EIR (□□□□□□)

□□

HSS □□□□□□□□ EIR□□□□□□□□□□□□□□□□□□□□□□□□□□□□EIR □□ IMEI□□□□□□□□□□□□□□□□□□□

EIR_RULE		
uuid	id	PK
string	action	
string	regex	
int	precedence	
timestamp	inserted_at	
timestamp	updated_at	

□□□□□

- `whitelist` - □□□□
- `blacklist` - □□□□
- `greylist` - □□□□

□□□□□□□□□□ IMEI□IMEISV □ IMSI □□

□□□□□

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□□□	0	□□□□□	□□□□□□
□□□	1	□□□□/□□□	□□□□□□
□□□	2	□□□□□□□□	□□□□□□

S13 □□

□□□□□

□□□□□□□□ **(ECR) /** □□□□□□□□ **(ECA)**

□□□MME/SGSN → HSS (EIR)

□□□MME □□□□□□□□□□□□□□□□□□□□□

□□ **AVPs**□

- Session-Id
- Origin-Host, Origin-Realm
- Destination-Realm
- Auth-Session-State
- Terminal-Information
  - IMEI□14 □□□□□□ S13 IMEI AVP □□□□□□□□□□□□ 16 □ IMEISV□□□□□□□□□
  - Software-Version□2 □□□□□□□
- User-Name□IMSI□□□□
- Vendor-Specific-Application-Id

EIR □□□

1. □□ IMEI□□□□□□□□□□□□ IMSI□□□□□□
2. □□□□ IMSI□
   - □□□□□□□□□□□□□
   - □□□□□□□□□□□□□□□□□`last_seen_realm`, `last_received_diameter_message_type`, `last_seen_imei`, `last_seen_imei_software_version`, `last_seen_imei_timestamp`□□□□□ □□□□□□□□□□□□□□□□□□□□□
3. □□□□□□□□□□□□□
   - **IMEISV** □□□IMEI + □□□□□□□
   - **IMEI** □□□□ IMEI□
   - **IMSI** □□□□□□□□□□□□
   - □□□□□□□□□□□□□□□□
4. □□□□□□

□□ **AVPs**□

- Session-Id□□□□□□□□
- Result-Code: 2001□□□□
- Equipment-Status: 0□□□□□/ 1□□□□□/ 2□□□□□

□□□□□

- Experimental-Result: 5422□□□/□□□□□□
- Experimental-Result: 5012□□□□□□

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□□□□□

EIR □□□□□□□□□□□□□□□□□□□□□□

```
1. IMEISV□IMEI + □□□□□
   ↓□□□□□□□□□
2. □ IMEI
   ↓□□□□□□□□□
3. IMSI□□□□□□□□□□□
   ↓□□□□□□□□□
4. □□□□□□□
```

□□□□

□□ 1□IMEISV □□

- □□ IMEI + □□□□□"35979139461611" + "08" = "3597913946161108"
- □□□□□□□□□□□□□ EIR □□
- □□□□□□□□□□□□□□□□"whitelist", "blacklist", "greylist"□

□□ 2□IMEI □□□□□□

- □□□ IMEI□"35979139461611"
- □□□□□□□□□□□ EIR □□
- □□□□□□□□□□□□□

□□ 3□IMSI □□□□□□□□ IMSI□□□□□

- □□□□□□□ IMSI□"999999876543210"

- □□□□□□□□□□ EIR □□
- □□□□□□□□□□□□
- □□□□□□□□□□□□□□

□□ **4**□□□□□□□□□□□□□

- □□□□□`eir_unknown_equipment_behaviour`
- □□□
  - `:whitelist` - □□□□□□□□□□
  - `:blacklist` - □□□□□□□□□□
  - `:greylist` - □□□□□□□□□□
  - `:reject_unknown_equipment` - □□□□ 5422□□□□

□□□□

□□□□□□□□□ 1 □ 65535 □□□ `precedence`□□□□□□□□□□□□□

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□□	□□	□□
`"35979139461650"`	□□ IMEI	□□□□□□□/□□□
`"3597913946165.*"`	IMEI □□□□□	□□□/□□□□
`"3597913946161108"`	□□ IMEISV	□□□□□□□□□□□
`"999999876543210"`	IMSI	□□□□□□□□□□
`"359791.*"`	TAC □□□	□□□□□□□□

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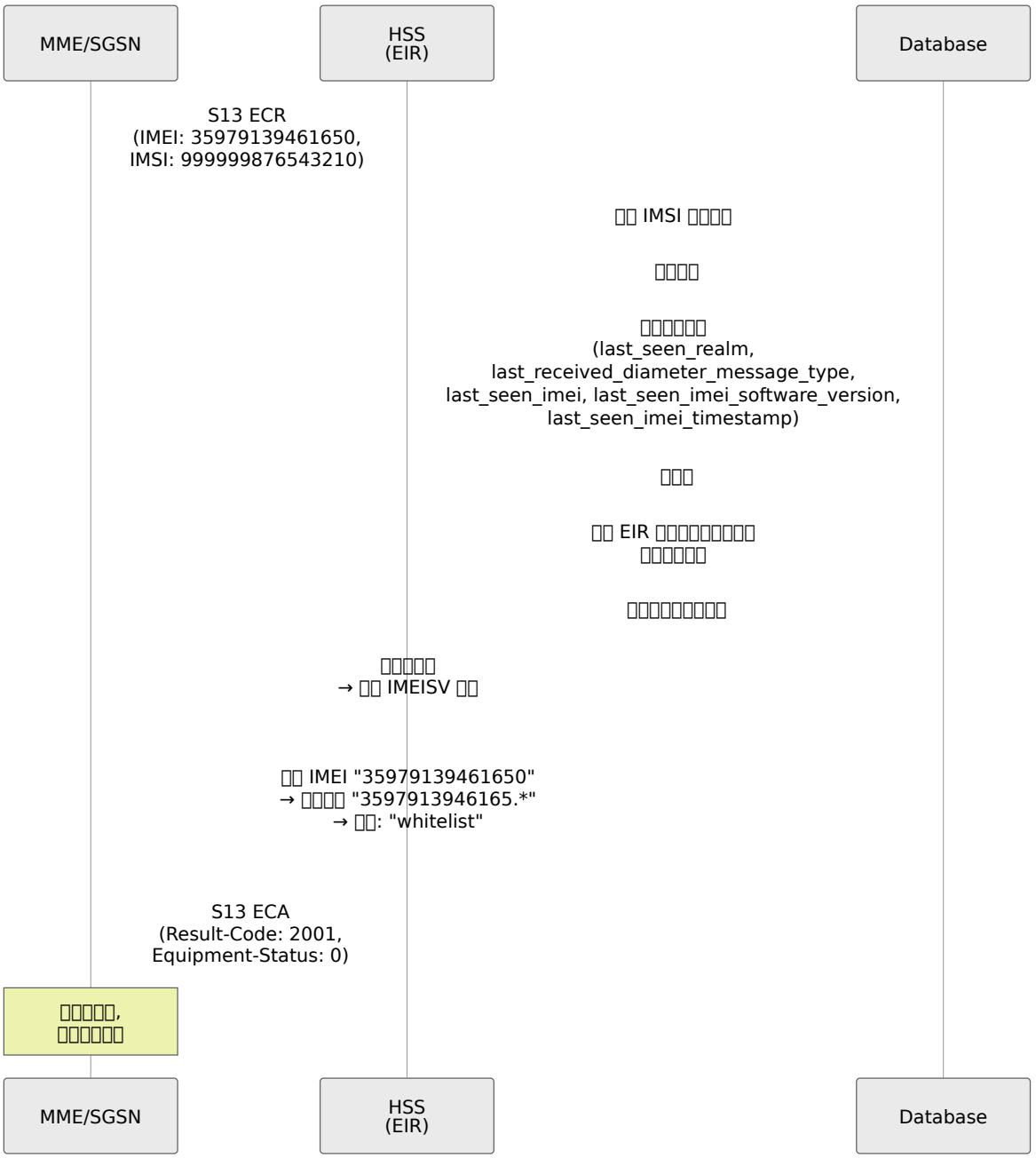
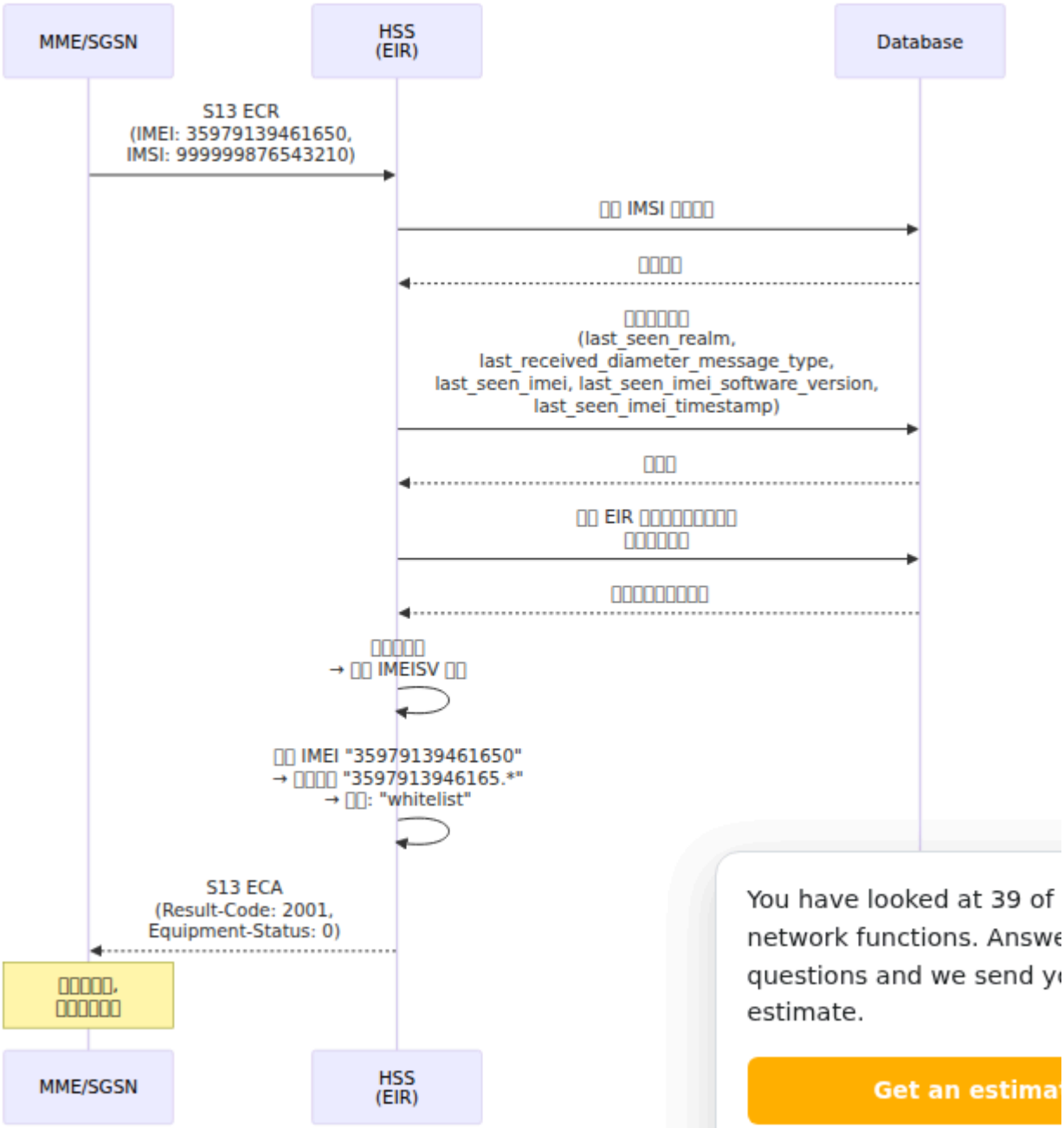
□□□ 1□□□□□ - □□□□□ IMEI

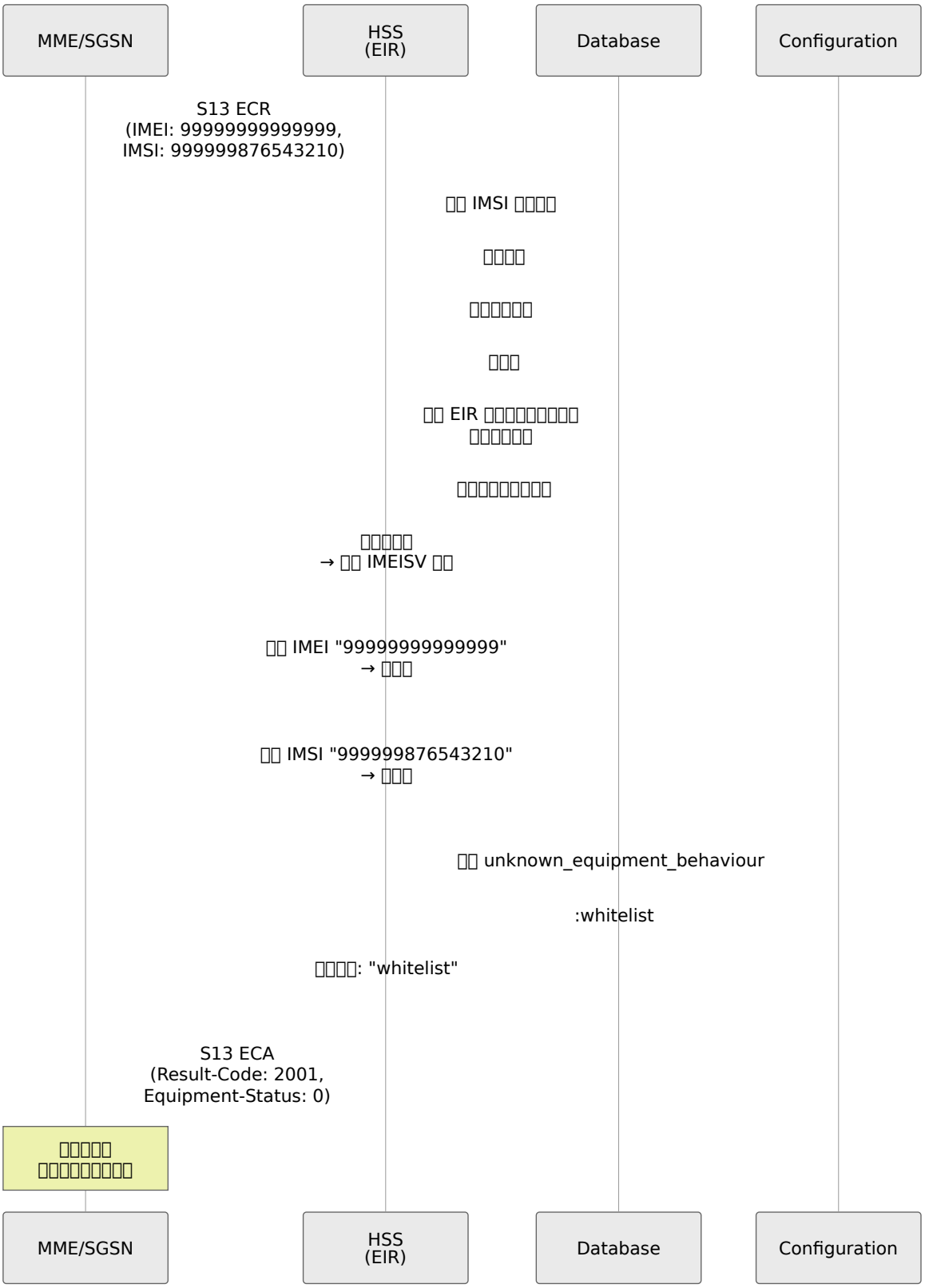

MME/SGSN
HSS
(EIR)
Database
S13 ECR
(IMEI: 35979139461650,
IMSI: 999999876543210)
□□ IMSI □□□□
□□□□
□□□□□□□
(last_seen_realm,
last_received_diameter_message_type,
last_seen_imei, last_seen_imei_software_version,
last_seen_imei_timestamp)
□□□
□□ EIR □□□□□□□□□□
□□□□□□□
□□□□□□□□□□
□□□□□
→ □□ IMEISV □□
□□ IMEI "35979139461650"
→ □□□□ "3597913946165.*"
→ □□: "whitelist"
S13 ECA
(Result-Code: 2001,
Equipment-Status: 0)
□□□□□,
□□□□□□□
MME/SGSN
HSS
(EIR)
Database

□□ 2□□□□□ - □□□ IMEI□□□□□□



You have looked at 39 of
network functions. Answe
questions and we send y
estimate.
Get an estima

□□ 3□□□□□ - □□□□□□□□□□□□


MME/SGSN
HSS
(EIR)
Database
Configuration
S13 ECR
(IMEI: 99999999999999,
IMSI: 999999876543210)
□□ IMSI □□□□
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□□ EIR □□□□□□□□□□
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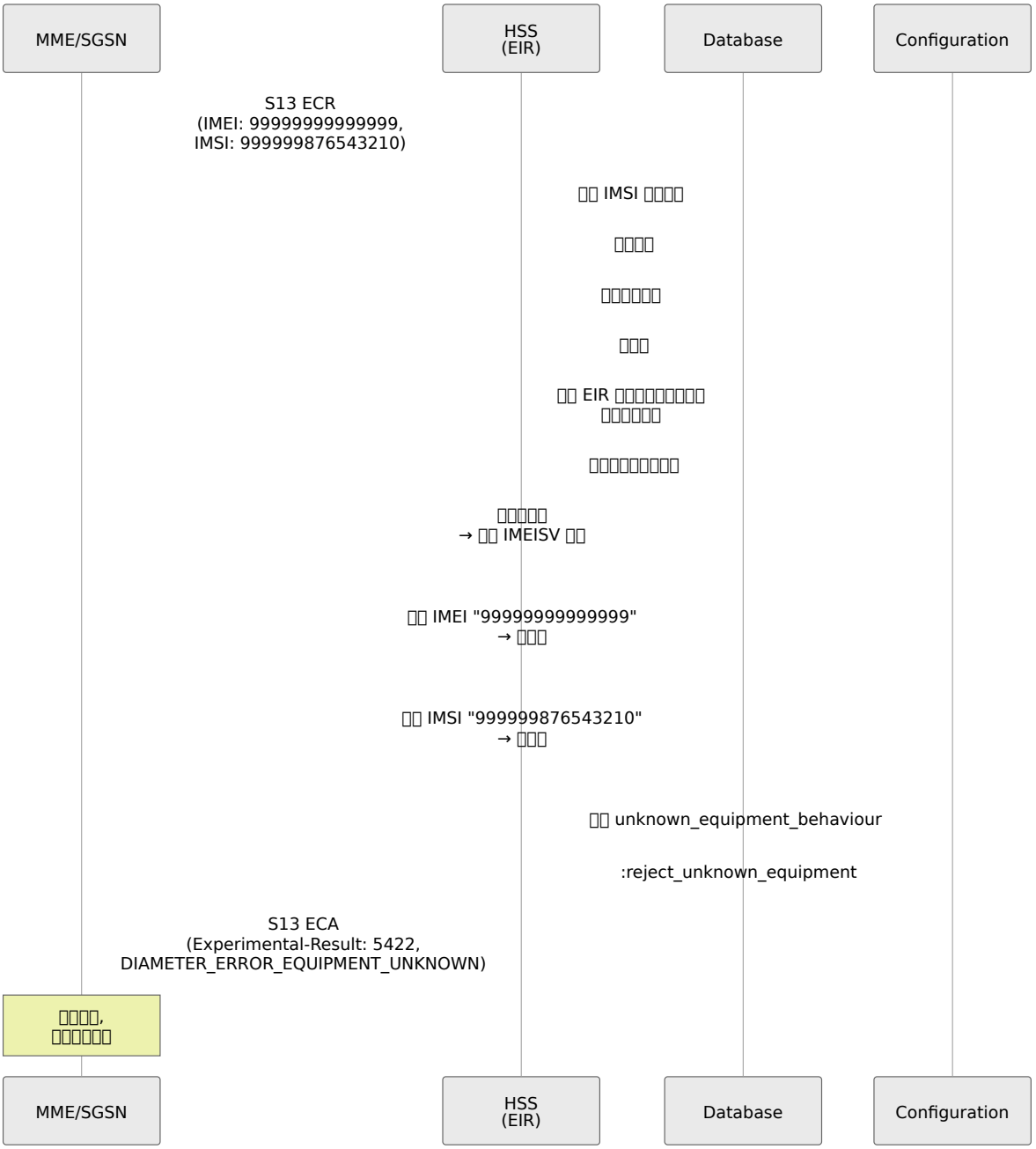
□□□□□
→ □□ IMEISV □□
□□ IMEI "99999999999999"
→ □□□
□□ IMSI "999999876543210"
→ □□□
□□ unknown_equipment_behaviour
:whitelist
□□□□: "whitelist"
S13 ECA
(Result-Code: 2001,
Equipment-Status: 0)
□□□□□
□□□□□□□□□□
MME/SGSN
HSS
(EIR)
Database
Configuration

□□ 4□□□□□ - □□□□□□□□□□


MME/SGSN
HSS
(EIR)
Database
Configuration
S13 ECR
(IMEI: 99999999999999,
IMSI: 999999876543210)
□□ IMSI □□□□
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□□ EIR □□□□□□□□□□
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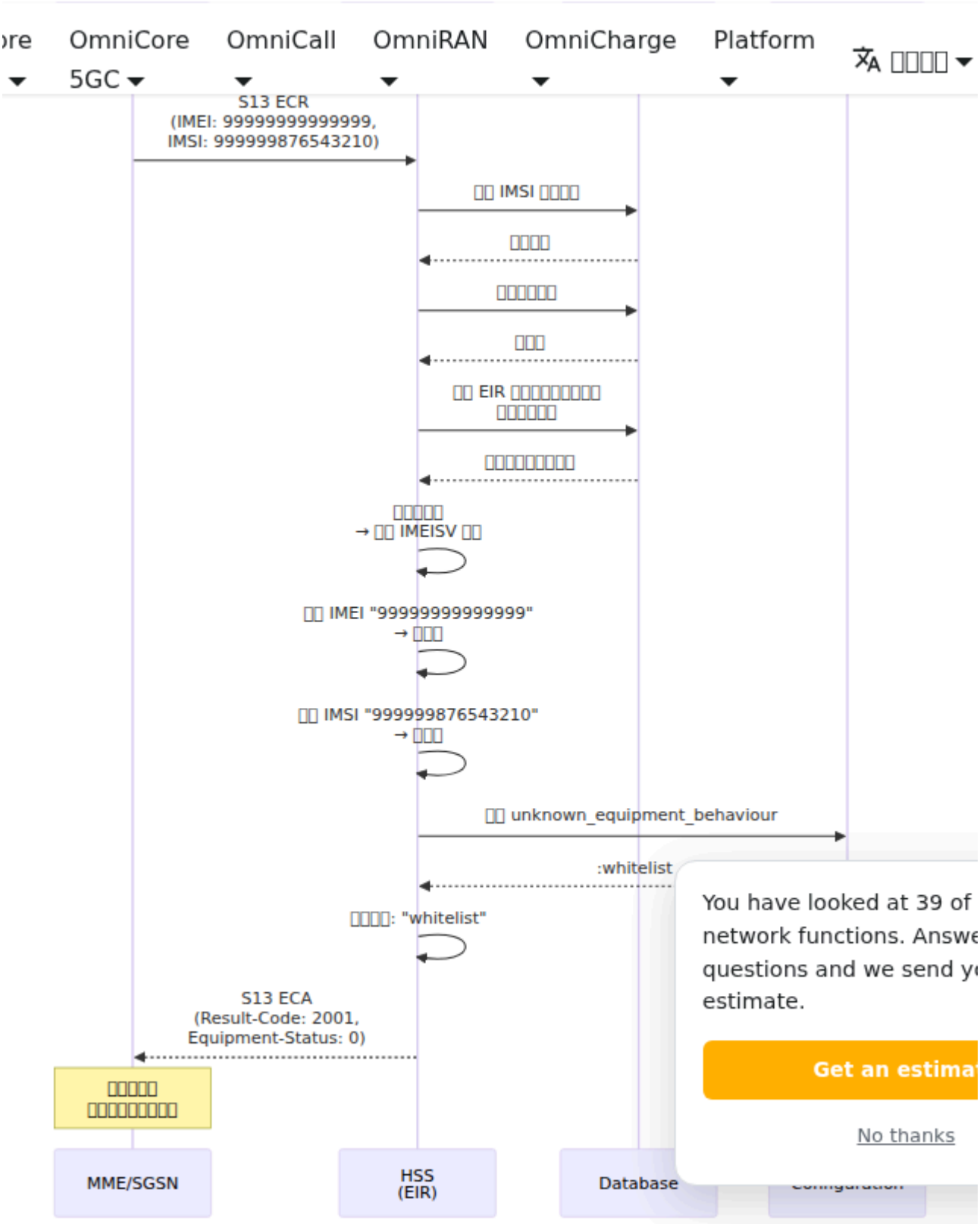
→ □□ IMEISV □□
□□ IMEI "99999999999999"
→ □□□
□□ IMSI "999999876543210"
→ □□□
□□ unknown_equipment_behaviour
:reject_unknown_equipment
S13 ECA
(Experimental-Result: 5422,
DIAMETER_ERROR_EQUIPMENT_UNKNOWN)
□□□□,
□□□□□□□
MME/SGSN
HSS
(EIR)
Database
Configuration

□□ 5□□□□□ - □□□□□□□□


re
OmniCore 5GC
OmniCall
OmniRAN
OmniCharge
Platform
□□□□
S13 ECR
(IMEI: 99999999999999,
IMSI: 999999876543210)
□□ IMSI □□□□
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□□ EIR □□□□□□□□□
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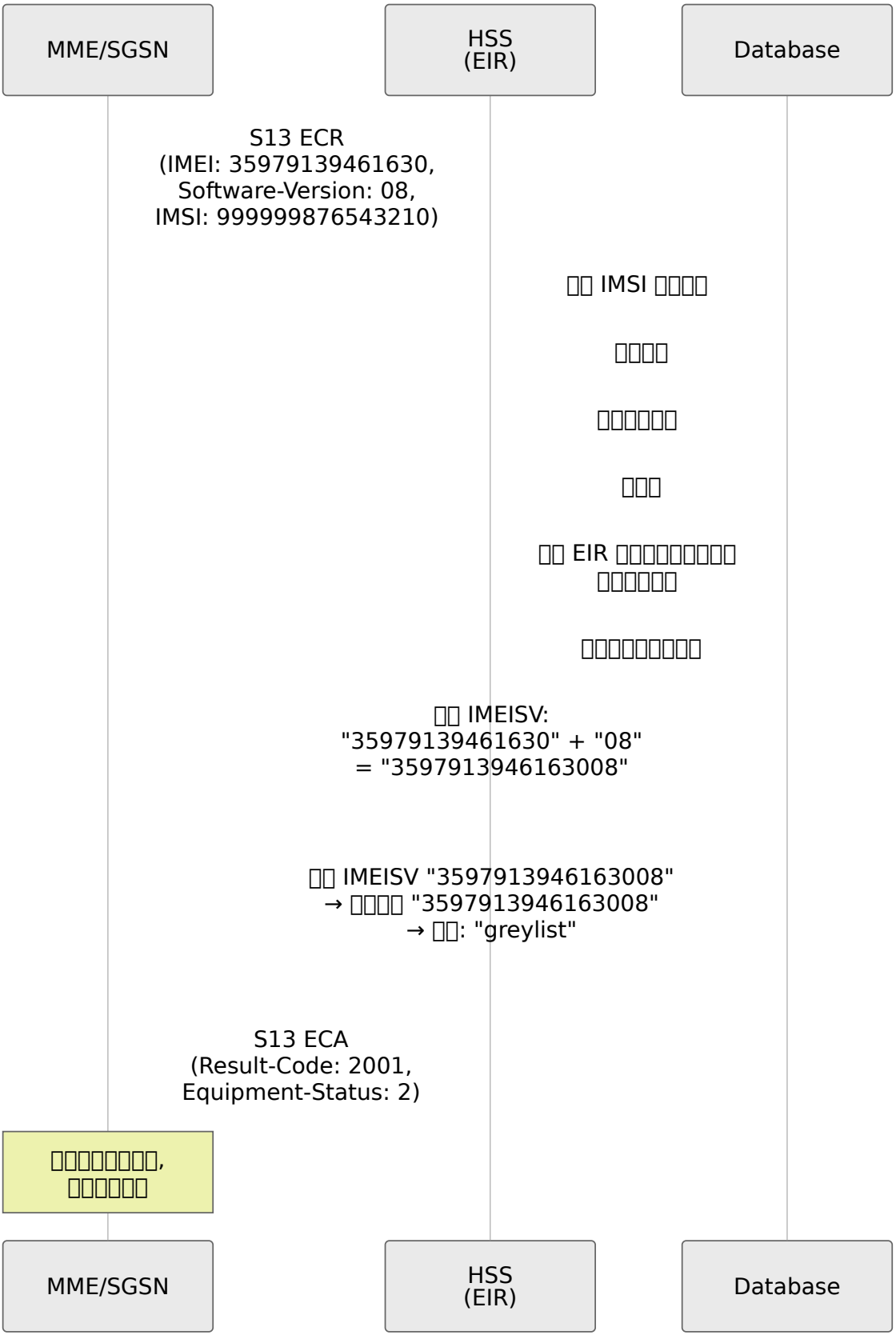
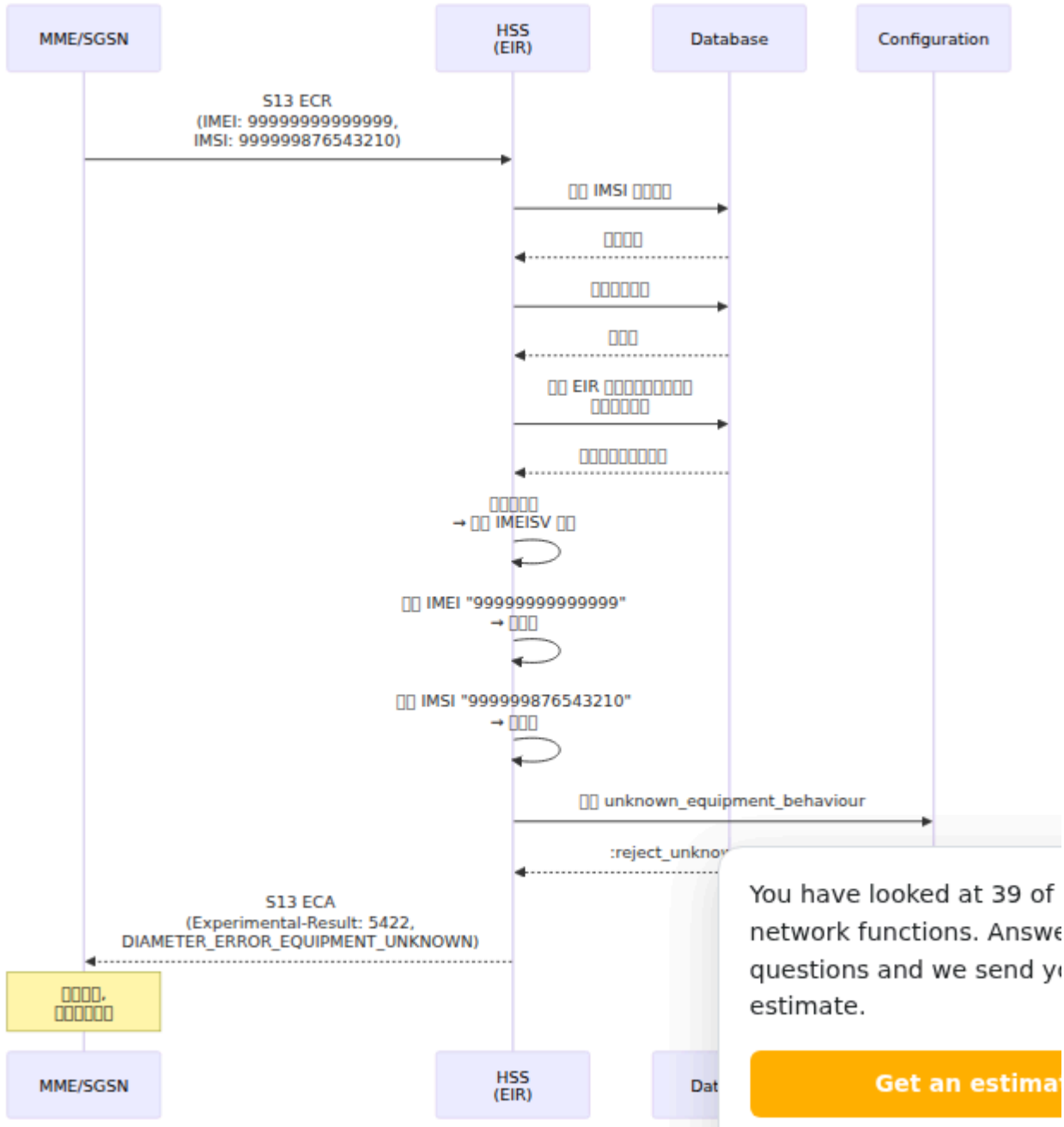
→ □□ IMEISV □□
□□ IMEI "99999999999999"
→ □□□
□□ IMSI "999999876543210"
→ □□□
□□ unknown_equipment_behaviour
:whitelist
□□□□: "whitelist"
S13 ECA
(Result-Code: 2001,
Equipment-Status: 0)
□□□□□
□□□□□□□□□
MME/SGSN
HSS
(EIR)
Database
You have looked at 39 of
network functions. Answe
questions and we send y
estimate.
Get an estima
No thanks

□□ 6□□□□□ - IMEISV □□


MME/SGSN
HSS
(EIR)
Database
S13 ECR
(IMEI: 35979139461630,
Software-Version: 08,
IMSI: 999999876543210)
□□ IMSI □□□□
□□□□
□□□□□□□
□□□
□□ EIR □□□□□□□□□□
□□□□□□□
□□□□□□□□□□□
□□ IMEISV:
"35979139461630" + "08"
= "3597913946163008"
□□ IMEISV "3597913946163008"
→ □□□□ "3597913946163008"
→ □□: "greylist"
S13 ECA
(Result-Code: 2001,
Equipment-Status: 2)
□□□□□□□□□,
□□□□□□□
MME/SGSN
HSS
(EIR)
Database

□□ 7□□□□□ - IMSI □□



REST API

EIR □□□□

□□□□□ `/api/eir/rule`

□□□□□□□□ JSON □□□□□□□□□□□□□□□□□ □□□□□□□□□□□ API □□ □□□□□□□□□□□□□□□□□□ `id`□ `action`□`regex` □ `precedence`□

□□□□ **EIR** □□

□□□

```
GET /api/eir/rule
```

□□□HTTP 200□□

```
{
  "status": "success",
  "response": [
    {
      "id": "e7f6a5b4-c3d2-4e1f-8a9b-0c1d2e3f4a5b",
      "action": "whitelist",
      "regex": "3597913946165.*",
      "precedence": 2
    },
    {
      "id": "f8a7b6c5-d4e3-4f2a-9b0c-1d2e3f4a5b6c",
      "action": "blacklist",
      "regex": "35979139461640",
      "precedence": 1
    }
  ]
}
```

□□□ `id` □□□□□□□□□□□□□□□□ `precedence` □□□□□□□□□□□

□□□□ **EIR** □□

□□□

```
GET /api/eir/rule/{id}
```

□□□HTTP 200□□

```
{
  "status": "success",
  "response": {
    "id": "e7f6a5b4-c3d2-4e1f-8a9b-0c1d2e3f4a5b",
    "action": "whitelist",
    "regex": "3597913946165.*",
    "precedence": 2
  }
}
```

□□ EIR □□

□□□

```
POST /api/eir/rule
Content-Type: application/json

{
  "action": "blacklist",
  "regex": "35979139461640",
  "precedence": 1
}
```

□□□

- `action`□□□□□□□ "whitelist"□"blacklist" □ "greylist"
- `regex`□□□□□□□□□□□□□□□□□□
- `precedence`□□□□□□□ 1 □ 65535□□□□□□□□□□□□□□□□□□

```
{
  "status": "success",
  "response": {
    "id": "0362b7ab-9bd6-4d8a-8b1a-2f4c6e8d0a1c",
    "action": "blacklist",
    "regex": "35979139461640",
    "precedence": 1
  }
}
```

□□□□□HTTP 422□□

```
{
  "status": "error",
  "response": {
    "invalid_fields": {
      "precedence": "must be greater than or equal to 1"
    }
  }
}
```

□□ **EIR** □□□□□□

□□□

```
PATCH /api/eir/rule/{id}
Content-Type: application/json

{
  "action": "greylist"
}
```

□□□HTTP 200□□

```
{
  "status": "success",
  "response": {
    "id": "0362b7ab-9bd6-4d8a-8b1a-2f4c6e8d0a1c",
    "action": "greylist",
    "regex": "35979139461640",
    "precedence": 1
  }
}
```

□□ `precedence` □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□ `precedence` □□□□□□□□□□□□□□□□□□□□□□□□ `null`□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□

□□ EIR □□□PUT□

□□□

```
PUT /api/eir/rule/{id}
Content-Type: application/json

{
  "action": "whitelist",
  "regex": "359791394616.*",
  "precedence": 3
}
```

□□□HTTP 200□□

```
{
  "status": "success",
  "response": {
    "id": "0362b7ab-9bd6-4d8a-8b1a-2f4c6e8d0a1c",
    "action": "whitelist",
    "regex": "359791394616.*",
    "precedence": 3
  }
}
```

PUT □□□□□□□□□□□□□□□□□□ PATCH□□□□□□□□□□□□□□□□□□ id □□ PUT □□□□□□□□□□□□□□ POST □□□□□□□□□□

□□ **EIR** □□

□□□

```
DELETE /api/eir/rule/{id}
```

□□□HTTP 200□□

```
{
  "status": "success",
  "response": ""
}
```

□□

□□

Diameter □□□□

S13 □□□`config/runtime.exs`□□

```
%{
  application_name: :s13,
  application_dictionary: :diameter_gen_3gpp_s13,
  vendor_specific_application_ids: [
    %{vendor_id: 10415, auth_application_id: 16_777_252}
  ]
}
```

□□□□□□

□ `config/runtime.exs` □□□□□□□□□□□□□□□□□□□□□□

□□□

```
config :hss, :eir,
  unknown_equipment_behaviour: :whitelist
```

□□□□

- `:whitelist` - □□□□□□□□□□□□□□□
- `:blacklist` - □□□□□□□□□□□
- `:greylist` - □□□□□□□□□□□
- `:reject_unknown_equipment` - □□ Diameter □□ 5422□□□□

□□□

- □□/□□□`:whitelist` - □□□□□□□
- □□□□□□□□`:whitelist` - □□□□□□□□□□
- □□□□□□□□`:greylist` - □□□□□□□□□□
- □□□□□□□□`:reject_unknown_equipment` - □□□□□□□□

□□□□

□□□□	□□	□□	□□
2001	□□	DIAMETER_SUCCESS	□□□□□□
5422	□□□	DIAMETER_ERROR_EQUIPMENT_UNKNOWN	□□□□□□□□□□□□□□□
5012	□□□	DIAMETER_UNABLE_TO_COMPLY	□□□□

□□

1. □□□□□□

□□□□□□□□□□□□

□□□

```
POST /api/eir/rule
{
  "action": "blacklist",
  "regex": "35979139461640"  # □□ IMEI
}
```

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2. □□□□□□

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```
POST /api/eir/rule
{
  "action": "whitelist",
  "regex": "359791394.*"  # □□□/□□□ TAC
}
```

□□□□□ TAC □□□□□□□□□□□

3. □□□□□□□

□□□□□□□□□□□□□□□□□□□SIM □□

□□□

```
POST /api/eir/rule
{
  "action": "blacklist",
  "regex": "999999876543210"  # IMSI
}
```

□□□□□□□□ SIM □□□□□□□□□□□□

4. □□□□□□□□

□□□□□□□□□□□□□□□□

□□□

```
POST /api/eir/rule
{
  "action": "greylist",
  "regex": "35979139.*"  # □□□□ TAC □□
}
```

□□□□□□□□□□□□□□□□

5. □□□□□□□

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```
POST /api/eir/rule
{
  "action": "blacklist",
  "regex": "359791394616.*05"  # IMEI □□ + □□□□ 05
}
```

□□□□□□□ IMEI □□□□□□□□□ "05" □□□

□□□□

□□□□

EIR □□□□□□□□□□□□□□□□□□

- **S13** □□□□□□ - ECR/ECA □□□□
- □□□□□□□ - □□□□□□□□□ IMEI/IMEISV/IMSI □□□□□□□□□

- □□□□□□ - □□□□□□□□□□□□□□□□□□□□□□□□□□ EIR □□□□□□□□□□□ 1 □ 65535 □□□□□□□□□□□□□□□□□□
- **EIR □□□□□□** - □□□□□□□□□
- **REST API** □□□ - □□□□□□□

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1. **IMEISV □□□□□□** IMEI + □□□□□□□□
2. **IMEI □□□□□□□** IMEI
3. **IMSI □□□□□□** IMSI□□□□□□□
4. □□□□□□□□□□□□□□□□□

□□□□□□□

- `whitelist` - □□□□□□
- `blacklist` - □□□□□□
- `greylist` - □□□□□□□□
- `reject_unknown_equipment` - □□□□

□□□□

IMEI □□

IMEI □□□□□□□□□□EIR□

- □□□□□□□□□□□□□ IMEI □
- □□□□□□□□□□□□□□□□□□□□□□□□□□□□ REST API□`config :api_ex, api: %{auth: %{key: "..."}}`□□□□□□□ `x-api-key` □□□□□□□□ `/api/eir/rule` □□□□□□□□□□□□□□□□□□□□

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□□□□□□□□□□□□□□□ `precedence` □□□□□□□□□□□□□□□□□□□□

```
□□□ 1: regex "35979139461640" action "blacklist"  (□□)
□□□ 2: regex "359791.*" action "whitelist"  (□□)
```

□□□□□□□ `"precedence": 1` □□□□□□□□□□□□□□□□□□□□ 1 □□□□□□□□□□□□□ 2□□□□□□□□□□□□ □□□ □□□□□□□

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- □□□□□□□□□□ S13 ECR □□
- REST API EIR □□□□
- IMEI □□□□□□□□□□□□

□□□□

- Diameter □□ - S13 □□□□
- API □□ - □□□ API □□
- □□ - □□ HSS □□
- □□□□ - □□□□

□□□IMEI □□

IMEI □□□15 □□□□

```
35 9791 394616 1
|  |    |      └─ □□□ (Luhn □□)
|  |    └─ □□□ (6 □□□)
|  └─ FAC (□□□□□□□, 4 □□□)
└─ TAC (□□□□□□□, □□ 8 □□□□□□□ RBI)
   |  └─ RBI (□□□□□□□□, 2 □□□)
   └─ □□□/□□ (6 □□□)
```

IMEISV □□□16 □□□□

```
35 9791 394616 1 08
|  |    |      | └─ □□□□ (2 □□□)
└─ IMEI (15 □□□)
```

□□□□

IMEI/IMEISV	□□	□□
359791394616108	`3597913946161.*`	□□ TAC+FAC+□□□□ 359791394616* □□□
359791394616140	`35979139461614.`	□□□ 359791394616141-9 □□□□ □□
35979139461640	`35979139461640`	□□□ IMEI □□
3597913946163008	`3597913946163008`	□□□ IMEISV□IMEI + SV□□□

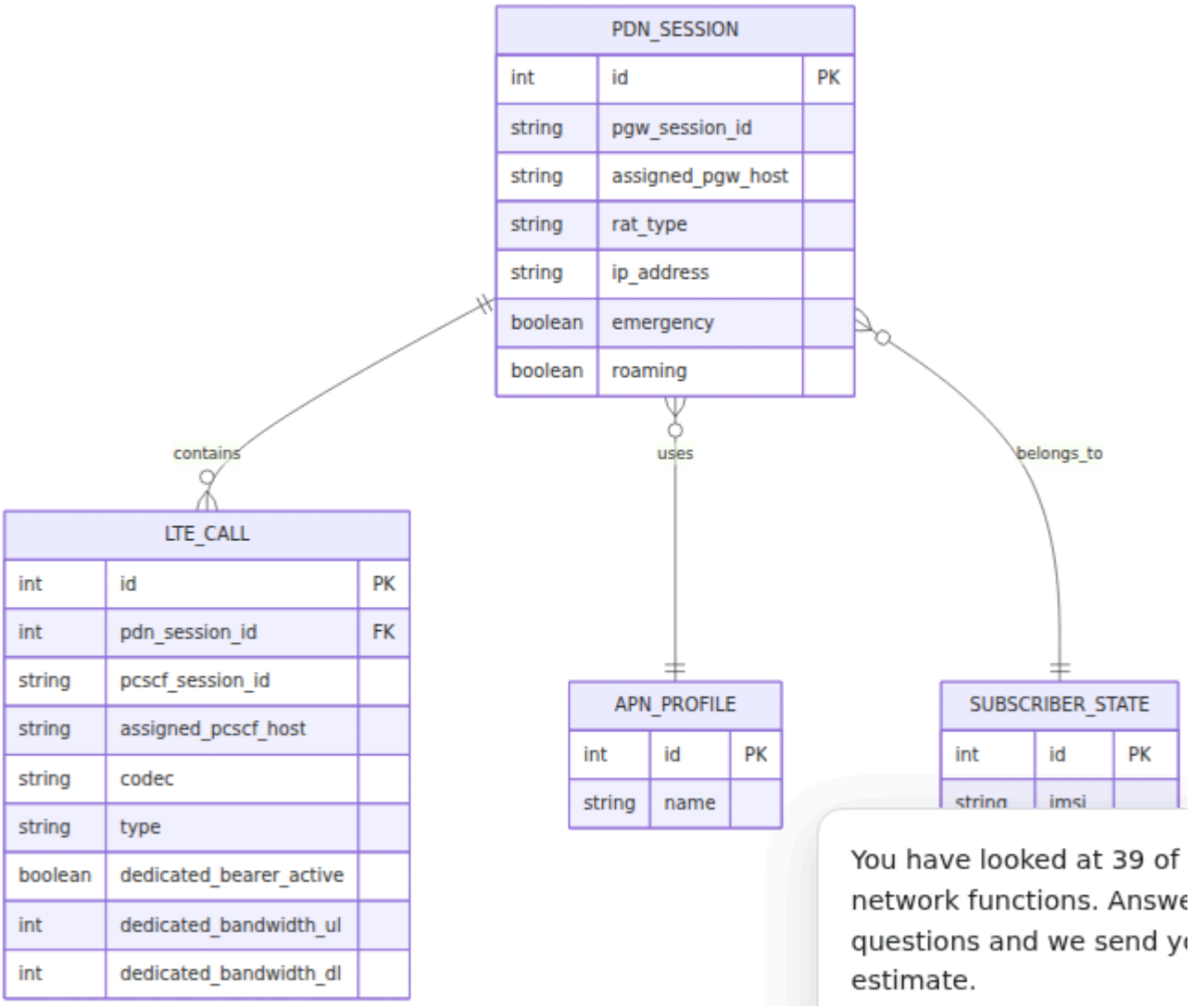
PCRF□□□□□□□□□□□□

□□

HSS □□□□□□ PCRF□□□□□□□□□□□□

□□□□□□

PCRF □□□□ PDN □□□ VoLTE □□□□□□□□



Gx □□

□□□□□

1. □□□□□□ - □□□CCR-I□

□□□PGW □□□□□□□ PDN □□

□□ **AVPs□**

- Session-Id

- Origin-Host, Origin-Realm
- Subscription-Id□□□ IMSI□
- Called-Station-Id□APN □□□
- IP-CAN-Type□IP □□□□□□□□□
- RAT-Type□□□□□□□□
- Framed-IP-Address□□□□□ IP □□□

PCRF □□□

1. □□ IMSI □□□□
2. □□ APN □□□□□ QoS □□
3. □□□□□□□□
4. □ APN □□□□□□ QoS □□

□□ **AVPs**□

- Result-Code: 2001□DIAMETER_SUCCESS□
- QoS-Information□APN □□□□□□□
- Default-EPS-Bearer-QoS□QCI, ARP, □□□□
- Bearer-Control-Mode
- □□/□□□□□□□□□□□□□ - □□ □□□□□/□□□□□

2. □□□□□□ **-** □□□**CCR-U**□

□□□PGW □□□□□□□□□□□□□RAT □□□□

PCRF □□□

1. □□□□ ID □□□□□□
2. □□□□□□□RAT □□□□□□□
3. □□□□□□□□□□□□

□□□Result-Code 2001□□□□□□□□□□

3. □□□□□□ **-** □□□**CCR-T**□

□□□PGW □□ PDN □□

PCRF □□□

1. □□□□ ID □□□□
2. □□□□□□□□□□□□
3. □□□□

□□□Result-Code 2001

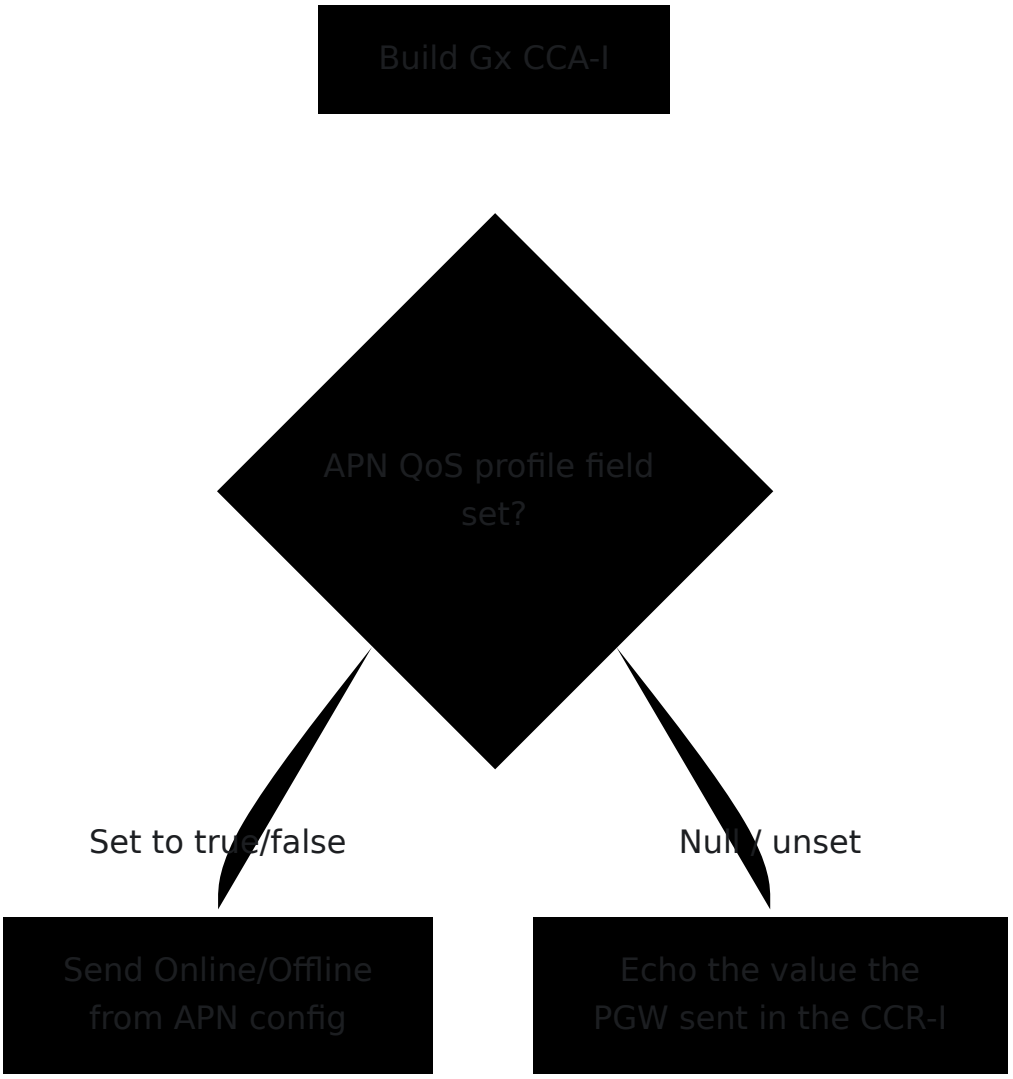
□□□□□/□□□□

□ Gx CCA-I □□□□□ `Online`□AVP 1009□□ `Offline`□AVP 1008□ AVPs □□ □□ **IP-CAN** □□□□□□□□□□□□□□□□□□□□ 3GPP TS 29.212 □□□□□□□□□□□□ `Online`/`Offline` □□□□□□□□□□□□□□□□□□□□

□□□□□□□PCRF □□ PGW/PCEF □ CCR-I □□□□□□□□APN QoS □□□□□□□ □□ □□□□□□□□□□□□□□□□ APN QoS □□□□□□□□□□□□□□□□□□□□

□□	□□	**AVP**	□□
`online_charging_enabled`	□□	`Online` □1009□	`true` → `ENABLE_ONLINE (1)`□`false` → `DISABLE_ONLINE (0)`
`offline_charging_enabled`	□□	`Offline` □1008□	`true` → `ENABLE_OFFLINE (1)`□`false` → `DISABLE_OFFLINE (0)`

□□□□□□□□□□



□□□□ **AVP** □□TS 29.212□□

AVP	□□	□	□□	□□
`Online`	1009	0	DISABLE_ONLINE	□□□□□OCS / Gy□□□□□□□
`Online`	1009	1	ENABLE_ONLINE	□□□□□□ - □□□□□□□□□□□□□
`Offline`	1008	0	DISABLE_OFFLINE	□□□□□CDR / Gz□□□□□□□
`Offline`	1008	1	ENABLE_OFFLINE	□□□□□□ - □□□□□□□□□

□□□□□□ `online_charging_enabled`/`offline_charging_enabled` □□□□□□□□□□□□□□□□□□□□□□□□□□ - PCRF □□ PGW □□□□□□□□□□□□□□□□□□□□

□□□□□□□□ APN □□□□□□□□□□□ PGW □□□□ OCS□□□□□□□□□□□□□□□□□/□□□ APN □□□□□□□□□□□□ CDR □□□□□□□□□□ APN QoS □□□□□□□□□□□□□□□□□□□□□□□□□□□ APN□

> □□□□□□□□ *□□□□□□*□□□□□□□□□□□□ □□□□ □□ `online_charging_enabled`/`offline_charging_enabled` □□□□□□□□□□□□□□ Charging-Rule-Definition AVPs □□

4. □□□□□□□□RAR□

□□□PCRF → PGW□HSS □□□

□□□

- IMS □□□□□Rx AAR □□ Gx RAR□
- IMS □□□□□Rx STR □□ Gx RAR□
- □□ REST API □□□□□□

RAR AVPs□

- Session-Id□PGW □□ ID□
- Auth-Application-Id: 16,777,238
- Re-Auth-Request-Type□0 = □□□□
- Charging-Rule-Install/Remove
- QoS-Information□□□□□□□□

PGW □□□□□□□□□□□□/□□/□□□□□□

□□□□□□□□□□

PCRF □□□□□□□□□□□TFT□□□□□□□□□□□□□

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- □□□□□□□□□ Gx RAR □□□□

- □□□□□□□□□□□□□□□□□□□□□□□□□□□□
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- □□□□□ - □□□□□□□□□□□□□□□□□□□□
- □□ **SLA** - □□□□□□□□□□ QoS

QoS □□□□

□□□□ **QoS**□□□ APN □□□□□□□

```
{
  "QoS-Class-Identifier": 9,          // QCI□9 = □□□□□
  "APN-Aggregate-Max-Bitrate-UL": 50000,  // kbps
  "APN-Aggregate-Max-Bitrate-DL": 100000, // kbps
  "Allocation-Retention-Priority": {
    "Priority-Level": 8,
    "Pre-emption-Capability": 1,      // □□□□
    "Pre-emption-Vulnerability": 1    // □□□□□
  }
}
```

□□□□ **QoS**□□□ VoLTE□□

```
{
  "QoS-Class-Identifier": 1,          // QCI 1 = □□□□
  "Max-Requested-Bandwidth-UL": 128000,   // bps
  "Max-Requested-Bandwidth-DL": 128000,   // bps
  "Guaranteed-Bitrate-UL": 128000,
  "Guaranteed-Bitrate-DL": 128000
}
```

Rx □□

□□□□□

1. AA □□□AAR□/ AA □□□AAA□

□□□P-CSCF □□ IMS □□□□□□□□□VoLTE □□□□□

□□ **AVPs**□

- Session-Id□P-CSCF □□□□□□
- Subscription-Id□IMSI □ SIP URI□
- □□□□□□
  - □□□□□□□□□□□□
  - Max-Requested-Bandwidth-UL/DL
  - Codec-Data
  - Flow-Description□5 □□□□□□□□□
- AF-Application-Identifier

PCRF □□□

1. □□ IMSI □ SIP URI □□□
2. □□□□ IMS □□
3. □□□□□□□□□□□□□□□□□□□□□□
4. □□□□□□□□
5. □□ **Gx RAR** □ **PGW** □□□□□□
6. □□ Gx RAA □□
7. □□ Rx AAA □□□□□

□□ **AVPs**□

- Result-Code: 2001□□□□□ 5063□□□□□□□

□□□SOS□□□□□□□□□/□ SIM □□□□□

□□□□□`urn:service:sos`□□□□□□□□□□□□□□□□ SIM □□□□□□□□□□□□□□□□□□□□

PCRF □□□□□□□□□□ AAR□

1. □□□□□□□□ □□ `Subscription-Id` □□□ `sos` □ SIP URI□□ AAR □ `Framed-IP-Address` □□□□□□ Gx CCR-I □□□□□□ PDN □□□Gx □□□ APN / `Called-Station-Id` □□ `sos` □□□□□□□□□□□□□□□□ □□ □□ INVITE□□□□□□□□□□□□□□□□□
2. □□□□□□□□ `Subscription-Id` □□□□□□□□ `Framed-IP-Address` □□□□□□ □□ **PDN**□□ Gx □□□□□□□□□□□□□□□`subscriber_state_id: nil`□□AAR □□□□□□□□□□□□□□□□□□□□□
3. **SOS APN** □□□□□□□□□□ QoS □ SOS APN □□□□□□□□□□□□“□□□□□ SOS APN □□□□”□□
4. Gx RAR □□□□□□PDN □□□□□□□□□□□QCI 1□□AAA □□ `2001`□

> □□□□□□□ `Framed-IP-Address` □□□ Gx □□ □□□□ □□□ PDN □□□□□□□□□□□□□□□ UE □ □□□□□□□□□ P-CSCF □□□□□□□□□□□□□□ AAR □□ PCRF□□

□□□□ **SOS APN** □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□ `sos` APN □□□□□□PCRF □ SOS APN □□□□□□□□□

- □□□□□□□□□□□□□□□ APN □□□□□□□ APN □□□□□ `sos`□□□
- □ OmniHSS □□□ □□□□□ SOS APN □□□□□□

□□□□□□□□□□□□□□□□□□□

□□□□□□□□□□ PCRF □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□ `sos` APN □□□□ - □□□□□□□□□□□□□□□□□□□□

2. □□□□□□□□STR□/ □□□□□□□□STA□

□□□P-CSCF □□ IMS □□□□□□□□□

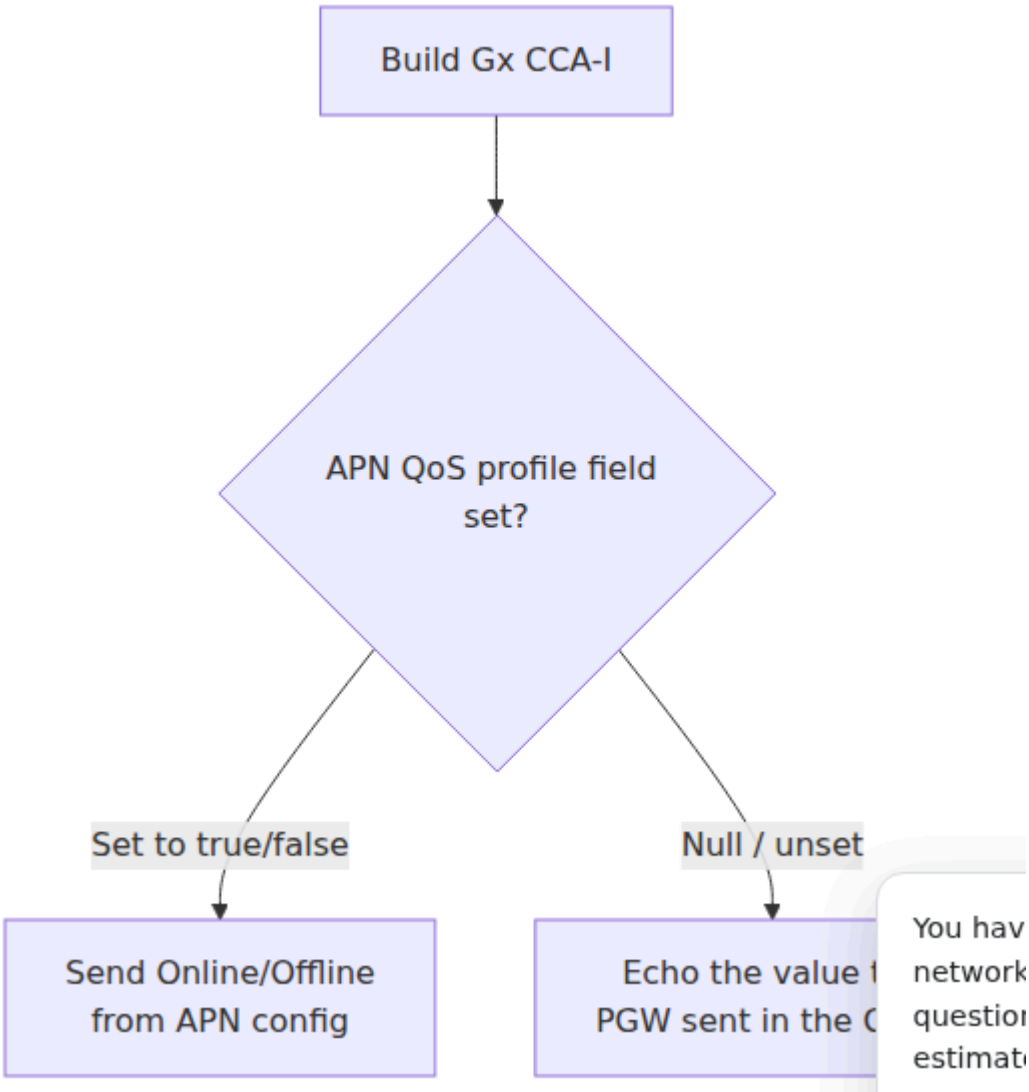
PCRF □□□

1. □□ P-CSCF □□ ID □□□□□□□
2. □□ **Gx RAR** □ **PGW** □□□□□□□
3. □□□□□□□□□
4. □□ STA □□

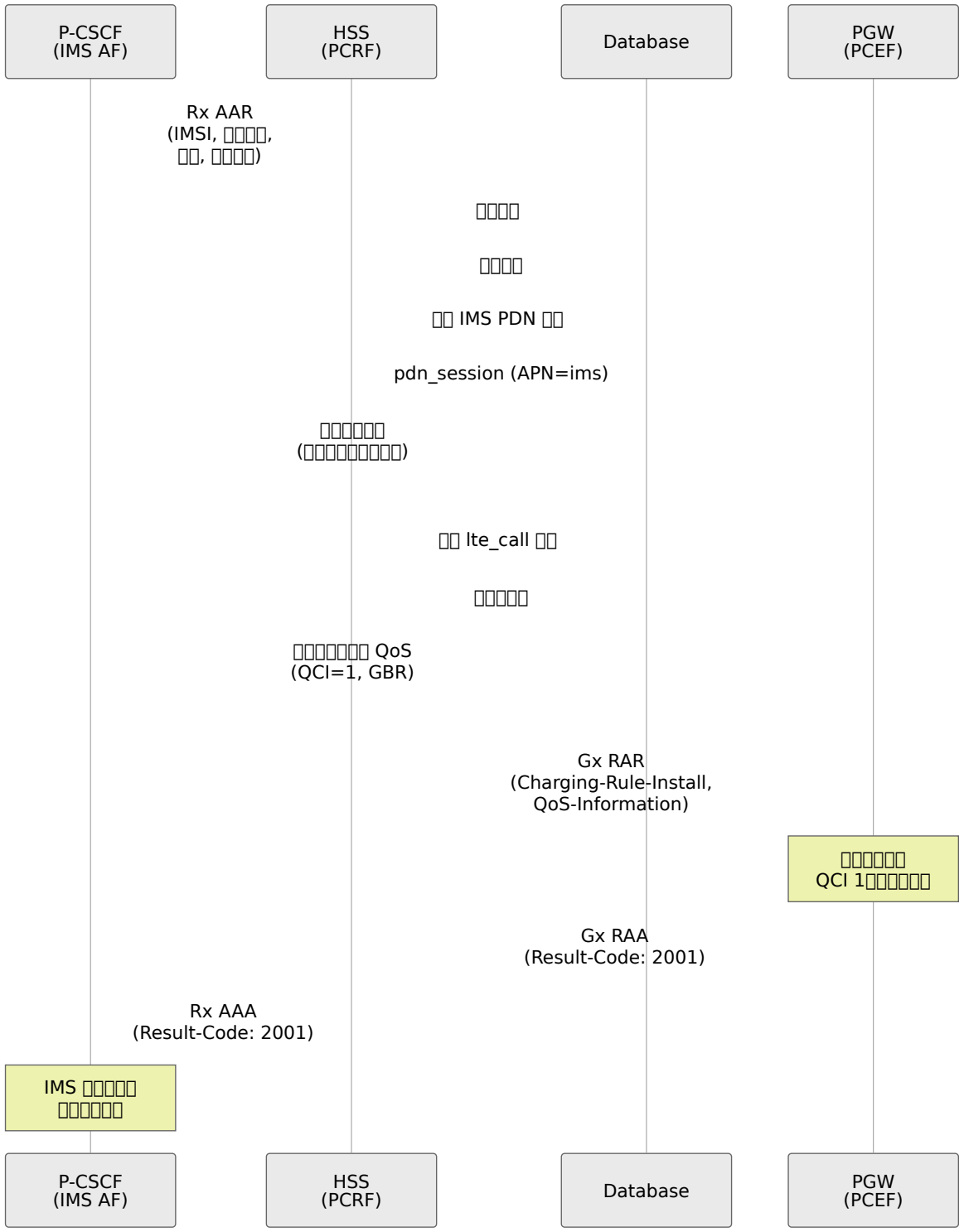
□□□Result-Code 2001

□□□□□

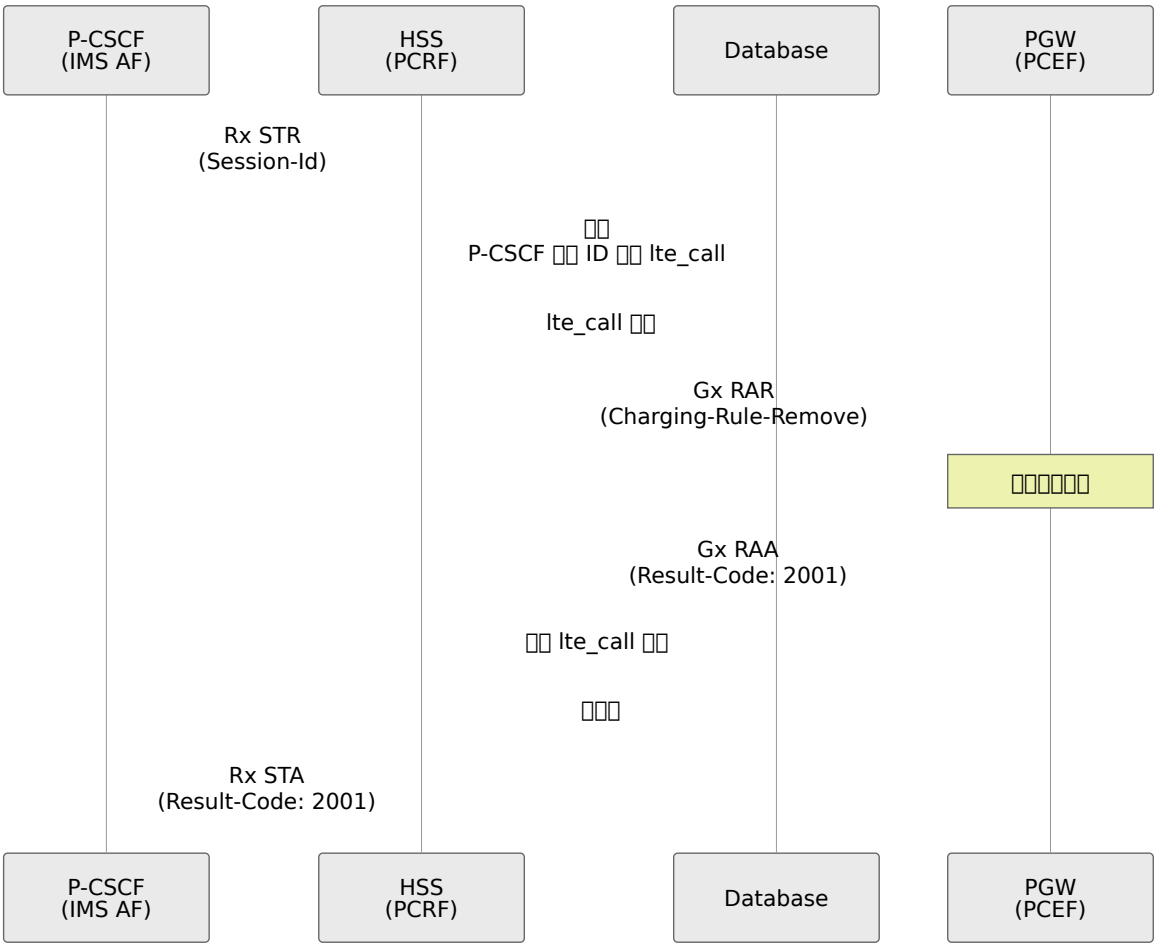
□□ 1□PDN □□□□


Build Gx CCA-I
APN QoS profile field set?
Set to true/false
Null / unset
Send Online/Offline from APN config
Echo the value
PGW sent in the
You hav
network
questio
estimat

