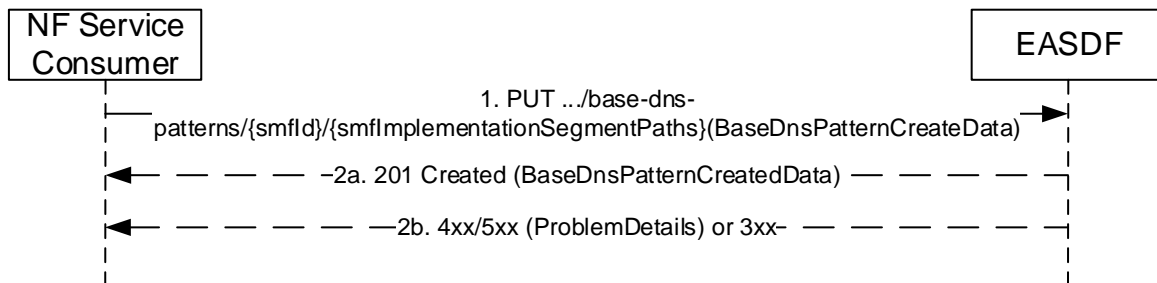


Figure 5.3.2.2.1-1: Baseline DNS Pattern creation

1. The NF Service Consumer shall send a PUT request to create the Baseline DNS Pattern in the EASDF. The content of the PUT request may contain:
 - one or more Baseline DNS message detection templates (MDTs);
 - one or more Baseline DNS action information templates (AITs).
- 2a. On success, a "201 Created" response shall be returned with the "Location" header containing the URI of the created resource.
- 2b. On failure, or redirection, one of the HTTP status code listed in Table 6.2.3.2.3.2-3 shall be returned.

5.3.2.3 Update

5.3.2.3.1 General

The Update service operation shall be used to update an individual Baseline DNS Pattern previously created in the EASDF. The update operation may apply to the whole Baseline DNS Pattern (complete replacement of the data of the existing Baseline DNS Pattern by new data), or it may apply to modify a subset of the parameters of the Baseline DNS Pattern.

It is used in the following procedures:

- BaselineDNSPattern management in the EASDF procedure (see clause 6.2.3.4.4 of 3GPP TS 23.548 [14]).

To perform a partial update of the Baseline DNS Pattern, the NF Service Consumer shall issue an HTTP PATCH request, as shown in Figure 5.3.2.3.1-1. This partial update shall be used to add, delete and/or replace individual parameters of the Baseline DNS Pattern.

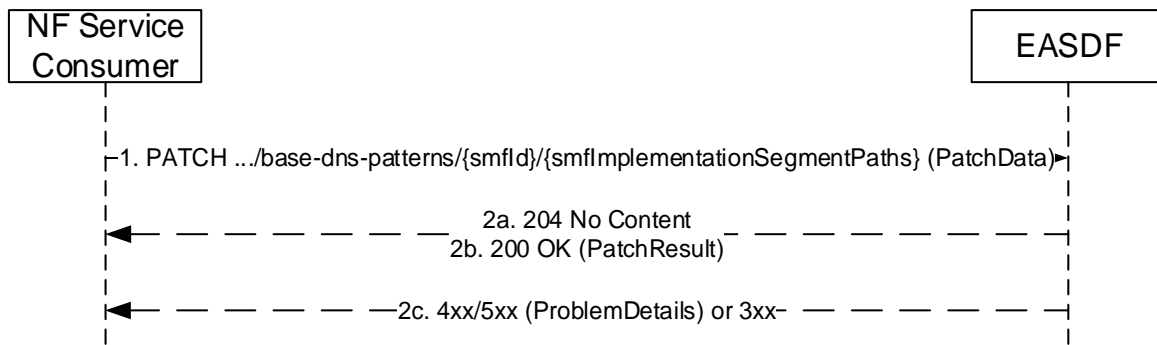


Figure 5.3.2.3.1-1: Baseline DNS Pattern Partial Update

1. The NF Service Consumer (e.g. SMF) shall send a PATCH request to the resource URI representing the individual Baseline DNS Pattern. The content of the PATCH request shall contain the list of operations (add/delete/replace) to be applied to parameters in the individual Baseline DNS Pattern.
- 2a. On success, if all the modification instructions in the PATCH request have been implemented, "204 No Content" shall be returned.
- 2b. If some of the modification instructions for unknown attribute(s) in the PATCH request have been ignored, the EASDF shall respond with "200 OK" with the response body containing PatchResult, as specified in clause 5.2.7.2 of 3GPP TS 29.500 [4].
- 2c. On failure or redirection, one of the HTTP status code listed in Table 6.2.3.2.3.1-3 shall be returned.

To perform a complete replacement of the data of the Baseline DNS Pattern, the NF Service Consumer shall issue an HTTP PUT request, as shown in Figure 5.3.2.3.1-2:

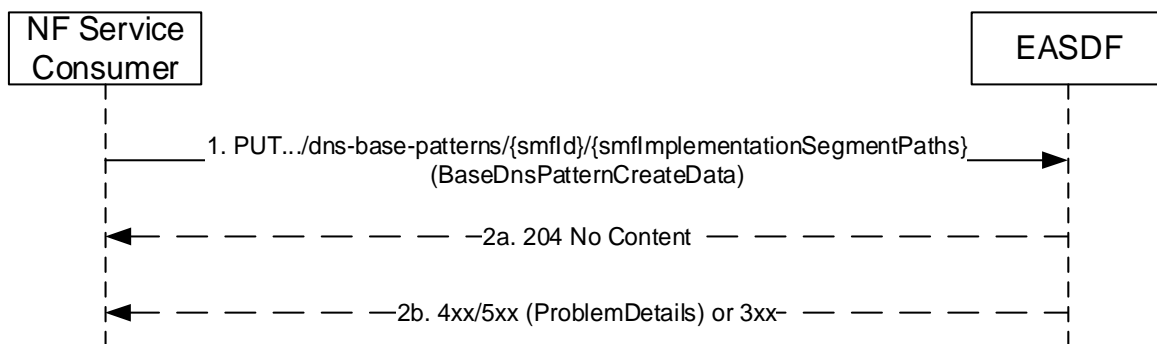


Figure 5.3.2.3.1-2: Baseline DNS Pattern Complete Replacement

1. The NF service consumer (e.g. SMF) shall send a PUT request to the resource URI representing the individual Baseline DNS Pattern. The content of the PUT request shall contain a representation of the individual Baseline DNS Pattern to be completely replaced in the EASDF.
- 2a. On success, "204 No Content" shall be returned.
- 2b. On failure or redirection, one of the HTTP status code listed in Table 6.2.3.2.3.2-3 shall be returned.

5.3.2.4 Delete

5.3.2.4.1 General

The Delete service operation shall be used to delete an individual Baseline DNS Pattern previously created in the EASDF.

It is used in the following procedures:

- BaselineDNSPattern management in the EASDF procedure (see clause 6.2.3.4.4 of 3GPP TS 23.548 [14]).

To perform a deletion of the Baseline DNS Pattern, the NF Service Consumer shall issue an HTTP DELETE request, as shown in Figure 5.3.2.4.1-1.

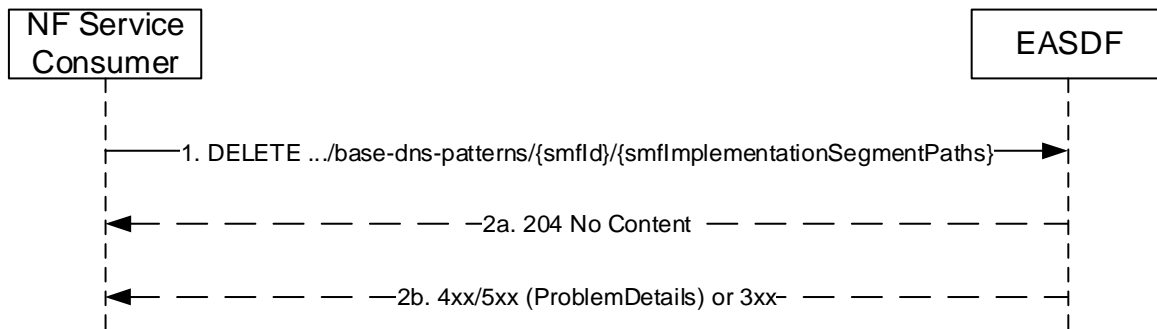


Figure 5.3.2.4.1-1: Baseline DNS Pattern Deletion

1. The NF Service Consumer (e.g. SMF) shall send a DELETE request to delete the individual Baseline DNS Pattern. The request body shall be empty.
- 2a. On success, "204 No Content" shall be returned. The response body shall be empty.
- 2b. On failure or redirection, one of the HTTP status code listed in Table 6.2.3.2.3.3-3 shall be returned.

6 API Definitions

6.1 Neasdf_DNSContext Service API

6.1.1 Introduction

The Neasdf_DNSContext shall use the Neasdf_DNSContext API.

The API URI of the Neasdf_DNSContext API shall be:

{apiRoot}/<apiName>/<apiVersion>

The request URIs used in HTTP requests from the NF service consumer towards the NF service producer shall have the Resource URI structure defined in clause 4.4.1 of 3GPP TS 29.501 [5], i.e.:

{apiRoot}/<apiName>/<apiVersion>/<apiSpecificResourceUriPart>

with the following components:

- The {apiRoot} shall be set as described in 3GPP TS 29.501 [5].
- The <apiName> shall be "neasdf-dnscontext".
- The <apiVersion> shall be "v1".
- The <apiSpecificResourceUriPart> shall be set as described in clause 6.1.3.

6.1.2 Usage of HTTP

6.1.2.1 General

HTTP/2, IETF RFC 9113 [11], 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].

The OpenAPI [6] specification of HTTP messages and content bodies for the Neasdf_DNSContext API is contained in Annex A.

6.1.2.2 HTTP standard headers

6.1.2.2.1 General

See clause 5.2.2 of 3GPP TS 29.500 [4] for the usage of HTTP standard headers.

6.1.2.2.2 Content type

The following content types shall be supported:

- JSON, as defined in IETF RFC 8259 [12], shall be used as content type of the HTTP bodies specified in the present specification as specified in clause 5.4 of 3GPP TS 29.500 [4]. The use of the JSON format shall be signalled by the content type "application/json".
- "Problem Details" JSON Object shall be used to indicate additional details of the error in a HTTP response body and shall be signalled by the content type "application/problem+json", as defined in IETF RFC 9457 [13];
- JSON Patch (IETF RFC 6902 [15]). The use of the JSON Patch format in a HTTP request body shall be signalled by the content type "application/json-patch+json".

6.1.2.3 HTTP custom headers

The mandatory HTTP custom header fields specified in clause 5.2.3.2 of 3GPP TS 29.500 [4] shall be supported, and the optional HTTP custom header fields specified in clause 5.2.3.3 of 3GPP TS 29.500 [4] may be supported. In this release of this specification, no custom headers specific to the Neasdf_DNSContext service are defined.

6.1.3 Resources

6.1.3.1 Overview

Figure 6.1.3.1-1 describes the resource URI structure of the Neasdf_DNSContext API.

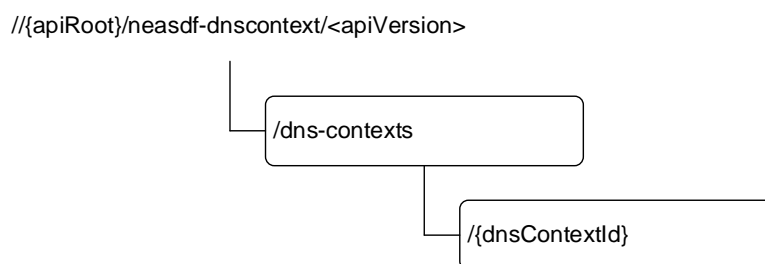


Figure 6.1.3.1-1: Resource URI structure of the Neasdf_DNSContext API

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	Description (service operation)
DNS contexts collection	/dns-contexts	POST	Create
Individual DNS context	/dns-contexts/{dnsContextId}	PATCH	Update (partial update)
		PUT	Update (complete replacement)
		DELETE	Delete

6.1.3.2 Resource: DNS contexts collection

6.1.3.2.1 Description

This resource represents the collection of the individual DNS contexts created in the EASDF.

