RADIUS Client

Feature Summary and Revision History

Summary Data

Table 1: Summary Data

Applicable Product(s) or Functional Area	SMF
Applicable Platform(s)	SMI
Feature Default Setting	Disabled – Configuration Required

Related Changes in this Release	Not Applicable
Related Documentation	Not Applicable

Revision History

Table 2: Revision History

Revision Details	Release
First introduced.	Pre-2020.02.0

Feature Description

In 5G architecture, serving network authenticates the Subscription Permanent Identifier (SUPI) during authentication and key agreement between UE and the network. In addition, the secondary authentication can also be performed for data networks outside the mobile operator domain. For this purpose, various EAP-based authentication methods and associated credentials can be used among which, RADIUS protocol is one of the widely used authentication protocols.

The RADIUS Client feature, which is integrated with SMF Network Function, enables generic Cloud Native 5G RADIUS functionality to be used for the authentication purpose. When RADIUS Client feature is enabled, the SMF performs secondary authentication with the configured external AAA server (for example, RADIUS Server) as per 3GPP TS 23.501.

NOTE: Only RADIUS protocol is currently used for secondary authentication.

RADIUS Client feature supports the following functionality:

- Server Selection
- Monitor Server and Dead Server Detection
- Timeout and Retry

Server Selection

RADIUS servers are configured with IP:Port as the key. The "algorithm" CLI specifies the fail-over/load-balancing algorithm to select the RADIUS server to which the request (authentication/accounting) must be sent. Servers that are marked "dead" are not considered for selection until they are marked "alive". The supported algorithms are first-server and round-robin.

- First-server: Specifies that the request must be sent to RADIUS server with the highest priority. If this server becomes unreachable, the request is sent to the server with the next highest configured priority. This is the default algorithm.
- Round-robin: Specifies that the request must be sent based on load balancing in circular queue fashion. The server that is last used is stored to maintain the round-robin selection. The order of the list is based on the configured relative priority of the servers.

Monitor Server and Dead Server Detection

MonitorServer revisits the server database and marks the server which has not received response beyond the configured "timeout" value after the first request is sent to it. The server is marked "dead" and remains in

dead-state for seconds configured as "deadtime". After the "deadtime" elapses, the server's dead-variable is reset to again mark it as up and ready to process requests. If the server is still not reachable, it is marked "dead" as part of the next request response timeout routine.

Timeout and Retry

After a server is selected and request is sent to the server, an entry is maintained in the request queue until response is received from the RADIUS server or until timeout occurs. MonitorRequests is called to check on the requests queue for response timeouts and retry. It walks through all the entries and checks if any request timeout value configured as "responseTimeout" is hit. For such requests, if the number of retries is less than the configured "maxRetries" value, the request is resent to the RADIUS server. Else, if the "maxRetries" count is reached, the request is deleted from the request queue. After a request is deleted, even if response comes for such requests, the response is discarded and not sent to the user.

Architecture

RADIUS Integration in Mobile CNAT Architecture

The Mobile CNAT architecture has four distinct layers:

1. Cloud - Host OS + Kubernetes installation.
2. Runtime - These are the "plugins" to Kubernetes provided by the Cloud. This includes the container runtime (Docker version) and Kubernetes plugins for Volume (storage), Networking, and Load-Balancing.
3. Orchestration - Kubernetes functionality. Kubernetes provides abstractions for provided plugins (Networking/Volumes/Load-Balancing) so the CNAT components do not need to have knowledge of them.
4. Mobile CNAT Components - Application layer where the applications are built for Mobility depending only on Kubernetes as much as possible.

For more details about Mobile CNAT architecture, visit the following link:
https://wwwin-github.cisco.com/pages/mobile-cnat-infrastructure/architecture/arch/cnat_architecture.html

5GC Network Functions (NFs), such as PCF, SMF, and so on, run in the "Application/CNAT Component" layer of this architecture. RADIUS Client is integral part of SMF and PCF NFs.