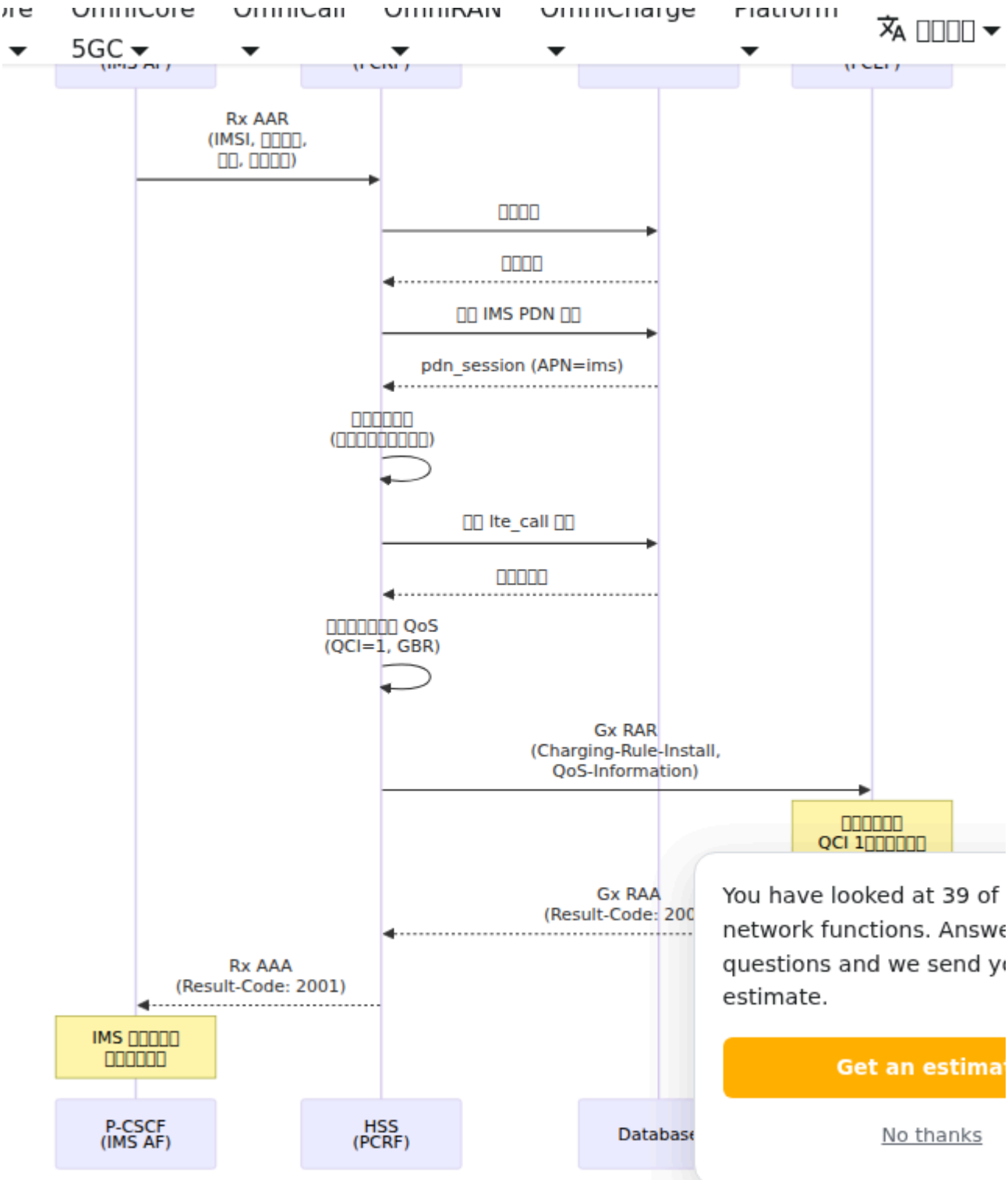
□□ 2□VoLTE □□□□□Rx AAR → Gx RAR□



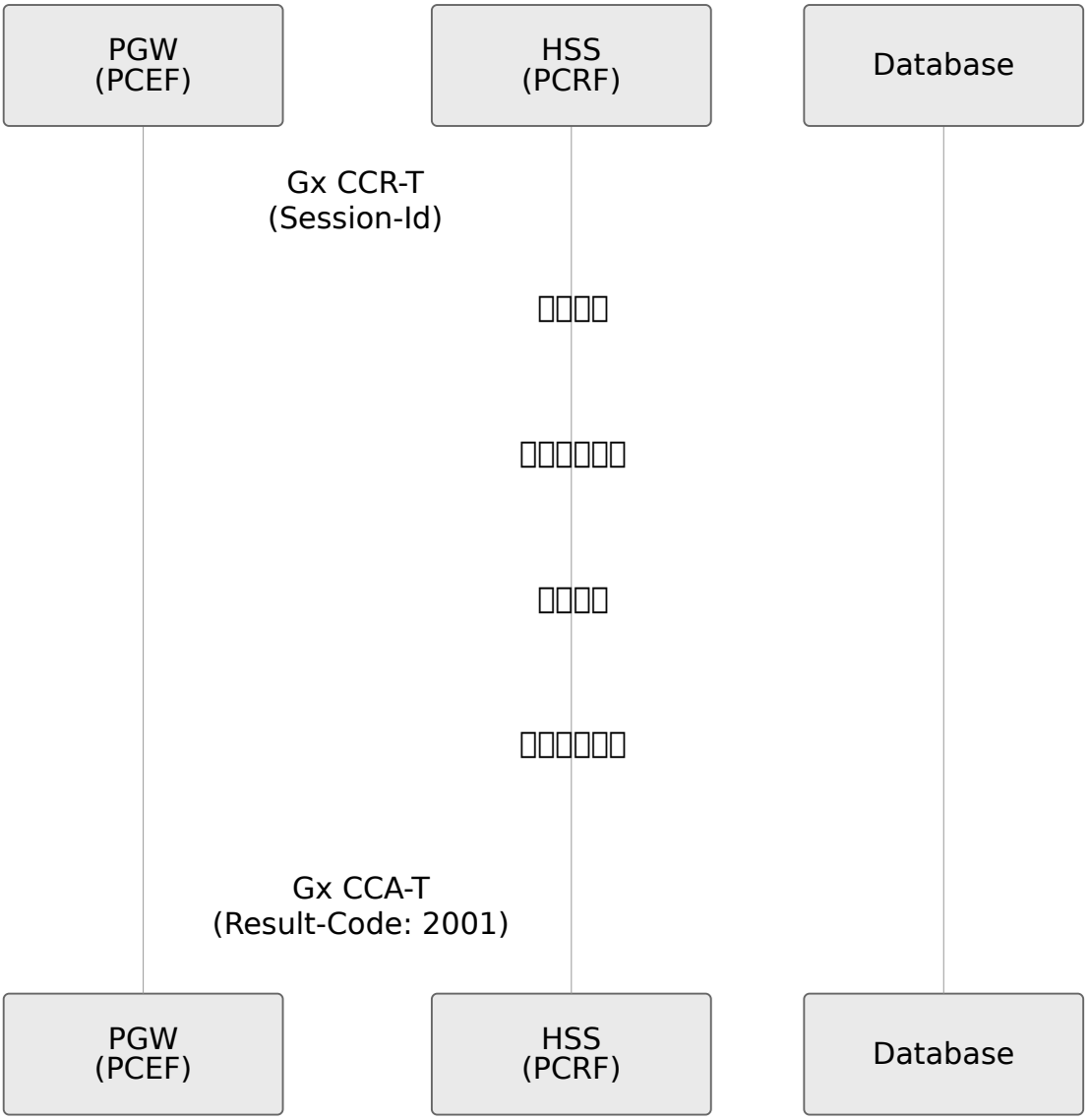
□□ 3□VoLTE □□□□□Rx STR → Gx RAR□



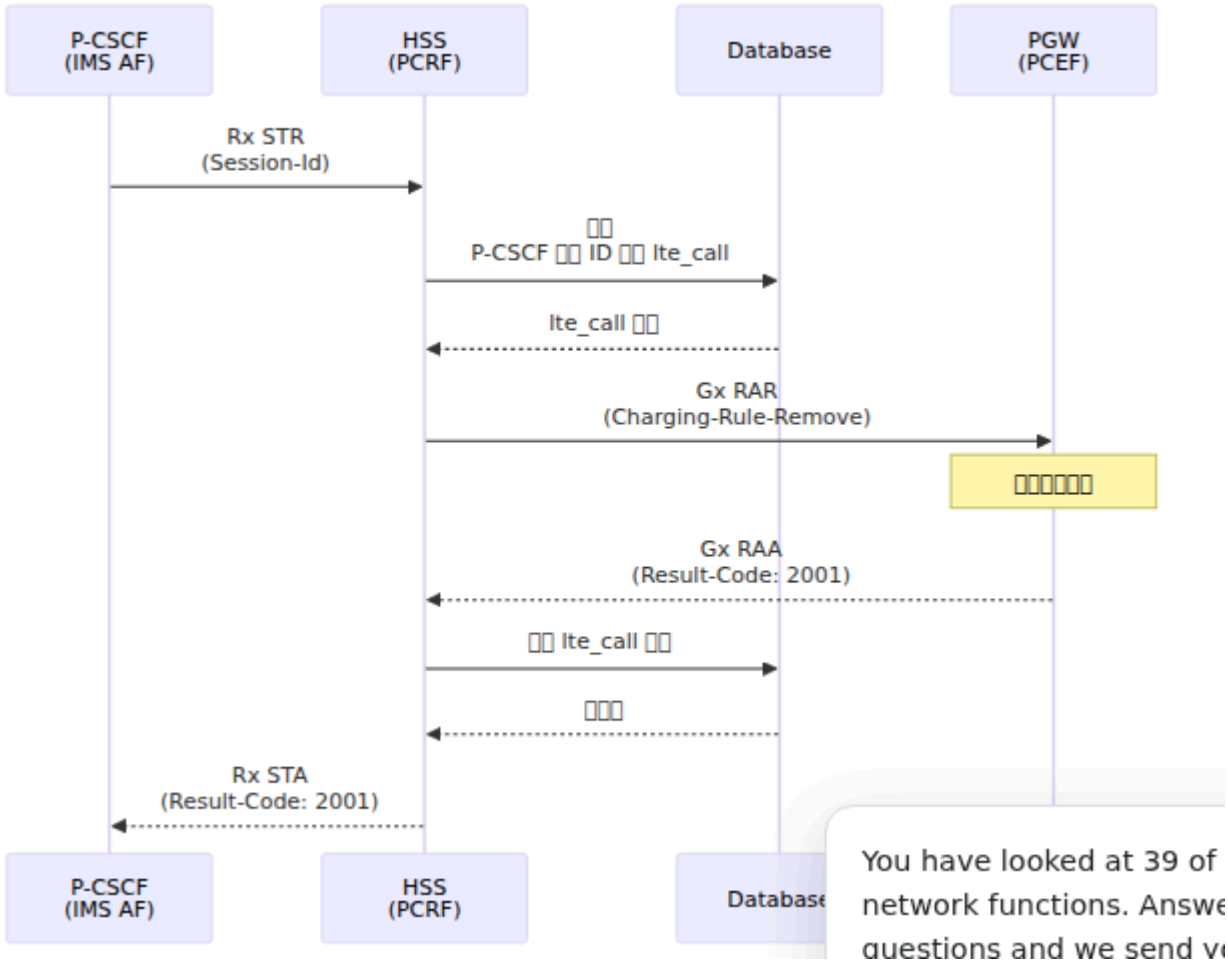
□□ 4□PDN □□□□


OmniCore
OmniCall
OmniRAN
OmniCharge
Platform
5GC
□□□□
Rx AAR
(IMSI, □□□□,
□□, □□□□)
□□□□
□□□□
□□ IMS PDN □□
pdn_session (APN=ims)
□□□□□□□
(□□□□□□□□□□)
□□ lte_call □□
□□□□□□
□□□□□□□ QoS
(QCI=1, GBR)
Gx RAR
(Charging-Rule-Install,
QoS-Information)
□□□□□□□
QCI 1□□□□□□□
Gx RAA
(Result-Code: 200
Rx AAA
(Result-Code: 2001)
IMS □□□□□□
□□□□□□□
P-CSCF
(IMS AF)
HSS
(PCRF)
Database
You have looked at 39 of
network functions. Answe
questions and we send y
estimate.
Get an estima
No thanks

□□ 5□PDN □□□□


PGW
(PCEF)
HSS
(PCRF)
Database
Gx CCR-T
(Session-Id)
□□□□
□□□□□□□
□□□□
□□□□□□□
Gx CCA-T
(Result-Code: 2001)
PGW
(PCEF)
HSS
(PCRF)
Database

□□ 6□□□ REST API □□□□□□□



REST API

PCRF □□□□□□

□□□`POST /api/operation/pcrf_re_auth`

□□□□□□□ Gx □□□□□□□□□□□

□□□□□□□□□□

```
{
  "imsi": "999999876543210",
  "apn": "ims"
}
```

□□□□□HTTP 200□□

```
{
  "data": "Gx □□□□□□□□□□□ pgw.epc.mnc999.mcc999.3gppnetwork.org□
Result-Code: 2001"
}
```

□□□□□HTTP 400□□

```
{
  "error": "□□□□ 999999876543210 □□□□□□□□□□□□□□□ PDN □□"
}
```

□□□□ API

PCRF □□□□□□□□□ APN □□□□□ QoS □□□□□□□□□□□ REST API □□□□□□

□□□□□□□□□□□ APN QoS □□□□□□□□□□□□□□□ QCI□□□□□□□□□□□□□□ APN □□□ PDN □□□ PGW □□ Gx □□□□□□□RAR□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□

□□□□

□□□□□□□□□□□□

```
APN □□□ → APN QoS □□□□ → APN □□□□
    ↓                  ↓                ↓
  "internet"      QCI, AMBR, ARP    □□□□□□□□
```

1. □□ APN □□□

□□ APN □□□ IP □□□□□

□□□`POST /api/apn/identifier`

□□□□

```
{
  "apn_identifier": {
    "apn": "internet",
    "ip_version": "ipv4v6"
  }
}
```

IP □□□□□

- `"ipv4"` - □ IPv4
- `"ipv6"` - □ IPv6
- `"ipv4v6"` - □□□IPv4 □ IPv6□
- `"ipv4_or_ipv6"` - □□□□□IPv4 □ IPv6□

□□□HTTP 201□□

```
{
  "data": {
    "id": "4fa85f64-5717-4562-b3fc-2c963f66afa6",
    "apn": "internet",
    "ip_version": "ipv4v6"
  }
}
```

□□□

- `apn`□□□□1-254 □□□□□□
- `ip_version`□□□□□□□□□□□□□□□□

□□ **APN** □□□□`GET /api/apn/identifier`

2. □□ APN QoS □□□□

□□ QoS □□□□□□QCI□□□□□□

□□□`POST /api/apn/qos_profile`

□□□□

```
{
  "apn_qos_profile": {
    "name": "□□□□□□□□",
    "qci": 9,
    "allocation_retention_priority": 8,
    "apn_ambr_dl_kbps": 100000,
    "apn_ambr_ul_kbps": 50000,
    "pre_emption_capability": false,
    "pre_emption_vulnerability": true,
    "online_charging_enabled": false,
    "offline_charging_enabled": true
  }
}
```

QoS □□□

□□	□□	□□	□□
`name`	□□□	1-254 □□□	□□□□□□□□□□□
`qci`	□□	1-254	QoS □□□□□1-4 = GBR□5-9 = □ GBR□
`allocation_retention_priority`	□□	1-15	ARP □□□1 = □□□□□□
`apn_ambr_dl_kbps`	□□	1-4,294,967,293	APN □□□□□□□□□ □kbps□
`apn_ambr_ul_kbps`	□□	1-4,294,967,293	APN □□□□□□□□□ □kbps□
`pre_emption_capability`	□□	true/false	□□□□□□□□□□□□
`pre_emption_vulnerability`	□□	true/false	□□□□□□□□□□□□□
`online_charging_enabled`	□□	true/false/null	□□□ `Online` AVP □□ Gx CCA-I□ `null`□□□□□□ PGW □ CCR-I □□□ □ □□□□□/□□□□
`offline_charging_enabled`	□□	true/false/null	□□□ `Offline` AVP □□ Gx CCA-I□ `null`□□□□□□ PGW □ CCR-I □□□ □ □□□□□/□□□□

□□ **QCI** □□

- `1` - □□□□□VoLTE□ - GBR□100ms □□□□
- `2` - □□□□ - GBR□150ms □□□□
- `5` - IMS □□ - □ GBR□100ms □□□□
- `9` - □□□□□□□□□ - □ GBR□300ms □□□□

□□□HTTP 201□□

```
{
  "data": {
    "id": "8d8ac610-566d-4ef0-9c22-186b2a5ed793",
    "name": "□□□□□□□□",
    "qci": 9,
    "allocation_retention_priority": 8,
    "apn_ambr_dl_kbps": 100000,
    "apn_ambr_ul_kbps": 50000,
    "pre_emption_capability": false,
    "pre_emption_vulnerability": true,
    "online_charging_enabled": false,
    "offline_charging_enabled": true
  }
}
```

□□ **QoS** □□□□□`GET /api/apn/qos_profile`

3. □□ **APN** □□□□

□ APN □□□□ QoS □□□□□□□

□□□`POST /api/apn/profile`

□□□□

```
{
  "apn_profile": {
    "name": "□□□ APN",
    "apn_identifier_id": "4fa85f64-5717-4562-b3fc-2c963f66afa6",
    "apn_qos_profile_id": "8d8ac610-566d-4ef0-9c22-186b2a5ed793"
  }
}
```

□□□

- `name`□□□□□□□□□□□□□□□□□□
- `apn_identifier_id`□□□ □□ APN □□□ □ ID
- `apn_qos_profile_id`□□□ □□ APN QoS □□□□ □ ID

□□□HTTP 201□□

```
{
  "data": {
    "id": "a1b2c3d4-e5f6-4a3b-8c2d-1e0f9a8b7c6d",
    "name": "□□□ APN",
    "apn_identifier_id": "4fa85f64-5717-4562-b3fc-2c963f66afa6",
    "apn_qos_profile_id": "8d8ac610-566d-4ef0-9c22-186b2a5ed793"
  }
}
```

□□□

- `apn_identifier_id` □ `apn_qos_profile_id` □□□□□□□□
- □□ APN □□□□ QoS □□□□□□□□□□□□□□

□□ **APN** □□□□□`GET /api/apn/profile`

□□□□□□□□

□□ **1**□□□ **IMS APN** □□□**VoLTE**□

```
# 1. □□ APN □□□
curl -X POST https://hss.example.com:8443/api/apn/identifier \
  -H "Content-Type: application/json" \
  -d '{
    "apn_identifier": {
      "apn": "ims",
      "ip_version": "ipv4v6"
    }
  }'
# □□□{"data": {"id": "2c3e4f5a-6b7c-4d8e-9f0a-1b2c3d4e5f6a", ...}}

# 2. □□ QoS □□□□□IMS □□□
curl -X POST https://hss.example.com:8443/api/apn/qos_profile \
  -H "Content-Type: application/json" \
  -d '{
    "apn_qos_profile": {
      "name": "IMS □□ QoS",
      "qci": 5,
      "allocation_retention_priority": 2,
      "apn_ambr_dl_kbps": 5000,
      "apn_ambr_ul_kbps": 5000,
      "pre_emption_capability": true,
      "pre_emption_vulnerability": false
    }
  }'
# □□□{"data": {"id": "7b44a3e0-27cc-4b21-8d7a-3f19e5c2b8d4", ...}}

# 3. □□ APN □□□□
curl -X POST https://hss.example.com:8443/api/apn/profile \
  -H "Content-Type: application/json" \
  -d '{
    "apn_profile": {
      "name": "IMS APN",
      "apn_identifier_id": "2c3e4f5a-6b7c-4d8e-9f0a-1b2c3d4e5f6a",
      "apn_qos_profile_id": "7b44a3e0-27cc-4b21-8d7a-3f19e5c2b8d4"
    }
  }'
# □□□{"data": {"id": "91c2f3a4-5d6e-4f7a-8b9c-0d1e2f3a4b5c", ...}}
```

□□ **2**□□□□□□

□□□□APN □□□□□□□ EPC □□□□□□□□□□□□□□□ API □□ □□□ APN □□□□□□□□□

□□□□□□□□

□□ **QoS** □□□□□

```
PATCH /api/apn/qos_profile/{id}
PUT /api/apn/qos_profile/{id}
```

□□ **-** □□□□□□□□□□□

```
# □□ QoS □□□□□□□□□
curl -X PATCH
https://hss.example.com:8443/api/apn/qos_profile/8d8ac610-566d-
4ef0-9c22-186b2a5ed793 \
  -H "Content-Type: application/json" \
  -d '{
    "apn_qos_profile": {
      "apn_ambr_dl_kbps": 150000,
      "apn_ambr_ul_kbps": 75000
    }
  }'
```

□□□□□□□□

1. □□□□□ QoS □□□□□□
2. □□□□□□□□□ QoS □□□□□□□ APN □□□ PDN □□
3. □□□□□□□□□□□□□ PGW □□ Gx RAR
4. PGW □□□□ QoS □□□□□□□□□
5. □□□□□□□□□□□□□□□□□□

□□□□□□□ 100 □□□□□□□□□□□ QoS □□□□□“□□□” APN □□□□ API □□□□□□□□□□□□□ 100 □ □□□□□□□□□□□ 150 Mbps □□/75 Mbps □□□

□□□□□□□ APN QoS □□□□□□□□ □□□□□□□□□□□□□□□□□ APN □□□ PDN □□□□□□□□□□□□□□□□ □□□

□□□□□

```
DELETE /api/apn/identifier/{id}
DELETE /api/apn/qos_profile/{id}
DELETE /api/apn/profile/{id}
```

□□□□□

- □□□□□ APN □□□□□□□ APN □□□□ QoS □□□□
- □□□□□□□□□□□□ APN □□□□

□□□□

□□□□□□□□ 100 Mbps / □□ 50 Mbps□□

```
{
  "apn_qos_profile": {
    "name": "□□□□□",
    "qci": 9,
    "allocation_retention_priority": 8,
    "apn_ambr_dl_kbps": 100000,
    "apn_ambr_ul_kbps": 50000,
    "pre_emption_capability": false,
    "pre_emption_vulnerability": true
  }
}
```

□□□□□□□□ 500 Mbps / □□ 100 Mbps□□

```
{
  "apn_qos_profile": {
    "name": "□□□□□",
    "qci": 8,
    "allocation_retention_priority": 5,
    "apn_ambr_dl_kbps": 500000,
    "apn_ambr_ul_kbps": 100000,
    "pre_emption_capability": true,
    "pre_emption_vulnerability": false
  }
}
```

□□□/M2M□□□□□□

```
{
  "apn_qos_profile": {
    "name": "□□□ M2M",
    "qci": 9,
    "allocation_retention_priority": 10,
    "apn_ambr_dl_kbps": 1024,
    "apn_ambr_ul_kbps": 512,
    "pre_emption_capability": false,
    "pre_emption_vulnerability": true
  }
}
```

□□□□□□□□□□□□□

```
{
  "apn_qos_profile": {
    "name": "□□ APN",
    "qci": 5,
    "allocation_retention_priority": 1,
    "apn_ambr_dl_kbps": 10000,
    "apn_ambr_ul_kbps": 10000,
    "pre_emption_capability": true,
    "pre_emption_vulnerability": false
  }
}
```

□□

Diameter □□□□

Gx □□□`config/runtime.exs`**□□**

```
%{
  application_name: :gx,
  application_dictionary: :diameter_gen_3gpp_gx,
  vendor_specific_application_ids: [
    %{vendor_id: 10415, auth_application_id: 16_777_238}
  ]
}
```

Rx □□□`config/runtime.exs`□□

```
%{
  application_name: :rx,
  application_dictionary: :diameter_gen_3gpp_rx,
  vendor_specific_application_ids: [
    %{vendor_id: 10415, auth_application_id: 16_777_236}
  ]
}
```

QoS □□

QoS □□□□□□

- □□□□□□□□□□ APN □□□□
  - `apn_qos_profile.qci`□QoS □□□□□
  - `apn_qos_profile.apn_ambr_ul_kbps`□□□□□□□□□□□
  - `apn_qos_profile.apn_ambr_dl_kbps`□□□□□□□□□□□
  - `apn_qos_profile.priority_level`□□□□□□□□□
- □□□□□□ Rx AAR □□□□□□□□□
  - QCI□1□□□□□□
  - □□□□□□□□ Max-Requested-Bandwidth AVPs
  - □□□□□□□ Flow-Description AVPs

□□□□

□□□□□	□□	□□	□□
2001	□□	DIAMETER_SUCCESS	□□□□□□□
5001	□□□	□□□□□□	IMSI □□□□□□□□□□
5002	□□□	□□□□□□	PDN □□□□□□□□□□□□/□□
5063	□□□	□□□□□□	IMS □□□□□□□□

□□□□

□□□□

PCRF □□□

- □□ **PDN** □□ - □□ APN □□□□□□□
- **VoLTE** □□ - □□ IMS □□□□□□□□□□□□□□□□□
- **QoS** □□ - □□ APN □□□□□□□
- □□□□ - □□□□□□□□□□□□□□

□□□□□□

PCRF □□□□□□□□□□□□□□

- □□ Gx □□□ □□□□□□□/□□
- □□□□□□□**TFT**□□□ □□□□□□□□
- □□□□□□□□□□□□□□□□□□
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- Sy □□ - □□□□ OCS □□□□□□□□□□
- Diameter □□ - □□□□□□□□
- API □□ - □□□ API □□
- □□ - □□ HSS □□
- □□□□ - □□□□ Diameter AVP □□□

API □□□□

← □□ API □□

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- □□□□□□□
- □□□□□□□

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400 □□□□

```
{
  "error": "Invalid JSON format"
}
```

□□□

- JSON □□□□
- □□□□□□□
- □□□□□□□

404 □□□

```
{
  "error": "Resource not found"
}
```

□□□

- □□□/□□□□/□□□□□
- URL □□ ID □□□

422 □□□□□□□

```
{
  "errors": {
    "imsi": ["has already been taken"],
    "key_set_id": ["does not exist"]
  }
}
```

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- □□□□
- □□□□□□□□
- □□□□□□□

500 □□□□□□□

```
{
  "error": "Internal server error"
}
```

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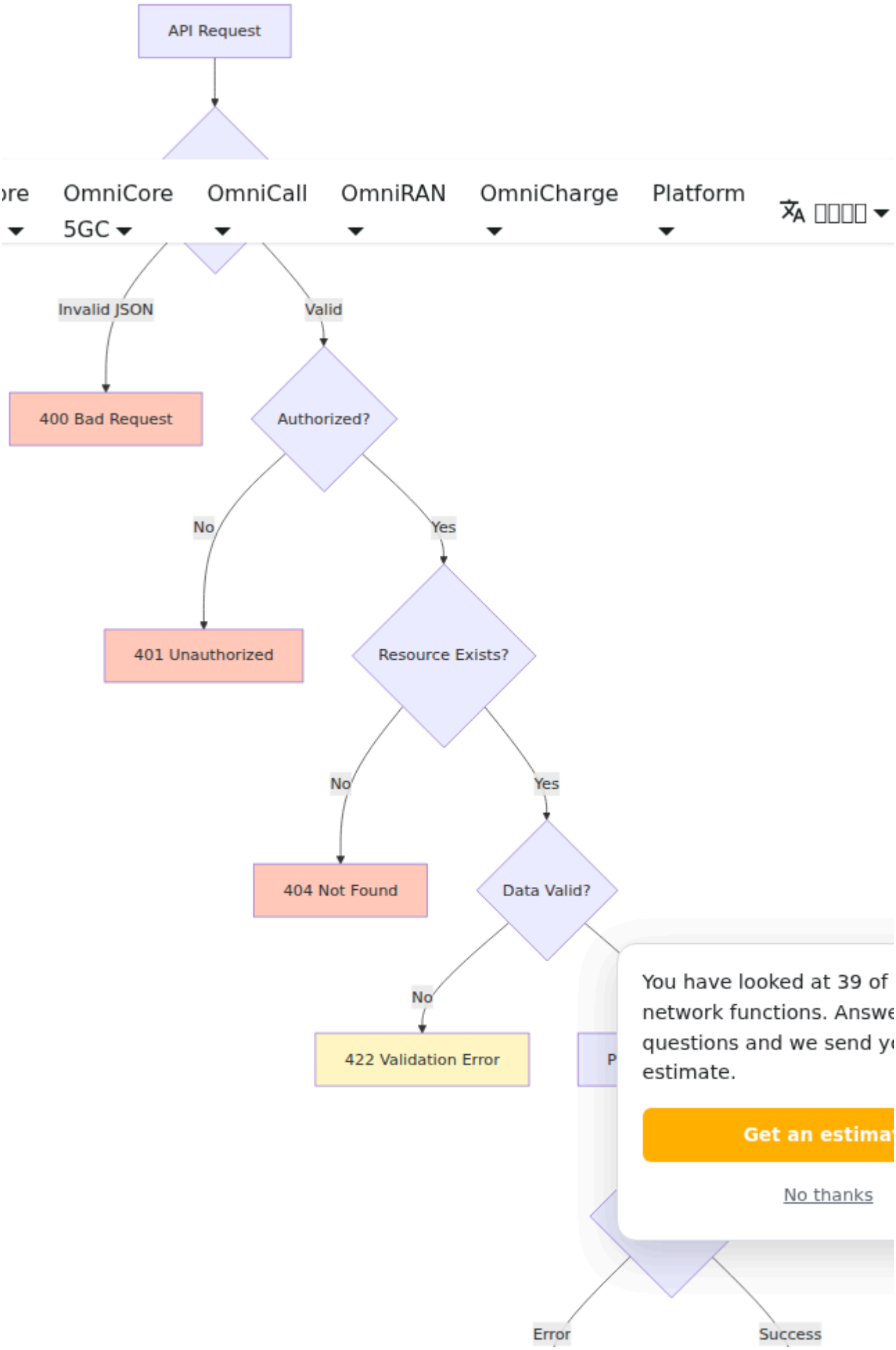
- □□□□□□□
- □□□□□□□□□


API Request
ore
OmniCore 5GC
OmniCall
OmniRAN
OmniCharge
Platform
Invalid JSON
Valid
400 Bad Request
Authorized?
No
Yes
401 Unauthorized
Resource Exists?
No
Yes
404 Not Found
Data Valid?
No
422 Validation Error
You have looked at 39 of
network functions. Answe
questions and we send y
estimate.
Get an estima
No thanks
Error
Success



← □□ API □□

API □□□□

← □□ API □□

□□

- □□□□□□□□
- □□□□□□□□
- □□□□□ IP □□

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□□□□□□□

```
# 1. □□□□□□
KEY_SET_ID=$(curl -k -X POST
https://hss.example.com:8443/api/key_set \
  -H "Content-Type: application/json" \
  -d '{
    "ki": "0123456789ABCDEF0123456789ABCDEF",
    "opc": "FEDCBA9876543210FEDCBA9876543210",
    "authentication_algorithm": "milenage",
    "amf": "8000",
    "sqn": 0
  }' | jq -r '.response.id')

# 2. □□ APN QoS □□□□
APN_QOS_ID=$(curl -k -X POST
https://hss.example.com:8443/api/apn/qos_profile \
  -H "Content-Type: application/json" \
  -d '{
    "name": "□□□□□ QoS",
    "allocation_retention_priority": 8,
    "apn_ambr_dl_kbps": 50000,
    "apn_ambr_ul_kbps": 25000,
    "pre_emption_capability": true,
    "pre_emption_vulnerability": true,
    "qci": 9
  }' | jq -r '.response.id')

# 3. □□ APN □□□
APN_ID=$(curl -k -X POST
https://hss.example.com:8443/api/apn/identifier \
  -H "Content-Type: application/json" \
  -d '{
    "apn": "internet",
    "ip_version": "ipv4v6"
  }' | jq -r '.response.id')

# 4. □□ APN □□□□
APN_PROFILE_ID=$(curl -k -X POST
https://hss.example.com:8443/api/apn/profile \
  -H "Content-Type: application/json" \
  -d "{
    \"apn_identifier_id\": \"$APN_ID\",
    \"apn_qos_profile_id\": \"$APN_QOS_ID\",
    \"name\": \"□□□ APN\"
```

```
  }" | jq -r '.response.id')

# 5. □□ EPC □□□□□
EPC_PROFILE_ID=$(curl -k -X POST
https://hss.example.com:8443/api/epc/profile \
  -H "Content-Type: application/json" \
  -d "{
    \"apn_profiles\": [$APN_PROFILE_ID],
    \"name\": \"□□□□□□□\",
    \"network_access_mode\": \"packet_only\",
    \"tracking_area_update_interval_seconds\": 600,
    \"ue_ambr_dl_kbps\": 100000,
    \"ue_ambr_ul_kbps\": 50000
  }" | jq -r '.response.id')

# 6. □□□□□
SUBSCRIBER_ID=$(curl -k -X POST
https://hss.example.com:8443/api/subscriber \
  -H "Content-Type: application/json" \
  -d "{
    \"imsi\": \"001001123456789\",
    \"key_set_id\": \"$KEY_SET_ID\",
    \"epc_profile_id\": \"$EPC_PROFILE_ID\"
  }" | jq -r '.response.id')

echo "□□□□□□□□ID: $SUBSCRIBER_ID"
```

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1. □□□□□ (□□□) - □□□□□□□
2. □□□□□□□□□□ (EPC □□□□□) - □□□□□□□□□□□
3. **APN** □□ (APN □□□□□) - □ QoS □□□□□
4. □□□□□ (□□) - □□□□□□□□□

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- □□□□□□□□□□□□ MSISDN □□
- □□□□□□□□□□□□□□ IMS □□□□□
- □□□□□□□□□□□□ □□□□□□□

- □□□□ SIM□□□□□□ SIM

□□□

- □ MSISDN □□ - □□□□□□□□
- □□□□□□ - □□□□□□□□

□□□□□□□

□□□□□□□□ SIM □□□□□□□□□

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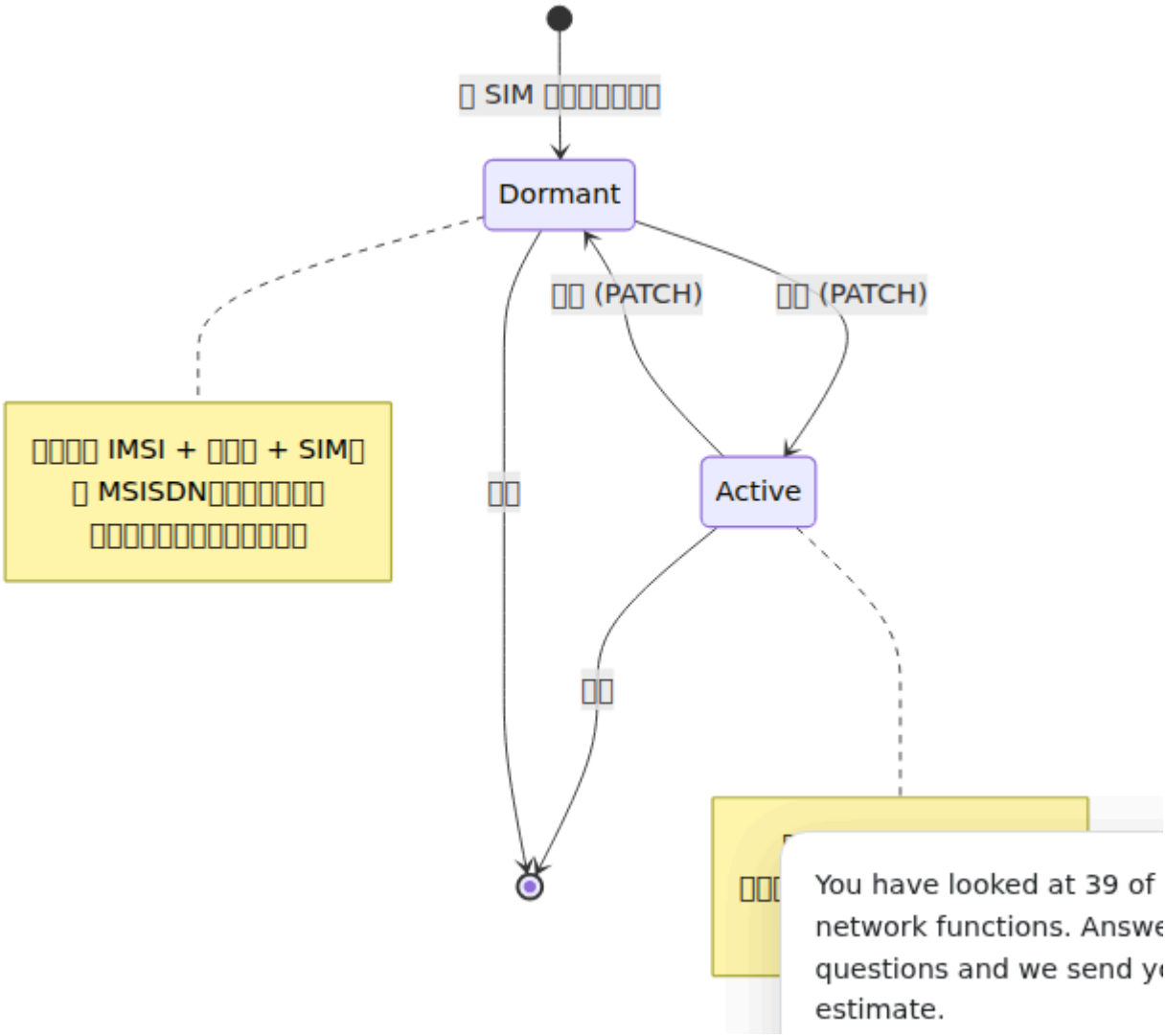

□ 1 □□□□□□□□ SIM□□□□□□□□□□□□

□ SIM □□□□□□□□□□□□□□□□□□□□□□□□ SIM □□□□□□□□□□□□□□□□ `jq` □□□□□□□□□□□□□□□□□□

```
# 1. □ SIM □□□□□□□□□□□ (Ki, OPc)
KEY_SET_ID=$(curl -k -X POST
https://hss.example.com:8443/api/key_set \
  -H "Content-Type: application/json" \
  -d '{
    "ki": "0123456789ABCDEF0123456789ABCDEF",
    "opc": "FEDCBA9876543210FEDCBA9876543210",
    "authentication_algorithm": "milenage",
    "amf": "8000",
    "sqn": 0
  }' | jq -r '.response.id')

# 2. □ SIM □□□□□□□ SIM (ICCID, PIN/PUK/ADM)
SIM_ID=$(curl -k -X POST https://hss.example.com:8443/api/sim \
  -H "Content-Type: application/json" \
  -d '{
    "iccid": "8944000000000000001",
    "is_esim": false,
    "ind_length": 5
  }' | jq -r '.response.id')

# 3. □□□□□□□□□□
#    imsi □ key_set_id □□□□□□□ SIM□□□□ MSISDN □□□□□□□
SUBSCRIBER_ID=$(curl -k -X POST
https://hss.example.com:8443/api/subscriber \
  -H "Content-Type: application/json" \
  -d "{
    \"imsi\": \"001010000000001\",
    \"key_set_id\": \"$KEY_SET_ID\",
    \"sim_id\": \"$SIM_ID\",
    \"enabled\": false,
    \"ims_enabled\": false
  }" | jq -r '.response.id')
```

□□□□□□□□□□

```
curl -k -X PATCH
https://hss.example.com:8443/api/subscriber/$SUBSCRIBER_ID \
  -H "Content-Type: application/json" \
  -d "{
    \"enabled\": true,
    \"ims_enabled\": true,
    \"msisdns\": [\"$MSISDN_ID\"],
    \"epc_profile_id\": \"$EPC_PROFILE_ID\",
    \"ims_profile_id\": \"$IMS_PROFILE_ID\",
    \"roaming_profile_id\": \"$ROAMING_PROFILE_ID\"
  }"
```

`PATCH` □□□□□□□□□□□□□□IMSI□□□□□ SIM □□□□□□□□□ MSISDN □□□□□□□□□□□□□□□□□□□□ □ □□□□□□ □□□□□□□□□□□□□

□ 3 □□□□□□□□□□

□□□□□□□ `enabled` □□□ `false`□□□□□□□□□□□□□□□□□□

```
curl -k -X PATCH
https://hss.example.com:8443/api/subscriber/$SUBSCRIBER_ID \
  -H "Content-Type: application/json" \
  -d '{
    "enabled": false,
    "ims_enabled": false
  }'
```

□□□□ IMS □□□□□□□□□□□ `ims_enabled` □□□ `false`□□□ `enabled` □□□ `true`□

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- □□□□□□`enabled` □ `false`□□
- □□□ IMS □□□□`ims_enabled` □ `false`□□
- □□□□□□□□□□□□□□□□□ LTE □□□ EPC □□□□□□□□□ IMS □□□ IMS □□□□□

□□□□□□□□□□ `DIAMETER_ERROR_USER_UNKNOWN (5001)` □ S6a □ Cx □□□□□□ 3GPP TS 29.272 □ 3GPP TS 29.229□□□□□□□ IMSI □□□□□□□□□□□□□□□□□□□□□□□□□ IMSI□

□□□□□ IP □□

□□□□□□□□□□□□□□□□□ IP □□□□□□

□□□ □□□□□□□“□□□” APN □□□□□ IPv4 □□□ IoT □□□□□

```
# □□□□□□□□□□ jq (apt-get install jq □ brew install jq)

# 1. □□□□□
KEY_SET_ID=$(curl -k -X POST
https://hss.example.com:8443/api/key_set \
  -H "Content-Type: application/json" \
  -d '{
    "ki": "0123456789ABCDEF0123456789ABCDEF",
    "opc": "FEDCBA9876543210FEDCBA9876543210",
    "authentication_algorithm": "milenage",
    "amf": "8000",
    "sqn": 0
  }' | jq -r '.response.id')

# 2. □□ APN QoS □□□□
APN_QOS_ID=$(curl -k -X POST
https://hss.example.com:8443/api/apn/qos_profile \
  -H "Content-Type: application/json" \
  -d '{
    "name": "IoT □□□□",
    "allocation_retention_priority": 8,
    "apn_ambr_dl_kbps": 10000,
    "apn_ambr_ul_kbps": 5000,
    "pre_emption_capability": false,
    "pre_emption_vulnerability": false,
    "qci": 9
  }' | jq -r '.response.id')

# 3. □□ APN □□□
APN_ID=$(curl -k -X POST
https://hss.example.com:8443/api/apn/identifier \
  -H "Content-Type: application/json" \
  -d '{
    "apn": "internet",
    "ip_version": "ipv4"
  }' | jq -r '.response.id')

# 4. □□ APN □□□□
APN_PROFILE_ID=$(curl -k -X POST
https://hss.example.com:8443/api/apn/profile \
  -H "Content-Type: application/json" \
  -d "{
    \"apn_identifier_id\": \"$APN_ID\",
```

```
    \"apn_qos_profile_id\": \"$APN_QOS_ID\",
    \"name\": \"IoT □□□ APN\"
  }" | jq -r '.response.id')

# 5. □ APN □□□□ IP
STATIC_IP_ID=$(curl -k -X POST
https://hss.example.com:8443/api/epc/static_ip \
  -H "Content-Type: application/json" \
  -d "{
    \"apn_profile_id\": \"$APN_PROFILE_ID\",
    \"ipv4_static_ip\": \"100.64.1.100\"
  }" | jq -r '.response.id')

# 6. □□ EPC □□□□
EPC_PROFILE_ID=$(curl -k -X POST
https://hss.example.com:8443/api/epc/profile \
  -H "Content-Type: application/json" \
  -d "{
    \"apn_profiles\": [$APN_PROFILE_ID],
    \"name\": \"IoT □□□□\",
    \"network_access_mode\": \"packet_only\",
    \"tracking_area_update_interval_seconds\": 600,
    \"ue_ambr_dl_kbps\": 10000,
    \"ue_ambr_ul_kbps\": 5000
  }" | jq -r '.response.id')

# 7. □□ MSISDN□□□□□□
MSISDN_ID=$(curl -k -X POST
https://hss.example.com:8443/api/msisdn \
  -H "Content-Type: application/json" \
  -d '{
    "msisdn": "14155551000"
  }' | jq -r '.response.id')

# 8. □□□□□□ IP □□□
SUBSCRIBER_ID=$(curl -k -X POST
https://hss.example.com:8443/api/subscriber \
  -H "Content-Type: application/json" \
  -d "{
    \"imsi\": \"001001999999999\",
    \"key_set_id\": \"$KEY_SET_ID\",
    \"epc_profile_id\": \"$EPC_PROFILE_ID\",
    \"msisdns\": [$MSISDN_ID],
    \"static_ips\": [$STATIC_IP_ID]
```

```
  }" | jq -r '.response.id')

echo "IoT □□□□□□□□"
echo "  □□ ID: $SUBSCRIBER_ID"
echo "  IMSI: 001001999999999"
echo "  MSISDN: 14155551000"
echo "  □□ IPv4: 100.64.1.100□□ 'internet' APN □□"
```

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□□□□□□□□□□□□□□□□□ IoT □□□□□□□

1. □□□□ (□□□) - □□□□□□□
2. **APN** □□ (APN □□□□) - “□□□□”□□□
3. □□ **IP** □□ (□□ IP) - □□□ IPv4 □□ 100.64.1.100
4. □□□□□□□□□ (EPC □□□□) - IoT □□□□□□□□
5. □□□□ (MSISDN) - □□□□□□□
6. □□□□ (□□) - □□□□□□□□

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□□□□□□□□□□□□□□“□□□” APN □□□□□□□□□ IP □□ `100.64.1.100`□□□□□□ DHCP □□□

□□□□□

- □□□□□□ IP □□□ APN□□□□ APN □□□□ 2-5
- □□□□□□□□□□□□ IMS □□□□
- □□□□□□□□□□ □□□□□□
- □□□□ SIM□□□□□□ SIM

□□□

- □□ IP □□ - □□□□□ IP □□
- □□□□□□□□ - □□□□ IP □□□□□
- □ MSISDN □□ - □□□□□□□□

← □□ API □□

API □□□□ (RBAC)

□□□□□□□□□□□□ OmniHSS REST API □□□□□□□□□ API □□□□□□□□□□□□□□□□ API □□□□□□□□□□ □□□□□□ OmniCRM□OmniWeb□OmniHLR □□□□□□□

□□ □□□□□□□□□ API □□□□□□□ API □□□

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- □□□□□□□
- OmniHSS □□□□□□□
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- OmniHSS □□□□
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- □□□□
- □□□□□□□ API
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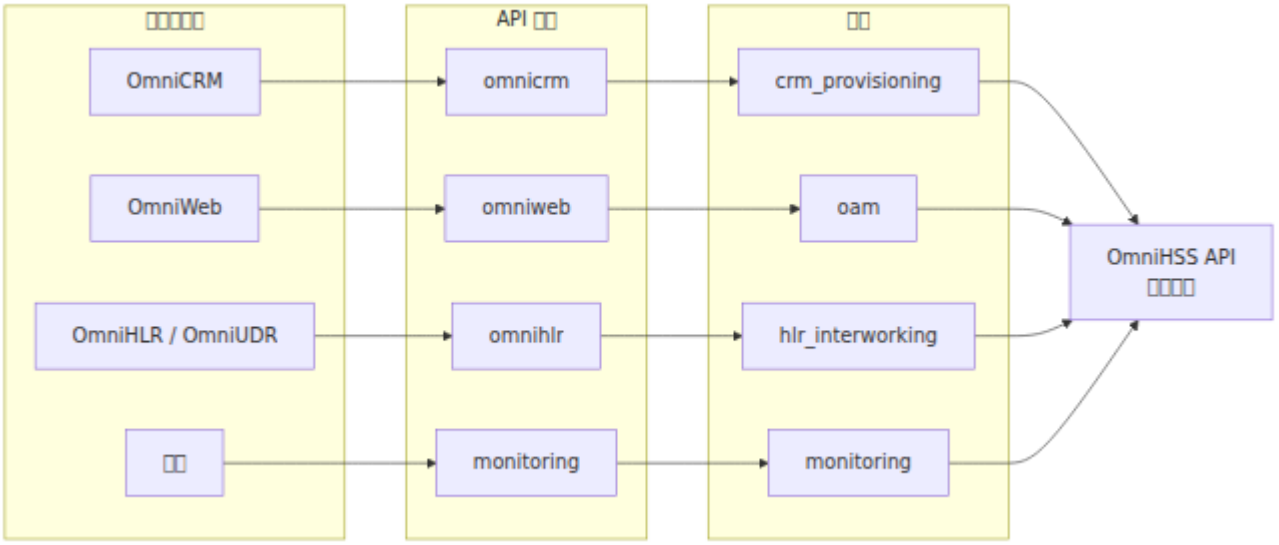
OmniHSS API □□□□□□□□□□□□□□□□



Diameter □□ (S6a□Cx□Sh□Gx□Rx □) □□□ API □□□Diameter □□□□ Diameter □□□□□□ □□□□□□□□□ Diameter □□□

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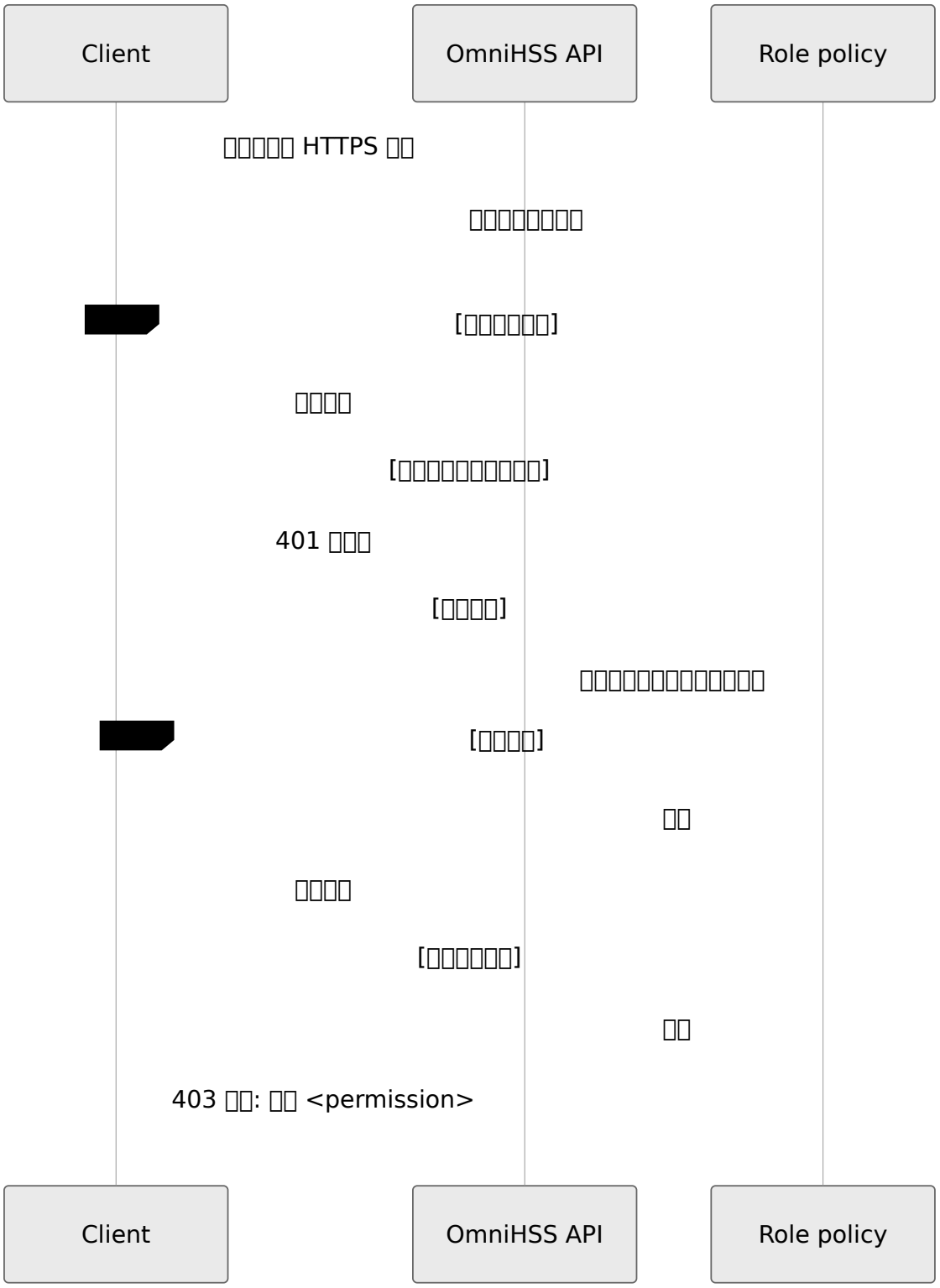
API □□□□□□□□□□□□□□□ `config :api_ex, :auth` □□□ `runtime.exs`□□□□□□□□□□□□□□□□□□

`config :api_ex, :auth`	□□	□□
□□□	□□	API □□□□□□□□□□□□□□□□□□□

- □□□□□□□□□□□□□□□□`key: ""` □□□□□□□API □□□ `503` □□□□□□□□
- OmniHSS □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□API □□ `503` □□□□□□□□□□□□□□□□□□□□□□□□□
- □ RBAC □□□□□□□□□□□□□□□□ API□□□□□□□□□□□□□□□□□□□□□□□□□API □□□□□□□□

OmniHSS □□□□□□



OmniHSS □□□□□□□□□□□□□□□□□□ `401`□`403` □ `503` □□□□□□□□□□□□□□□□□□□□□

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□ `config :api_ex, :auth` □□□□□□□□□□ `runtime.exs`□□□□□□□□□□□□□□□□ `/etc/omnihss/runtime.exs`□□□□□□□□□□ OmniHSS□

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```
# runtime.exs
config :api_ex, :auth,
  header: "x-omnihss-key",
  user_header: "x-omnihss-user",
  public: ["status/api:read"],
  roles: %{
    admin: ["*"],
    monitoring: ["status/**:read", "subscriber/**:read"]
  },
  api_keys: [
    %{
      name: "monitoring",
      roles: [:monitoring],
      secrets: ["REPLACE-WITH-A-64-CHARACTER-RANDOM-HEX-SECRET-
FROM-OPENSSL-RAND"]
    },
    %{
      name: "break-glass",
      roles: [:admin],
      secrets: ["REPLACE-WITH-A-DIFFERENT-64-CHARACTER-RANDOM-HEX-
SECRET-VALUE"]
    }
  ],
  log: [deny: :warning, unauthenticated: :info, allow: false,
not_found: false]
```

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`header`	□□□	□	`"x-api-key"`	□□ API □□□ HTTP □□□□□□□□□□□□□□ `"x-omnihss-key"`□□□□□□□□ `"x-api-key"`□□□ OmniWeb □□ `X-API-Key` □□□□□□□□□□□□□ OmniWeb□
`user_header`	□□□□	□	□□□	□□□□□□□□□□□□□□□□□ HTTP □□□□□ `header` □□□□□□ □□□□□
`public`	□□□□□□□	□	`[]`	□□□□□□□□□□□□□□□□□

API □□□□

□□	□□	□□	□□	□□
`name`	□□□	□	-	□□□□□□□□□□□□□□□□□□□□□□□□□□□□ `"omnicrm"`□□□□□□□□□□□□□□□□□□□□□□□□□□□□
`roles`	□□□□	□	-	□□□□□□□□□□□□□□□ `roles` □□□□□□□□□□□□□□□□□□□□□□□□
`secrets`	□□□□□	□	-	□□□□□□□□□□□□□□□□□□□□

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`deny`	□□□□□□ `false`	□	`:warning`	□□□□□□□□□□□□□□□□□□□□ (`403`)□
`unauthenticated`	□□□□□□ `false`	□	`:info`	□□□□□□□□□□□□□□□□□□□□ (`401`)□
`allow`	□□□□□□ `false`	□	`false`	□□□□□□□□□□□□□□ `:info` □□ □□□□□□□ API □□□
`not_found`	□□□□□□ `false`	□	`false`	□□□□□□□□□□□□□□□□□□□□□□□ (`404`)□

□□□□□□ `:debug`□`:info`□`:warning` □ `:error`□□ `false` □□□□□□□□□□□□□

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□□□□□□□□□□□□□ `resource:verb` □□□□

- □□ □□□□ `/api` □□□□□□□□□□□□ API □□□□□□□□□□□ `GET /api/subscriber/imsi/:imsi` □□□□ `subscriber/imsi`□
- □□ □□ HTTP □□□

HTTP □□	□□
`GET` (□□□□□□□□)	`read`
`POST`	`write`
`PUT`□`PATCH`	`write`
`DELETE`	`delete`

□□□`POST /api/operation/s6a/clr` □□□□ `operation/s6a/clr:write`□□ `DELETE /api/subscriber/:id` □□□□ `subscriber:delete`□

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`*` (□□□□)	□□	□□□□□□
`*` (□□□)	□□□	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
`**`	□□□□□□□	□□□□□□□□
`*` (□□)	□ `:` □	□□□□□□

□□□□ `/` □□□□□□□□□`*` □□□□□□□□□□□`sub*` □□□□□□□□

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`*` □ `**` □□□□□□□□□□□□□□□□□□□□□□□□□□□□

□□	`subscriber:read`	`subscriber/imsi:read`	`subscr`
`subscriber:read`	□	□	□
`subscriber:*`	□	□	□
`subscriber/*:read`	□	□	□
`subscriber/**:read`	□	□	□
`subscriber/**:*`	□	□	□
`*:read`	□	□	□
`*`	□	□	□

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- `subscriber/*:read` □□□□□□ (`subscriber/imsi`□`subscriber/msisdn` □)□□□□□ `subscriber` □□□
- `subscriber/**:read` □□ `subscriber` □□□□□ `subscriber` □□□□□□
- □□□□□□□□□□“□□”□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□

OmniHSS □□□□

□□□□ OmniHSS API □□□□□□□□□□□□□□□□□□□□□□□□□□□□□ API □□□

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`status/api:read`	`GET /api/status/api`	API □□□□□□□□□
`status/license:read`	`GET /api/status/license`	□□□□□□□
`status/database:read`	`GET /api/status/database`	□□□□□□□
`docs:read`	`GET /api/docs`□`GET /docs`	Swagger UI□
`schema:read`	`GET /api/schema`□`GET /schema`	OpenAPI □□□
`version:read`	`GET /version`	□□□□□□□□□

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`subscriber:read`	`GET /api/subscriber`□`GET /api/subscriber/:id`
`subscriber:write`	`POST /api/subscriber`□`PUT` □ `P /api/subscriber/:id`
`subscriber:delete`	`DELETE /api/subscriber/:id`
`subscriber/imsi:read`	`GET /api/subscriber/imsi/:im`
`subscriber/iccid:read`	`GET /api/subscriber/iccid/:i`
`subscriber/msisdn:read`	`GET /api/subscriber/msisdn/:`
`subscriber/ip:read`	`GET /api/subscriber/ip/:ip_a`
`subscriber/repository_data:read`	`GET /api/subscriber/repository_da`
`subscriber/repository_data:write`	`PUT` □ `PATCH /api/subscriber/repository_da`
`subscriber/repository_data:delete`	`DELETE /api/subscriber/repository_da`
`msisdn:read`	`GET /api/msisdn`□`GET /api/msi`

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`msisdn:write`	`POST /api/msisdn`□`PUT` □ `PATCH` `/api/msisdn/:id`
`msisdn:delete`	`DELETE /api/msisdn/:id`
`msisdn/digits:read`	`GET /api/msisdn/digits/:digi`
`ims_subscription:read`□`:write`□`:delete`	`/api/ims_subscription`
`epc/static_ip:read`□`:write`□`:delete`	`/api/epc/static_ip`

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`key_set:read`	`GET /api/key_set`□`GET /api/key_set/:id`	□□□□□ Ki□OPc□OP□ PSK□DES □ SIP □□□□□ □□□□□□□□□□□□□□□□
`key_set:write`	`POST /api/key_set`□`PUT` □ `PATCH /api/key_set/:id`	□□□ □□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□
`key_set:delete`	`DELETE /api/key_set/:id`	□□□
`sim:read`	`GET /api/sim`□`GET /api/sim/:id`	□□□□□ KIc□KID □ ADM1□
`sim:write`	`POST /api/sim`□`PUT` □ `PATCH /api/sim/:id`	
`sim:delete`	`DELETE /api/sim/:id`	
`sim/iccid:read`	`GET /api/sim/iccid/:iccid`	□ ICCID □□□

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□□□□□□□□□□□□□□□ `read`□`write` □ `delete`□□□□□□□□ `GET`□`POST`□`PUT`□`PATCH` □ `DELETE`□□□□□□□□□□□□□□□

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`apn/profile`	`/api/apn/profile`	APN □ □□□□□ □□ □□ □□□□□
`apn/identifier`	`/api/apn/identifier`	APN □ □□
`apn/qos_profile`	`/api/apn/qos_profile`	APN QoS□
`epc/profile`	`/api/epc/profile`	EPC (□□) □ □□□□
`ims/profile`	`/api/ims/profile`	IMS (□ □) □□□ □□
`roaming/profile`	`/api/roaming/profile`	□□□□□ □□□□□ □□□□□
`roaming/rule`	`/api/roaming/rule`	□□□□□
`eir/rule`	`/api/eir/rule`	EIR □ □□□□□ EIR□
`pcrf/profile`	`/api/pcrf/profile`	PCRF □□□□□ □□□ PCRF□

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`pcrf/charging_rule`	`/api/pcrf/charging_rule`	PCRF □□□□□
`pcrf/flow_information_rule`	`/api/pcrf/flow_information_rule`	PCRF □□□□

HLR □□

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`hlr/generate_auth_vectors:write`	`POST /api/hlr/generate_auth_`
`hlr/generate_eutran_auth_vectors:write`	`POST` `/api/hlr/generate_eutran_aut`
`hlr/circuit_session:write`□`:delete`	`PUT`□`PATCH`□`DELETE` `/api/hlr/circuit_session/:im`
`hlr/subscriber_state:write`	`PUT` □ `PATCH` `/api/hlr/subscriber_state/:i`
`hlr/pdn_session:write`□`:delete`	`POST`□`PUT`□`PATCH`□`DELETE` `/api/hlr/pdn_session`

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`operation/count:read`	`GET /api/operation/count/:type`	□□□□□
`operation/s6a/clr:write`	`POST /api/operation/s6a/clr`	□ MME □□□□□ □□□□□ □□□□□ □□□ □□ □□□
`operation/s6a/idr:write`	`POST /api/operation/s6a/idr`	□ MME □□□□□ □□□□□ □□
`operation/pcrf/re_auth:write`	`POST /api/operation/pcrf/re_auth`	□ PGW □□ Gx □□□□□ □□□□□ PCRF□

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`admin`	□□□□□□□□□□□	□□□□□
`crm_provisioning`	OmniCRM	□□□□MSISDN□SIM □□□□□□ □□□□□□□□□
`oam`	OmniWeb	□□□□□□□□□□□□□□□□□□□□□□ HLR □□□□
`hlr_interworking`	OmniHLR (OmniSS7)□ OmniUDR	□□□□□□□□□□□□□□□□□□□□□
`monitoring`	□□□□□□□□□□□□□□□□	□□□□□□□□□□□
`eir_lookup`	OmniEIR	□□□ EIR □□□

□□□ (□□□)

