

Oracle® Communications

Unified Data Management (UDM) User's Guide



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The Oracle logo, consisting of a solid red square with the word "ORACLE" in white, uppercase, sans-serif font centered within it.

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Contents

1	What's New in This Guide?	
<hr/>		
2	Introduction	
<hr/>		
	UDM Overview	2-1
	Acronyms	2-2
	How to use this document	2-2
	Documentation Admonishments	2-3
	Locate Product Documentation on the Oracle Help Center Site	2-4
	Customer Training	2-4
	My Oracle Support	2-4
	Emergency Response	2-5
3	UDM Architecture	
<hr/>		
4	Features Supported	
<hr/>		
5	UDM Services	
<hr/>		
	Authentication Service	5-1
	NRF Client Services	5-1
	Subscription Data Management (SDM) Service	5-2
	Subscription Data Management Notify (SDM Notify) Service	5-2
	UE Context Management (CM) Service	5-3
	AuSF Service	5-3
6	Metrics on UDM	
<hr/>		

List of Figures

2-1	Example of a Procedure Steps Used in This Document	2-3
3-1	UDM Architecture	3-2

List of Tables

2-1	Acronyms	2-2
2-2	Admonishments	2-3
6-1	Ingress API Gateway Metrics	6-1
6-2	Nudm-uecm Micro Service Metrics	6-1
6-3	Nudm-auth Micro Service Metrics	6-4
6-4	Nudm-sdm Micro Service Metrics	6-7
6-5	Nudm-Sdm-Notify Micro Service Metrics	6-11
6-6	Nudm-NRF Client Micro Service Metrics	6-12
6-7	KPI Micro Service Metrics	6-13
6-8	AUSF Micro Service Metrics	6-16

1

What's New in This Guide?

This section shares the list of new features introduced in every OCUDM release. For more release specific information, please refer to its release notes.

Release 1.2

No updates for this release.

Release 1.1

The following new features are introduced in this release:

- – UDM support to SIDF - SUCI de-concealment
- UDM's Nudm-sdm service support to subscriptions and notifications

2

Introduction

This document provides information on how to use the Oracle Communications Unified Data Management (UDM) product in the cloud native 5G core network. The UDM product from Oracle communications is a combination of the Authentication Server Function (AUSF) and Unified Data Management (UDM) network functions as detailed out by 3GPP.

The UDM consolidates the data sources to create a single data narrative within a data warehouse. The resources, data model and usage are defined to access the subscription data through the Unified Data Repository services.

UDM Overview

Oracle 5G UDM, implemented as a cloud native function, offers a combination of the AUSF and UDM NF's as detailed out by 3GPP.

1. The Authentication Server Function (AUSF) supports authentication for 3GPP access as specified in 3GPP TS 33.501.
2. The Unified Data Management Function (UDM) supports following functionalities:
 - Generate 3GPP 5G AKA Authentication Vectors
 - User Identification Handling (e.g. storage and management of SUPI for each subscriber in the 5G system)
 - UE's Serving NF Registration Management (e.g. storing the serving AMF for UE, storing the serving SMF for UE's PDU Session)
 - Supports retrieval of the UE's individual subscription data for slice selection, AM data, SM data, SmfSelection data, smf ue context data and supports acknowledgment of SoR and UpU function
 - Supports subscription based on data change notification service

Oracle 5G UDM Solution

- Encapsulates the AUSF and UDM functionalities under a common Network Function.
- Provides a HTTP2 based RESTful interface for other NFs to consume the services offered.
- Uses Helm chart for all configurations and deployment.
- Runs in stateless mode of offloading storage of all information externally in 5G UDR.
 - Uses Nudr services as specified in 3GPP TS 29.504 and 3GPP TS 29.505 to retrieve required data from the UDR
 - Processes the incoming request includes updating data in the UDR whenever applicable
- Leverages a common Oracle Communications Cloud Native Framework

- Compliant to 3GPP Release 15 specification
- Has tiered architecture providing separation between the connectivity, business logic and data layers
- Uses MySQL NDB Cluster as the backend database in the Data Tier
- Registers with NRF in the 5G network, so the other NFs in the network can discover AUSF/UDM through NRF and also enables discovery of UDR(s) from NRF

Some of the consumers of the UDM services are:

- **Authentication Service Function (AUSF)** - For authenticating subscribers within the network.
- **Access Management Function (AMF)** - The AMF utilizes the UDM to retrieve any access based information/restrictions of the subscriber. It also uses UDM to identify the allowed functionalities of the SMF's for the subscriber to make a decision.
- **Network Exposure Function (NEF)** - The NEF utilizes the UDM services to retrieve any non-3GPP access based information/restriction of the subscriber.

Acronyms

Table 2-1 Acronyms

Acronyms	Definition
3GPP	3rd Generation Partnership Project
AM (Data)	Access and Mobility Subscription Data
AMF	Access and Mobility Management Function
AuSF	Authentication Server Function
GUAMI	Globally Unique AMF Identifier
NEF	Network Exposure Function
NRF	Network Repository Function
NSSAI	Network Slice Selection Assistance Information
SIDF	Subscription Identifier De-concealing Function
SM (Data)	Session Management Subscription Data
SMF	Session Management Function
SMSF	Short Message Service Function
SoR	Support of Optimal Routeing
SUCI	Subscription Concealed Identifier
SUPI	Subscription Permanent Identifier
UDM	Unified Data Management
UDR	Unified Data Repository
UpU	UE (User Equipment)Parameter Update

How to use this document

Although this document is primarily to be used as an initial user guide, its secondary purpose is to be used as a reference for Disaster Recovery procedures.

When executing this document for either purpose, there are a few points which help to ensure that the user understands the author's intent. These points are as follows:

1. Before beginning a procedure, completely read the instructional text (it will appear immediately after the Section heading for each procedure) and all associated procedural WARNINGS or NOTES.
2. Before execution of a STEP within a procedure, completely read the left and right columns including any STEP specific WARNINGS or NOTES.

If a procedural STEP fails to execute successfully, STOP and contact Oracle's Customer Service for assistance before attempting to continue. [My Oracle Support](#) for information on contacting Oracle Customer Support.

Figure 2-1 Example of a Procedure Steps Used in This Document

Each step has a checkbox the user should check to keep track of the progress of the procedure.

The Title column describes the operations to perform during that step.

Each command the user enters, and any response output, is formatted in 10-point Courier font.