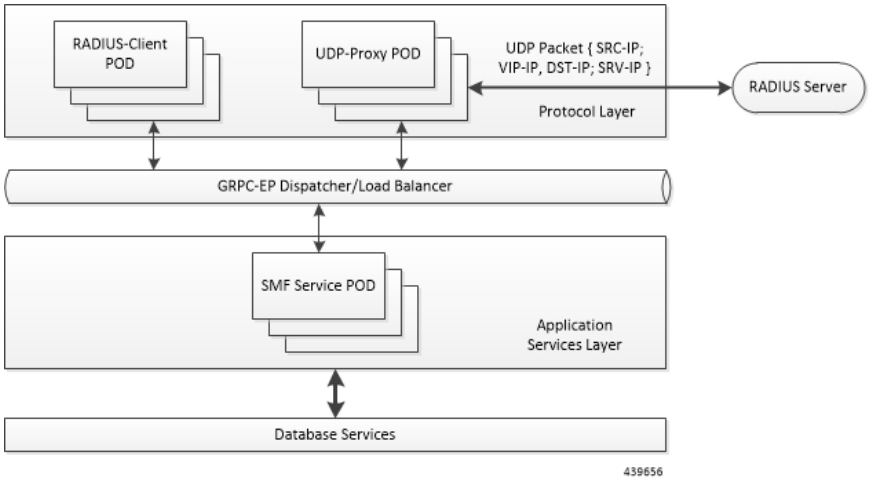
RADIUS Client Integration in SMF

SMF Network Function comprises of loosely coupled micro-services. Micro-service decomposition is based on the following 3-layered architecture:

1. Layer 1: Protocol and Load Balancer Services (Stateless)
2. Layer 2: Application services (Stateless)
3. Layer 3: Database Services (Stateful)

RADIUS Client POD is integrated as part of the "Protocol" layer.

The following figure illustrates the integration of RADIUS Client in SMF.



Radius-EP App (RADIUS-Client POD): RADIUS Client functionality is added in a new POD. It is responsible for handling RADIUS protocol-specific functions such as authentication, accounting, and so on.

NOTE: In this release, only Authentication is supported.

SMF Service App (SMF Service POD): SMF Service App is responsible for providing PDU session service. During session bring-up, SMF service decides if secondary authentication is required or not and acts accordingly.

UDP-Proxy App (UDP-Proxy POD): UDP-Proxy App is enabled with host-networking and helps with sending and receiving of packets using external Virtual-IPs. All RADIUS packets are transmitted out and received from an outside cluster using this app.

How it Works

This section describes about authentication method applied by RADIUS.

RADIUS Authentication Method

RADIUS uses the following authentication methods:

- User-Name: Only MSISDN-based user-authentication is supported. The GPSI/MSISDN value is set as the User-Name in RADIUS Authentication requests (with stripped-off "msisdn-" string). Other methods such as PAP, CHAP, MSCHAP, and so on, are not supported in this release.
- **User-Password: RADIUS server's "secret" key is used as password of the user.**

RADIUS Client - Dictionary

The primary purpose of the dictionary is to map descriptive names to attribute numbers in a packet. For efficiency reasons, each packet contains an encoded version of an attribute. The encoded version is binary data and is non-readable. The secondary function is to define data types for an attribute. On the client side, the dictionary file is used to determine the attribute type and encoding or decoding of attribute values are

based on the type. For example, to determine that the attribute should be interpreted as a User-Name attribute of type string when the header contains Type field as 1. Each RADIUS attribute contains a header with Type, Length, and Value fields. For standard attributes, the type is fixed and for VSA attributes the type is 26. In case of VSA attributes, there are two headers - the outermost is a normal RADIUS attribute header, and the inner header contains information like VSAType, Length, Vendor-Id, and Attribute Value.

The dictionary file is defined based on the RFC .dct file format. The following is an example of RADIUS dictionary file:

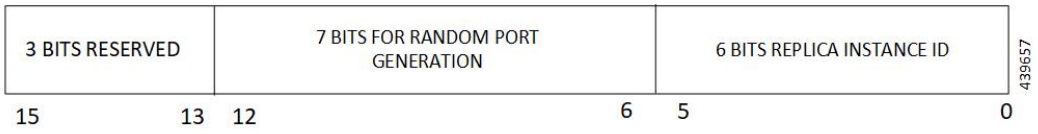
```
# radius standard attributes, vsa with enum values
# format is based on rfc .dct files

# Standard attributes
ATTRIBUTE   User-Name        Standard(1)             string
ATTRIBUTE   User-Password     Standard(2)             octets
ATTRIBUTE   Service-Type          Standard(6)             integer
VALUE       Service-Type              Login-User              1
VALUE       Service-Type               Framed-User             2
VALUE       Service-Type               Callback-Login-User     3
VALUE       Service-Type               Callback-Framed-User4
VALUE       Service-Type               Outbound-User           5
VALUE       Service-Type               Administrative-User     6
VALUE       Service-Type               NAS-Prompt-User         7
VALUE       Service-Type               Authenticate-Only       8
VALUE       Service-Type               Callback-NAS-Prompt   9
VALUE       Service-Type               Call-Check              10
VALUE       Service-Type               Callback-Administrative11

# VSA
ATTRIBUTE   3GPP-IMSI                           3GPP-VSA(1)     string
ATTRIBUTE   3GPP-IMSI-MCC-MNC       3GPP-VSA(8)     string
ATTRIBUTE   3GPP-User-Location-Info                 3GPP-VSA(22)    UeLocType
ATTRIBUTE   3GPP-MS-Time-Zone               3GPP-VSA(23)    octets
```

The first column denotes if it is an ATTRIBUTE entry or VALUE entry to indicate an attribute or enum value of an attribute respectively. The second column contains name of the attribute in case of both ATTRIBUTE and VALUE entries. For ATTRIBUTE entries, the third column denotes if the attribute is a Standard attribute with attribute type number, or in case of VSA attribute it contains the VendorName with vendor attribute type number. For VALUE entries, the third column contains the enum description. The last column denotes the data type of attribute in case of ATTRIBUTE or the enum value of an attribute in case of VALUE entry.