This resource is modelled with the Collection resource archetype (see clause C.2 of 3GPP TS 29.501 [5]).

6.1.3.2.2 Resource Definition

Resource URI: {apiRoot}/neasdf-dnscontext/<apiVersion>/dns-contexts

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	Data type	Definition
apiRoot	string	See clause 6.1.1
apiVersion	string	See clause 6.1.1

6.1.3.2.3 Resource Standard Methods

6.1.3.2.3.1 POST

This method creates an individual DNS context resource in the EASDF.

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 POST method on this resource

Name	Data type	P	Cardinality	Description	Applicability
n/a					

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 POST Request Body on this resource

Data type	P	Cardinality	Description
DnsContextCreateData	M	1	Representation of the DNS context to be created in the EASDF

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

Data type	P	Cardinality	Response codes	Description
DnsContextCreatedData	M	1	201 Created	Successful creation of a DNS context
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. (NOTE 2)
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. (NOTE 2)
ProblemDetails	O	0..1	400 Bad Request	The "cause" attribute may be set to one of the following application errors: - BASELINE_DNS_PATTERN_UNKNOWN - BASELINE_DNS_MDT_UNKNOWN - BASELINE_DNS_AIT_UNKNOWN

NOTE 1: The mandatory HTTP error status code for the POST method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] also apply.

NOTE 2: RedirectResponse may be inserted by an SCP, see clause 6.10.9.1 of 3GPP TS 29.500 [4].

Table 6.1.3.2.3.1-4: Headers supported by the 201 response code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	Contains the URI of the newly created resource, according to the structure: {apiRoot}/neasdf-dnscontext/<apiVersion>/dns-contexts/{dnsContextId}

Table 6.1.3.2.3.1-5: Headers supported by the 307 response code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same EASDF or EASDF (service) set. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target EASDF (service) instance ID towards which the request is redirected

Table 6.1.3.2.3.1-6: Headers supported by the 308 response code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same EASDF or EASDF (service) set. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target EASDF (service) instance ID towards which the request is redirected

6.1.3.2.4 Resource Custom Operations

None.

6.1.3.3 Resource: Individual DNS context

6.1.3.3.1 Description

This resource represents an individual DNS context created in the EASDF.

This resource is modelled with the Document resource archetype (see clause C.1 of 3GPP TS 29.501 [5]).

6.1.3.3.2 Resource Definition

Resource URI: **{apiRoot}/neasdf-dnscontext/<apiVersion>/dns-contexts/{dnsContextId}**

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	Data type	Definition
apiRoot	string	See clause 6.1.1.
apiVersion	string	See clause 6.1.1.
dnsContextId	string	DNS context Identifier assigned by the EASDF during the Create service operation.

6.1.3.3.3 Resource Standard Methods

6.1.3.3.3.1 DELETE

This method deletes an individual DNS context resource in the EASDF.

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 DELETE method on this resource

Name	Data type	P	Cardinality	Description	Applicability
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 DELETE 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 DELETE Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Successful deletion of the DNS context.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. (NOTE 2)
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. (NOTE 2)
ProblemDetails	O	0..1	404 Not Found	Indicates that the deletion of the DNS context failed due to an application error. The "cause" attribute may be used to indicate one of the following application errors: - DNS_CONTEXT_NOT_FOUND.
NOTE 1: The mandatory HTTP error status code for the DELETE method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] also apply.				
NOTE 2: RedirectResponse may be inserted by an SCP, see clause 6.10.9.1 of 3GPP TS 29.500 [4].				

Table 6.1.3.3.3.1-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same EASDF or EASDF (service) set. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target EASDF (service) instance ID towards which the request is redirected

Table 6.1.3.3.3.1-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same EASDF or EASDF (service) set. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target EASDF (service) instance ID towards which the request is redirected

6.1.3.3.3.2 PATCH

This method updates (partial update) an individual DNS context resource in the EASDF.

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 PATCH method on this resource

Name	Data type	P	Cardinality	Description	Applicability
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 6.1.3.3.2-2: 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 DNS context, according to the JSON PATCH format specified in IETF RFC 6902 [15].

Table 6.1.3.3.2-3: Data structures supported by the PATCH Response Body on this resource

Data type	P	Cardinality	Response codes	Description
PatchResult	M	1	200 OK	Upon partial success, e.g. some of the requested modifications for unknown attribute(s) are discarded while the rest of the modification instructions are fully accepted, the EASDF shall return the execution report.
n/a			204 No Content	Successful update of the DNS context.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. (NOTE 2)
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. (NOTE 2)
ProblemDetails	O	0..1	404 Not Found	Indicates that the modification of the DNS context failed due to an application error. The "cause" attribute may be used to indicate one of the following application errors: - DNS_CONTEXT_NOT_FOUND.
NOTE 1: The mandatory HTTP error status code for the PATCH method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] also apply.				
NOTE 2: RedirectResponse may be inserted by an SCP, see clause 6.10.9.1 of 3GPP TS 29.500 [4].				

Table 6.1.3.3.2-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same EASDF or EASDF (service) set. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target EASDF (service) instance ID towards which the request is redirected

Table 6.1.3.3.2-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same EASDF or EASDF (service) set. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target EASDF (service) instance ID towards which the request is redirected

6.1.3.3.3.3 PUT

This method updates (complete replacement) an individual DNS context resource in the EASDF.

This method shall support the URI query parameters specified in table 6.1.3.3.3-1.

Table 6.1.3.3.3-1: URI query parameters supported by the PUT method on this resource

Name	Data type	P	Cardinality	Description	Applicability
n/a					

This method shall support the request data structures specified in table 6.1.3.3.3-2 and the response data structures and response codes specified in table 6.1.3.3.3-3.

Table 6.1.3.3.3-2: Data structures supported by the PUT Request Body on this resource

Data type	P	Cardinality	Description
DnsContextCreateData	M	1	DNS Context Data to replace the existing DNS context data

Table 6.1.3.3.3-3: Data structures supported by the PUT Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Successful update of the DNS context.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. (NOTE 2)
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. (NOTE 2)

NOTE 1: The mandatory HTTP error status code for the PUT method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] also apply.

NOTE 2: RedirectResponse may be inserted by an SCP, see clause 6.10.9.1 of 3GPP TS 29.500 [4].

Table 6.1.3.3.3-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same EASDF or EASDF (service) set. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target EASDF (service) instance ID towards which the request is redirected

Table 6.1.3.3.3-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same EASDF or EASDF (service) set. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target EASDF (service) instance ID towards which the request is redirected

6.1.3.3.4 Resource Custom Operations

There are no resource custom operations for the Neasdf_DNSContext service in this release of the specification.

6.1.4 Custom Operations without associated resources

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

6.1.5 Notifications

6.1.5.1 General

This clause specifies the notifications supported by the Neasdf_DNSContext service.

Notifications shall comply to clause 6.2 of 3GPP TS 29.500 [4] and clause 4.6.2.3 of 3GPP TS 29.501 [5].

Table 6.1.5.1-1: Notifications overview

Notification	Callback URI	HTTP method or custom operation	Description (service operation)
DNS Context Notification	{notifyUri} (Notification URI provided by NF Service Consumer)	POST	DNS Context Notify

6.1.5.2 DNS Context Notify

6.1.5.2.1 Description

The Event Notification is used by the EASDF to report one or several observed Events to a NF service consumer(e.g. SMF) that has subscribed to such Notifications.

6.1.5.2.2 Target URI

The Callback URI "{**notifyUri**}" shall be used with the callback URI variables defined in table 6.1.5.2.2-1.

Table 6.1.5.2.2-1: Callback URI variables

Name	Definition
notifyUri	String formatted as URI with the Callback Uri

6.1.5.2.3 Standard Methods

6.1.5.2.3.1 POST

This method shall support the request data structures specified in table 6.1.5.2.3.1-1 and the response data structures and response codes specified in table 6.1.5.2.3.1-1.

Table 6.1.5.2.3.1-2: Data structures supported by the POST Request Body

Data type	P	Cardinality	Description
DnsContextNotification	M	1	Representation of the DNS context notification

Table 6.1.5.2.3.1-3: Data structures supported by the POST Response Body

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Successful notification of the DNS context change
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. (NOTE 2)
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. (NOTE 2)
ProblemDetails	O	0..1	404 Not Found	Indicates that the notification for the DNS context failed due to an application error. The "cause" attribute may be used to indicate one of the following application errors: - DNS_CONTEXT_NOT_FOUND.
NOTE 1: The mandatory HTTP error status codes for the POST method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] also apply.				
NOTE 2: RedirectResponse may be inserted by an SCP, see clause 6.10.9.1 of 3GPP TS 29.500 [4].				

Table 6.1.5.2.3.1-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance. For the case when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the notification is redirected

Table 6.1.5.2.3.1-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance. For the case when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the notification is redirected

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 Neasdf_DNSContext service based interface protocol.

Table 6.1.6.1-1: Neasdf_DNSContext specific Data Types

Data type	Clause defined	Description	Applicability
DnsContextCreateData	6.1.6.2.2	Data in DNS Context Create request	
DnsContextCreatedData	6.1.6.2.3	Data in DNS Context Create response	
DnsRule	6.1.6.2.4	DNS handling rule	
DnsQueryMdt	6.1.6.2.5	DNS Query Message Detection Template	
DnsRspMdt	6.1.6.2.6	DNS Response Message Detection Template	
Ipv4AddressRange	6.1.6.2.7	IPv4 addresses range	
Ipv6PrefixRange	6.1.6.2.8	IPv6 addresses range	
Action	6.1.6.2.9	Action to apply to DNS messages matching a message detection template	
DnsContextNotification	6.1.6.2.10	DNS context notification	
ForwardingParameters	6.1.6.2.11	Forwarding instructions	
EcsOption	6.1.6.2.12	ECS Option information	
DnsContextEventReport	6.1.6.2.13	DNS context Event report	
DnsQueryReport	6.1.6.2.14	DNS Query Event Report	
DnsRspReport	6.1.6.2.15	DNS Response Event Report	
EcsOptionInfo	6.1.6.2.16	ECS option information	
DnsServerAddressInfo	6.1.6.2.17	DNS Server address information	
BaselineDnsMdtId	6.1.6.2.18	Baseline DNS Message Detection Template Identifier	
BaselineDnsAitId	6.1.6.2.19	Baseline DNS Action Information Template Identifier	
BaselineDnsQueryMdtInfo	6.1.6.2.20	Baseline DNS Query MDT ID and optionally associated information	
BaselineDnsRspMdtInfo	6.1.6.2.21	Baseline DNS Response MDT ID and optionally associated information	
RespondParameters	6.1.6.2.22	Instructions to apply to build a DNS response message	
N6RoutingInfo	6.1.6.2.23	N6 traffic routing information	
ApplyAction	6.1.6.3.3	Action to apply to the DNS packet	

Table 6.1.6.1-2 specifies data types re-used by the Neasdf 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 Neasdf_DNSContext service based interface.