```
admin: ["*"]
```

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□□□□□ OmniCRM □□□□□□□□□□□□ MSISDN□□□□□□□□□□□ SIM □□□□□□□ IMSI □ UE IP □□□□□□□□□□□□

OmniHLR □ OmniUDR (HLR □□)

```
hlr_interworking: [
  "subscriber/imsi:read",
  "subscriber/msisdn:read",
  "key_set:read",
  "hlr/generate_auth_vectors:write",
  "hlr/generate_eutran_auth_vectors:write",
  "hlr/circuit_session:*",
  "status/api:read"
]
```

□□□□□ HLR □ UDR □□□□□□

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□□□□□□□□ RAN □□□ `admin` □□□□□□□□□□□□□□□□□□□□

```
# runtime.exs
config :api_ex, :auth,
  # □□□□ x-api-key□OmniWeb □□□□□□□□□□ X-API-Key □
  header: "x-omnihss-key",
  user_header: "x-omnihss-user",

  # □□□□□□□□
  public: ["status/api:read"],

  roles: %{
    admin: ["*"],
    crm_provisioning: [
      "subscriber:*",
      "subscriber/*:read",
      "msisdn/**:*",
      "sim/**:read",
      "sim:write",
      "key_set:write",
      "status/**:read"
    ],
    oam: [
      "*:read",
      "subscriber/**:*",
      "msisdn/**:*",
      "sim/**:*",
      "key_set:*",
      "ims_subscription:*",
      "apn/**:*",
      "epc/**:*",
      "ims/**:*",
      "roaming/**:*",
      "eir/**:*",
      "pcrf/**:*",
      "operation/**:write",
      "hlr/subscriber_state:write",
      "hlr/generate_auth_vectors:write",
      "hlr/generate_eutran_auth_vectors:write"
    ],
    hlr_interworking: [
      "subscriber/imsi:read",
      "subscriber/msisdn:read",
      "key_set:read",
      "hlr/generate_auth_vectors:write",
```

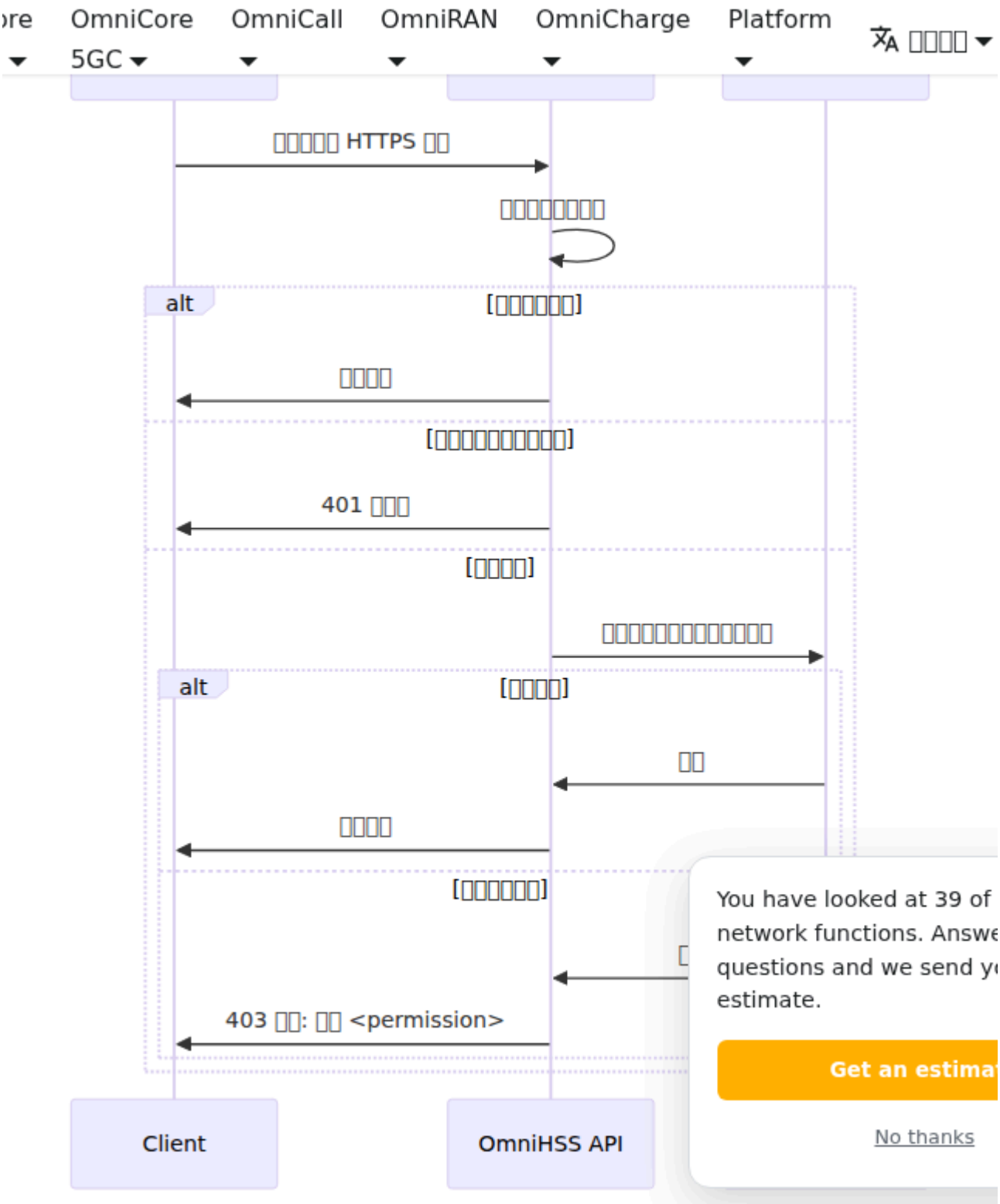
```
      "hlr/generate_eutran_auth_vectors:write",
      "hlr/circuit_session:*",
      "status/api:read"
    ],
    monitoring: ["status/**:read", "subscriber/**:read",
"operation/count:read"],
    eir_lookup: ["eir/rule:read"]
  },

  api_keys: [
    %{
      name: "omnicrm",
      roles: [:crm_provisioning],
      may_assert_user: true,
      secrets: ["REPLACE-WITH-OPENSSL-RAND-HEX-32-OUTPUT-FOR-THE-
OMNICRM-KEY-00"]
    },
    %{
      name: "omniweb",
      roles: [:oam],
      may_assert_user: true,
      secrets: ["REPLACE-WITH-OPENSSL-RAND-HEX-32-OUTPUT-FOR-THE-
OMNIWEB-KEY-00"]
    },
    %{
      name: "omnihlr",
      roles: [:hlr_interworking],
      secrets: ["REPLACE-WITH-OPENSSL-RAND-HEX-32-OUTPUT-FOR-THE-
OMNIHLR-KEY-00"]
    },
    %{
      name: "omniudr",
      roles: [:hlr_interworking],
      secrets: ["REPLACE-WITH-OPENSSL-RAND-HEX-32-OUTPUT-FOR-THE-
OMNIUDR-KEY-00"]
    },
    %{
      name: "monitoring",
      roles: [:monitoring],
      secrets: ["REPLACE-WITH-OPENSSL-RAND-HEX-32-OUTPUT-FOR-THE-
MONITOR-KEY-00"]
    },
    %{
      name: "break-glass",
```

```
      roles: [:admin],
      metadata: %{owner: "NOC", vault: "omnihss/break-glass"},
      secrets: ["REPLACE-WITH-OPENSSL-RAND-HEX-32-OUTPUT-FOR-
BREAK-GLASS-KEY-00"]
    }
  ],

  log: [deny: :warning, unauthenticated: :info, allow: false,
not_found: false]
```

□□□□□ OmniHSS □ RBAC □□□□□□□ `api_keys` □□□□□□□



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- OmniHSS □□□□□□□□ `may_assert_user: true` □□□□□□□□□□□□□□OmniHSS □□□□□□□
- □□□□□□□□□□ UTF-8□□□ 256 □□□□□□□□□□□□□□□
- □□□□□□□□□□□□□□□□□□OmniHSS □□□□□□□□□□□□□□□□□□

□□□□□□ API

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4. □□□□□□□□□□ `x-omnihss-key` □□□□□□□□□
5. □ `config :api_ex, :auth` □□□□□□ OmniHSS □□□□ `runtime.exs`□
6. □□□□□□□□□□ OmniHSS□
7. □□□□□□□□□□□□□ `mode: rbac` □□□□□□□□□
8. □□□□□□ `403` □ `401` □□□□ `403` □□□□□□□□□□□□□
9. □□□ OmniHSS□
10. □□□□□ OmniHSS □□□□□□ 6 □ 9□

□□ RBAC□□□□□□□□□□□□□□□□□ `401`□

□□□□□□□□□□□ OmniHSS □□□□□□□□ `config :api_ex, :auth` □□□□□□□□□□□□□□□□□□□□

□□□□□□□□□□□□□□□□ `api_keys` □□□□□□□□□□□□□□□ OmniHSS□

□□□□□

- OmniHSS □□□□□□□□□□□□□□□□□□□□ `api_ex_principal=<key name>`□□□□□□□□□□□□□□□□□□□□
- `403` □□ `/api/subscriber/:imsi`□□□□□□□□□□
- □□□□□□□□□□□□□□□□□□□□□□□□
- □□□□□□□□□□□□□□□□□□□ `log: [allow: :info]`□□□□□□□□ API □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□

□□□□

□□□□□□□□□□□□□ 401

□□□□□□□□□□□□□ `401 unauthorized`□

□□□□□□

- □□□□□□□□□□□□
- □□□□□□□□□□□□□□□□□□□□ `x-api-key`□
- □□□□□□□□□□ `runtime.exs` □□□□□□□□□□

□□□□□□

1. □□□□□□□□□□□□□□□□□□□□
2. □□□□□□□□□□□□□□□□□□□□□□
3. □□□□□□□□□□□□□□□ `api_keys` □□□□□□□□□□□

□□□□□□ 403

□□□□□□□□□□ `403 forbidden: requires <permission>`□

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- □□□□□□□□□□□□□□□□□□
- □□□□□□ `*`□□□□□ `**`□□□□□ □□□□□□

□□□□□

1. □□□□□□□□□□□□□□□□
2. □ OmniHSS □□□□□ □□□□□□□
3. □□
4. □□□□□ OmniHSS□

API □□□□□□□□ 503

□□□□□□□□□□□□ `503 authentication misconfigured`□

□□□□□□

- □□□ `key` □□□□□□□
- □□□□□□□□□□□□□□□□□□□□□

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1. □□□□□□□□□□□□□□□□□
2. □□ `config :api_ex, :auth` □□
3. □□□□□ OmniHSS□

□□□ OmniHSS □□□□

□□□OmniHSS □□□□□□□□□□□□□ `ApiEx: invalid RBAC configuration`□

□□□□□□

- □□□□□□□□□□ `roles` □□□□
- □□□□□□□□□□ `name`□
- □□□□□□□□□□□□□
- `user_header` □ `header` □□□
- □□□□□□□□

□□□□□

1. □□□□□□□□□□□□□□□□
2. □□ `runtime.exs` □□□□□□□□
3. □□□□ OmniHSS□

□□□□□□□□

□□□□□□□□□ `ApiEx auth warning:` □□

□□□□□

- □□□□ 16 □□□
- □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
- `public` □□□□□□□□□□□□□□□□□

□□□□□

1. □□□□□□□□□
2. □□ `openssl rand -hex 32` □□□□□□
3. □□□□□□□□□ OmniHSS □□□□ □□□□□
4. □□ `public` □□□□□□

OmniHSS API □□

← □□□□□□

□□

- API □□
- □□□□□□□□□□
- □□□□□
- □□□□
- Sh RepositoryData□□□□□□
- MSISDN □□
- IMS □□□□
- SIM □□
- □□□□□
- □□□□□□
- □□ IP □□
- □□□□
- EIR □□
- □□□□□
- □□□□
- API □□□□

API □□

□□ URL

```
https://[hostname]:8443/api
```

□□□□

□□□□□□□□□□□□□□□□ API □□□□□□ `x-omnihss-key`□□□□□□□□□□□□□□□□

```
# ✓ □□
curl -X POST https://hss.example.com:8443/api/ims/profile \
  -H "Content-Type: application/json" \
  -d '{"name": "default", "ifc_template": "..."}'

# ✗ □□
curl -X POST https://hss.example.com:8443/api/ims/profile \
  -H "Content-Type: application/json" \
  -d '{"ims_profile": {"name": "default", "ifc_template": "..."}}'
```

□□□□

□□□□□□ JSON□□□□□□□□

□□□□:

```
{
  "status": "success",
  "response": { ... }
}
```

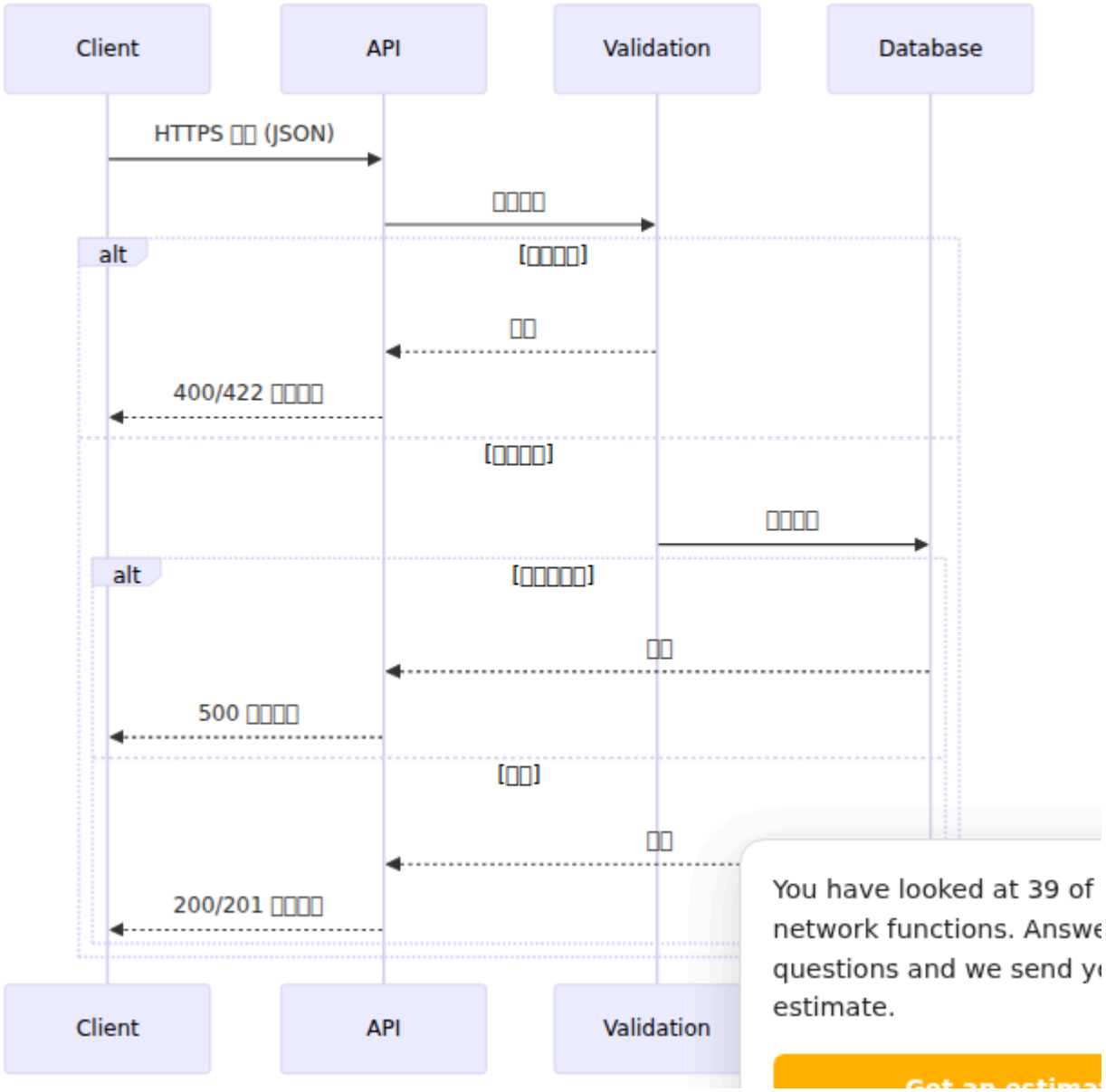
□□□□:

```
{
  "status": "error",
  "response": {
    "invalid_fields": {
      "field_name": "error message"
    }
  }
}
```

HTTP □□□

□□	□□	□□
200	OK	□□□ GET□PUT□DELETE
201	□□	□□□ POST
400	□□□□	□□□□□□□
401	□□□	□□ API □□□□□□□□□□□□□□ API □□□□
403	□□	□□□□□□□□□□□□□□□□□ API □□□□
404	□□□	□□□□□
422	□□□□□□□	□□□□
500	□□□□□□□	□□□□□□
503	□□□□□	API □□□□□□□□□□□□ API □□□□

API □□□□



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□□: `GET /api/subscriber`

□□□□:

□□	□□	□□
`enabled`	boolean	□□□□□□□
`ims_enabled`	boolean	□ IMS □□□□□□

□□□□:

```
curl -k https://hss.example.com:8443/api/subscriber
```

□□□□:

```
{
  "data": [
    {
      "id": "d290f1ee-6c54-4b01-90e6-d701748f0851",
      "imsi": "001001123456789",
      "enabled": true,
      "ims_enabled": true,
      "sim_id": "3f2504e0-4f89-41d3-9a0c-0305e82c3301",
      "key_set_id": "6ba7b810-9dad-41d1-80b4-00c04fd430c8",
      "epc_profile_id": "e58ed763-928c-4155-bee9-fdbaaadc15f3",
      "ims_profile_id": "7c9e6679-7425-40de-944b-e07fc1f90ae7",
      "roaming_profile_id": "9c858901-8a57-4791-81fe-
4c455b099bc9",
      "custom_attributes": {},
      "inserted_at": "2025-10-15T10:30:00Z",
      "updated_at": "2025-10-15T10:30:00Z"
    }
  ]
}
```

□□ ID □□□□

□□□□□ ID □□□□□□□□

□□: `GET /api/subscriber/:id`

□□□□:

□□	□□	□□
`id`	string (UUID)	□□□□□ ID

□□□□:

```
curl -k https://hss.example.com:8443/api/subscriber/d290f1ee-6c54-
4b01-90e6-d701748f0851
```

□□ IMSI □□□□

□□□ IMSI □□□□□

□□: `GET /api/subscriber/imsi/:imsi`

□□□□:

□□	□□	□□	□□
`imsi`	string	□□□□□□□□	14-15 □□□

□□□□:

```
curl -k
https://hss.example.com:8443/api/subscriber/imsi/001001123456789
```

□□: □□□ IMSI □□□□□□□□□□□□□

□□ MSISDN □□□□

□□□□□□□□□□□□

□□: `GET /api/subscriber/msisdn/:msisdn`

□□□□:

□□	□□	□□	□□
`msisdn`	string	□□□ ISDN □□	1-15 □□□ (E.164)

□□□□:

```
curl -k
https://hss.example.com:8443/api/subscriber/msisdn/14155551234
```

□□: □□□□□□□□□□□□□□□□□□□□□□□□

□□□□

□□□□□□□

□□: `POST /api/subscriber`

□□□:

```
{
  "subscriber": {
    "imsi": "001001123456789",
    "enabled": true,
    "ims_enabled": true,
    "sim_id": "3f2504e0-4f89-41d3-9a0c-0305e82c3301",
    "key_set_id": "6ba7b810-9dad-41d1-80b4-00c04fd430c8",
    "epc_profile_id": "e58ed763-928c-4155-bee9-fdbaaadc15f3",
    "ims_profile_id": "7c9e6679-7425-40de-944b-e07fc1f90ae7",
    "roaming_profile_id": "9c858901-8a57-4791-81fe-4c455b099bc9",
    "custom_attributes": {
      "note": "□□□□"
    }
  }
}
```

□□□□:

- `imsi` - □□□ 14-15 □□□□□□□
- `key_set_id` - □□□□□□□□ □□□
- `epc_profile_id` - □□□□□□□□ EPC □□□□

□□□□□:

- `enabled` - □□: true
- `ims_enabled` - □□: true
- `sim_id` - □□ SIM □
- `ims_profile_id` - □□ IMS □□□□□IMS □□□□□
- `roaming_profile_id` - □□ □□□□□□□□□□□□□□□
- `msisdns` - MSISDN ID□□□□□□□□
- `static_ips` - □□ APN □□□ □□ IP ID □□
- `ims_subscription_id` - □□ IMS □□□□□□□□□□□□□□□□□□□□□ S-CSCF □
- `custom_attributes` - □□□□□□

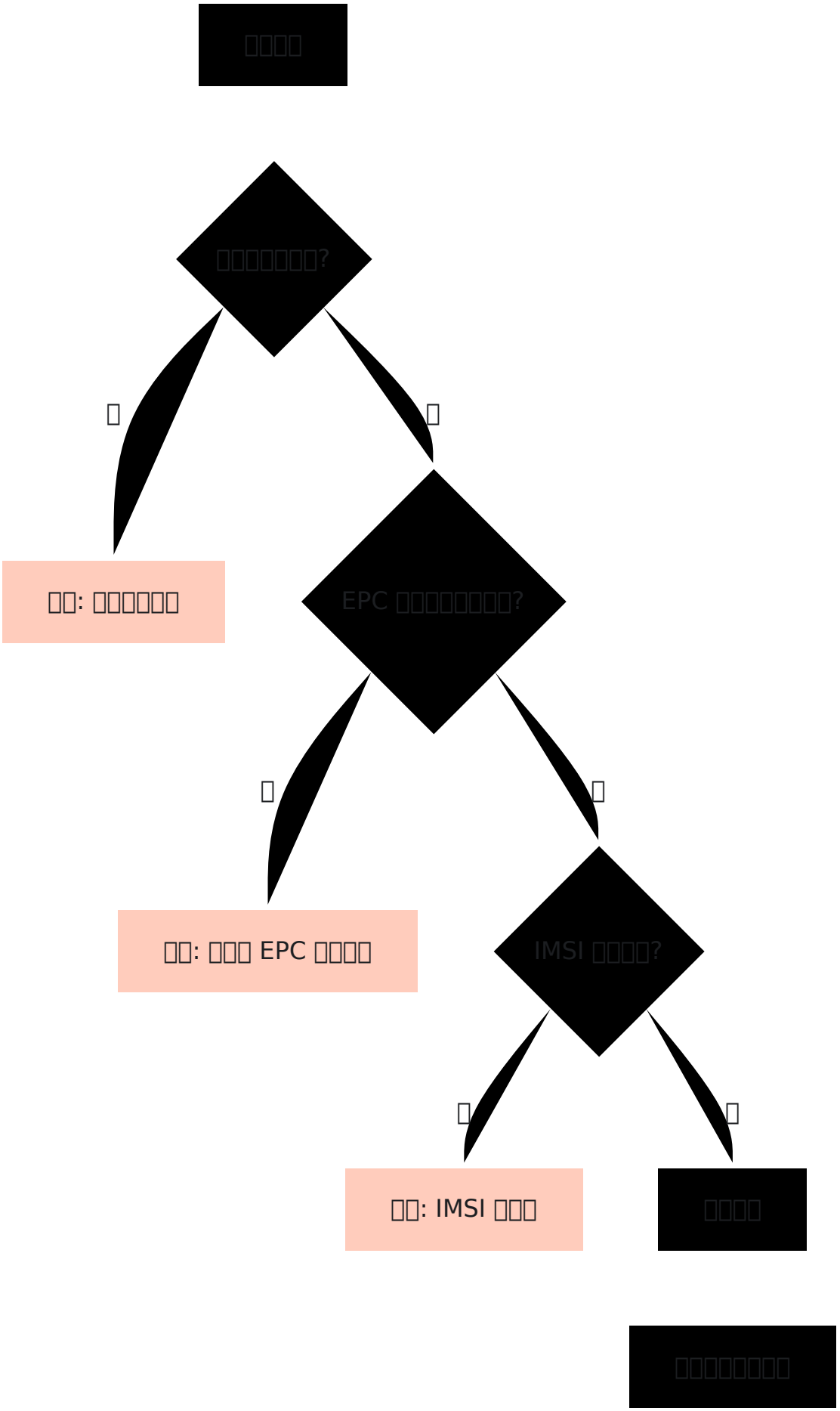
□□:

- □□□□□□□□□□ - □□□□□□
- □ MSISDN □□ - □□□□□□□□□□
- □□ IP □□ - □□□ IP □□□ APN

□□□□:

```
curl -k -X POST https://hss.example.com:8443/api/subscriber \
  -H "Content-Type: application/json" \
  -d '{
    "subscriber": {
      "imsi": "001001123456789",
      "key_set_id": "6ba7b810-9dad-41d1-80b4-00c04fd430c8",
      "epc_profile_id": "e58ed763-928c-4155-bee9-fdbaaadc15f3"
    }
  }'
```

□□□□: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EPC □□□□□□□□□?
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□□: □□□ EPC □□□□
IMSI □□□□?
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□□: IMSI □□□
□□□□
□□□□□□□□□

201 □□□□

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□□□□□□□□

□□: `PUT /api/subscriber/:id`

□□□□□:

□□	□□	□□
`id`	string (UUID)	□□□□□ ID

□□□:

```
{
  "subscriber": {
    "enabled": false,
    "ims_enabled": false,
    "epc_profile_id": "f47ac10b-58cc-4372-a567-0e02b2c3d479",
    "custom_attributes": {
      "note": "□□□□"
    }
  }
}
```

□□□□□:

- `enabled` - □□/□□□□□□
- `ims_enabled` - □□/□□ IMS □□
- `sim_id` - □□ SIM □ □□
- `key_set_id` - □□ □□□□□□□□□□
- `epc_profile_id` - □□ □□□□□□□□
- `ims_profile_id` - □□ □□□□□□□□
- `roaming_profile_id` - □□ □□□□

- `msisdns` - □□□□□□□□□ □□□□□□ `[]` □□□□□□
- `static_ips` - □□□□□□ APN □ □□ IP□ `[]` □□□□□□
- `custom_attributes` - □□□□□□□□

□□□□□:

- `imsi` - □□□□□ IMSI□□□□□□□□□□□□
- `subscriber_state` - □ HSS □□□□□□□□□□□□□□□□□□□□□□□□□□□□□ `PATCH /api/hlr/subscriber_state/:imsi` □□□□□□ `assigned_scscf`

□□:

- □□□□□□□□ - □□□□□□□□□□

□□□□□:

```
curl -k -X PUT
https://hss.example.com:8443/api/subscriber/d290f1ee-6c54-4b01-
90e6-d701748f0851 \
  -H "Content-Type: application/json" \
  -d '{
    "subscriber": {
      "enabled": false
    }
  }'
```

□□:

- □□□□□□□□: `{"enabled": false}`
- □□□□□□□□□: `{"ims_enabled": false}`
- □□□□□□□□□□: `{"epc_profile_id": "f47ac10b-58cc-4372-a567-0e02b2c3d479"}` □□ EPC □□□□□□
- □□□□□□□: `{"roaming_profile_id": "1b671a64-40d5-491e-99b0-da01ff1f3341"}` □□ □□□□□□

□□□□

□□□□□□□□□□

□□: `DELETE /api/subscriber/:id`

□□□□:

□□	□□	□□
`id`	string (UUID)	□□□□□ ID

□□□□:

```
curl -k -X DELETE
https://hss.example.com:8443/api/subscriber/d290f1ee-6c54-4b01-
90e6-d701748f0851
```

□□: □□□□□□□□□□□□□□□□□□□□□PDN □□□□□□□□□□□□□□□□□ IMSI□

□□: □□□□□□□□□□□□□

- □□□ - □□□□□□□□□□
- SIM - □□□□□□□□□□□
- □□□□ - □□□□□□□□□□
- MSISDNs - □□□□□□□□□□□□

□□□□□□□□□□□□

□□□□□□□□□□CLR□□□□□□□□□□□□□□□□□ MME□

□□: `POST /api/subscriber/cancel_location`

□□□:

```
{
  "imsi": "001001123456789"
}
```

□□:

□□	□□	□□	□□
`imsi`	string	□	□□□□□□□ IMSI□14-15 □□□□

□□□□:

```
curl -k -X POST
https://hss.example.com:8443/api/subscriber/cancel_location \
  -H "Content-Type: application/json" \
  -d '{"imsi": "001001123456789"}'
```

□□□□ **(200 OK):**

```
{
  "data": {
    "message": "□□□□□□□□□□□□",
    "imsi": "001001123456789",
    "destination_host": "mme01.operator.com",
    "destination_realm": "epc.operator.com"
  }
}
```

□□□□ **(404 □□□):**

```
{
  "error": "□□□□□□□□□□□□□□ MME □□"
}
```

□□:

- □□□□□□ MME □□ S6a CLR□`subscriber_state.last_seen_mme`□
- □□ `Cancellation-Type: subscription_withdrawal`□□□□□□□□
- □□ `CLR-Flags: {s6a_indicator: 1, reattach_required: 1}`□UE □□□□□□□
- □□□□□□□□□ `last_seen_mme` □ null□□□□ 404
- □□□□□ **IMSI** □□□ **MSISDNs**□□□□□□□□/SIM□

□□:

- □□□□: □□□□□□□□□
- □□□□: □□□□□□□□□□□□
- □□□□: □□□□□□ MME □□□□□□□□
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- □□: □□□□□□□□□□□□

□ **IMSI** □□:

□□□ CLR □□ MSISDN □□□□

1. □□ **MSISDN□□□ IMSI:**

```
// □□□□ IMSI 001001123456789□MSISDNs ["+1234567890",
"+9876543210"]
POST /api/subscriber/cancel_location
{"imsi": "001001123456789"}

// □□: □□□□ CLR□□□ MSISDN □□□□□□□□□□
```

2. □□ **IMSIs□□□□□□:**

```
// □□□□□□□□□□ MSISDN□□□□□ IMSIs□□□□□□□□
// □□ A: IMSI 001001111111111, MSISDN "+1234567890"
// □□ B: IMSI 001001222222222, MSISDN "+1234567890"

POST /api/subscriber/cancel_location
{"imsi": "001001111111111"}

// □□: □□□ A □□□□□□ B □□□□
```

□□□□:

- □□ **IMSI:** CLR □□□ IMSI □□□□□□□ MSISDN
- □□: CLR □□□□□□□□□□□□□□□ CLR □□□□□□□ MME □□□
- □□□ **MME** □□: □□ MME □□□□□CLR □□□□□□□ HSS □□□
- □□: □□□ IMSI □□□□□□□□

□□□□:

- □□□□□□□□□□□
- □ IMSI □□
- S6a □□□□

Sh RepositoryData□□□□□□

□□□□ Sh □□□□□MMTEL □□□IMS-ODB □□□□□□□□□□□□□□□□□□□□□□□□ Sh □□□□□□□□□□□□□□□ □□□□□□□□□ `GET`/`PUT`/`DELETE /api/subscriber/repository_data/:imsi`□

□□□□□□□□□□□□**SequenceNumber** □□□□□□□□ **REST API** □□□□□□□ **Sh RepositoryData**□□□□□□□□

MSISDN □□

MSISDN□□□□□□□□□□□□□□□□□□□

```
curl -k https://hss.example.com:8443/api/msisdn
```

□□ MSISDN

□□□□□□□□□□

□□: `GET /api/msisdn/:id`

□□□□:

```
curl -k https://hss.example.com:8443/api/msisdn/16fd2706-8baf-
433b-82eb-8c7fada847da
```

□□□□:

```
{
  "status": "success",
  "response": {
    "id": "16fd2706-8baf-433b-82eb-8c7fada847da",
    "msisdn": "14155551234",
    "shared": false
  }
}
```

□□ MSISDN

□□□□□□□□□□□□

□□: `POST /api/msisdn`

□□□:

```
{
  "msisdn": {
    "msisdn": "14155551234"
  }
}
```

□□:

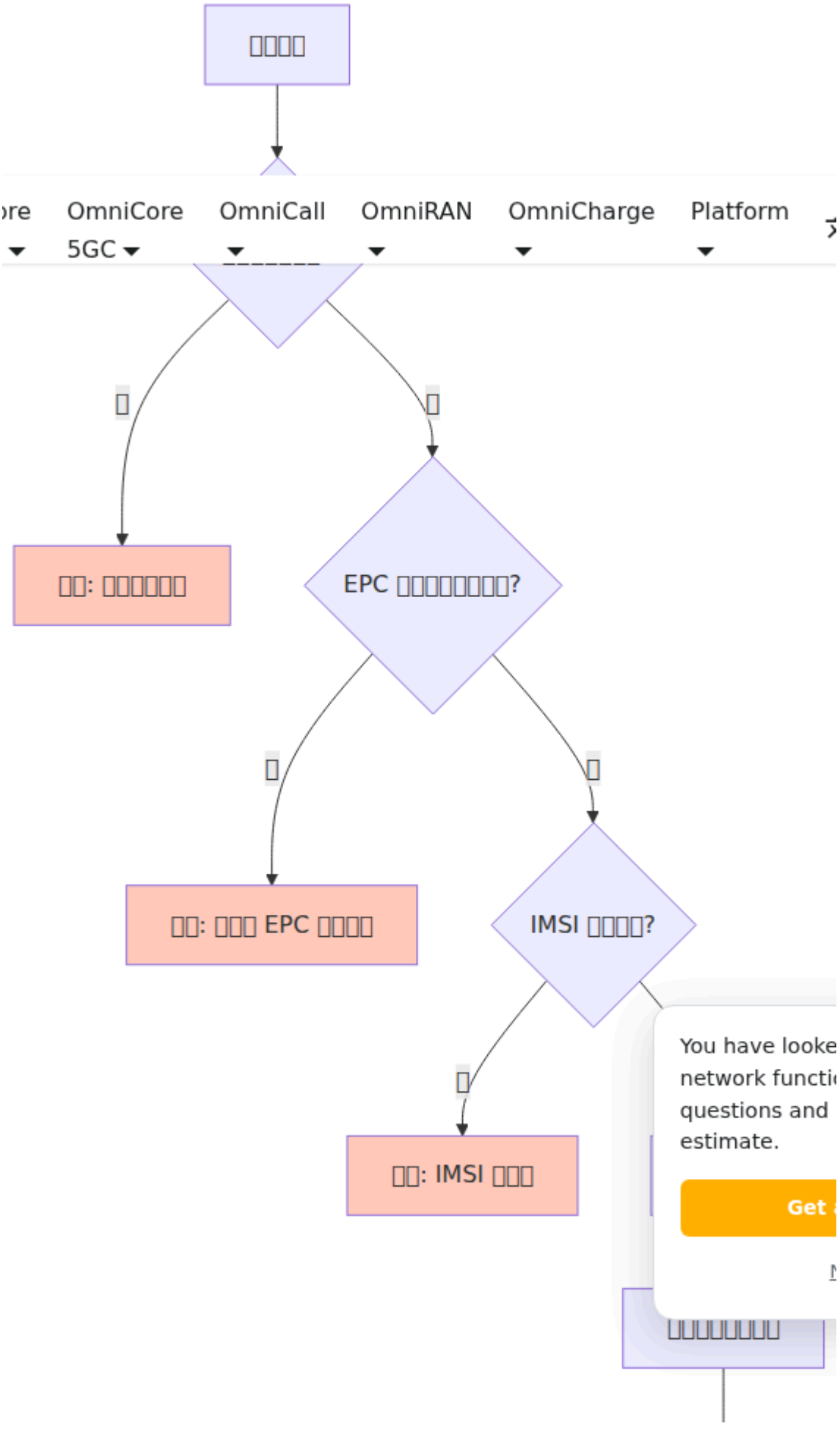
- □□□ 1-15 □□□
- □□□□
- □□□□ E.164 □□□□□□□□□□ + □□□

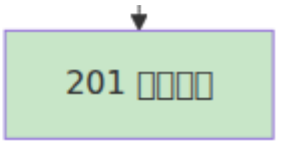
□□□□:

```
curl -k -X POST https://hss.example.com:8443/api/msisdn \
  -H "Content-Type: application/json" \
  -d '{
    "msisdn": {
      "msisdn": "14155551234"
    }
  }'
```

□ MSISDN □□□□□

□□□□□□□□□


□□□□
ore
OmniCore
5GC
OmniCall
OmniRAN
OmniCharge
Platform
□
□
□□: □□□□□□□
EPC □□□□□□□□□?
□
□
□□: □□□ EPC □□□□
IMSI □□□□?
□
□□: IMSI □□□
You have looke
network functi
questions and
estimate.
Get
□□□□□□□□□



□□□ □ MSISDN □□ IMSI □□ □□□□□□□□□

□□ MSISDN

□□□□□□□□□□

□□: `DELETE /api/msisdn/:id`

□□□□:

```
curl -k -X DELETE
https://hss.example.com:8443/api/msisdn/16fd2706-8baf-433b-82eb-
8c7fada847da
```

IMS □□□□

IMS □□□□□□□□IMSI / IMPI□□□□□□ IMS □□□□□□□□□□□□□□□□□□□□□ S-CSCF□□□□ □□□□□□□□□□□

□□ IMS □□

□□: `GET /api/ims_subscription`

```
curl -k https://hss.example.com:8443/api/ims_subscription
```

□□ IMS □□

□□: `GET /api/ims_subscription/:id`

```
curl -k
https://hss.example.com:8443/api/ims_subscription/16fd2706-8baf-
433b-82eb-8c7fada847da
```

□□ IMS □□

□□: `POST /api/ims_subscription`

```
curl -k -X POST https://hss.example.com:8443/api/ims_subscription
\
  -H "Content-Type: application/json" \
  -d '{"name": "Smith family - shared number"}'
```

□□:

- `name` - □□□□□□□□□□□□
- `ims_profile_id` - □□□□□ IMS □□□□□□□□□□□□□

`assigned_scscf` □ `last_seen_scscf_timestamp` □□ HSS □□□□□□□□□□□□□□□□□□

□□ IMS □□

□□: `PATCH /api/ims_subscription/:id`

□□ IMS □□

□□: `DELETE /api/ims_subscription/:id`

□□ IMS □□□□□□□□□□□□□ `ims_subscription_id` □□□□□□□□□□□□□□□□□□□□□□□□□□□□ `ims_subscription_id`□□ □□□□□□

SIM □□

SIM □□□□□□□ SIM □□□□□□ ICCID□□□□□□□□□PIN/PUK □□□ OTA □□□SIM □□□□□□□□□□□□□□□□□

□□□

- □IMSI□□ - □□□□SIM□□□□□□□

□□SIM□

□□□□SIM□□

□□□ `GET /api/sim`

□□□□□

```
curl -k https://hss.example.com:8443/api/sim
```

□□SIM□

□□□□□SIM□□`adm1`-`adm10`□`kic`□`kid`□□□□□□□

```
{
  "sim": {
    "iccid": "89911012000003204510",
    "sim_vendor": "Gemalto",
    "batch_name": "2025-Q1-Batch-01",
    "is_esim": false,
    "pin1": "1234",
    "pin2": "5678",
    "puk1": "12345678",
    "puk2": "87654321",
    "adm1": "admin-code-1",
    "kic": "0123456789ABCDEF0123456789ABCDEF",
    "kid": "FEDCBA9876543210FEDCBA9876543210"
  }
}
```

□□□□□

- `iccid` - 19-20□□□□□□

□□□□□□□□□□

- `sim_vendor` - □□□□□
- `batch_name` - □□□□
- `is_esim` - eSIM□□□□□
- `pin1`□`pin2` - □□□□PIN□
- `puk1`□`puk2` - PIN□□□
- `adm1-adm10` - □□□□
- `kic`□`kid` - OTA□□□□□□□□□□□□□□□

□□□□□

```
curl -k -X POST https://hss.example.com:8443/api/sim \
  -H "Content-Type: application/json" \
  -d '{
    "sim": {
      "iccid": "89911012000003204510",
      "sim_vendor": "Gemalto"
    }
  }'
```

□□SIM□

□□SIM□□□□

□□□ `PUT /api/sim/:id`

□□□□□

```
curl -k -X PUT https://hss.example.com:8443/api/sim/3f2504e0-4f89-
41d3-9a0c-0305e82c3301 \
  -H "Content-Type: application/json" \
  -d '{
    "sim": {
      "batch_name": "Updated-Batch-Name"
    }
  }'
```

□□SIM□

□□SIM□□□□

□□□ `DELETE /api/sim/:id`

□□□ □□□□□□□□□□□□□□□□□□□□SIM□

□□□□□

□□□□□□□□□Milenage□□□□□□□□□□□□□□□□□□Ki□OPC/OP□AMF□SQN□□□□□□□□□□□□□□□□□□

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- □□□□ - □□□□□□□□□□□□□

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□□□ `GET /api/key_set`

□□□□□

```
curl -k https://hss.example.com:8443/api/key_set
```

□□□□□

□□□□□□□□□`ki`□`opc`□`op`□`psk`□`des`□`sip_password`□□□□□□□□□□□□□□□□□□

```
{
  "data": {
    "id": "6ba7b810-9dad-41d1-80b4-00c04fd430c8",
    "amf": "8000",
    "sqn": 0,
    "authentication_algorithm": "milenage",
    "ota_counter": 0
  }
}
```


□□□□□

□□□□□□□□□□□

□□□ `POST /api/key_set`

□□□□


```
{
  "key_set": {
    "ki": "0123456789ABCDEF0123456789ABCDEF",
    "opc": "FEDCBA9876543210FEDCBA9876543210",
    "amf": "8000",
    "sqn": 0,
    "authentication_algorithm": "milenage"
  }
}
```


□□□□□

- `ki` - 128□□□□32□□□□□□□□
- `opc`□`op`□OPC□□□OP□□□
- `authentication_algorithm` - □□□□“milenage”

□□□□□□

- `amf` - □□□□“8000”
- `sqn` - □□□□0

- `ota_counter` - □□□□0

□□□□□

- □□□□□□□□□□□□□□□□
- Ki□OPC□OP□32□□□□□□□□□128□□
- AMF□4□□□□□□□□□16□□

□□□□□

```
curl -k -X POST https://hss.example.com:8443/api/key_set \
  -H "Content-Type: application/json" \
  -d '{
    "key_set": {
      "ki": "0123456789ABCDEF0123456789ABCDEF",
      "opc": "FEDCBA9876543210FEDCBA9876543210",
      "authentication_algorithm": "milenage"
    }
  }'
```

□□□□□ □□□□□□□□□□□□□□□□□□□□□□□□□□□API□□□

□□□□□

□□□□□□□□□

□□□ `PUT /api/key_set/:id`

□□□ □□□

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□□□□□□□

□□□ `DELETE /api/key_set/:id`

□□□ □□

□□□□□□

EPC□□□□

EPC□□□□□

□□	□□	□□	□□□
`name`	□□□□□□	□□	□□□□□
`ue_ambr_dl_kbps`	□□□□□□	Kbps	10000-1000000
`ue_ambr_ul_kbps`	□□□□□□	Kbps	5000-500000
`network_access_mode`	□□□□	□□□	"□□□"□"□□□□□"
`tracking_area_update_interval_seconds`	TAU□□□	□	600□□□□
`apn_profiles`	APN□□□□ID□□	□□	[]□[1, 2, 3]

□□□□□

```
curl -k -X POST https://hss.example.com:8443/api/epc/profile \
  -H "Content-Type: application/json" \
  -d '{
    "apn_profiles": [],
    "name": "□□100Mbps",
    "network_access_mode": "□□□",
    "tracking_area_update_interval_seconds": 600,
    "ue_ambr_dl_kbps": 100000,
    "ue_ambr_ul_kbps": 50000
  }'
```

□□□

- □□□□□□ - □□□□□□□□□□□□
- □□□□□□□□ - □□□□□□EPC□□□□

□□EPC□□□□

□□□ `PUT /api/epc/profile/:id`

□□□ □EPC□□□

□□	□□	□□□
`{{ imsi }}`	□□□IMSI	`001001123456789`
`{{ msisdns }}`	MSISDN□□□□□□□□	`["14155551234", "14155555678"]`
`{{ mcc }}`	□□□□□□	`001`
`{{ mnc }}`	□□□□□□	`001`

□□□□□□□□□□

IFC□□□□**Liquid**□□□□□□Jinja2□□□□□□IMS□□□□□□□□□

1. □□□□□IMS□□□□□□□□□□□□□□□□□□`{{ imsi }}`□`{% for msisdn in msisdns %}`□
2. □□□API□□□□□□□□□□□□□□□□□□□□□□□□□□□□XML□□□
3. □□□□□□□□□□□□IMS□□□MAA/SAA□□□HSS□
   - □□□□□□IMS□□□□
   - □□□□□□□□□□□□□□□
     - `{{ imsi }}` → □□□□IMSI
     - `{{ msisdns }}` → □□□□□□□□
     - `{{ mcc }}` → □□□□□□□□□
     - `{{ mnc }}` → □□□□□□□□□
   - □□Cx/Diameter□□□□XML□□□S-CSCF□

□□□□□

```
<!-- □□□□□□ -->
{{ imsi }}

<!-- □□□□□□ -->
{% for msisdn in msisdns %}
  <MSISDN>{{ msisdn }}</MSISDN>
{% endfor %}

<!-- □□□□ -->
{{ imsi }}@ims.mnc{{ mnc }}.mcc{{ mcc }}.3gppnetwork.org
```

IFC□□□□□

```
<?xml version="1.0" encoding="UTF-8"?>
<IMSSubscription>
<PrivateID>{{ imsi }}@ims.mnc{{ mnc }}.mcc{{ mcc
}}.3gppnetwork.org</PrivateID>
<ServiceProfile>
{% for msisdn in msisdns %}
<PublicIdentity>
<Identity>sip:{{ msisdn }}@ims.mnc{{ mnc }}.mcc{{ mcc
}}.3gppnetwork.org</Identity>
<Extension>
<IdentityType>0</IdentityType>
</Extension>
</PublicIdentity>
<PublicIdentity>
<Identity>tel:{{ msisdn }}</Identity>
<Extension>
<IdentityType>0</IdentityType>
</Extension>
</PublicIdentity>
{% endfor %}
<InitialFilterCriteria>
<Priority>10</Priority>
<TriggerPoint>
<ConditionTypeCNF>0</ConditionTypeCNF>
<SPT>
<ConditionNegated>0</ConditionNegated>
<Group>0</Group>
<Method>REGISTER</Method>
</SPT>
</TriggerPoint>
<ApplicationServer>
<ServerName>sip:as.ims.mnc{{ mnc }}.mcc{{ mcc
}}.3gppnetwork.org</ServerName>
<DefaultHandling>0</DefaultHandling>
</ApplicationServer>
</InitialFilterCriteria>
</ServiceProfile>
</IMSSubscription>
```

□□□□□curl□□

```
curl -k -X POST https://hss.example.com:8443/api/ims/profile \
  -H "Content-Type: application/json" \
  -d '{
    "name": "default",
    "ifc_template": "<?xml version=\"1.0\" encoding=\"UTF-8\"?>
<IMSSubscription><ServiceProfile>...</ServiceProfile>
</IMSSubscription>"
  }'
```

□□□□□Python□□

```
import requests

response = requests.post(
    "https://hss.example.com:8443/api/ims/profile",
    json={
        "name": "default",
        "ifc_template": ifc_template_string
    },
    verify=False  # □□□□□□□□
)
```

□□□□□201 Created□□

```
{
  "status": "success",
  "response": {
    "id": "0f8fad5b-d9cb-469f-a165-70867728950e",
    "name": "default",
    "ifc_template": "<?xml version=\"1.0\" encoding=\"UTF-8\"?
>..."
  }
}
```

□□□

- API□□IFC□□□□□□□□□XML
- □□□□□□□□□□□□□□□□□□□
- `name`□□□□□□□□□□

□□□

- □□□□□□□ - IFC□□□□□□□□□□
- □□□□ - IMS□□□□□□□□
- □□IFC□□ - □□□□

APN□□□□

APN□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□

1. **APN□□□** - □□APN□□□IP□□
2. **APN QoS□□□□** - □□□□□□□□□
3. **APN□□□□** - □□□□□□□QoS□□□□EPC□□□□

□□□**PCRF**□□□□□□□□□□□□□□□**QoS**□□□□□□□□□□□□□□□ □□□□□□□□□□□□□APN□□□□□

□□**APN**□□□

□□□ `GET /api/apn/identifier`

□□**APN**□□□

□□□ `POST /api/apn/identifier`

□□□□

```
{
  "apn": "internet",
  "ip_version": "ipv4v6"
}
```

IP□□□□

- `"ipv4"` - □IPv4
- `"ipv6"` - □IPv6
- `"ipv4v6"` - IPv4v6□□□□
- `"ipv4_or_ipv6"` - IPv4□IPv6□□□□□□

□□APN QoS□□□□

□□□ `GET /api/apn/qos_profile`

□□APN QoS□□□□

□□□ `POST /api/apn/qos_profile`

□□□□

```
{
  "name": "□□□□□□□□",
  "allocation_retention_priority": 8,
  "apn_ambr_dl_kbps": 50000,
  "apn_ambr_ul_kbps": 25000,
  "pre_emption_capability": false,
  "pre_emption_vulnerability": true,
  "qci": 9
}
```

□□APN□□□□

□□□ `GET /api/apn/profile`

□□APN□□□□

□□□ `POST /api/apn/profile`

□□□□

```
{
  "apn_identifier_id": "4fa85f64-5717-4562-b3fc-2c963f66afa6",
  "apn_qos_profile_id": "8d8ac610-566d-4ef0-9c22-186b2a5ed793",
  "name": "□□□APN"
}
```

□□□□□

- `apn_identifier_id` - □□□□□□□□APN□□□
- `apn_qos_profile_id` - □□□□□□□□APN QoS□□□□

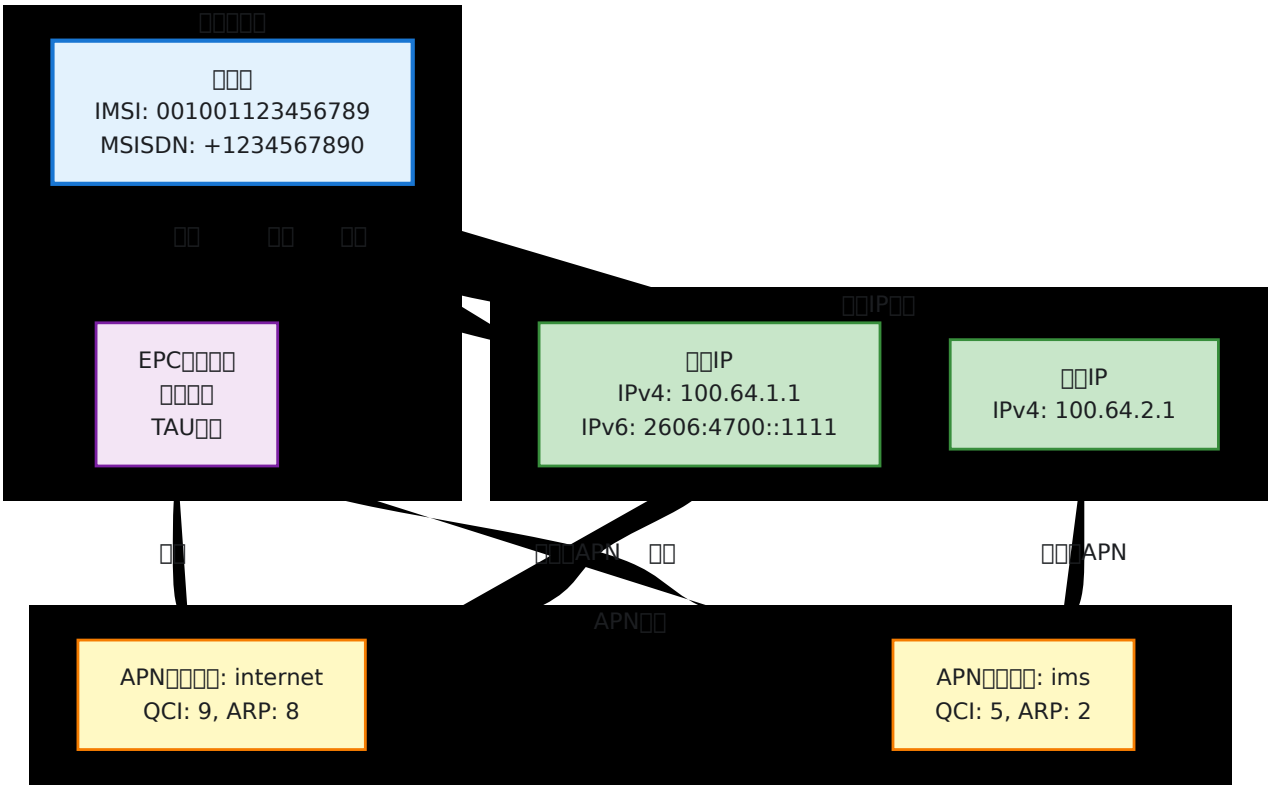
□□□

- □□□□□□□□□ - □□APN□□□□□□□
- EPC□□□□ - APN□□□□□□□EPC□□□□

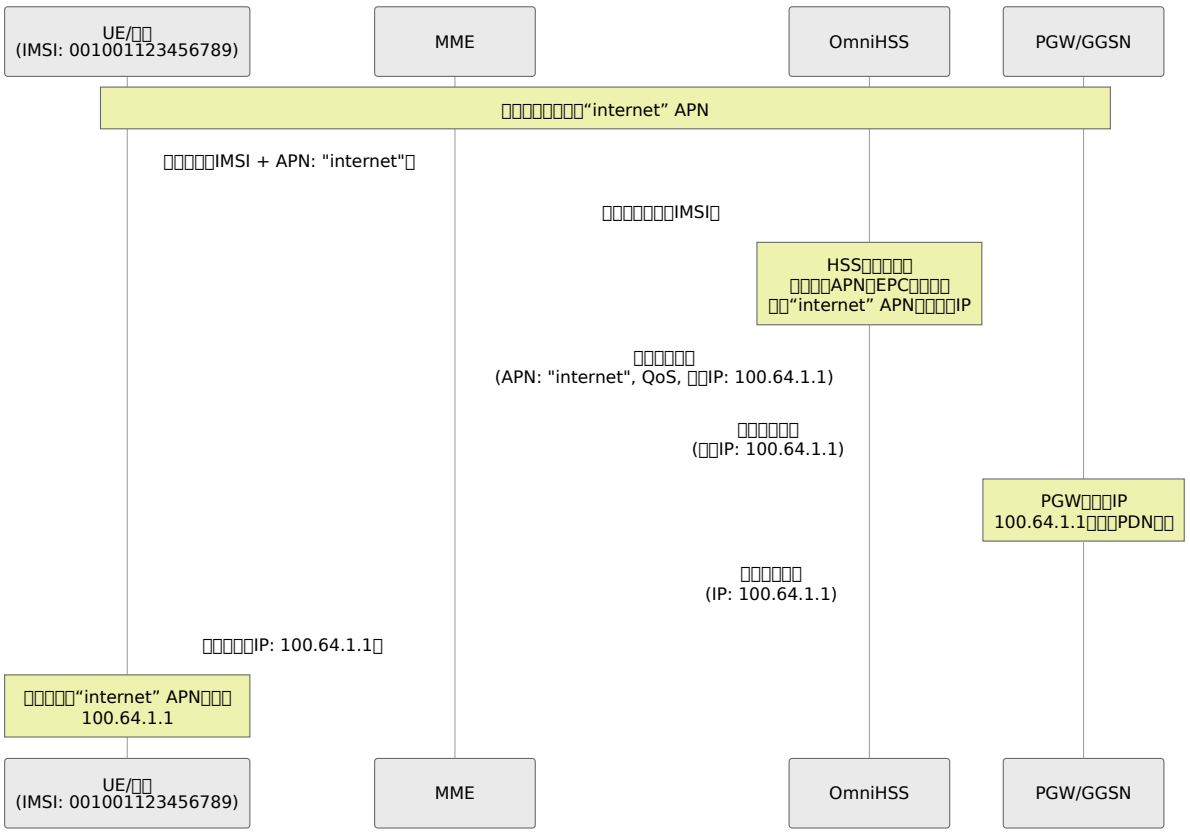
□□IP□□

□□IP□□□□□□□□□APN□□□□□□□□□□□□□□□□□□□□□□□APN□□□□□□IPv4□/□IPv6□□□□□□□
DHCP□□□□□□□□□

□□□



□□□□□□□□□□□□□□



□□□□□□□ - **APN**□□□□□□□□

□□□□□□S6a□□□□□□□APN-□□AVP□□□□□□□□□

- □□ **APN** □□□□□□□□ IP □□□□□ APN □□□□ □□□
- □□□□□□□□ **APN** □□ **IP**□□□□□□□□□□ APN □□□□□□□□□ IP □□
- □□ **IPv4** □ **IPv6**□□□ IP □□□□ IPv4□□ IPv6 □□□
- □□ **IP** □□□□□□□ IP □□□□□□□□ □□ □□ IP □□□□□□□□□□□□
  - □□□ IPv4 □ IPv6 □□□□□□□□□□□□□□□□□□□□□□□ APN □□
  - □□□□□□□□□□□ IP □□□□
  - □□ `ipv4_static_ip` □ `ipv6_static_ip` □□□□□□□□□□□□□□□□
- □□□□□□□□□□□□□ IP □□□□□□□□

□□□

- IoT □□□□□ IP □□
- □□□□□□□□□□□□□□□□□ IP □□□□□□□□□
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- □□ IP □□□□□□□□□

□□□□ IP

□□□□□□ IP □□□

□□□ `GET /api/epc/static_ip`

□□□□□

```
curl -k https://hss.example.com:8443/api/epc/static_ip
```

□□□□□

```
{
  "data": [
    {
      "id": "c56a4180-65aa-42ec-a945-5fd21dec0538",
      "apn_profile_id": "a1b2c3d4-e5f6-4a3b-8c2d-1e0f9a8b7c6d",
      "ipv4_static_ip": "100.64.1.1",
      "ipv6_static_ip": "2606:4700:4700::1111",
      "apn_profile": {
        "id": "a1b2c3d4-e5f6-4a3b-8c2d-1e0f9a8b7c6d",
        "name": "Internet APN",
        "apn_identifier": {
          "apn": "internet",
          "ip_version": "ipv4v6"
        }
      },
      "inserted_at": "2025-11-15T10:30:00Z",
      "updated_at": "2025-11-15T10:30:00Z"
    }
  ]
}
```


□□□□ IP

□□□□□□□ IP □□□

□□□ `GET /api/epc/static_ip/:id`

□□□□□

□□	□□	□□
`id`	string (UUID)	□□ IP □□□ ID

□□□□□

```
curl -k https://hss.example.com:8443/api/epc/static_ip/c56a4180-65aa-42ec-a945-5fd21dec0538
```

□□□□ IP

□ APN □□□□□□ IP □□□

□□□ `POST /api/epc/static_ip`

□□□□

```
{
  "static_ip": {
    "apn_profile_id": "a1b2c3d4-e5f6-4a3b-8c2d-1e0f9a8b7c6d",
    "ipv4_static_ip": "100.64.1.1",
    "ipv6_static_ip": "2606:4700:4700::1111"
  }
}
```

□□□□□

- `apn_profile_id` - □□□□□□□ APN □□□
- □□□ `ipv4_static_ip` □ `ipv6_static_ip` □□□□□

□□□□□

- `ipv4_static_ip` - IPv4 □□□□□□□□□□□□
- `ipv6_static_ip` - IPv6 □□□□□□□□□

IP □□□□□

- IPv4□□□□□□□□□□□□□□□`100.64.1.1`□
- IPv6□□□□□□□□□□□□□□□□□□□`2606:4700:4700::1111`□
- IPv4 □ IPv6 □□□□□ □□□□ **IP** □□□□□□□
  - □□□□□□□□□ IP □□□□
  - □□□ IP □□□□□□□□□□□□□□□□□ APN □
  - □□□□□□□□□□□□□□□□□□□□□□

□□□□□

□□	IPv4	IPv6	□□
□ IPv4	✓	-	`{"ipv4_static_ip": "100.64.1.1"}`
□ IPv6	-	✓	`{"ipv6_static_ip": "2606:4700:4700::1111"}`
□□	✓	✓	□□□□□□□□□

□□□□□

□ IPv4 □□□ IP□

```
curl -k -X POST https://hss.example.com:8443/api/epc/static_ip \
  -H "Content-Type: application/json" \
  -d '{
    "static_ip": {
      "apn_profile_id": "a1b2c3d4-e5f6-4a3b-8c2d-1e0f9a8b7c6d",
      "ipv4_static_ip": "100.64.1.1"
    }
  }'
```

□ IPv6 □□□ IP□

```
curl -k -X POST https://hss.example.com:8443/api/epc/static_ip \
  -H "Content-Type: application/json" \
  -d '{
    "static_ip": {
      "apn_profile_id": "b2c3d4e5-f6a7-4b1c-9d2e-3f4a5b6c7d8e",
      "ipv6_static_ip": "2606:4700:4700::1111"
    }
  }'
```

□□□□ IP□

```
curl -k -X POST https://hss.example.com:8443/api/epc/static_ip \
  -H "Content-Type: application/json" \
  -d '{
    "static_ip": {
      "apn_profile_id": "a1b2c3d4-e5f6-4a3b-8c2d-1e0f9a8b7c6d",
      "ipv4_static_ip": "100.64.1.1",
      "ipv6_static_ip": "2606:4700:4700::1111"
    }
  }'
```

□□□□ **(201 □□)**□

```
{
  "data": {
    "id": "c56a4180-65aa-42ec-a945-5fd21dec0538",
    "apn_profile_id": "a1b2c3d4-e5f6-4a3b-8c2d-1e0f9a8b7c6d",
    "ipv4_static_ip": "100.64.1.1",
    "ipv6_static_ip": "2606:4700:4700::1111",
    "inserted_at": "2025-11-15T10:30:00Z",
    "updated_at": "2025-11-15T10:30:00Z"
  }
}
```

□□□□□

- □□□ IP □□□□□□ - □□□□□□□□□□
- APN □□□ - □□ APN □□

□□□ IP

□□□□□□□ IP □□□

□□□ `PUT /api/epc/static_ip/:id`

□□□□□

□□	□□	□□
`id`	string (UUID)	□□ IP □□□ ID

□□□□

```
{
  "static_ip": {
    "ipv4_static_ip": "100.64.1.2",
    "ipv6_static_ip": "2606:4700:4700::1112"
  }
}
```

□□□□□□

- `ipv4_static_ip` - □□ IPv4 □□
- `ipv6_static_ip` - □□ IPv6 □□
- `apn_profile_id` - □□ APN □□

□□□□□

- `id` - □□□□□□

□□□ □□□□□□□□ IP □□□□□□□□□□□ PDN □□□□□ PDN □□□□□□□□ IP□□□□□□□□□□□□□

□□□□□