Basic RADIUS attribute types are integer, string, octets, ipaddr, and vsa. If new attribute types are needed, encode/decode functions should be defined in the backend for the newly defined types.

RADIUS Client – UDP Source Port Generation Logic

The following logic is used for generating UDP source Port.



3 Bits - Reserved for future use

6 Bits - Max 64 Replicas instances

7 Bits - Max 128 Source ports per instance

x 256 IDs - Max 32 Outstanding RADIUS Requests per instance

13 Bits Total- Max 8000 Source ports per instance

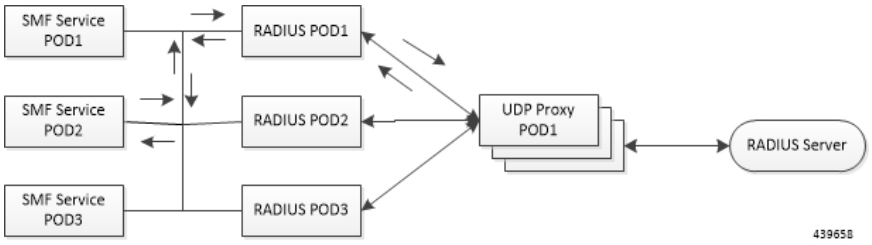
x 256 IDs - Max 2 million Outstanding RADIUS Requests per cluster

RADIUS Client – POD Replica Support

Multiple RADIUS PODs can be spawned based on the need. Replicas work as follows:

- SMF Service requests are sent to any of the RADIUS POD using cluster's load-balancing method. RADIUS POD, which receives the request, initiates access-request packet and uniquely reserves a UDP source Port using the "instance-id" logic.
- UDP-Proxy, when it receives the response back, finds the actual instance of RADIUS POD by decoding the UDP-Dest-Port value, and unicasts the packet to respective RADIUS POD.

The following figure illustrates the way POD replica works.



RADIUS Client – Attributes Encoding

The following attributes in the access-request packet are supported in this release.

ATTRIBUTE	Reference Specification	Encoding Type
USER-NAME	RFC2865 - 5.1	String
PASSWORD	RFC2865 - 5.2	Encrypted String
CALLING-STATION-ID	RFC2865 - 5.31	String
CALLED-STATION-ID	RFC2865 - 5.30	String
NAS-IP-ADDRESS	RFC2865 - 5.4	IPv4 Address
NAS-IDENTIFIER	RFC2865 - 5.32	String
SERVICE-TYPE	RFC2865 - 5.6	Octets - 4 bytes
FRAMED-PROTOCOL	RFC2865 - 5.7	Octets - 4 bytes
NAS-PORT-TYPE	RFC2865 - 5.41	Octets - 4 bytes
NAS-PORT	RFC2865 - 5.5	Octets - 4 bytes
3GPP-IMSI	3GPP 29.061 - 16.4.7.2-1	String
3GPP-CHARGING-ID	3GPP 29.061 - 16.4.7.2-2	Octets - 4 bytes
3GPP-PDP-TYPE	3GPP 29.061 - 16.4.7.2-3	Octets - 4 bytes

ATTRIBUTE	Reference Specification	Encoding Type
3GPP-CHARGING-GATEWAY-ADDR	3GPP 29.061 - 16.4.7.2-4	IPv4 Address
3GPP-GPRS-NEG-QOS-PROFILE	3GPP 29.061 - 16.4.7.2-5	Special Encoded Octets
	3GPP 29.274 - 8.7	
3GPP-SGSN-ADDRESS	3GPP 29.061 - 16.4.7.2-6	IPv4 Address
3GPP-GGSN-ADDRESS	3GPP 29.061 - 16.4.7.2-7	IPv4 Address
3GPP-IMSI-MCC-MNC	3GPP 29.061 - 16.4.7.2-8	String
3GPP-GGSN-MCC-MNC	3GPP 29.061 - 16.4.7.2-9	String
3GPP-NSAPI	3GPP 29.061 - 16.4.7.2-10	String
3GPP-SELECTION-MODE	3GPP 29.061 - 16.4.7.2-12	String
3GPP-CHARGING-CHARACTERISTICS	3GPP 29.061 - 16.4.7.2-13	String
3GPP-SGSN-MCC-MNC	3GPP 29.061 - 16.4.7.2-18	String
3GPP-IMEISV	3GPP 29.061 - 16.4.7.2-20	String
3GPP-RAT-TYPE	3GPP 29.061 - 16.4.7.2-21	Octet - 1 byte
3GPP-USER-LOCATION	3GPP 29.061 - 16.4.7.2-22	Special Encoded Octets
	3GPP 29.274 - 8.21-4	
	3GPP 29.274 - 8.21-5	
3GPP-MS-TIMEZONE	3GPP 29.061 - 16.4.7.2-23	Special Encoded Octets
	3GPP 29.274 - 8.44	
3GPP-NEGOTIATED-DSCP	3GPP 29.061 - 16.4.7.2-26	Octet - 1 byte