Table 6.1.6.1-2: Neasdf_DNSContext re-used Data Types

Data type	Reference	Comments	Applicability
IPv4Addr	3GPP TS 29.571 [16]	IPv4 address	
IPv6Prefix	3GPP TS 29.571 [16]	IPv6 prefix	
Dnn	3GPP TS 29.571 [16]	DNN	
Uri	3GPP TS 29.571 [16]	URI	
UInt32	3GPP TS 29.571 [16]	Unsigned 32-bit integer	
IpAddr	3GPP TS 29.571 [16]	IP address	
IPv6Addr	3GPP TS 29.571 [16]	IPv6 address	
SupportedFeatures	3GPP TS 29.571 [16]	Supported features	
DateTime	3GPP TS 29.571 [16]	Date and time	
PatchResult	3GPP TS 29.571 [16]		
FqdnPatternMatchingRule	3GPP TS 29.571 [16]	FQDN Pattern Matching Rule	
Fqdn	3GPP TS 29.571 [16]		
Snssai	3GPP TS 29.571 [16]		
PlmnId	3GPP TS 29.571 [16]	PLMN Identity	

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: DnsContextCreateData

Table 6.1.6.2.2-1: Definition of type DnsContextCreateData

Attribute name	Data type	P	Cardinality	Description	Applicability
uelpv4Addr	Ipv4Addr	C	0..1	UE IPv4 address (NOTE 1)	
uelpv6Prefix	Ipv6Prefix	C	0..1	UE IPv6 prefix (NOTE 1)	
dnn	Dnn	M	1	DNN of the PDU session (NOTE 2)	
sNssai	Snssai	M	1	S-NSSAI of the PDU session (NOTE 2)	
hplmnlid	Plmnlid	C	0..1	This IE shall be included by the V-SMF towards the V-EASDF, for a PDU session supporting HR-SBO. When present, it shall be set to the H-PLMN ID of the PDU session.	HR-SBO
n6RoutingInfo	N6RoutingInfo	O	0..1	This IE may be present when using N6 tunneling between the L-PSA and V-EASDF, to disambiguate the DNS traffic using a private UE IP address from a certain HPLMN using a specific L-PSA UPF IP address and optional port number of the N6 tunnel between the Local PSA-UPF and V-EASDF	HR-SBO
dnsRules	map(DnsRule)	M	1..N	Map of DNS message handling rules. The key of the map shall be a (unique) valid JSON string per clause 7 of IETF RFC 8259 [12], with a maximum of 32 characters.	
notifyUri	Uri	C	0..1	Callback URI to receive notifications. This IE shall be present if the NF service consumer subscribes to receive DNS context notifications.	
supportedFeatures	SupportedFeatures	C	0..1	This IE shall be present if at least one optional feature defined in clause 6.1.8 is supported.	
NOTE 1: At least one of the uelpv4Addr and uelpv6Prefix attributes shall be present. If the EASDF supports the HR-SBO feature (i.e. if it supports acting as a V-EASDF), for a PDU session supporting HR-SBO, the V-SMF shall set the uelpv4Addr IE and/or uelpv6Prefix to an unspecified address (see clause 5.2.2.2.1) if the UE IP address is not yet known.					
NOTE 2: The UE IP address shall be used together with the DNN and S-NSSAI to uniquely identify the DNS context associated with a PDU session (e.g. in deployments where the same EASDF is used for PDU sessions to DNS with overlapping IP address spaces) and to associate the DNS context with a specific DN (and e.g. related tunnels connecting to the DN).					

6.1.6.2.3 Type: DnsContextCreatedData

Table 6.1.6.2.3-1: Definition of type DNSContextCreatedData

Attribute name	Data type	P	Cardinality	Description	Applicability
easdlpv4Addr	IPv4Addr	C	0..1	EASDF IPv4 address	
easdlpv6Addr	IPv6Addr	C	0..1	EASDF IPv6 address	
supportedFeatures	SupportedFeatures	C	0..1	This IE shall be present if at least one optional feature defined in clause 6.1.8 is supported.	
NOTE: At least one of the easdlpv4Addr and easdlpv6Addr attributes shall be present.					

6.1.6.2.4 Type: DnsRule

Table 6.1.6.2.4-1: Definition of type DnsRule

Attribute name	Data type	P	Cardinality	Description	Applicability
dnsRuleId	string	C	0..1	Unique Identifier of the DNS rule within the DNS context This IE shall be present for a DNS rule other than a One-Time DNS rule.	
label	string	O	0..1	DNS rule's label (NOTE 5)	
precedence	Uint32	C	0..1	Precedence of the DNS message handling rule. This IE shall be present for a DNS rule other than a One-Time DNS rule. The lower precedence values indicate higher precedence of the DNS rule, and the higher precedence values indicate lower precedence of the DNS rule when matching a DNS message.	
dnsQueryMdtList	map(DnsQueryMdt)	C	1..N	Map of DNS Query message detection templates. The key of the map shall be a (unique) valid JSON string per clause 7 of IETF RFC 8259 [12], with a maximum of 32 characters. (NOTE 3)	
baseDnsQueryMdtList	array(BaselineDnsQueryMdtInfo)	C	1..N	List of Baseline DNS Query Message Detection Template IDs and optionally associated information. (NOTE 3)	
dnsRspMdtList	map(DnsRspMdt)	C	1..N	Map of DNS Response message detection templates. The key of the map shall be a (unique) valid JSON string per clause 7 of IETF RFC 8259 [12], with a maximum of 32 characters. (NOTE 4)	
baseDnsRspMdtList	array(BaselineDnsRspMdtInfo)	C	1..N	List of Baseline DNS Response Message Detection Template IDs and optionally associated information. (NOTE 4)	
dnsMsgId	string	C	0..1	DNS message identifier This IE shall be present for a One-Time DNS Rule and it shall be set to the identifier of the DNS message buffered in the EASDF for which the DNS rule shall apply (see clause 5.2.3.2.4). (NOTE 6)	
actionList	map(Action)	M	1..N	Map of Actions to apply to DNS messages matching the DNS message detection templates. The key of the map shall be a (unique) valid JSON string per clause 7 of IETF RFC 8259 [12], with a maximum of 32 characters.	
<p>NOTE 1: A DNS rule shall be provisioned either for DNS Query messages or for DNS Response messages.</p> <p>NOTE 2: A DNS rule including the dnsMsgId IE shall be considered as a One-Time DNS Rule (see clause 5.2.3.2.4).</p> <p>NOTE 3: For a DNS rule other than a One-Time DNS rule provisioned for DNS Query messages, at least one of the dnsQueryMdtList and baseDnsQueryMdtList IEs shall be present.</p> <p>NOTE 4: For a DNS Rule other than a One-Time DNS rule provisioned for DNS Response messages, at least one of the dnsRspMdtList and baseDnsRspMdtList IEs shall be present.</p> <p>NOTE 5: This attribute may contain free information describing the scope of the DNS rule. It may be used e.g. for trouble-shooting.</p> <p>NOTE 6: An EASDF can encode the DNS message identifier as the ID field in the header of the DNS message, or as any other string uniquely identifying the DNS message within the DNS context.</p>					

6.1.6.2.5 Type: DnsQueryMdt

Table 6.1.6.2.5-1: Definition of type DnsQueryMdt

Attribute name	Data type	P	Cardinality	Description	Applicability
mdtId	string	M	1	Identifier of the DNS Query message detection template, with a maximum of 32 characters.	
label	string	O	0..1	DNS Query MDT's label (NOTE 2)	
sourceIpv4Addr	Ipv4Addr	O	0..1	UE IPv4 address (NOTE 1)	
sourceIpv6Prefix	Ipv6Prefix	O	0..1	UE IPv6 prefix (NOTE 1)	
fqdnPatternList	array(FqdnPatternMatchingRule)	O	1..N	List of FQDN patterns, where each FQDN pattern is described by a FQDN Pattern Matching Rule. An FQDN value is considered part of the template if and only if the FQDN in the Queries field in the DNS Query message fully matches at least one FQDN pattern. (NOTE 3)	
NOTE 1: If neither the sourceIpv4Addr IE nor the sourceIpv6Prefix IE is present, the UE IP address in the DNS Context Data shall be assumed.					
NOTE 2: This attribute may contain free information describing the scope of the DNS Query MDT. It may be used e.g. for trouble-shooting.					
NOTE 3: The list of FQDN patterns may encode some FQDN patterns with a string matching rule and others with a regular expression (when the FQDN patterns cannot be described by a string matching rule).					

6.1.6.2.6 Type: DnsRspMdt

Table 6.1.6.2.6-1: Definition of type DnsRspMdt

Attribute name	Data type	P	Cardinality	Description	Applicability
mdtId	string	M	1	Identifier of the DNS Response message detection template, with a maximum of 32 characters.	
label	string	O	0..1	DNS Response MDT's label (NOTE 1)	
fqdnPatternList	array(FqdnPatternMatchingRule)	O	1..N	List of FQDN patterns, where each FQDN pattern is described by a FQDN Pattern Matching Rule. An FQDN value is considered part of the template if and only if the FQDN in the Queries field in the DNS Response message fully matches at least one FQDN pattern. (NOTE 2)	
easIpv4AddrRanges	array(Ipv4AddressRange)	O	1..N	List of EAS IPv4 addresses ranges	
easIpv6PrefixRanges	array(Ipv6PrefixRange)	O	1..N	List of EAS IPv6 prefixes ranges	
dnsServerSrcAddrList	array(IpAddr)	O	1..N	List of DNS Server source IP addresses	HR-SBO
NOTE 1: This attribute may contain free information describing the scope of the DNS Response MDT. It may be used e.g. for trouble-shooting.					
NOTE 2: The list of FQDN patterns may encode some FQDN patterns with a string matching rule and others with a regular expression (when the FQDN patterns cannot be described by a string matching rule).					

6.1.6.2.7 Type: Ipv4AddressRange

Table 6.1.6.2.7-1: 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

6.1.6.2.8 Type: Ipv6PrefixRange

Table 6.1.6.2.8-1: 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

6.1.6.2.9 Type: Action

Table 6.1.6.2.9-1: Definition of type Action

Attribute name	Data type	P	Cardinality	Description	Applicability
applyAction	ApplyAction	M	1	Action to apply to the DNS message	
fwdParas	ForwardingParameters	O	0..1	This IE may be present if the applyAction IE is set to "FORWARD" or "SEND_ANOTHER_DNS_QUERY". When present, it shall contain forward instructions to apply to the DNS message before forwarding it.	
reportingOnceInd	boolean	O	0..1	Reporting-once Indication This IE may be present if the applyAction is set to "REPORT". When present, it shall be set as follows: - true: only one report shall be sent to the SMF, i.e. one report shall only be sent when a first DNS message matches any Message Detection Template of the DNS rule. - false (default): a report shall be sent to the SMF for any DNS message matching any Message Detection Template of the DNS rule.	
resetReportingOnceInd	boolean	O	0..1	Reset the Reporting-once Indication This IE may be present in a request modifying a DNS rule, if the applyAction is set to "REPORT" and the reportingOnceInd is set to "true". When present, it shall be set as follows: - true: reset the Reporting-once Indication, i.e. send (only) one more report to the SMF when a next first DNS message matches any Message Detection Template of the DNS rule. - false (default): do not reset the Reporting-once Indication	
respParas	RespondParameters	C	0..1	This IE shall be present if the applyAction IE is set to "RESPOND". When present, it shall contain instructions to apply to build the DNS response message.	CEASD

6.1.6.2.10 Type: DnsContextNotification

Table 6.1.6.2.10-1: Definition of type DnsContextNotification

Attribute name	Data type	P	Cardinality	Description
eventreportList	array(DnsContextEventReport)	O	1..N	List of event reports

6.1.6.2.11 Type: ForwardingParameters

Table 6.1.6.2.11-1: Definition of type ForwardingParameters

Attribute name	Data type	P	Cardinality	Description
ecsOptionInfo	EcsOptionInfo	O	0..1	Information to build optional EDNS Client Subnet (ECS) option to be included in the DNS Query as defined in IETF RFC 7871 [18], or to be used for replacing the ECS option received in the DNS Query message from the UE.
dnsServerAddressInfo	DnsServerAddressInfo	O	0..1	DNS Server Address Information to be used as destination address of the outgoing DNS Query

6.1.6.2.12 Type: EcsOption

Table 6.1.6.2.12-1: Definition of type EcsOption

Attribute name	Data type	P	Cardinality	Description
sourcePrefixLength	integer	M	1	Leftmost number of significant bits of the IP address as defined for the SOURCE PREFIX-LENGTH in clause 6 of IETF RFC 7871 [18]. Minimum=0. Maximum=128
scopePrefixLength	integer	O	0..1	Leftmost number of bits of the IP address that the DNS response covers as defined for the SCOPE PREFIX-LENGTH in clause 6 of IETF RFC 7871 [18]. This attribute shall only be sent in EASDF notification to the SMF. Minimum=0. Maximum=128
ipAddr	IpAddr	M	1	IP address as defined for the ADDRESS in clause 6 of IETF RFC 7871 [18]

6.1.6.2.13 Type: DnsContextEventReport

Table 6.1.6.2.13-1: Definition of type DnsContextEventReport

Attribute name	Data type	P	Cardinality	Description
timestamp	DateTime	M	1	Time of detection of the event
dnsRuleId	Uint32	C	0..1	Identifies the DNS rule that triggered the report. This IE shall be present if the report is triggered by an event matching a DNS rule.
dnsQueryReport	DnsQueryReport	O	0..1	DNS Query Report
dnsRspReport	DnsRspReport	O	0..1	DNS Response Report
dnsMsgId	string	O	0..1	DNS message identifier When present, this IE shall be set to a unique identifier of the DNS message for which the event is reported (see clause 5.2.3.2.4)

