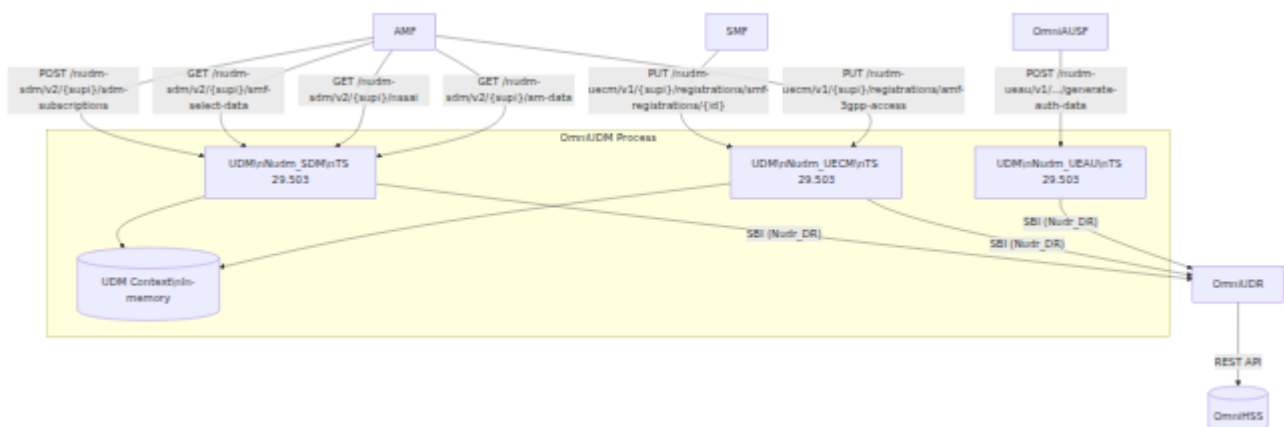


OmniUDM Operations

1. Component Overview

OmniUDM is the Unified Data Management (UDM) function for the Omnitouch 5G core. It provides subscriber data management, UE authentication data generation (Nudm_UEAU), UE context management (Nudm_UECM), and subscriber data management (Nudm_SDM).

Architecture note: AUSF and UDR are now separate standalone NFs (OmniAUSF and OmniUDR respectively). OmniUDM no longer co-locates AUSF or UDR. UDM calls UDR via SBI for all subscriber data retrieval (authentication subscriptions, AM data, SM data). Per-UE runtime state (registration contexts, SDM subscriptions) is held in in-memory Agent processes.



2. 3GPP Role and Spec References

Aspect	Reference
UDM functional definition	TS 23.501 Section 6.2.7
Nudm_UEAU service	TS 29.503 Section 5.2.2
Nudm_UECM service	TS 29.503 Section 5.3
Nudm_SDM service	TS 29.503 Section 5.2.3
Nudr_DataRepository service	TS 29.504
5G-AKA authentication	TS 33.501 Section 6.1.3
Milenage algorithm	TS 35.206
SUCI concealment / de-concealment	TS 23.003 Section 2.2B, TS 33.501 Section 6.12
SQN resynchronisation	TS 33.102 Section 6.3.5, TS 33.501 Section 6.1.3.4
Key derivation (Kausf, Kseaf, HXRES*)	TS 33.501 Annex A

3. SBI Endpoints

All endpoints are HTTP/1.1 with `Content-Type: application/json`.

Nudm_UEAU (TS 29.503 Section 5.2.2)

Method	Path	Description	Success
POST	/nudm-ueau/v1/{supiOrSuci}/security-information/generate-auth-data	Generate 5G-AKA authentication vector	200 OK
POST	/nudm-ueau/v1/{supi}/auth-events	Store authentication result event	201 Created
DELETE	/nudm-ueau/v1/{supi}/auth-events/{authEventId}	Delete authentication event	204 No Content

Nudm_UECM (TS 29.503 Section 5.3)

Method	Path	Description	Success
PUT	<code>/nudm-uecm/v1/{supi}/registrations/amf-3gpp-access</code>	AMF registers 3GPP access for a UE	200 OK
GET	<code>/nudm-uecm/v1/{supi}/registrations/amf-3gpp-access</code>	Retrieve AMF 3GPP access registration	200 OK
PUT	<code>/nudm-uecm/v1/{supi}/registrations/smf-registrations/{pduSessionId}</code>	SMF registers PDU session context	200 OK
DELETE	<code>/nudm-uecm/v1/{supi}/registrations/smf-registrations/{pduSessionId}</code>	SMF deregisters PDU session context	204 No Content