- USER-NAME

  Description: String value encoded as per RFC 2865.

  - 5G call: GPSI value is used, with stripped-off "msisdn-"
  - 4G call: MSISDN value is used, with stripped-off "msisdn-"

  NOTE: PAP, CHAP, and MSCHAP authentication methods are not supported in this release.

- PASSWORD

  Description: Encrypted string value encoded as per RFC 2865.

For both 5G and 4G calls, selected RADIUS server's "secret" is set as user-password.

- CALLING-STATION-ID

  Description: String value encoded as per RFC 2865.

  5G call: GPSI value is used, with stripped of "msisdn-"

  4G call: MSISDN value is used, with stripped of "msisdn-"

- CALLED-STATION-ID

  Description: String value encoded as per RFC 2865.

  For both 5G and 4G calls, DNN value is set as called-station-id.

- NAS-IP-ADDRESS

  Description: IPv4 address value encoded as per RFC 2865.

  For both 5G and 4G calls, user-configured RADIUS Client interface-type's VIP-IP is used.

- NAS-IDENTIFIER

  Description: String value encoded as per RFC 2865.

  For both 5G and 4G calls, user-configured nas-identifier attribute value is used.

- SERVICE-TYPE

  Description: 4-byte Octet (int) value encoded as per RFC 2865.

  For both 5G and 4G calls, "FRAMED (2)" value is set.

- FRAMED-PROTOCOL

  Description: 4-byte Octet (int) value encoded as per RFC 2865.

  For both 5G and 4G calls, "GPRS-PDP-CONTEXT (7)" value is set.

- NAS-PORT-TYPE

  Description: 4-byte Octet (int) value encoded as per RFC 2865.

  For both 5G and 4G calls, "WIRELESS-OTHER (18)" value is set.

- NAS-PORT

  Description: 4-byte Octet (int) value encoded as per RFC 2865.

  For both 5G and 4G calls, the base value of respective instance is used. That is:

  0x40 00 00 00 is set for replica-0

  0x40 00 00 01 is set for replica-1

- 3GPP-IMSI

  Description: String value encoded as per 3GPP TS 29.061.

  5G call: SUPI value is used.

  4G call: IMSI value is used.

- 3GPP-CHARGING-ID

  Description: 4-byte octet (int) value encoded as per 3GPP TS 29.061.

For both 5G and 4G calls, charging-ID is set.

- 3GPP-PDP-TYPE

  Description: 4-byte octet (int) value encoded as per 3GPP TS 29.061.

  For both 5G and 4G calls, pdp-type is set as follows:

  - 0 = IPv4
  - 2 = IPv6
  - 3 = IPv4v6

- 3GPP-CHARGING-GATEWAY-ADDR

  Description: 4-byte octet (IPv4-address) value encoded as per 3GPP TS 29.061.

  For both 5G and 4G calls, charging gateway address is set.

- 3GPP-GPRS-NEG-QOS-PROFILE

  Description: Octets (special encoding) value encoded as per 3GPP TS 29.061 & 29.274.

  For 5G call, the values from default-qos profile of the system are used and the encoding is performed as follows:

Table 3: Non-GBR case

1-2	<Release indicator>- = "15" (UTF-8 encoded)
3	"-" (UTF-8 encoded)
4-5	ARP (UTF-8 encoded)
6-7	5QI (UTF-8 encoded)
8-9	UL Session-AMBR length (UTF-8 encoded)
10-m	UL Session-AMBR (UTF-8 encoded)
(m+1) - (m+2)	DL Session-AMBR length (UTF-8 encoded)
(m+3) – n	DL Session-AMBR (UTF-8 encoded)

Table 4: GBR case

1-2	<Release indicator> = "15" (UTF-8 encoded)
3	"-" (UTF-8 encoded)
4-5	ARP (UTF-8 encoded)
6-7	5QI (UTF-8 encoded)
8-9	UL MFBR length (UTF-8 encoded)
10-m	UL MFBR (UTF-8 encoded)
(m+1)-(m+2)	DL MFBR length (UTF-8 encoded)
(m+3)-n	DL MFBR (UTF-8 encoded)