	Title	Directive/Result Step
1. <input type="checkbox"/>	Change directory	Change to the backout directory. <pre>\$ cd /var/TKLC/backout</pre>
2. <input type="checkbox"/>	ServerX: Connect to the console of the server	Establish a connection to the server using cu on the terminal server/console. <pre>\$ cu -l /dev/ttyS7</pre>
3. <input type="checkbox"/>	Verify Network Element data	View the Network Elements configuration data; verify the data; save and print report. 3. Select Configuration > Network Elements to view Network Elements Configuration screen.

Documentation Admonishments

Admonishments are icons and text throughout this manual that alert the reader to assure personal safety, to minimize possible service interruptions, and to warn of the potential for equipment damage.

Table 2-2 Admonishments




Icon	Description
 DANGER	Danger: (This icon and text indicate the possibility of personal injury.)
 WARNING	Warning: (This icon and text indicate the possibility of equipment damage.)

Table 2-2 (Cont.) Admonishments

Icon	Description
 CAUTION	Caution: (This icon and text indicate the possibility of service interruption.)

Locate Product Documentation on the Oracle Help Center Site

Oracle Communications customer documentation is available on the web at the Oracle Help Center site, <http://docs.oracle.com>. You do not have to register to access these documents. Viewing these files requires Adobe Acrobat Reader, which can be downloaded at <http://www.adobe.com>.

1. Access the Oracle Help Center site at <http://docs.oracle.com>.
2. Click **Industries**.
3. Under the Oracle Communications subheading, click **Oracle Communications documentation** link.
The Communications Documentation page displays.
4. Click on your product and then the release number.
A list of the documentation set for the selected product and release displays.
5. To download a file to your location, right-click the **PDF** link, select **Save target as** (or similar command based on your browser), and save to a local folder.

Customer Training

Oracle University offers training for service providers and enterprises. Visit our web site to view, and register for, Oracle Communications training at <http://education.oracle.com/communication>.

To obtain contact phone numbers for countries or regions, visit the Oracle University Education web site at www.oracle.com/education/contacts.

My Oracle Support

My Oracle Support (<https://support.oracle.com>) is your initial point of contact for all product support and training needs. A representative at Customer Access Support can assist you with My Oracle Support registration.

Call the Customer Access Support main number at 1-800-223-1711 (toll-free in the US), or call the Oracle Support hotline for your local country from the list at <http://www.oracle.com/us/support/contact/index.html>. When calling, make the selections in the sequence shown below on the Support telephone menu:

1. Select **2** for New Service Request.
2. Select **3** for Hardware, Networking and Solaris Operating System Support.

3. Select one of the following options:

- For Technical issues such as creating a new Service Request (SR), select **1**.
- For Non-technical issues such as registration or assistance with My Oracle Support, select **2**.

You are connected to a live agent who can assist you with My Oracle Support registration and opening a support ticket.

My Oracle Support is available 24 hours a day, 7 days a week, 365 days a year.

Emergency Response

In the event of a critical service situation, emergency response is offered by the Customer Access Support (CAS) main number at 1-800-223-1711 (toll-free in the US), or by calling the Oracle Support hotline for your local country from the list at <http://www.oracle.com/us/support/contact/index.html>. The emergency response provides immediate coverage, automatic escalation, and other features to ensure that the critical situation is resolved as rapidly as possible.

A critical situation is defined as a problem with the installed equipment that severely affects service, traffic, or maintenance capabilities, and requires immediate corrective action. Critical situations affect service and/or system operation resulting in one or several of these situations:

- A total system failure that results in loss of all transaction processing capability
- Significant reduction in system capacity or traffic handling capability
- Loss of the system's ability to perform automatic system reconfiguration
- Inability to restart a processor or the system
- Corruption of system databases that requires service affecting corrective actions
- Loss of access for maintenance or recovery operations
- Loss of the system ability to provide any required critical or major trouble notification

Any other problem severely affecting service, capacity/traffic, billing, and maintenance capabilities may be defined as critical by prior discussion and agreement with Oracle.

3

UDM Architecture

Connectivity Tier

- 5GNF API gateway (uses SpringCloudGateway) receives all ingress requests and forwards them to UDM micro service in Business Tier
- Runs on Kubernetes as a micro service

Business Tier

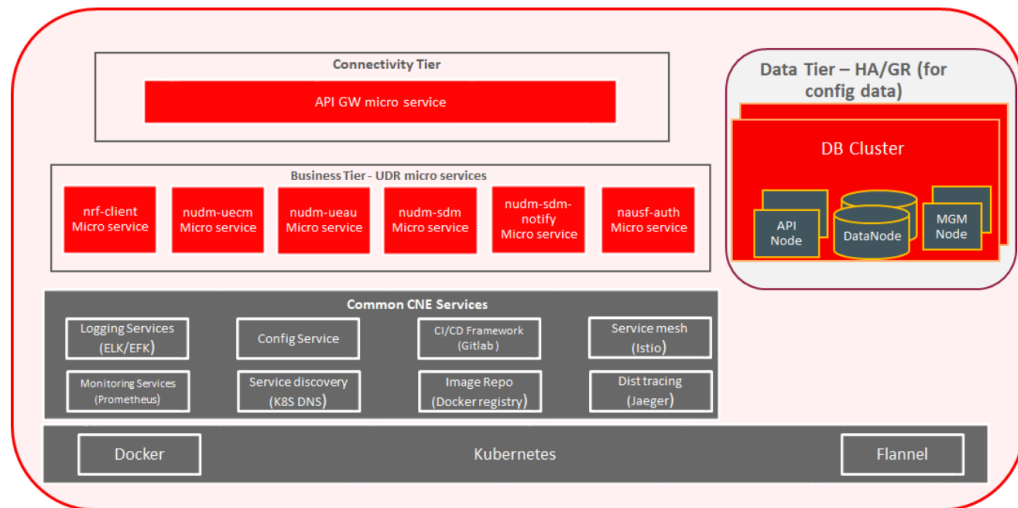
- Provides the business logic of 5G UDM
- Runs on Kubernetes and has 6 micro services
- **ausfueauthenticator**: Provides AUSF authentication services functionality and connects to Data Tier for DB operations
- **ocudm-nudm-ue-auth-service**: Provides UDM authentication functionality
- **ocudm-nudm-uecm-service**: Provides UDM Context Management functionality
- **ocudm-nudm-sdm-service**: Provides UDM Subscriber Data Management functionality
- **ocudm-nudm-sdm-notify-service**: Provides UDM Subscriber Data Management, Data Change notification functionality
- **nudm-nrf-client-service**: Supports NRF registration, heartbeat, update and de-registration with NRF

Data Tier

- Uses Oracle MySQL Cluster CGE database technology for back-end database in the DB tier, which provides HA and geo-redundcancy capabilities.
- Runs on virtual machines.

