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1 Scope

The present document provides the stage 3 specification of the PFD Management Service of 5G system.

The stage 2 definition and related procedures of the PFD Management Service are contained in 3GPP TS 23.502 [3] and 3GPP TS 23.503 [4]. The 5G System Architecture is defined in 3GPP TS 23.501 [2].

The Technical Realization of the Service Based Architecture and the Principles and Guidelines for Services Definition of the 5G System are specified in 3GPP TS 29.500 [5] and 3GPP TS 29.501 [6].

The Packet Flow Description Function (PFDF) provides the PFD Management Service to the NF consumers (i.e. Session Management Function). The PFDF is functionality within the NEF.

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.
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- [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 23.503: "Policy and Charging Control Framework for the 5G System; Stage 2".
- [5] 3GPP TS 29.500: "5G System; Technical Realization of Service Based Architecture; Stage 3".
- [6] 3GPP TS 29.501: "5G System; Principles and Guidelines for Services Definition; Stage 3".
- [7] IETF RFC 7540: "Hypertext Transfer Protocol Version 2 (HTTP/2)".
- [8] IETF RFC 8259: "The JavaScript Object Notation (JSON) Data Interchange Format".
- [9] OpenAPI: "OpenAPI 3.0.0 Specification", <https://github.com/OAI/OpenAPI-Specification/blob/master/versions/3.0.0.md>.
- [10] 3GPP TS 29.571: "5G System; Common Data Types for Service Based Interfaces Stage 3".
- [11] 3GPP TS 29.122: "T8 reference point for Northbound APIs".
- [12] 3GPP TS 29.251: "Gw and Gwn reference points for sponsored data connectivity".
- [13] 3GPP TS 29.510: "5G System; Network Function Repository Services; Stage 3".
- [14] 3GPP TS 33.501: "Security architecture and procedures for 5G system".
- [15] IETF RFC 6749: "The OAuth 2.0 Authorization Framework".
- [16] IETF RFC 7807: "Problem Details for HTTP APIs".
- [17] 3GPP TR 21.900: "Technical Specification Group working methods".

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].

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].

JSON	JavaScript Object Notation
NEF	Network Exposure Function
NRF	Network Repository Function
PFD	Packet Flow Description
PFDF	Packet Flow Description Function
SBI	Service Based Interface
SMF	Session Management Function

4 Packet Flow Description Management Service

4.1 Service Description

4.1.1 Overview

The PFD Management Service, as defined as defined in 3GPP TS 23.501 [2], 3GPP TS 23.502 [3] and 3GPP TS 23.503 [4], is provided by the Packet Flow Description Function (PFDF).

The only known NF Service Consumer is the SMF.

This service:

- allows an SMF to subscribe to and unsubscribe from PFD changes;
- notifies an SMF about the changed PFDs; and
- allows an SMF to retrieve PFDs.

4.1.2 Service Architecture

The 5G System Architecture is defined in 3GPP TS 23.501 [2]. The Policy and Charging related 5G architecture is also described in 3GPP TS 23.503 [4].

The PFD Management Service is provided by the PFDF to the SMF and shown in the SBI representation model in Figure 4.1.2-1. PFDF is functionality within NEF.

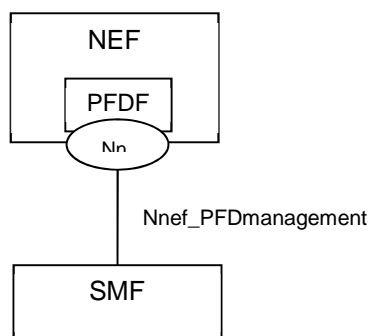


Figure 4.1.2-1: Reference Architecture for the Nnef_PFDmanagement Service; SBI representation



Figure 4.1.2-2: Reference Architecture for the Nnef_PFDmanagement Service; reference point representation

4.1.3 Network Functions

4.1.3.1 Packet Flow Description Function (PFDF)

The Packet Flow Description Function (PFDF):

- provides PFDs associated with one or more Application Identifiers; and
- allows NF consumers to subscribe to and unsubscribe from the notification of changes of PFDs for Application Identifier.

4.1.3.2 NF Service Consumers

The SMF shall support:

- requesting and receiving the PFD(s) for one or more Application Identifiers.

4.2 Service Operations

4.2.1 Introduction

Service operations defined for the Nnef_PFDmanagement Service are shown in table 4.2.1-1.

Table 4.2.1-1: Nnef_PFDmanagement Service Operations

Service Operation Name	Description	Initiated by
Nnef_PFDmanagement_Fetch	Provides the PFDs for application identifier(s) to the NF service consumer.	SMF
Nnef_PFDmanagement_Subscribe	Allows NF service consumers to subscribe the notification of events when the PFDs for application identifier change.	SMF
Nnef_PFDmanagement_Notify	Notifies NF service consumer to update and/or delete the PFDs for application identifier(s).	PFDF
Nnef_PFDmanagement_Unsubscribe	Allows NF service consumers to unsubscribe the notification of events.	SMF

4.2.2 Nnef_PFDmanagement_Fetch Service Operation

4.2.2.1 General

The Nnef_PFDmanagement_Fetch service operation provides a means for the NF service consumer to retrieve the PFDs for one or more application identifier(s).

The following procedures using the Nnef_PFDmanagement_Fetch service operation are supported:

- Retrieval of PFDs.

4.2.2.2 Retrieval of PFDs

This procedure as shown in Figure 4.2.2.2-1 is used to retrieve PFDs for an application identifier from the PFDF. This procedure enables the NF service consumer to retrieve PFDs for an Application Identifier(s) from the PFDF when:

- a PCC rule with this application identifier is provided/activated by the PCF and the PFDs provided by the PFDF are not available at the NF service consumer; or
- the caching timer for an application identifier elapses and a PCC rule for this application identifier is still active.

When the SMF removes the last PCC rule that refers to the corresponding application identifier, or when the caching timer expires and no PCC rule refers to the application identifier, the SMF may remove the PFD(s) related with the application identifier.

The PFDs retrieved from PFDF take precedence over any PFDs pre-configured in the SMF. If all PFDs retrieved from the PFDF are removed for an application identifier, the pre-configured PFDs shall be applied again for the application identifier.