(n+1)-(n+2)	UL GFBR length (UTF-8 encoded)
(n+3)-o	UL GFBR (UTF-8 encoded)
(o+1) – (o+2)	UL GFBR length (UTF-8 encoded)
(o+3) - p	DL GFBR (UTF-8 encoded)

For 4G call, the values from the default-qos profile of the system are used and the encoding is performed as follows:

Table 5: Non-GBR case

1-2	<Release indicator>- = "08" (UTF-8 encoded)
3	"-" (UTF-8 encoded)
4-5	ARP (UTF-8 encoded)
6-7	5QI (UTF-8 encoded)
8-11	UL Session-AMBR (UTF-8 encoded)
12-15	DL Session-AMBR (UTF-8 encoded)

Table 6: GBR case

1-2	<Release indicator> = "08" (UTF-8 encoded)
3	"-" (UTF-8 encoded)
4-5	ARP (UTF-8 encoded)
6-7	5QI (UTF-8 encoded)
8-11	UL MBR (UTF-8 encoded)
12-15	DL MBR (UTF-8 encoded)
16-19	UL GBR (UTF-8 encoded)
20-23	DL GBR (UTF-8 encoded)

- 3GPP-SGSN-ADDRESS

  Description: 4-byte octet (IPv4-address) value encoded as per 3GPP TS 29.061.

  For 5G call, the AMF address is set.

  For 4G call, the S-GW address is set.

- 3GPP-GGSN-ADDRESS

  Description: 4-byte octet (IPv4-address) value encoded as per 3GPP TS 29.061.

  For both 5G and 4G call, SMF-Service IP is set.

- 3GPP-IMSI-MCC-MNC

  Description: String value encoded as per 3GPP TS 29.061.

  For 5G call, SUPIs MCC and MNC values are set.

For 4G call, IMSIs MCC and MNC values are set.

MCC is first 3 bytes, MNC is next 2 or 3 bytes.

If MCC value is any of the following, then MNC will be of 3 bytes, else MNC will be of 2 bytes.

300 302 310 311 312 313 316 334 338 342 344 346 348 354 356 358 360 365 376 405 708 722 732

- 3GPP-GGSN-MCC-MNC

  Description: String value encoded as per 3GPP TS 29.061.

  For both 5G and 4G call, configured MCC and MNC value of SMF is used.

  MCC is first 3 bytes, and MNC is next 2 or 3 bytes.

- 3GPP-SGSN-MCC-MNC

  Description: String value encoded as per 3GPP TS 29.061.

  For 5G call, AMFs MCC and MNC values are set.

  For 4G call, SGWs MCC and MNC values are set.

  MCC is first 3 bytes, and MNC is next 2 or 3 bytes.

- 3GPP-NSAPI

  Description: String value encoded as per 3GPP TS 29.061.

  For 5G call, QFI value from the defaultQos profile is set.

  For 4G call, EPS bearer ID is set.

- 3GPP-SELECTION-MODE

  Description: String value encoded as per 3GPP TS 29.061.

  For both 4G and 5G call, value is set to "0".

- 3GPP-CHARGING-CHARACTERISTICS

  Description: String value encoded as per 3GPP TS 29.061.

  For both 4G and 5G call, generic charging character is set.

- 3GPP-IMEISV

  Description: String value encoded as per 3GPP TS 29.061.

  For 5G call, PEI value is set.

  For 4G call, IMEI value is set.

- 3GPP-RAT-TYPE

  Description: 1-byte octet encoded as per 3GPP TS 29.061.

  For 5G call, value "NR (10)" is set.

  For 4G call, value "EUTRAN (6)" is set.

- 3GPP-USER-LOCATION

  Description: Special encoded octet value encoded as per 3GPP TS 29.061.

  For 5G call, the following encoding logic is used:

1	Location-Type Only TAI = 136 Only NCGI = 135 Both TAI + NCGI =137
2-6	TAI-Encoding (if present)
7-14	NCGI-Encoding (if present)

TAI Encoding header:

1	MCC digit 2	MCC digit 1
2	MNC digit 3	MCC digit 3
3	MNC digit 2	MNC digit 1
4-5	TAC value	

NCGI Encoding header:

1	MCC digit 2	MCC digit 1
2	MNC digit 3	MCC digit 3
3	MNC digit 2	MNC digit 1
4	SPARE	NCI
5-8	NR Cell Identifier (NCI)	

For 4G call, the following encoding logic is used:

1	Location-Type
	Only TAI = 128
	Only ECGI = 129
	Both TAI + ECGI =130
2-6	TAI-Encoding (if present)
7-13	ECGI-Encoding (if present)

TAI Encoding header:

1	MCC digit 2	MCC digit 1
2	MNC digit 3	MCC digit 3
3	MNC digit 2	MNC digit 1
4-5	TAC value	

ECGI Encoding header:

1	MCC digit 2	MCC digit 1

2	MNC digit 3	MCC digit 3
3	MNC digit 2	MNC digit 1
4	Spare	ECI
5-7	EUTRAN Cell Identifier (ECI)	

- 3GPP-MS-TIMEZONE

  Description: Special encoded octet value encoded as per 3GPP TS 29.061.