[Figure 3-1](#) shows the detailed view of the UDM Architecture:

Figure 3-1 UDM Architecture



4

Features Supported

Following are the features that are supported by the UDM:

- Deployable on OCCNE (1.3 and above) and integrated to use DB Tier
- Integrated with CNE services
- Integrated with UDR (1.3 and above) as backend data store
- Integrated with 5G Ingress API gateway for ingress traffic
- Provides AUSF authentication capability as part of deployment
- Compliant with 29.503 v15.4.0
- Supports Nudm-ueau service for authentication procedures for 5G AKA (Authentication and Key Agreement)
- Supports Nudm-uecm for context management procedures for AMF registrations, SMF registrations, SMSF for 3gpp access. Also supports implicit notifications to AMF
- Supports Nudm-sdm for subscriber data management procedures for slice selection, AM, SM data, SoRAck and UpU Ack and other APIs
- Supports Nudm-sdm subscription to notification of data change service (for UE individual data)

5

UDM Services

Following sections describe the services provided by the UDM.

Authentication Service

UDM UE Authentication service supports authentication procedure as described in 33.501 section 6.1.3. This authentication service:

- Processes authentication request from AUSF by obtaining the provisioned authentication method, authentication keys from the UDR for 5G-AKA and computing the authentication vectors.
- Updates the subscriber profile in UDR with the authentication status after the completion of the authentication procedures as defined in 29.509 and 29.503.
- Supports re-synchronization procedure as described in 33.501 section 6.1.3
- Supports SIDF functionality, which further:
 - Performs SUCI to SUPI conversion
 - Supports all 3 protection schemes
 - * null-scheme
 - * profile A
 - * profile B
 - Stores HN Public Key ID and HN private key mapping in the HN_SIDF_PRIVATE_KEY_TABLE table.

For more information, refer to UDM UE Authentication Service User configuration parameters in UDM Installation Guide.

NRF Client Services

UDM NRF Client service handles NRF management service for AuSF and UDM. This NRF Client service:

- Registers/de-registers AUSF/UDM NF
- Sends Heartbeats and NF update
- Discovers and subscribes to UDR
- Processes notifications from NRF Server
- De-registers automatically from NRF if AUSF/UDM's health is not up after configurable retries

For more information, refer to NRF Client Services User configuration parameters in UDM Installation Guide.

Subscription Data Management (SDM) Service

The UDM SDM service supports data retrieval of the shared data identified by the received shared data Ids for the following subscription:

- **Slice Selection Subscription:** The NF service consumer (AMF) sends a request to the UDM to fetch Network Slice Selection Assistance Information (NSSAI) data of the UE.
- **Access and Mobility Subscription:** The NF service consumer (AMF) sends a request to the UDM to retrieve Access and Mobility Subscription data of the UE. The request contains the UE's identity ($\{supi\}$), the type of the requested information ($\{am-data\}$) and query parameters (supported-features, plmn-id).
- **SMF Selection Subscription:** An AMF sends a request to the UDM for SMF selection information for a particular subscriber using the SMF selection subscription data retrieval procedure.
 - **Session Management Subscription:** An SMF sends a request to the UDM for Session Management subscription data of a particular UE.
 - **UE Context In SMF:** The UDM can be requested to provide the context of the UE in SMF during times of call recovery (Example: SMF to SMF handover/ AMF recovery etc).
- **Subscription to Notification of Data Change Service:**
 - The NF service consumer sends a request to UDM to subscribe to data change notification, which contains a callback URI and URI of the monitored resource.
 - UDM maps the request to UDR, which in turn creates the subs-to-notify subscription.
 - UDR monitors the resources and informs UDM when a change is observed in the monitored resource.
 - It also supports modification/deletion of the subscription.

For more information, refer to Subscription Data Management (SDM) Service User configuration parameters in UDM Installation Guide.

Subscription Data Management Notify (SDM Notify) Service

The UDM SDM Notify service sends notification to the corresponding NFs for all the subscribed data change notifications. Using this data change notification service,

- UDR monitors the resources and sends notification to UDM when a change is observed in the monitored resources.
- UDM forwards the notification to the NF, which subscribes for the data change notification using "Original Callback Reference".
- UDM retries if notification attempt fails. Retry count and interval are configurable parameters using custom template.

For more information, refer to Subscription Data Management Notify (SDM Notify) Service User configuration parameters in UDM Installation Guide.

UE Context Management (CM) Service

UDM UE CM service:

- Supports registration and de-registration procedures for the AMF/SMF/SMSF requesting for registering a UE for 3GPP access only
- Supports retrieving and updating the registration information for 3GPP access for a subscriber for AMF/SMSF
- Supports de-registration notification for AMF
 - Upon successful re-registration of a subscriber for a new AMF, UDM CM service sends an implicit de-registration notification to the old AMF.
 - This notification is sent to the old AMF "de-registration callback uri" by obtaining the earlier registration record from UDR

For more information, refer to UE Context Management (CM) Service User configuration parameters in UDM Installation Guide.

AuSF Service

UDM AUSF Service:

- Supports subscriber authentication request from AMF for 3GPP access only
- Requests authentication vector for UDM Authentication service and also generates key material for the AMF
- Processes and notifies UDM Authentication service about the authentication completion status of the UE
- Uses DB tier to store context information for each authentication session, which is indexed by contextId
- Subsequently processing of 5G-AKA authentication confirmation request from AMF, which is linked to the authentication session using the contextId and upon processing, the entry is deleted from DB

For more information, refer to AuSF Service User configuration parameters in UDM Installation Guide.

6

Metrics on UDM

This section covers UDM metrics for the following micro services.