```
curl -k -X PUT
https://hss.example.com:8443/api/epc/static_ip/c56a4180-65aa-42ec-
a945-5fd21dec0538 \
  -H "Content-Type: application/json" \
  -d '{
    "static_ip": {
      "ipv4_static_ip": "100.64.1.2"
    }
  }'
```

□□□□ IP

□□□□ IP □□□

□□□ `DELETE /api/epc/static_ip/:id`

□□□□□

□□	□□	□□
`id`	string (UUID)	□□ IP □□□ ID

□□□□□

```
curl -k -X DELETE
https://hss.example.com:8443/api/epc/static_ip/c56a4180-65aa-42ec-
a945-5fd21dec0538
```

□□□

- □□□□ IP □□
- □□□ APN □□□□□□APN □□□□□□□□□□□□
- □□□□□ IP □□□□□□□□□□□□□□□□□ IP
- □□□□IP □□□□□□□□

□□□ □□□□□□□□□□□□□ IP□□□□□□□□□□□□□ PDN □□□□□□□□ IP□□□□□□□□□□□□□□□□□□□□□□□□ □□□ □□□□□

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□□□□□

1. □□□□ **IP**□□□□ □□□□ IP□
2. □□ `static_ips` □□□□□□□□□

□□□□□□ **IP** □□□□□

```
# □□ 1□□ "internet" APN □□□□ IP
STATIC_IP_ID=$(curl -k -X POST
https://hss.example.com:8443/api/epc/static_ip \
  -H "Content-Type: application/json" \
  -d '{
    "static_ip": {
      "apn_profile_id": "a1b2c3d4-e5f6-4a3b-8c2d-1e0f9a8b7c6d",
      "ipv4_static_ip": "100.64.1.1",
      "ipv6_static_ip": "2606:4700:4700::1111"
    }
  }' | jq -r '.data.id')

# □□ 2□□□□□□□□ IP □□□□
curl -k -X POST https://hss.example.com:8443/api/subscriber \
  -H "Content-Type: application/json" \
  -d "{
    \"subscriber\": {
      \"imsi\": \"001001123456789\",
      \"key_set_id\": \"6ba7b810-9dad-41d1-80b4-00c04fd430c8\",
      \"epc_profile_id\": \"e58ed763-928c-4155-bee9-
fdbaaadc15f3\",
      \"static_ips\": [$STATIC_IP_ID]
    }
  }"
```

□□□□□□□□□ **IP** □□□□□

```
curl -k -X PUT
https://hss.example.com:8443/api/subscriber/d290f1ee-6c54-4b01-
90e6-d701748f0851 \
  -H "Content-Type: application/json" \
  -d '{
    "subscriber": {
      "static_ips": ["c56a4180-65aa-42ec-a945-5fd21dec0538",
"5a8f9c3e-2d4b-4e6f-8a1b-3c5d7e9f0a2b"]
    }
  }'
```

□□□□ **IP**□□□ **APN**□□

□□□□□□□□□□□ IP□□□□□ IP □□□□□ APN□

```
# □ "internet" APN □□□□ IP
INTERNET_IP=$(curl -k -X POST
https://hss.example.com:8443/api/epc/static_ip \
  -H "Content-Type: application/json" \
  -d '{
    "static_ip": {
      "apn_profile_id": "a1b2c3d4-e5f6-4a3b-8c2d-1e0f9a8b7c6d",
      "ipv4_static_ip": "100.64.1.1"
    }
  }' | jq -r '.data.id')

# □ "ims" APN □□□□ IP
IMS_IP=$(curl -k -X POST
https://hss.example.com:8443/api/epc/static_ip \
  -H "Content-Type: application/json" \
  -d '{
    "static_ip": {
      "apn_profile_id": "b2c3d4e5-f6a7-4b1c-9d2e-3f4a5b6c7d8e",
      "ipv4_static_ip": "100.64.2.1"
    }
  }' | jq -r '.data.id')

# □□□ IP □□□□□□
curl -k -X POST https://hss.example.com:8443/api/subscriber \
  -H "Content-Type: application/json" \
  -d "{
    \"subscriber\": {
      \"imsi\": \"001001123456789\",
      \"key_set_id\": \"6ba7b810-9dad-41d1-80b4-00c04fd430c8\",
      \"epc_profile_id\": \"e58ed763-928c-4155-bee9-
fdbaaadc15f3\",
      \"static_ips\": [$INTERNET_IP, $IMS_IP]
    }
  }"
```

□□□□□

- ✓ □□□□□ APN □□□□□ IP
- ✗ □□□□□ APN □□□□□ IP

□□□□ **-** □□ **APN**□

```
# □□□□□□□ IP □□□□□□ APN□□□□□□
curl -k -X POST https://hss.example.com:8443/api/subscriber \
  -H "Content-Type: application/json" \
  -d '{
    "subscriber": {
      "imsi": "001001123456789",
      "static_ips": ["c56a4180-65aa-42ec-a945-5fd21dec0538",
"5a8f9c3e-2d4b-4e6f-8a1b-3c5d7e9f0a2b"]
    }
  }'

# □□□□□□
{
  "errors": {
    "static_ips": [
      "□□□□□□□□ APN □□□ IP □□□□□□□□□□□□□□□□□ internet □□□□ IP
100.64.1.1□□□□□ internet □□ 100.64.1.2"
    ]
  }
}
```

□□□□□

- □□□□□ - □□□□□
- □□□□□ - □□□□□□□□
- □□□□□ IP □□□□ - □□□□□□□

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□□□□□□□□□

□□□ `GET /api/roaming/profile`

□□□□□□□□

□□□ `POST /api/roaming/profile`

□□□□

```
{
  "roaming_profile": {
    "name": "□□□□□□□",
    "data_action_if_no_rules_match": "deny",
    "ims_action_if_no_rules_match": "deny",
    "roaming_rules": []
  }
}
```

□□□□

- `"allow"` - □□
- `"deny"` - □□

□□□□□

- `data_action_if_no_rules_match` - □□□ □□□□ □□□□□□
- `ims_action_if_no_rules_match` - IMS □□□□□□□

□□□□□□

□□□ `GET /api/roaming/rule`

□□□□□□

□□□ `POST /api/roaming/rule`

□□□□

```
{
  "roaming_rule": {
    "name": "□□ AT&T",
    "mcc": "310",
    "mnc": "410",
    "data_action": "allow",
    "ims_action": "allow"
  }
}
```

□□□

- `mcc` - □□□□□□□□3 □□□□
- `mnc` - □□□□□□□□2-3 □□□□
- `data_action` - `"allow"` □ `"deny"` □□□□
- `ims_action` - `"allow"` □ `"deny"` IMS/□□□□

□□□□□

- □□□□ - □□□□□□□□
- □□□□ - □□□□□ Diameter □□□□□□□

EIR □□

OmniHSS □□ S13 Diameter □□□□□□□□□□□□EIR□□EIR □□□□□□□□ IMEISV □□□□□□□□□□□□ □□ IMEI□□□□□□□□ IMSI□□□□□□□□□□□□□□□ `precedence` □□□□□□□□□□□□□□□□□□

□□□□□□□□□□□□**S13** □□□□□**IMEI** □□□ □□□□□ □□□□□□□□ **EIR** □□□

□□ EIR □□

□□□□ EIR □□□

□□□ `GET /api/eir/rule`

□□□ `id` □□□□□□□ `precedence` □□□□□□□□□□

□□ EIR □□

□□□□ EIR □□□

□□□ `GET /api/eir/rule/:id`

□□ EIR □□

□□□□□□□□□□□□□□□□□□

□□□ `POST /api/eir/rule`

□□□□

```
{
  "action": "blacklist",
  "regex": "35979139461640",
  "precedence": 1
}
```

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- `action` - `"whitelist"`□□□□□`"blacklist"`□□□□□ `"greylist"`□□□□□□□
- `regex` - □□ IMEISV□IMEI □ IMSI □□□□□□□□□□□□□□

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- `precedence` - □ 1 □ 65535 □□□□□□□□□□□□□□□□□□□

```
{
  "status": "success",
  "response": {
    "id": "0362b7ab-9bd6-4d8a-8b1a-2f4c6e8d0a1c",
    "action": "blacklist",
    "regex": "35979139461640",
    "precedence": 1
  }
}
```

□□□□ `precedence` □□□□□□□□□□□□□□□□□□□□ `action`□□□□□□□□ `regex`□`precedence` □□ 1 □ 65535□□□ HTTP 422□□□□ □□□□□□□□

□□ EIR □□

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□□□ `PATCH /api/eir/rule/:id` □ `PUT /api/eir/rule/:id`

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- EIR □□ - □□□□□□□□□□□□ S13 □
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- □□□□□ - OmniHSS EIR □□

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□□□ `GET /api/status`

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```
curl -k https://hss.example.com:8443/api/status
```

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```
{
  "status": "ok"
}
```

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OmniHSS □□□□

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OmniHSS □□ Elixir □ Erlang/OTP □□□□□□

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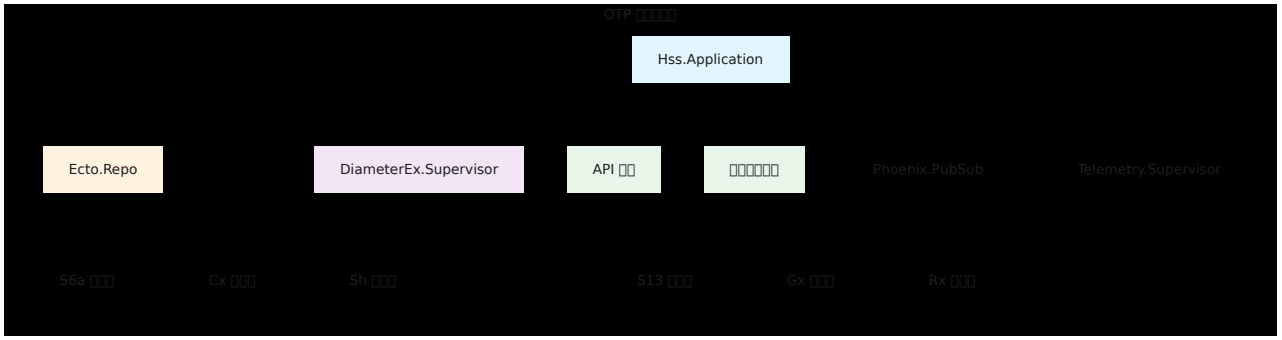
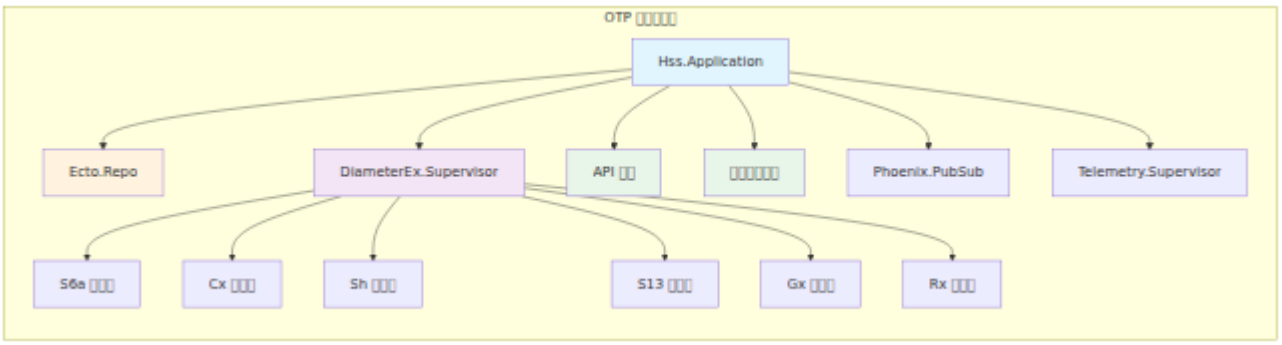


Diameter □□□□□

□□ Diameter □□□S6a, Cx, Sh, S13, Gx, Rx□□□□□□ DiameterEx □□□□□□□□□□□□□□□

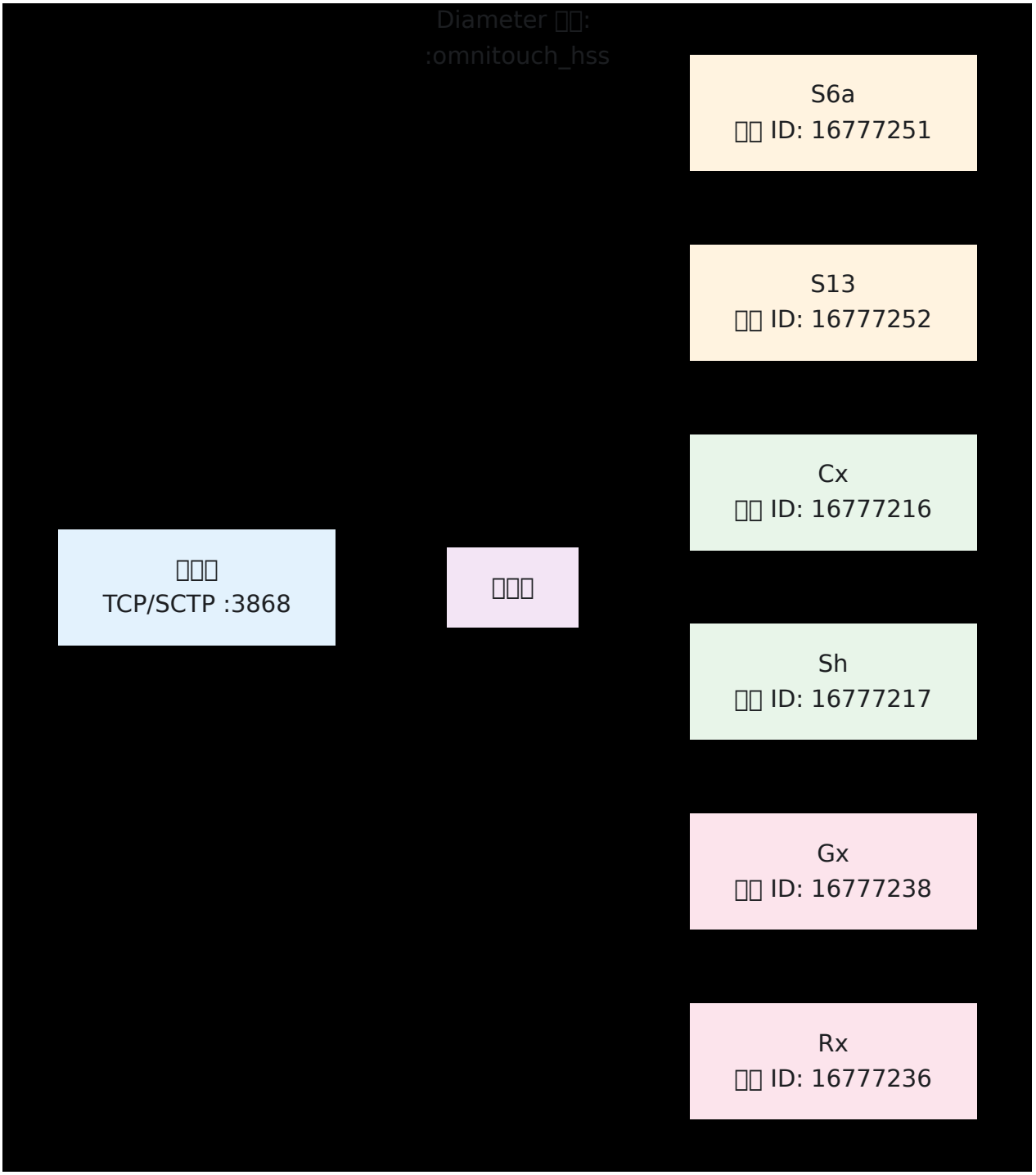
1. □ **DiameterEx** □□ - □□□□□ Diameter □□ ID
2. □□□□ - □□ AVP□□□□□□□
3. □□□□□□□ - □□□□□□□□□□□
4. □□□□ - □□ AVP □□ Diameter □□□□
5. □□□□ - □□□□□ Diameter □□□□



Diameter □

Diameter □□□□

OmniHSS □□□□□□□□ Diameter □□□□□□□□□□□□



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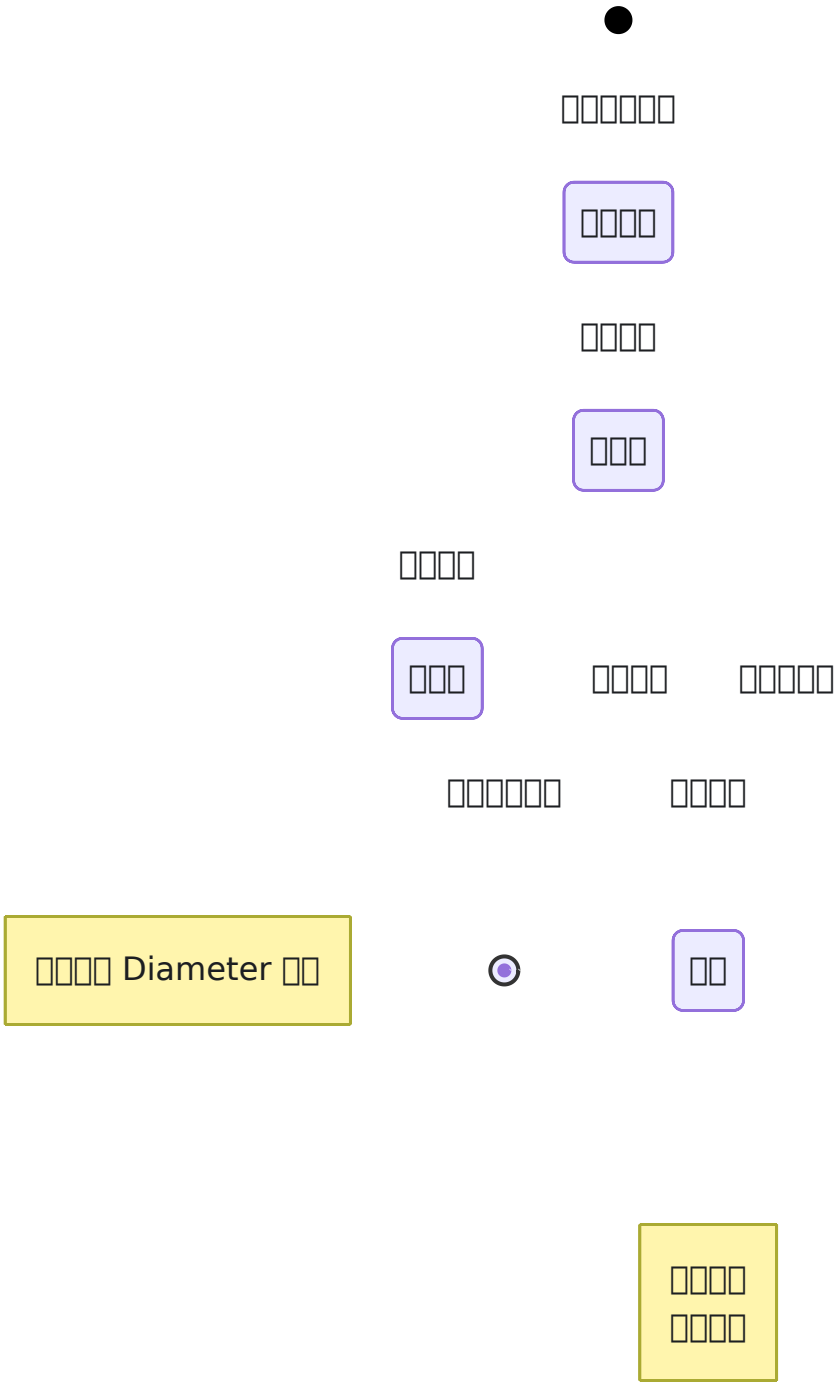
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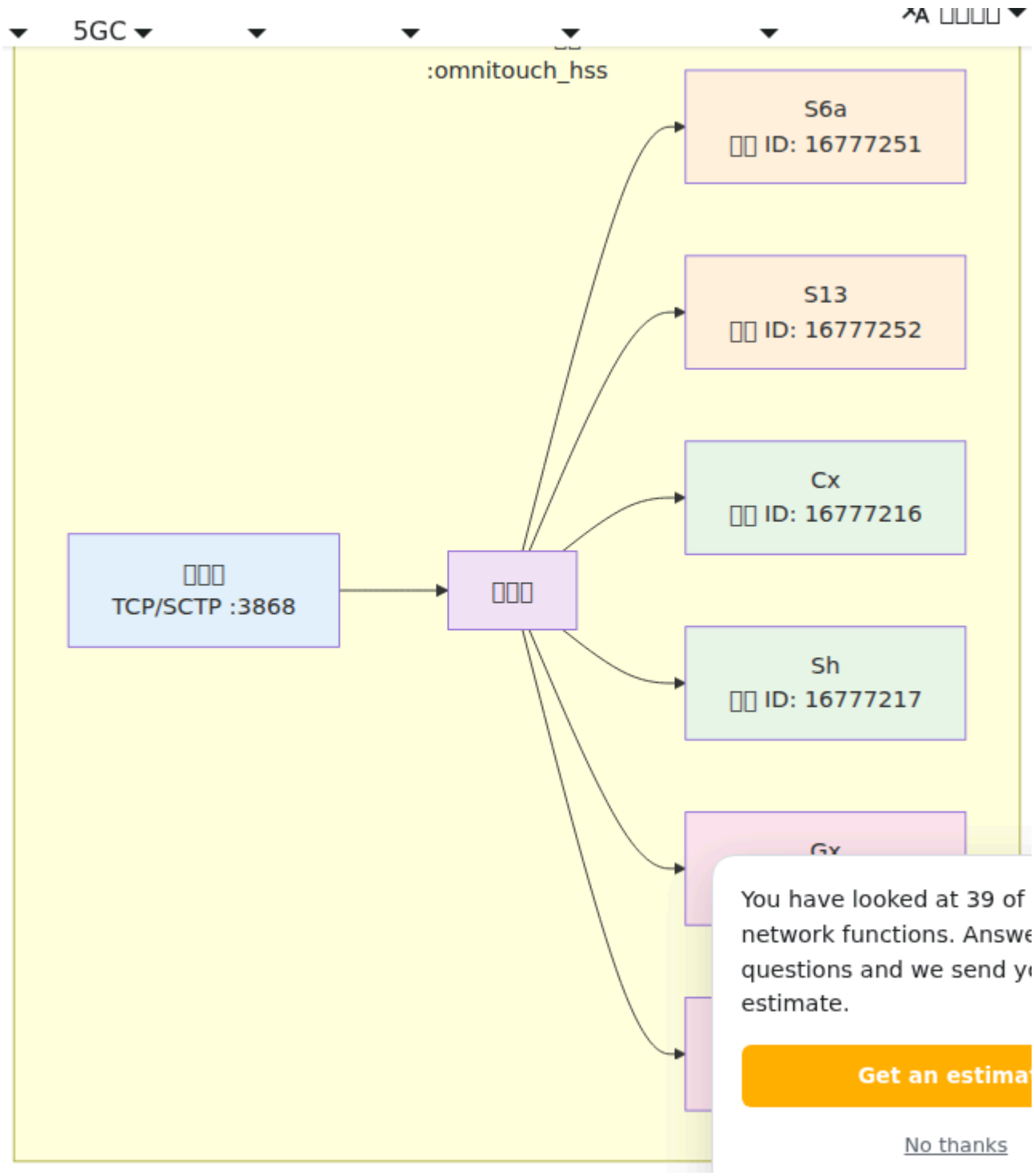
5GC
:omnitouch_hss
S6a
□□ ID: 16777251
S13
□□ ID: 16777252
Cx
□□ ID: 16777216
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TCP/SCTP :3868
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Gx
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network functions. Answe
questions and we send y
estimate.
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S6a □□ (LTE/EPC)

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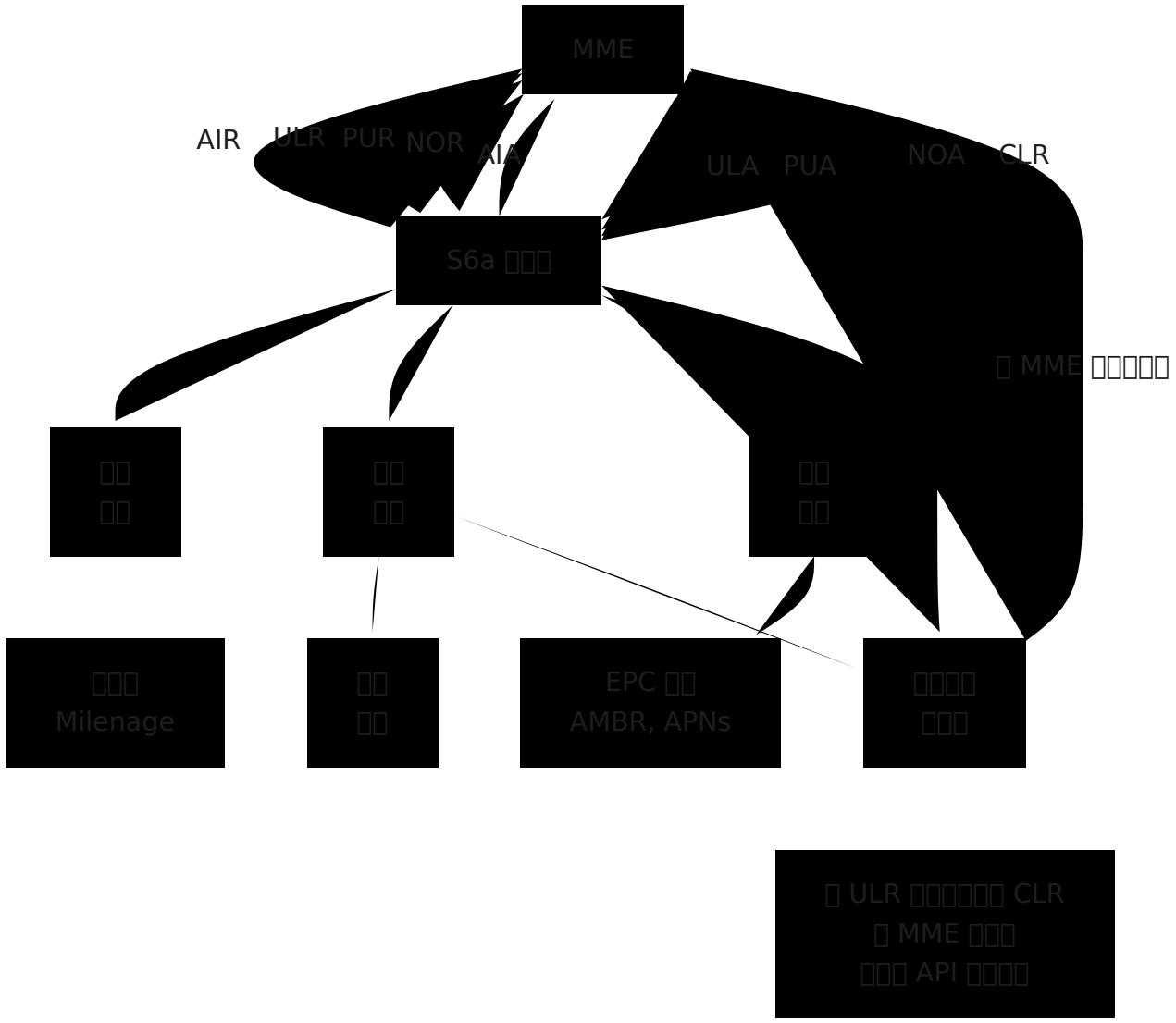
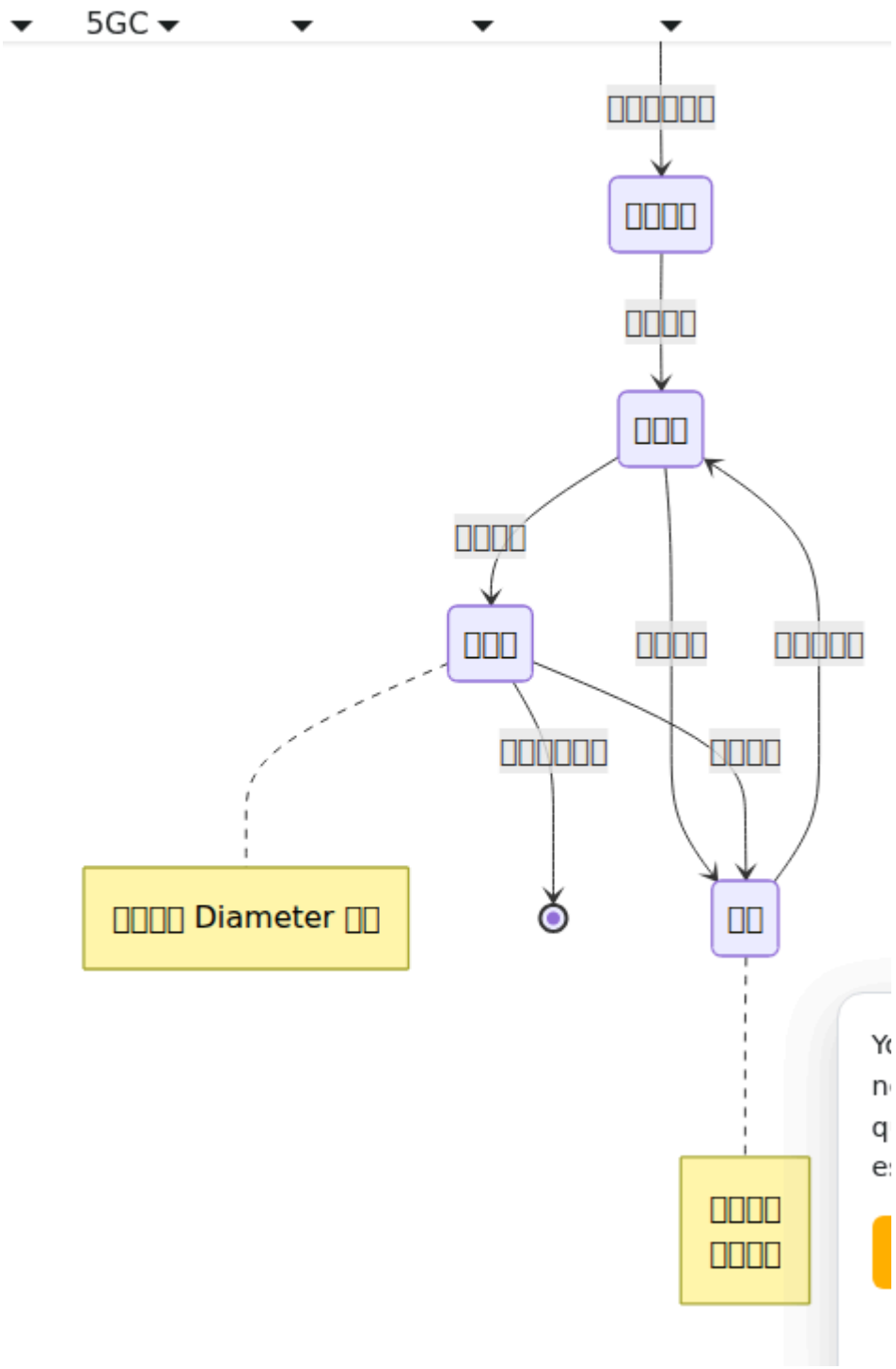


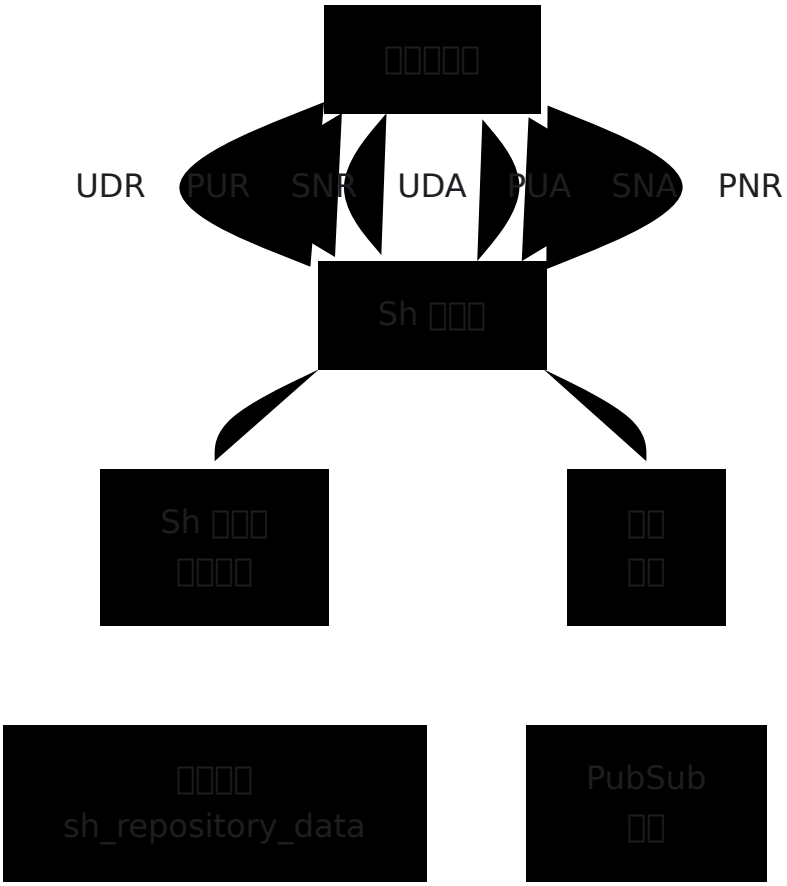
Cx □□ (IMS)

□□ IMS □□□□□□



Sh □□ (IMS □□□□)

□ IMS □□□□□□□□□□□□□□□□□□□□□□□□



Gx □□ (□□□□)

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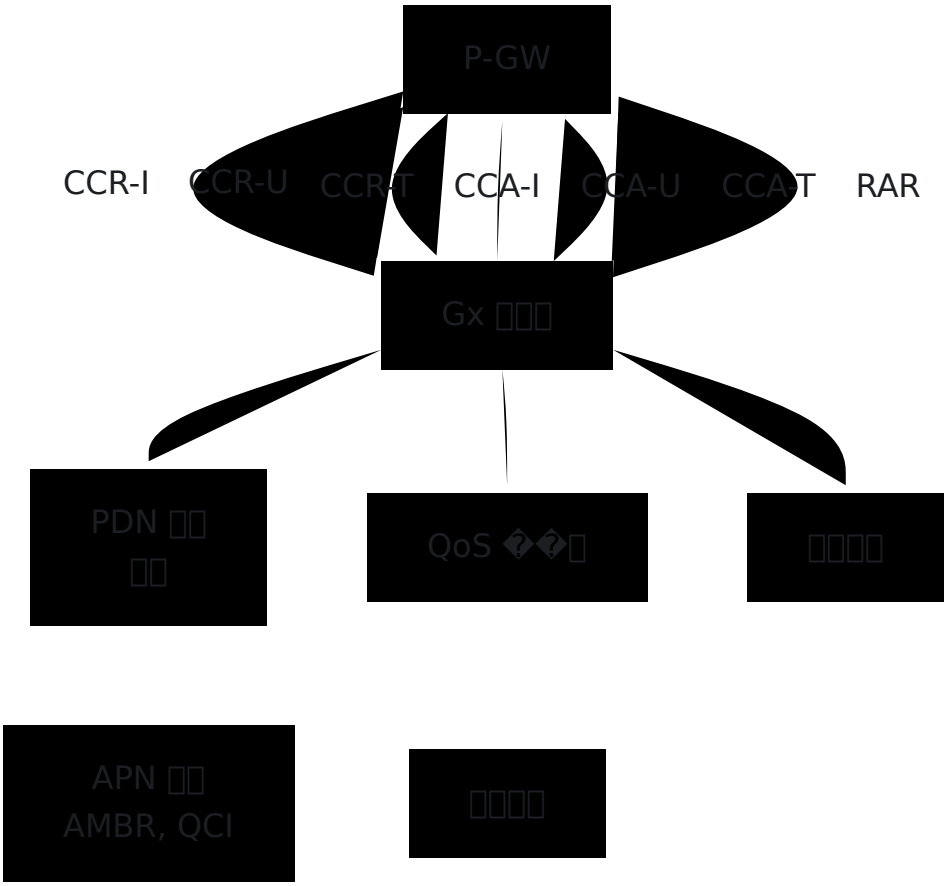
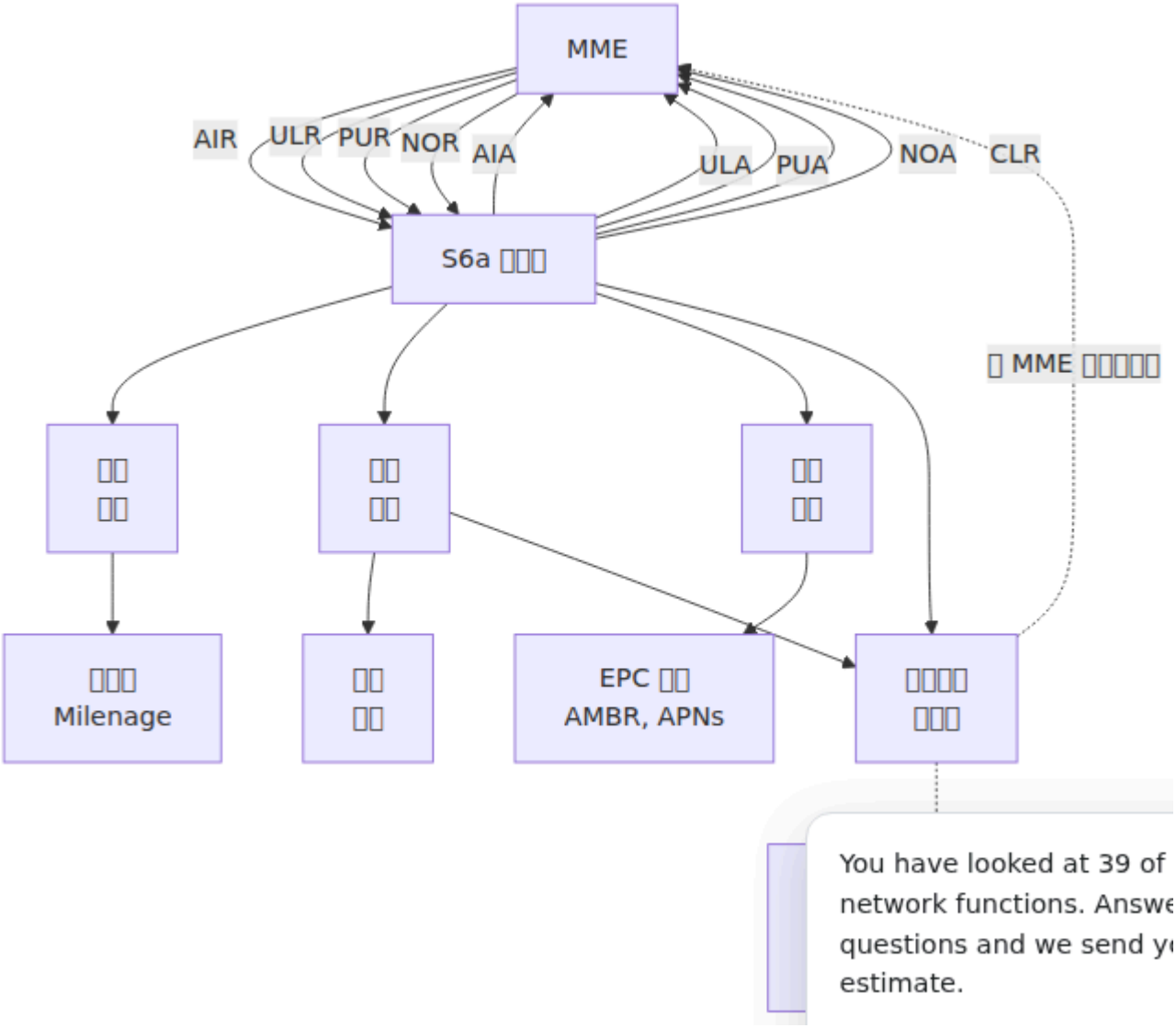


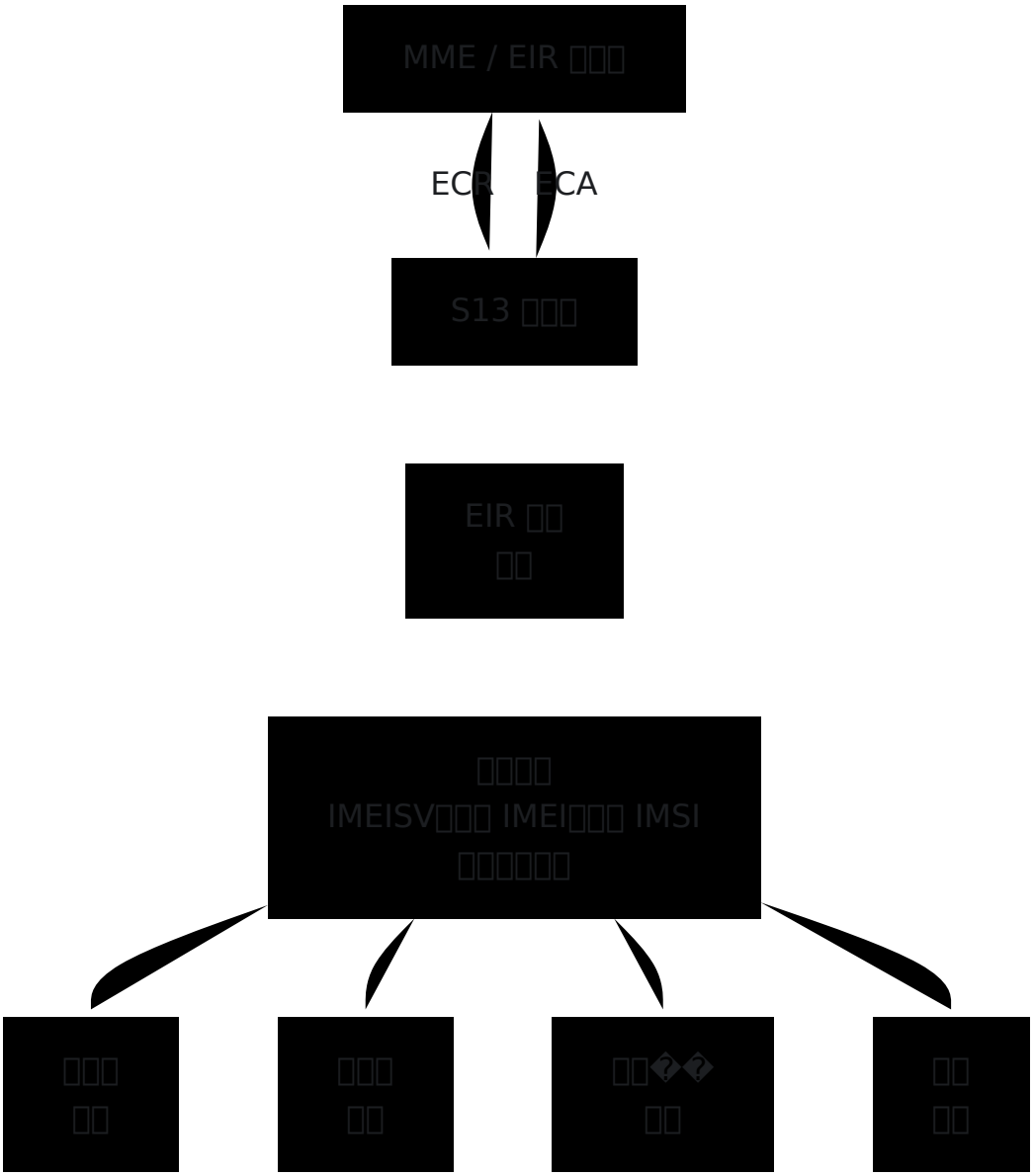
Rx □□ (IMS □□)

□□ IMS □□□□□ VoLTE □□□□□□□□□□□□□□□□ **PCRF** □□□



S13 □□ (EIR)

OmniHSS □□ EIR□□□□□□ IMEISV □ IMEI□□□ ECR □□□□□□ AVP □□□□□□□□ IMSI□□□□□ □□□□□□□□□□□□□□□□□□□□□□□□□□□□□ **EIR □□**□



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OmniHSS □□ **PostgreSQL** □□□□□□□□□□□□□ **Ecto** □□□□□□□□□□□□□□□□□□ UUID □□□□□□□ □□□□□□□□□□□□□□□□□

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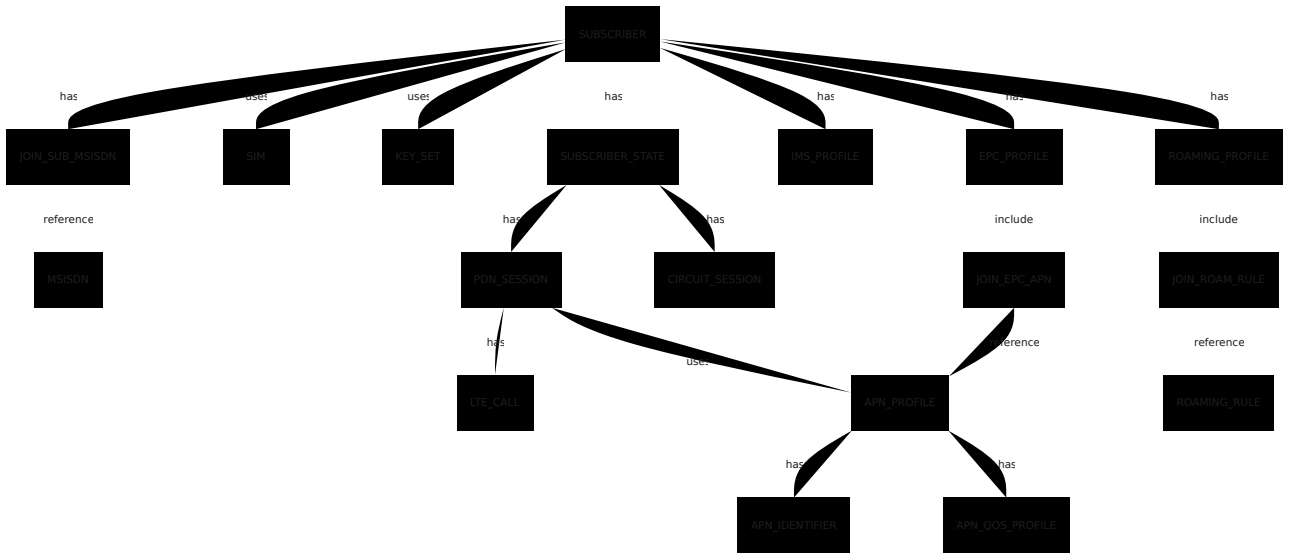
SUBSCRIBER
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JOIN_SUB_MSISDN
SIM
KEY_SET
SUBSCRIBER_STATE
IMS_PROFILE
EPC_PROFILE
ROAMING_PROFILE
reference
include
include
MSISDN
PDN_SESSION
CIRCUIT_SESSION
JOIN_EPC_APN
JOIN_ROAM_RULE
has
reference
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LTE_CALL
APN_PROFILE
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has
APN_IDENTIFIER
APN_QOS_PROFILE

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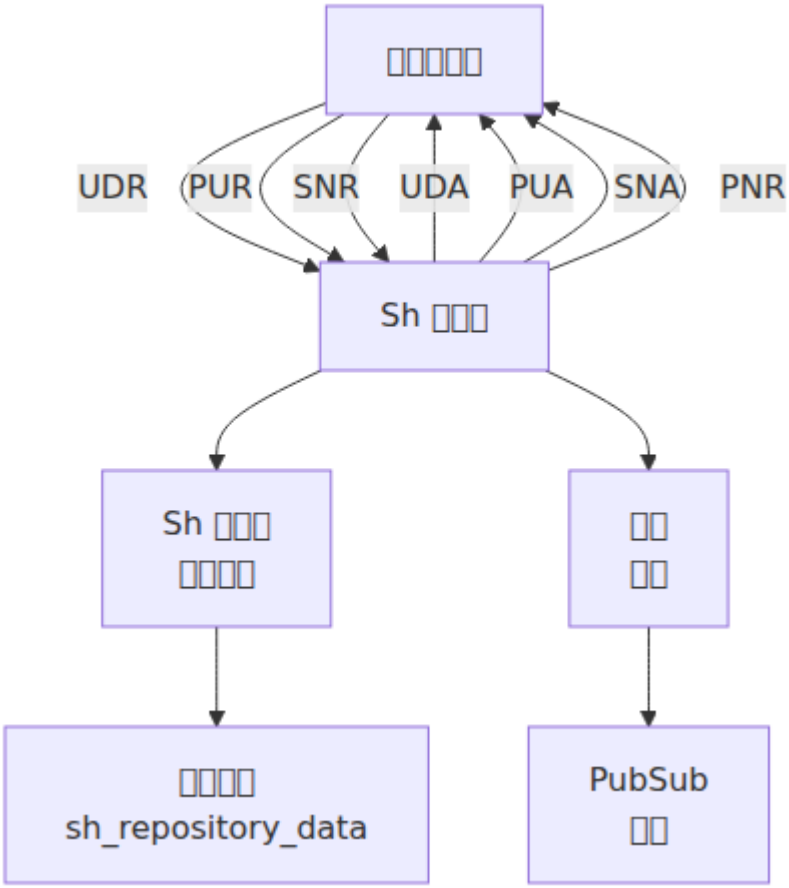
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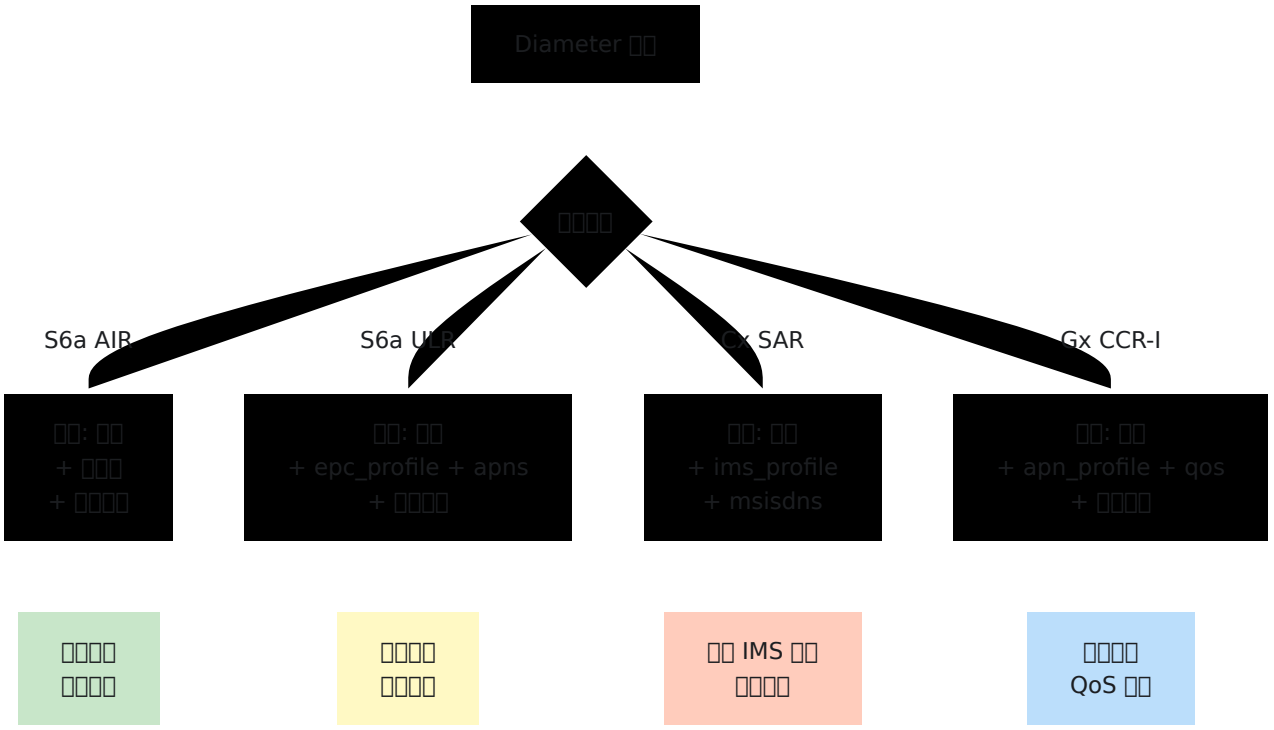
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Gx CCR-I
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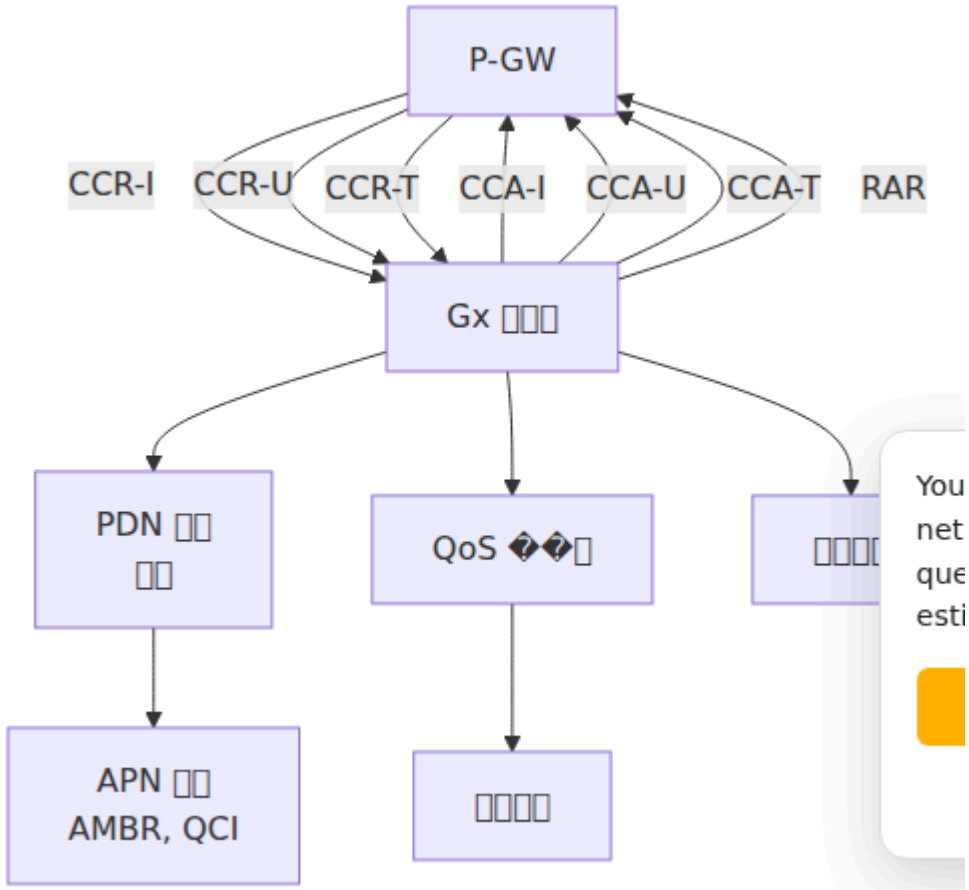

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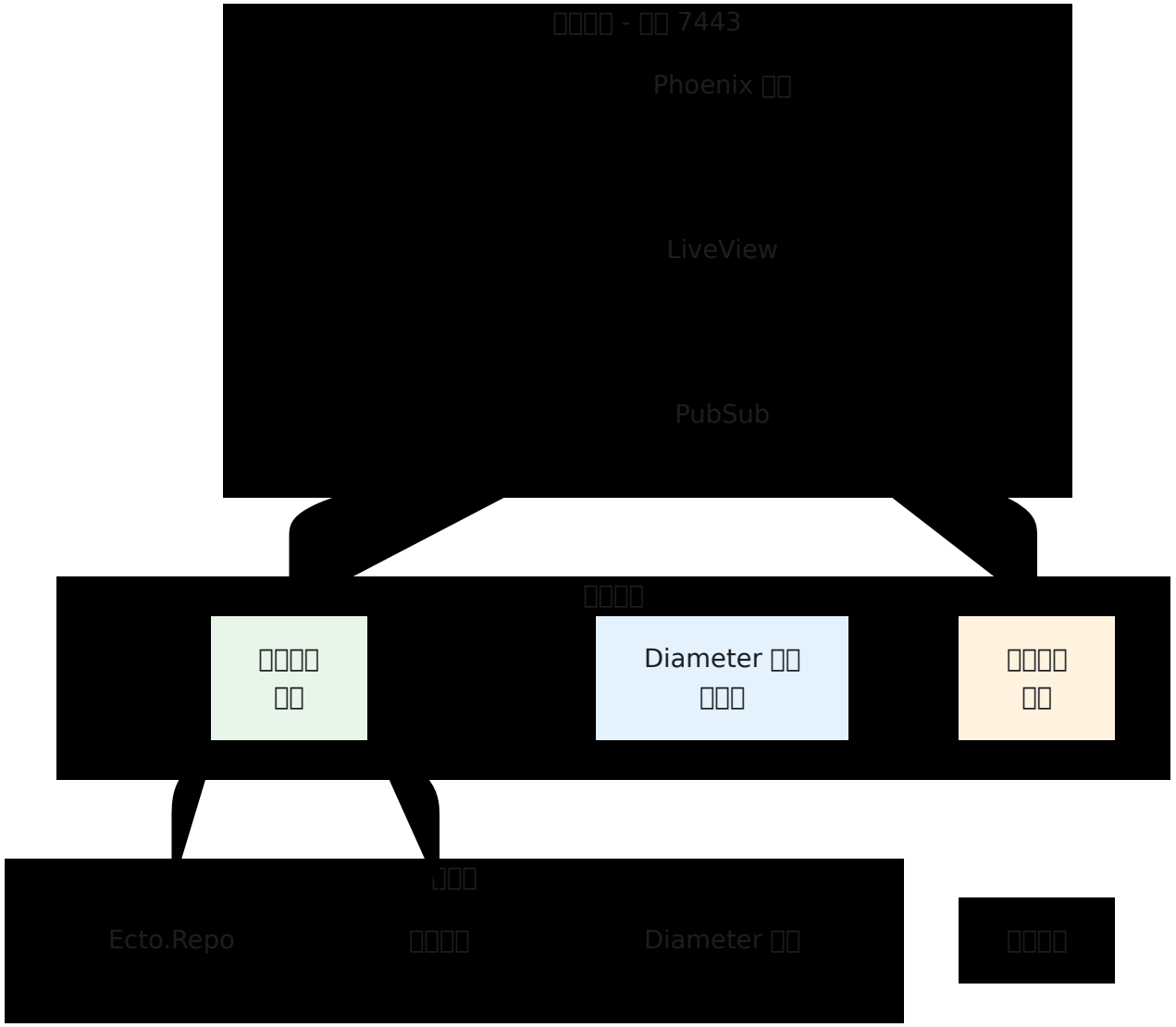
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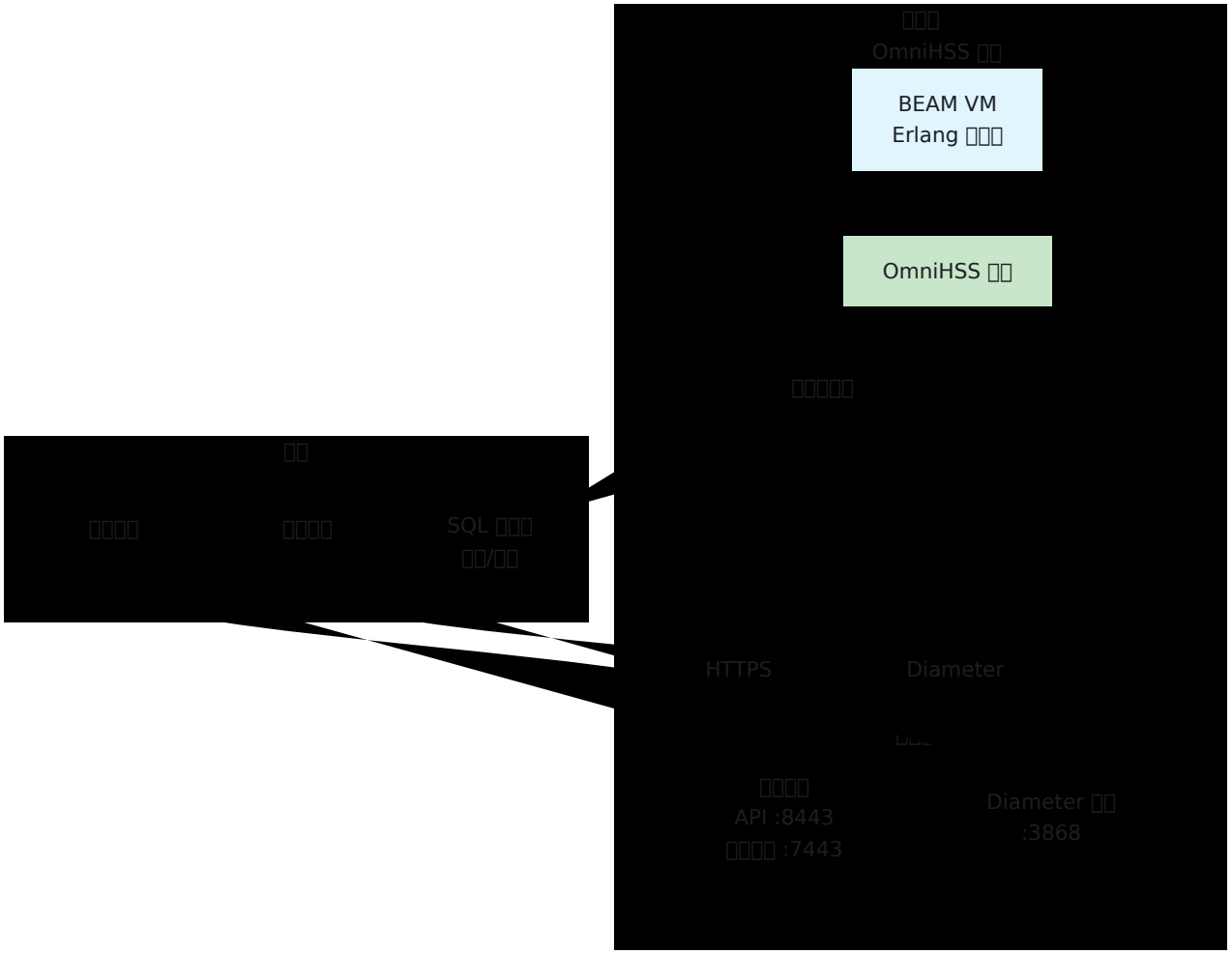

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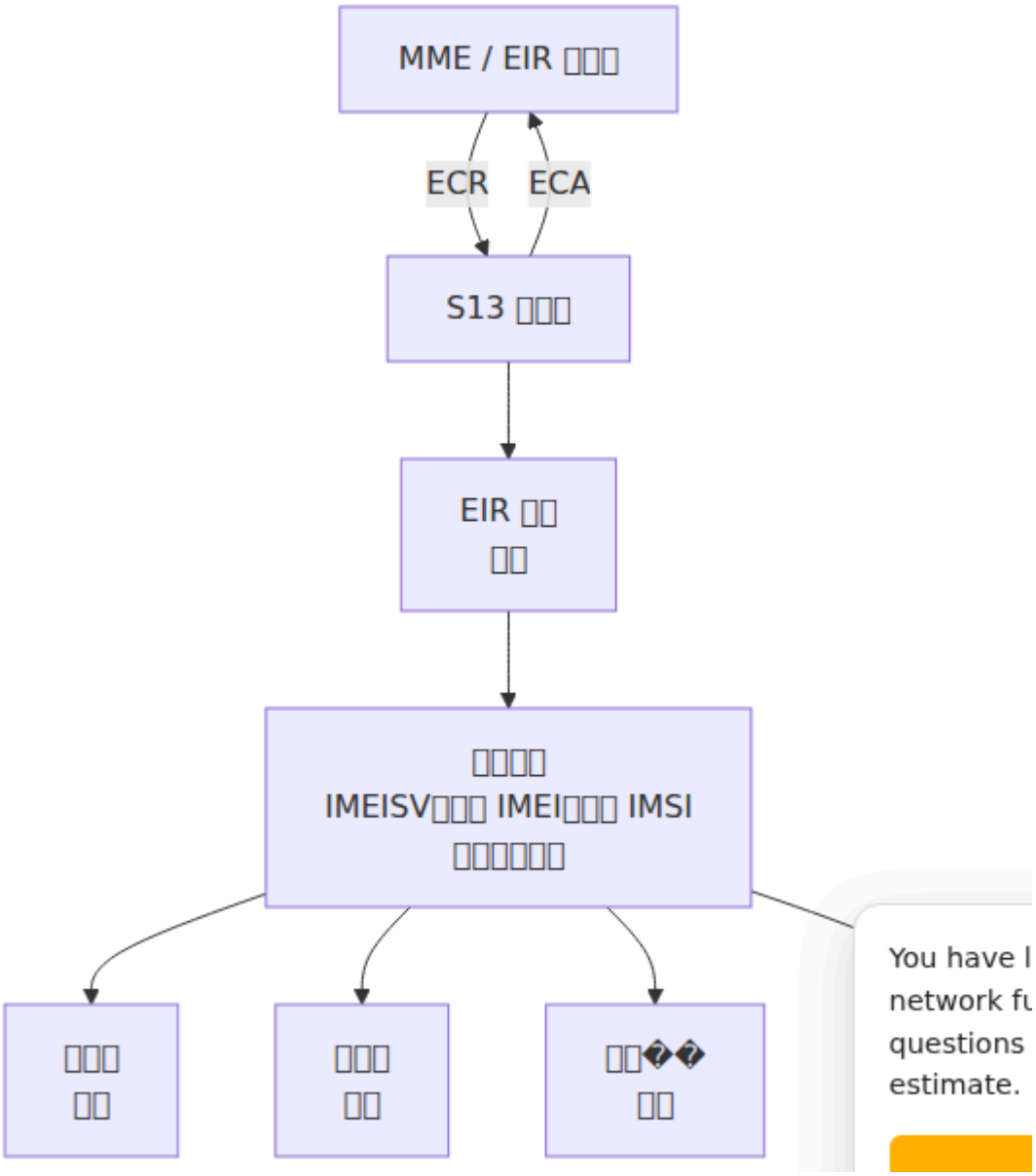

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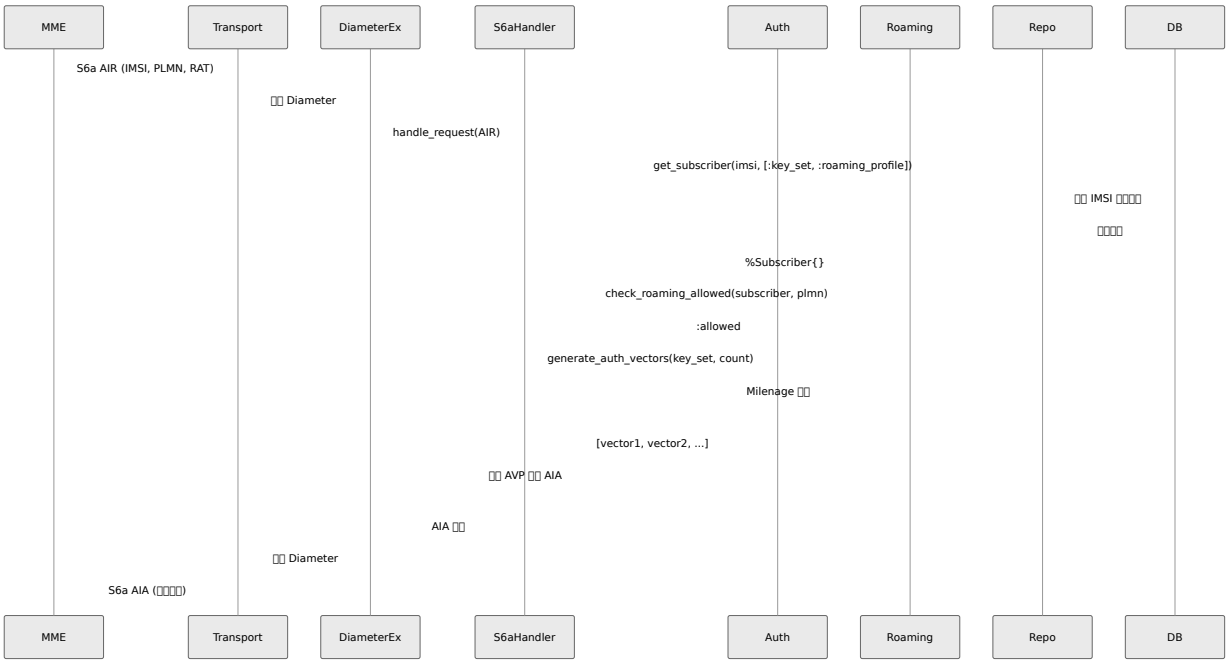

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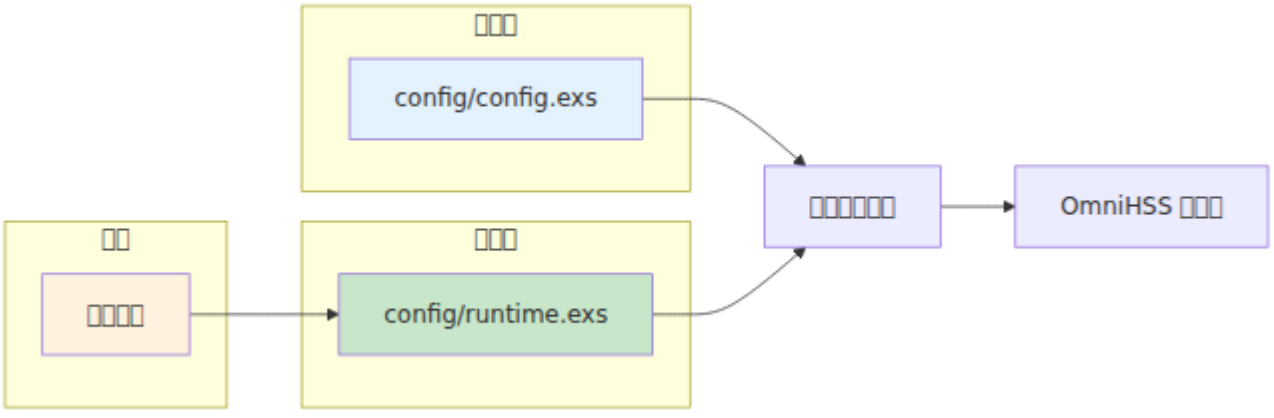

config/config.exs (□□□)

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config/runtime.exs (□□□)

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`license_server_api_urls`	□□□□□□ URL □□	□	`["https://10.0.0.1:8443/api"]`
`licensee`	□□□□□□□□□	□	`"ACME Telecom"`
`product_name`	□□□□□□□□□	□	`"omnihss"`

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- □□□□□□□□□□□□□ HSS □□
- □□ HTTPS □□□□□□□□□□
- □□ URL □□□□□□□□□
- □□□□□□□□□□□□□□□□□

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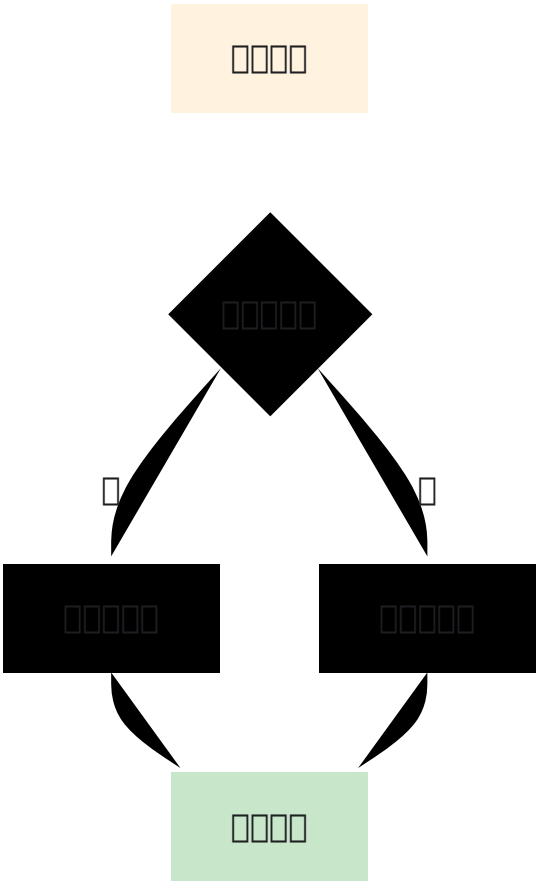

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OmniHSS □□□□□□□□□□

- □□□□□□□□□□□□□□□□□□
- □□□□ runtime.exs □□□
- □□□□□□□□□□□□□□□□□□□□

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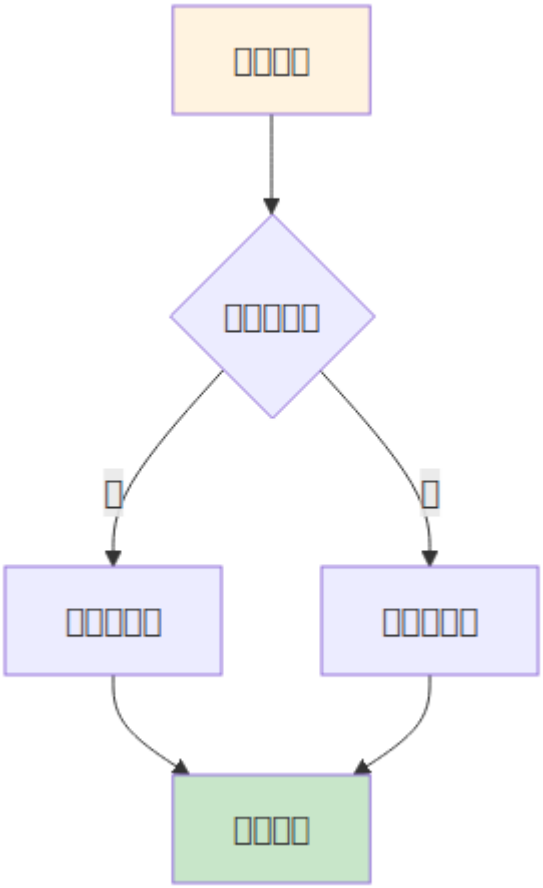
```
# config/runtime.exs

config :hss, Hss.Repo,
  # □□□□□□□□
  username: System.get_env("DATABASE_USERNAME", "root"),
  password: System.get_env("DATABASE_PASSWORD", "password"),
  hostname: System.get_env("DATABASE_HOSTNAME", "localhost"),
  database: System.get_env("DATABASE_NAME", "omnihss"),