  Timezone string (for example: -07:00+1) is encoded as two-byte value mentioned below:

  First byte timezone – NA

  Second byte daylight – two bits used (00-0, 01-+1, 10-+2, 11 – Unused)

1	TIMEZONE
2	DAYLIGHT SAVING 0, or +1 or +2

- 3GPP-NEGOTIATED-DSCP

  Description: 1-byte octet encoded as per 3GPP TS 29.061

  For both 5G and 4G calls, DSCP configuration from DNN qos-profile configuration is used.

  Sub -> DNN profile -> QosProfile -> DSCPMap -> Qi5 value check -> ARP priority check

Call Flows

SMF - RADIUS Authentication Call Flow

The following figure illustrates the end to end call flow between SMF server and RADIUS-EP functionality.

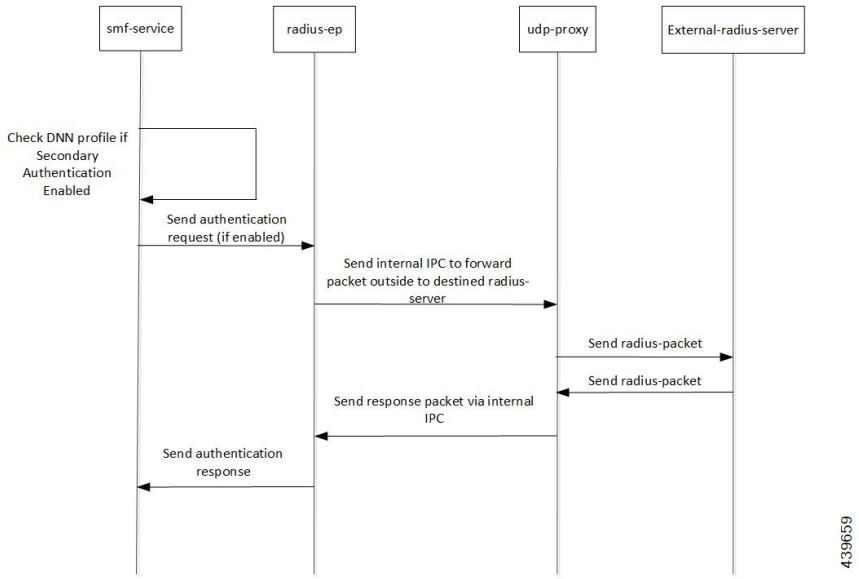


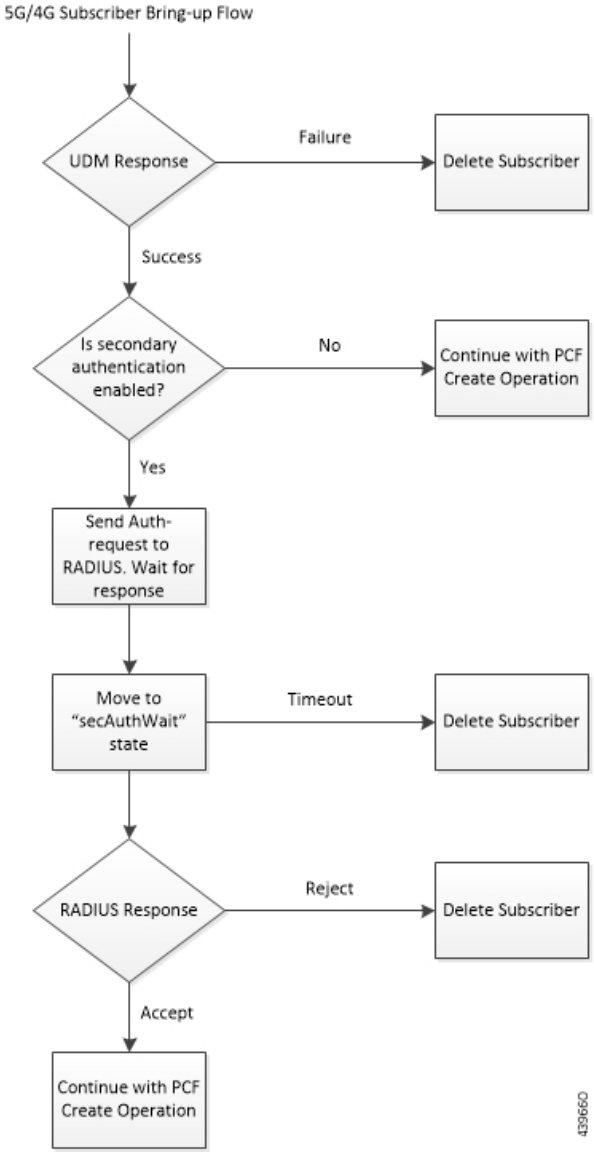
Table 7: RADIUS Authentication Call Flow