6.1.6.2.14 Type: DnsQueryReport

Table 6.1.6.2.14-1: Definition of type DnsQueryReport

Attribute name	Data type	P	Cardinality	Description
fqdn	Fqdn	O	0..1	FQDN received in the DNS Query

6.1.6.2.15 Type: DnsRspReport

Table 6.1.6.2.15-1: Definition of type DnsRspReport

Attribute name	Data type	P	Cardinality	Description
fqdn	Fqdn	O	0..1	FQDN received in the DNS Response
easIpv4Addresses	array(Ipv4Addr)	O	1..N	EAS IPv4 address(es) received in the DNS Response
easIpv6Addresses	array(Ipv6Addr)	O	1..N	EAS IPv6 address(es) received in the DNS Response
ecsOption	EcsOption	O	0..1	EDNS Client Subnet (ECS) option received in the DNS Response (as defined in IETF RFC 7871 [18])

6.1.6.2.16 Type: EcsOptionInfo

Table 6.1.6.2.16-1: Definition of type EcsOptionInfo

Attribute name	Data type	P	Cardinality	Description
ecsOption	EcsOption	C	0..1	Information to build optional EDNS Client Subnet (ECS) option to be included in the DNS Query as defined in IETF RFC 7871 [18], or to be used for replacing the ECS option received in the DNS Query message from the UE. (NOTE 1)
baseDnsAitld	BaselineDnsAitld	C	0..1	Identifier of the Baseline DNS Action Information Template that contains information to build optional EDNS Client Subnet (ECS) option to be included in the DNS Query as defined in IETF RFC 7871 [18], or to be used for replacing the ECS option received in the DNS Query message from the UE. (NOTE 1, NOTE 2)
NOTE 1: Either the ecsOption IE or the baseDnsAitld IE shall be present.				
NOTE 2: The referenced baseline DNS Action Information Template may contain other information beyond the information to build the ECS option, in which case the EADSF shall only apply the information to build the ECS option.				

6.1.6.2.17 Type: DnsServerAddressInfo

Table 6.1.6.2.17-1: Definition of type DnsServerAddressInfo

Attribute name	Data type	P	Cardinality	Description
dnsServerAddressList	array(IpAddr)	C	1..N	DNS Server Address to be used as destination address of the outgoing DNS Query. More than one IP address may be provided for resiliency. (NOTE 1)
baseDnsAitld	BaselineDnsAitld	C	0..1	Identifier of the Baseline DNS Action Information Template that contains DNS Server Address to be used as destination address of the outgoing DNS Query. (NOTE 1, NOTE 2)
NOTE 1: Either the dnsServerAddressList IE or the baseDnsAitld IE shall be present.				
NOTE 2: The referenced baseline DNS Action Information Template may contain other information beyond the DNS Server Address information, in which case the EADSF shall only apply the DNS Server Address information.				

6.1.6.2.18 Type: BaselineDnsMdtld

Table 6.1.6.2.18-1: Definition of type BaselineDnsMdtld

Attribute name	Data type	P	Cardinality	Description	Applicability
baseDnsPatternUri	Uri	M	1	URI of the baseline DNS pattern returned in the Location header in the baseline DNS pattern creation response	
mdtld	string	M	1	Identifier of the baseline DNS Message Detection Template ID within the baseline DNS pattern	

6.1.6.2.19 Type: BaselineDnsAitld

Table 6.1.6.2.19-1: Definition of type BaselineDnsAitld

Attribute name	Data type	P	Cardinality	Description	Applicability
baseDnsPatternUri	Uri	M	1	URI of the baseline DNS pattern returned in the Location header in the baseline DNS pattern creation response	
aitld	string	M	1	Identifier of the baseline DNS Action Information Template ID within the baseline DNS pattern	

6.1.6.2.20 Type: BaselineDnsQueryMdtInfo

Table 6.1.6.2.20-1: Definition of type BaselineDnsQueryMdtInfo

Attribute name	Data type	P	Cardinality	Description	Applicability
sourceIpv4Addr	Ipv4Addr	O	0..1	UE IPv4 address (NOTE)	
sourceIpv6Prefix	Ipv6Prefix	O	0..1	UE IPv6 prefix (NOTE)	
baseDnsMdtList	array(BaselineDnsMdtld)	M	1..N	List of Baseline DNS Query Message Detection Template IDs.	
NOTE: If neither the sourceIpv4Addr IE nor the sourceIpv6Prefix IE is present, the UE IP address in the DNS Context Data shall be assumed.					

6.1.6.2.21 Type: BaselineDnsRspMdtInfo

Table 6.1.6.2.21-1: Definition of type BaselineDnsRspMdtInfo

Attribute name	Data type	P	Cardinality	Description	Applicability
baseDnsMdtList	array(BaselineDnsMdtld)	M	1..N	List of Baseline DNS Response Message Detection Template IDs.	

6.1.6.2.22 Type: RespondParameters

Table 6.1.6.2.22-1: Definition of type RespondParameters

Attribute name	Data type	P	Cardinality	Description
easIpv4Addresses	array(Ipv4Addr)	O	1..N	EAS IPv4 address(es) to be included in the DNS Response
easIpv6Addresses	array(Ipv6Addr)	O	1..N	EAS IPv6 address(es) to be included in the DNS Response

6.1.6.2.23 Type: N6RoutingInfo

Table 6.1.6.2.23-1: Definition of type N6RoutingInfo

Attribute name	Data type	P	Cardinality	Description
ipv4Address	Ipv4Addr	O	0..1	IPv4 address of the Local PSA-UPF for the N6 tunnel between the Local PSA-UPF and V-EASDF
ipv6Address	Ipv6Addr	O	0..1	IPv6 address of the Local PSA-UPF for the N6 tunnel between the Local PSA-UPF and V-EASDF
portNumber	UInteger	O	0..1	Port number of the Local PSA-UPF for the N6 tunnel between the Local PSA-UPF and V-EASDF.

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	Applicability
	<one simple data type, i.e. boolean, integer, number, or string>		

6.1.6.3.3 Enumeration: ApplyAction

The enumeration ApplyAction represents an action to apply to the DNS packet. It shall comply with the provisions defined in table 6.1.6.3.3-1.

Table 6.1.6.3.3-1: Enumeration ApplyAction

Enumeration value	Description	Applicability
"BUFFER"	Buffer the DNS Query or Response message	
"REPORT"	Report the DNS Query or Response message content to the SMF	
"FORWARD"	Forward the DNS Query or Response message, after applying the instructions indicated in the forwarding parameters if any	
"DISCARD"	Discard DNS messages	
"RESPOND"	Respond to a DNS Query message, i.e. build and send a DNS Response message to the UE, after applying the instructions indicated in the respond parameters.	CEASD
"SEND_ANOTHER_DNS_QUERY"	Send another DNS Query message, after applying the instructions indicated in the forwarding parameters if any.	HR-SBO

6.1.6.4 Data types describing alternative data types or combinations of data types

There is no alternative data types or combinations of data types used for the Neasdf_DNSContext service in this version of the API.

6.1.6.5 Binary data

There is no binary data used for the Neasdf_DNSContext service in this version of the API.

6.1.7 Error Handling

6.1.7.1 General

For the Neasdf_DNSContext API, HTTP error responses shall be supported as specified in clause 4.8 of 3GPP TS 29.501 [5]. Protocol errors and application errors specified in table 5.2.7.2-1 of 3GPP TS 29.500 [4] shall be supported for an HTTP method if the corresponding HTTP status codes are specified as mandatory for that HTTP method in table 5.2.7.1-1 of 3GPP TS 29.500 [4].

In addition, the requirements in the following clauses are applicable for the Neasdf_DNSContext API.

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]. No further specific procedures for the Neasdf_DNSContext service are specified.

6.1.7.3 Application Errors

The application errors defined for the Neasdf_DNSContext service are listed in Table 6.1.7.3-1.

Table 6.1.7.3-1: Application errors

Application Error	HTTP status code	Description
BASELINE_DNS_PATTERN_UNKNOWN	400 Bad Request	The request to create or modify a DNS context is rejected due to a baseline DNS pattern being unknown to the EASDF (i.e the URI of the baseline DNS pattern is unknown).
BASELINE_DNS_MDT_UNKNOWN	400 Bad Request	The request to create or modify a DNS context is rejected due to a baseline DNS Message Detection Template being unknown to the EASDF (the baseline DNS pattern is known).
BASELINE_DNS_AIT_UNKNOWN	400 Bad Request	The request to create or modify a DNS context is rejected due to a baseline DNS Action Information Template being unknown to the EASDF (the baseline DNS pattern is known).
DNS_CONTEXT_NOT_FOUND	404 Not Found	The request to modify or delete a DNS context, or the notification about an event of a DNS context, is rejected because the DNS context is not found.

6.1.8 Feature negotiation

The optional features in table 6.1.8-1 are defined for the Neasdf_DNSContext API. They shall be negotiated using the extensibility mechanism defined in clause 6.6 of 3GPP TS 29.500 [4].

Table 6.1.8-1: Supported Features

Feature number	Feature Name	M/O	Description
1	CEASD	O	Support of Common EAS Discovery for a set of UEs defined as part of EDGE Phase 2 in 3GPP Release 18. An NF Service Consumer and EASDF which support this feature shall support DNS rules with an applyAction requesting the EASDF to respond to a DNS query with EAS IP addresses provided by the NF Service Consumer, i.e. with the ApplyAction value "RESPOND". See clauses 5.2.3.4.1 and 6.1.6.3.3.
2	HR-SBO	O	Support of EAS Discovery Procedure with V-EASDF for HR-SBO An EASDF which supports this feature shall support behaving as a V-EASDF including support of: <ul style="list-style-type: none"> - DNS context creation with an unspecified UE IP address and DNS context update with the UE IP address assigned by the H-PLMN; - DNS context creation and handling with the H-PLMN ID of the H-PLMN of the HR PDU session; - the new ApplyAction enumeration value "SEND_ANOTHER_DNS_QUERY" (see clause 5.2.3.4.1); and - Dns Response MDT including DNS Server Source IP Addresses.

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.
M/O: Defines if the implementation of the feature is mandatory ("M") or optional ("O").
Description: A clear textual description of the feature.

6.1.9 Security

As indicated in 3GPP TS 33.501 [8] and 3GPP TS 29.500 [4], the access to the Neasdf_DNSContext API may be authorized by means of the OAuth2 protocol (see IETF RFC 6749 [9]), based on local configuration, using the "Client Credentials" authorization grant, where the NRF (see 3GPP TS 29.510 [10]) plays the role of the authorization server.

If OAuth2 is used, an NF Service Consumer, prior to consuming services offered by the Neasdf_DNSContext API, shall obtain a "token" from the authorization server, by invoking the Access Token Request service, as described in 3GPP TS 29.510 [10], clause 5.4.2.2.

NOTE: When multiple NRFs are deployed in a network, the NRF used as authorization server is the same NRF that the NF Service Consumer used for discovering the Neasdf_DNSContext service.

The Neasdf_DNSContext API defines a single scope "neasdf-dnscontext" for the entire service, and it does not define any additional scopes at resource or operation level.

6.1.10 HTTP redirection

An HTTP request may be redirected to a different EASDF service instance within the same EASDF, or to a different EASDF of an EASDF set, when using direct or indirect communications (see 3GPP TS 29.500 [4]).

An SCP that reselects a different EASDF producer instance will return the NF Instance ID of the new EASDF producer instance in the 3gpp-Sbi-Producer-Id header, as specified in clause 6.10.3.4 of 3GPP TS 29.500 [4].

If an EASDF redirects a service request to a different EASDF using an 307 Temporary Redirect or 308 Permanent Redirect status code, the identity of the new EASDF towards which the service request is redirected shall be indicated

in the 3gpp-Sbi-Target-Nf-Id header of the 307 Temporary Redirect or 308 Permanent Redirect response as specified in clause 6.10.9.1 of 3GPP TS 29.500 [4].