Nudm_SDM (TS 29.503 Section 5.2.3)

Method	Path	Description	Success
GET	/nudm-sdm/v2/{supi}/nssai	Network slice subscription data	200 OK
GET	/nudm-sdm/v2/{supi}/am-data	Access and mobility subscription data	200 OK
GET	/nudm-sdm/v2/{supi}/smf-select-data	SMF selection subscription data	200 OK
GET	/nudm-sdm/v2/{supi}/sm-data	Session management subscription data	200 OK
POST	/nudm-sdm/v2/{supi}/sdm-subscriptions	Subscribe to subscriber data change notifications	201 Created
DELETE	/nudm-sdm/v2/{supi}/sdm-subscriptions/{subscriptionId}	Unsubscribe	204 No Content

4. Configuration Reference

OmniUDM is configured via Elixir application environment under the `:omniudm` key.

Example Configuration

```
config :omniudm,  
  sbi_scheme: "http",  
  sbi_addr: "127.0.0.12",  
  sbi_port: 7777,  
  nrf_uri: "http://127.0.0.10:7777",  
  udr_uri: "http://127.0.0.22:7777",  
  mcc: "999",  
  mnc: "70",  
  heartbeat_interval: 10_000,  
  hnet_key_dir: "/etc/omniudm/hnet"
```

Parameter Table

Parameter	Type	Default	Description
sbi_scheme	string	"http"	URI scheme for the SBI HTTP server
sbi_addr	string	"127.0.0.12"	IP address the SBI HTTP server binds to
sbi_port	integer	7777	TCP port the SBI HTTP server listens on
nrf_uri	string	"http://127.0.0.10:7777"	Base URI of the NRF for NF registration and heartbeat
mcc	string	"999"	Mobile Country Code for the serving PLMN used in serving network name construction for key derivation
mnc	string	"70"	Mobile Network Code

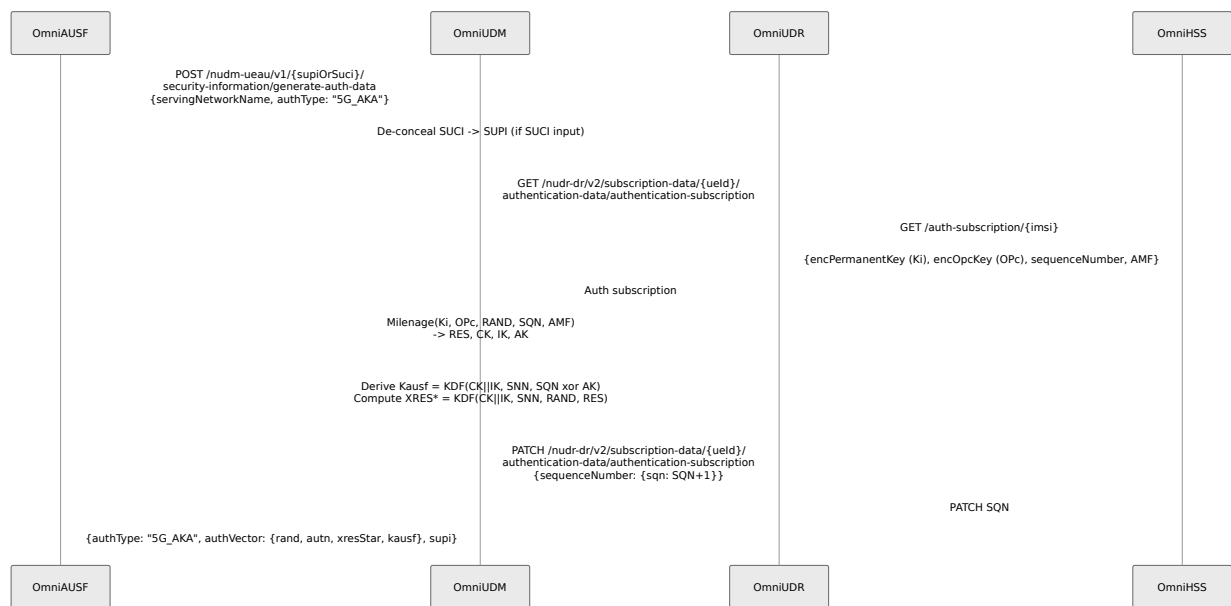
Parameter	Type	Default	Description
			for the serving PLMN
heartbeat_interval	integer (ms)	10000	Interval at which OmniUDM sends NRF heartbeat PATCH requests
udr_uri	string	"http://127.0.0.22:7777"	Base URI of the standalone UDR (OmniUDR). UDM calls UDR via SBI for authenticating subscription data, AM data, SM data, and SQ updates. Previously, a co-located UDR proxy called OmniHSS directly; that functionality is now in OmniUDR