The PFDF may provide caching time value together with the PFDs for an application identifier. The caching time value retrieved from the PFDF takes precedence over the default caching time value configured in the NF service consumer. If no caching time value is received from the PFDF, the configured default caching time value shall be applied.

NOTE 1: The NF service consumer(s) and the PFDF(s) within an operator network are configured with the same default caching time value to be applied for all application identifiers.

NOTE 2: The configuration of a caching time value per application identifier in the PFDF is based on the SLA between the operator and the ASP.

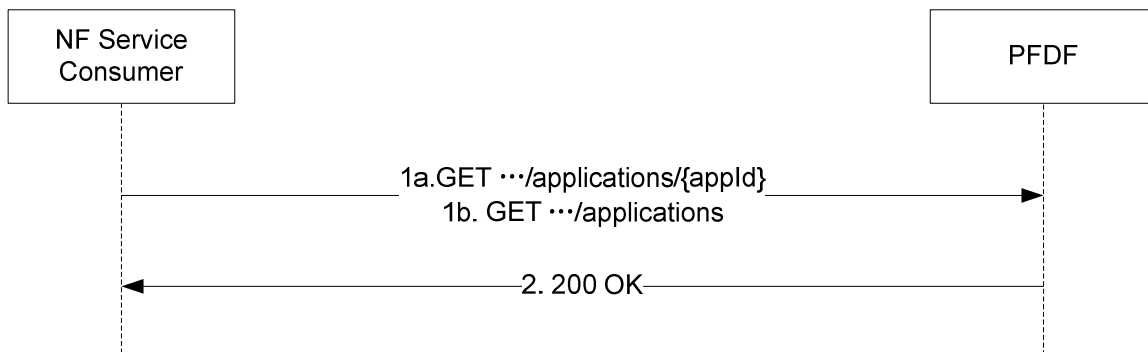


Figure 4.2.2.2-1: Retrieval of PFDs

1. The NF service consumer (i.e. SMF) shall send a GET request to the resource representing the PFD for application identifier(s) to be required:
 - for PFD of individual application identifier, the request URI shall include "{apiRoot}/nnef-pfdmanagement/v1/applications/{appld}" (as shown in figure 4.2.2.2-1, step 1a); and
 - for PFD of a collection of application identifiers, the request URI shall include "{apiRoot}/nnef-pfdmanagement/v1/applications" (as shown in figure 4.2.2.2-1, step 1b) with query parameters indicating the requested application identifier(s).
2. On success, "200 OK" shall be returned; the payload body of GET response shall contain a representation of "Individual application PFD" resource or "PFD of applications" resource for the requested application identifier(s). The NF service consumer shall replace the stored PFD(s) retrieved from the PFDF with the new received PFD(s) for the requested application identifier(s). If the resource of one or more requested application identifier(s) is not provided in the response, the NF service consumer shall remove the PFD(s) of the requested application identifier(s) which is not included in the response and re-apply the pre-configured PFDs.

On failure, one of the HTTP status code listed in table 5.3.2.3.1-3 or table 5.3.3.3.1-3 shall be returned. For "404 Not Found", the NF service consumer shall remove the PFD(s) of the requested application identifier(s) in the NF service consumer and re-apply the pre-configured PFDs.

4.2.3 Nnef_PFDmanagement_Subscribe Service Operation

4.2.3.1 General

The Nnef_PFDmanagement_Subscribe service operation enables NF service consumer to subscribe the notification of events when the PFDs for application identifier change.

4.2.3.2 Subscription for event notifications on PFDs change

This procedure as shown in Figure 4.2.3.2-1 is used to subscribe the notification of events when the PFDs for application identifier change.

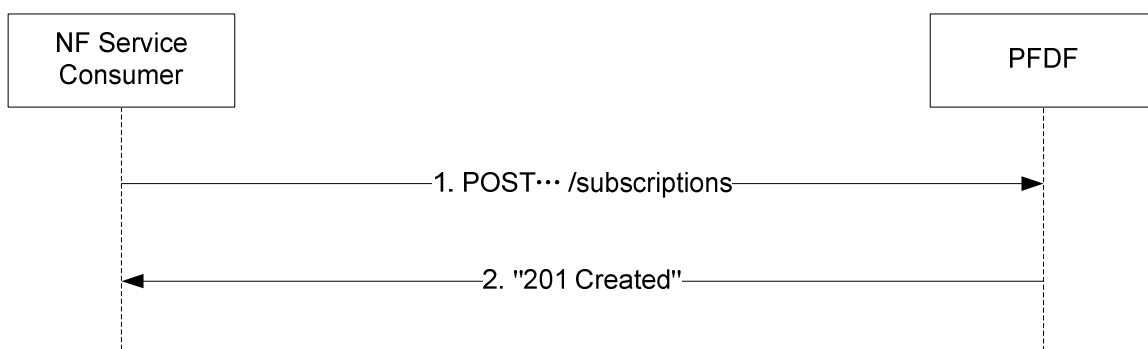


Figure 4.2.3.2-1: Creation of a subscription

1. The NF service consumer (i.e. SMF) shall send a POST request to the request URI representing the PFD subscriptions resource "{apiRoot}/nnef-pfdmanagement/v1/subscriptions". The NF service consumer shall include the PfdSubscription data type in the request payload body. Within the PfdSubscription data type, the NF service consumer shall include:
 - an URI where to receive the requested notifications as "notifyUri" attribute;
 may include:
 - subscribed application identifier(s) within the "applicationIds" attribute.
2. If the request is accepted, the PFDF shall:
 - create a new subscription;
 - assign an subscriptionId;
 - store the subscription; and
 - send the response with "201 Created". The payload body shall contain a representation of the created subscription, and the Location header shall contain the URI of the created subscription "{apiRoot}/nnef-pfdmanagement/v1/subscriptions/{subscriptionId}".

Otherwise, one of the HTTP status code listed in table 5.3.4.3.1-3 shall be returned.

NOTE: The PFDs that have been provisioned to the PFDF before the NF service consumer performs the subscription are not notified to the NF service consumer as a result of this subscription, but the NF service consumer can retrieve them before performing the subscription by invoking Nnef_PFDmanagement_Fetch Service Operation.