6.2 Neasdf_BaselineDNSPattern Service API

6.2.1 Introduction

The Neasdf_BaselineDNSPattern service shall use the Neasdf_BaselineDNSPattern API.

The API URI of the Neasdf_BaselineDNSPattern API shall be:

{apiRoot}/<apiName>/<apiVersion>

The request URIs used in HTTP requests from the NF service consumer towards the NF service producer shall have the Resource URI structure defined in clause 4.4.1 of 3GPP TS 29.501 [5], i.e.:

{apiRoot}/<apiName>/<apiVersion>/<apiSpecificResourceUriPart>

with the following components:

- The {apiRoot} shall be set as described in 3GPP TS 29.501 [5].
- The <apiName> shall be "neasdf-baselinednspattern".
- The <apiVersion> shall be "v1".
- The <apiSpecificResourceUriPart> shall be set as described in clause 6.2.3.

6.2.2 Usage of HTTP

6.2.2.1 General

HTTP/2, IETF RFC 9113 [11], 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].

The OpenAPI [6] specification of HTTP messages and content bodies for the Neasdf_BaselineDNSPattern API is contained in Annex A.

6.2.2.2 HTTP standard headers

6.2.2.2.1 General

See clause 5.2.2 of 3GPP TS 29.500 [4] for the usage of HTTP standard headers.

6.2.2.2.2 Content type

The following content types shall be supported:

- JSON, as defined in IETF RFC 8259 [12], shall be used as content type of the HTTP bodies specified in the present specification as specified in clause 5.4 of 3GPP TS 29.500 [4]. The use of the JSON format shall be signalled by the content type "application/json".
- "Problem Details" JSON Object shall be used to indicate additional details of the error in a HTTP response body and shall be signalled by the content type "application/problem+json", as defined in IETF RFC 9457 [13].
- JSON Patch (IETF RFC 6902 [15]). The use of the JSON Patch format in a HTTP request body shall be signalled by the content type "application/json-patch+json".

6.2.2.3 HTTP custom headers

The mandatory HTTP custom header fields specified in clause 5.2.3.2 of 3GPP TS 29.500 [4] shall be supported, and the optional HTTP custom header fields specified in clause 5.2.3.3 of 3GPP TS 29.500 [4] may be supported.

6.2.3 Resources

6.2.3.1 Overview

Figure 6.2.3.1-1 describes the resource URI structure of the Neasdf_BaselineDNSPattern API.

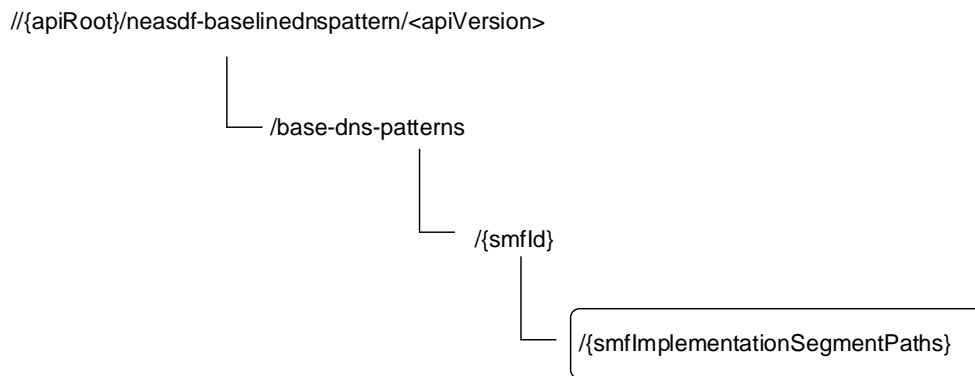


Figure 6.2.3.1-1: Resource URI structure of the Neasdf_BaselineDNSPattern API

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	Description (service operation)
Individual Baseline DNS Pattern	/base-dns-patterns/{smfId}/{smfImplementationSegmentPaths}	PUT	Create a new Baseline DNS pattern, or replace the existing Baseline DNS pattern, by providing an Baseline DNS pattern
		PATCH	Update (partial update)
		DELETE	Delete

6.2.3.2 Resource: Individual Baseline DNS Pattern

6.2.3.2.1 Description

This resource represents an individual Baseline DNS Pattern created in the EASDF.

This resource is modelled with the Document resource archetype (see clause C.1 of 3GPP TS 29.501 [5]).

6.2.3.2.2 Resource Definition

Resource URI: **{apiRoot}/neasdf-baselinednspattern/<apiVersion>/base-dns-patterns/{smfId}/{smfImplementationSegmentPaths}**

This resource shall support the resource URI variables defined in table 6.2.3.2.2-1.

Table 6.2.3.2.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See clause 6.2.1.
apiVersion	string	See clause 6.2.1.
smfld	VarNfld	Represents the SMF Set Identifier (see NF Set Identifier in clause 28.12 of 3GPP TS 23.003 [19]) or the Set ID part within the SMF Set Identifier (see <Set Id> within the NF Set Identifier in clause 28.12 of 3GPP TS 23.003 [19]) or NF Instance Id of the SMF. The SMF Set Identifier or the Set ID part within the SMF Set ID shall be included if the EASDF is controlled by the SMF set, or the NF Instance Id of the SMF shall be included if the EASDF is controlled by a SMF.

EXAMPLE 1: .../base-dns-patterns/smfInstanceId=4947a69a-f61b-4bc1-b9da-47c9c5d14b64/{smfImplementationSegmentPaths}

EXAMPLE 2: .../base-dns-patterns/smfSetId=set1.smfset.5gc.mnc012.mcc345/{smfImplementationSegmentPaths}

EXAMPLE 3: .../base-dns-patterns/setId=set1/{smfImplementationSegmentPaths}

6.2.3.2.3 Resource Standard Methods

6.2.3.2.3.1 PATCH

This method updates (partial update) an individual Baseline DNS Pattern resource in the EASDF.

This method shall support the URI query parameters specified in table 6.2.3.2.3.1-1.

Table 6.2.3.3.3.1-1: URI query parameters supported by the PATCH method on this resource

Name	Data type	P	Cardinality	Description	Applicability
n/a					

This method shall support the request data structures specified in table 6.2.3.2.3.1-2 and the response data structures and response codes specified in table 6.2.3.2.3.1-3.

Table 6.2.3.2.3.1-2: 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 Baseline DNS pattern, according to the JSON PATCH format specified in IETF RFC 6902 [15].

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

Data type	P	Cardinality	Response codes	Description
PatchResult	M	1	200 OK	Upon partial success, e.g. some of the requested modifications for unknown attribute(s) are discarded while the rest of the modification instructions are fully accepted, the EASDF shall return the execution report.
n/a			204 No Content	Successful update of the Baseline DNS Pattern.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. (NOTE 2)
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. (NOTE 2)
ProblemDetails	O	0..1	404 Not Found	Indicates that the modification of the baseline DNS pattern failed due to an application error. The "cause" attribute may be used to indicate one of the following application errors: - BASELINE_DNS_PATTERN_NOT_FOUND.
NOTE 1: The mandatory HTTP error status code for the PATCH method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] also apply.				
NOTE 2: RedirectResponse may be inserted by an SCP, see clause 6.10.9.1 of 3GPP TS 29.500 [4].				

Table 6.2.3.2.3.1-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same EASDF or EASDF (service) set. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target EASDF (service) instance ID towards which the request is redirected

Table 6.2.3.2.3.1-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same EASDF or EASDF (service) set. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target EASDF (service) instance ID towards which the request is redirected

6.2.3.2.3.2 PUT

This method creates or updates (complete replacement) an individual Baseline DNS Pattern resource in the EASDF.

This method shall support the URI query parameters specified in table 6.2.3.2.3.2-1.

Table 6.2.3.2.3.2-1: URI query parameters supported by the PUT method on this resource

Name	Data type	P	Cardinality	Description	Applicability
n/a					

This method shall support the request data structures specified in table 6.2.3.2.3.2-2 and the response data structures and response codes specified in table 6.2.3.2.3.2-3.

Table 6.2.3.2.3.2-2: Data structures supported by the PUT Request Body on this resource

Data type	P	Cardinality	Description
BaseDnsPatternCreateData	M	1	Baseline DNS Pattern Data to be created or to replace the existing Baseline DNS Pattern data

Table 6.2.3.2.3.2-3: Data structures supported by the PUT Response Body on this resource

Data type	P	Cardinality	Response codes	Description
DnsBasePatternCreatedData	M	1	201 Created	Successful creation of a Baseline DNS Pattern
n/a			204 No Content	Successful update of the Baseline DNS Pattern.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. (NOTE 2)
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. (NOTE 2)

NOTE 1: The mandatory HTTP error status code for the PUT method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] also apply.

NOTE 2: RedirectResponse may be inserted by an SCP, see clause 6.10.9.1 of 3GPP TS 29.500 [4].

Table 6.2.3.2.3.2-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same EASDF or EASDF (service) set. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target EASDF (service) instance ID towards which the request is redirected

Table 6.2.3.2.3.2-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same EASDF or EASDF (service) set. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target EASDF (service) instance ID towards which the request is redirected

6.2.3.2.3.3 DELETE

This method deletes an individual Baseline DNS Pattern resource in the EASDF.

This method shall support the URI query parameters specified in table 6.2.3.2.3.3-1.

Table 6.2.3.2.3.3-1: URI query parameters supported by the DELETE method on this resource

Name	Data type	P	Cardinality	Description	Applicability
n/a					

This method shall support the request data structures specified in table 6.2.3.3.3-2 and the response data structures and response codes specified in table 6.2.3.2.3.3-3.

Table 6.2.3.2.3.3-2: Data structures supported by the DELETE Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 6.2.3.2.3.3-3: Data structures supported by the DELETE Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Successful deletion of the Baseline DNS Pattern.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection.. (NOTE 2)
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection.. (NOTE 2)
ProblemDetails	O	0..1	404 Not Found	Indicates that the deletion of the baseline DNS pattern failed due to an application error. The "cause" attribute may be used to indicate one of the following application errors: - <u>BASELINE_DNS_PATTERN_NOT_FOUND</u> .
NOTE 1: The mandatory HTTP error status code for the DELETE method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] also apply.				
NOTE 2: RedirectResponse may be inserted by an SCP, see clause 6.10.9.1 of 3GPP TS 29.500 [4].				

Table 6.2.3.2.3.3-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same EASDF or EASDF (service) set. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target EASDF (service) instance ID towards which the request is redirected

Table 6.2.3.2.3.3-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same EASDF or EASDF (service) set. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target EASDF (service) instance ID towards which the request is redirected

6.2.3.3.4 Resource Custom Operations

6.2.3.3.4.1 Overview

Table 6.2.3.3.4.1-1: Custom operations

Operation Name	Custom operation URI	Mapped HTTP method	Description (Service operation)

6.2.4 Custom Operations without associated resources

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

6.2.5 Notifications

There are no notifications defined for the Neasdf_BaselineDNSPattern 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 Neasdf_BaselineDNSPattern service based interface protocol.

Table 6.2.6.1-1: Neasdf_BaselineDNSPattern specific Data Types

Data type	Clause defined	Description	Applicability
BaseDnsPatternCreateData	6.2.6.2.2	Data in Baseline DNS Pattern Create request	
BaseDnsPatternCreatedData	6.2.6.2.3	Data in Baseline DNS Pattern Create response	
BaselineDnsMdt	6.2.6.2.4	Baseline DNS message detection template	
BaselineDnsAit	6.2.6.2.5	Baseline DNS action information Template	
VarNfld	6.2.6.2.6	SMF or SMF Set Id or Set Id part in SMF set identifier	

Table 6.2.6.1-2 specifies data types re-used by the Neasdf 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 Neasdf_BaselineDNSPattern service based interface.