Parameter	Type	Default	Description
<code>hnet_key_dir</code>	string	<code>"/etc/omniudm/hnet"</code>	Directory containing home network private keys for ECIES SU(de-concealment Each key file is named <code><key_id>.<curve>.key</code> where curve is <code>x25519</code> (Profile A) or <code>secp256r1</code> (Profile B). File contents are hex-encoded or raw binary private key material. Set via <code>HNET_KEY_DIR</code> environment variable

5. Key Procedures

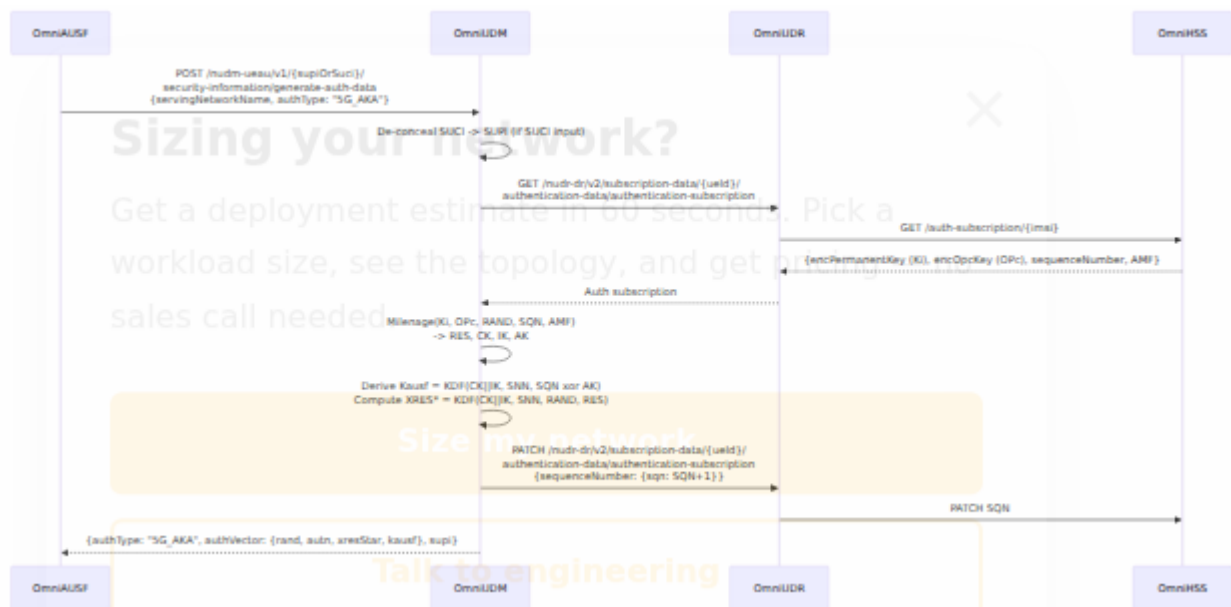
5.1 Authentication Data Generation (Nudm_UEAU)

UDM generates authentication vectors on request from AUSF. AUSF is now a standalone NF (OmniAUSF) and calls UDM over SBI.