4.2.4 Nnef_PFDmanagement_Notify Service Operation

4.2.4.1 General

The Nnef_PFDmanagement_Notify service operation notifies the NF service consumer to update and/or delete the PFDs for application identifier(s).

The following procedures using the Nnef_PFDmanagement_Notify service operation are supported:

- Management of PFDs.

4.2.4.2 Notification of PFD change

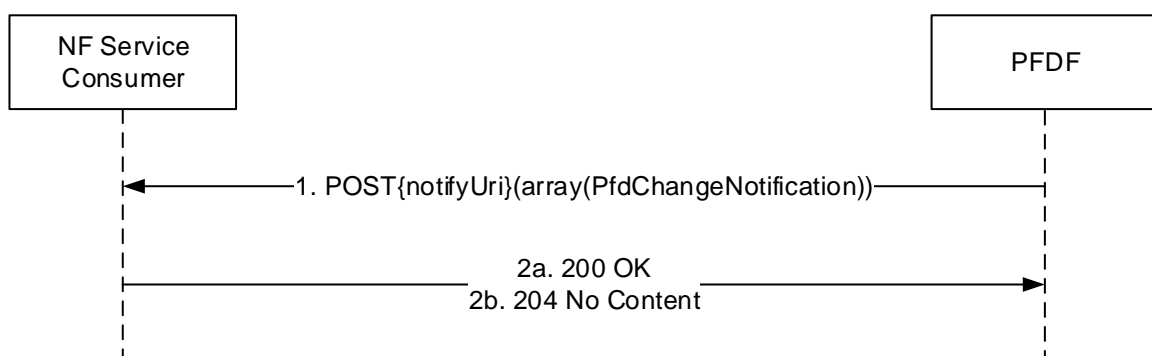


Figure 4.2.4.2-1: Notification of PFD change

1. The PFDF shall send a POST request to the NF service consumer (i.e. SMF) using the notifyUri provided during creation of the subscription resource as specified in subclause 5.6.2.3. The payload body of the POST request shall contain one or more PfdChangeNotification data structure(s).
2. If the notification is accepted, the NF service consumer shall reply with:

- "204 No Content" indicating the successful provisioning of all PFDs; or
- "200 OK" and the payload body of the response shall contain "PfdChangeReport" data structure with detailed information of failed application(s).

Otherwise, one of the HTTP status code listed in table 5.5.2.3.1-3 shall be returned.

4.2.5 Nnef_PFDmanagement_Unsubscribe Service Operation

4.2.5.1 General

The Nnef_PFDmanagement_Unsubscribe service operation is used by the NF service consumer to unsubscribe the notification of events.

4.2.5.2 Unsubscribe from event notifications on PFDs change

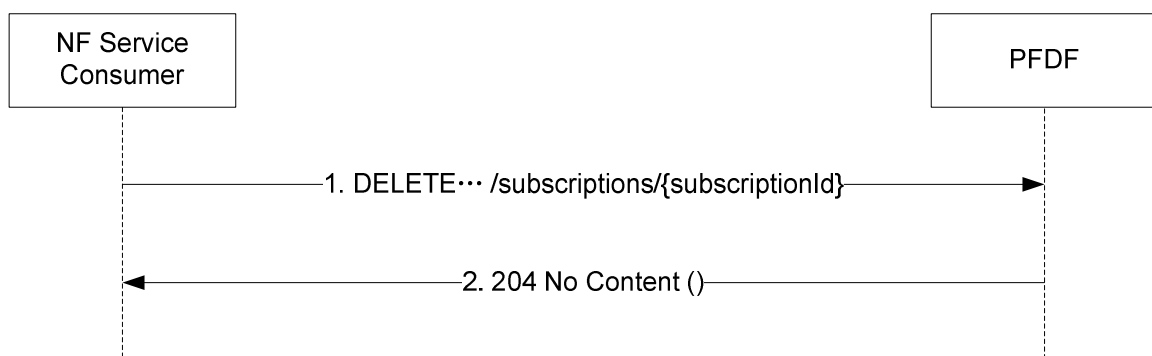


Figure 4.2.5.2-1: Unsubscribe from event notifications on PFDs change

1. The NF Service Consumer (i.e. SMF) shall send a DELETE request to the resource URI representing the individual PFD subscription. The request body shall be empty.
2. If the request is accepted, "204 No Content" shall be returned. The response body shall be empty.

Otherwise, one of the HTTP status code listed in table 5.3.5.3.1-3 shall be returned.

5 Nnef_PFDmanagement API

5.1 Introduction

The Packet Flow Description Management Service shall use the Nnef_PFDmanagement API.

The request URI used in HTTP request from the NF service consumer towards the PFDF shall have the structure defined in subclause 4.4.1 of 3GPP TS 29.501 [6], i.e.:

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

with the following components:

- The {apiRoot} shall be set as described in 3GPP TS 29.501 [6].
- The {apiName} shall be "nnef-pfdmanagement".
- The {apiVersion} shall be "v1".
- The {apiSpecificResourceUriPart} shall be set as described in subclause 5.3.

5.2 Usage of HTTP

5.2.1 General

HTTP/2, IETF RFC 7540 [7], shall be used as specified in subclause 5.2 of 3GPP TS 29.500 [5].

HTTP/2 shall be transported as specified in subclause 5.3 of 3GPP TS 29.500 [5].

The OpenAPI [9] specification of HTTP messages and content bodies for the Nnef_PFDmanagement service is contained in Annex A.

5.2.2 HTTP standard headers

5.2.2.1 General

See subclause 5.2.2 of 3GPP TS 29.500 [5] for the usage of HTTP standard headers.

5.2.2.2 Content type

JSON, IETF RFC 8259 [8], shall be used as content type of the HTTP bodies specified in the present specification, as specified in subclause 5.4 of 3GPP TS 29.500 [5]. 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 7807 [16].