Table 6.2.6.1-2: Neasdf_BaselineDNSPattern re-used Data Types

Data type	Reference	Comments	Applicability
DnsQueryMdt	6.1.6.2.5	DNS Query Message Detection Template	
DnsRspMdt	6.1.6.2.6	DNS Response Message Detection Template	
EcsOption	6.1.6.2.12	ECS Option information	
IpAddr	3GPP TS 29.571 [16]	IP address	
NfSetId	3GPP TS 29.571 [16]	NF Set Id	
NfInstanceId	3GPP TS 29.571 [16]	NF Instance Id	
PatchResult	3GPP TS 29.571 [16]		

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: BaseDnsPatternCreateData

Table 6.2.6.2.2-1: Definition of type BaseDnsPatternCreateData

Attribute name	Data type	P	Cardinality	Description	Applicability
label	string	O	0..1	Baseline DNS pattern's label (NOTE)	
baseDnsMdtList	map(BaselineDnsMdt)	O	1..N	When present, this IE contains the map of DNS message detection templates. The key of the map shall be a (unique) valid JSON string per clause 7 of IETF RFC 8259 [12], carrying the identifier of the baseline DNS Message Detection Template, with a maximum of 32 characters.	
baseDnsAitList	map(BaselineDnsAit)	O	1..N	When present, this IE contains the map of Baseline DNS action information Templates. The key of the map shall be a (unique) valid JSON string per clause 7 of IETF RFC 8259 [12], carrying the identifier of the baseline DNS Message Detection Template, with a maximum of 32 characters.	
supportedFeatures	SupportedFeatures	C	0..1	This IE shall be present if at least one optional feature defined in clause 6.2.8 is supported.	
NOTE: This attribute may contain free information describing the scope of the baseline DNS pattern. It may be used e.g. for trouble-shooting.					

6.2.6.2.3 Type: BaseDnsPatternCreatedData

Table 6.2.6.2.3-1: Definition of type BaseDnsPatternCreatedData

Attribute name	Data type	P	Cardinality	Description	Applicability
supportedFeatures	SupportedFeatures	C	0..1	This IE shall be present if at least one optional feature defined in clause 6.2.8 is supported.	

6.2.6.2.4 Type: BaselineDnsMdt

Table 6.2.6.2.4-1: Definition of type BaselineDnsMdt

Attribute name	Data type	P	Cardinality	Description	Applicability
mdtId	string	M	1	Identifier of the DNS message detection template within the baseline DNS pattern, with a maximum of 32 characters.	
label	string	O	0..1	Baseline DNS MDT's label (NOTE 2)	
dnsQueryMdtList	map(DnsQueryMdt)	C	1..N	Map of DNS Query message detection templates. The key of the map shall be a (unique) valid JSON string per clause 7 of IETF RFC 8259 [12], carrying the identifier of the DNS Query message detection template, with a maximum of 32 characters. If present, only fqdnList attribute shall be included in the DNS Query message detection template. (NOTE 1)	
dnsRspMdtList	map(DnsRspMdt)	C	1..N	Map of DNS Response message detection templates. The key of the map shall be a (unique) valid JSON string per clause 7 of IETF RFC 8259 [12], carrying the identifier of the DNS Response message detection template, with a maximum of 32 characters. (NOTE 1)	
NOTE 1: Either the dnsQueryMdtList IE or the dnsRspMdtList IE shall be present.					
NOTE 2: This attribute may contain free information describing the scope of the baseline DNS MDT. It may be used e.g. for trouble-shooting.					

6.2.6.2.5 Type: BaselineDnsAit

Table 6.2.6.2.5-1: Definition of type BaselineDnsAit

Attribute name	Data type	P	Cardinality	Description	Applicability
aitId	string	M	1	Identifier of the DNS message handling action within the baseline DNS pattern	
label	string	O	0..1	Baseline DNS AIT's label (NOTE)	
ecsOption	EcsOption	C	0..1	Information to build optional EDNS Client Subnet (ECS) option to be included in the DNS Query as defined in IETF RFC 7871 [18], or to be used for replacing the ECS option received in the DNS Query message from the UE.	
dnsServerAddressList	array(IpAddr)	C	1..N	DNS Server Address to be used as destination address of the outgoing DNS Query More than one IP address may be provided for resiliency.	
NOTE: This attribute may contain free information describing the scope of the baseline DNS AIT. It may be used e.g. for trouble-shooting.					

6.2.6.2.6 Type: VarNfld

Table 6.2.6.2.6-1: Definition of type VarNfld

Attribute name	Data type	P	Cardinality	Description	Applicability
smfSetId	NfSetId	C	0..1	This IE shall be present if available. When present, this IE includes the SMF Set Id (NOTE)	
setId	string	C	0..1	This IE shall be present if available. When present, this IE includes Set Id part in NF Set Identifier (see clause 28.12 of 3GPP TS 23.003 [7]), formatted as the following string: "set<Set ID>" with <Set ID> encoded as a string of characters consisting of alphabetic characters (A-Z and a-z), digits (0-9) and/or the hyphen (-) and that shall end with either an alphabetic character or a digit. Pattern: '^([A-Za-z0-9\-\-]*[A-Za-z0-9])\$' Examples: "setxyz" "set12" (NOTE)	
smfInstanceld	NfInstanceld	C	0..1	This IE shall be present if available. When present, this IE includes SMF Instance Id (NOTE)	
NOTE: Either smfSetId attribute or setId or smfInstanceld attribute shall be included.					

6.2.7 Error Handling

6.2.7.1 General

For the Neasdf_BaselineDNSPattern API, HTTP error responses shall be supported as specified in clause 4.8 of 3GPP TS 29.501 [5]. Protocol errors and application errors specified in table 5.2.7.2-1 of 3GPP TS 29.500 [4] shall be supported for an HTTP method if the corresponding HTTP status codes are specified as mandatory for that HTTP method in table 5.2.7.1-1 of 3GPP TS 29.500 [4].

In addition, the requirements in the following clauses are applicable for the Neasdf_BaselineDNSPattern API.

6.2.7.2 Protocol Errors

No specific procedures for the Neasdf_BaselineDNSPattern API service are specified.

6.2.7.3 Application Errors

The application errors defined for the Neasdf_BaselineDNSPattern service are listed in Table 6.2.7.3-1.

Table 6.2.7.3-1: Application errors

Application Error	HTTP status code	Description
BASELINE_DNS_PATTERN_NOT_FOUND	404 Not Found	The request to modify or delete a baseline DNS pattern is rejected because the baseline DNS pattern is not found (i.e. the URI of the baseline DNS pattern is not found).

6.2.8 Feature negotiation

The optional features in table 6.2.8-1 are defined for the Neasdf_BaselineDNSPattern API. They shall be negotiated using the extensibility mechanism defined in clause 6.6 of 3GPP TS 29.500 [4].

Table 6.2.8-1: Supported Features

Feature number	Feature Name	Description

6.2.9 Security

As indicated in 3GPP TS 33.501 [8] and 3GPP TS 29.500 [4], the access to the Neasdf_BaselineDNSPattern API may be authorized by means of the OAuth2 protocol (see IETF RFC 6749 [9]), based on local configuration, using the "Client Credentials" authorization grant, where the NRF (see 3GPP TS 29.510 [10]) plays the role of the authorization server.

If OAuth2 is used, an NF Service Consumer, prior to consuming services offered by the Neasdf_BaselineDNSPattern API, shall obtain a "token" from the authorization server, by invoking the Access Token Request service, as described in 3GPP TS 29.510 [10], clause 5.4.2.2.

NOTE: When multiple NRFs are deployed in a network, the NRF used as authorization server is the same NRF that the NF Service Consumer used for discovering the Neasdf_BaselineDNSPattern service.

The Neasdf_BaselineDNSPattern API defines a single scope "neasdf-baselinednspattern" for the entire service, and it does not define any additional scopes at resource or operation level.

6.2.10 HTTP redirection

An HTTP request may be redirected to a different EASDF service instance within the same EASDF, or to a different EASDF of an EASDF set, when using direct or indirect communications (see 3GPP TS 29.500 [4]).

An SCP that reselects a different EASDF producer instance will return the NF Instance ID of the new EASDF producer instance in the 3gpp-Sbi-Producer-Id header, as specified in clause 6.10.3.4 of 3GPP TS 29.500 [4].

If an EASDF redirects a service request to a different EASDF using an 307 Temporary Redirect or 308 Permanent Redirect status code, the identity of the new EASDF towards which the service request is redirected shall be indicated in the 3gpp-Sbi-Target-Nf-Id header of the 307 Temporary Redirect or 308 Permanent Redirect response as specified in clause 6.10.9.1 of 3GPP TS 29.500 [4].

Annex A (normative): OpenAPI specification

A.1 General

This Annex specifies the formal definition of the API(s) defined in the present specification. It consists of OpenAPI 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 a Git-based repository that uses the GitLab software version control system (see 3GPP TS 29.501 [5] clause 5.3.1 and 3GPP TR 21.900 [7] clause 5B).

A.2 Neasdf_DNSContext API

```
openapi: 3.0.0
```

```
info:
```

```
  version: '1.1.0-alpha.5'
  title: 'Neasdf_DNSContext'
  description: |
    EASDF DNS Context Service.
    © 2024, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.
```

```
externalDocs:
```

```
  description: 3GPP TS 29.556 V18.5.0; 5G System; Edge Application Server Discovery Services; Stage3
  url: https://www.3gpp.org/ftp/Specs/archive/29_series/29.556/
```

```
servers:
```

```
- url: '{apiRoot}/neasdf-dnscontext/v1'
  variables:
    apiRoot:
      default: https://example.com
      description: apiRoot as defined in clause 4.4 of 3GPP TS 29.501.
```

```
security:
```

```
- {}
- oAuth2ClientCredentials:
  - neasdf-dnscontext
```

```
paths:
```

```
  /dns-contexts:
    post:
      summary: Create
      tags:
        - DNS contexts collection
      operationId: CreateDnsContext
      requestBody:
        description: representation of the DNS context to be created in the EASDF
        required: true
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/DnsContextCreateData'
      callbacks:
        dnsContextNotification:
          '{$request.body#/notifyUri}':
            post:
              requestBody: # contents of the DNS context Notify request
```

```

    required: true
    content:
      application/json:
        schema:
          $ref: '#/components/schemas/DnsContextNotification'
  responses:
    '204':
      description: successful notification
    '307':
      $ref: 'TS29571_CommonData.yaml#/components/responses/307'
    '308':
      $ref: 'TS29571_CommonData.yaml#/components/responses/308'
    '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'
    '502':
      $ref: 'TS29571_CommonData.yaml#/components/responses/502'
    '503':
      $ref: 'TS29571_CommonData.yaml#/components/responses/503'
    default:
      $ref: 'TS29571_CommonData.yaml#/components/responses/default'

  responses:
    '201':
      description: successful creation of a DNS context
      content:
        application/json:
          schema:
            $ref: '#/components/schemas/DnsContextCreatedData'
      headers:
        Location:
          description: >
            'Contains the URI of the newly created resource, according to the structure:
            {apiRoot}/neadfd-dnscontext/<apiVersion>/dns-contexts/{dnsContextId}'
          required: true
          schema:
            type: string
    '307':
      $ref: 'TS29571_CommonData.yaml#/components/responses/307'
    '308':
      $ref: 'TS29571_CommonData.yaml#/components/responses/308'
    '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'
    '502':
      $ref: 'TS29571_CommonData.yaml#/components/responses/502'
    '503':
      $ref: 'TS29571_CommonData.yaml#/components/responses/503'
    default:
      $ref: 'TS29571_CommonData.yaml#/components/responses/default'

```

```

/dns-contexts/{dnsContextId}:
  delete:
    summary: Delete the DNS Context
    tags:
      - Individual DNS context
    operationId: DeleteDnsContext
    parameters:
      - name: dnsContextId
        in: path
        description: DNS context Identifier
        required: true
        schema:
          type: string
    responses:
      '204':
        description: successful deletion of an SM context
      '307':
        $ref: 'TS29571_CommonData.yaml#/components/responses/307'
      '308':
        $ref: 'TS29571_CommonData.yaml#/components/responses/308'
      '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'
      '502':
        $ref: 'TS29571_CommonData.yaml#/components/responses/502'
      '503':
        $ref: 'TS29571_CommonData.yaml#/components/responses/503'
      default:
        $ref: 'TS29571_CommonData.yaml#/components/responses/default'

  patch:
    summary: Updates the DNS context
    operationId: UpdateDnsContext
    tags:
      - Individual DNS context
    parameters:
      - name: dnsContextId
        in: path
        description: DNS context Identifier
        required: true
        schema:
          type: string
      - name: Content-Encoding
        in: header
        description: Content-Encoding, described in IETF RFC 7231
        schema:
          type: string
    requestBody:
      content:
        application/json-patch+json:
          schema:
            type: array
            items:
              $ref: 'TS29571_CommonData.yaml#/components/schemas/PatchItem'
          required: true
    responses:
      '200':
        description: Partial update of the DNS context
        content:
          application/json:
            schema:
              $ref: 'TS29571_CommonData.yaml#/components/schemas/PatchResult'