  # □□□□□
  pool_size:
String.to_integer(System.get_env("DATABASE_POOL_SIZE", "20")),

  # □□□□□□□□□□□
  timeout: 15_000,
  connect_timeout: 15_000,

  # □□□□
  show_sensitive_data_on_connection_error: false
```

□□□□□□□

□□	□□	□□□	□□
`username`	SQL □□□□□□	`"root"`	□□□□□□□□□□□□□
`password`	SQL □□□□□	`"password"`	□□□□□□□□□□□□□□□
`hostname`	SQL □□□□□□□□□	`"localhost"`	□□□□□□□□ FQDN □ IP
`database`	□□□□□	`"omnihss"`	□□□□□□□□□□□□□□□□
`pool_size`	□□□□□	`20`	□□□□□□□10-50 □□□□□

□□□□□



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- □ 20 □□□□□
- □□“□□□□□”□□
- □□□□□□□□□□□□□□□□□□□□ 10
- □□□□□□□□ 4MB □□□
- □□□□□□□□□□ SQL □□□□□

□□□□□□□□□□

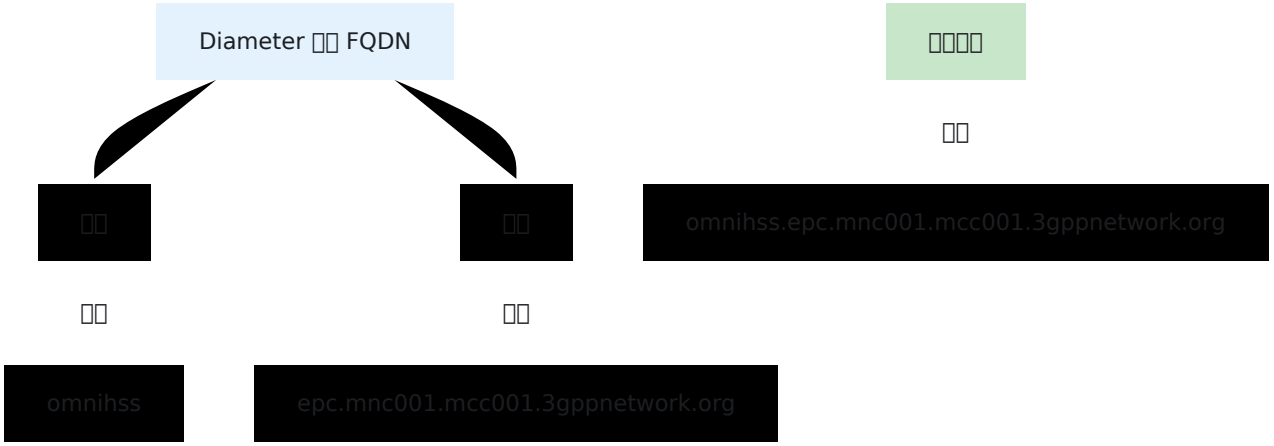
```
# config/runtime.exs - □□□□

config :hss, Hss.Repo,
  username: System.fetch_env!("DATABASE_USERNAME"),      # □□□□□□□□
  password: System.fetch_env!("DATABASE_PASSWORD"),      # □□□□□□□□
  hostname: System.get_env("DATABASE_HOSTNAME",
"db.internal.example.com"),
  database: System.get_env("DATABASE_NAME", "omnihss"),
  port: String.to_integer(System.get_env("DATABASE_PORT",
"5432")),
  pool_size:
String.to_integer(System.get_env("DATABASE_POOL_SIZE", "30")),
  ssl: true,
  ssl_opts: [
    cacertfile: "/etc/ssl/certs/postgres-ca.pem",
    verify: :verify_peer
  ]
```

Diameter □□

Diameter □□□□

```
# config/runtime.exs

diameter_config = %{
  service_name: :omnitouch_hss,

  # □□□□
  listen_ip: System.get_env("DIAMETER_LISTEN_IP", "10.7.25.186"),
  listen_port:
String.to_integer(System.get_env("DIAMETER_LISTEN_PORT", "3868")),

  # Diameter □□
  host: System.get_env("DIAMETER_HOST", "omnihss"),
  realm: System.get_env("DIAMETER_REALM",
"epc.mnc001.mcc001.3gppnetwork.org"),

  # □□□□
  product_name: "OmniHSS",
  vendor_id: 10415,  # 3GPP
  supported_vendor_ids: [5535, 10415],

  # □□□□
  request_timeout: 5000,

  # □□□□□
  peers: [
    # □□□□□□□□□□
  ]
}

config :hss, :diameter, diameter_config
```

Diameter □□□□



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- □□□ HSS □□□□□□□□□□“omnihss”□“hss01”□
- □□□ □□□ PLMN □□□ Diameter □□□□ □□“epc.mnc001.mcc001.3gppnetwork.org”□
- □□□□□ □□□ `{host}.{realm}`

□□ Diameter □□□

□□□□□□□□□□□□□□

```
# config/runtime.exs

peers: [
  # MME □□□□□
  %{
    host: "mme01.epc.mnc001.mcc001.3gppnetwork.org",
    realm: "epc.mnc001.mcc001.3gppnetwork.org",
    ip: "10.7.25.100",
    port: 3868,
    transport: :sctp,  # □ :tcp
    applications: [:s6a]
  },

  # P-GW □□□□□
  %{
    host: "pgw01.epc.mnc001.mcc001.3gppnetwork.org",
    realm: "epc.mnc001.mcc001.3gppnetwork.org",
    ip: "10.7.25.101",
    port: 3868,
    transport: :sctp,
    applications: [:gx]
  },

  # I-CSCF □□□□□
  %{
    host: "icscf01.ims.mnc001.mcc001.3gppnetwork.org",
    realm: "ims.mnc001.mcc001.3gppnetwork.org",
    ip: "10.7.25.102",
    port: 3868,
    transport: :tcp,
    applications: [:cx]
  }
]
```

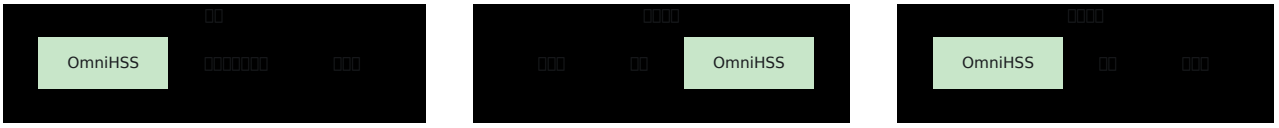
□□□□□

□□□□□□ HSS □□□□□□□□□

```
# config/runtime.exs

diameter_config = %{
  # ... □□□□ ...
  peers: []  # □ - □□□□□□□□
}
```

Diameter □□□□□□□



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SCTP	□□□□□□□□□□	□□□□□□□□□□□□	□□□□ Diameter
TCP	□□□□□□□□□□□□□□□	□□□□□□□□□□	□□ SCTP □□□□□□

□□□

□□ PLMN □□

□□ PLMN □□□□□□□□□□

```
# config/runtime.exs

config :hss, :home_plmn, %{
  mcc: System.get_env("HOME_PLMN_MCC", "001"),  # □□□□□□
  mnc: System.get_env("HOME_PLMN_MNC", "001")   # □□□□□□
}
```

HSS □□□□

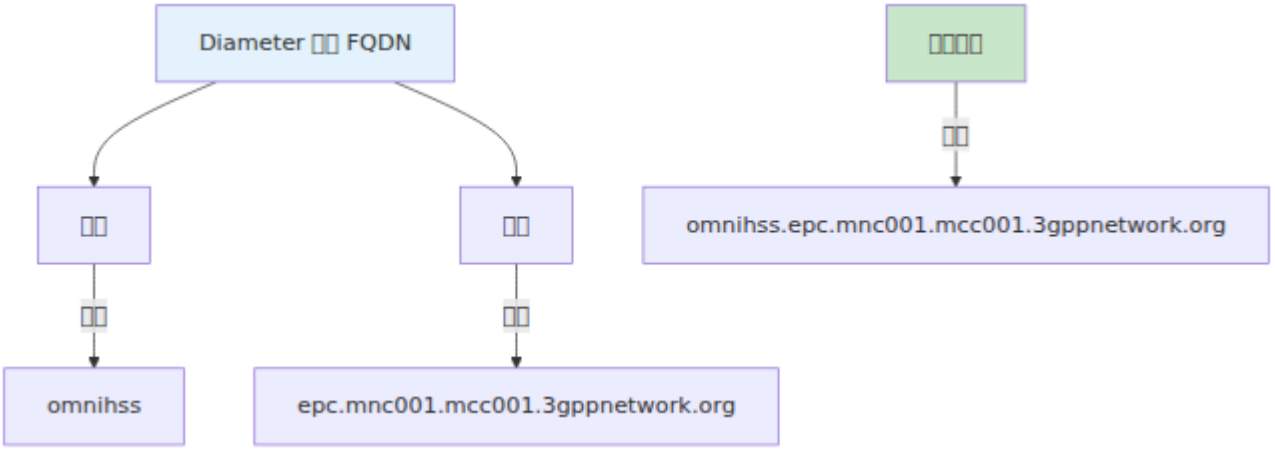
□□□□□□ HSS □□□□□□□

```
# config/runtime.exs

config :hss,
  # □□□□□□□□□□ Ecto □□□
  ecto_repos: [Hss.Repo],

  # MME □□□□ CLR□□□□□□□□
  send_clr_on_mme_change: true,

  # □□□□□□□□□□ Diameter □□
  stop_diameter_on_database_failure: true,

  # □□□□□□□□□□
  license_enforced: true,
  license_module: LicenseClient
```

HSS □□□□□

□□	□□	□□□	□□
`ecto_repos`	□□□□□□□□ Ecto □□□□□	`[Hss.Repo]`	□□ □□ □□ □
`send_clr_on_mme_change`	□□□□□□ MME □□□□ □□□□□	`true`	□□ □□ □□ □□ □□ □□ □
`stop_diameter_on_database_failure`	□□□□□□□□□□ □□ Diameter □□	`true`	□□ □□ □□ □□ □□
`license_enforced`	□□□□□□□□□	`true`	□□ □□ □□
`license_module`	□□□□□□□□□ □	`LicenseClient`	□□ □□

PLMN □□□□



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- AT&T□□□□□MCC=310□MNC=410
- Verizon□□□□□MCC=311□MNC=480
- Vodafone□□□□□MCC=234□MNC=15
- □□□□□MCC=001□MNC=01

□□□□□□

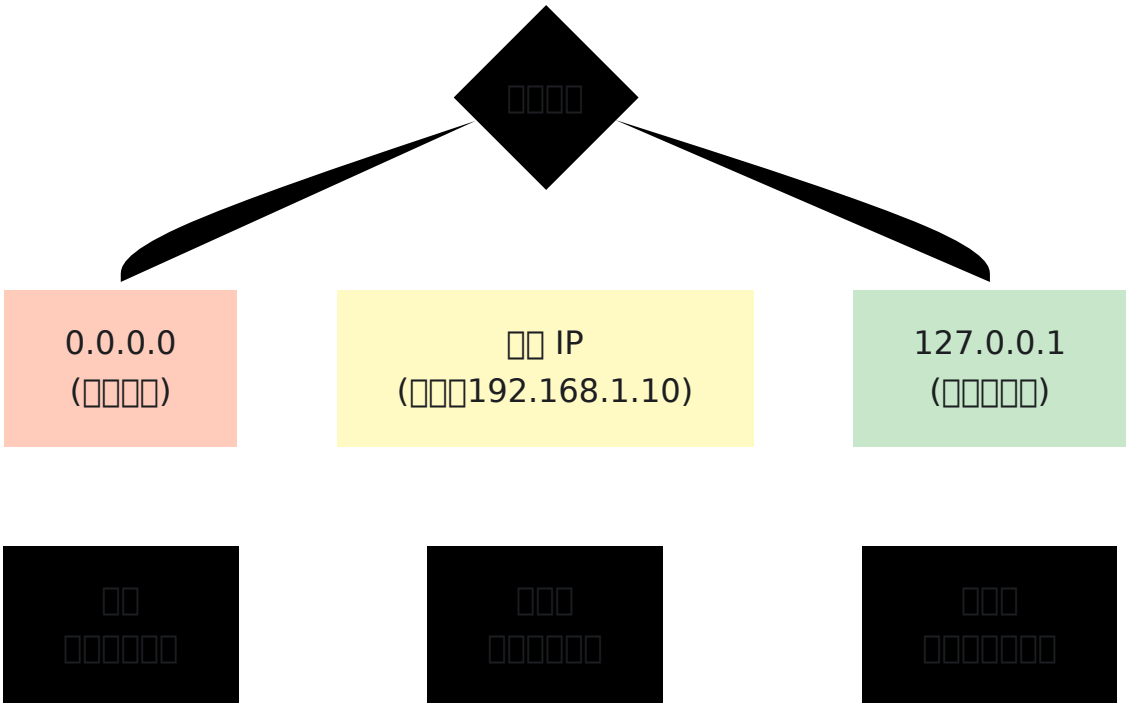
```
# config/runtime.exs

# Diameter □□
listen_ip: System.get_env("DIAMETER_LISTEN_IP", "0.0.0.0"),  # □□□
□
# □□□□□□□
# listen_ip: "10.7.25.186",

# API □□
config :hss, HssWeb.Api.Endpoint,
  http: [
    ip: {0, 0, 0, 0},  # □□□□
    port: 8443
  ]

# □□□□□□□
config :hss, HssWeb.ControlPanel.Endpoint,
  http: [
    ip: {0, 0, 0, 0},  # □□□□
    port: 7443
  ]
```

□□□□□□□



IMS □□

S-CSCF □□□□

HSS □□□□□ REGISTER □□□ S-CSCF□□□□□□□ S-CSCF □□□□□□□□□ S-CSCF □□□□□□ HSS □□□□□□□□□□□□□□□□□□□□□□ REGISTER □□□ IMS-AKA □□□□□□□□□□ S-CSCF □□□□□□ □□□□□

□□□□□□□□□□□□□□ S-CSCF □□□HSS □ SAR □□□□□ SAR □□□□□□ HSS □□□□□□□□□□□□□□□ □□□□□□ UAR □□□□□□ LIR □□□□□□□□□□□□□□ IMS □□□□□□□□□□□□□□□□□□□□ □□□□□□□□ S-CSCF□

```
# config/runtime.exs

config :hss, :ims, %{
  scscf: %{
    # □□□ REGISTER □□□□□:pool_uri □ :random_peer
    selection_method: :pool_uri,

    # :pool_uri □□□ S-CSCF □□□□□□□□□□□□ I-CSCF □□□□□□
    # SRV □□ (_sip._tcp/_udp.<name>)□HSS □□□□□ REGISTER □□□□
    # □□□□□□□□□□□□□□ S-CSCF□
    pool_uri: "sip:scscf.ims.mnc001.mcc001.3gppnetwork.org",

    # IMS-AKA □□□ HSS □□□□□□ S-CSCF □□□□□□□□□□
    auth_pending_ttl_seconds: 30,

    # :random_peer □ S-CSCF □□□□□□□□ S-CSCF □□
    peers: [
      %{
        host: "sip:scscf01.ims.mnc001.mcc001.3gppnetwork.org:5060"
      },
      %{
        host: "sip:scscf02.ims.mnc001.mcc001.3gppnetwork.org:5060"
      }
    ]
  }
}
```

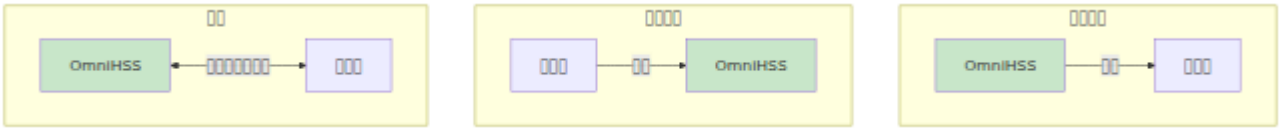
□□□

□□	□□	□□	□□	□□
`selection_method`	□□	□	`:pool_uri`	□□□ REGIST S-CSCF □□□ □ `:pool_uri` `:random_pe` □ S-CSCF □□ □□
`pool_uri`	□□□	□□ `:pool_uri` □□□□	-	□□□ REGIST □□□□□□ S-CS □□□□□□□□□□ I-CSCF □□ S □□□□□□□□□□ HSS □□□□□□ □□□□□□ S-CSCF□□□□□□ `pool_uri` □H □□□□□□□□□□ `peers` □□□□
`auth_pending_ttl_seconds`	□□	□	30	HSS □□□□□□ CSCF □□□□□ □□□□□□□□□H □□□□□□□□□□ □□□□ S-CSC □□□□
`peers`	□□	□□ `:random_peer` □□□□	-	S-CSCF □□□ □□□□□□□□□□

□□□□□□

□□	□□	□□	□□	□□
`host`	□□□	□	-	S-CSCF SIP URI□□□ FQDN □□□□I-CSCF □□□□□□□□

S-CSCF □□□□



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□□	□□	□□
`:pool_uri`	□□□□ `pool_uri`□I-CSCF □□ DNS SRV □□□□□□□□□□DNS □□□□□□□□□ REGISTER □□□□□□□	□□□□□□□□□ REGISTER □□□□□□□□□□□
`:random_peer`	□ `peers` □□□□□□□□□□□

IMS □□□□

□□□IMS □□□ EPC □□□□□□

```
# EPC □□
"epc.mnc001.mcc001.3gppnetwork.org"

# IMS □□
"ims.mnc001.mcc001.3gppnetwork.org"
```

EIR □□

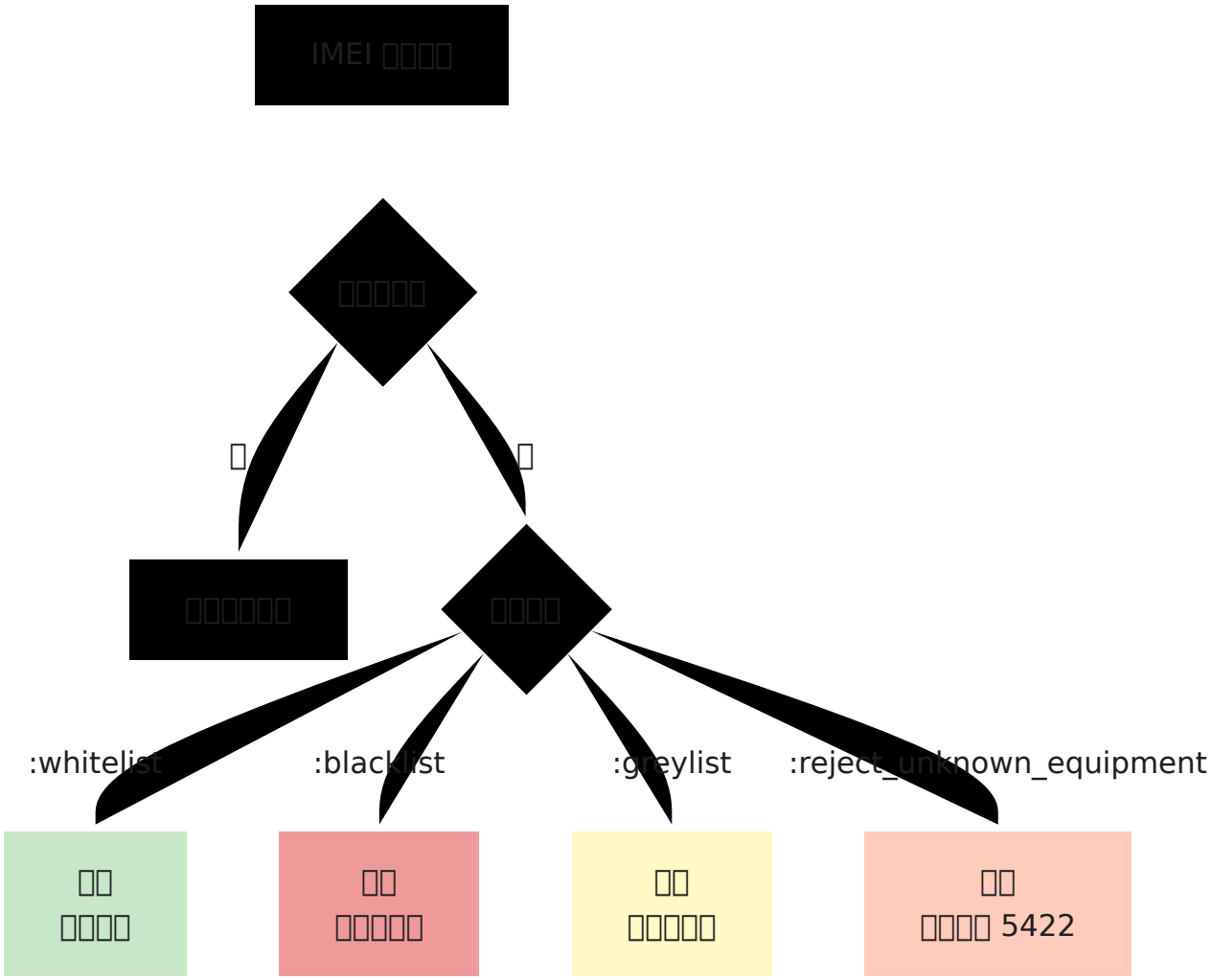
□□□□□□□□□□□□□□□□□□□ **EIR** □□□

□□□□□□□□

```
# config/runtime.exs

config :hss, :eir, %{
  # □□□□□□□□□□□□□□□□□□□
  unknown_equipment_behaviour: :whitelist
  # □□□
  #   :whitelist - □□□□□□
  #   :blacklist - □□□□□□
  #   :greylist - □□□□□□□□□
  #   :reject_unknown_equipment - □□□□□□□□□□□
}
```

□□□□□□



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□□	□□	□□
`:whitelist`	□□□□□□ IMEI	□□□□□□□
`:blacklist`	□□□□□□ IMEI	□□□□□
`:greylist`	□□□□□□□ IMEI	□□□
`:reject_unknown_equipment`	□□□□□□□□□	□□□

□□ □□□□□□ `:whitelist` □□□□□□□□□□□□ `:greylist`□□□□□□□□□□ `:blacklist`□

API □□□□□□□

API □□□□

```
# config/config.exs

config :hss, HssWeb.Api.Endpoint,
  url: [host: "localhost"],
  render_errors: [view: HssWeb.ErrorView, accepts: ~w(json)],
  pubsub_server: Hss.PubSub,

  # HTTPS □□
  https: [
    port: 8443,
    cipher_suite: :strong,
    certfile: "priv/cert/omnitouch.crt",
    keyfile: "priv/cert/omnitouch.pem"
  ]
```

API □□□□

`config :api_ex, :auth` □□ `runtime.exs` □□□ API □□□□□□□□□□□□□□□□□ API □□□□ (RBAC)□

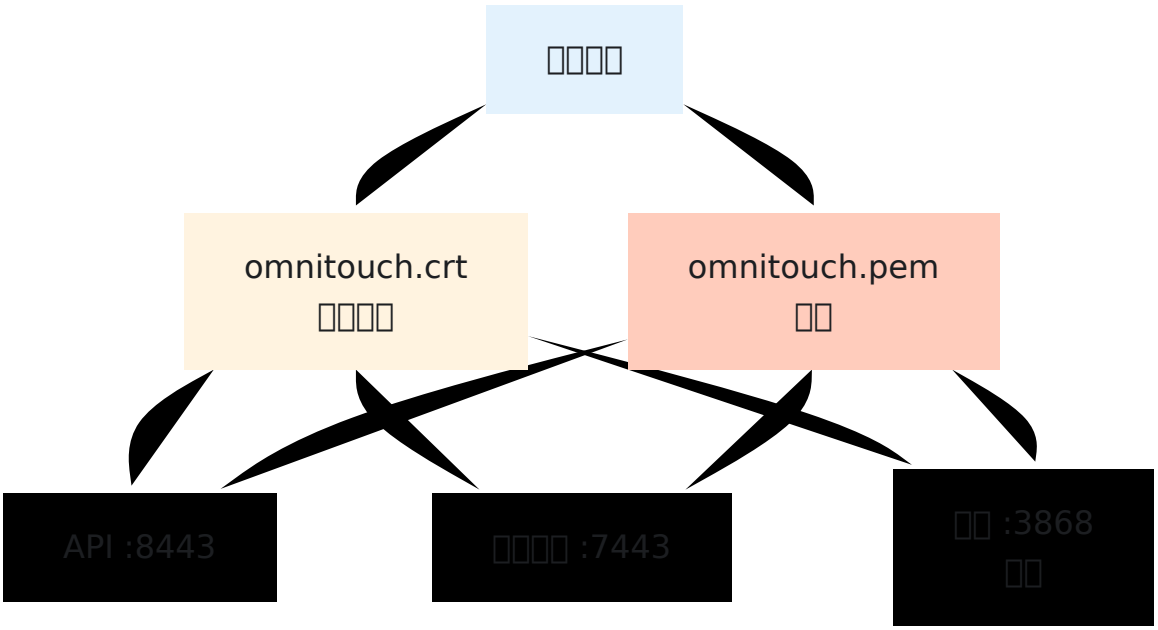
□□□□□□

```
# config/config.exs

config :hss, HssWeb.ControlPanel.Endpoint,
  url: [host: "localhost"],
  render_errors: [view: HssWeb.ErrorView, accepts: ~w(html json)],
  pubsub_server: Hss.PubSub,
  live_view: [signing_salt: "some-secret"],

  # HTTPS □□
  https: [
    port: 7443,
    cipher_suite: :strong,
    certfile: "priv/cert/omnitouch.crt",
    keyfile: "priv/cert/omnitouch.pem"
  ]
```

TLS □□□□



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- □□□ X.509 □□
- □□□□□
- □□□□□□□□□□□□

- CN □ SAN □□□□□□□□□

□□□□□

```
https: [
  port: 8443,
  cipher_suite: :strong,
  certfile: System.get_env("TLS_CERT_FILE",
"/etc/ssl/certs/omnihss.crt"),
  keyfile: System.get_env("TLS_KEY_FILE",
"/etc/ssl/private/omnihss.key"),
  cacertfile: System.get_env("TLS_CA_FILE", "/etc/ssl/certs/ca-
bundle.crt")
]
```

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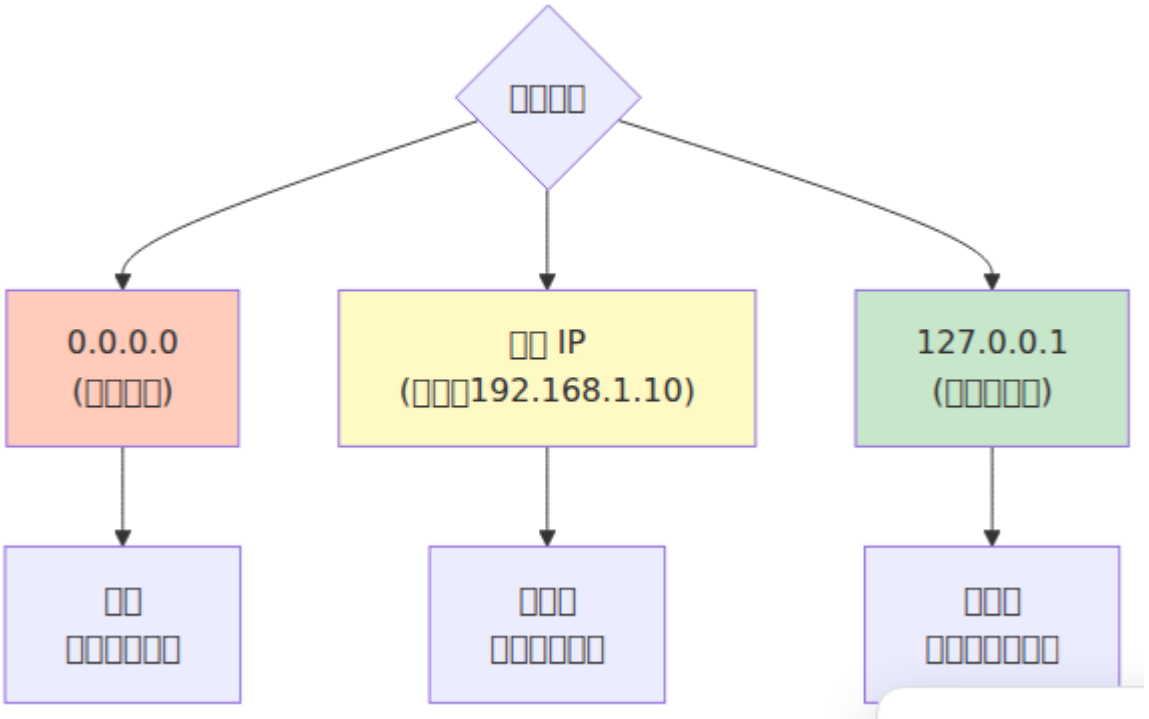

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- [ ] □□□□□□□□□□□□□□□□
- [ ] □□ PLMN□MCC□MNC□
- [ ] □□□□□□□□
- [ ] □□□□□ IP □□□
- [ ] API □□□□□□□ TLS □□
- [ ] □□□□□□□□□□□□□□ URL□□□□□□□□□□□□□□□
- [ ] HSS □□□□□□send_clr_on_mme_change□stop_diameter_on_database_failure□

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- [ ] □□□□□□□□□□□□□□□□□□□□□□
- [ ] □□□□□□□□□□□□□□□□□□ 3868□
- [ ] □□□□□□□□□ HTTPS □□□□□□ 7443□8443□
- [ ] □□□□□□ DNS □□

IMS □□□□□□□□ **IMS** □□□

- [ ] □□ S-CSCF □□□□□□
- [ ] □□ S-CSCF □□□□□
- [ ] □□ IMS □□

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- [ ] □□ EIR □□
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1. □□□□□

```
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```

2. □□□□□□□□

```
□□ https://[hostname]:7443
□□□□□□□□□□□□
```

3. **API** □□□

```
curl -k https://[hostname]:8443/api/status
```

4. □□□□□□

```
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```

5. □□□□□□□□

```
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□□□□□□□□ SQL □□□□
```

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```
# config/runtime.exs - □□□□□□□□

import Config

#
=============================================================================
# □□□□□□
#
=============================================================================
config :hss, Hss.Repo,
  username: System.fetch_env!("DATABASE_USERNAME"),
  password: System.fetch_env!("DATABASE_PASSWORD"),
  hostname: System.get_env("DATABASE_HOSTNAME", "db.omnihss.internal'
  database: System.get_env("DATABASE_NAME", "omnihss"),
  port: String.to_integer(System.get_env("DATABASE_PORT", "5432")),
  pool_size: String.to_integer(System.get_env("DATABASE_POOL_SIZE", '
  timeout: 15_000,
  connect_timeout: 15_000,
  ssl: true,
  ssl_opts: [
    cacertfile: "/etc/ssl/certs/postgres-ca.pem",
    verify: :verify_peer
  ]

#
=============================================================================
# □□□□□□□□□□
#
=============================================================================
config :license_client,
  license_server_api_urls: [System.get_env("LICENSE_SERVER_URL",
"https://license.example.com:8443/api")],
  licensee: System.get_env("LICENSE_ORGANIZATION", "□□□□"),
  product_name: "omnihss"

#
=============================================================================
# □□ PLMN □ HSS □□□□
#
=============================================================================
```

```
config :hss,
  ecto_repos: [Hss.Repo],
  home_plmn: %{
    mcc: System.get_env("HOME_PLMN_MCC", "001"),
    mnc: System.get_env("HOME_PLMN_MNC", "001")
  },
  send_clr_on_mme_change: true,
  stop_diameter_on_database_failure: true,
  license_enforced: true,
  license_module: LicenseClient

#
============================================================================
# □□□□
#
============================================================================
diameter_config = %{
  service_name: :omnitouch_hss,
  listen_ip: System.get_env("DIAMETER_LISTEN_IP", "10.7.25.186"),
  listen_port: String.to_integer(System.get_env("DIAMETER_LISTEN_PORT
"3868")),
  host: System.get_env("DIAMETER_HOST", "omnihss01"),
  realm: System.get_env("DIAMETER_REALM",
"epc.mnc001.mcc001.3gppnetwork.org"),
  product_name: "OmniHSS",
  vendor_id: 10415,
  supported_vendor_ids: [5535, 10415],
  request_timeout: 5000,
  peers: [
    %{
      host: "mme01.epc.mnc001.mcc001.3gppnetwork.org",
      realm: "epc.mnc001.mcc001.3gppnetwork.org",
      ip: "10.7.25.100",
      port: 3868,
      transport: :sctp,
      applications: [:s6a]
    }
  ]
}

config :hss, :diameter, diameter_config

#
============================================================================
```

```
# IMS □□
#
============================================================================
config :hss, :ims, %{
  scscf: %{
    selection_method: :random_peer,
    peers: [
      %{host: "sip:scscf01.ims.mnc001.mcc001.3gppnetwork.org:5060"},
      %{host: "sip:scscf02.ims.mnc001.mcc001.3gppnetwork.org:5060"}
    ]
  }
}

#
============================================================================
# EIR □□
#
============================================================================
config :hss, :eir, %{
  unknown_equipment_behaviour: :whitelist
}

#
============================================================================
# API □□□□
#
============================================================================
config :hss, HssWeb.Api.Endpoint,
  http: [ip: {0, 0, 0, 0}, port: 8443],
  https: [
    port: 8443,
    cipher_suite: :strong,
    certfile: System.get_env("TLS_CERT_FILE", "/etc/ssl/certs/omnihss
    keyfile: System.get_env("TLS_KEY_FILE", "/etc/ssl/private/omnihss
  ],
  url: [host: System.get_env("API_HOST", "api.omnihss.internal"), por
8443]

#
============================================================================
# □□□□□□□□□
#
============================================================================
config :hss, HssWeb.ControlPanel.Endpoint,
```

```
  http: [ip: {0, 0, 0, 0}, port: 7443],
  https: [
    port: 7443,
    cipher_suite: :strong,
    certfile: System.get_env("TLS_CERT_FILE", "/etc/ssl/certs/omnihss
    keyfile: System.get_env("TLS_KEY_FILE", "/etc/ssl/private/omnihss
  ],
  url: [host: System.get_env("CP_HOST", "hss.omnihss.internal"), port
```

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OmniHSS □□□□□□

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OmniHSS □□□□□□

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```
URL: https://[hostname]:7443
Protocol: HTTPS Only
Port: 7443 (configurable)
Certificate: Configured in config/config.exs
```

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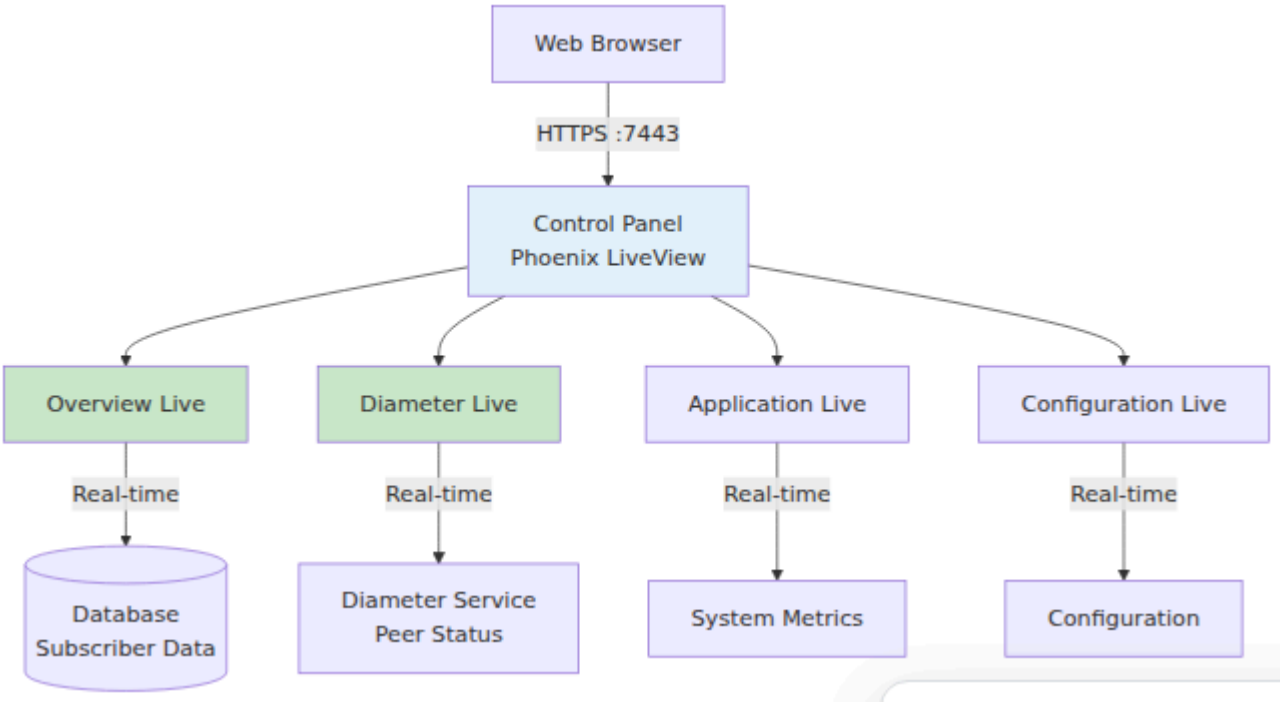

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2. □□□ `https://[hostname]:7443`
3. □□ TLS □□□□□□□□□□□
4. □□□□□□□□□□□□□□□

TLS □□□□

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- □□ **7443** □□□□□□□□□□□□□□□□
- **HTTPS** □□□□□□ - □□□□ HTTP
- □□□□□□ □□□□□□□□□□□□ 7443

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- Chrome/Chromium□□□□
- Firefox
- Safari
- Edge

□□□ □□□ Internet Explorer□

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URL: `https://[hostname]:7443/overview`

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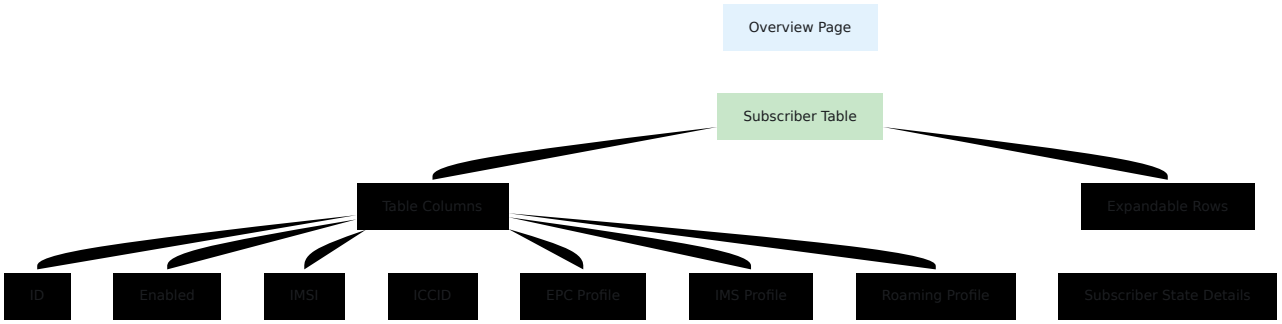

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ID	□□□□□ ID	□□□ (UUID)
Enabled	□□□□	✓ (□□) / ✗ (□□)
IMSI	□□□□□□□□	14-15 □□□
ICCID	SIM □ ID	19-20 □□□□ "N/A"
EPC Profile	□□□□□□□□□□	□□□□□□□ ID
IMS Profile	□□□□□□□□□□	□□□□□□□ID □ "N/A"
Roaming Profile	□□□□□□	□□□□□□□ID □ "N/A"

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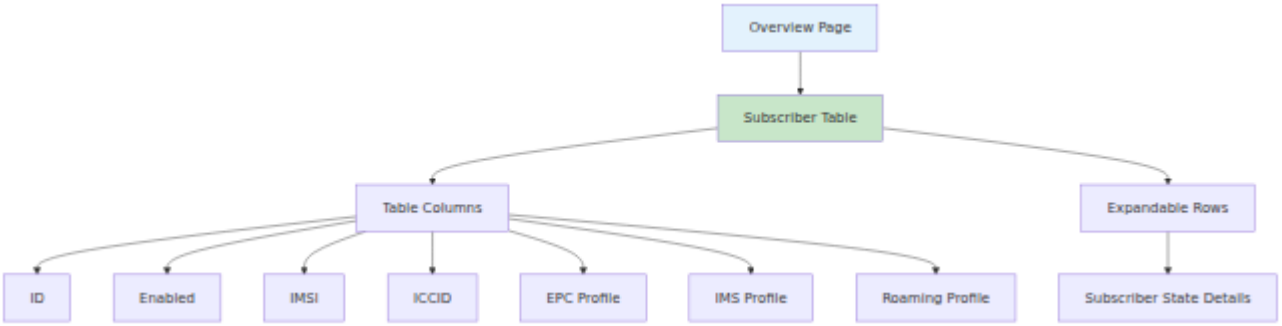

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- **MCC** - □□□□□□□□3 □□□□
- **MNC** - □□□□□□□□2-3 □□□□
- **TAC** - □□□□□□□
- **Cell ID** - □□□□□□□□
- **eNodeB ID** - □□□□□
- **ECI** - E-UTRAN □□□□□

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- □□□□□ **MME** - □□□□□ MME □□□
- □□□□□□□□ - MME □□□□□
- **RAT** □□ - □□□□□□□□□□“E-UTRAN”□□ LTE□
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IMS □□

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- □□□ **S-CSCF** - □□□□□ S-CSCF SIP URI
- **IMS** □□□□ - SIP URI□□□□sip:+14155551234@ims.example.com□
- □□□□□ **P-CSCF** - □□□□□□ HSS □ P-CSCF
- □□□□□ **I-CSCF** - □□□□□□ HSS □ I-CSCF

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- **PDN** □□ - □□□□□□□□□□
- □□□□ - □□ VoLTE □□□□□

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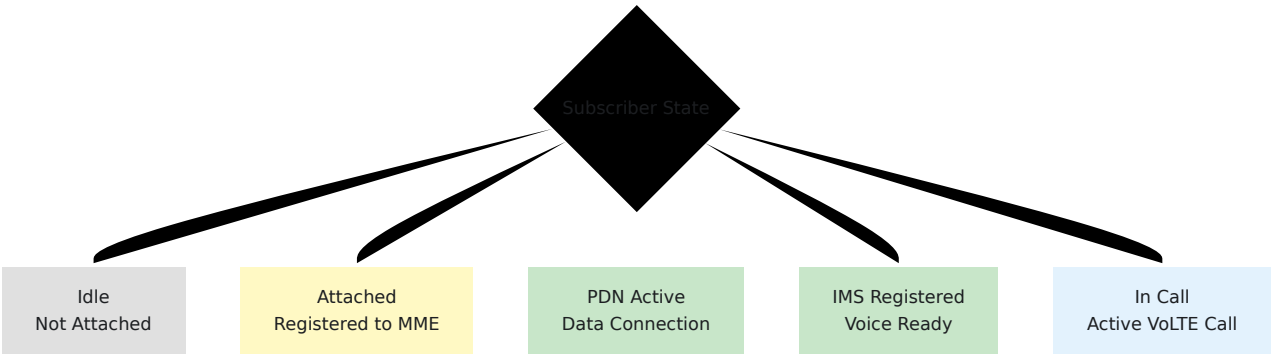

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- **Idle:** □□□□□□□□□□ MME
- **Attached:** □□□□□ MME □□□□□□□□□
- **PDN Active:** PDN □□□□ > 0
- **IMS Registered:** □□□ S-CSCF □□
- **In Call:** □□□□□□ > 0

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- □□□□ VoLTE □□

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URL: `https://[hostname]:7443/diameter`

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Hostname	□□□□□□□	FQDN
Realm	□□□□	□□
IP:Port	□□□□	IP □□□□□
Transport	□□□□	TCP □ SCTP
Status	□□□□	Connected / Disconnected

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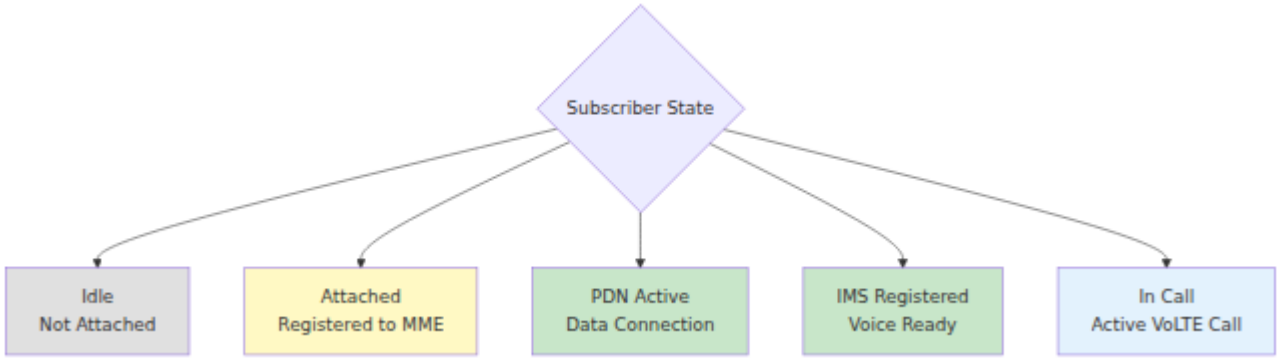

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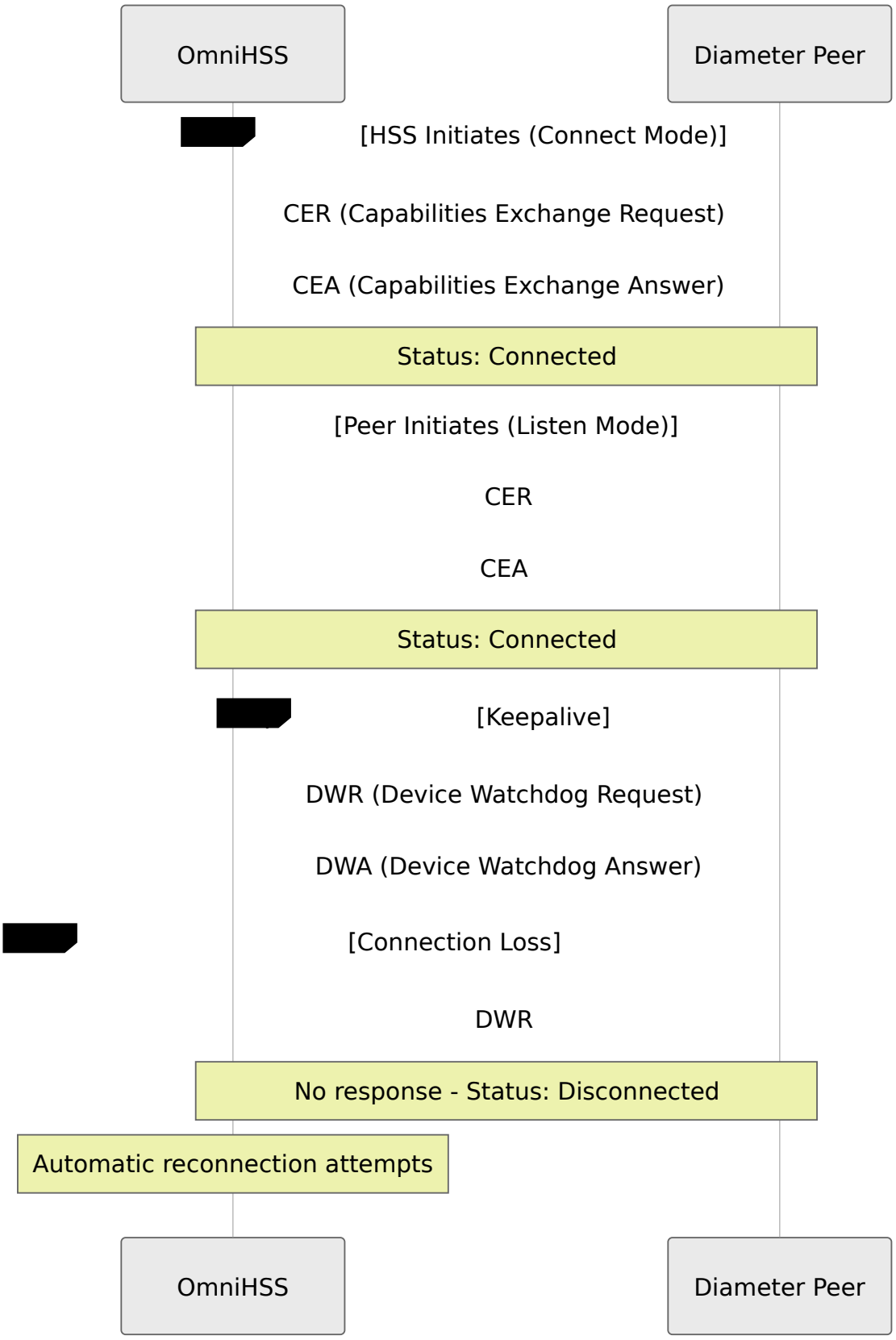
- □□□□ - □ HSS □□□□□□
- □□□□ - □□□□□□□□
- □□□□ **ID** - □□□□□□□□□

□□□□ **ID** □□□

- 16777251 - S6a (MME)

- 16777238 - Gx (P-GW)
- 16777216 - Cx (I-CSCF, S-CSCF)
- 16777217 - Sh (□□□□□)
- 16777236 - Rx (P-CSCF)
- 16777252 - S13 (EIR □□□□□□□□□)

[redacted]


OmniHSS
Diameter Peer
[redacted]
[HSS Initiates (Connect Mode)]
CER (Capabilities Exchange Request)
CEA (Capabilities Exchange Answer)
Status: Connected
[Peer Initiates (Listen Mode)]
CER
CEA
Status: Connected
[redacted]
[Keepalive]
DWR (Device Watchdog Request)
DWA (Device Watchdog Answer)
[redacted]
[Connection Loss]
DWR
No response - Status: Disconnected
Automatic reconnection attempts
OmniHSS
Diameter Peer

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    - □□□□□□□□□TCP □ SCTP□
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3. □□□□□□□□
4. □□□□□□□□
5. □□□□□□□□□□ TLS□

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1. □□□□□□□□ `ping [peer-ip]`
2. □□□□□□□□□□ `telnet [peer-ip] 3868`
3. □□□□□□□□
4. □□ HSS □□□□□□□□□
5. □□□□□□□□□□□□ HSS □□

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URL: `https://[hostname]:7443/application`

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- □□□□ - Erlang VM □□□□□□□□
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- □□□□□□□ - OmniHSS □□□□□
- **Erlang VM** □□ - □□□□□□□□

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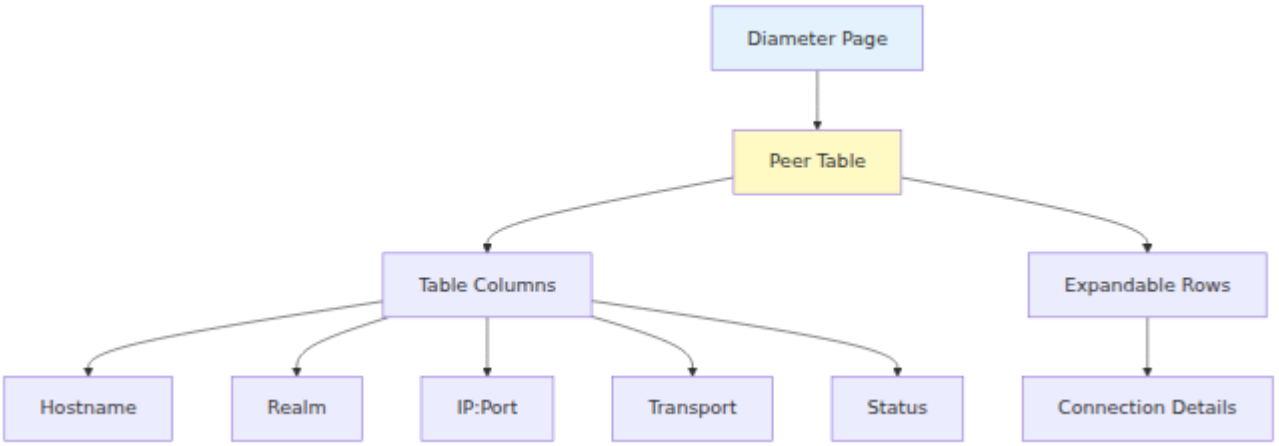

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   - □□ Erlang VM □□

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URL: `https://[hostname]:7443/configuration`

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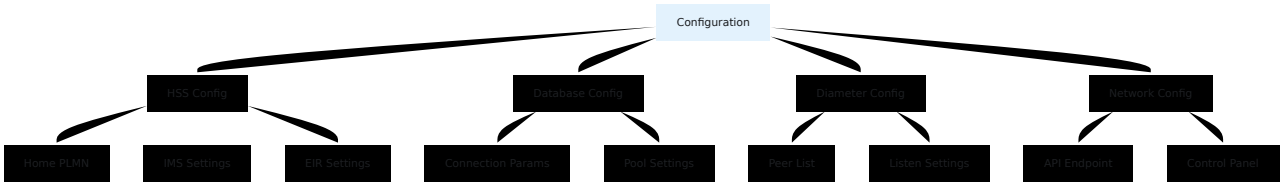

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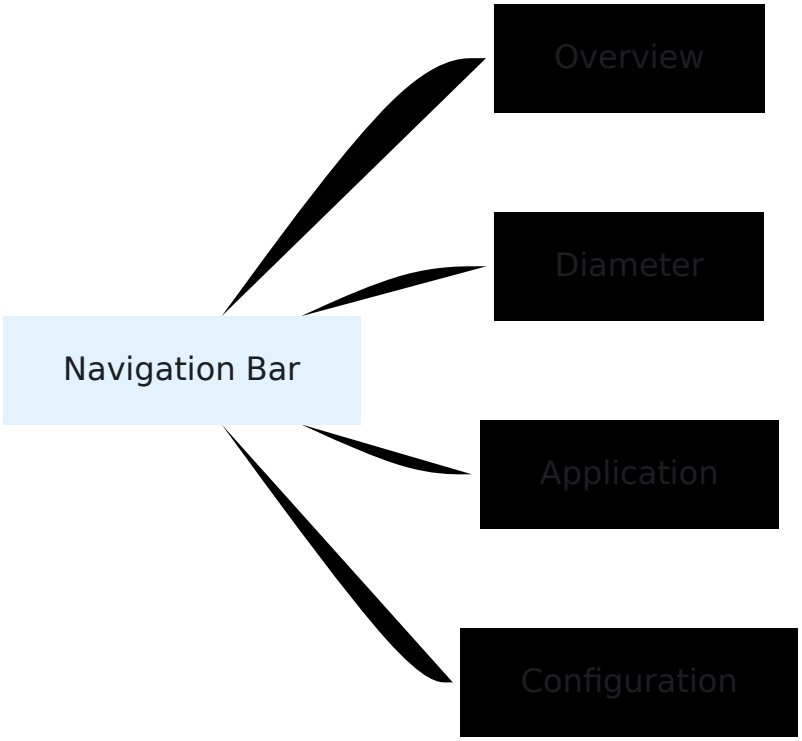

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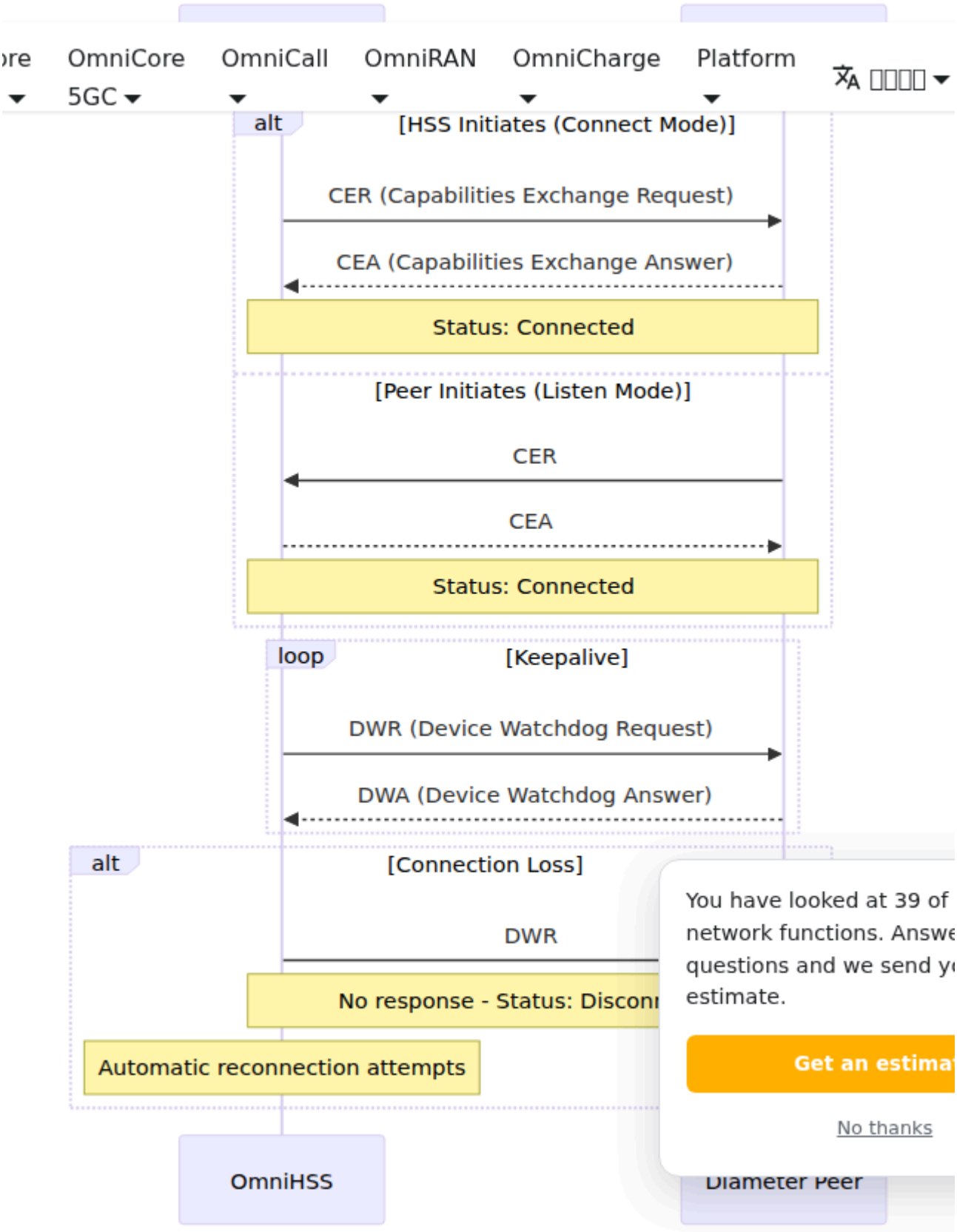
ore
OmniCore 5GC
OmniCall
OmniRAN
OmniCharge
Platform
alt
[HSS Initiates (Connect Mode)]
CER (Capabilities Exchange Request)
CEA (Capabilities Exchange Answer)
Status: Connected
[Peer Initiates (Listen Mode)]
CER
CEA
Status: Connected
loop
[Keepalive]
DWR (Device Watchdog Request)
DWA (Device Watchdog Answer)
alt
[Connection Loss]
DWR
No response - Status: Disconn
Automatic reconnection attempts
OmniHSS
Diameter Peer
You have looked at 39 of
network functions. Answe
questions and we send y
estimate.
Get an estima
No thanks

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OmniHSS □□ **PostgreSQL** □ □□□□□□ □□□□□□□□□□□□□□□□□□□□□□□□□□□/□□□□□□□□□□□□□□□□□□□

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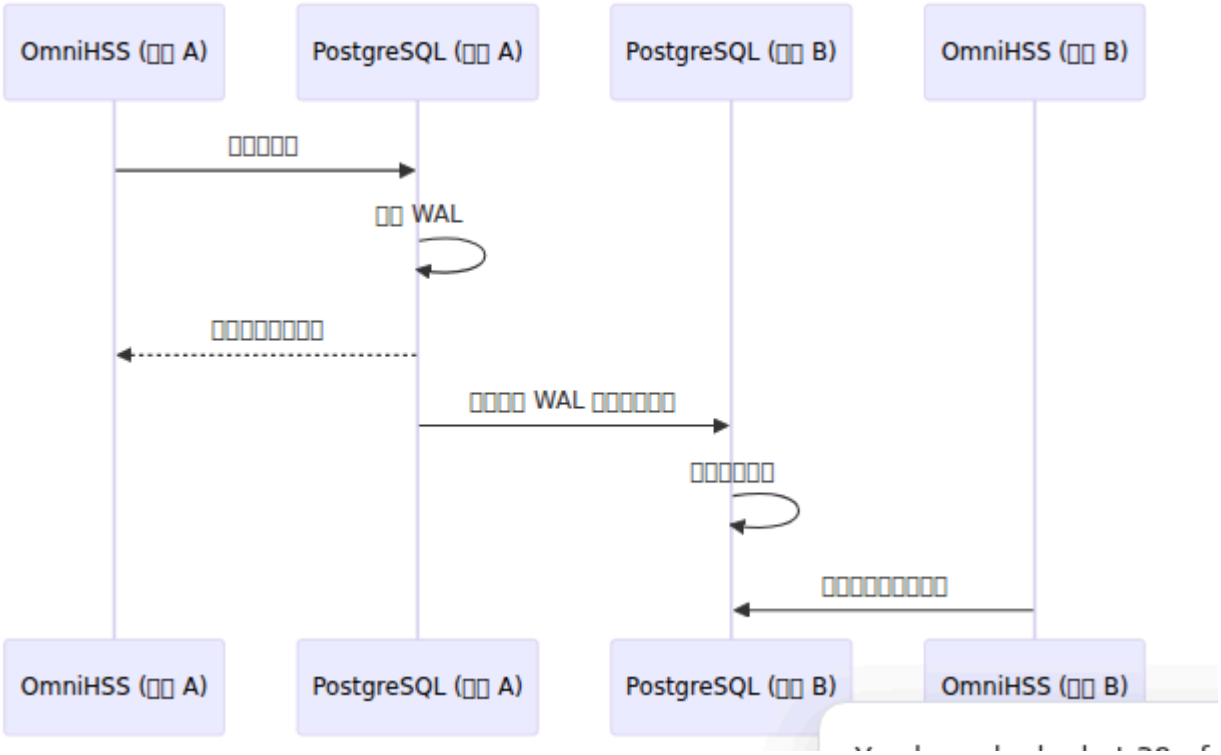
OmniHSS (□□ A)
PostgreSQL (□□ A)
PostgreSQL (□□ B)
OmniHSS (□□ B)
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OmniHSS (□□ A)
PostgreSQL (□□ A)
PostgreSQL (□□ B)
OmniHSS (□□ B)

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- □□ □□□□□□□□□□□□□□□□ `schema_migrations`□
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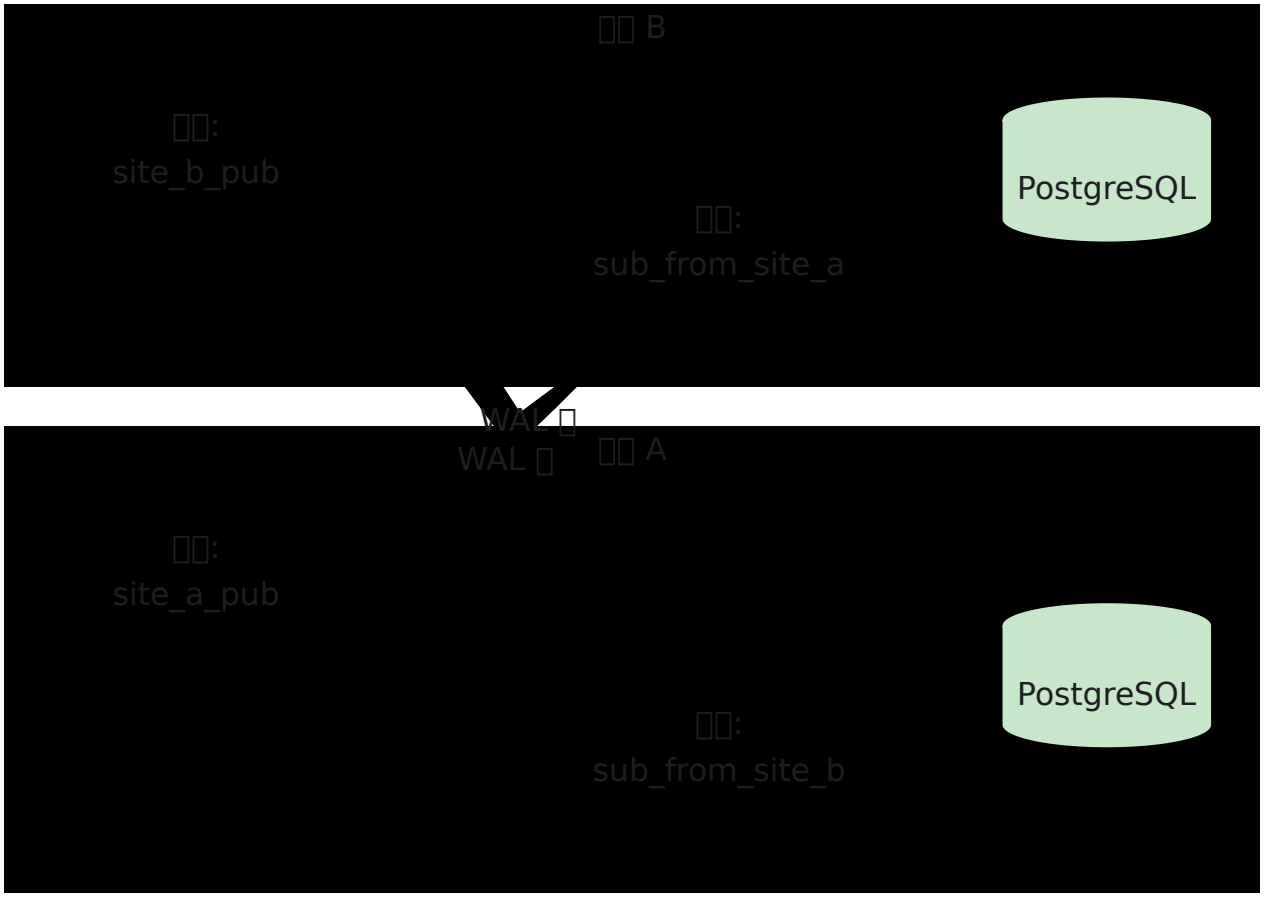

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2. WAL □□□□□□□□
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5. □□□□□□□□□□□□□

WAL □□□ `max_slot_wal_keep_size` □□□□□□□□□□□□□□□□□□□□□□□□□□□□

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UUID □□□□

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`subscriber_state`	ULR, SAR, AIR, PUR, ECR, CCR	□□□□/□□□□
`pdn_session`	CCR-I, CCR-T	□□ PDN □□□□/□□
`lte_call`	AAR, STR	□□ VoLTE □□□□□/□□
`ims_subscription`	UAR, SAR□□□ S-CSCF□	□□□□□□□□

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LWW □□□□□□□□□□□ □□□□□□□□□□□□□□□ `foo`□□□□□□□□ `lww_foo()`□□□□□□□□□ `lww_foo_trigger`□

OmniCore □ `omnihss` Ansible □□□□ □ □□□□□□□□□□□□□□□□□□□□□□□□ `lww_<table>_trigger` □□□□□□□□□□□□□□□□□□□□□□□□ `ENABLE REPLICA` □□□□□□□□□□□□ □□□

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1. □□□□□□□ `updated_at` □□Ecto □ `timestamps()` □□□□□□□□
2. □□□□□□□□□□ `lww_<table>()` □ `lww_<table>_trigger`□□□□□□□□□□□
3. □□□□□□□□□□ `ALTER TABLE <table> ENABLE REPLICA TRIGGER lww_<table>_trigger`□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□

`ims_subscription` □□□□□□□□□□□□□□□□□□□□

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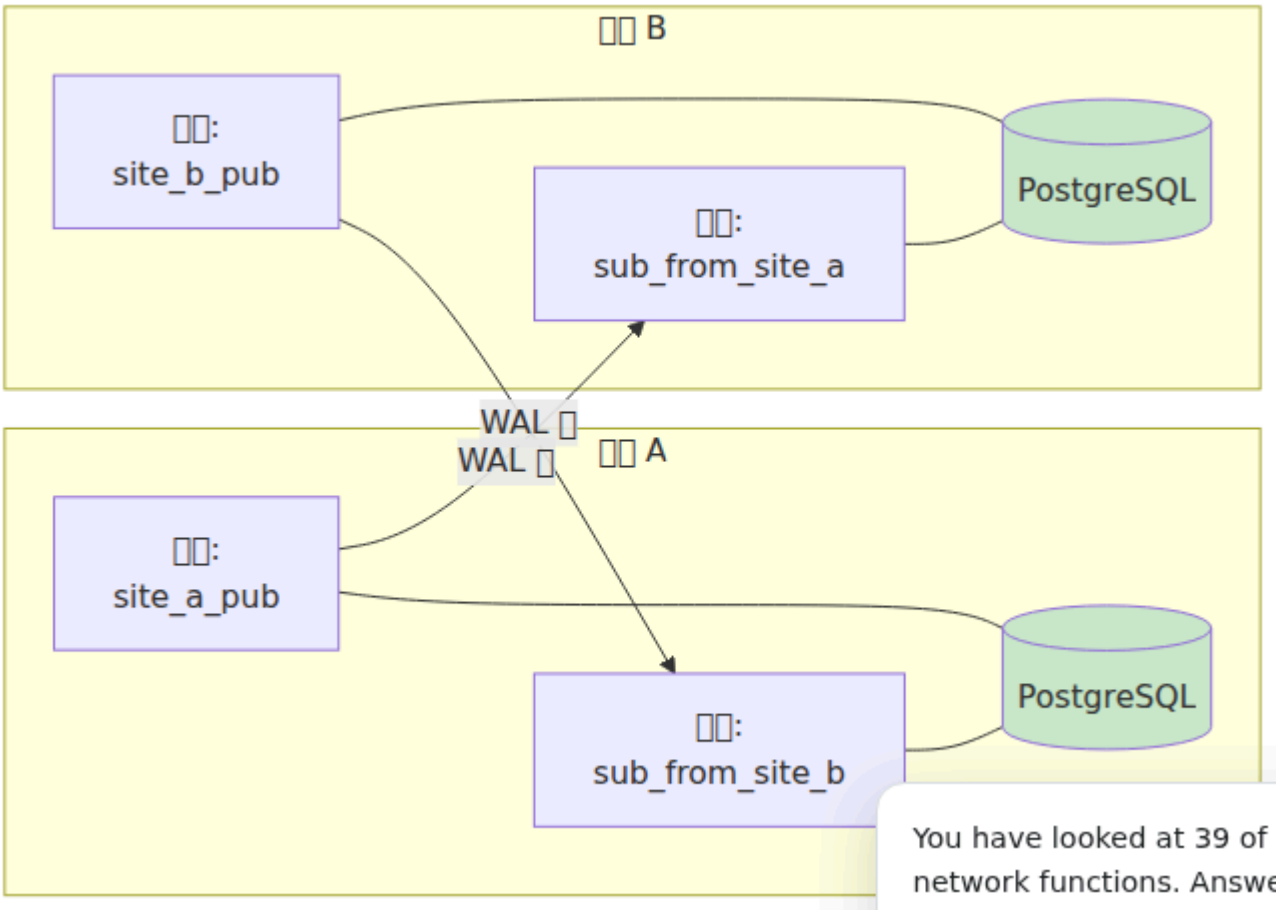

□□ HSS □□□□□□□□□ PostgreSQL □□□□□□□□□□□□□□□□□ PostgreSQL □□□□□□□□□□□□□□□□□

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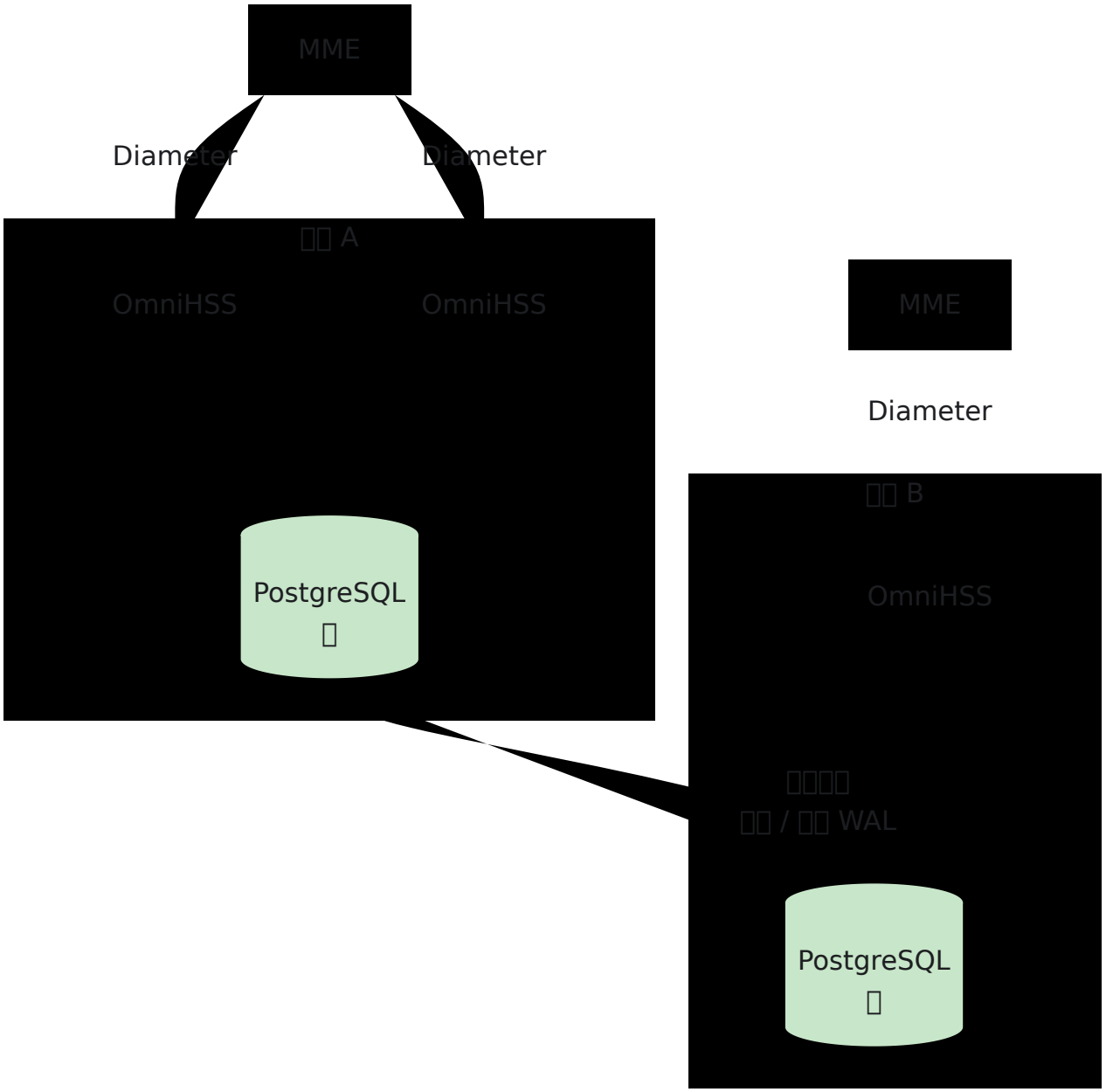
MME
Diameter
Diameter
□□ A
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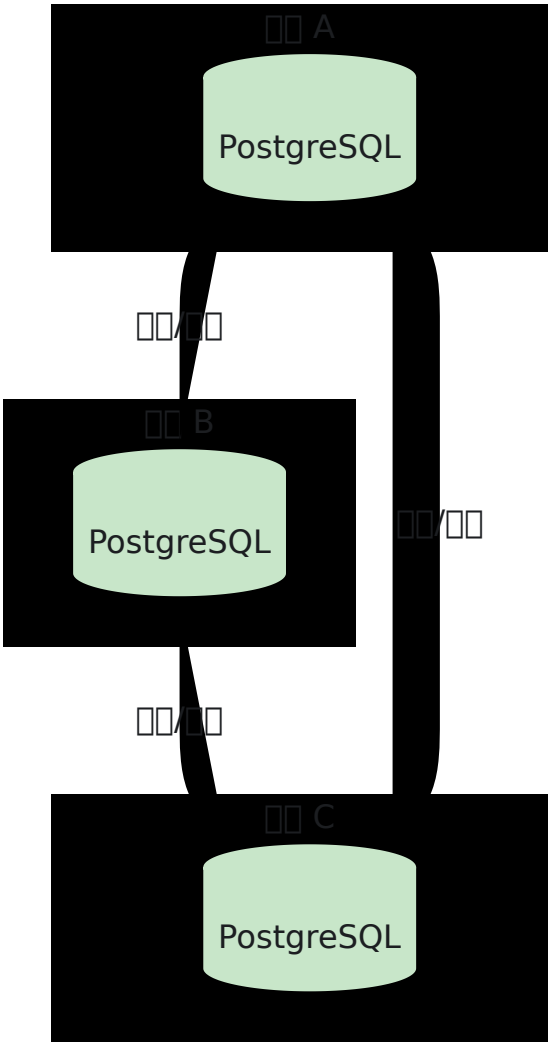

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5432	TCP	PostgreSQL □□□□□□□□□□

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Ansible □□

□□□□□□□□□ HSS □□□□