5.2.3 HTTP custom headers

None

5.3 Resources

5.3.1 Resource Structure

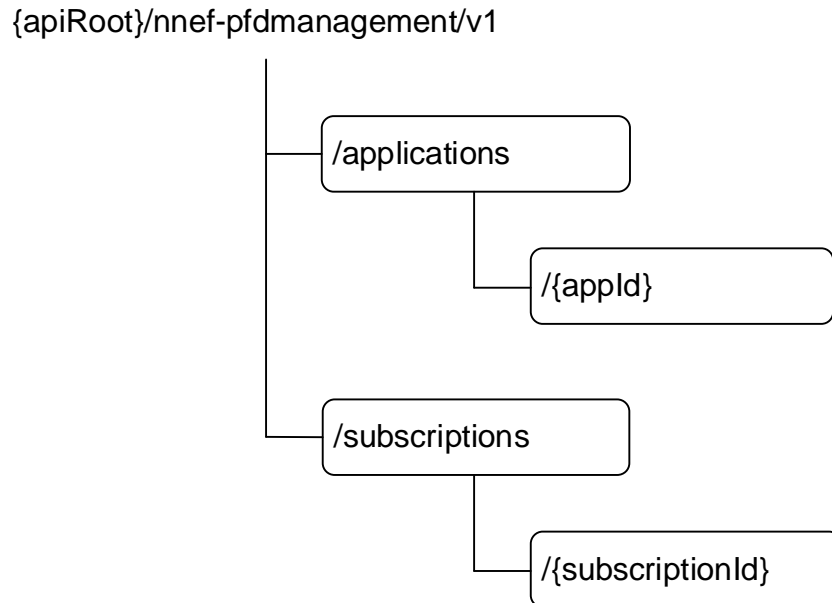


Figure 5.3.1-1: Resource URI structure of the Nnef_PFDmanagement API

Table 5.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 5.3.1-1: Resources and methods overview

Resource name	Resource URI	HTTP method or custom operation	Description
PFD of applications	/{apiRoot}/nnef-pfdmanagement/v1/applications	GET	Nnef_PFDmanagement_Fetch. Retrieve PFDs for one or multiple applications with query parameter.
Individual application PFD	/{apiRoot}/nnef-pfdmanagement/v1/applications/{appId}	GET	Nnef_PFDmanagement_Fetch. Retrieve the PFD for an application.
PFD subscriptions	/{apiRoot}/nnef-pfdmanagement/v1/subscriptions	POST	Nnef_PFDmanagement_Subscribe. Subscribe the notification of PFD changes.
Individual PFD subscription	/{apiRoot}/nnef-pfdmanagement/v1/subscriptions/{subscriptionId}	DELETE	Nnef_PFDmanagement_Unsubscribe. Delete a subscription of PFD change notification.

5.3.2 Resource: PFD of applications

5.3.2.1 Description

This resource represents PFDs for all applications.

5.3.2.2 Resource definition

Resource URI: {apiRoot}/nnef-pfdmanagement/v1/applications

This resource shall support the resource URI variables defined in table 5.3.2.2-1.

Table 5.3.2.2-1: Resource URI variables for this resource

Name	Definition
apiRoot	See subclause 5.1

5.3.2.3 Resource Standard Methods

5.3.2.3.1 GET

This method shall support the URI query parameters specified in table 5.3.2.3.1-1.

Table 5.3.2.3.1-1: URI query parameters supported by the GET method on this resource

Name	Data type	P	Cardinality	Description
application-ids	array(ApplicationId)	M	1..N	The required application identifier(s) for the returned PFDs
supported-features	SupportedFeatures	O	0..1	To filter irrelevant responses related to unsupported features.

This method shall support the request data structures specified in table 5.3.2.3.1-2 and the response data structures and response codes specified in table 5.3.2.3.1-3.

Table 5.3.2.3.1-2: Data structures supported by the GET Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 5.3.2.3.1-3: Data structures supported by the GET Response Body on this resource

Data type	P	Cardinality	Response codes	Description
array(PfdDataForApp)	M	0..N	200 OK	The PFDs for one or more application identifier(s) in the request URI are returned.
NOTE: In addition, the HTTP status codes which are specified as mandatory in table 5.2.7.1-1 of 3GPP TS 29.500 [5] for the GET method shall also apply.				

5.3.2.4 Resource Custom Operations

None.

5.3.3 Resource: Individual application PFD

5.3.3.1 Description

This resource represents the PFD identified by an application identifier.

5.3.3.2 Resource definition

Resource URI: {apiRoot}/nnef-pfdmanagement/v1/applications/{appId}

This resource shall support the resource URI variables defined in table 5.3.3.2-1.

Table 5.3.3.2-1: Resource URI variables for this resource

Name	Definition
apiRoot	See subclause 5.1.
appld	String identifying a set of PFD for an application identifier.

5.3.3.3 Resource Standard Methods

5.3.3.3.1 GET

This method shall support the URI query parameters specified in table 5.3.3.3.1-1.

Table 5.3.3.3.1-1: URI query parameters supported by the GET method on this resource

Name	Data type	P	Cardinality	Description
supported-features	SupportedFeatures	O	0..1	To filter irrelevant responses related to unsupported features.

This method shall support the request data structures specified in table 5.3.3.3.1-2 and the response data structures and response codes specified in table 5.3.3.3.1-3.

Table 5.3.3.3.1-2: Data structures supported by the GET Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 5.3.3.3.1-3: Data structures supported by the GET Response Body on this resource

Data type	P	Cardinality	Response codes	Description
PfdDataForApp	M	1	200 OK	A representation of PFDs for an application in the request URI is returned.
NOTE: In addition, the HTTP status codes which are specified as mandatory in table 5.2.7.1-1 of 3GPP TS 29.500 [5] for the GET method shall also apply.				

5.3.3.4 Resource Custom Operations

None.

5.3.4 Resource: PFD subscriptions

5.3.4.1 Description

This resource represents a collection of subscriptions created by NF service consumers of Nnef_PFDmanagement service.

5.3.4.2 Resource definition

Resource URI: {apiRoot}/nnef-pfdmanagement/v1/subscriptions

This resource shall support the resource URI variables defined in table 5.3.4.2-1.

Table 5.3.4.2-1: Resource URI variables for this resource

Name	Definition
apiRoot	See subclause 5.1

5.3.4.3 Resource Standard Methods

5.3.4.3.1 POST

This method shall support the URI query parameters specified in table 5.3.4.3.1-1.