```

```

'204':
  description: Successful update of the DNS context
  headers:
    Accept-Encoding:
      description: Accept-Encoding, described in IETF RFC 7694
      schema:
        type: string
'307':
  $ref: 'TS29571_CommonData.yaml#/components/responses/307'
'308':
  $ref: 'TS29571_CommonData.yaml#/components/responses/308'
'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'
'502':
  $ref: 'TS29571_CommonData.yaml#/components/responses/502'
'503':
  $ref: 'TS29571_CommonData.yaml#/components/responses/503'
default:
  $ref: 'TS29571_CommonData.yaml#/components/responses/default'

put:
  summary: Updates the DNS context (complete replacement)
  operationId: ReplaceDnsContext
  tags:
    - Individual DNS context
  parameters:
    - name: dnsContextId
      in: path
      description: DNS context Identifier
      required: true
      schema:
        type: string
    - name: Content-Encoding
      in: header
      description: Content-Encoding, described in IETF RFC 7231
      schema:
        type: string
  requestBody:
    required: true
    content:
      application/json:
        schema:
          $ref: '#/components/schemas/DnsContextCreateData'
  responses:
    '204':
      description: Successful update of the DNS context
      headers:
        Accept-Encoding:
          description: Accept-Encoding, described in IETF RFC 7694
          schema:
            type: string
    '307':
      $ref: 'TS29571_CommonData.yaml#/components/responses/307'
    '308':
      $ref: 'TS29571_CommonData.yaml#/components/responses/308'
    '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'
  '502':
    $ref: 'TS29571_CommonData.yaml#/components/responses/502'
  '503':
    $ref: 'TS29571_CommonData.yaml#/components/responses/503'
  default:
    $ref: 'TS29571_CommonData.yaml#/components/responses/default'

```

```

components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{nrfApiRoot}/oauth2/token'
          scopes:
            neasdf-dnscontext: Access to the neasdf-dnscontext API

  schemas:
    #
    # STRUCTURED DATA TYPES
    #
    DnsContextCreateData:
      description: Data within Create request
      type: object
      properties:
        ueIpv4Addr:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv4Addr'
        ueIpv6Prefix:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv6Prefix'
        dnn:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Dnn'
        sNssai:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
        hplmnId:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/PlmnId'
        n6RoutingInfo:
          $ref: '#/components/schemas/N6RoutingInfo'
        dnsRules:
          description: map of DNS message handling rules where a valid JSON string serves as key
          type: object
          additionalProperties:
            $ref: '#/components/schemas/DnsRule'
          minProperties: 1
        notifyUri:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
        supportedFeatures:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
      required:
        - dnn
        - sNssai
        - dnsRules
      anyOf:
        - required: [ ueIpv4Addr ]
        - required: [ ueIpv6Prefix ]

    DnsContextCreatedData:
      description: Data within Create response
      type: object
      properties:
        easdfIpv4Addr:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv4Addr'

```

```

easdfIpv6Addr:
  $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv6Addr'
supportedFeatures:
  $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
anyOf:
  - required: [ easdfIpv4Addr ]
  - required: [ easdfIpv6Addr ]

DnsRule:
description: DNS message handling rule
type: object
properties:
  dnsRuleId:
    type: string
  label:
    type: string
  precedence:
    $ref: 'TS29571_CommonData.yaml#/components/schemas/Uint32'
  dnsQueryMdtList:
    description: >
      map of DNS query message detection templates where a valid JSON string serves as key
    type: object
    additionalProperties:
      $ref: '#/components/schemas/DnsQueryMdt'
    minProperties: 1
  baseDnsQueryMdtList:
    type: array
    items:
      $ref: '#/components/schemas/BaselineDnsQueryMdtInfo'
    minItems: 1
  dnsRspMdtList:
    description: >
      map of DNS response message detection templates where a valid JSON string serves as key
    type: object
    additionalProperties:
      $ref: '#/components/schemas/DnsRspMdt'
    minProperties: 1
  baseDnsRspMdtList:
    type: array
    items:
      $ref: '#/components/schemas/BaselineDnsRspMdtInfo'
    minItems: 1
  dnsMsgId:
    type: string
  actionList:
    description: map of actions where a valid JSON string serves as key
    type: object
    additionalProperties:
      $ref: '#/components/schemas/Action'
    minProperties: 1
  required:
    - actionList
  allOf:
    - not:
        required: [ dnsQueryMdtList, dnsRspMdtList ]
    - not:
        required: [ dnsQueryMdtList, baseDnsRspMdtList ]
    - not:
        required: [ baseDnsQueryMdtList, dnsRspMdtList ]
    - not:
        required: [ baseDnsQueryMdtList, baseDnsRspMdtList ]

DnsQueryMdt:
description: DNS Query message detection template
type: object
properties:
  mdtId:
    type: string
  label:
    type: string
  sourceIpv4Addr:
    $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv4Addr'
  sourceIpv6Prefix:
    $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv6Prefix'
  fqdnPatternList:
    type: array
    items:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/FqdnPatternMatchingRule'

```



```

    minItems: 1
    required:
      - mdtId
DnsRspMdt:
  description: DNS Response message detection template
  type: object
  properties:
    mdtId:
      type: string
    label:
      type: string
    fqdnPatternList:
      type: array
      items:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/FqdnPatternMatchingRule'
      minItems: 1
    easIpv4AddrRanges:
      type: array
      items:
        $ref: '#/components/schemas/Ipv4AddressRange'
      minItems: 1
    easIpv6PrefixRanges:
      type: array
      items:
        $ref: '#/components/schemas/Ipv6PrefixRange'
      minItems: 1
    dnsServerSrcAddrList:
      type: array
      items:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/IpAddr'
      minItems: 1
    required:
      - mdtId
Ipv4AddressRange:
  description: Range of IPv4 addresses
  type: object
  properties:
    start:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv4Addr'
    end:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv4Addr'
  required:
    - start
    - end
Ipv6PrefixRange:
  description: Range of IPv6 prefixes
  type: object
  properties:
    start:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv6Prefix'
    end:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv6Prefix'
  required:
    - start
    - end
Action:
  description: Action to apply to DNS messages matching a message detection template
  type: object
  properties:
    applyAction:
      $ref: '#/components/schemas/ApplyAction'
    fwdParas:
      $ref: '#/components/schemas/ForwardingParameters'
    reportingOnceInd:
      type: boolean
      default: false
    resetReportingOnceInd:
      type: boolean
      default: false
    respParas:
      $ref: '#/components/schemas/RespondParameters'
  required:
    - applyAction

```

```
DnsContextNotification:
  description: Data within DNS Context Notify
  type: object
  properties:
    eventreportList:
      type: array
      items:
        $ref: '#/components/schemas/DnsContextEventReport'
      minItems: 1

ForwardingParameters:
  description: Forwarding instructions
  type: object
  properties:
    ecsOptionInfo:
      $ref: '#/components/schemas/EcsOptionInfo'
    dnsServerAddressInfo:
      $ref: '#/components/schemas/DnsServerAddressInfo'

EcsOptionInfo:
  description: ECS Option Information
  type: object
  properties:
    ecsOption:
      $ref: '#/components/schemas/EcsOption'
    baseDnsAitId:
      $ref: '#/components/schemas/BaselineDnsAitId'
  oneOf:
    - required: [ ecsOption ]
    - required: [ baseDnsAitId ]

DnsServerAddressInfo:
  description: DNS Server Address Information
  type: object
  properties:
    dnsServerAddressList:
      type: array
      items:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/IpAddr'
      minItems: 1
    baseDnsAitId:
      $ref: '#/components/schemas/BaselineDnsAitId'
  oneOf:
    - required: [ dnsServerAddressList ]
    - required: [ baseDnsAitId ]

BaselineDnsMdtId:
  description: Baseline DNS Message Detection Template Identifier
  type: object
  properties:
    baseDnsPatternUri:
      items:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
    mdtId:
      type: string
  required:
    - baseDnsPatternUri
    - mdtId

BaselineDnsAitId:
  description: Baseline DNS Action Information Template Identifier
  type: object
  properties:
    baseDnsPatternUri:
      items:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
    aitId:
      type: string
  required:
    - baseDnsPatternUri
    - aitId

EcsOption:
  description: ECS Option Information
  type: object
  properties:
    sourcePrefixLength:
      type: integer
```

```
    minimum: 0
    maximum: 128
  scopePrefixLength:
    type: integer
    minimum: 0
    maximum: 128
  ipAddress:
    $ref: 'TS29571_CommonData.yaml#/components/schemas/IpAddress'
  required:
    - sourcePrefixLength
    - ipAddress

DnsContextEventReport:
  description: DNS context event report
  type: object
  properties:
    timestamp:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
    dnsRuleId:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/UInt32'
    dnsQueryReport:
      $ref: '#/components/schemas/DnsQueryReport'
    dnsRspReport:
      $ref: '#/components/schemas/DnsRspReport'
    dnsMsgId:
      type: string
  required:
    - timestamp

DnsQueryReport:
  description: DNS Query Event Report
  type: object
  properties:
    fqdn:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/Fqdn'

DnsRspReport:
  description: DNS Response Event Report
  type: object
  properties:
    fqdn:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/Fqdn'
    easIpv4Addresses:
      type: array
      items:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv4Addr'
      minItems: 1
    easIpv6Addresses:
      type: array
      items:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv6Addr'
      minItems: 1
    ecsOption:
      $ref: '#/components/schemas/EcsOption'

BaselineDnsQueryMdtInfo:
  description: Baseline DNS Query MDT Information
  type: object
  properties:
    sourceIpv4Addr:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv4Addr'
    sourceIpv6Prefix:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv6Prefix'
    baseDnsMdtList:
      type: array
      items:
        $ref: '#/components/schemas/BaselineDnsMdtId'
      minItems: 1
  required:
    - baseDnsMdtList

BaselineDnsRspMdtInfo:
  description: Baseline DNS Response MDT Information
  type: object
  properties:
    baseDnsMdtList:
      type: array
```

```

    items:
      $ref: '#/components/schemas/BaselineDnsMdtId'
    minItems: 1
  required:
    - baseDnsMdtList

RespondParameters:
  description: Respond instructions
  type: object
  properties:
    easIpv4Addresses:
      type: array
      items:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv4Addr'
      minItems: 1
    easIpv6Addresses:
      type: array
      items:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv6Addr'
      minItems: 1

N6RoutingInfo:
  description: N6 traffic routing information
  type: object
  properties:
    ipv4Address:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv4Addr'
    ipv6Address:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv6Addr'
    portNumber:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'

#
# SIMPLE DATA TYPES
#

#
# ENUMERATIONS
#

ApplyAction:
  anyOf:
    - type: string
      enum:
        - BUFFER
        - REPORT
        - FORWARD
        - DISCARD
        - RESPOND
        - SEND_ANOTHER_DNS_QUERY
    - type: string
      description: >
        This string provides forward-compatibility with future
        extensions to the enumeration but is not used to encode
        content defined in the present version of this API.
  description: >
    Action to apply to the DNS packet

```

A.3 Neasdf_BaselineDNSPattern API

openapi: 3.0.0

info:

```

version: '1.1.0-alpha.3'
title: 'Neasdf_BaselineDNSPattern'
description: |
  EASDF Baseline DNS Pattern Service.
  © 2024, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
  All rights reserved.