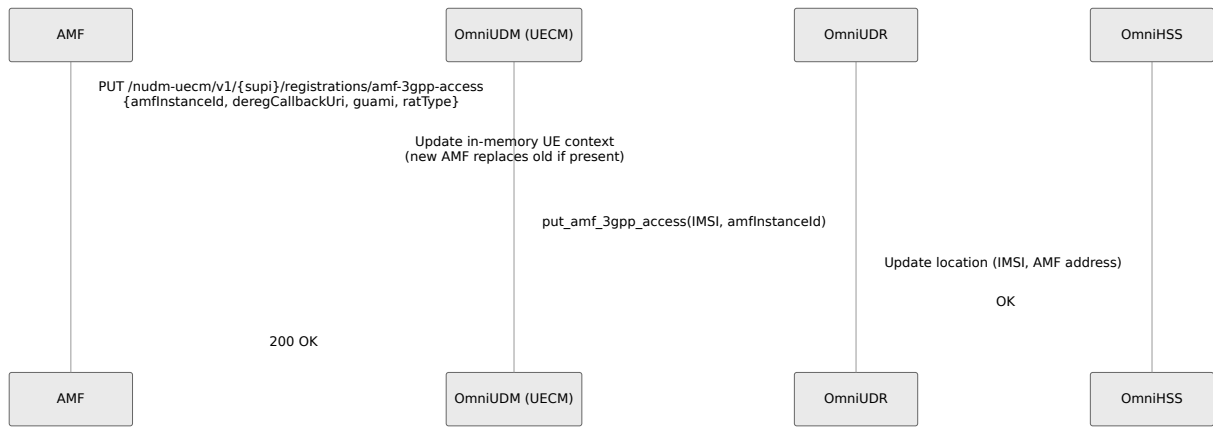
5.2 SQN Resynchronisation

When the UE detects an SQN mismatch it sends an Authentication Failure with AUTS. On the next authentication attempt the AMF includes `resynchronizationInfo` in the `AuthenticationInfo` body.



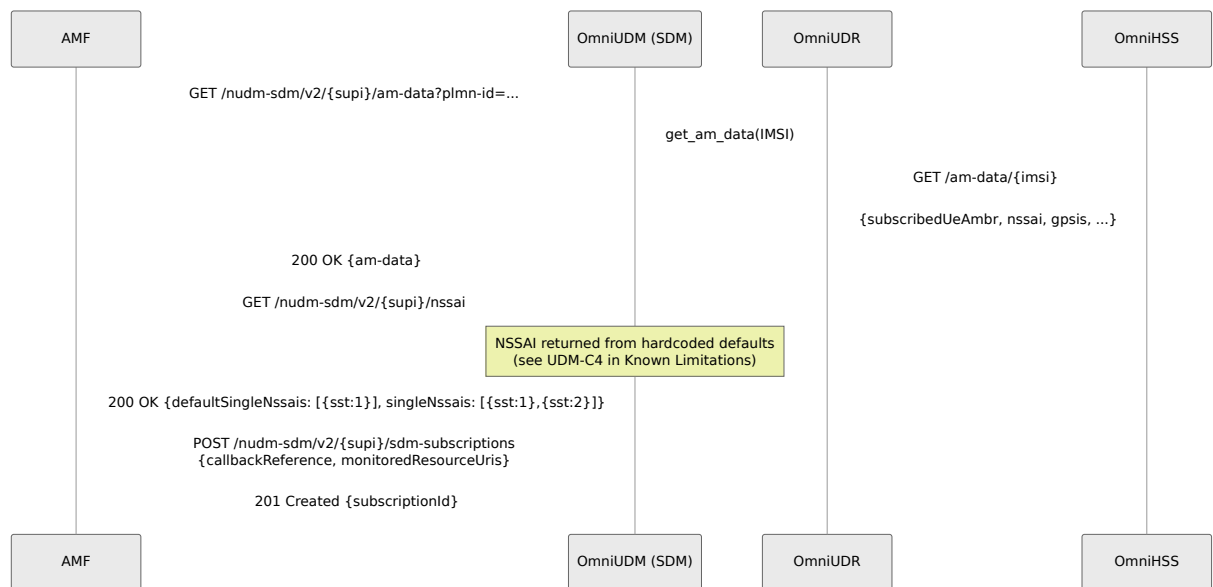
5.3 UE Context Registration (AMF → UDM)

After authentication succeeds and the Security Mode is complete, the AMF registers itself for the UE at UDM.



5.4 Subscriber Data Management (SDM)

After UE context registration, the AMF fetches subscription data.



6. Known Limitations

ID	Area	Description
UDM-M6	In-memory state	All UDM contexts (UE registration, SDM subscriptions) are stored in memory only. State is lost on process restart

7. Prometheus Metrics

UDM Metrics

Metric	Type	Tags	Description
<code>omni_udm.auth.requests.count</code>	counter	<code>supi</code> , <code>result</code>	Authentication data requests
<code>omni_udm.uecm.amf_registration.count</code>	counter	<code>supi</code>	AMF registration requests
<code>omni_udm.auth.result.count</code>	counter	<code>supi</code> , <code>result</code>	Authentication results
<code>omni_udm.auth_vector_generations.total</code>	counter	<code>result</code>	Total authentication vector generation attempts
<code>omni_udm.uecm_registrations.total</code>	counter	<code>result</code>	Total UECM AMF registrations
<code>omni_udm.sdm_queries.total</code>	counter	<code>data_type</code>	Total SDM data queries
<code>omni_udm.active_ue_contexts.count</code>	gauge	--	Number of active UE contexts
<code>omni_udm.nrf.registration.status</code>	gauge	<code>nf_type</code>	NRF registration status