Table 5.3.4.3.1-1: URI query parameters supported by the POST method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 5.3.4.3.1-2 and the response data structures and response codes specified in table 5.3.4.3.1-3.

Table 5.3.4.3.1-2: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
PfdSubscription	M	1	Create a PfdSubscription resource.

Table 5.3.4.3.1-3: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
PfdSubscription	M	1	201 Created	The creation of a PfdSubscription resource is confirmed and a representation of that resource is returned.
NOTE: In addition, the HTTP status codes which are specified as mandatory in table 5.2.7.1-1 of 3GPP TS 29.500 [5] for the POST method shall also apply.				

5.3.4.4 Resource Custom Operations

None.

5.3.5 Resource: Individual PFD subscription

5.3.5.1 Description

This resource represents an individual PFD subscription created by NF service consumers of Nnef_PFDmanagement service.

5.3.5.2 Resource definition

Resource URI: {apiRoot}/nnef-pfdmanagement/v1/subscriptions/{subscriptionId}

This resource shall support the resource URI variables defined in table 5.3.5.2-1.

Table 5.3.5.2-1: Resource URI variables for this resource

Name	Definition
apiRoot	See subclause 5.1
subscriptionId	String identifies an individual subscription to the PFD management service

5.3.5.3 Resource Standard Methods

5.3.5.3.1 DELETE

This method shall support the URI query parameters specified in table 5.3.5.3.1-1.

Table 5.3.5.3.1-1: URI query parameters supported by the DELETE method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 5.3.5.3.1-2 and the response data structures and response codes specified in table 5.3.5.3.1-3.

Table 5.3.5.3.1-2: Data structures supported by the DELETE Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 5.3.5.3.1-3: Data structures supported by the DELETE Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	The PfdSubscription resource matching the subscriptionId was deleted successfully.
NOTE: In addition, the HTTP status codes which are specified as mandatory in table 5.2.7.1-1 of 3GPP TS 29.500 [5] for the DELETE method shall also apply.				

5.3.5.4 Resource Custom Operations

None.

5.4 Custom Operations without associated resources

None

5.5 Notifications

5.5.1 General

Notifications shall comply to subclause 6.2 of 3GPP TS 29.500 [5] and subclause 4.6.2.3 of 3GPP TS 29.501 [6].

Table 5.5.1-1: Notifications

Custom operation URI	Mapped HTTP method	Description
{notifyUri}	POST	Notification of PFD change.

5.5.2 PFD Change Notification

5.5.2.1 Description

The PFD Change Notification is used by the PFDF to inform the NF service consumer, which has subscribed to this Notification via the PFD subscriptions resource.

5.5.2.2 Target URI

The Notification URI "{**notifyUri**}" shall be used with the URI variables defined in table 5.5.2.2-1.

Table 5.5.2.2-1: URI variables

Name	Definition
notifyUri	String formatted as URI with the Notification Uri as assigned within the PFD subscriptions resource and described within the PfdSubscription data type (see table 5.6.2.3-1).

5.5.2.3 Standard Methods

5.5.2.3.1 POST

This method shall support the URI query parameters specified in table 5.5.2.3.1-1.

Table 5.5.2.3.1-1: URI query parameters supported by the POST method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 5.5.2.3.1-2 and the response data structures and response codes specified in table 5.5.2.3.1-3.

Table 5.5.2.3.1-2: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
array(PfdChangeNotification)	M	1..N	Provides PFD change information.

Table 5.5.2.3.1-3: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	The PFD operation in the notification is performed successfully, i.e. all PFD changes are accepted by the SMF.
array(PfdChangeReport)	M	1..N	200 OK	The PFD operation in the notification is performed and the PfdChangeReport indicates failure reason for each failed application in the partial success.
ProblemDetails	M	1	500 Internal Server Error	The server encountered an unexpected condition that prevented it from fulfilling the request. PFDs for all applications are not accepted by the SMF. (NOTE 2)
NOTE 1: In addition, the HTTP status codes which are specified as mandatory in table 5.2.7.1-1 of 3GPP TS 29.500 [5] for the POST method shall also apply.				
NOTE 2: Failure cases are described in subclause 5.7.				

5.6 Data Model

5.6.1 General

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

Table 5.6.1-1 specifies the data types defined for the Nnef_PFDmanagement service based interface protocol.

Table 5.6.1-1: Nnef_PFDmanagement specific Data Types

Data type	Section defined	Description	Applicability
PfdDataForApp	5.6.2.2	Represents the PFDs for an application identifier.	
PfdSubscription	5.6.2.3	Represents a PFD subscription.	
PfdChangeNotification	5.6.2.4	Represents PFD change information.	
PfdContent	5.6.2.5	Represents the content of a PFD for an application identifier.	
PfdChangeReport	5.6.2.6	Represents error of PFD change.	

Table 5.6.1-2 specifies data types re-used by the Nnef_PFDmanagement 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 Nnef_PFDmanagement service based interface.

Table 5.6.1-2: Nnef_PFDmanagement re-used Data Types

Data type	Reference	Comments	Applicability
ApplicationId	3GPP TS 29.571 [10]		
DateTime	3GPP TS 29.571 [10]		
SupportedFeatures	3GPP TS 29.571 [10]		
Uri	3GPP TS 29.571 [10]		

5.6.2 Structured data types

5.6.2.1 Introduction

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

Allowed structures are: array, object.

5.6.2.2 Type: PfdDataForApp

Table 5.6.2.2-1: Definition of type PfdDataForApp

Attribute name	Data type	P	Cardinality	Description	Applicability
applicationId	ApplicationId	M	1	Identifier of an application.	
pfd	array(PfdContent)	M	1..N	PFDs for the application identifier.	
cachingTime	DateTime	O	0..1	Caching time for an application identifier.	

5.6.2.3 Type: PfdSubscription

Table 5.6.2.3-1: Definition of type PfdSubscription

Attribute name	Data type	P	Cardinality	Description	Applicability
applicationIds	array(ApplicationId)	O	1..N	Identifiers of applications with PFDs change.	
notifyUri	Uri	M	1	Identifies the recipient of notifications sent by PFDF for this subscription.	
supportedFeatures	SupportedFeatures	M	1	List of supported features used as described in subclause 5.8. This parameter shall be provided by the NF service consumer in the POST request that request the creation of a subscription, and shall be provided by the PFDF in the response of corresponding request.	