```
hss:
  hosts:
    site-a-hss01:
      ansible_host: 10.80.12.140
    site-a-hss02:
      ansible_host: 10.80.12.141
  vars:
    omnihss:
      database_type: postgres
      database_host: localhost
      database_port: 5432
      database_name: omnihss
      database_username: omnihss
      database_password: "secure_password"
      replication:
        enabled: true
```

Ansible □□

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`database_type`	□□□□	□	`postgres`	□□□□□□□□□□□□□□ `postgres`□
`database_host`	□□□□	□	`localhost`	PostgreSQL □□□□ Postgres □□ OmniHSS □□□□□□□□□□□□ `localhost`□
`database_port`	□□□	□	`5432`	PostgreSQL □□□
`database_name`	□□□□	□	`omnihss`	□□□□□□
`database_username`	□□□□	□	-	PostgreSQL □□□□□□□ `CREATEDB` □ `REPLICATION` □□□
`database_password`	□□□□	□	-	PostgreSQL □□□
`replication.enabled`	□□	□	`false`	□□□□□□□□□□□ `true` □□ Ansible □□□□□□□□□□□□ □ `pg_hba.conf` □□□

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1. □□□□□□□`hss` Ansible □□□□□□□□□□
2. □□□□□□□□ `prod_master_peers.yml` □ `connected_sites.hss` □□

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□□□□□□□□ (prod_master_peers.yml)

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```yaml
# group_vars/prod_master_peers.yml
connected_sites:
  hss:
    - remote-site-hss01: 10.80.20.140
    - remote-site-hss02: 10.80.20.141
```

PostgreSQL □□

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□□	□	□□
`wal_level`	`logical`	□□□□□□□□□ WAL □□□□□□□□□□□
`max_wal_senders`	`10`	□□□□ WAL □□□□□□□□□□□□□□□
`max_replication_slots`	`10`	□□□□□□□□□□□□□□□□□□
`listen_addresses`	`*`	□□□□□□□□□□□□□

□□□□□□□□ `pg_hba.conf` □□□□□□□□□□□□□□□□ IP □□□□□□

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1. □□□□□□□□ `hss` □□□□□□□ `prod_master_peers.yml` □□□□ `connected_sites.hss`
2. □□ OmniHSS □□

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- □□□□□□□□ PostgreSQL □ OmniHSS
- □□□□□□□□
- □□□□□□□□□
- □□□□□□□□□□□□□□□□
- □□□□□□□□□□□□□ `pg_hba.conf` □□□□□□□
- □□□□□□□□□□□□□□□□□□

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```
ansible-playbook -i hosts site.yml --tags hss-remove-peer \
  -e "peer_name=site_b confirm_remove=yes"
```

`confirm_remove=yes` □□□□□□□□□□□□□□□□□□

```
ansible-playbook -i hosts site.yml --tags hss-add-peer \
  -e "peer_name=site_b peer_host=10.80.20.140"
```

□□

Prometheus □□

postgres_exporter □□□□□ HSS □□□□□□□□□ `9187` □□ Prometheus □□ PostgreSQL □□□

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`pg_replication_slots_active`	Gauge	□□□□□□□□□□□□□□□□□□□□ `1` □□□□□□□□□□ `0`
`pg_replication_slots_pg_wal_lsn_diff`	Gauge	□□□□□□□□□□□□□□□□ WAL □□□□□□□□□□□□□□□□□□□□
`pg_stat_replication_pg_current_wal_lsn_bytes`	Gauge	□□□□□□□ WAL □□

□□ **Prometheus** □□

```
# □□□□□□□1 = □□□0 = □□□□□
pg_replication_slots_active{slot_name=~"sub_from_.*"}

# □□□□□□□□□□□□□□□□□
pg_replication_slots_pg_wal_lsn_diff / 1048576

# □□□□□□□□ 60 □□□□□
pg_replication_slots_active == 0
```

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□□□□□□	`pg_replication_slots_active == 0` □□ 60 □	□□	□□□□□□□□□□ WAL □□□□□
WAL □□□□	`pg_replication_slots_pg_wal_lsn_diff > 104857600` □□ 5 □□	□□	□□□□□□ 100MB□□□□□ □□□□□□□□□□
WAL □□□	WAL □□□ `lost`	□□	□□□□□□□□□□□□□ □□□□□□

Ansible □□

OmniHSS □□□□□□□□□□□□□□□□□□□□□□□□□□□□

1. □□□□□□□□□□□□□□□□□
2. □□□□□□□□□□□□□□□
3. WAL □□□□□□□□□□ 100MB□
4. WAL □□□□ `reserved` □ `extended`□□□□ `lost`□

□□□□□□□□□□□□□□□□□□□

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```
# □□□□□□□□□□□□□□□□□□□□
sudo -u postgres psql -d omnihss -c \
  "SELECT subname, pid IS NOT NULL as worker_alive FROM
pg_stat_subscription;"

# □□□□□□□□□□
sudo -u postgres psql -d omnihss -c \
  "SELECT slot_name, active,
    pg_wal_lsn_diff(pg_current_wal_lsn(), confirmed_flush_lsn) as
lag_bytes,
    wal_status
  FROM pg_replication_slots WHERE slot_type = 'logical';"

# □□□□□□□□□□□□□□□
sudo -u postgres psql -d omnihss -c "SELECT count(*) FROM
subscriber;"
```

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□□□`pg_stat_subscription` □□□□□□□□ `pid IS NULL`□Ansible □□□□□□□□“□□□□□”□

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- □□□□□□□□□□□□□□□□□□□□DDL □□□□
- □□□□□□□□□□□□□□□□□
- □□□□□□□□□□□□□□ WAL □□□

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1. □□ PostgreSQL □□□□□□□□□□□

   ```
   journalctl -u postgresql | grep "logical replication" | tail
   -20
   ```

2. □□□ DDL □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
3. □□□□□□□□□□□□□□□□□□□□□□□□□□□□□

```
ALTER SUBSCRIPTION sub_from_<peer> ENABLE;
```

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□□□`pg_replication_slots` □□ `active = false`□Prometheus □□□□□

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- □□□□□□ PostgreSQL □□
- □□□□□□□□□□ IP □ 5432 □□

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1. □□□□□□□□□□□□□

```
pg_isready -h <peer_ip> -U <db_user> -d omnihss
```

2. □□□□□□□ PostgreSQL □□□□□□
3. □□□□□□□□□□□□□□ IP □ 5432 □□

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WAL □□□

□□□`pg_replication_slots` □□ `wal_status = 'lost'`□Ansible □□□□□□□“WAL □□□”□

□□□□□□□□□□□□□□□□□□□□ WAL □□□ `max_slot_wal_keep_size` □□□□□

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1. □□□□□□□□□□□□□□

```
DROP SUBSCRIPTION sub_from_<peer>;
```

2. □□□□□□□□□□□□□□□

```
SELECT pg_drop_replication_slot('sub_from_<this_site>');
```

3. □□□□ OmniHSS □□□□□□□□□□□□□□ `copy_data = true` □□□□□□□□□

WAL □□□□

□□□`pg_replication_slots_pg_wal_lsn_diff` □□□□□□□□Prometheus □□□□□

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1. □□□□□□□□□□□□□□

```
SELECT slot_name,
  pg_wal_lsn_diff(pg_current_wal_lsn(), confirmed_flush_lsn) as
lag_bytes
FROM pg_replication_slots WHERE slot_type = 'logical';
```

2. □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
3. □□□□□□□□□□□□□□□□□□□□□□□
4. □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□

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OmniHSS □□□□

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OmniHSS □□□□□□

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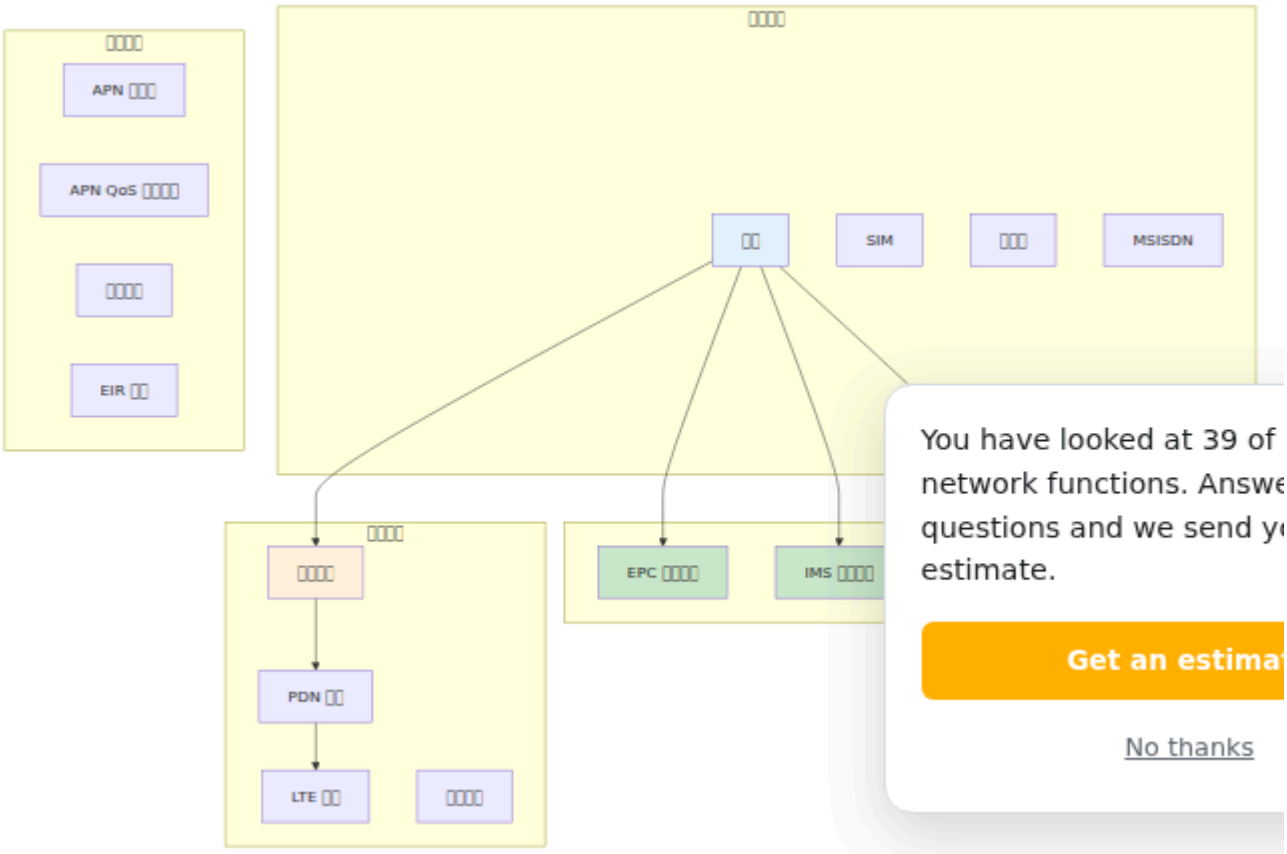
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APN □□□
APN QoS □□□□
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EIR □□
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PDN □□
LTE □□
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EPC □□□□
IMS □□□□
You have looked at 39 of
network functions. Answe
questions and we send y
estimate.
Get an estima
No thanks

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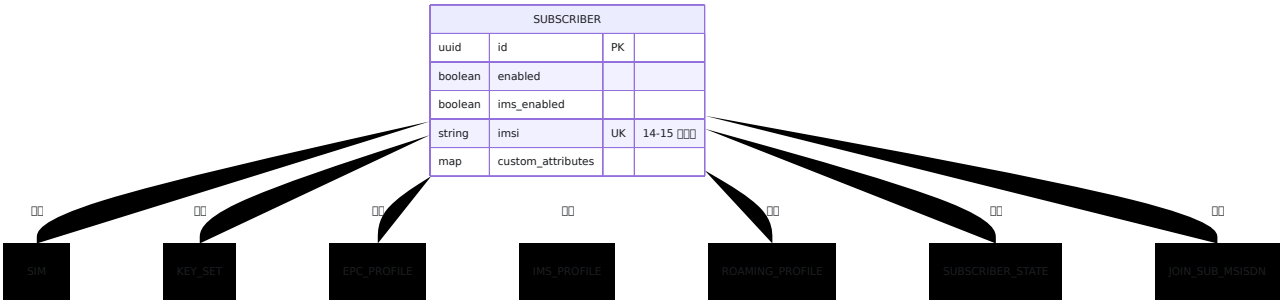
SUBSCRIBER
uuid
id
PK
boolean
enabled
boolean
ims_enabled
string
imsi
UK
14-15 □□□
map
custom_attributes
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SIM
KEY_SET
EPC_PROFILE
IMS_PROFILE
ROAMING_PROFILE
SUBSCRIBER_STATE
JOIN_SUB_MSISDN

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`id`	uuid	□□	UUID□□□ (`gen_random_uuid()`)
`enabled`	boolean	□□□□□□	□□: true
`ims_enabled`	boolean	IMS □□□□	□□: true
`imsi`	string	□□□□□□□□	14-15 □□□□□□
`custom_attributes`	map	□□□□□□□	□□
`sim_id`	uuid	SIM □□□	□□□□□□□□□□□□□□ null□
`key_set_id`	uuid	□□□□□□	□□
`epc_profile_id`	uuid	EPC □□□□ □□□	□□□□□□□□□□□□□□ null□
`ims_profile_id`	uuid	IMS □□□□ □□□	IMS/□□□□□□□□□□□□ null□
`roaming_profile_id`	uuid	□□□□□□□□ □	□□□□□□ null□□□□□□□□□□□□□□ □□
`subscriber_state_id`	uuid	□□□□□□□	□□□□
`ims_subscription_id`	uuid	IMS □□□□ □	□□

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□□□□□□□IMS □□□	`key_set` □ `sim`
LTE □□□□□S6a □□□	`epc_profile`
IMS / □□□Cx □□□	`ims_profile`□□□□□□□□ MSISDN
□□□□□□□□□	□□□□□□□□□□ `roaming_profile`

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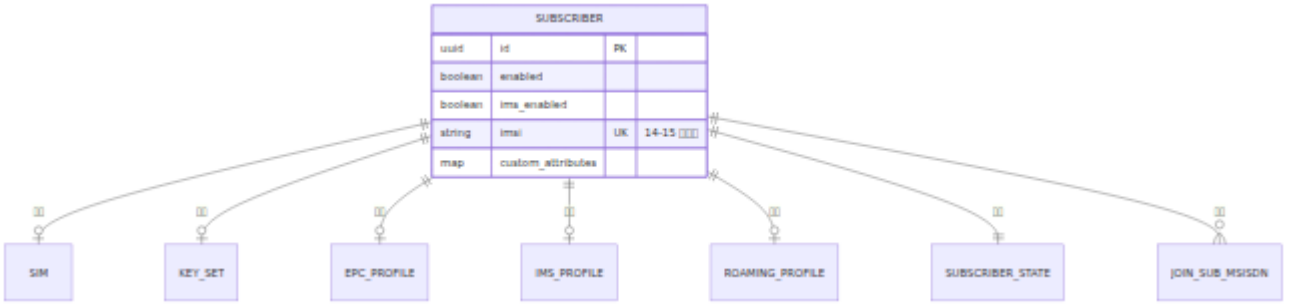
- IMSI □□□ 14-15 □□□□□□□□□□□□□□□
- □□□□□□□□ MSISDN□□□□□□□□
- □□□□□□□□□□□□□□□□□
- `enabled` □□□□□□□□□□□□□ IMS□□
- `ims_enabled` □□□□□□ IMS □□□
- □□□□□□□ IMSI □□□ IMS □□□□□□□□□□□□ IMS□ □□□□□□□□□□□□□□□□□□□□□□□□
- □□ `ims_subscription_id` □□□□□□□□□□□□ `ims_subscription_id` □□□□□□□□IMSI□ □□□□□□ IMS □□□□□□□□□□□□□□□□□□□□□□□□ S-CSCF□□□□ IMS □□ □ □□□□□□□□□□□

SIM

SIM □□□□□□□□□□□□ SIM □□



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□□	□□	□□	□□□□
`iccid`	string	□□□□□ ID	□□
`sim_vendor`	string	SIM □□□	□□
`batch_name`	string	□□□□	□□
`is_esim`	boolean	□□□ SIM □□	□□
`pin1`, `pin2`	string	PIN □□	□□
`puk1`, `puk2`	string	PUK □□	□□
`adm1` - `adm10`	string	□□□□	□□□□
`kic`, `kid`	binary	OTA □□□□	□□□□

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- ICCID □□□□ SIM □
- □□ SIM □□□□□□□□□□□□□
- PIN/PUK □□□□□□□□□ SIM □□
- ADM □□□□□□ SIM □□
- KIC/KID □□ SIM OTA□□□□□□□□

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KEY_SET			
uuid	id	PK	
binary	ki		128 □
binary	opc		128 □
binary	op		128 □
binary	amf		16 □
bigint	sqn		48 □□□
string	authentication_algorithm		

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□□	□□	□□	□□
`ki`	binary	□□□□	128 □□16 □□□
`opc`	binary	□□□□□□□□□□□□	128 □
`op`	binary	□□□□□□□□□□□□ OPC□	128 □
`amf`	binary	□□□□□□	16 □□2 □□□
`sqn`	bigint	□□□□□□□□	48 □
`authentication_algorithm`	string	□□□□	□□□ "milenage"
`ota_counter`	bigint	OTA □□□□□	���□

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- Ki □□ SIM □□□□□□
- □□□□ OPC □ OP□OPC □□□ OP □□□
- SQN □□□□□□□□
- Milenage □□□□□□□□□□

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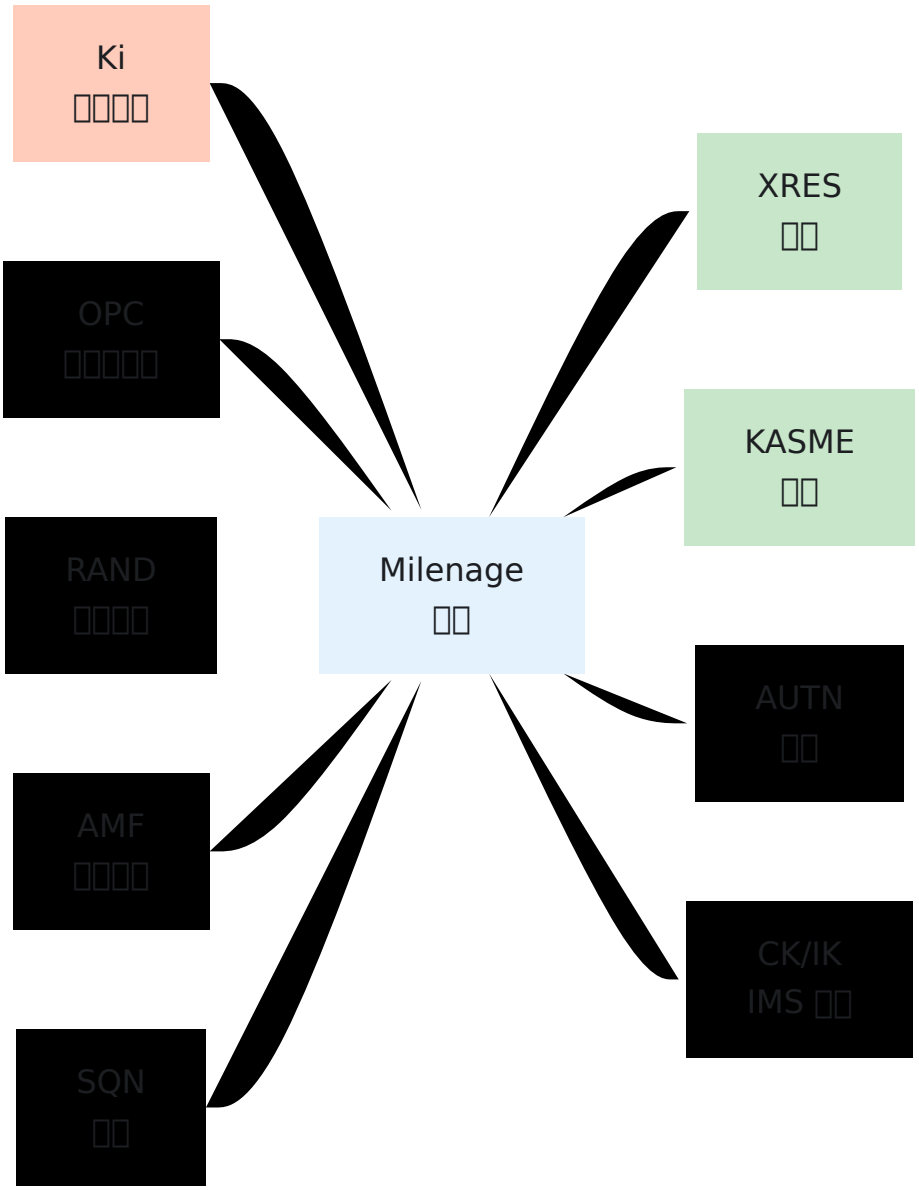
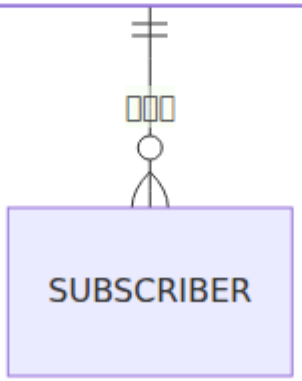


□□□□SIM □□□

SIM□□□□□

KEY_SET			
uuid	id	PK	
binary	ki		128 □
binary	opc		128 □
binary	op		128 □
binary	amf		16 □
bigint	sqn		48 □□□
string	authentication_algorithm		



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- **SIM** □□□ □□□□□□□□□□□□ SIM□□□□□□□□□ MSISDN□□□□□□□ IMS □□□□□□□□□□□ SIM □□ □□□□□□□□□□□
- □ **IMSI SIM**□ □□ ICCID □□□□ IMSI□□□ IMSI □□□□□□□□□□□□ IMSI □□□□□□□□□□□ IMSI □□□□□□□□□□□□□ IMSI□□□□□□□□□□ □ IMSI SIM □□□
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MSISDN

MSISDN □□□□□□□□□□

MSISDN			
uuid	id	PK	
string	msisdn	UK	1-15 □□□

□□□

JOIN_SUB_MSISDN		
uuid	subscriber_id	FK
uuid	msisdn_id	FK

□□



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`msisdn`	string	□□□ ISDN □□	1-15 □□□□E.164 □□

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- MSISDN □□□□□□□□□□□□
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- □□ MSISDN □□□□□□□□□□□□□ IMSI□□□□□□□□□□□□

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EPC □□□□

EPC □□□□□□□ LTE □□□□□□□□□

EPC_PROFILE			
uuid	id	PK	
string	name	UK	
integer	ue_ambr_dl_kbps		
integer	ue_ambr_ul_kbps		
string	network_access_mode		□□□□□□□□□
integer	tracking_area_update_interval_seconds		

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JOIN_EPC_APN

SUBSCRIBER

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APN_PROFILE

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□□	□□	□□	□□
`name`	string	□□□□□□	□□
`ue_ambr_dl_kbps`	integer	□□□□□□	Kbps
`ue_ambr_ul_kbps`	integer	□□□□□□	Kbps
`network_access_mode`	string	□□□ ◆◆	"□□□" □ "□□ □□□"
`tracking_area_update_interval_seconds`	integer	TAU □ □	□

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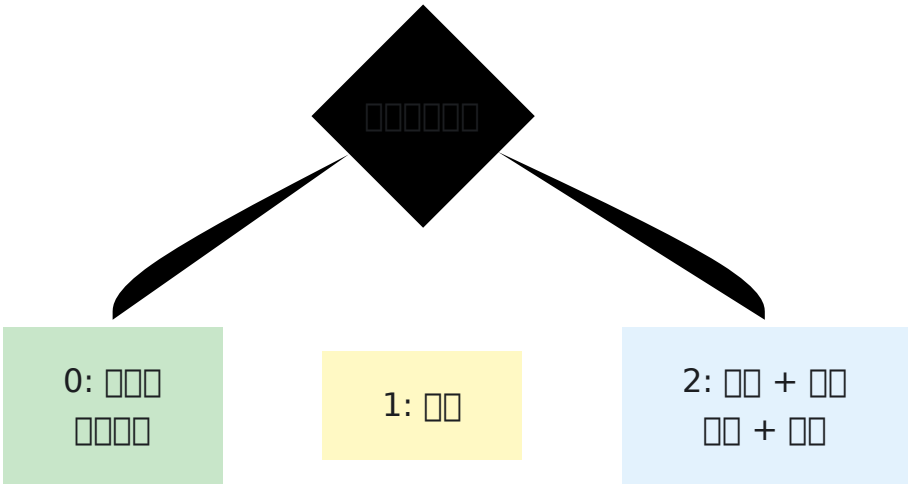

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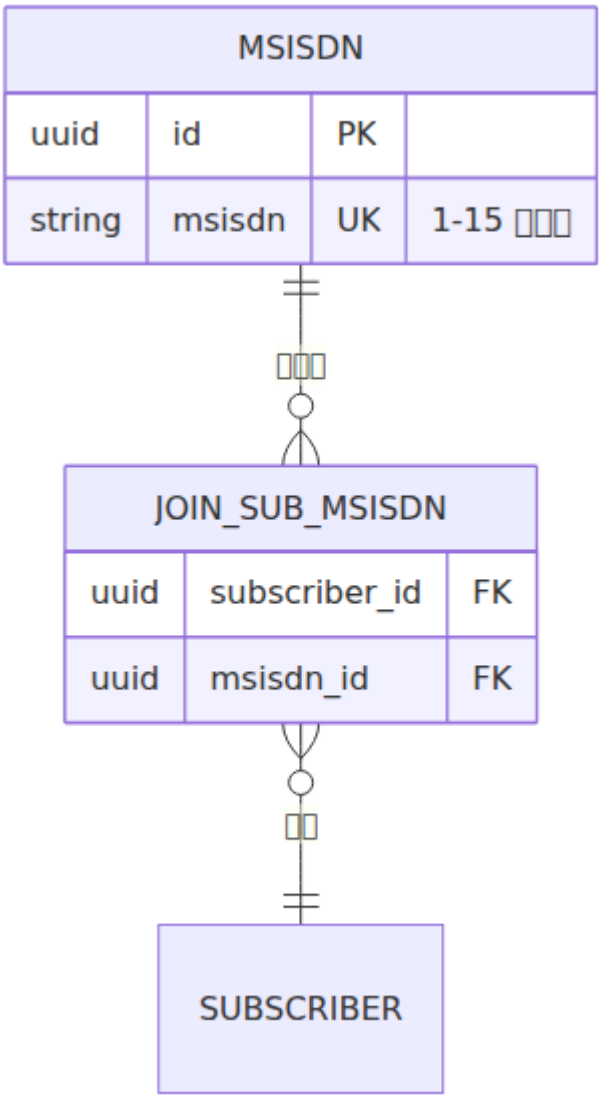
MSISDN
uuid
id
PK
string
msisdn
UK
1-15 □□□
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JOIN_SUB_MSISDN
uuid
subscriber_id
FK
uuid
msisdn_id
FK
□□
SUBSCRIBER

IMS □□□□

IMS □□□□□□□□□/□□□□□□□□

IMS_PROFILE		
uuid	id	PK
string	name	UK
text	ifc_template	

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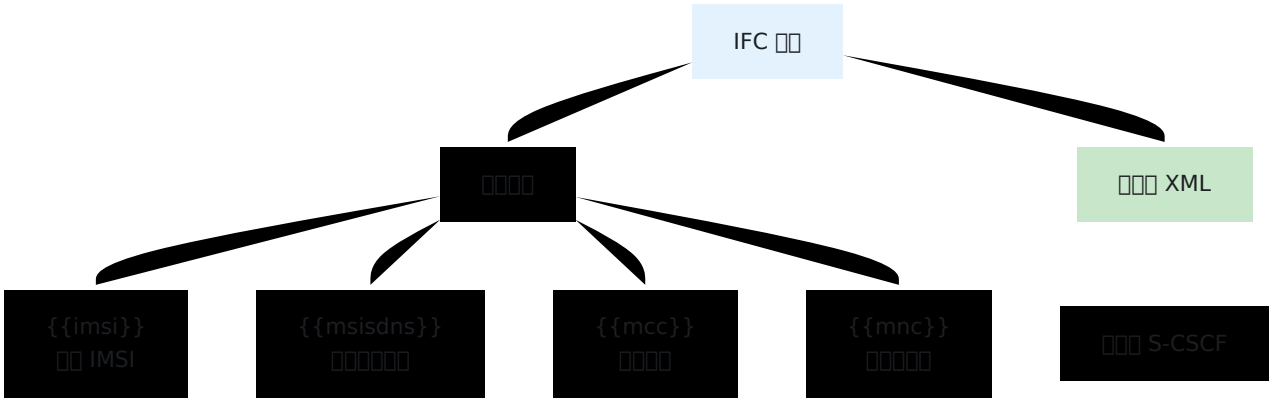
`name`	string	□□□□□□□	□□
`ifc_template`	text	□□□□□□□ XML □□	□□□□ XML

IFC □□□□□



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- IFC□□□□□□□□□□□□ IMS □□□□□□□
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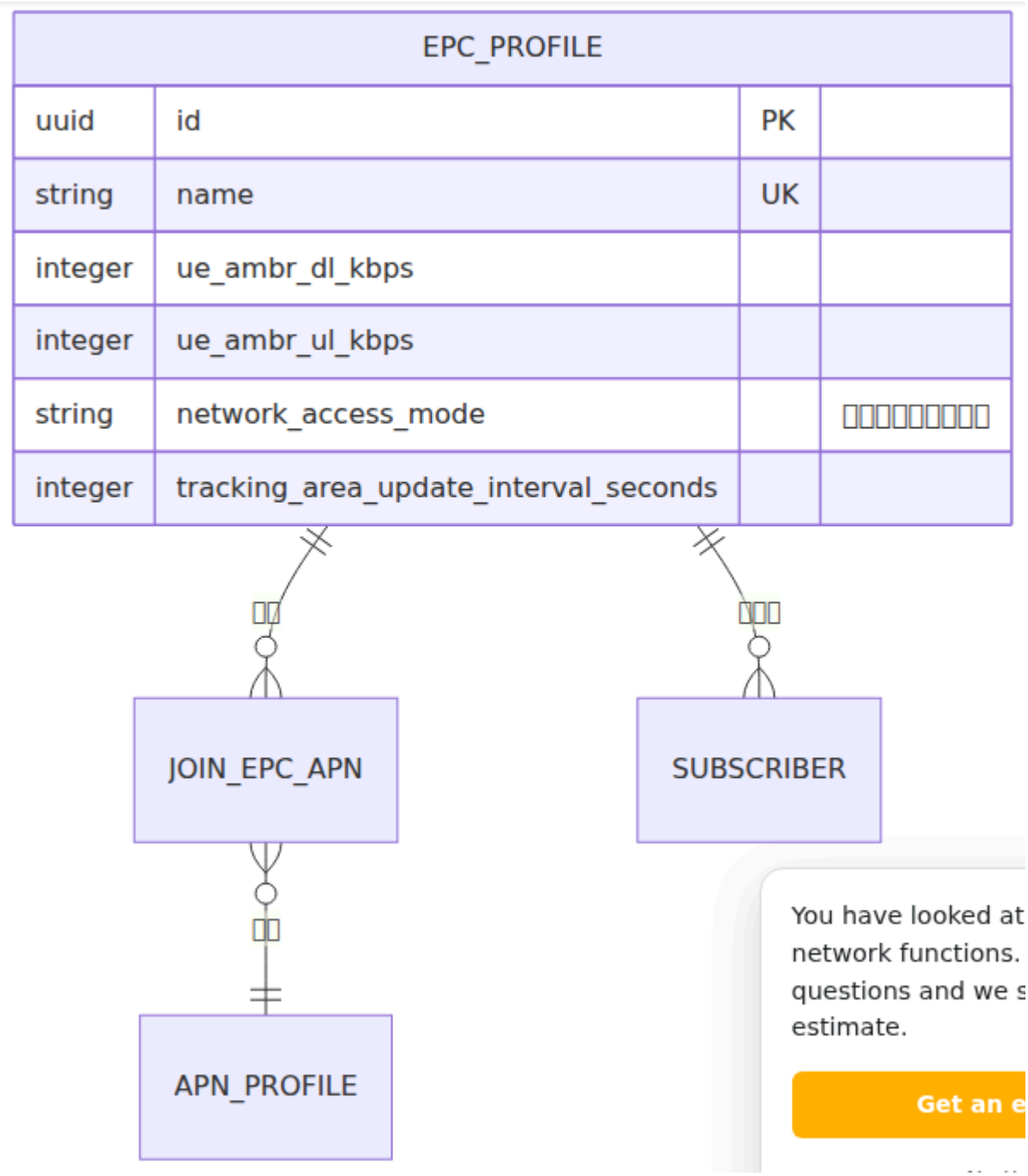
- □ IMS □□□□□□□ S-CSCF

APN □□□□

APN □□□□□□□□□□□□□□□□□□□□



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APN □□□

APN_IDENTIFIER			
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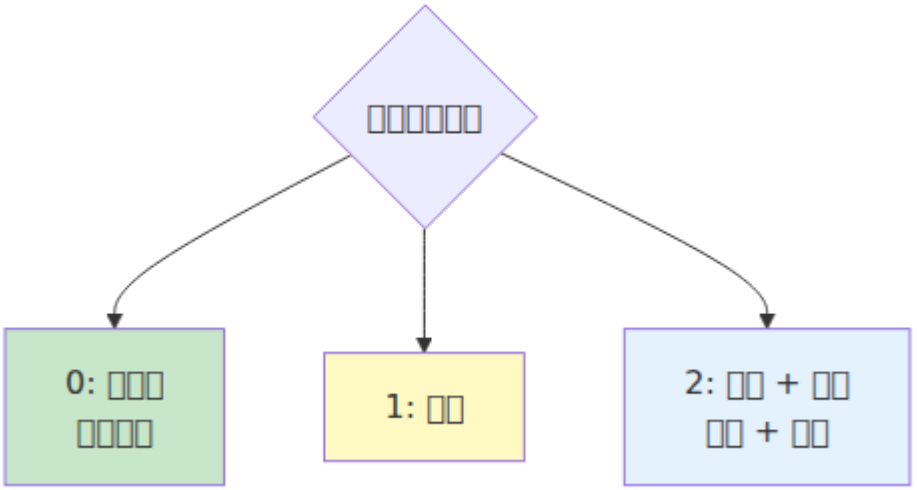
string	apn	UK	
string	ip_version		ipv4, ipv6, ipv4v6 □ ipv4_or_ipv6

□□	□□	□□	□□
`apn`	string	APN □□	"internet", "ims", "mms"
`ip_version`	string	IP □□□□	□□□

IP □□□□□



APN QoS □□□□

APN_QOS_PROFILE		
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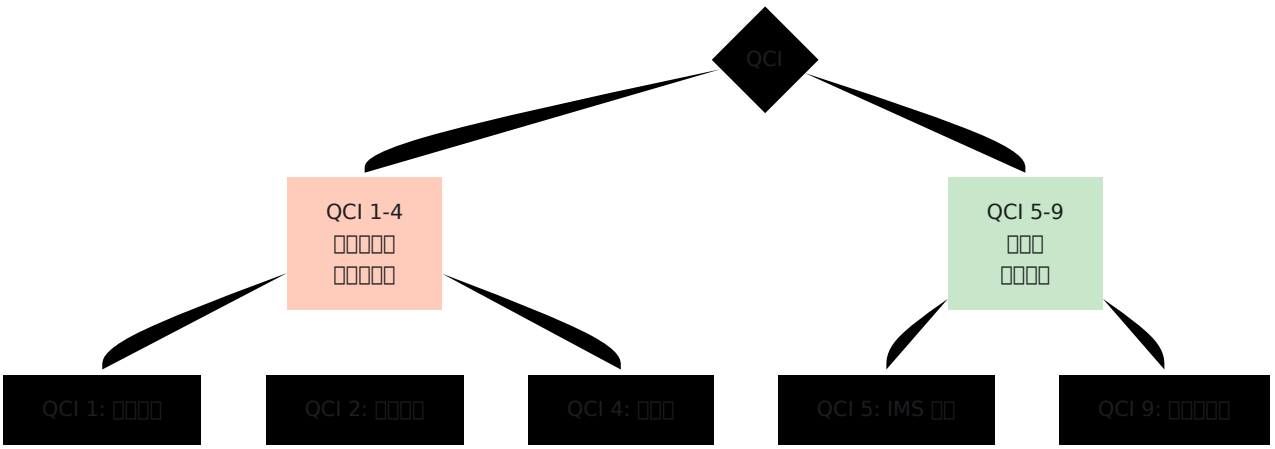
string	name	UK
integer	qci	
integer	allocation_retention_priority	
integer	apn_ambr_dl_kbps	
integer	apn_ambr_ul_kbps	
boolean	pre_emption_capability	
boolean	pre_emption_vulnerability	

QoS □□□

□□	□□	□□	□□□□
`qci`	QoS □□□□□	1-9	QCI 9□□□□□
`allocation_retention_priority`	ARP □□□	1-15	8□□□□□□□
`apn_ambr_dl_kbps`	APN □□□□	0+	□□
`apn_ambr_ul_kbps`	APN □□□□	0+	□□
`pre_emption_capability`	□□□□□□	true/false	false
`pre_emption_vulnerability`	□□□□□	true/false	true

QCI □□


QCI
QCI 1-4
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QCI 5-9
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QCI 1: □□□□
QCI 2: □□□□
QCI 4: □□□
QCI 5: IMS □□
QCI 9: □□□□□

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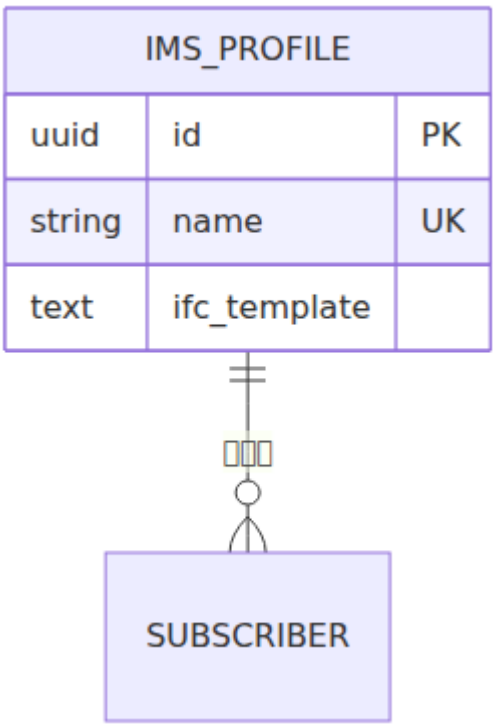
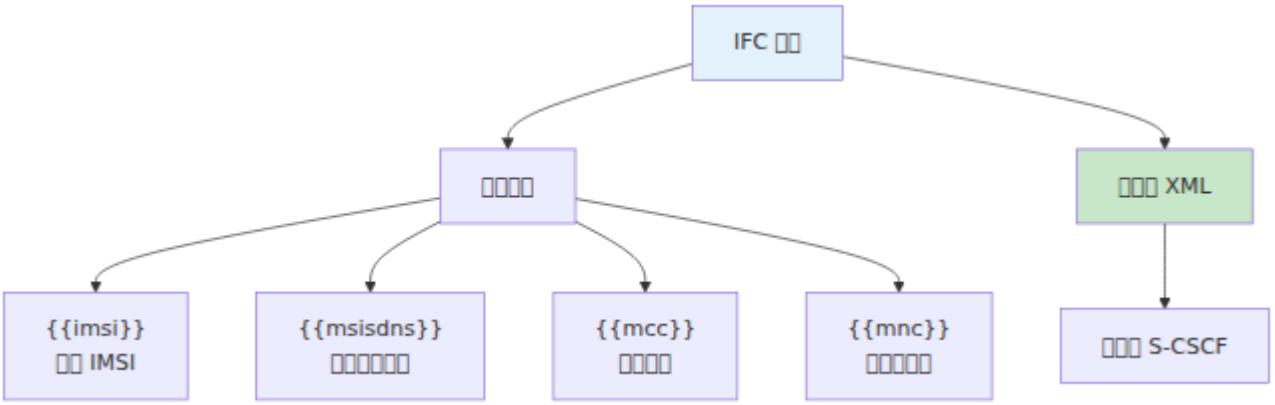

IMS_PROFILE
uuid
id
PK
string
name
UK
text
ifc_template
□□□
SUBSCRIBER

□□□□□

ROAMING_RULE			
uuid	id	PK	
string	name	UK	
string	mcc		3 □□□
string	mnc		2-3 □□□
string	data_action		□□□□□
string	ims_action		□□□□□

□□□□□

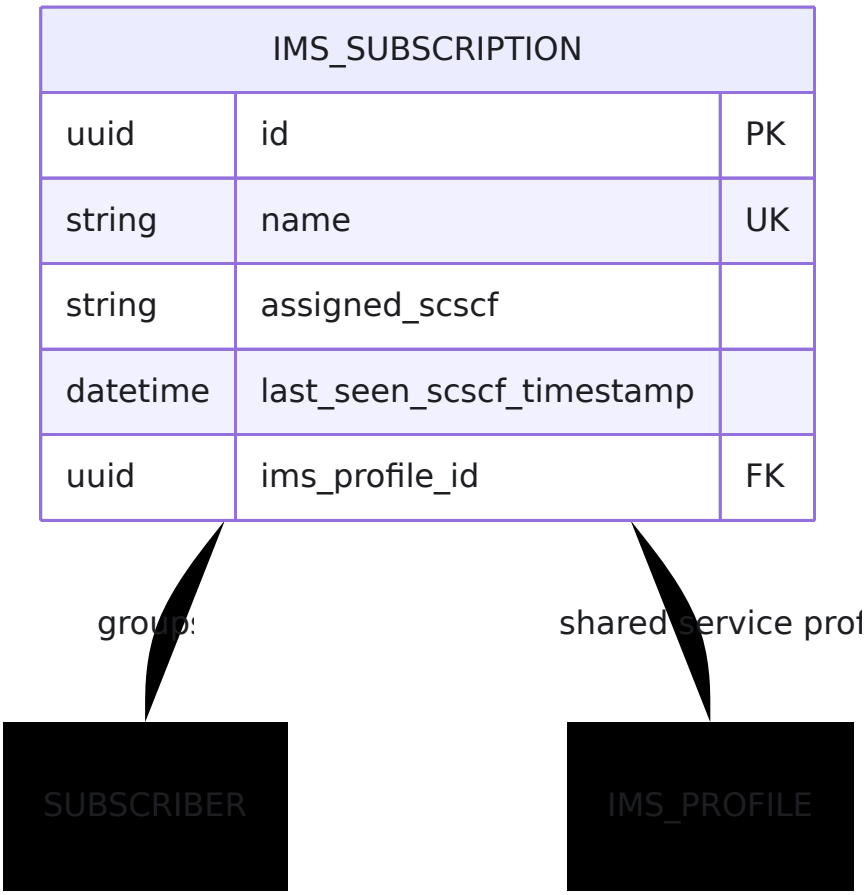


EIR □□

□□□□□□□ S13 EIR □□□□□EIR □□□□□□□□□□□□□□□□□□□□□□□□□□□□ EIR □□□

EIR_RULE			
uuid	id	PK	
string	action		□□□□□□□□□□□□
string	regex		□□ IMEISV□□□□ IMEI□□□□ IMSI
integer	precedence		1-65535□□□□□□□□□□

□□	□□	□□	□□
`action`	string	□□□□□□□□□□	"□□□"
`regex`	string	□□ IMEISV□IMEI □ IMSI □□□□□□□□	"35979139461640"
`precedence`	integer	□□□□□□□□□□