Metric	Type	Tags	Descr
			(1=reg 0=not)

BEAM VM Metrics

Metric	Type	Description
<code>beam.memory.total</code>	gauge	Total BEAM memory in bytes
<code>beam.memory.processes</code>	gauge	Memory used by Erlang processes
<code>beam.memory.processes_used</code>	gauge	Memory actually used by processes
<code>beam.memory.system</code>	gauge	System memory (ETS, atoms, code)
<code>beam.memory.atom</code>	gauge	Total atom memory
<code>beam.memory.atom_used</code>	gauge	Used atom memory
<code>beam.memory.binary</code>	gauge	Binary memory
<code>beam.memory.code</code>	gauge	Code memory
<code>beam.memory.ets</code>	gauge	ETS table memory
<code>beam.processes.count</code>	gauge	Number of Erlang processes
<code>beam.ports.count</code>	gauge	Number of Erlang ports
<code>beam.atom.count</code>	gauge	Number of atoms
<code>beam.vm.uptime</code>	gauge	VM uptime in seconds

8. Troubleshooting

Authentication fails with 404 User Not Found

OmniUDM requests auth subscription data from OmniUDR via SBI. Confirm:

1. `udr_uri` is reachable from the OmniUDM host.
2. OmniUDR can reach OmniHSS and the subscriber IMSI exists.
3. The SUCI presented by the AMF/AUSF is correctly formatted. OmniUDM de-conceals SUCI to SUPI before the UDR lookup; if de-concealment fails, the request is rejected with 403 rather than forwarding the raw SUCI to UDR.

Authentication fails with 403 SUCI De-concealment Failed

OmniUDM could not de-conceal the SUCI received from AUSF. Check:

1. Home network private keys are deployed to the `hnet_key_dir` directory (default `/etc/omniudm/hnet`).
2. Key files are named `<key_id>.<curve>.key` — e.g. `1.x25519.key` for Profile A, `2.secp256r1.key` for Profile B. The key ID must match the `home_network_public_key_id` provisioned on the SIM.
3. The key file contains the correct private key material (hex-encoded string or raw binary).
4. Check logs for `SUCI de-concealment failed` with the specific error:
`:unknown_home_network_key_id` (key not loaded),
`:ecies_mac_verification_failed` (wrong key or corrupted SUCI), or
scheme output too short (truncated SUCI).

Authentication fails with 401 Authentication Failure

The AUSF computed HRES* from the received RES* and it did not match the stored HXRES*. This indicates the UE's Milenage credentials (Ki, OPc) do not match those stored in OmniHSS, or the RAND/AUTN were corrupted in transit.

SQN desynchronisation causes repeated authentication failures

If the UE sends an Authentication Failure with AUTS, the AMF must pass `resynchronizationInfo` in the next authentication request. OmniAMF now handles this (AMF-H7 resolved). The AUSF forwards the resync info to UDM, which recovers the correct SQN via UDR/HSS.

AMF data fetch returns stale NSSAI

The `GET /nudm-sdm/v2/{supi}/nssai` endpoint returns hardcoded NSSAI values (`sst=1`, `sst=2`) regardless of subscriber configuration (UDM-C4). To change the served NSSAI, modify the hardcoded values in `NudmSDM.get_nssai/1`. Per-subscriber NSSAI from OmniHSS is not used until UDM-C4 is resolved.

UE context not found after process restart

All UE context data is in-memory (UDM-M6). After a restart, the AMF must re-register each UE by re-sending `PUT /nudm-uecm/v1/{supi}/registrations/amf-3gpp-access`. UEs will re-register naturally as they send periodic registration updates or power cycle.

SDM data change notification not received

Confirm the `callbackReference` URI in the SDM subscription is reachable from the OmniUDM host. Notifications are sent asynchronously via `Task.start`; check for `SDM notification to {uri} failed` warning log entries. Note that `GET /nudm-sdm/v2/{supi}/sdm-subscriptions/{id}` does not exist (UDM-L3); subscriptions cannot be inspected via SBI.

SMF registration appears lost after restart

SMF registrations are stored in memory only. After a restart, the SMF must re-register its PDU session contexts. This happens automatically when the SMF re-establishes SM contexts following AMF-triggered PDU session re-establishment.