- Ingress API Gateway metrics
- Nudm-uecm micro service
- Nudm-Auth micro service
- Nudm-Sdm micro service
- Nudm-Sdm-Notify micro service
- Nudm-NRF Client micro service
- KPI
- AUSF Micro Service Metrics

The metrics for each micro service are described below:

Ingress API Gateway Metrics

Table 6-1 Ingress API Gateway Metrics

Metrics Name	Dimensions	Description
apigateway_http_requests_total	Method (GET/PUT/PATCH/POST/DELETE)	Total ingress request for UDM
apigateway_http_responses_total	Method (GET/PUT/PATCH/POST/DELETE) X Status("2.*"/ "4.*")	Total responses from UDM

Nudm-uecm Micro Service

Table 6-2 Nudm-uecm Micro Service Metrics

Metrics Name	Dimensions	Description
udm_uecm_rest_allrequests_total	None	Total number of requests received by UECM service
udm_uecm_rest_allresponse_total	None	Total number of response sent by UECM service
udm_uecm_rest_successResponse_total	None	Total number of success responses sent by UECM service
udm_uecm_rest_failureResponse_total	None	Total number of failure responses sent by UECM service
udm_uecm_rest_request_total	Method (GET/PUT/PATCH/POST/DELETE)	Total number of requests received by UECM service method wise

Table 6-2 (Cont.) Nudm-uecm Micro Service Metrics

Metrics Name	Dimensions	Description
udm_uecm_rest_response_success_total	Method (GET/PUT/PATCH/POST/DELETE)	Total number of success responses sent by UECM servicemethod wise
udm_uecm_rest_response_failure_total	Method (GET/PUT/PATCH/POST/DELETE)	Total number of failure responses sent by UECM servicemethod wise
udm_uecm_amf3gppaccess_allrequests_total	None	Total number of amf3gppaccess requests received by UECM service
udm_uecm_amf3gppaccess_allresponse_total	None	Total number of amf3gppaccess responses sent by UECM service
udm_uecm_amf3gppaccess_successResponse_total	None	Total number of amf3gppaccess success responses sent by UECM service
udm_uecm_amf3gppaccess_failureResponse_total	None	Total number of amf3gppaccess failure responses sent by UECM service
udm_uecm_amf3gppaccess_request_total	Type (InitialRegistration/ UpdateRegistration/ GetRegistrationDetails/ DeleteRegistration)	Total number of amf3gppaccess registration requests received by UECM service based on registration operation type
udm_uecm_amf3gppaccess_success_total	Type (InitialRegistration/ UpdateRegistration/ GetRegistrationDetails/ DeleteRegistration)	Total number of amf3gppaccess registration success responses sent by UECM service based on registration operation type
udm_uecm_amf3gppaccess_failure_total	Type (Registration) X ErrorType (Schema_Validation_Failure/ Others) Type (InitialRegistration/ UpdateRegistration) X ErrorType (404_NotFound / 400_BadRequest/ 403_Forbidden/ udr_error_429/ udr_error_502/ udr_error_503/ udr_error_504/ Others) Type (GetRegistrationDetails) X ErrorType (404_NotFound/ udr_error_429/ udr_error_502/ udr_error_503/ udr_error_504/ Others) Type (DeleteRegistration) X ErrorType (404_NotFound/ 403_Forbidden/ udr_error_429/ udr_error_502/ udr_error_503/ udr_error_504/ Others)	Total number of amf3gppaccess registration failures response sent by UECM service based on registration operation type and different error types

Table 6-2 (Cont.) Nudm-uecm Micro Service Metrics

Metrics Name	Dimensions	Description
udm_uecm_smf_allrequests_total		Total number of smf requests received by UECM service
udm_uecm_smf_allresponse_total		Total number of smf responses sent by UECM service
udm_uecm_smf_successResponse_total		Total number of smf success responses sent by UECM service
udm_uecm_smf_failureResponse_total		Total number of smf failure responses sent by UECM service
udm_uecm_smf_request_total	Type (Registration/Deregistration)	Total number of smf registration requests received by UECM service based on registration operation type
udm_uecm_smf_success_total	Type (Registration/Deregistration)	Total number of smf registrations success responses sent by UECM service based on registration operation type
udm_uecm_smf_failure_total	Type (Registration) X ErrorType (Schema_Validation_Failure/ 404_NotFound/ 403_Forbidden/ udr_error_429/ udr_error_502/ udr_error_503/ udr_error_504/ Others) Type (Deregistration) X ErrorType (404_NotFound/ udr_error_429/ udr_error_502/ udr_error_503/ udr_error_504/ Others)	Total number of SMF registration failure response sent by UECM
udm_uecm_smsf3gppAccess_allrequests_total		Total number of smsf3gppAccess requests received by UECM service
udm_uecm_smsf3gppAccess_allresponse_total		Total number of smsf3gppAccess response sent by UECM service
udm_uecm_smsf3gppAccess_successResponse_total		Total number of smsf3gppAccess success responses sent by UECM service
udm_uecm_smsf3gppAccess_failureResponse_total		Total number of smsf3gppAccess failure responses sent by UECM service
udm_uecm_smsf3gppAccess_request_total	Type (Registration/Deregistration/GetRegistrationDetails)	Total number of smsf3gppAccess requests received by UECM service based on registration operation type

Table 6-2 (Cont.) Nudm-uecm Micro Service Metrics

Metrics Name	Dimensions	Description
udm_uecm_smsf3gppAccess_success_total	Type (Registration/ Deregistration/ GetRegistrationDetails)	Total number of smsf3gppAccessregistrations access responses sent by UECM servicebased on registration operation type
udm_uecm_smsf3gppAccess_failure_total	Type (Registration) X ErrorType (Schema_Validation_Failure/ 404_NotFound / 403_Forbidden/ udr_error_429/ udr_error_502/ udr_error_503/ udr_error_504/ Others) Type (GetRegistrationDetails) X ErrorType (404_NotFound / udr_error_429/ udr_error_502/ udr_error_503/ udr_error_504/ Others) Type (Deregistration) X ErrorType (404_NotFound/ udr_error_429/ udr_error_502/ udr_error_503/ udr_error_504/ Others)	Total number of smsf3gppAccess registration failure response sent by UECM based on registration operation type
udm_uecm_deregister_old_AMF_requests_total		Total number of old AMF deregistration notifications generated from UECM
udm_uecm_deregister_old_AMF_success_response_total		Total number of old AMF deregistration notifications succeeded based on the success response from AMF
udm_uecm_deregister_old_AMF_failure_response_total		Total number of old AMF deregistration notifications failure