5.6.2.4 Type: PfdChangeNotification

Table 5.6.2.4-1: Definition of type PfdChangeNotification

Attribute name	Data type	P	Cardinality	Description	Applicability
applicationId	ApplicationId	M	1	Identifier of an application.	
removalFlag	boolean	O	0..1	Indication of removal of PFDs for an existing application identifier.	
partialFlag	boolean	O	0..1	Indication of partial update of PFDs for an existing application identifier if this operation is supported according to feature negotiation.	PartialUpdate
pfd	array(PfdContent)	O	1..N	PFD creation/update for the application identifier as specified in subclause 6.3.3.5 of 3GPP TS 29.251 [12].	

5.6.2.5 Type: PfdContent

Table 5.6.2.5-1: Definition of type PfdContent

Attribute name	Data type	P	Cardinality	Description	Applicability
pfdId	string	C	0..1	Identifies a PFD of an application identifier. If PartialUpdate feature is supported, this attribute shall be provided by the PFDF.	
flowDescriptions	array(string)	O	1..N	Represents a 3-tuple with protocol, server ip and server port for UL/DL application traffic. (NOTE)	
urls	array(string)	O	1..N	Indicates a URL or a regular expression which is used to match the significant parts of the URL. (NOTE)	
domainNames	array(string)	O	1..N	Indicates an FQDN or a regular expression as a domain name matching criteria. (NOTE)	

NOTE: If a PFD contains multiple filter types, the PFD is only matched when every filter type contained in the PFD has a matching value.

5.6.2.6 Type: PfdChangeReport

Table 5.6.2.6-1: PfdChangeReport

Attribute name	Data type	P	Cardinality	Description	Applicability
pfdError	ProblemDetails	M	1	More information on the error shall be provided in the "cause" attribute of the "ProblemDetails" structure. The "cause" attribute in the ProblemDetails shall be set to one of following application errors (see table 5.2.7.1-1 of 3GPP TS 29.500 [5]): - SYSTEM_FAILURE - INSUFFICIENT_RESOURCES - UNSPECIFIED_NF_FAILURE	
applicationId	array(ApplicationId)	M	1..N	Indicates the application identifier(s) which PFD(s) are failed to be added or modified.	

5.6.3 Simple data types and enumerations

5.6.3.1 Introduction

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

5.6.3.2 Simple data types

The simple data types defined in table 5.6.3.2-1 shall be supported.

Table 5.6.3.2-1: Simple data types

Type Name	Type Definition	Description	Applicability

5.7 Error handling

5.7.1 General

HTTP error handling shall be supported as specified in subclause 5.2.4 of 3GPP TS 29.500 [5].

For the Nnef_PFDmanagement API, HTTP error responses shall be supported as specified in subclause 4.8 of 3GPP TS 29.501 [6]. Protocol errors and application errors specified in table 5.2.7.2-1 of 3GPP TS 29.500 [5] 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 [5].

In addition, the requirements in the following subclauses shall apply.

5.7.2 Protocol Errors

In this Release of the specification, there are no additional protocol errors applicable for the Nnef_PFDmanagement API.

5.7.3 Application Errors

The application errors defined for the Nnef_PFDmanagement service are listed in table 5.7.3-1.

Table 5.7.3-1: Application errors

Application Error	HTTP status code	Description
SYSTEM_FAILURE	500 Internal Server Error	Something functions wrongly in PFD provisioning or the PFD provisioning does not function at all. (NOTE)
INSUFFICIENT_RESOURCE	500 Internal Server Error	There is limitation for resource storage. (NOTE)
UNSPECIFIED_NF_FAILURE	500 Internal Server Error	Unspecified reason. (NOTE)
NOTE: This application error is included in the responses to the POST request of PFD change notification.		

5.8 Feature negotiation

The optional features in table 5.8-1 are defined for the Nnef_PFDmanagement API. They shall be negotiated using the extensibility mechanism defined in subclause 6.6 of 3GPP TS 29.500 [5].

Table 5.8-1: Supported Features

Feature number	Feature Name	Description
1	PartialUpdate	The PFDF can use this feature for partial update of PFDs.

5.9 Security

As indicated in 3GPP TS 33.501 [14] and 3GPP TS 29.500 [5], the access to the Nnef_PFDmanagement API may be authorized by means of the OAuth2 protocol (see IETF RFC 6749 [15]), based on local configuration, using the "Client Credentials" authorization grant, where the NRF (see 3GPP TS 29.510 [13]) plays the role of the authorization server.

If OAuth2 is used, an NF Service Consumer, prior to consuming services offered by the Nnef_PFDmanagement API, shall obtain a "token" from the authorization server, by invoking the Access Token Request service, as described in 3GPP TS 29.510 [13], subclause 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 Nnef_PFDmanagement service.

The Nnef_PFDmanagement API defines a single scope "nnef-pfdmanagement" for OAuth2 authorization (as specified in 3GPP TS 33.501 [14]) for the entire service, and it does not define any additional scopes at resource or operation level.

Annex A (normative): OpenAPI specification

A.1 General

The present Annex contains an OpenAPI [9] specification of HTTP messages and content bodies used by the Nnef_PFDmanagement API.

This Annex shall take precedence when being discrepant to other parts of the specification with respect to the encoding of information elements and methods within the API.

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 file contained in this 3GPP Technical Specification are available on the public 3GPP file server in the following locations (see clause 5B of the 3GPP TR 21.900 [17] for further information):

- <https://www.3gpp.org/ftp/Specs/archive/OpenAPI/<Release>/>, and
- <https://www.3gpp.org/ftp/Specs/<Plenary>/<Release>/OpenAPI/>.