Step	Description
1	Bring up RADIUS-POD: Add respective endpoint configuration, with VIP-IP same as protocol-ep VIP-IP. Add radius-server information to profile-radius configuration.
2	Add “secondary authentication radius” configuration to required DNN profiles.
3	During session-bringup, after successful UDM validation, DNN profile checks if secondary authentication is enabled: • If not enabled, continue with PCF. • If enabled, send IPC to Radius-POD to authenticate the subscriber.
4	RADIUS-POD prepares the access-request packet that is destined to a configured radius-server, sends the packet to UDP Proxy POD to proxy the packet out.
6	UPD Proxy POD creates a socket (if not already present) and sends out packet to the radius-server.
7	Radius-server validates access-request. If accepted, responds “access-accept”. Else, responds “access-reject”.
8	UDP Proxy responds to respective Radius-ep instance.
9	Radius-ep instance validates the response, fetches framed-ip (if present) and updates smf-service.
10	Smf-service, upon success response from radius-ep, continues with PCF flow. Else, disconnects the subscriber.

SMF - Secondary Authentication Flow

The following flowchart explains the smf-service handling of secondary authentication of 4G/5G subscribers. After successful UDM Subscriber-Notification response, smf-service invokes secondary authentication if enabled in the DNN-profile configuration. Currently, only RADIUS method is supported. It does a sync-wait for RADIUS-response and continues with PCF create upon successful response. If secondary authentication fails, subscriber is deleted.

Figure 1: SMF - Secondary Authentication Flow



Standards Compliance

The RADIUS Client feature complies with the following standard:

- RFC 2865: Remote Authentication Dial in User Service (RADIUS)

Limitations and Restrictions

The RADIUS Client feature has the following limitations:

- AAA group concept is not supported.
  - Global RADIUS profile configuration is supported, which is applicable to all DNNs.
- Authorization and Accounting is not supported.
- User authentication based on PAP, CHAP, MSCHAP, and so on, is not supported. Only MSISDN-based user authentication is supported in this release.
- RADIUS Client interfaces' VIP-IP is mandatory configuration for RADIUS Client to work.
- Currently, only one VIP-IP is supported.
- VIP-IP must be same as the UDP-PROXY PODs IP.
- Currently, RADIUS POD-level VIP-IP is not applicable.

Configuring the RADIUS Client Feature

This section describes how to configure the RADIUS Client feature.

Configuring the RADIUS Client feature involves the following steps:

1. Configuring RADIUS Server
2. Configuring RADIUS Server Selection Logic
3. Configuring RADIUS NAS-Identifier
4. Configuring RADIUS Detect-dead-server
5. Configuring RADIUS Dead-time
6. Configuring RADIUS Max-retry
7. Configuring RADIUS Timeout
8. Configuring RADIUS POD
9. Configuring RADIUS NAS-IP
10. Configuring Secondary Authentication Method

Configuring RADIUS Server

This section describes how to configure the RADIUS Server.

```
configure
   profile radius
      server ipv4_address auth_port
         secret secret_key
         priority priority_value
         commit
```

NOTES:

- **profile radius**: Enters RADIUS configuration mode.
- **server** *ipv4_address auth_port*: Specifies IPv4 address and authorization port of RADIUS server.
- **secret** *secret_key*: Specifies the secret key.
- **priority** *priority_value*: Specifies the priority of server.
- **commit**: Commits the configuration.

Configuration Example

```
profile dnn intershat
 ...
 authentication secondary radius
exit
```

Configuring RADIUS Server Selection Logic

This section describes how to configure the RADIUS Server selection logic.

```
configure
   profile radius
      algorithm first-server
      algorithm round-robin
      commit
```

NOTES:

- **profile radius**: Enters RADIUS configuration mode.
- **algorithm first-server**: Sets the selection logic as highest priority first. This is the default behavior.
- **algorithm round-robin**: Sets the selection logic as round-robin order of servers.
- **commit**: Commits the configuration.