Nudm-auth Micro Service Metrics**Table 6-3 Nudm-auth Micro Service Metrics**

Metrics Name	Dimensions	Description
udm_ue_auth_rest_allrequests_total	None	Total number of requests received by UEAUTH service
udm_ue_auth_rest_allresponse_total	None	Total number of response received sent by UEAUTH service
udm_ue_auth_rest_successResponse_total	None	Total number of success responses sent by UEAUTH service
udm_ue_auth_rest_failureResponse_total	None	Total number of failure responses sent by UEAUTHservice

Table 6-3 (Cont.) Nudm-auth Micro Service Metrics

Metrics Name	Dimensions	Description
udm_ue_auth_rest_request_total	Method (GET/PUT/PATCH/POST/DELETE)	Total number of requests received by UEAUTHservice method wise
udm_ue_auth_rest_response_success_total	Method (GET/PUT/PATCH/POST/DELETE)	Total number of success responses sent by UEAUTHservice method wise
udm_ue_auth_rest_response_failure_total	Method (GET/PUT/PATCH/POST/DELETE)	Total number of failure responses sent by UEAUTHservice method wise
udm_ue_auth_request_general_failure_total	Error(400_bad_request) X cause(schema_validation_fail / invalid_uri/ invalid_json_format) Error(405_method_not_allowed) X cause(invalid_method) Error(415_unsupported_media_type) Xcause(unsupported_media_type) Error(500_internal_server_error) X cause(other)	Used to track all failure response sent by UEAUTHservice due to general auth service error. It tracks the response code using "Error" and the reason under "cause"
udm_ue_auth_info_retrieval_request_category_total	Type(Authentication/ resynchronization)	Used to track all authentication request received by UEAUTHservice type wise
udm_ue_auth_info_retrieval_request_success_total	Type(authentication_5g_aka/ authentication_eap_aka_prime/ resynchronization)	Used to track all UE Auth Info Retrieval request success response sent by UEAUTHservice authentication method type wise

Table 6-3 (Cont.) Nudm-auth Micro Service Metrics

Metrics Name	Dimensions	Description
udm_ue_auth_info_retrieval_request_failure_total	Error(404_not_found) X cause(user_not_found) Error(400_bad_request) X cause(supi_not_valid/ suci_not_valid/ unknown_sup_i_type/ suci_nai_not_supported/ unknown_subscriber_id_format) Error(500_internal_server_error) X cause(udr_connect_error/ udr_error_429/udr_error_502/ udr_error_503/ udr_error_504/ udr_error_other/ auth_av_generation_failure/ sidf_db_read_exception/ other) Error(403_forbidden) X cause(sqn_scheme_not_supported/ sqn_length_not_valid/ sqn_index_length_not_valid/ auth_subscription_data_not_valid/ invalid_hn_public_key_identifier/ sidf_mac_mismatch/ sidf_invalid_public_key/ sidf_scheme_length_not_valid/ invalid_scheme_output) Error(501_not_implemented) X cause(auth_method_not_supported/ unsupported_protection_scheme)	Used to track all UE Auth Info Retrievalrequest failure responsesentby UEAUTHservice. It tracks the response code using "Error" and the reason under "cause"
udm_ue_auth_confirmation_request_success_total		Used to track all UE Auth Confirmationrequest success responsesentby UEAUTHservice
udm_ue_auth_confirmation_request_failure_total	Error(400_bad_request) X cause(supi_not_valid) Error(500_internal_server_error) X cause(udr_connect_error/ udr_error_429/ udr_error_502/ udr_error_503/ udr_error_504/ udr_error_other/ other)	Used to track all UE Auth Confirmationrequest failure responsesentby UEAUTHservice. It tracks the response code using "Error" and the reason under "cause"

Nudm-sdm Micro Service Metrics

Table 6-4 Nudm-sdm Micro Service Metrics

Metrics Name	Dimensions	Description
udm_sdm_rest_allrequests_total		Total number of requests received by SDM service
udm_sdm_rest_successResponse_total		Total number of Success response sent by SDM service
udm_sdm_rest_failureResponse_total		Total number of Failure response sent by SDM service
udm_sdm_rest_allresponse_total		Total number of responses sent by SDM service
udm_sdm_rest_request_total	Method (GET/PUT/PATCH/POST/DELETE)	Total number of requests received by SDM service method wise
udm_sdm_rest_response_success_total	Method (GET/PUT/PATCH/POST/DELETE)	Total number of success response sent by SDM service method wise
udm_sdm_rest_response_failure_total	Method (GET/PUT/PATCH/POST/DELETE)	Total number of failure responses sent by SDM service method wise
udm_sdm_AM_Data_requests_total		Total number of AM data request received on SDM service
udm_sdm_AM_Data_successResponse_total		Total number of success response for AM-data request sent by SDM service
udr_sdm_failure_response		Total number of failure response for AM-data request sent by SDM service
udm_sdm_SM_Data_requests_total		Total number of SM data request received on SDM service
udm_sdm_SM_Data_successResponse_total		Total number of success response for SM-data request sent by SDM service
udm_sdm_SM_Data_failureResponse_total		Total number of failure response for SM-data request sent by SDM service
udm_sdm_Slice_Selection_Sub_Data_requests_total		Total number of Slice Selection Subscription data request received on SDM service
udm_sdm_Slice_Selection_Sub_Data_successResponse_total		Total number of success response for Slice Selection Subscription data request sent by SDM service

Table 6-4 (Cont.) Nudm-sdm Micro Service Metrics

Metrics Name	Dimensions	Description
udm_sdm_Slice_Selection_Sub_Data_failureResponse_total		Total number of failure response for Slice Selection Subscription data request sent by SDM service
udm_sdm_smf_select_data_requests_total		Total number of SmfSelection Subscriptiondata request received on SDM service
udm_sdm_smf_select_data_successResponse_total		Total number of success response for SmfSelection Subscriptiondata request sent by SDM service
udm_sdm_smf_select_data_failureResponse_total		Total number of failure response for SmfSelection Subscriptiondata request sent by SDM service
udm_sdm_ue_context_in_smf_data_requests_total		Total number of Ue Context In Smfdata request received on SDM service
udm_sdm_ue_context_in_smf_data_successResponse_total		Total number of success response for UE Context In Smfdata request sent by SDM service
udm_sdm_ue_context_in_smf_data_failureResponse_total		Total number of failure response for Ue Context In Smfdata request sent by SDM service
udm_sdm_sor_acknowledgement_requests_total		Total number of sor acknowledgementrequest received on SDM service
udm_sdm_sor_acknowledgement_successResponse_total		Total number of success response for sor acknowledgementrequest sent by SDM service
udm_sdm_sor_acknowledgement_failureResponse_total		Total number of failure response for SOR Acknowledgementrequest sent by SDM service
udm_sdm_upu_acknowledgement_requests_total		Total number of UPU acknowledgementrequest received on SDM service
udm_sdm_upu_acknowledgement_successResponse_total		Total number of success response for UPU acknowledgementrequest sent by SDM service
udm_sdm_upu_acknowledgement_failureResponse_total		Total number of failure response for UPU acknowledgementrequest sent by SDM service
udm_sdm_retrieval_Of_MultipleDataSets_requests_total		Total number of retrieval Of multiple Data-Setsrequest received on SDM service