```

externalDocs:

```

description: 3GPP TS 29.556 V18.5.0; 5G System; Edge Application Server Discovery Services; Stage
3
url: 'https://www.3gpp.org/ftp/Specs/archive/29_series/29.556/'
servers:
- url: '{apiRoot}/neasdf-baselinednspattern/v1'
  variables:
    apiRoot:
      default: https://example.com
      description: apiRoot as defined in clause 4.4 of 3GPP TS 29.501.
security:
- {}
- OAuth2ClientCredentials:
  - neasdf-baselinednspattern
paths:
  /base-dns-patterns/{smfId}/{smfImplementationSegmentPaths}:
    patch:
      summary: Updates the Baseline DNS Pattern
      operationId: UpdateBasedDNSPattern
      tags:
        - Individual Baseline DNS Pattern
      parameters:
        - name: smfId
          in: path
          description: SMF or SMF set identifier or Set Id part in SMF set identifier
          required: true
          schema:
            $ref: '#/components/schemas/VarNfId'
            style: simple
            explode: true
        - name: smfImplementationSegmentPaths
          in: path
          description: SMF Implementation Dependent Segment Paths
          required: true
          schema:
            type: string
        - name: Content-Encoding
          in: header
          description: Content-Encoding, described in IETF RFC 7231
          schema:
            type: string
      requestBody:
        content:
          application/json-patch+json:
            schema:
              type: array
              items:
                $ref: 'TS29571_CommonData.yaml#/components/schemas/PatchItem'
            required: true
      responses:
        '200':
          description: Partial update of the Baseline DNS Pattern
          content:
            application/json:
              schema:
                $ref: 'TS29571_CommonData.yaml#/components/schemas/PatchResult'
        '204':
          description: Successful update of the Baseline DNS Pattern
          headers:
            Accept-Encoding:
              description: Accept-Encoding, described in IETF RFC 7694
              schema:
                type: string
        '307':
          $ref: 'TS29571_CommonData.yaml#/components/responses/307'
        '308':
          $ref: 'TS29571_CommonData.yaml#/components/responses/308'
        '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'
'502':
  $ref: 'TS29571_CommonData.yaml#/components/responses/502'
'503':
  $ref: 'TS29571_CommonData.yaml#/components/responses/503'
default:
  $ref: 'TS29571_CommonData.yaml#/components/responses/default'

put:
  summary: Creates or Updates the Baseline DNS Pattern (complete replacement)
  operationId: CreateOrReplaceBaseDnsPattern
  tags:
    - Individual Baseline DNS Pattern
  parameters:
    - name: smfId
      in: path
      description: SMF or SMF set identifier or Set Id part in SMF set identifier
      required: true
      schema:
        $ref: '#/components/schemas/VarNfId'
      style: simple
      explode: true
    - name: smfImplementationSegmentPaths
      in: path
      description: SMF Implementation Dependent Segment Paths
      required: true
      schema:
        type: string
    - name: Content-Encoding
      in: header
      description: Content-Encoding, described in IETF RFC 7231
      schema:
        type: string
  requestBody:
    required: true
    content:
      application/json:
        schema:
          $ref: '#/components/schemas/BaseDnsPatternCreateData'
  responses:
    '201':
      description: successful creation of a Baseline DNS pattern
      content:
        application/json:
          schema:
            $ref: '#/components/schemas/BaseDnsPatternCreatedData'
      headers:
        Location:
          description: >
            'Contains the URI of the newly created resource, according to the structure:
            {apiRoot}/neadsf-baselinednspattern/<apiVersion>/
            base-dns-patterns/{smfId}/{smfImplementationSegmentPaths}'
          required: true
          schema:
            type: string
    '204':
      description: Successful update of the Baseline DNS Pattern
      headers:
        Accept-Encoding:
          description: Accept-Encoding, described in IETF RFC 7694
          schema:
            type: string
    '307':
      $ref: 'TS29571_CommonData.yaml#/components/responses/307'
    '308':
      $ref: 'TS29571_CommonData.yaml#/components/responses/308'
    '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'
  '502':
    $ref: 'TS29571_CommonData.yaml#/components/responses/502'
  '503':
    $ref: 'TS29571_CommonData.yaml#/components/responses/503'
  default:
    $ref: 'TS29571_CommonData.yaml#/components/responses/default'

```

delete:

summary: Deletes a Baseline DNS Pattern

tags:

- Individual Baseline DNS Pattern

operationId: DeleteBaseDnsPattern

parameters:

- name: smfId
 - in: path
 - description: SMF or SMF set identifier or Set Id part in SMF set identifier
 - required: true
 - schema:
 - \$ref: '#/components/schemas/VarNfId'
 - style: simple
 - explode: true
- name: smfImplementationSegmentPaths
 - in: path
 - description: SMF Implementation Dependent Segment Paths
 - required: true
 - schema:
 - type: string

responses:

```

  '204':
    description: successful deletion of a Baseline DNS Pattern
  '307':
    $ref: 'TS29571_CommonData.yaml#/components/responses/307'
  '308':
    $ref: 'TS29571_CommonData.yaml#/components/responses/308'
  '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'
  '502':
    $ref: 'TS29571_CommonData.yaml#/components/responses/502'
  '503':
    $ref: 'TS29571_CommonData.yaml#/components/responses/503'
  default:
    $ref: 'TS29571_CommonData.yaml#/components/responses/default'

```

```

components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{nrfApiRoot}/oauth2/token'
          scopes:
            neasdf-baselinednspattern: Access to the neasdf-baselinednspattern API

  schemas:
#
# STRUCTURED DATA TYPES
#
  BaseDnsPatternCreateData:
    description: Data in Baseline DNS Pattern Create request
    type: object
    properties:
      label:
        type: string
      baseDnsMdtList:
        description: >
          map of baseline DNS message detection templates where a valid JSON string serves as key
        type: object
        additionalProperties:
          $ref: '#/components/schemas/BaselineDnsMdt'
        minProperties: 1
      baseDnsAitList:
        description: >
          map of Baseline DNS action information Template where a valid JSON string serves as key
        type: object
        additionalProperties:
          $ref: '#/components/schemas/BaselineDnsAit'
        minProperties: 1
      supportedFeatures:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'

  BaseDnsPatternCreatedData:
    description: Data in Baseline DNS Pattern Create response
    type: object
    properties:
      supportedFeatures:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'

  BaselineDnsMdt:
    description: Baseline DNS message detection template
    type: object
    properties:
      mdtId:
        type: string
      label:
        type: string
      dnsQueryMdtList:
        description: >
          map of DNS query message detection templates where a valid JSON string serves as key
        type: object
        additionalProperties:
          $ref: 'TS29556_Neasdf_DNSContext.yaml#/components/schemas/DnsQueryMdt'
        minProperties: 1
      dnsRspMdtList:
        description: >
          map of DNS response message detection templates where a valid JSON string serves as key
        type: object
        additionalProperties:
          $ref: 'TS29556_Neasdf_DNSContext.yaml#/components/schemas/DnsRspMdt'
        minProperties: 1
      required:
        - mdtId
      oneOf:
        - required: [ dnsQueryMdtList ]
        - required: [ dnsRspMdtList ]

  BaselineDnsAit:
    description: Baseline DNS action information Template
    type: object
    properties:
      aitId:
        type: string

```



```
label:
  type: string
ecsOption:
  $ref: 'TS29556_Neasdf_DNSContext.yaml#/components/schemas/EcsOption'
dnsServerAddressList:
  type: array
  items:
    $ref: 'TS29571_CommonData.yaml#/components/schemas/IpAddr'
  minItems: 1
required:
  - aitId
```

```
VarNfId:
  description: SMF or SMF Set Id or Set Id part in NF Set Id
  type: object
  properties:
    smfSetId:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/NfSetId'
    setId:
      type: string
      pattern: '^([A-Za-z0-9\-\-]*[A-Za-z0-9])$'
    smfInstanceId:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/NfInstanceId'
```

```
#
# SIMPLE DATA TYPES
#
```

```
#
# ENUMERATIONS
#
```

Annex B (informative): Change history

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2021-04	CT4#103e	C4-212440				TS skeleton	0.0.0
2021-04	CT4#103e	C4-212441 C4-212442				Implementation of pCRs agreed in CT4#103E	0.1.0
2021-06	CT4#104e	C4-213092 C4-213093 C4-213094 C4-213095 C4-213096 C4-213182 C4-213184 C4-213185 C4-213429 C4-213430 C4-213479				Implementation of pCRs agreed in CT4#104E	0.2.0
2021-09	CT4#105e	C4-214676				Implementation of pCRs agreed in CT4#105E	0.3.0
2021-10	CT4#106e	C4-215049 C4-215365 C4-215366 C4-215488 C4-215489 C4-215246 C4-215429 C4-215430 C4-215431 C4-215432 C4-215433 C4-215434				Implementation of pCRs agreed in CT4#106E	0.4.0
2021-11	CT4#107e	C4-216189 C4-216551 C4-216303 C4-216304 C4-216305 C4-216306 C4-216307				Implementation of pCRs agreed in CT4#107E	0.5.0
2021-12	CT#94	CP-213156				V1.0.0 presented for information	1.0.0
2022-01	CT4#107b ise	C4-220101 C4-220103 C4-220239 C4-220399 C4-220419 C4-220452				Implementation of pCRs agreed in CT4#107bisE	1.1.0
2022-03	CT4#108e	C4-221136 C4-221296 C4-221482				Implementation of pCRs agreed in CT4#108E	1.2.0
2022-03	CT#95e	CP-220105				TS send for approval	2.0.0
2022-03	CT#95e					TS approved	17.0.0
2022-06	CT#96	CP-221034	0001	2	F	Key of Map in Data Structure for Baseline DNS Pattern	17.1.0
2022-06	CT#96	CP-221034	0002		F	Reference point between SMF and EASDF	17.1.0
2022-06	CT#96	CP-221034	0003	1	B	Using FQDN Pattern Matching Rule for fqdnPatternList	17.1.0
2022-06	CT#96	CP-221034	0004		F	Reuse of type Fqdn from 29.571	17.1.0
2022-06	CT#96	CP-221034	0005		F	S-NSSAI in Create DNS context	17.1.0
2022-06	CT#96	CP-221051	0006		F	29.556 Rel-17 API version and External doc update	17.1.0
2022-12	CT#98e	CP-223045	0009	1	F	Handling of EDNS Client Subnet option by EASDF	17.2.0
2022-12	CT#98e	CP-223045	0010		F	Corrections on DnsServerAddressInfo	17.2.0
2022-12	CT#98e	CP-223029	0008	1	F	Missing mandatory status codes in OpenAPI	18.0.0
2022-12	CT#98e	CP-223033	0012		F	29.556 Rel-18 API version and External doc update	18.0.0
2023-03	CT#99	CP-230033	0013	2	B	Common EAS discovery for a set of UEs	18.1.0
2023-03	CT#99	CP-230060	0014	1	F	Application errors of Neasdf_DNSContext API	18.1.0
2023-03	CT#99	CP-230075	0016	1	A	Misalignments between OpenAPI definitions and normative tables	18.1.0
2023-03	CT#99	CP-230033	0019	1	B	Support of edge computing in roaming	18.1.0
2023-03	CT#99	CP-230071	0023		F	29.556 Rel-18 API version and External doc update	18.1.0
2023-06	CT#100	CP-231027	0022	4	F	Location header and missing Redirection clause	18.2.0
2023-06	CT#100	CP-231033	0025	3	B	HR-SBO impacts on Neasdf_DNSContext service	18.2.0
2023-06	CT#100	CP-231070	0026		F	29.556 Rel-18 API version and External doc update	18.2.0
2023-09	CT#101	CP-232036	0027		B	BaselineDNSPattern for HR-SBO roaming	18.3.0
2023-12	CT#102	CP-233027	0028		F	HTTP RFC obsoleted by IETF RFC 9113	18.4.0
2023-12	CT#102					DNS traffic routing between UE and V-EASDF where multiple DNN networks with the same IP address range are deployed	18.4.0
2023-12	CT#102	CP-233038	0030	1	B		
2023-12	CT#102	CP-233038	0031		B	Remove editor note for unspecified IPv6 Prefix	18.4.0

2023-12	CT#102	CP-233030	0032		F	ProblemDetails RFC 7807 obsoleted by 9457	18.4.0
2023-12	CT#102	CP-233060	0033		F	29.556 Rel-18 API version and External doc update	18.4.0
2024-03	CT#103	CP-240031	0034		B	Enforcement of VPLMN specific offloading information for IP addresses ranges	18.5.0
2024-03	CT#103	CP-240053	0035		F	Editorial and Style Corrections	18.5.0
2024-03	CT#103	CP-240056	0036		F	29.556 Rel-18 API version and External doc update	18.5.0

History

Document history		
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