Configuration Example

```
profile radius
 server 1.2.3.4 1812
  secret   $8$73a0i4G3ILj0Np+8tn2QOoWDj3QkB+oefPc2ZK6RE6A=
  priority 1
 exit
 server 1.2.5.6 1812
  secret   $8$VccEEUVou7m5ptA9WZRPR7KDmxQ/L3KlJ3QqgHjexkk=
  priority 2
 exit
exit
```

Configuring RADIUS NAS-Identifier

This section describes how to configure the RADIUS NAS-Identifier.

```
configure
   profile radius
      attribute nas-identifier value_in_string
      commit
```

NOTES:

- **profile radius**: Enters RADIUS configuration mode.
- **attribute nas-identifier** *value_in_string*: Sets the nas-identifier value that is used while encoding.
- **commit**: Commits the configuration.

Configuration Example

```
profile radius
 algorithm round-robin
exit
```

Configuring RADIUS Detect-dead-server

This section describes how to configure the RADIUS Detect-dead-server.

```
configure
   profile radius
      detect-dead-server response-timeout value_in_seconds
      commit
```

NOTES:

- **profile radius**: Enters RADIUS configuration mode.
- **detect-dead-server response-timeout** *value_in_seconds*: Sets the timeout value that marks a server as "dead" when packet is not received for *value_in_seconds*. **Default = 10 secon**ds.
- **commit**: Commits the configuration.

Configuration Example

```
profile radius
 attribute
  nas-identifier CiscoSmf
 exit
exit
```

Configuring RADIUS Dead-time

This section describes how to configure the RADIUS Dead-time.

```
configure
   profile radius
      deadtime value_in_minutes
      commit
```

NOTES:

- **profile radius**: Enters RADIUS configuration mode.
- **deadtime** *value_in_minutes*: Sets the time to elapse between RADIUS server marked unreachable and when we can re-attempt to connect. Default = 10 minutes.
- **commit**: Commits the configuration.

Configuration Example

```
profile radius
 detect-dead-server response-timeout 100
exit
```

Configuring RADIUS Max-retry

This section describes how to configure the RADIUS Max-retry.

```
configure
   profile radius
      max-retry value
      commit
```

NOTES:

- **profile radius**: Enters RADIUS configuration mode.
- **max-retry** *value*: Sets the maximum number of times system will attempt retry with RADIUS server. Default = 5.
- **commit**: Commits the configuration.

Configuration Example

```
profile radius
 deadtime 15
exit
```

Configuring RADIUS Timeout

This section describes how to configure the RADIUS Timeout.

```
configure
   profile radius
      timeout value_in_seconds
      commit
```

NOTES:

- **profile radius**: Enters RADIUS configuration mode.
- **timeout** *value_in_seconds*: Sets the time to wait for response from RADIUS server before re-transmitting. Default = 3 seconds
- **commit**: Commits the configuration.

Configuration Example

```
profile radius
 max-retry 2
exit
```

Configuring RADIUS POD

This section describes how to configure the RADIUS POD.

```
configure
   endpoint radius-dns
      replicas number_of_replicas
      commit
```

NOTES:

- **endpoint radius-dns**: Enters endpoint radius-ep configuration mode.
- **replicas** *number_of_replicas*: Sets the number of replicas required.
- **commit**: Commits the configuration.

Configuration Example

```
profile radius
 timeout 4
exit
```

Configuring RADIUS NAS-IP

This section describes how to configure the RADIUS NAS-IP

```
configure
   endpoint radius-dns
      interface radius-client
         vip-ip ipv4_address
         commit
```

NOTES:

- **endpoint radius-dns**: Enters endpoint radius-ep configuration mode.
- **interface radius-client**: Enters the radius-client interface-type configuration mode.
- **vip-ip** *ipv4_address*: Sets the NAS-IP value, which is also used as source-ip in UDP requests toward RADIUS server.
- **commit**: Commits the configuration.

Configuration Example

```
endpoint radius-dns
 replicas 3
exit
```

Configuring Secondary Authentication Method

This section describes how to configure the secondary authentication method.

```
configure
   profile dnn dnn_name
      authentication secondary radius
      commit
```

NOTES:

- **profile dnn** *dnn_name*: Enters the DNN Profile configuration mode.
- **authentication secondary radius**: Enables the "secondary-authentication" under the DNN profile and sets method as "RADIUS".
- **commit**: Commits the configuration.

Configuration Example

```
endpoint radius-dns
interface radius-client
```

```
  vip-ip 10.86.73.89
 exit
exit
```

RADIUS Client OA&M Support

This section describes operations, administration, and maintenance information for this feature.

Statistics

Following statistics are available related to RADIUS functionality:

- SMF-Service:
  - Number of Secondary-Authentication requests sent
  - Number of Secondary-Authentication response received
- RADIUS-EP:
  - Number of Secondary-Authentication requests sent
  - Number of Secondary-Authentication response received
  - Number of RADIUS packets sent
  - Number of RADIUS packets received