Table 6-4 (Cont.) Nudm-sdm Micro Service Metrics

Metrics Name	Dimensions	Description
udm_sdm_retrieval_Of_MultipleDataSets_successResponse_total		Total number of success response for retrieval Of multiple Data-Setsrequest sent by SDM service
udm_sdm_retrieval_Of_MultipleDataSets_failureResponse_total		Total number of failure response for retrieval Of multiple Data-Setsrequest sent by SDM service
udm_sdm_ue_context_in_smsf_data_requests_total		Total number of SDM UE Context In Smsf Data Requestreceived on SDM service
udm_sdm_ue_context_in_smsf_data_successResponse_total		Total number of success response for Sdm UE Context In Smsf Data Requestsent by SDM service
udm_sdm_ue_context_in_smsf_data_failureResponse_total		Total number of failure response for Sdm Ue Context In Smsf Data Requestsent by SDM service
udm_sdm_subscriptiondatasubscriptions_allrequests_total		Total number of Sdm Subscription Data Subscriptions Requestreceived on SDM service
udm_sdm_subscriptiondatasubscriptions_request_total	Type(PostSubscriptionDataSubscriptions/ PatchSubscriptionDataSubscriptions/ DeleteSubscriptionDataSubscriptions)	Total number of Sdm Subscription Data Subscriptions Requestreceived on SDM service method wise
udm_sdm_subscriptiondatasubscriptions_success_total	Type(PostSubscriptionDataSubscriptions/ Retry/ PatchSubscriptionDataSubscriptions/ DeleteSubscriptionDataSubscriptions)	Total number of POST success response for Sdm Subscription Data Subscriptions Requestsent by SDM service method wise

Table 6-4 (Cont.) Nudm-sdm Micro Service Metrics

Metrics Name	Dimensions	Description
udm_sdm_subscriptiondatasubscriptions_failure_total	Type(PostSubscriptionDataSubscriptions) X ErrorType(403_Forbidden/ 404_NotFound/ 400_BadRequest/ Schema_Validation_Failure/ udr_error_429/ udr_error_502/ udr_error_503/ udr_error_504/ others) Type(retry) X ErrorType(403_Forbidden/ 404_NotFound/ 400_BadRequest/ Schema_Validation_Failure/ others) Type(DeleteSubscriptionDataSubscriptions) X ErrorType(404_NotFound/ udr_error_429/ udr_error_502/ udr_error_503/ udr_error_504/ others) Type(PatchSubscriptionDataSubscriptions) X ErrorType(400_BadRequest/ udr_error_429/ udr_error_502/ udr_error_503/ udr_error_504/ others)	Total number of failure response for Sdm Subscription Data Subscriptions sent by SDM service. It tracks method and the cause of failure
udm_sdm_subscription_data_allrequest_total		Total number of Sdm Subscriptions Data Request received by SDM service
udm_sdm_subscription_data_allresponse_total		Total number of Sdm Subscriptions Data Response sent by SDM service
udm_sdm_subscription_data_request_total	Method (POST/PATCH/DELETE)	Total number of Sdm Subscriptions Data Request received by SDM service method wise
udm_sdm_subscription_data_Success_response_total	Method (POST/PATCH/DELETE)	Total number of Sdm Subscriptions Success Data Response sent by SDM service method wise
udm_sdm_subscription_data_Failure_response_total	Method (POST/PATCH/DELETE)	Total number of Sdm Subscriptions Data Failure Response sent by SDM service method wise
udr_sdm_failure_response_total	ErrorType (429/ 502/ 503/ 504/ Others)	Total number of failures response sent by SDM service due to UDR communication error

Nudm-sdm-notify Micro Service Metrics

Table 6-5 Nudm-Sdm-Notify Micro Service Metrics

Metrics Name	Dimensions	Description
udm_sdm_notify_rest_allrequests_total		Total number of requests received by SDM Notify service
udm_sdm_notify_rest_allresponse_total		Total number of responses sent by SDM Notify service
udm_sdm_notify_rest_successResponses_total		Total number of Success response sent by SDM Notify service
udm_sdm_notify_rest_failureResponse_total		Total number of failure response sent by SDM Notify service
udm_sdm_notify_rest_request_total	Method (GET/PUT/PATCH/POST/DELETE)	Total number of requests received by SDM Notify service method wise
udm_sdm_notify_rest_response_success_total	Method (GET/PUT/PATCH/POST/DELETE)	Total number of success responses sent by SDM Notify service method wise
udm_sdm_notify_rest_response_failure_total	Method (GET/PUT/PATCH/POST/DELETE)	Total number of failure responses sent by SDM Notify service method wise
udm_sdm_notify_notification_allrequests_total		Total number of Sdm Notify request sent by SDM Notify service
udm_sdm_notify_notification_allresponse_total		Total number of Sdm Notify response received by SDM Notify service
udm_sdm_notify_notification_success_total	Type (FIRST_ATTEMPT/RETRY)	Total number of success response for notification request sent by SDM Notify service. It tracks notification send attempts type (i.e. FIRST_ATTEMPT/RETRY)
udm_sdm_notify_notification_failure_total	Type (FIRST_ATTEMPT / RETRY) X ErrorType (403_Forbidden/ 400_BadRequest/ 404_NotFound/ udr_error_429/ udr_error_502/ udr_error_503/ udr_error_504/ Others)	Total number of failure response for notification request sent by sdm notify service. It tracks notification send attempts type (i.e. FIRST_ATTEMPT/RETRY) and failure reason
udm_sdm_notify_retry_audit_result_total	Type (INPROGRESS_TO_RETRY)	Keeps track of SDM Notify requests hung in "INPROGRESS" state which has been moved to "RETRY" state