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

A.2 Nnef_PFDmanagement API

```

openapi: 3.0.0
info:
  title: Nnef_PFDmanagement Service API
  version: 1.0.1
  description: |
    Packet Flow Description Management Service.
    © 2019, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.
#
externalDocs:
  description: 3GPP TS 29.551 v15.4.0, 5G System; Packet Flow Description Management Service
  url: 'http://www.3gpp.org/ftp/Specs/archive/29_series/29.551/'
#
servers:
  - url: '{apiRoot}/nnef-pfdmanagement/v1'
    variables:
      apiRoot:
        default: https://example.com
        description: apiRoot as defined in subclause 4.4 of 3GPP TS 29.501
security:
  - {}
  - oAuth2ClientCredentials:
    - nnef-pfdmanagement
paths:
  /applications:
    get:
      summary: Retrieve PFDs for all applications or for one or multiple applications with query
parameter.
      tags:
        - PFD of applications
      operationId: Nnef_PFDmanagement_Fetch
      parameters:
        - name: application-ids
          description: The required application identifier(s) for the returned PFDs.
          in: query

```

```

    required: true
    schema:
      type: array
      items:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/ApplicationId'
      minItems: 1
  - name: supported-features
    in: query
    description: To filter irrelevant responses related to unsupported features
    schema:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
responses:
  '200':
    description: The PFDs for one or more application identifier(s) in the request URI are
returned.
    content:
      application/json:
        schema:
          type: array
          items:
            $ref: '#/components/schemas/PfdDataForApp'
          minItems: 0
  '400':
    $ref: 'TS29571_CommonData.yaml#/components/responses/400'
  '401':
    $ref: 'TS29571_CommonData.yaml#/components/responses/401'
  '403':
    $ref: 'TS29571_CommonData.yaml#/components/responses/403'
  '404':
    $ref: 'TS29571_CommonData.yaml#/components/responses/404'
  '406':
    $ref: 'TS29571_CommonData.yaml#/components/responses/406'
  '414':
    $ref: 'TS29571_CommonData.yaml#/components/responses/414'
  '429':
    $ref: 'TS29571_CommonData.yaml#/components/responses/429'
  '500':
    $ref: 'TS29571_CommonData.yaml#/components/responses/500'
  '503':
    $ref: 'TS29571_CommonData.yaml#/components/responses/503'

/applications/{appId}:
get:
  summary: Retrieve the PFD for an application.
  tags:
    - Individual application PFD
  operationId: Nnef_PFDmanagement_Fetch
  parameters:
    - name: appId
      description: The required application identifier(s) for the returned PFDs.
      in: path
      required: true
      schema:
        type: string
    - name: supported-features
      in: query
      description: To filter irrelevant responses related to unsupported features
      schema:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
  responses:
    '200':
      description: A representation of PFDs for an application in the request URI is returned.
      content:
        application/json:
          schema:
            $ref: '#/components/schemas/PfdDataForApp'
    '400':
      $ref: 'TS29571_CommonData.yaml#/components/responses/400'
    '401':
      $ref: 'TS29571_CommonData.yaml#/components/responses/401'
    '403':
      $ref: 'TS29571_CommonData.yaml#/components/responses/403'
    '404':
      $ref: 'TS29571_CommonData.yaml#/components/responses/404'
    '406':
      $ref: 'TS29571_CommonData.yaml#/components/responses/406'
    '429':
      $ref: 'TS29571_CommonData.yaml#/components/responses/429'

```

```

    '414':
      $ref: 'TS29571_CommonData.yaml#/components/responses/414'
    '500':
      $ref: 'TS29571_CommonData.yaml#/components/responses/500'
    '503':
      $ref: 'TS29571_CommonData.yaml#/components/responses/503'

/subscriptions:
  post:
    summary: Subscribe the notification of PFD changes.
    tags:
      - PFD subscriptions
    operationId: Nnef_PFDmanagement_Subscribe
    requestBody:
      description: a PfdSubscription resource to be created.
      required: true
    content:
      application/json:
        schema:
          $ref: '#/components/schemas/PfdSubscription'
    callbacks:
      PfdChangeNotification:
        '{request.body#/notifyUri}':
          post:
            summary: Notification of PFD change.
            tags:
              - PfdChangeNotification data
            operationId: Nnef_PFDmanagement_Notify
            requestBody:
              required: true
            content:
              application/json:
                schema:
                  type: array
                  items:
                    $ref: '#/components/schemas/PfdChangeNotification'
                  minItems: 1
            responses:
              '200':
                description: The PFD operation in the notification is performed and the
                PfdChangeReport indicates failure reason.
                content:
                  application/json:
                    schema:
                      type: array
                      items:
                        $ref: '#/components/schemas/PfdChangeReport'
                    minItems: 1
              '204':
                description: The PFD operation in the notification is performed successfully.
              '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'
              '503':
                $ref: 'TS29571_CommonData.yaml#/components/responses/503'

    responses:
      '201':
        description: The creation of a PfdSubscription resource is confirmed and a representation
        of that resource is returned.
        content:
          application/json:

```

```

    schema:
      $ref: '#/components/schemas/PfdSubscription'
  headers:
    Location:
      description: 'Contains the URI of the newly created resource, according to the
structure: {apiRoot}/nnef-pfdmanagement/v1/subscriptions/{subscriptionId}'
      required: true
      schema:
        type: string
  '400':
    $ref: 'TS29571_CommonData.yaml#/components/responses/400'
  '401':
    $ref: 'TS29571_CommonData.yaml#/components/responses/401'
  '403':
    $ref: 'TS29571_CommonData.yaml#/components/responses/403'
  '404':
    $ref: 'TS29571_CommonData.yaml#/components/responses/404'
  '411':
    $ref: 'TS29571_CommonData.yaml#/components/responses/411'
  '413':
    $ref: 'TS29571_CommonData.yaml#/components/responses/413'
  '415':
    $ref: 'TS29571_CommonData.yaml#/components/responses/415'
  '429':
    $ref: 'TS29571_CommonData.yaml#/components/responses/429'
  '500':
    $ref: 'TS29571_CommonData.yaml#/components/responses/500'
  '503':
    $ref: 'TS29571_CommonData.yaml#/components/responses/503'

/subscriptions/{subscriptionId}:
  delete:
    summary: Delete a subscription of PFD change notification.
    tags:
      - Individual PFD subscription
    operationId: Nnef_PFDmanagement_Unsubscribe
    parameters:
      - name: subscriptionId
        description: Identify the subscription.
        in: path
        required: true
        schema:
          type: string
    responses:
      '204':
        description: The PfdSubscription resource matching the subscriptionId was deleted
successfully.
      '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'
      '429':
        $ref: 'TS29571_CommonData.yaml#/components/responses/429'
      '500':
        $ref: 'TS29571_CommonData.yaml#/components/responses/500'
      '503':
        $ref: 'TS29571_CommonData.yaml#/components/responses/503'

components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{nrfApiRoot}/oauth2/token'
          scopes:
            nnef-pfdmanagement: Access to the Nnef_PFDmanagement API
  schemas:
#
# STRUCTURED DATA TYPES
#
  PfdContent:
    type: object
    properties:

```

```

    pfdId:
      type: string
      description: Identifies a PDF of an application identifier.
    flowDescriptions:
      type: array
      items:
        type: string
      minItems: 1
      description: Represents a 3-tuple with protocol, server ip and server port for UL/DL
application traffic.
    urls:
      type: array
      items:
        type: string
      minItems: 1
      description: Indicates a URL or a regular expression which is used to match the
significant parts of the URL.
    domainNames:
      type: array
      items:
        type: string
      minItems: 1
      description: Indicates an FQDN or a regular expression as a domain name matching criteria.

PfdDataForApp:
  type: object
  properties:
    applicationId:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/ApplicationId'
    pfd:
      type: array
      items:
        $ref: '#/components/schemas/PfdContent'
      minItems: 1
    cachingTime:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
  required:
    - applicationId
    - pfd

PfdSubscription:
  type: object
  properties:
    applicationIds:
      type: array
      items:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/ApplicationId'
      minItems: 1
    notifyUri:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
    supportedFeatures:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
  required:
    - notifyUri
    - supportedFeatures

PfdChangeNotification:
  type: object
  properties:
    applicationId:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/ApplicationId'
    removalFlag:
      type: boolean
      default: false
    partialFlag:
      type: boolean
      default: false
    pfd:
      type: array
      items:
        $ref: '#/components/schemas/PfdContent'
      minItems: 1
  required:
    - applicationId

PfdChangeReport:
  type: object
  properties:

```

```
  pfdError:
    $ref: 'TS29571_CommonData.yaml#/components/schemas/ProblemDetails'
  applicationId:
    type: array
    items:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/ApplicationId'
    minItems: 1
required:
- pfdError
- applicationId
```

Annex B (informative): Change history

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2018-01						TS skeleton of PFD Management Service specification	0.0.0
2018-01	CT3#94					Includes the following contribution agreed by CT3 at CT3#94: C3-180045, C3-180270, C3-180271.	0.1.0
2018-03	CT3#95					Includes the following contribution agreed by CT3 at CT3#95: C3-181100, C3-181262, C3-181102, C3-181103, C3-181314.	0.2.0
2018-04	CT3#96					Includes the following contribution agreed by CT3 at CT3#96: C3-182153, C3-182411, C3-182412, C3-182413, C3-182414, C3-182477, C3-182478.	0.3.0
2018-05	CT3#97					Includes the following contribution agreed by CT3 at CT3#97: C3-183115, C3-183557, C3-183558, C3-183560.	0.4.0
2018-06	CT#80	CP-181029				TS sent to plenary for approval	1.0.0
2018-06	CT#80	CP-181029				TS approved by plenary	15.0.0
2018-09	CT#81	CP-182015	0001	2	F	Protocol error statement	15.1.0
2018-09	CT#81	CP-182015	0002	1	F	Description of Structured data types	15.1.0
2018-12	CT#82	CP-183205	0003		F	Default value for apiRoot	15.2.0
2018-12	CT#82	CP-183205	0004	3	F	Cardinality	15.2.0
2018-12	CT#82	CP-183205	0005	1	F	Correct Nnef_PFDmanagement API	15.2.0
2018-12	CT#82	CP-183205	0006		F	Location Header	15.2.0
2018-12	CT#82	CP-183205	0007	1	F	Alignment of openAPI	15.2.0
2018-12	CT#82	CP-183205	0008		F	API version update	15.2.0
2018-12	CT#82	CP-183205	0009		F	Security	15.2.0
2018-12	CT#82	CP-183205	0010		F	Content type	15.2.0
2019-03	CT#83	CP-190116	0011	1	F	Fetch PFD for all applications	15.3.0
2019-03	CT#83	CP-190116	0014	1	F	Correction of resource URIs	15.3.0
2019-03	CT#83					TS version correction in Open API by MCC	15.3.0
2019-06	CT#84	CP-191083	0015	1	F	Precedence of OpenAPI file	15.4.0
2019-06	CT#84	CP-191083	0018		F	Correction to Notification of PFD change	15.4.0
2019-06	CT#84	CP-191083	0020		F	Copyright Note in YAML file	15.4.0
2019-06	CT#84	CP-191083	0022		F	API version Update	15.4.0
2019-09	CT#85	CP-192149	0024	2	F	Correct presence condition in PFD definition	15.5.0
2020-09	CT#89e	CP-202056	0034		F	Correction to the PFD change notification	15.6.0
2020-12	CT#90e	CP-203120	0044	1	F	Correction to PFD retrieval in PULL mode	15.7.0
2020-12	CT#90e	CP-203120	0047		F	Correction to notification URI of PFD change notification	15.7.0
2021-03	CT#91e	CP-210200	0070		F	Datatype and figure corrections	15.8.0
2021-06	CT#92e	CP-211208	0077	1	F	Correction of request URI in 4.2.2.2	15.9.0
2021-09	CT#93e	CP-212190	0086		F	default caching time value	15.10.0
2021-09	CT#93e	CP-212190	0089		F	Presentation condition of pfld attribute	15.10.0
2021-12	CT#94e	CP-213215	0095	1	F	Correction to PFD management in push mode	15.11.0

History

Document history		
V15.0.0	July 2018	Publication
V15.1.0	October 2018	Publication
V15.2.0	April 2019	Publication
V15.3.0	April 2019	Publication
V15.4.0	October 2019	Publication
V15.5.0	October 2019	Publication
V15.6.0	November 2020	Publication
V15.7.0	January 2021	Publication
V15.8.0	April 2021	Publication
V15.9.0	August 2021	Publication
V15.10.0	September 2021	Publication
V15.11.0	January 2022	Publication