Nudm-NRF Client Micro Service Metrics

Table 6-6 Nudm-NRF Client Micro Service Metrics

Metrics Name	Dimensions	Description
udm_nrf_registration_requests_total		Total number of UDM registration requests sent by nrf_client_service
udm_nrf_registration_success_total		Total number of UDM registration success response by nrf_client_service
udm_nrf_deregistration_requests_total		Total number of UDM deregistration requests sent by nrf_client_service
udm_nrf_deregistration_success_total		Total number of UDM deregistration success response by nrf_client_service
udm_nrf_heartBeatUpdate_requests_total		Total number of UDM Heart Beat requests sent by nrf_client_service
udm_nrf_heartBeatUpdate_success_total		Total number of UDM Heart Beat Success Response by nrf_client_service
udm_nrf_livenessProbe_failure_total		Total number of UDM Liveness Probe Failure
ausf_nrf_registration_requests_total		Total number of AUSF registration requests sent by nrf_client_service
ausf_nrf_registration_success_total		Total number of AUSF registration success response by nrf_client_service
ausf_nrf_deregistration_requests_total		Total number of AUSF deregistration requests sent by nrf_client_service
ausf_nrf_deregistration_success_total		Total number of AUSF deregistration success response by nrf_client_service
ausf_nrf_heartBeatUpdate_requests_total		Total number of AUSF Heart Beat requests sent by nrf_client_service
ausf_nrf_heartBeatUpdate_success_total		Total number of AUSF Heart Beat Success Response by nrf_client_service
ausf_nrf_livenessProbe_failure_total		Total number of AUSF Liveness Probe Failure
udm_nrf_subscription_requests_total		Total number of UDM subscription requests sent by nrf_client_service
udm_nrf_subscription_success_total		Total number of UDM subscription success response by nrf_client_service

Table 6-6 (Cont.) Nudm-NRF Client Micro Service Metrics

Metrics Name	Dimensions	Description
udm_nrf_unsubscription_requests_total		Total number of UDM unsubscribe requests sent by nrf_client_service
udm_nrf_unsubscription_success_total		Total number of UDM unsubscribe success response by nrf_client_service
udm_nrf_discovery_requests_total		Total number of UDM discovery requests sent by nrf_client_service
udm_nrf_discovery_success_total		Total number of UDM discovery success response by nrf_client_service
udm_nrf_notify_requests_total		Total number of notify request received by nrf_client_service
udm_nrf_notify_success_total		Total number of notify success response by nrf_client_service
udm_get_discovery_requests_total		Total number of Get discovery request received by nrf_client_service
udm_get_discovery_success_total		Total number of Get discovery success response by nrf_client_service

KPI Micro Service Metrics**Table 6-7 KPI Micro Service Metrics**

KPI	KPI Details	Microservice	Service Operations	Response Codes	Notes (Add Grafana metrics formula)
UDM Ingress Request rate	Requests/sec	endpoint (api-gateway)	ALL	Not Applicable	sum(irate(api_gateway_http_requests_total{ namespace="m yudm"}[2m])) by (kubernetes_namespace)
% success response	(Total success response/ Total Response)* 100	nudm-uecm-service	ALL	2xx	sum(udm_uecm_rest_response_success_total)/ sum(udm_uecm_rest_all_response_total)*100

Table 6-7 (Cont.) KPI Micro Service Metrics

KPI	KPI Details	Microservice	Service Operations	Response Codes	Notes (Add Grafana metrics formula)
		nudm-ue-auth-service	ALL	2xx	$\frac{\text{sum}(\text{udm_ue_auth_rest_response_success_total})}{\text{sum}(\text{udm_ue_auth_rest_allresponse_total})} * 100$
		nudm-sdm-service	ALL	2xx	$\frac{\text{sum}(\text{udm_sdm_rest_response_success_total})}{\text{sum}(\text{udm_sdm_rest_allresponse_total})} * 100$
		nudm-sdm-notify-service	ALL	2xx	$\frac{\text{sum}(\text{udm_sdm_notify_rest_response_success_total})}{\text{sum}(\text{udm_sdm_notify_rest_allresponse_total})} * 100$
		ausfueauthenticator	ALL	2xx	$\frac{\text{sum}(\text{udm_ausf_auth_rest_successResponse_total})}{\text{sum}(\text{udm_ausf_auth_rest_allresponse_total})} * 100$
success response rate	(Total success response/ Total Response) per sec	nudm-uecm-service	ALL	2xx	$\frac{\text{sum}(\text{rate}(\text{udm_uecm_rest_response_success_total}[5\text{m}]})}{\text{sum}(\text{rate}(\text{udm_uecm_rest_allresponse_total}[5\text{m}]})} * 100$
		nudm-ue-auth-service	ALL	2xx	$\frac{\text{sum}(\text{rate}(\text{udm_ue_auth_rest_response_success_total}[5\text{m}]})}{\text{sum}(\text{rate}(\text{udm_ue_auth_rest_allresponse_total}[5\text{m}]})} * 100$

Table 6-7 (Cont.) KPI Micro Service Metrics

KPI	KPI Details	Microservice	Service Operations	Response Codes	Notes (Add Grafana metrics formula)
		nudm-sdm-service	ALL	2xx	$\text{sum}(\text{rate}(\text{udm_sdm_rest_response_success_total}[5\text{m}]))/\text{sum}(\text{rate}(\text{udm_sdm_rest_allresponse_total}[5\text{m}]))*100$
		nudm-sdm-notify-service	ALL	2xx	$\text{sum}(\text{rate}(\text{udm_sdm_notify_rest_response_success_total}[5\text{m}]))/\text{sum}(\text{rate}(\text{udm_sdm_notify_rest_allresponse_total}[5\text{m}]))*100$
		ausfueauthenticator	ALL	2xx	$\text{sum}(\text{rate}(\text{udm_ausf_auth_rest_successResponse_total}[5\text{m}]))/\text{sum}(\text{rate}(\text{udm_ausf_auth_rest_allresponse_total}[5\text{m}]))*100$
failure response rate	(Total failure response/ Total Response) per sec	nudm-uecm-service	ALL	4xx/5xx	$\text{sum}(\text{rate}(\text{udm_uecm_rest_response_failure_total}[5\text{m}]))/\text{sum}(\text{rate}(\text{udm_uecm_rest_allresponse_total}[5\text{m}]))*100$
		nudm-ue-auth-service	ALL	4xx/5xx	$\text{sum}(\text{rate}(\text{udm_ue_auth_rest_response_failure_total}[5\text{m}]))/\text{sum}(\text{rate}(\text{udm_ue_auth_rest_allresponse_total}[5\text{m}]))*100$

Table 6-7 (Cont.) KPI Micro Service Metrics

KPI	KPI Details	Microservice	Service Operations	Response Codes	Notes (Add Grafana metrics formula)
		nudm-sdm-service	ALL	4xx/5xx	$\frac{\text{sum}(\text{rate}(\text{udm_sdm_rest_response_failure_total}[5\text{m}]))}{\text{sum}(\text{rate}(\text{udm_sdm_rest_all_response_total}[5\text{m}]))*100}$
		nudm-sdm-notify-service	ALL	4xx/5xx	$\frac{\text{sum}(\text{rate}(\text{udm_sdm_notify_rest_response_failure_total}[5\text{m}]))}{\text{sum}(\text{rate}(\text{udm_sdm_notify_rest_allresponse_total}[5\text{m}]))*100}$
		ausfueauthenticator	ALL	4xx/5xx	$\frac{\text{sum}(\text{rate}(\text{udm_ausf_auth_rest_failureResponse_total}[5\text{m}]))}{\text{sum}(\text{rate}(\text{udm_ausf_auth_rest_allresponse_total}[5\text{m}]))*100}$

AUSF Micro Service Metrics

Table 6-8 AUSF Micro Service Metrics

Generic Measurements					
udm_ausf_auth_rest_allrequests_total	None	Total number of requests received on ausf service	UEAuthentication	1.0	
udm_ausf_auth_rest_allresponse_total	None	Total number of response sent by ausf service	UEAuthentication	1.0	
udm_ausf_auth_rest_failureResponse_total	None	Total number of failure responses sent by ausf service	UEAuthentication	1.0	

Table 6-8 (Cont.) AUSF Micro Service Metrics

udm_ausf_auth_rest_successfulResponse_total	None	Total number of success responses sent by ausf service	UEAuthentication	1.0
udm_ausf_request_total	Method (GET/PUT/PATCH/POST/DELETE)	Total number of requests received on ausf service method wise	UEAuthentication	1.0
udm_ausf_response_total	Method (GET/PUT/PATCH/POST/DELETE)	Total number of response sent by ausf service method wise	UEAuthentication	1.0
udm_ausf_response_failure_total	Method (GET/PUT/PATCH/POST/DELETE)	Total number of failure responses sent by ausf service method wise	UEAuthentication	1.0
udm_ausf_response_success_total	Method (GET/PUT/PATCH/POST/DELETE)	Total number of success responses sent by ausf service method wise	UEAuthentication	1.0
Success Measurements				
authenticate_request_ue_authentication	HTTP Operation (GET/PUT/PATCH/POST/DELETE) Serving Network Name (String)	Count of UE Authenticate request messages received by AUSF for the authenticate service	UEAuthentication	1.0
authenticate_request_conformation	Authentication_Type (5G-AKA/EAP-AKA) HTTP Operation (GET/PUT/PATCH/POST/DELETE)	Count of UE Authentication conformation request messages received by AUSF for the authenticate service	UEAuthentication	1.0

Table 6-8 (Cont.) AUSF Micro Service Metrics

authenticate_tx_conformation_response	HTTP Return Code(Integer code) HTTP Operation (GET/PUT/PATCH/POST/DELETE) Authentication _Result (AUTH_SUCESS/AUTH_FAILED) Authentication _Type (5G-AKA/EAP-AKA)	Count of UE Authentication conformation response messages sent by AUSF for the AUSF authenticate service	UEAuthentication	1.0
authenticate_tx_ue_authentication_response	HTTP Return Code(Integer code) HTTP Operation (GET/PUT/PATCH/POST/DELETE)	Count of UE Authentication response messages sent by AUSF for the AUSF authenticate service	UEAuthentication	1.0
authenticate_tx_ue_generate_auth_vectors	HTTP Operation (GET/PUT/PATCH/POST/DELETE) Serving Network Name (String) UDM FQDN (String)	Count of Generate Auth Vectors request messages sent by AUSF to UDM authenticate service	UEAuthentication	1.0

Table 6-8 (Cont.) AUSF Micro Service Metrics

authenticate_tx_authentication_event	Authentication _Result (AUTH_SUCCESS/AUTH_FAILURE) Authentication_Type (5G-AKA/EAP-AKA) HTTP Operation (GET/PUT/PATCH/POST/DELETE) Serving Network Name (String) UDM FQDN (String)	Count of Authentication event notification request messages sent by AUSF to UDM authenticate service	UEAuthentication 1.0
authenticate_rx_ue_generate_auth_vectors_response	HTTP Return Code Authentication_Type (5G-AKA/EAP-AKA)	Count of Generate Auth Vectors response messages sent by UDM to AUSF authenticate service	UEAuthentication 1.0
authenticate_rx_authentication_event_response	HTTP Return Code Authentication_Type (5G-AKA/EAP-AKA) Authentication_Result (AUTH_SUCCESS/AUTH_FAILURE)	Count of Authentication event notification response messages sent by UDM to AUSF authenticate service	UEAuthentication 1.0
Error Measurements			
ausf_context_not_found	None	Count of number of ueauthentication_requests responded with 404 context not found	

Table 6-8 (Cont.) AUSF Micro Service Metrics

ausf_authentication_failed	None	Count of number of ueauthentication_requests responded with authentication failed			
ausf_state_data_read_error	None	Count of errors encountered when trying to read the state database	UEAuthentication	1.0	
ausf_state_data_write_error	None	Count of errors encountered when trying to write to the state database	UEAuthentication	1.0	
udm_connection_failure	Request_Type	Count of errors encountered when trying to reach UDM	UEAuthentication	1.0	
udm_connection_retrys	Request_Type	Count of retry attempts encountered when trying to reach UDM	UEAuthentication	1.0	
nrf_connection_failure	Request_Type	Count of connection failure attempts sent to NRF	NRFClient	1.0	
nrf_connection_retrys	Request_Type	Count of retry attempts sent to NRF	NRFClient	1.0	