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□□	□□	□□	□□
`name`	string	□□□□□□□□	□□□□□
`assigned_scscf`	string	□□□□□□ S-CSCF	□□□□□□□□ HSS □□
`last_seen_scscf_timestamp`	datetime	□□□□□□ S-CSCF □□□	□□□□□
`ims_profile_id`	uuid	□□□□□□□□□□□□□□□□ □□□□	□□

□□□□

- □□□□ `subscriber.ims_subscription_id` □□□□
- HSS □□□□□□□□□□□□□□ S-CSCF□□□□□□□□□□□□□□□□□□□□□□□□□□□□ `assigned_scscf`□

- □□□ `ims_profile_id` □□□□ IMS □□□□

□□□

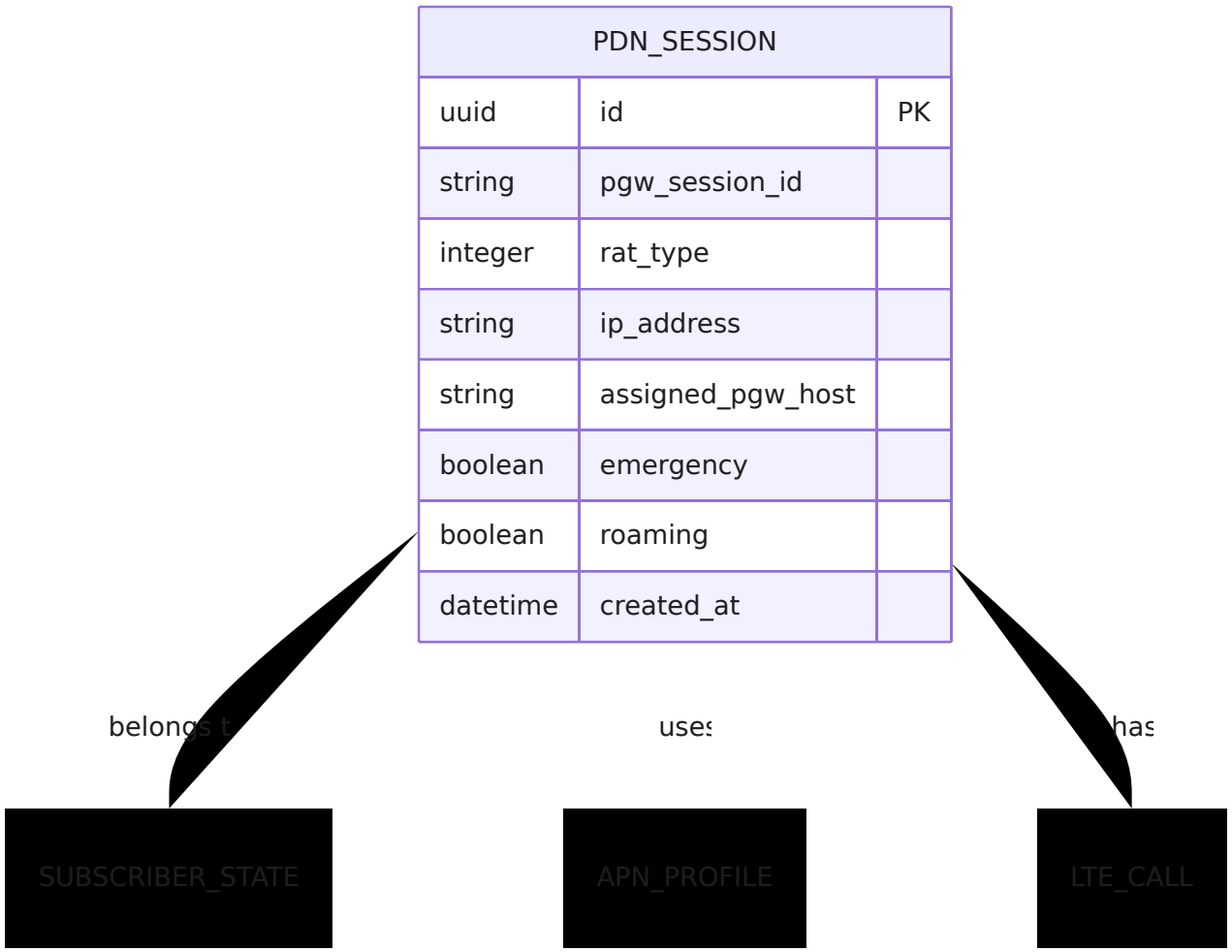
- `last_seen_imei` - □ S13 ECR □ S6a ULR □□□□□ AVP □□□□□□ IMEI
- `last_seen_imei_software_version` - □□ IMEI □□□□□□□□□ (IMEISV = IMEI + □□□)□□□□□ IMEI □□□□□□□□□□□□□□□□□□□
- `last_seen_imei_timestamp` - □□□□ IMEI □□□

□□□□

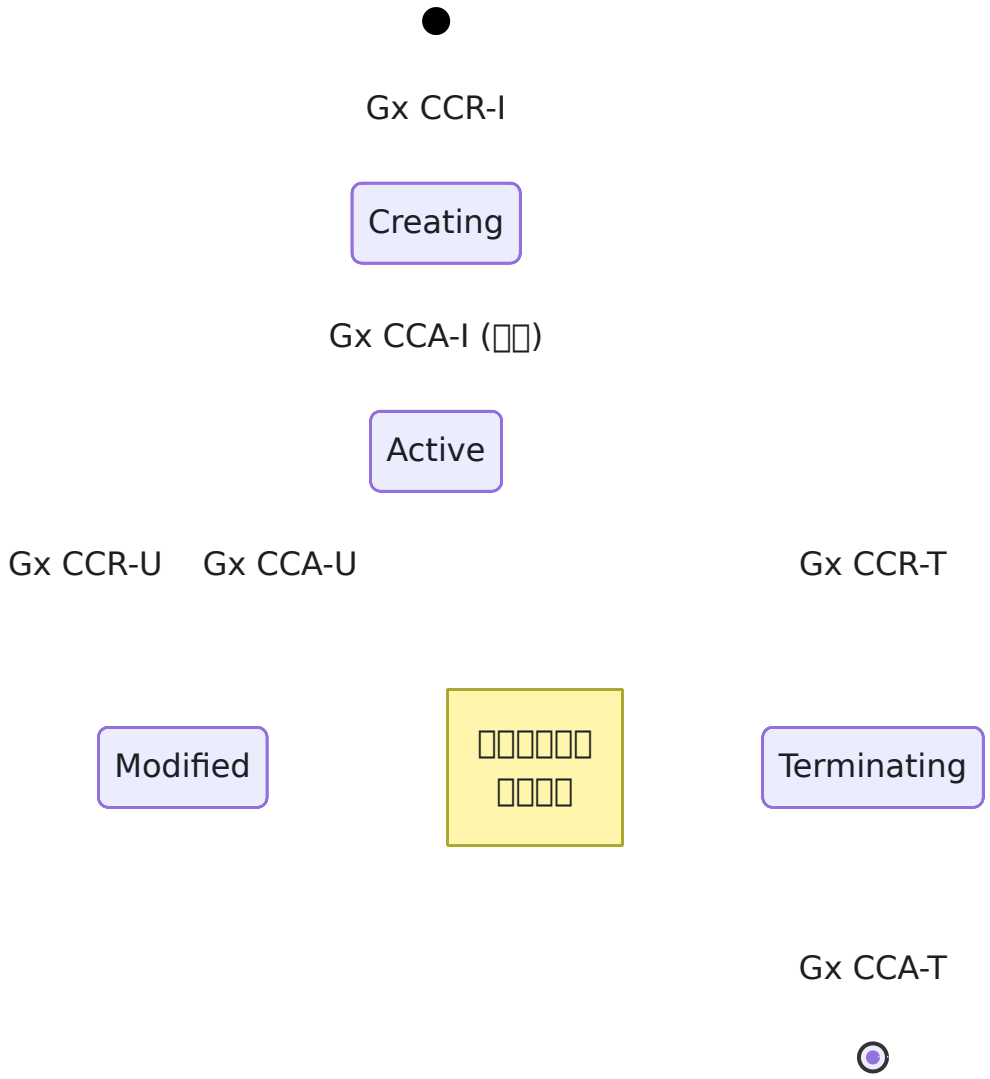
- `last_seen_at` - □□□□□□□□□
- □□ `last_*_at` □□□□□□□□□□

PDN □□

PDN □□ □□□□□□□□□□□□□



PDN □□□□□□□



LTE □□

LTE □□ □□□□□□□□ VoLTE □□/□□□□□□

APN_QOS_PROFILE		
uuid	id	PK
string	name	UK
integer	qci	
integer	allocation_retention_priority	
integer	apn_ambr_dl_kbps	
integer	apn_ambr_ul_kbps	
boolean	pre_emption_capability	
boolean	pre_emption_vulnerability	

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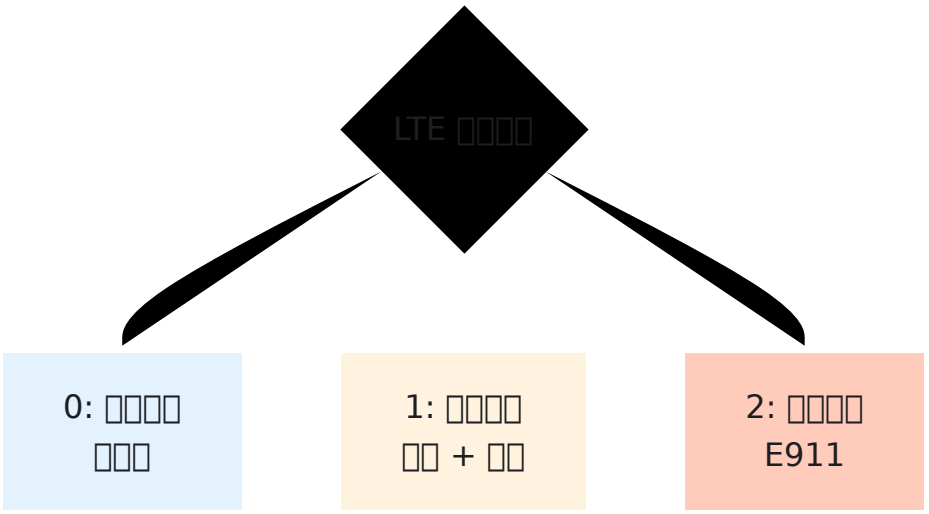
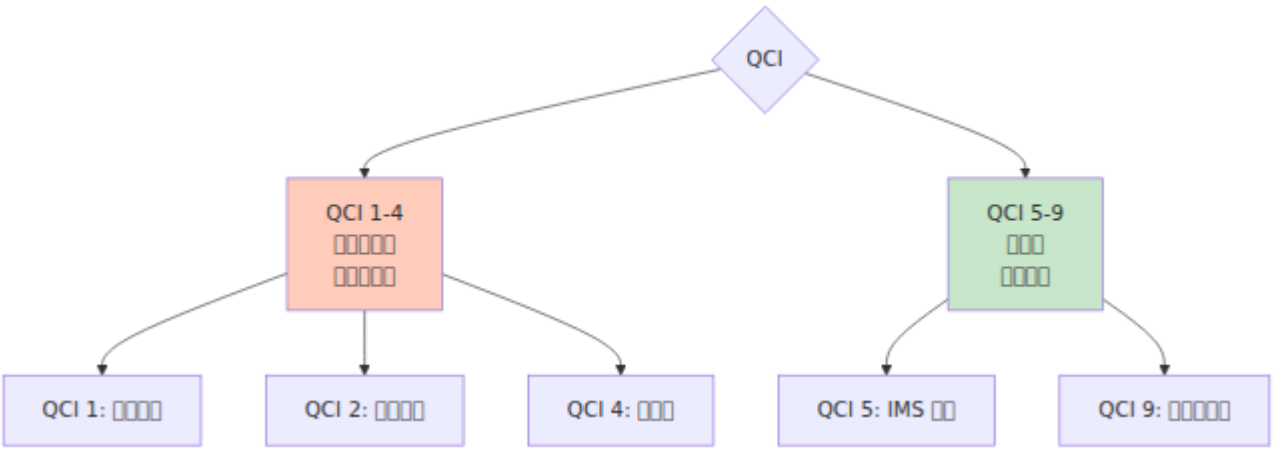


VoLTE □□□□□


QCI
QCI 1-4
QCI 5-9
QCI 1:
QCI 2:
QCI 4:
QCI 5: IMS
QCI 9:

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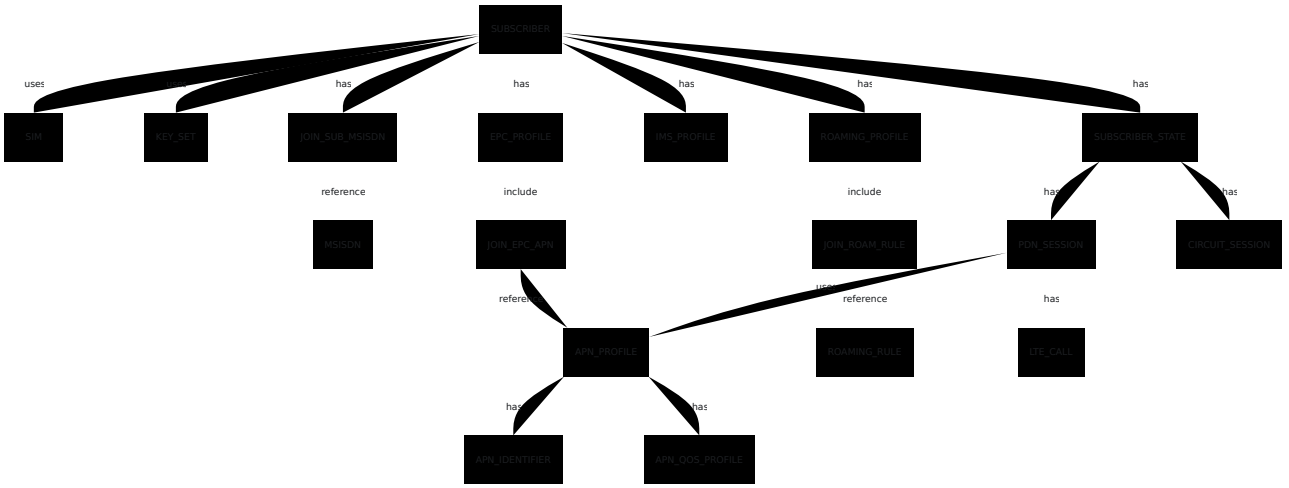
□□□□□□


SUBSCRIBER
uses
has
has
has
has
has
SIM
KEY_SET
JOIN_SUB_MSISDN
EPC_PROFILE
IMS_PROFILE
ROAMING_PROFILE
SUBSCRIBER_STATE
reference
include
include
has
has
MSISDN
JOIN_EPC_APN
JOIN_ROAM_RULE
PDN_SESSION
CIRCUIT_SESSION
reference
reference
has
APN_PROFILE
ROAMING_RULE
LTE_CALL
has
has
APN_IDENTIFIER
APN_QOS_PROFILE

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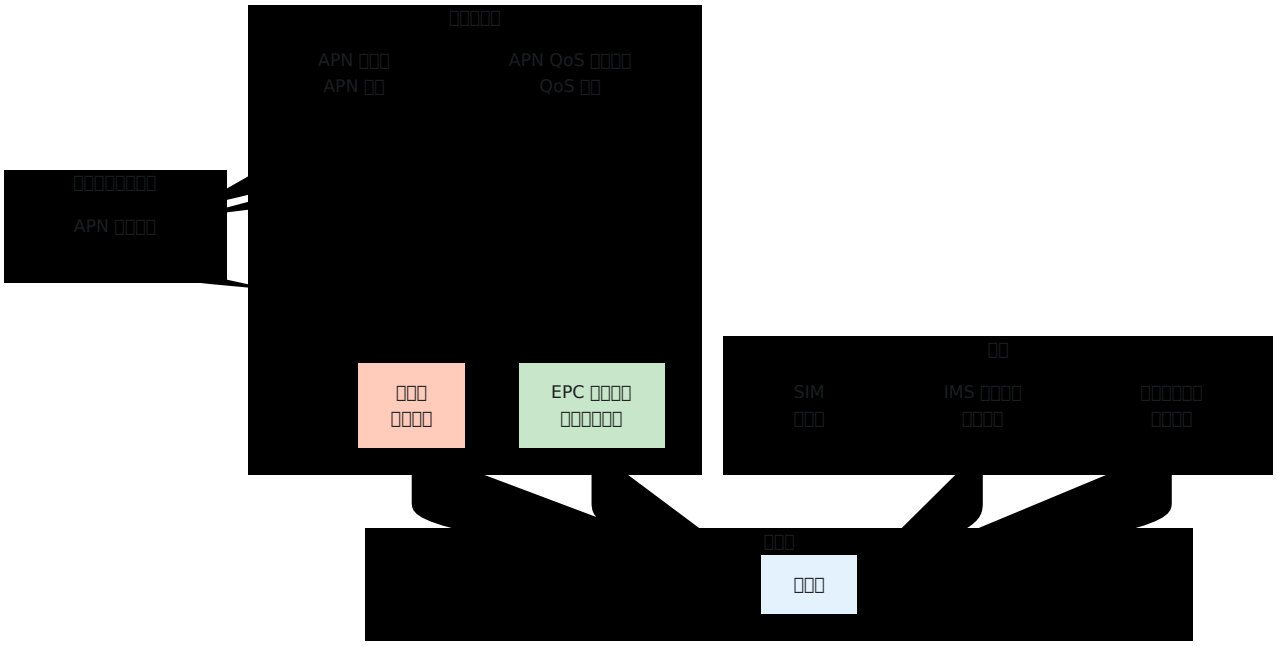

□□□□□□

ROAMING_RULE			
uuid	id	PK	
string	name	UK	
string	mcc		3 □□□
string	mnc		2-3 □□□
string	data_action		□□□□□
string	ims_action		□□□□□

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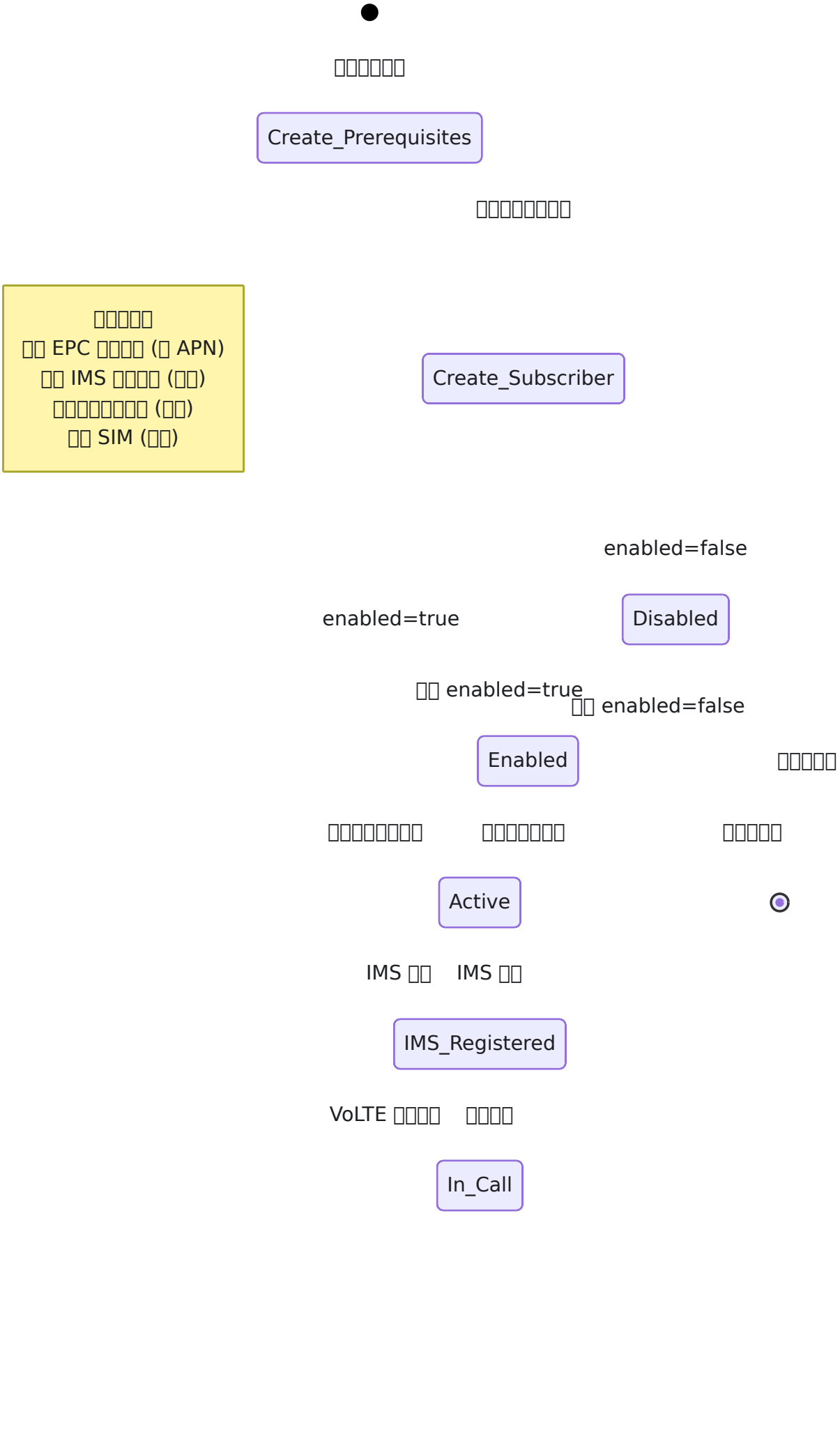
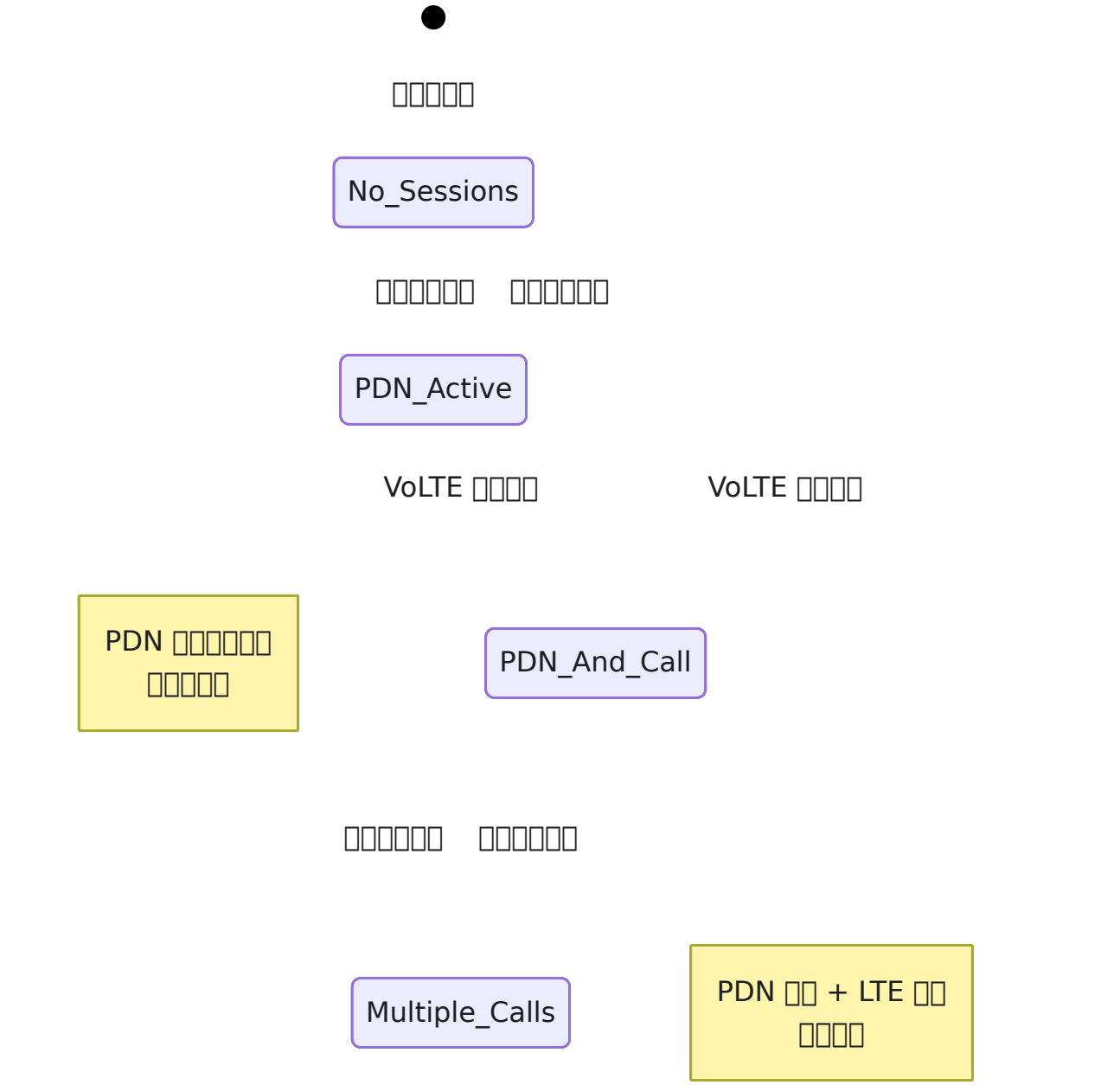
□□□□□□□□□


Create_Prerequisites
Create_Subscriber
enabled=false
enabled=true
Disabled
enabled=true
enabled=false
Enabled
Active
IMS
IMS
IMS_Registered
VoLTE
In_Call

□□□□□□□


□□□□□□
No_Sessions
□□□□□□□ □□□□□□□
PDN_Active
VoLTE □□□□
VoLTE □□□□
PDN □□□□□□□ □□□□□
PDN_And_Call
□□□□□□□ □□□□□□□
Multiple_Calls
PDN □□ + LTE □□ □□□□

□□□□□

□□□□

EIR_RULE			
uuid	id	PK	
string	action		□□□□□□□□□□□□
string	regex		□□ IMEISV□□□□ IMEI□□□□ IMSI
integer	precedence		1-65535□□□□□□□□□□

□□□□□□

S6a ULR □□

□□ IMSI □□□□□

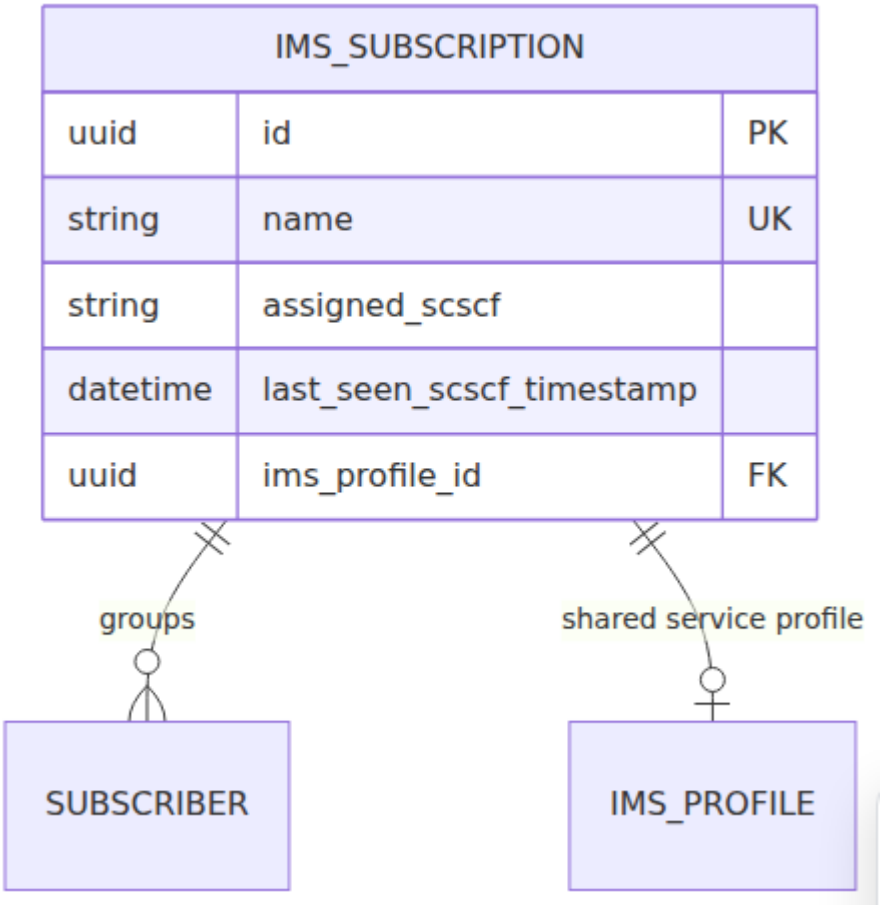
□□ EPC □□□□
+ APN □□□□

□□□□□□□□
□□□MME □

□□□□□□□
AMBR□APN□QoS

S6a ULA □□

IMS □□□□


IMS_SUBSCRIPTION
uuid
id
PK
string
name
UK
string
assigned_scscf
datetime
last_seen_scscf_timestamp
uuid
ims_profile_id
FK
groups
shared service profile
SUBSCRIBER
IMS_PROFILE

□□□□□□

Gx CCR-I □□

□□ IMSI □□□□□

□□ APN □□□□
+ QoS □□□□

□□□□□□□

□□ PDN □□
□□□□□□□

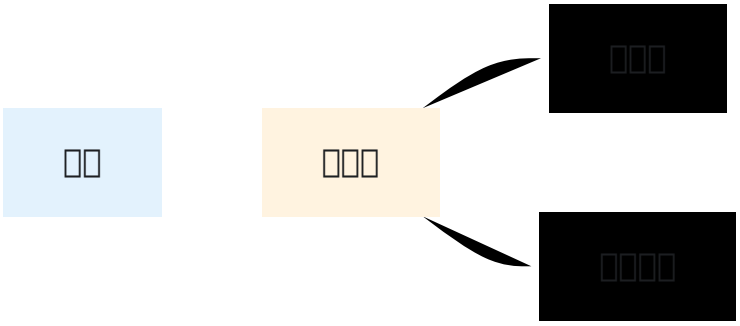
□□ QoS □□
AMBR□QCI□ARP

Gx CCA-I □□

□□□□□□□

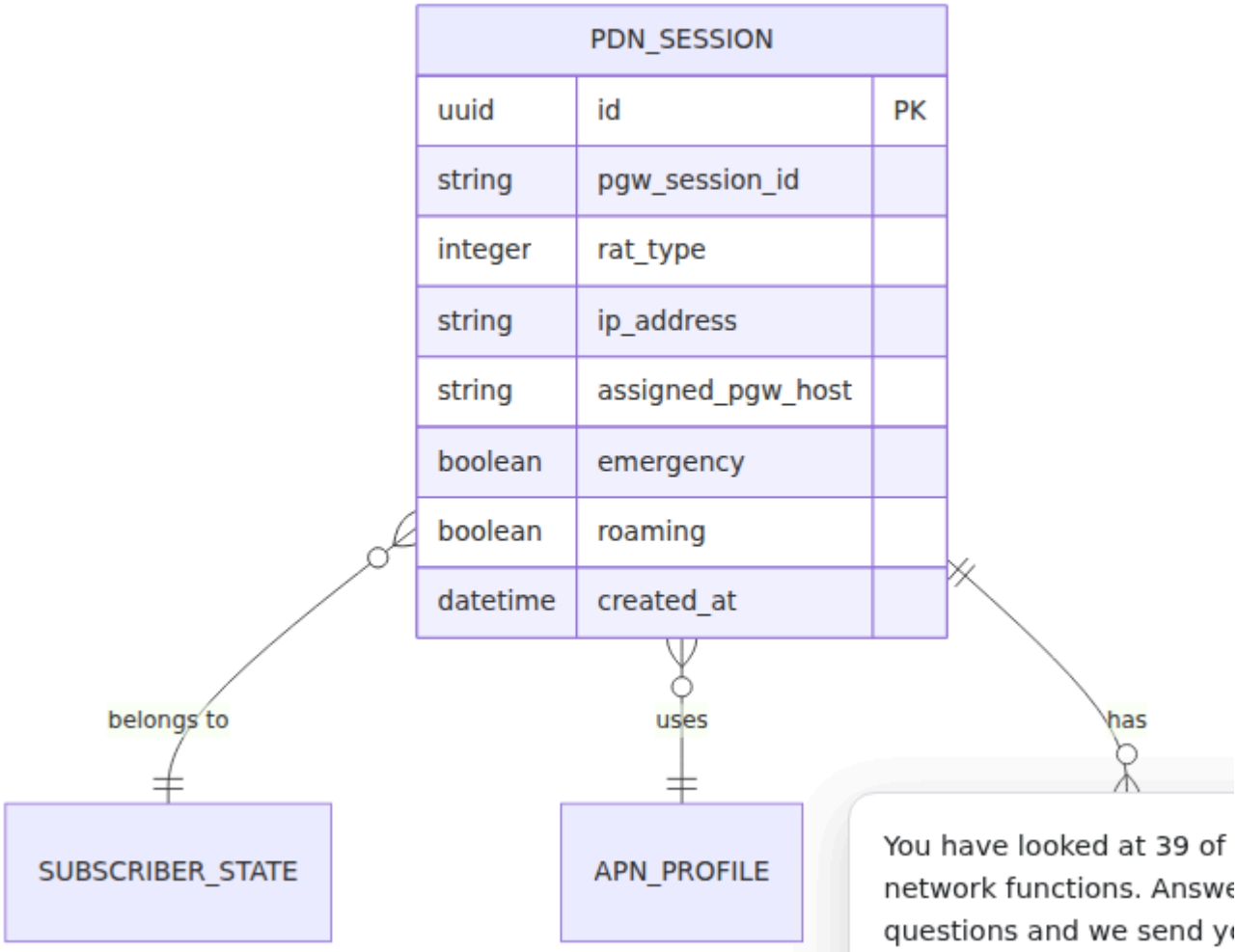
OmniHSS □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□

□□□□□ (□□)



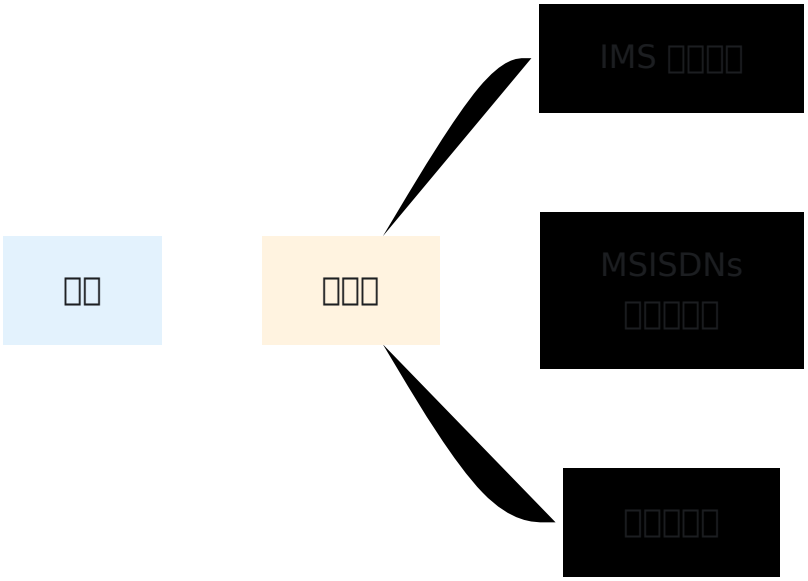
□□□ S6a AIR - □□□□□□□□□□□□□□□

□□□□□ (□□□□□)



□□□ S6a ULR - □□□□□ EPC □□□□□□

□□□□ (IMS □□)



□□□ Cx SAR - □□ IMS □□□□□□□□□□□□

← □□□□□□ | □□□□API □□ →

Diameter □□□□□□

← □□□□□□□

□□□□□□□□□ mermaid □□□□□□□ Diameter □□□□□□□□□□□ OmniHSS □□□□□□□□

□□

- □□□□□□□ (S6a ULA)
- □□□□□□□ (S6a AIA)
- □□□□□□□□ (Cx SAA)
- □□□□□□□ (Gx CCA)
- □□□□□□□ (Sh UDA)
- ME □□□□□□□ (S13 ECA)

□□□□□□□ (S6a ULA)

□□□□□□□□ HSS □ LTE □□□□□□□□□ MME□□□□□□□□□□□□□□ Diameter AVP □□□□□□□□

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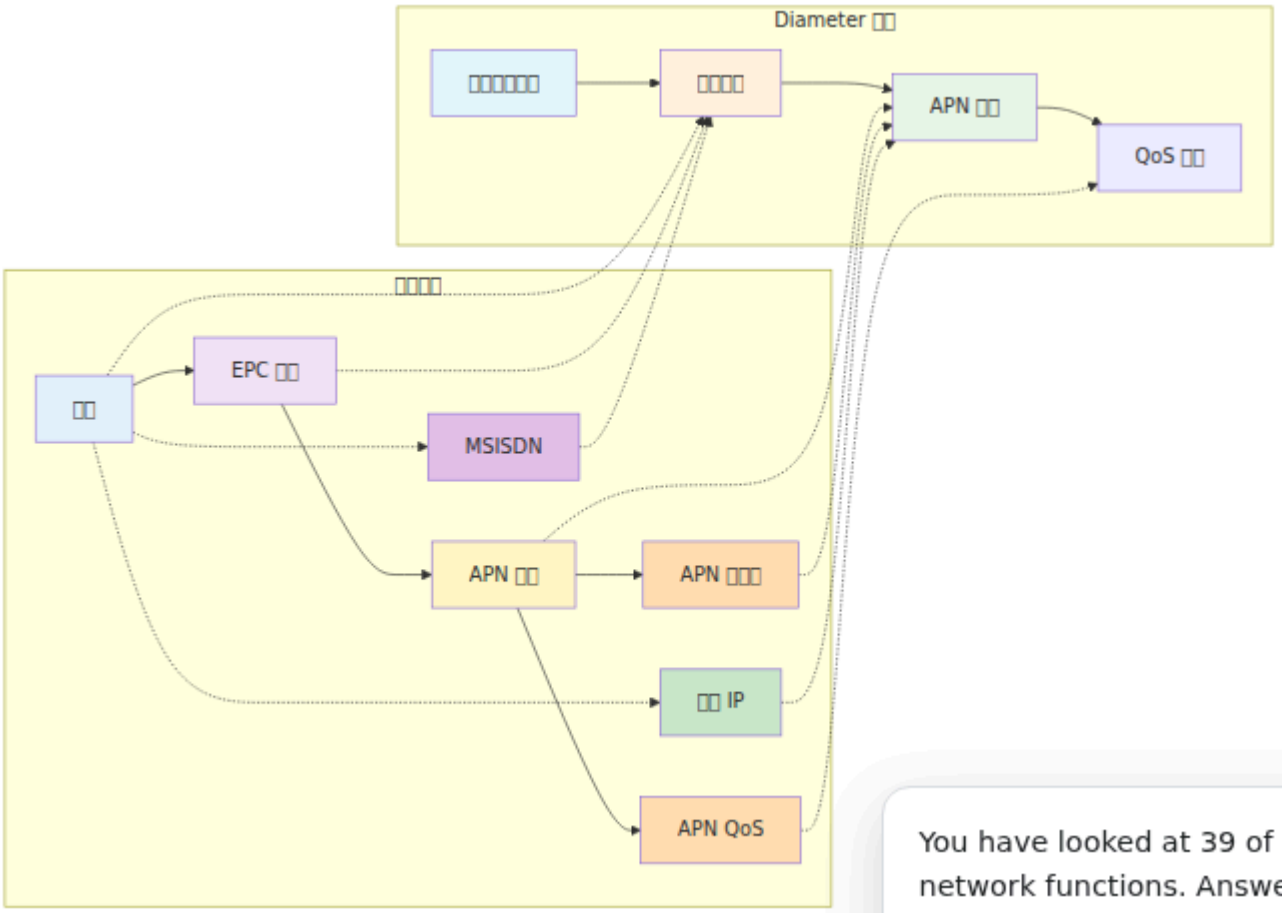

You have looked at 39 of
network functions. Answe

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subscriber.enabled	`true/false`	Su St
msisdn.msisdn	`'14155551234'`	MS
epc_profile.ue_ambr_ul_kbps	`50000`	Ma Re Ba UL
epc_profile.ue_ambr_dl_kbps	`100000`	Ma Re Ba DL
epc_profile.network_access_mode	`'packet_only'`	Ne Ac Mo
apn_identifier.apn	`'internet'`	Se Se
apn_identifier.ip_version	`'ipv4v6'`	PD
apn_qos_profile.qci	`9`	Qo Id
apn_qos_profile.allocation_retention_priority	`8`	Pr Le

□□□□□	□□	D
apn_qos_profile.pre_emption_capability	`false`	Pr en Ca
apn_qos_profile.pre_emption_vulnerability	`true`	Pr en Vu
apn_qos_profile.apn_ambr_ul_kbps	`25000`	AP UL
apn_qos_profile.apn_ambr_dl_kbps	`50000`	AP DL
static_ip.ipv4_static_ip	`'100.64.1.1'`	Se Pa Ad (IP
static_ip.ipv6_static_ip	`'2606:4700::1111'`	Se Pa Ad (IP

□□□□□

1. **AMBR** □□□□□□□□ kbps □□□Diameter □□ bps□□□ 1000□
2. **IP** □□□□□□`0=IPv4, 1=IPv6, 2=IPv4v6, 3=IPv4_or_IPv6`
3. □□□□□□`enabled: true → 0 (SERVICE_GRANTED)`□`enabled: false → 1 (OPERATOR_DETERMINED_BARRING)`
4. □□□□□□□□□□□ APN □□□□□□□□□□□□□□□0, 1, 2...□
5. □□ **IP**□□□□□□ `static_ips` □□□□□□□□□□□

□□□□□□□

- □□□□□□□□□□ PLMN □ `roaming_profile.roaming_rules`
- □□□□□□□`subscriber.enabled == true`
- □□ APN□□□□□□□□□ IMS APN□□□□□□ IMS APN

□□□□□□ (S6a AIA)

□□□□□□□ LTE/EPC □□□□□□□□□

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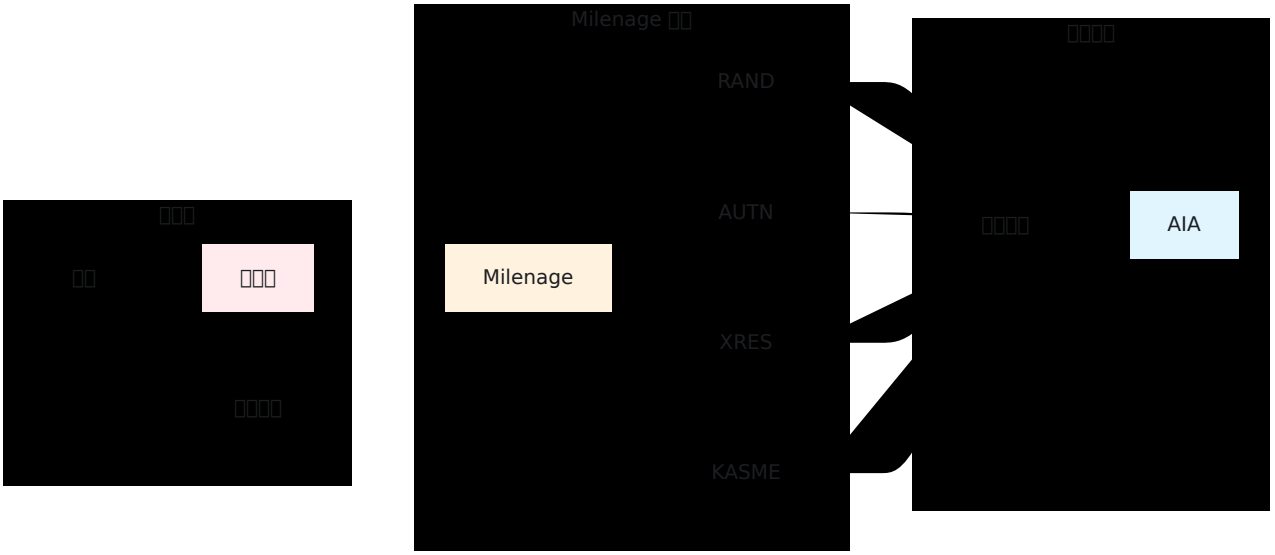

□□□□□

1. □□□□□□□□□□□□□□□□□□□□□□ `key_set` □□
2. **SQN** □□□□□□□□□□□□□□□□□□□□□□□□□□□□□
3. **Milenage** □□□3GPP TS 35.206 - □□□□□□□
4. **KASME** □□□□□□ TS 33.401 □□ KDF □ CK||IK □□□□

□□□□□□

- □□□□□□□ SQN□□□□□
- Ki/OPc □□□□□ HSS□□□□□□□□
- AUTN □□□□□□SQN□□ AMF □□□□□□
- Milenage □□□□ UE □□□□□□□□□□

□□□□□□□□ (Cx SAA)

□□□□□□□□□ HSS □□□ S-CSCF □□ IMS □□□

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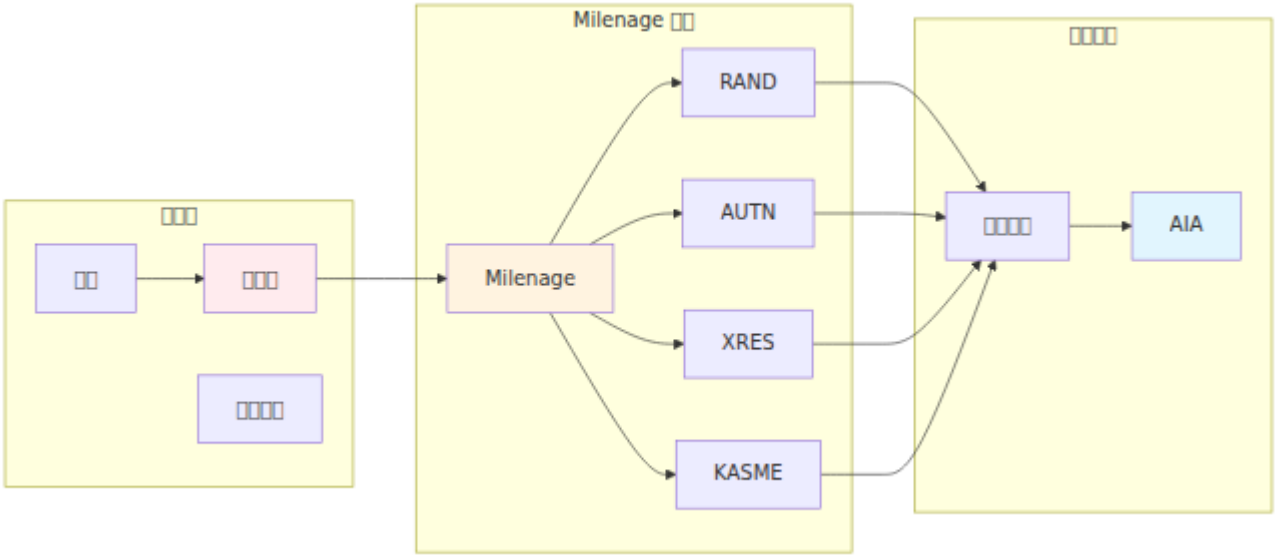

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1. **IFC** □□□XML □□□□□□ `ims_profile.ifc_template`
2. □□□□□□□□□□□□□ `{{msisdn}}`□`{{imsi}}`□`{{impu}}`
3. **S-CSCF** □□□□ `subscriber_state.assigned_scscf` □□□□□□ S-CSCF
4. **IMS** □□□□□□□□ `sip:+{msisdn}@{ims_domain}` □ `tel:+{msisdn}`

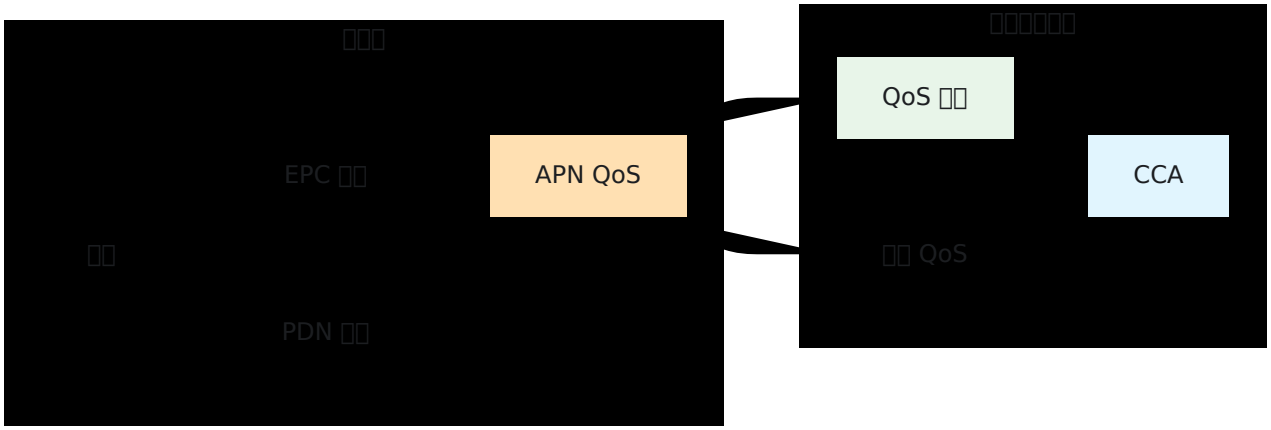
IFC □□□□□□

- `{{msisdn}}` - □□□□□□□ MSISDN
- `{{imsi}}` - □□ IMSI
- `{{impu}}` - IMS □□□□□□□□□□ subscriber_state□
- `{{impi}}` - IMS □□□□□□□□□□□ IMSI@realm□

□□□□□□ (Gx CCA)

□□□□□□□□ PCRF □□□□□□□□□□□□□ PGW□

□□□□□



□□□□□

1. □□□□□□□□□□□□□□/□□ `pdn_session` □□
2. **QoS** □□□□□□□□ APN QoS □□□ QCI □□□□□
3. □□□□□□□□□□□□□□□□□□□□□□□□
4. **CC-**□□□□□□□□ INITIAL (1)□UPDATE (2)□TERMINATION (3)

□□□□□□□□

- `INITIAL_REQUEST`□□□□□ PDN □□□□
- `UPDATE_REQUEST`□□□□□ PDN □□
- `TERMINATION_REQUEST`□□□ PDN □□□□

□□□□□□ (Sh UDA)

□□□□□□□□ HSS □□ Sh □□□□□□ AS□□□□□□□□□

□□□□□



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1. □□□□□□□□□□ `subscriber_state.sh_repository_data` □□□□□□□ XML
2. □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
3. □□□□□□□□□□□□□□ IMS □□□□
4. □□□□□□□□□□□□□□□□□□□□

ME □□□□□□□ (S13 ECA)

ME □□□□□□□□ EIR □□□□□□ MME □□ IMEI ◆◆□□

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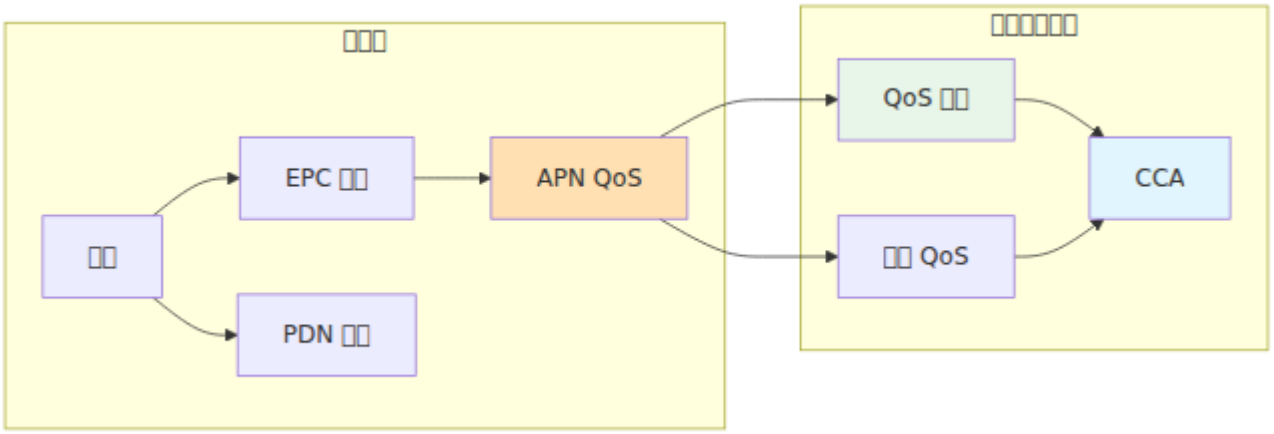

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1. □□□□□□□□□□□ IMEISV □□□□□□□□□□□□□□ IMEI□□□□□□□□ IMSI□□□□□□ IMSI□□□□□□□□□□□□ `precedence` □□□□□□□□□□□□□□□□□□□□□ □□□□□□□ □ □□□□□□
2. □□ **TAC** □□□□□□□□□□□□□□□□□□□ 8 □□□□□
3. □□□□□□`unknown_equipment_behaviour` □□□□□□□□□□□□□□□□□□□□□□□□□□□□ 5422□□□□□□□ □□□□□□□□□□□□ EIR □□
4. □□□□□□□□
   - `0` = □□□□□□□□□□□
   - `1` = □□□□□□□/□□□
   - `2` = □□□□□□□□□□□□
   - □□□□□□□□□ `unknown_equipment_behaviour` □□□□□□□□□□□□ `:reject_unknown_equipment` □□ECA □□□□□□□□□□ 5422

(DIAMETER_ERROR_EQUIPMENT_UNKNOWN) □□□□□□□□

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- □□□□ IMEI □□□□□□□
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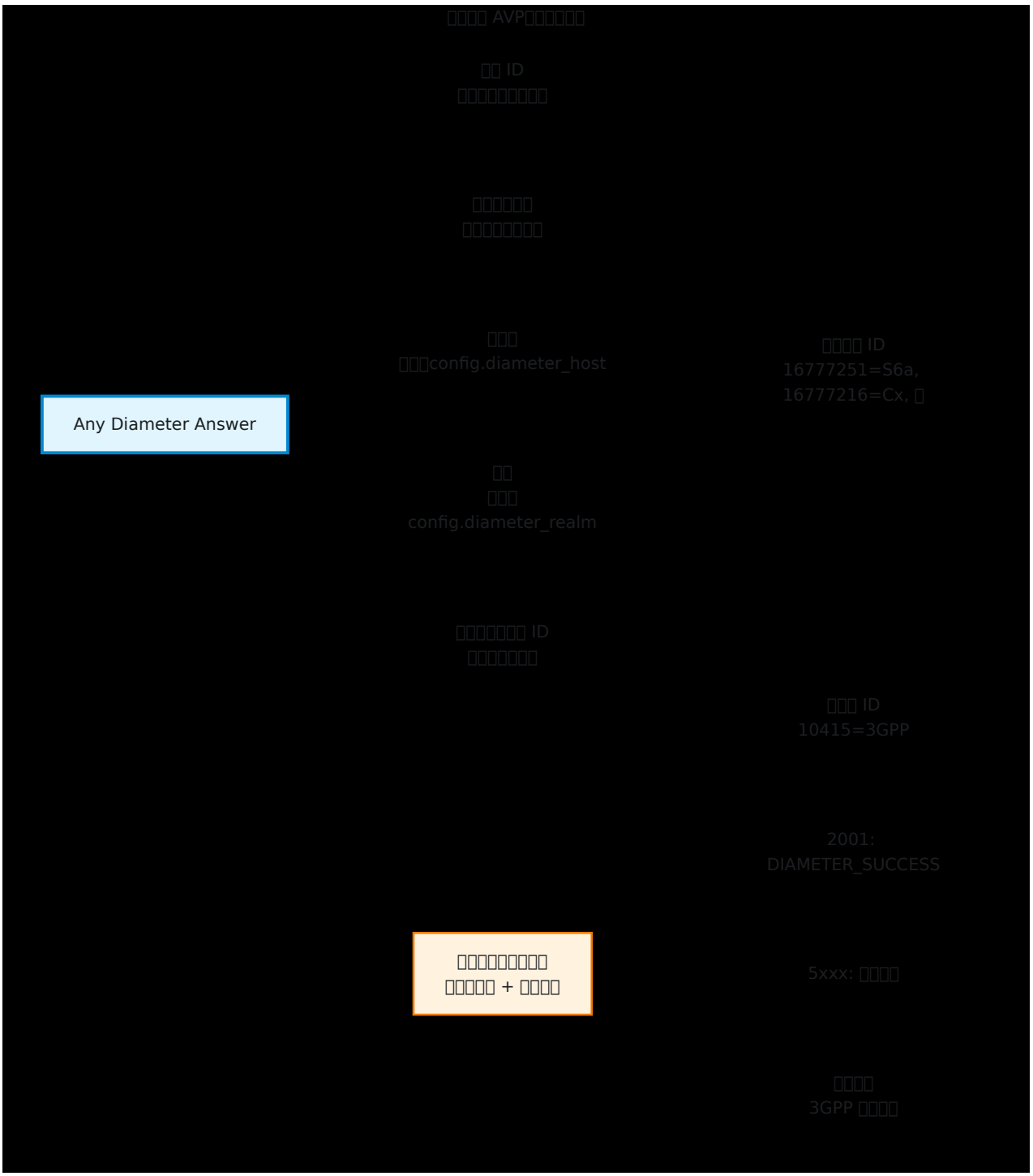

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```
config :diameter_ex,
  diameter_host: "hss",
  diameter_realm: "example.com",
  diameter_service_name: "OmniHSS"
```

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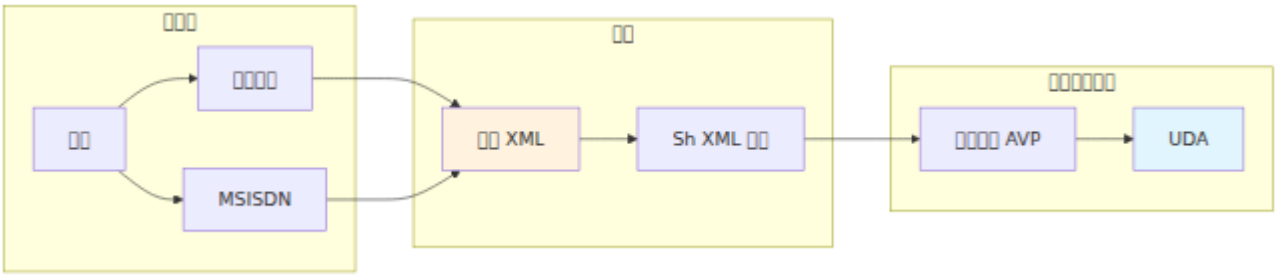

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- **S6a** - LTE/MME □□□□□□□□□□□□□
- **Cx** - IMS/CSCF □□□□ IMS □□□□□□□□□
- **Sh** - IMS/AS □□□□□□□□□□□
- **Gx** - PCRF □□□□□□□□□□□□
- **Rx** - IMS/AF □□□□□□□□□
- **S13** - EIR □□□□ IMEI □□
- **SWx** - WiFi/IMS □□□□□ 3GPP □□□□

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- □□ - □□□□□□□□□ IMSI
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- **EPC** □□ - LTE □□□□
- **APN** □□ - □□□□□
- **IMS** □□ - □□ IFC □□□ IMS □□□□

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- **PDN** □□ - □□□□□□□□□
- □□ **IP** - □□ IP □□□□
- **EIR** □□ - □□□□□□□□□□ IMEISV□IMEI □ IMSI □□□□□□□□□□□□□□□□□□

← □□□□□□ | API □□ → | □□□□ →

OmniHSS □□□□□□□

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URL: `https://[hostname]:7443/overview`

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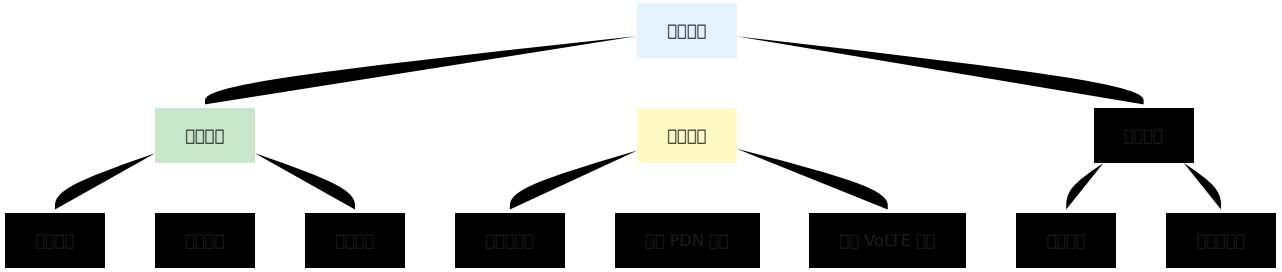

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IMS □□	S-CSCF □□	□□□□□□□□□
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4. □□□□□□□□□□□□□□□□□□□□

Diameter □□□□

URL: `https://[hostname]:7443/diameter`

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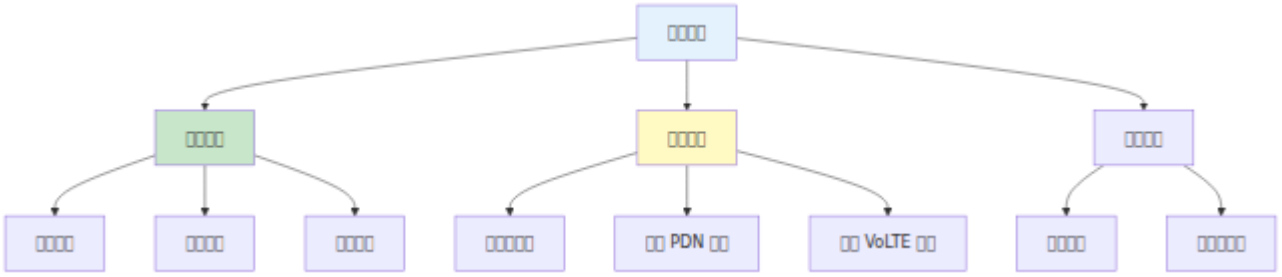

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MME	□	□□□□□□ LTE □□
P-GW	□	□□□□□□□□
S-CSCF	□	□□□□ IMS □□
P-CSCF	□	□□□□ VoLTE □��□
I-CSCF	□	IMS □□□□
AS	□-□	□□□□□□□

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URL: `https://[hostname]:7443/application`

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OmniHSS □□□□□□□ **stdout/stderr**□□□□□□□□□□□□□□□

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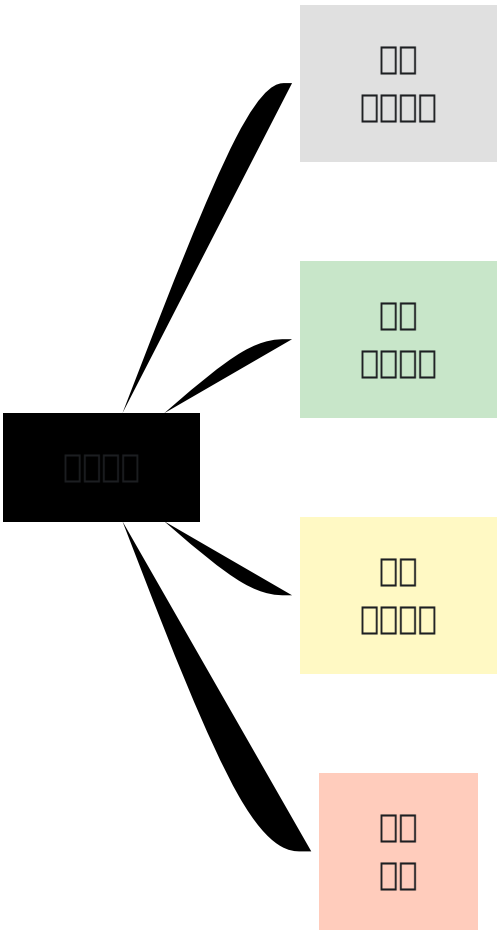

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Diameter □□□□□:

```
[info] Diameter peer connected: mme01.epc.example.com
[warn] Diameter peer disconnected: pgw01.epc.example.com
[error] Diameter peer connection failed: timeout
```

□□□□□:

```
[info] Database connection established
[error] Database connection lost: timeout
[error] Database query failed: deadlock detected
```

□□□□:

```
[info] Authentication successful: IMSI 001001123456789
[warn] Authentication failed: IMSI 001001123456789, invalid vector
[error] Roaming denied: IMSI 001001123456789, MCC 310 MNC 410
```

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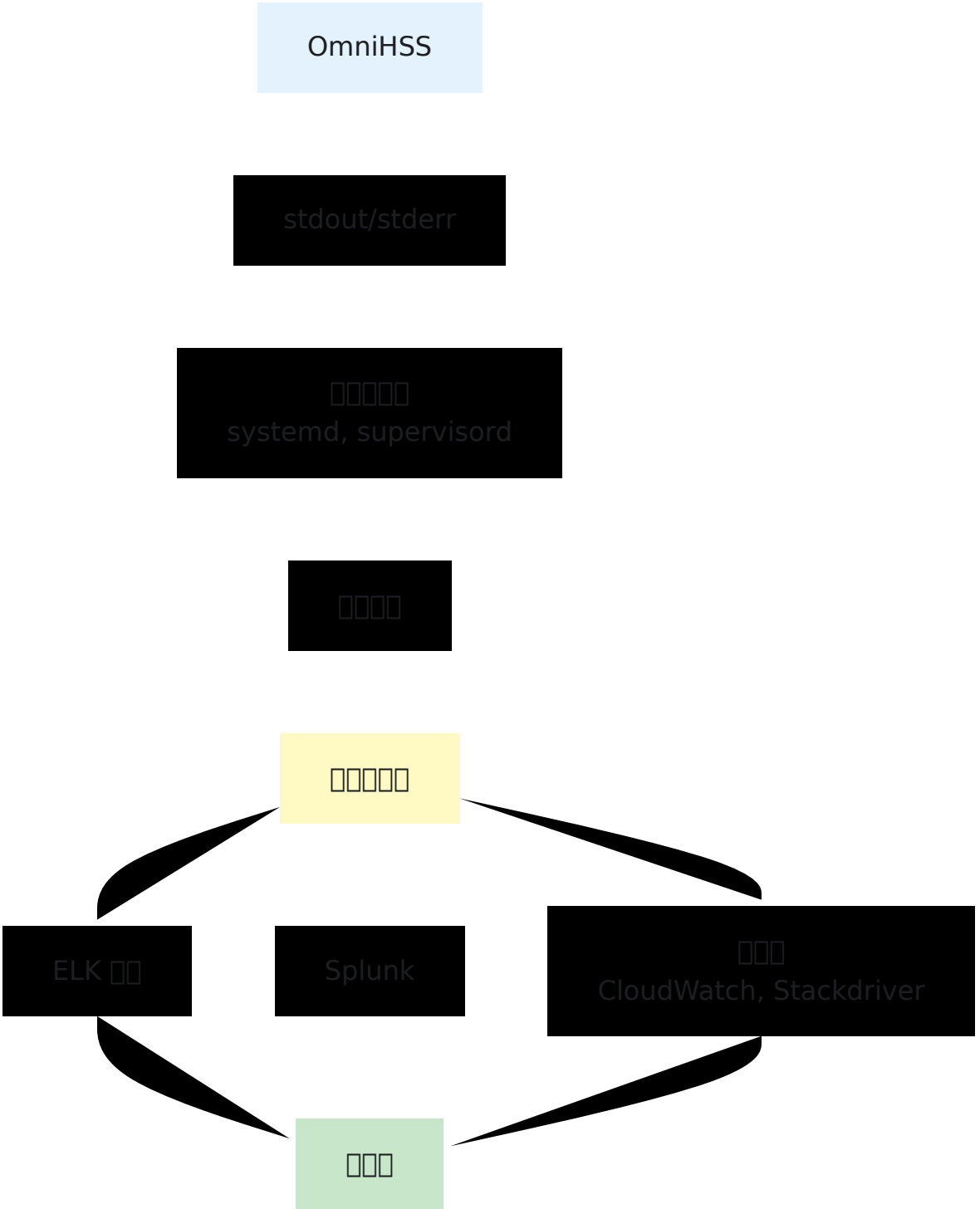

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API □□□□: `GET /api/status`

```
curl -k https://hss.example.com:8443/api/status
```

□□□□:

```
{"status": "ok"}
```

HTTP □□: 200 OK

□□□□□□

Nagios/Icinga □□

```
#!/bin/bash
# check_omnihss.sh

API_URL="https://hss.example.com:8443/api/status"

response=$(curl -k -s -o /dev/null -w "%{http_code}" "$API_URL" --
max-time 5)

if [ "$response" = "200" ]; then
    echo "OK - OmniHSS API responding"
    exit 0
else
    echo "CRITICAL - OmniHSS API not responding (HTTP $response)"
    exit 2
fi
```

Prometheus □□

OmniHSS □□□□□□ Prometheus □□□□□□□ `http://<host>:9568/metrics`□□□□ `prometheus_metrics_port` □□□□□□□ `9568`□

□□□□□ BEAM □□□□□□□□□□□□□□Diameter □□□□□□□□□□ Diameter □□□□□□□□□□ Cx □□□□

S-CSCF □□□□□□□

□□: `hss_cx_auth_abandon_total` □□: □□□ □□: □□□□ IMS-AKA □□□□□□□□□ Cx SAR□ □□□□□□□□□□□□□□□□ `auth_vector_timeout` □□□□□□□□□□□□S-CSCF □□ `AUTHENTICATION_TIMEOUT` SAR□□□□□□□□□□ `AUTHENTICATION_FAILURE` SAR□□□□ S-CSCF □□□□□□ □□:

- `sar_type` - □□□□□□□: `authentication_timeout` □ `authentication_failure`□
- `outcome` - □ S-CSCF □□□□□□□ `name_cleared`□□□□□□□□□□□□□□ `kept_registered`□□□□□□□□□HSS □□□□□□□□□ SAR □□□□□□□□□ S-CSCF □□□□□□ □□□□□□□□ I-CSCF □□□□□ REGISTER□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
- `origin_host` - □□ SAR □ S-CSCF□

□□□□:

```
# □□□□□/□□□□□□
rate(hss_cx_auth_abandon_total[5m])

# □□□□□
sum by (sar_type) (rate(hss_cx_auth_abandon_total[5m]))

# □□□□□□□ S-CSCF □□
topk(5, sum by (origin_host)
(rate(hss_cx_auth_abandon_total[5m])))
```

□□ `origin_host` □□□□□□□□□ S-CSCF □□□□□□□□□□□□□□□□□□□□□□□□

SNMP □□

□□□□ SNMP □□□□□□□□□□□ SNMP □□□□□□□□□□ API □□□□□□□□ SNMP OID □□□□

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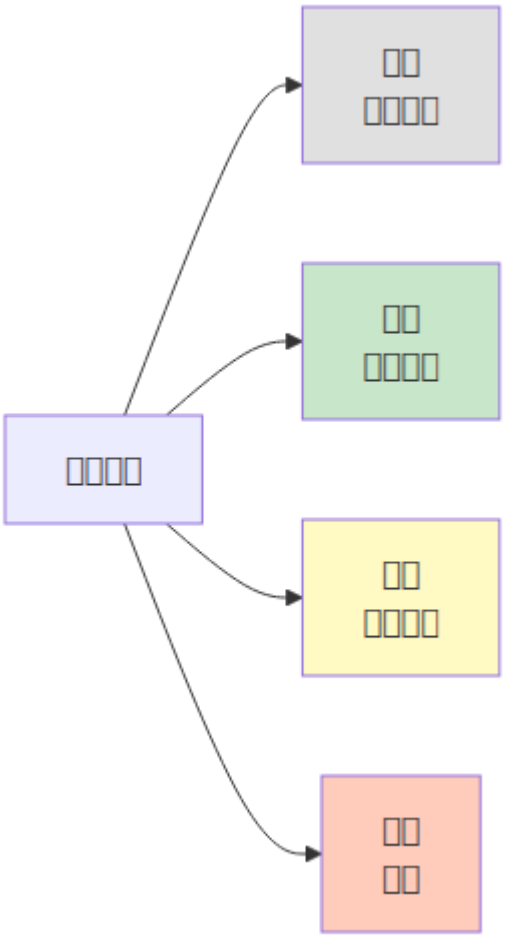
□□ KPI



□□□ KPI □□

KPI	□□	□□	□□
□□□□□□□□□	99.99%	< 99.95%	< 99.9%
Diameter □□□□□□□□□□	99.9%	< 99.5%	< 99%
□□□□□	> 99%	< 99%	< 95%
Diameter □□□	< 100ms	> 200ms	> 500ms
□□□□□□□	< 50ms	> 100ms	> 500ms
□□□	< 0.1%	> 0.5%	> 1%

□□ KPI

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□□ **PDN** □□	□□□□	□□□□□□ 70%
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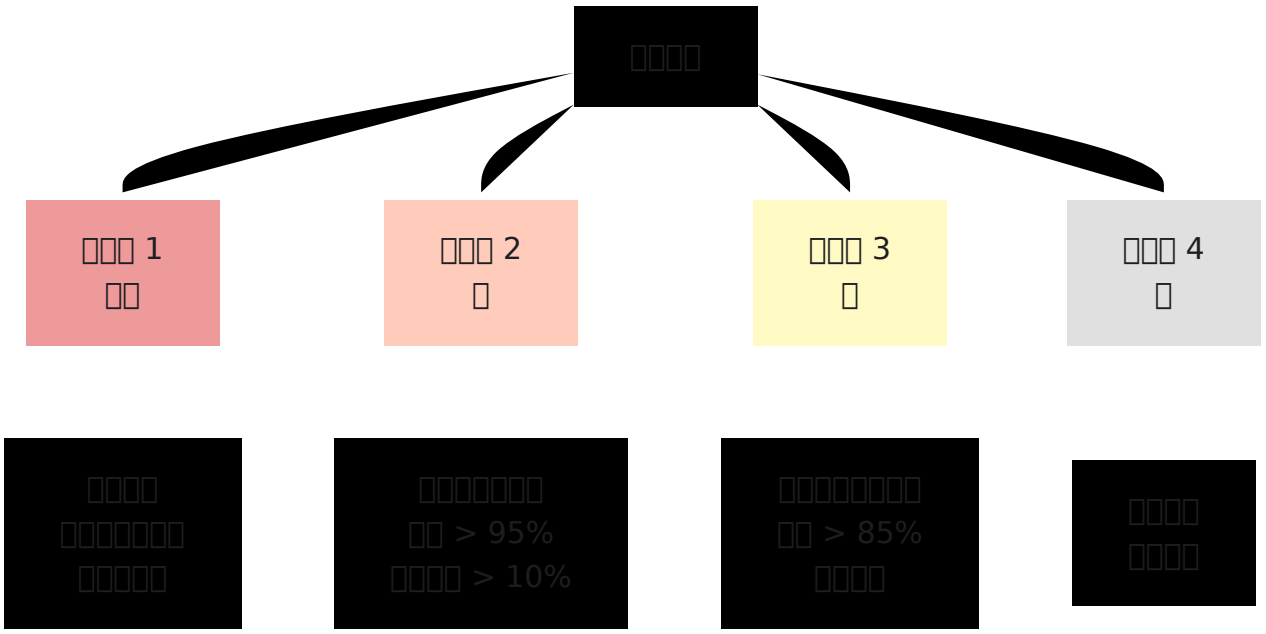

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□□ **Diameter** □□□□□:

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□□□□□□□ **(P2)**

□□ **Diameter □□□□□:**

- □ MME □□
- □ P-GW □□
- □ S-CSCF □□
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□□□□□□ **(P4)**

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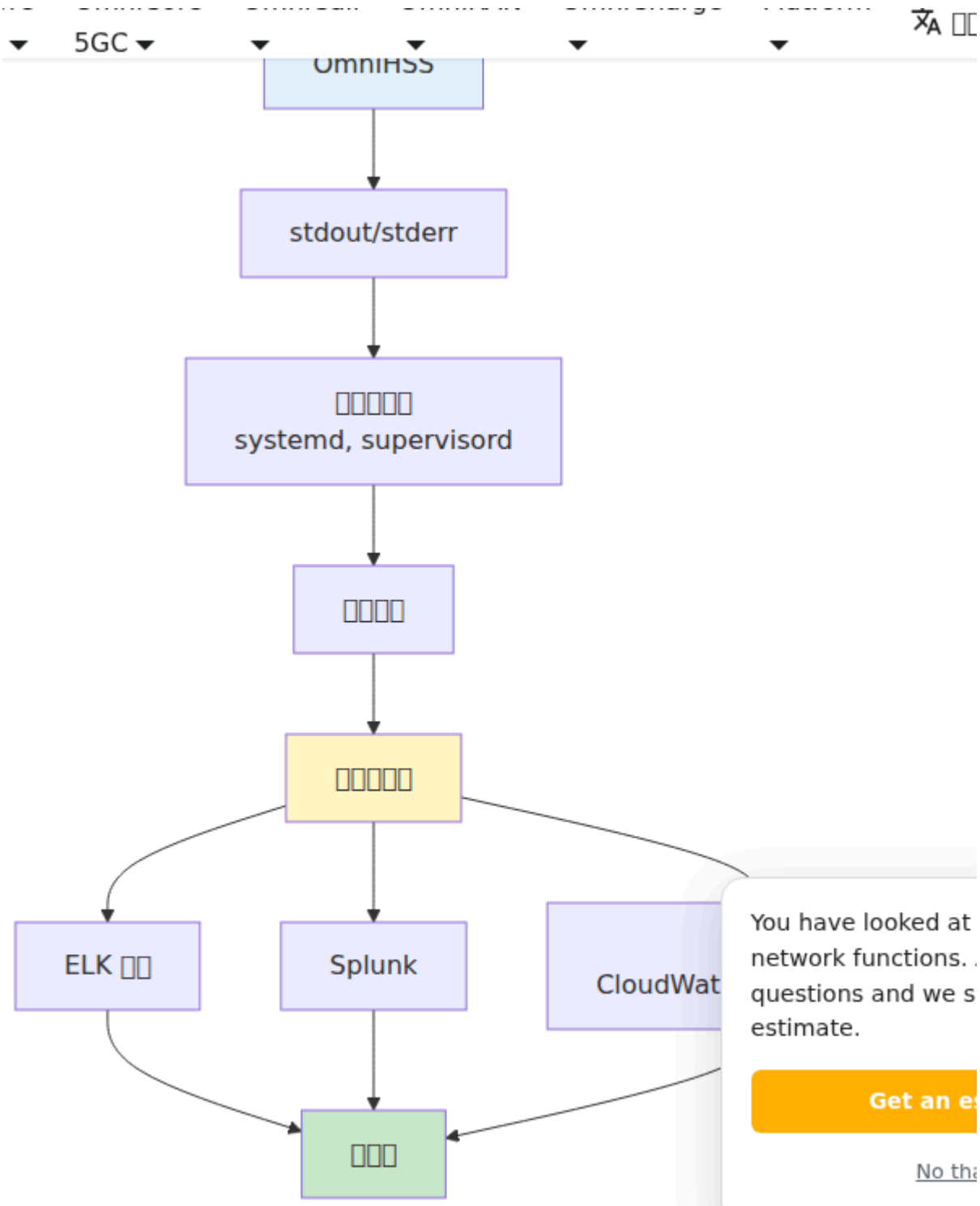
5GC
OmniHSS
stdout/stderr
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systemd, supervisord
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OmniHSS □ MSISDN □□ IMSI □□

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- □□
- □ MSISDN□□□□□□□
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OmniHSS □□□□□□□□□□□□□□□□□□□□□□□□□□

□ MSISDN □□

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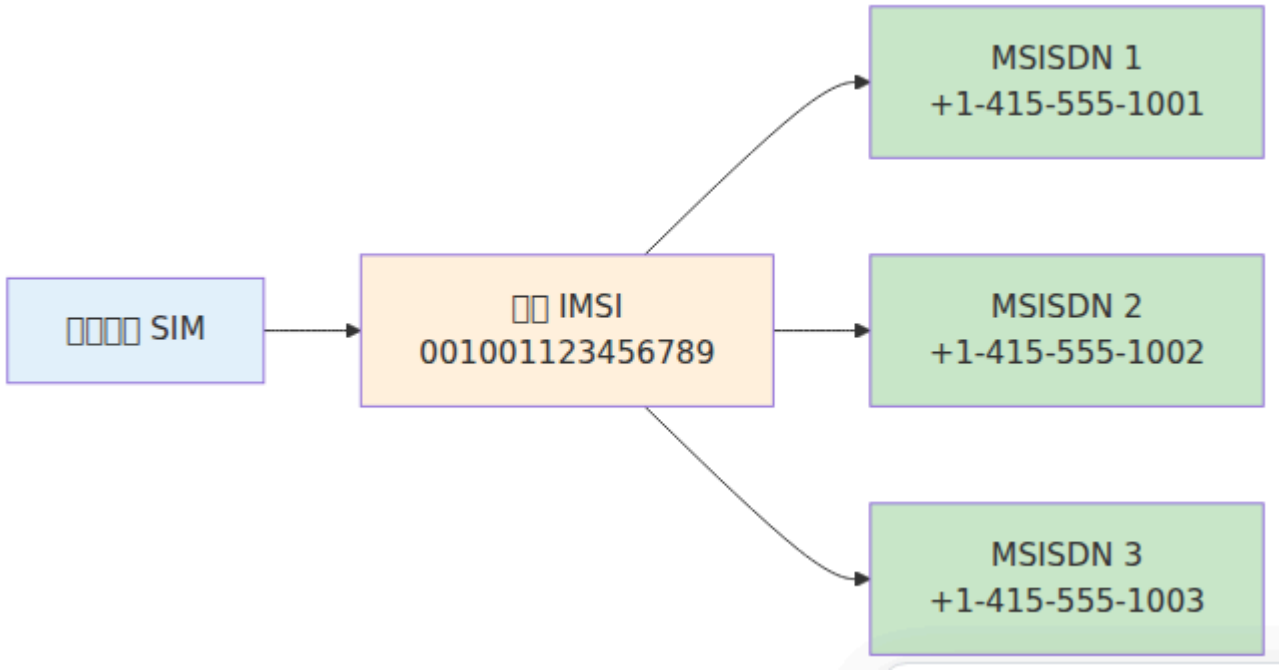

□ IMSI SIM □□

□□ SIM → □□ IMSI

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□ MSISDN□□□□□□□

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HSS □□□□□□□□□□□□□□□□□□ MSISDN□□□□□□□□ IMS □□□□ MSISDN □□□□ IMS □□□□□□□□□□□□□□□□□□□□□□□□

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- □□ **IMSI** - □□□□□□□□ SIM □□□□ IMSI
- □□ **MSISDN** - □□□□□□□□□□□□□□
- **IMS** □□ - □□ MSISDN □□ IMS □□□
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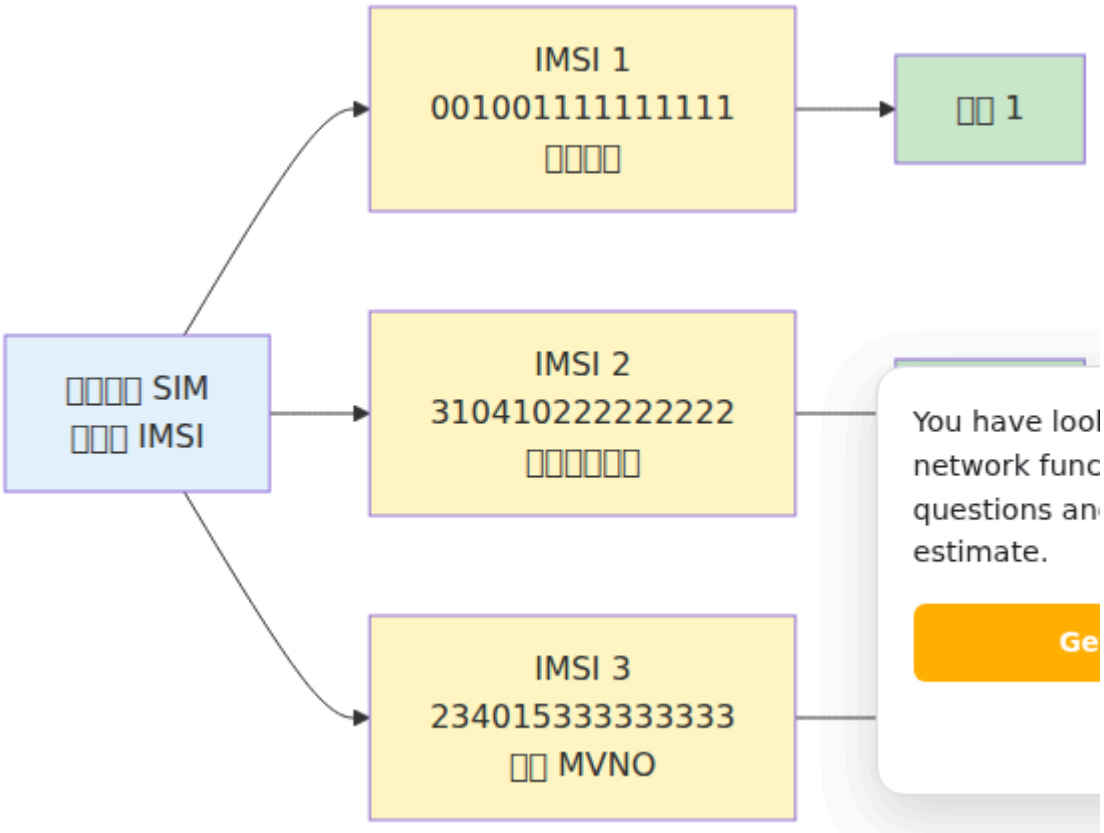

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1. □□□□□□□□

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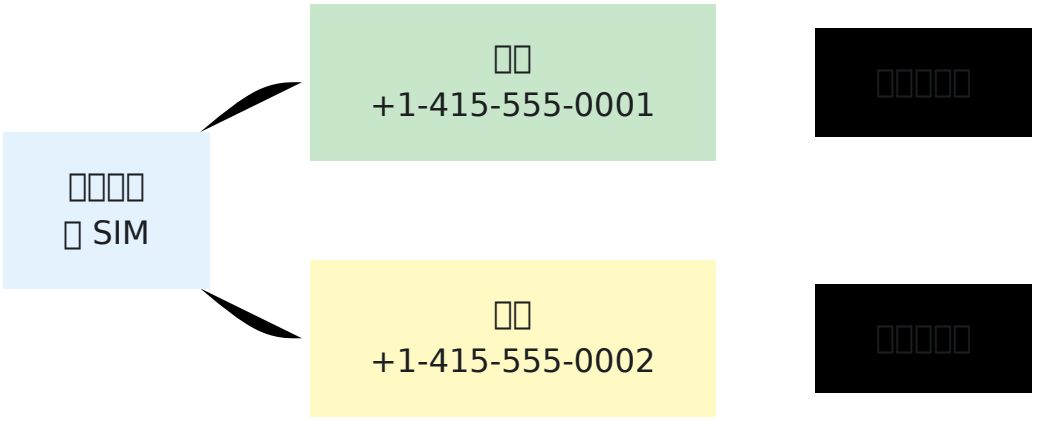

2. □□□□

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□□□ □ OmniHSS □□□□□□□□□□□□□□□ SIM/IMSI □□□□□□□□□□□□□□□□ MSISDN□

4. □□□□□□□

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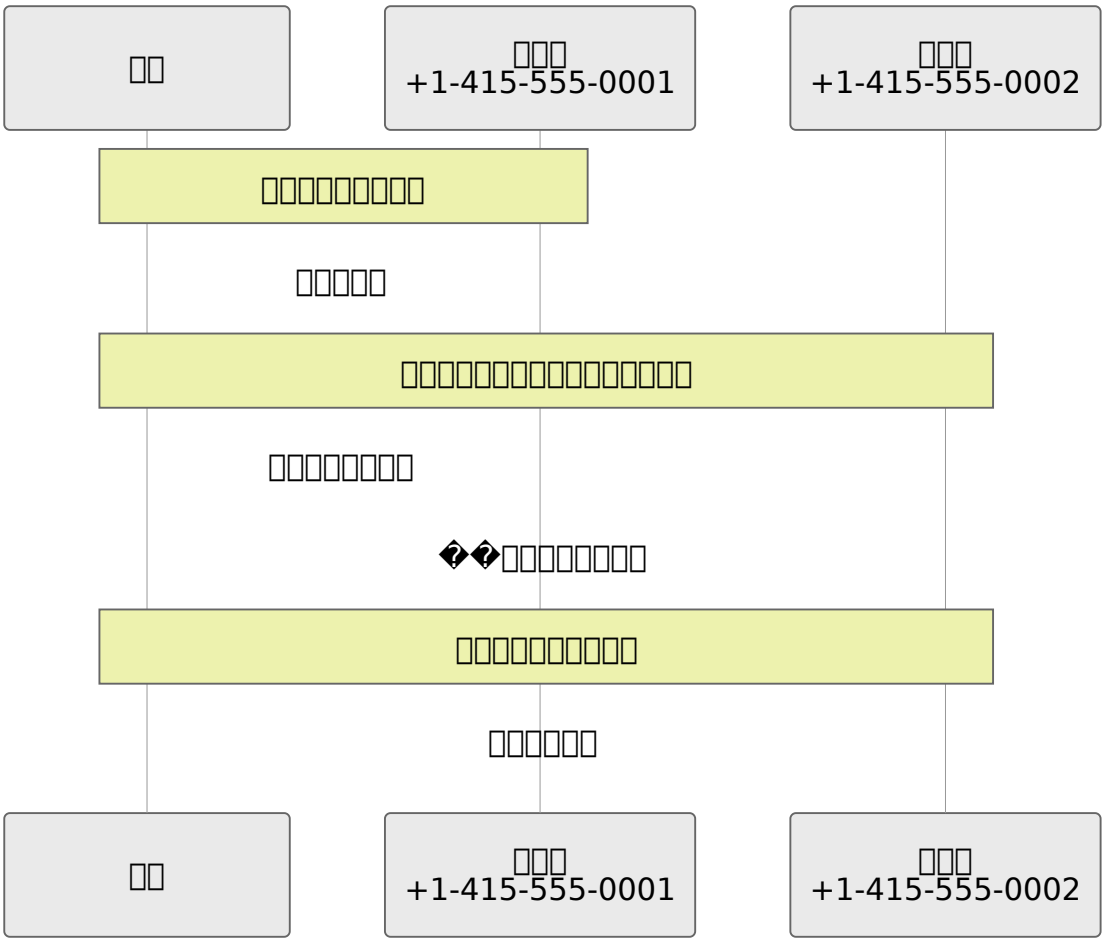

□□

□□ MSISDN

□□□□□□□□□□□□□□□ MSISDN□

```
# □□□□□□ MSISDN
curl -k -X POST https://hss.example.com:8443/api/msisdn \
  -H "Content-Type: application/json" \
  -d '{"msisdn": {"msisdn": "14155551001"}}'

# □□□□□□ MSISDN
curl -k -X POST https://hss.example.com:8443/api/msisdn \
  -H "Content-Type: application/json" \
  -d '{"msisdn": {"msisdn": "14155551002"}}'
```

□ MSISDN □□□□□

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1. □□□□□□□□□□□ IMSI □□□ ID
2. □□□□□□□□□□□□□□ MSISDN ID
3. □□□□□□□□□□□ subscriber_id □□□□□ msisdn_id

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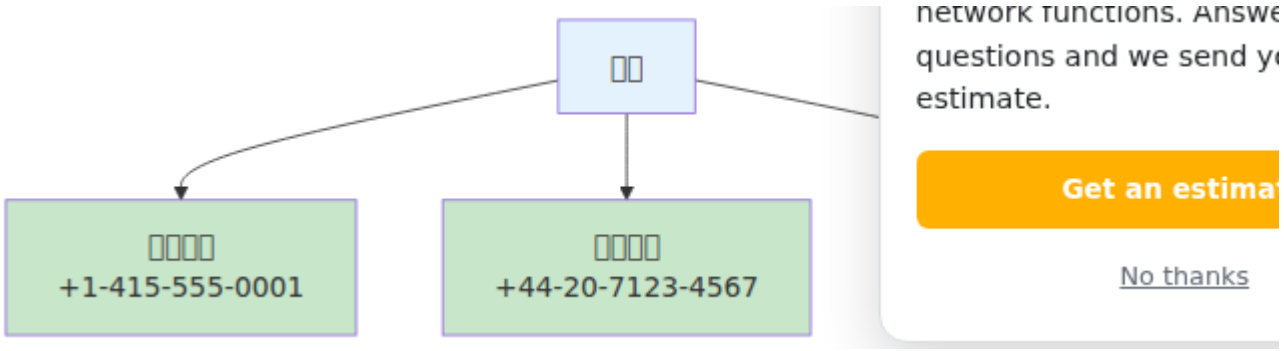

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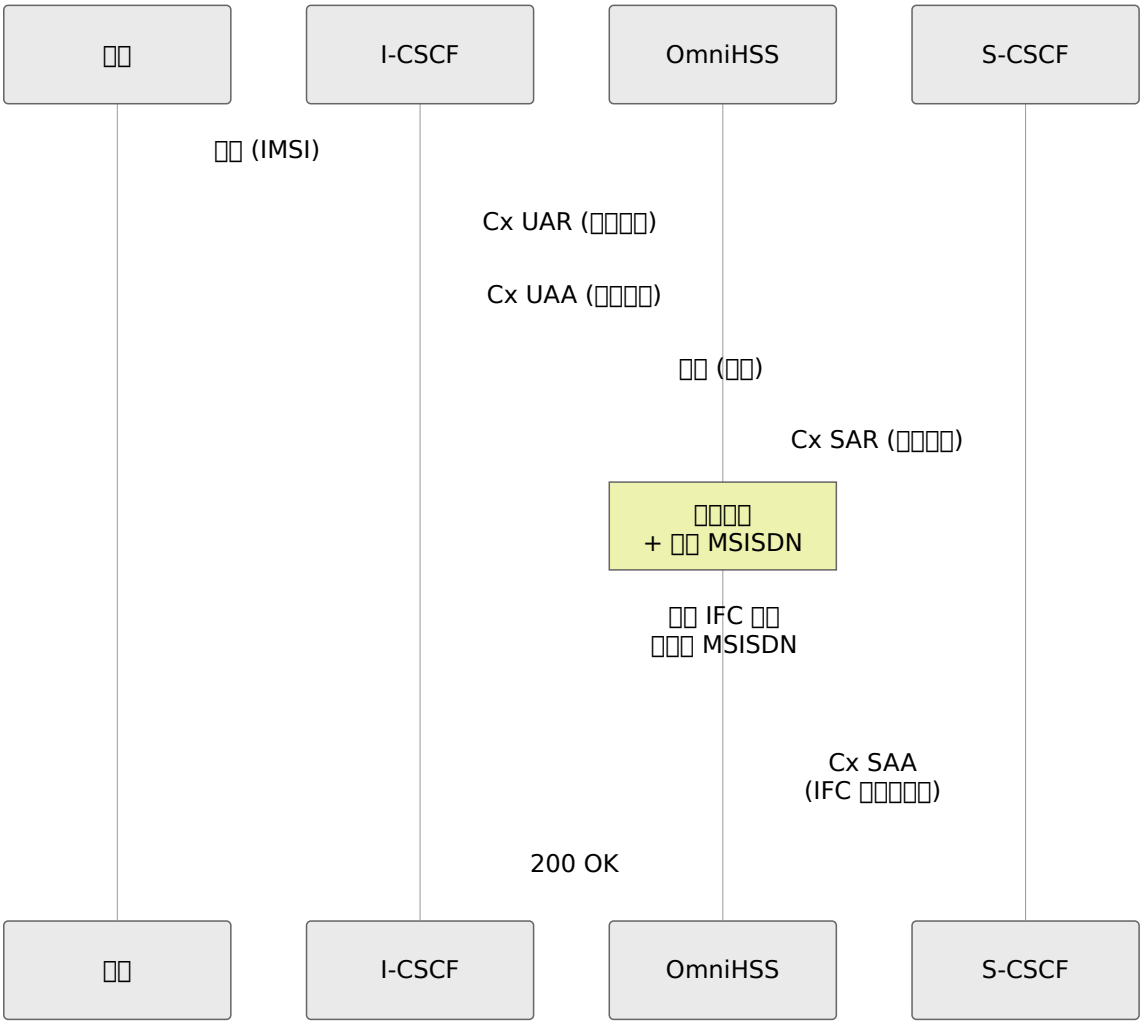

IFC □□□□

IMS IFC □□□□□□□ `{{msisdns}}` □□□□□□□ MSISDN□

□□ **IFC □□□**

```
<ServiceProfile>
  <PublicIdentity>
    <Identity>sip:
{{imsi}}@ims.mnc{{mnc}}.mcc{{mcc}}.3gppnetwork.org</Identity>
  </PublicIdentity>
  <!-- □□□ MSISDN □□ -->
  <PublicIdentity>
    <Identity>sip:+14155551001@ims.example.com</Identity>
  </PublicIdentity>
  <PublicIdentity>
    <Identity>tel:+14155551001</Identity>
  </PublicIdentity>
  <PublicIdentity>
    <Identity>sip:+14155551002@ims.example.com</Identity>
  </PublicIdentity>
  <PublicIdentity>
    <Identity>tel:+14155551002</Identity>
  </PublicIdentity>
  <!-- ... -->
</ServiceProfile>
```

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- `{{msisdns}}` - □□□□□□□□ MSISDN □□

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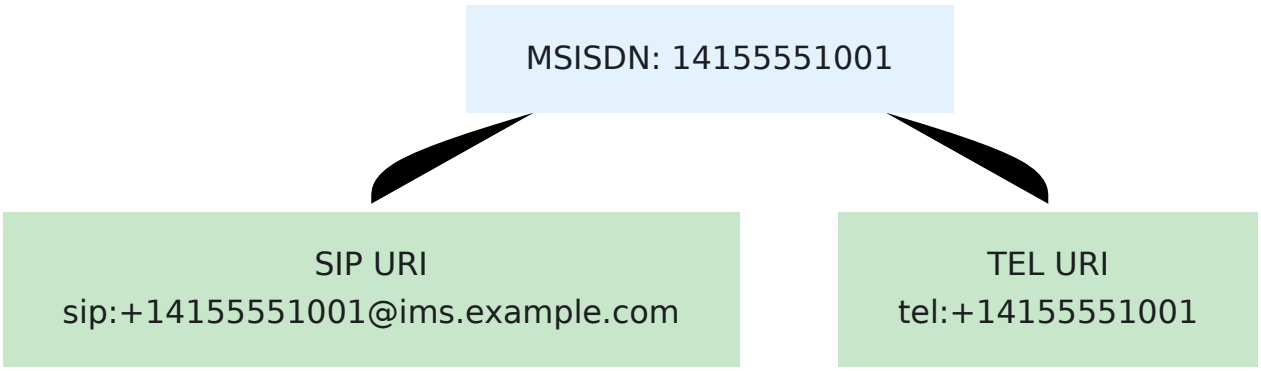

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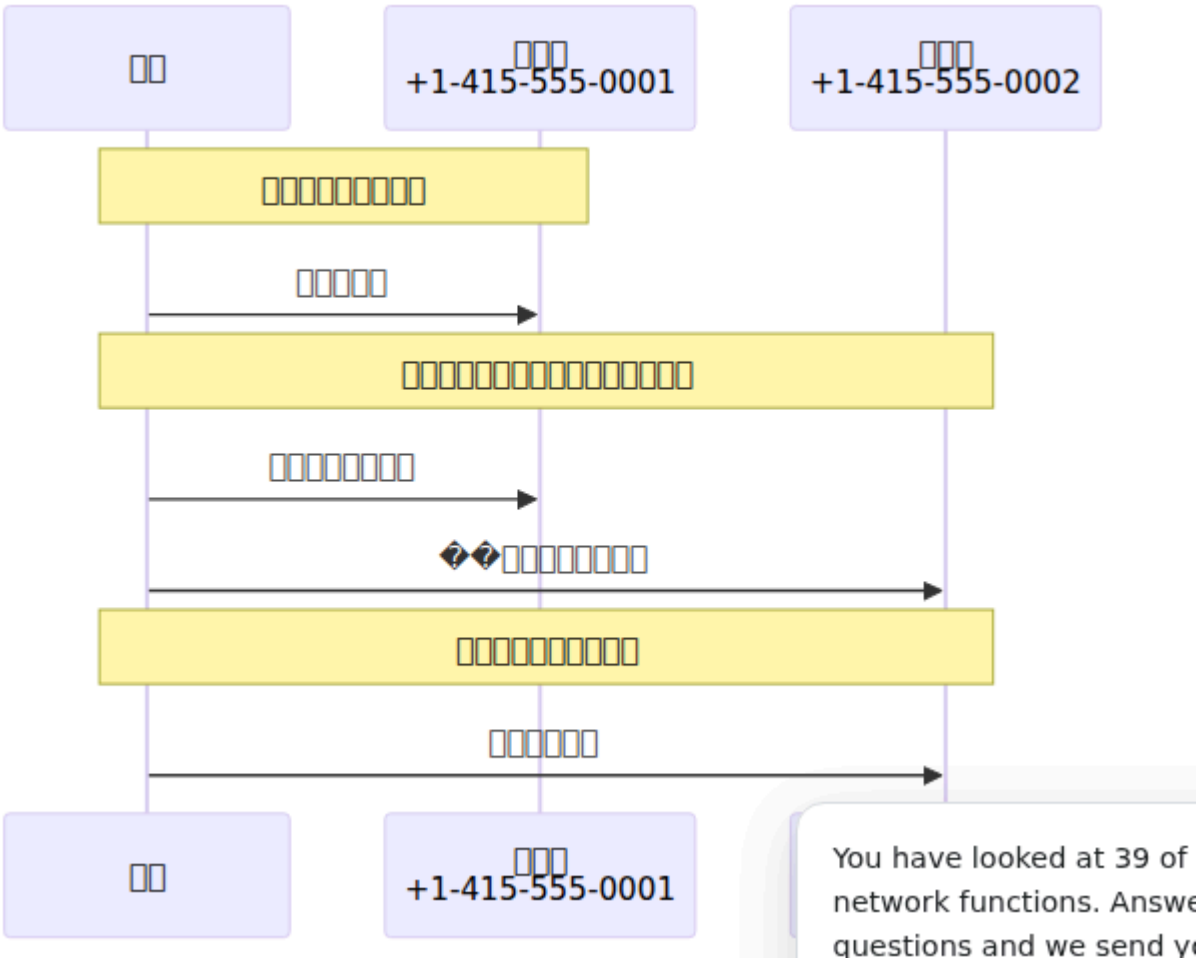
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+1-415-555-0002
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network functions. Answe
questions and we send y

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- S-CSCF □□□□□□□□□□
- □□□□□□□□□□

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1. □□□□□□□□ **MSISDN** □□□
    - □□□□□□□□□□□□□□ IMSI □□□□□ MSISDN
    - □□□□□□□□□□□□□□
2. □□ **IMS** □□□□□□□□
    - □□□□□□□□□ `{{msisdns}}` □□
    - □□□□□□□□□□□ XML
3. □□ **HSS** □□□
    - □□ IMS □□□Cx SAR□□□
    - □□□□ MSISDN □□□□□□□□
4. □□ **IMS** □□□
    - □□□□□□□□□□
    - □□ S-CSCF □□□□□□□□□□□□

□□□□□□ **MSISDN** □□□□□□

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1. **MSISDN** □□□□
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    - □□□□□ □□□□□□□□□□□□□□□□□□
2. **MSISDN** □□□□

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    - □□□□□□ □□□□□ API □□□□□□□□□ MSISDN □□

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1. □□ **IMS** □□□□□□□□□□

    - □□ S-CSCF □□□□□□□□
    - □□□□ SIP URI □□

2. □□ **IMS** □□□□□□

    - □□ IFC □□□□□□□□□□□□□□□□
    - □□□□□□□□□□□□□□□□□

3. □□□□□□□□

```
# □ SIP □□□□□□
sip:+14155551001@ims.example.com  # □□□□
sip:+14155551002@ims.example.com  # □□□□□
```

□□□API □ MSISDN □□□□□□□□□□

□□□

- API □□ `/api/subscriber/msisdn/:msisdn` □□□□□□□□

□□□

□□□□□□□□□ MSISDN □□□□□□□□□□□□□□□□□□□□

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1. □□□□□□ MSISDN
2. □□□□
3. □ MSISDN □□□□□
4. □□□□□□□□□

MSISDN □□

- □□□□ **custom_attributes** □□□□□□□□□□
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IMS □□

- □□ IFC □□□□□□□□□□□□□
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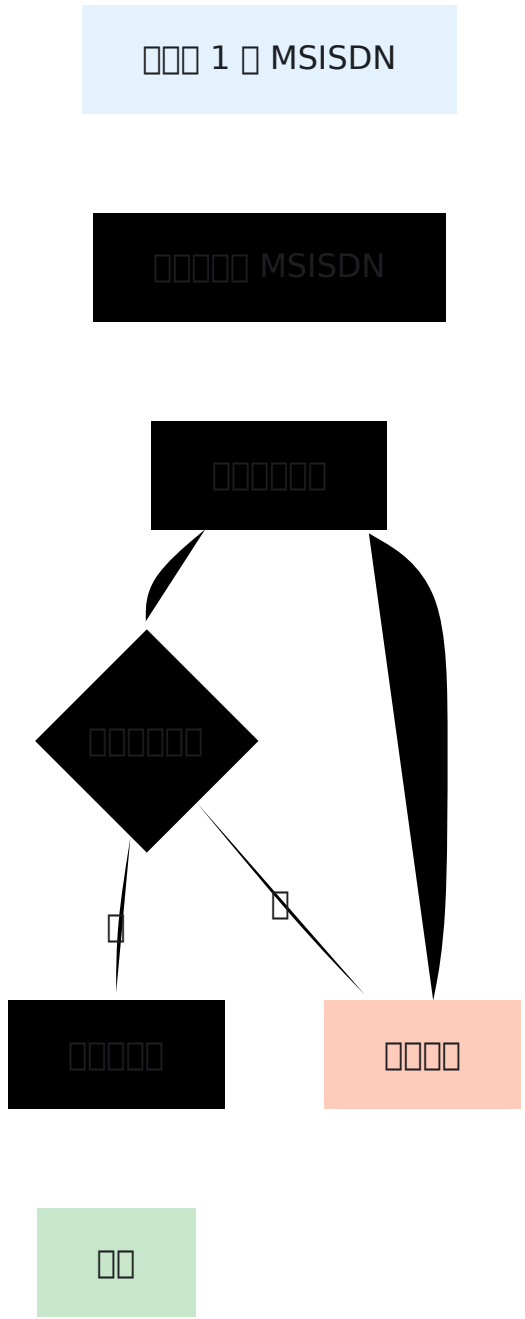

□ IMSI SIM□□□□□□□

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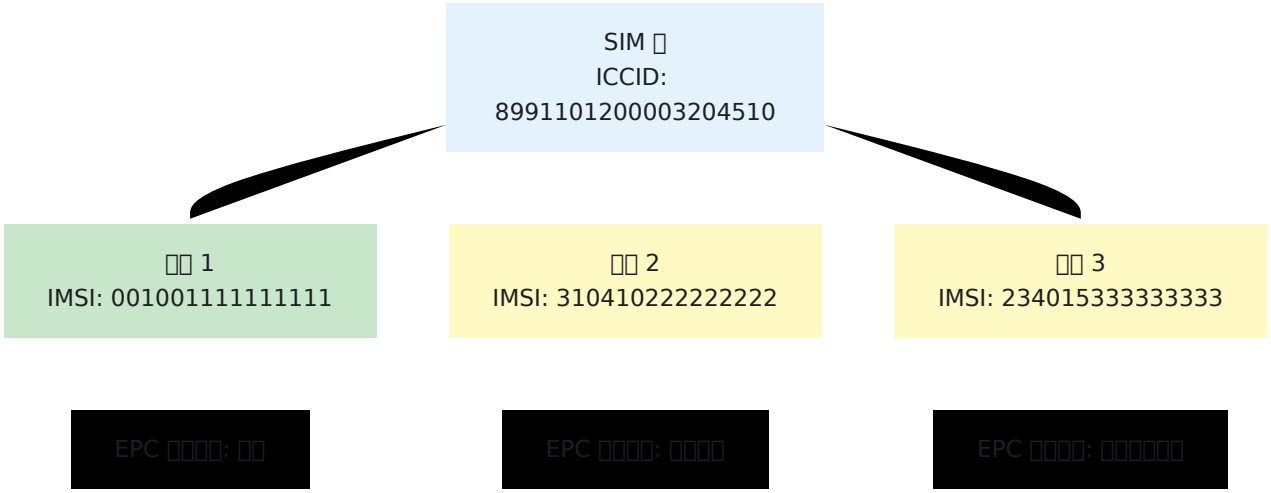
□ IMSI SIM □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□ IMSI□□□□□□□□□□□□□□ IMSI □□□□□□□□□□□□□□□□□□□□

□□□ □□□□□□□ □□□□□ **IMSI**□□□□□□□□ SIM □□□□□□□□□ IMSI □□HSS □□□□□□□□□□□□ IMSI□

OmniHSS □□

□ OmniHSS □□□ IMSI SIM □□□□ IMSI □□□□ □□□□□□□□□□□□□□ □□□ **SIM** □□



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1. □□□□□□

- □□ IMSI: 001-001□□□□□□□□
- □□□□ IMSI: 310-410□□□□□□□□
- □□□□ IMSI: 234-015□□□□□□□□
- □□□□□□□□ IMSI

2. MVNO □□

- □ IMSI: MVNO □□□□□□□
- □□ IMSI: □□□□□□□□□
- □□ MVNO □□□□□□□□□□□□

3. IoT/M2M □□

- IMSI 1: □□□□□
- IMSI 2: □□□□□□□□□

- IMSI 3: □□/□□□□□
- □□□□□□□□□

4. □□□

- □□□ IMSI □□□□□□□□□□
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□ IMSI □□

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- □□ IMSI □□□□□□□
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- □□□ EPC □□□□□□□□□APN□
- □□□ IMS □□□□□□□□□□
- □□ IMSI □□□□□□□

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- □□ IMSI □□□□ SIM□□□ sim_id□
- □□□□□□□□□□□ ICCID
- □□ SIM □□□□□□□

□□□□

- □□□ SIM □□□□□□□ IMSI
- □□□□□□□□□□□□
- HSS □□□□□□□□□ IMSI

□□

```
# 1. □□ SIM □□□□□□ IMSI□
SIM_ID=$(curl -k -X POST https://hss.example.com:8443/api/sim \
  -d '{"sim": {"iccid": "8991101200003204510", "is_esim": false}}'
\
  | jq -r '.data.id')

# 2. □ IMSI 1 □□□□□□□□□□□□□
KEYSET1=$(curl -k -X POST https://hss.example.com:8443/api/key_set
\
  -d '{"key_set": {"ki": "0123456789ABCDEF...", "opc":
"FEDCBA9876..."}}' \
  | jq -r '.data.id')

# 3. □□□□ 1□□□ IMSI□
curl -k -X POST https://hss.example.com:8443/api/subscriber \
  -d "{\"subscriber\": {
    \"imsi\": \"001001111111111\",
    \"sim_id\": \"$SIM_ID\",
    \"key_set_id\": \"$KEYSET1\",
    \"epc_profile_id\": \"e58ed763-928c-4155-bee9-fdbaaadc15f3\"
  }}"

# 4. □ IMSI 2 □□□□□□□□□□□□□□
KEYSET2=$(curl -k -X POST https://hss.example.com:8443/api/key_set
\
  -d '{"key_set": {"ki": "1111111111111111...", "opc":
"2222222222..."}}' \
  | jq -r '.data.id')

# 5. □□□□ 2□□□ IMSI□
curl -k -X POST https://hss.example.com:8443/api/subscriber \
  -d "{\"subscriber\": {
    \"imsi\": \"310410222222222\",
    \"sim_id\": \"$SIM_ID\",
    \"key_set_id\": \"$KEYSET2\",
    \"epc_profile_id\": \"f47ac10b-58cc-4372-a567-0e02b2c3d479\"
  }}"

# 6. □ SIM □□□□ IMSI □□□□□...
```

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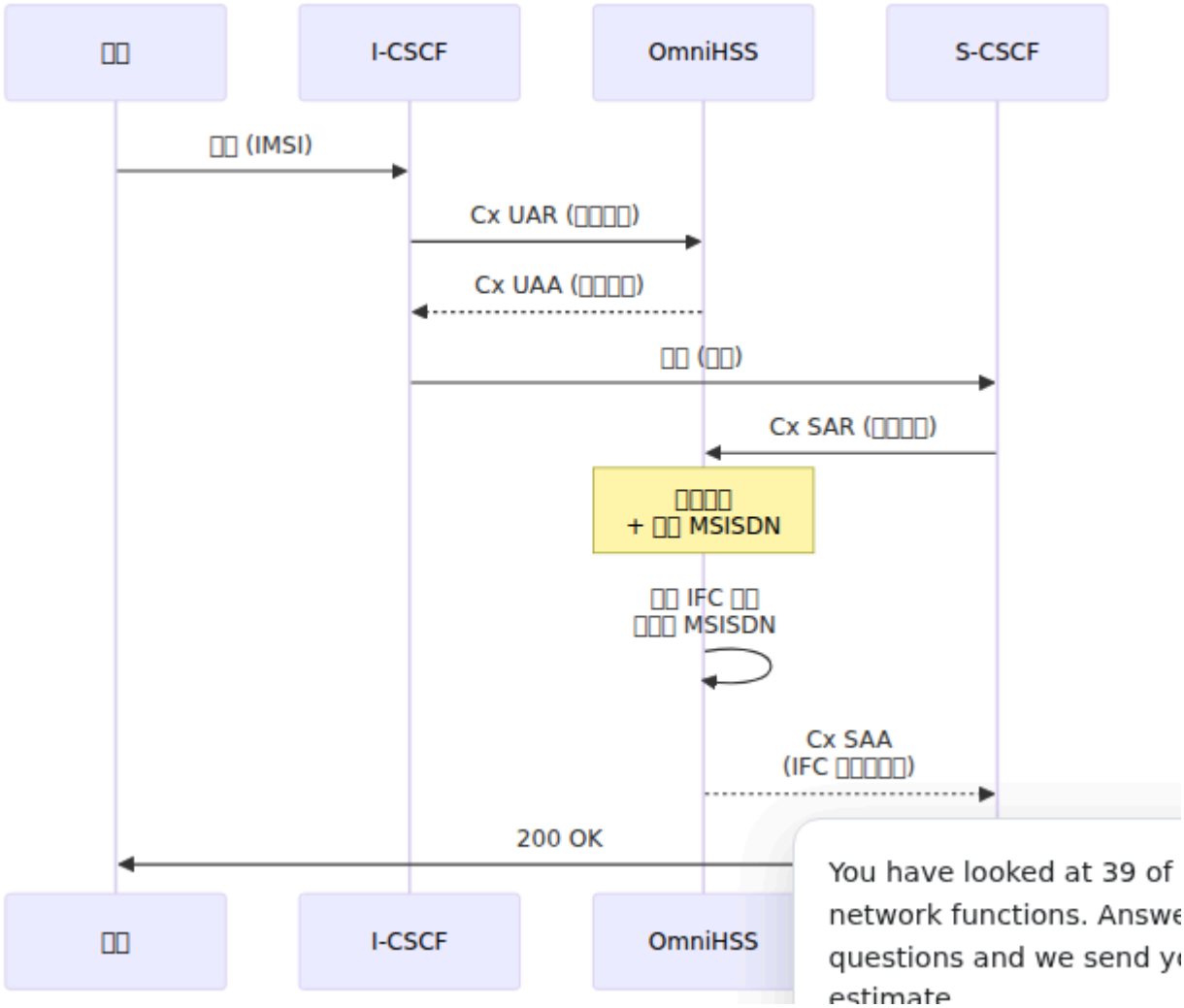
□□ IMSI □□□□□□□



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IMSI □□□□□□□

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- □□ HSS □□□□ **IMSI Y**□□□ IMSI X □□□ SIM □□□□□□□□□

- HSS □□□□□□ □□□□□□□ □□□ **IMSI X**

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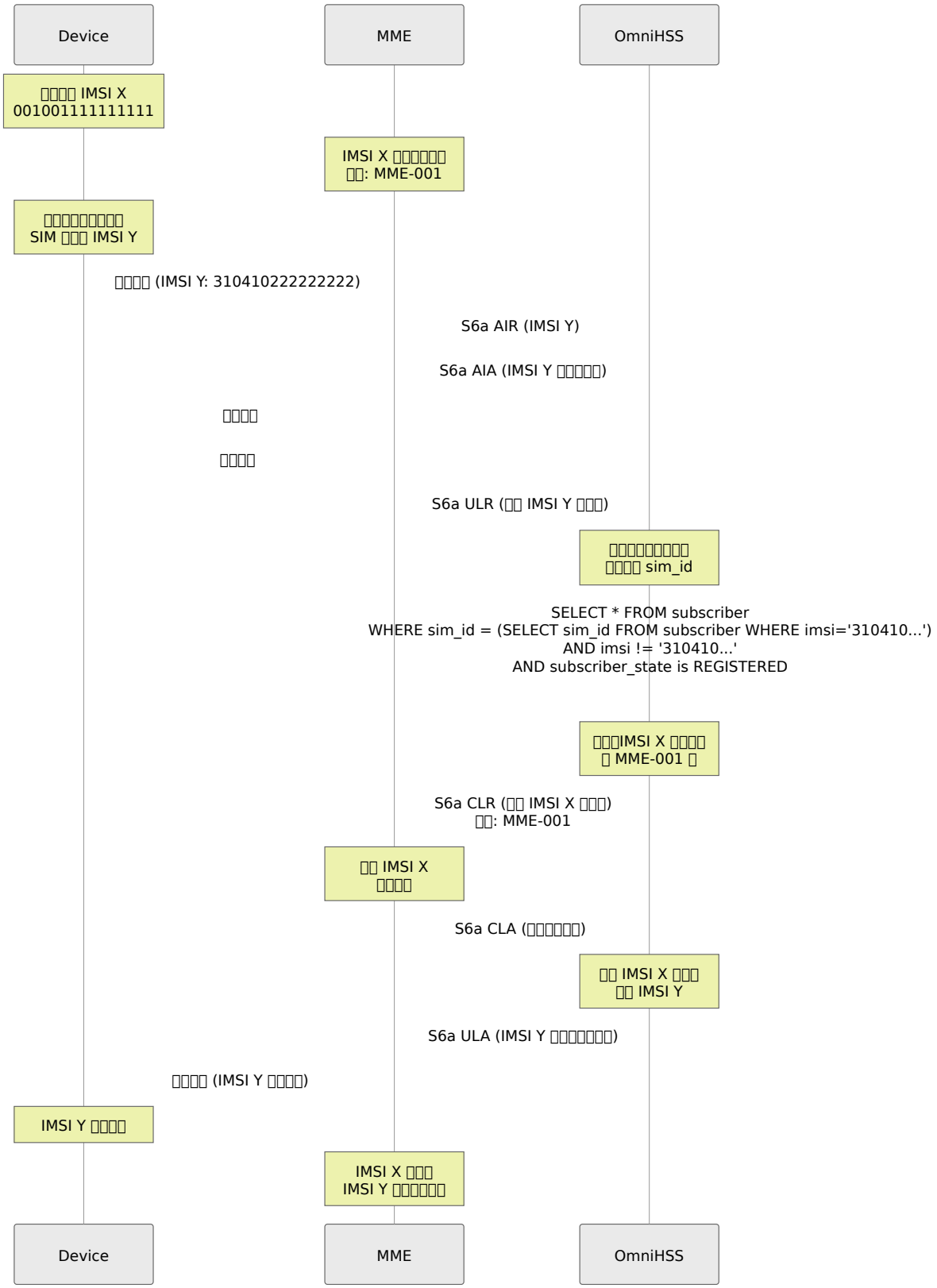

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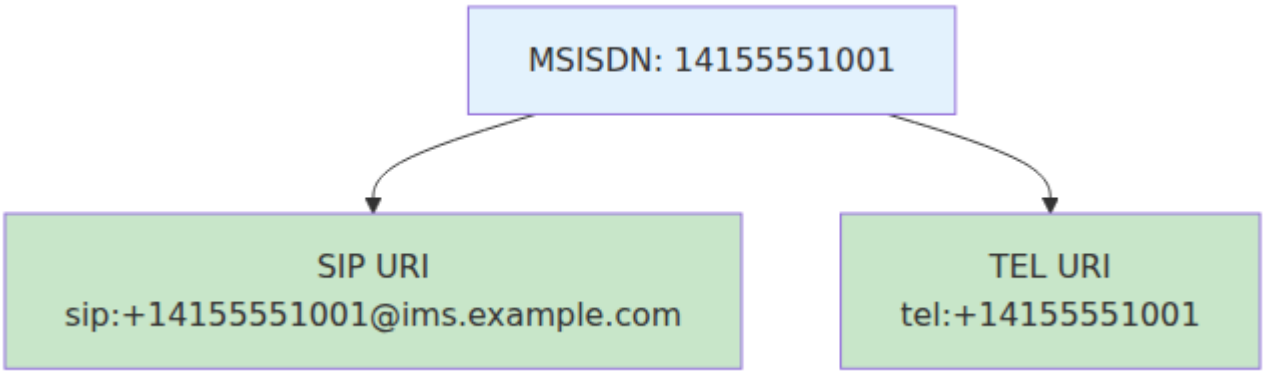

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3. □□□□□ `subscriber_state`□□□□IMSI□□□MME/SGSN□□IMSI□□□□□□□□□□□
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□IMSI + □MSISDN

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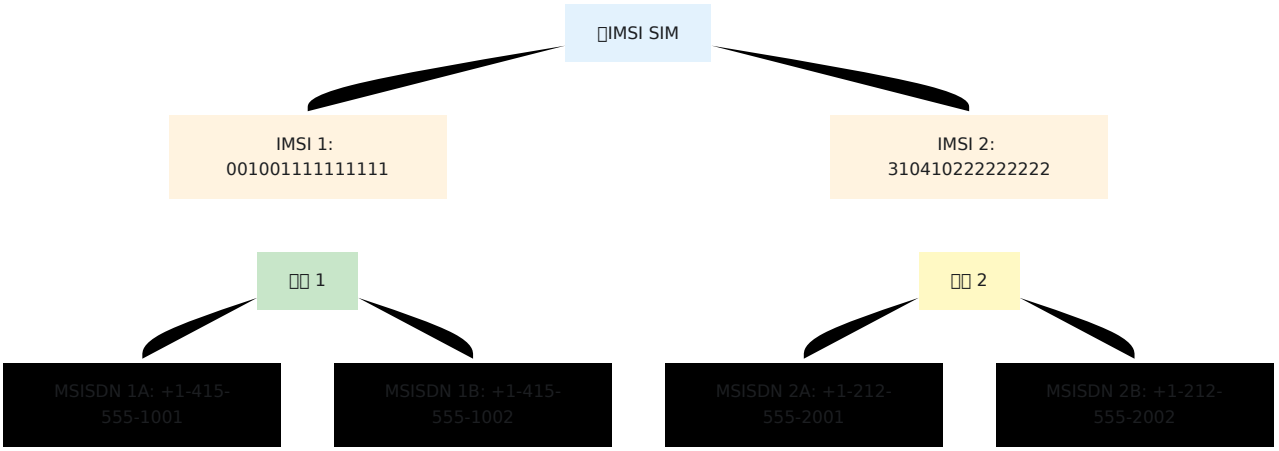

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  - □□□□□+1-415-555-1001
  - □□□□□+1-415-555-1002
- □□□□□□□**IMSI 2**□□
  - □□□□□+1-212-555-2001
  - □□□□□+1-212-555-2002

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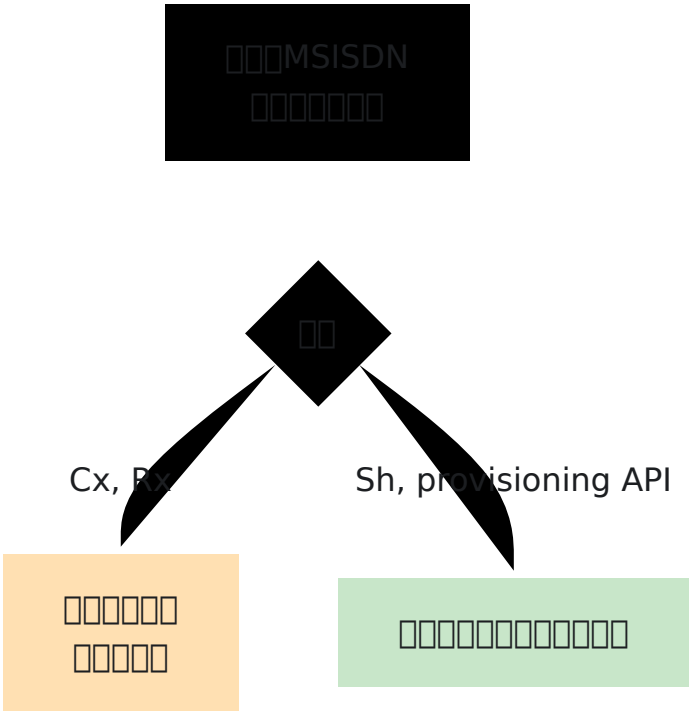

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API `GET /subscriber/msisdn/:msisdn`	MSISDN	□□□□□	□□□□□□□□□ □□□□

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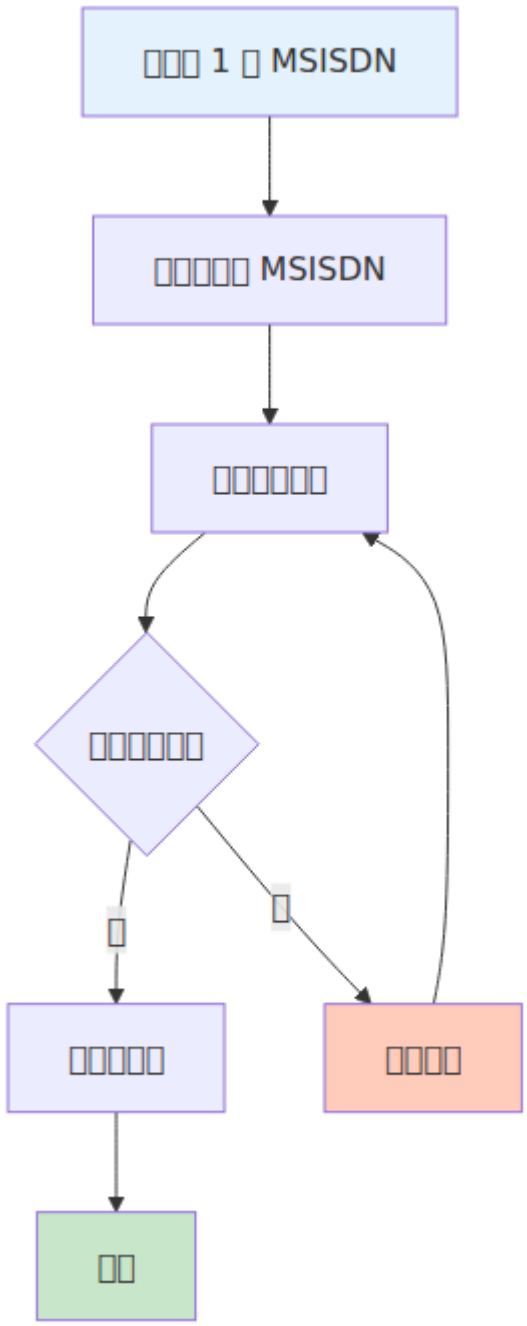

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```
# 1. □□IMS□□□□□□□□□□ims_profile_id□□□□□□□□□□□□□□□□□□□□
GROUP_ID=$(curl -k -X POST
https://hss.example.com:8443/api/ims_subscription \
  -H "Content-Type: application/json" \
  -d '{"name": "Smith family - shared number"}' | jq -r
'.response.id')

# 2. □□□□□□□□□□□□□□□□□□□□MSISDN□
curl -k -X PATCH
https://hss.example.com:8443/api/subscriber/$PHONE_SUBSCRIBER_ID \
  -H "Content-Type: application/json" \
  -d "{\"ims_subscription_id\": \"$GROUP_ID\", \"msisdns\":
[\"$SHARED_MSISDN_ID\"]}"

curl -k -X PATCH
https://hss.example.com:8443/api/subscriber/$WATCH_SUBSCRIBER_ID \
  -H "Content-Type: application/json" \
  -d "{\"ims_subscription_id\": \"$GROUP_ID\", \"msisdns\":
[\"$SHARED_MSISDN_ID\"]}"
```

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`name`	□□□	□	IMS□□□□□□□□□□□□□□□□
`ims_profile_id`	UUID	□	□□□□□□□□□□□□□□□□□iFC□□□□□□□□□□□□□□□□□□IMS□□□□□
`ims_subscription_id`	UUID	□	□□□□□□□□□□□□□□□□□□□□

- □□□□□□□□MSISDN□□□□□□□

3. □□IMS□□□□□□□□□□□□
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EPC □□

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`ue_ambr_dl_kbps`	□□□ □□□	10,000 - 1,000,000 Kbps
`ue_ambr_ul_kbps`	□□□ □□□	5,000 - 500,000 Kbps
`network_access_mode`	□□□ □	"packet_only" □ "packet_and_circuit"
`tracking_area_update_interval_seconds`	TAU □□□	54 □□□□□

□□ EPC □□

```
curl -k -X POST https://hss.example.com:8443/api/epc/profile \
  -H "Content-Type: application/json" \
  -d '{
    "apn_profiles": [],
    "name": "Premium 100Mbps",
    "network_access_mode": "packet_only",
    "tracking_area_update_interval_seconds": 600,
    "ue_ambr_dl_kbps": 100000,
    "ue_ambr_ul_kbps": 50000
  }'
```

□□ EPC □□□□

□□□□□:

- □□: 10 Mbps (10,000 Kbps)
- □□: 5 Mbps (5,000 Kbps)

□□:

- □□: 50 Mbps (50,000 Kbps)
- □□: 25 Mbps (25,000 Kbps)

□□:

- □□: 100 Mbps (100,000 Kbps)
- □□: 50 Mbps (50,000 Kbps)

□□□:

- □□: 1 Gbps (1,000,000 Kbps)
- □□: 500 Mbps (500,000 Kbps)

IMS □□

IMS □□□□□□□□□□□□□□□□□ IFC□□□□□□□□□□□□□□□

IFC □□

IFC □□□□□ S-CSCF □□□□□□□ XML □□□

□□□□:

- `{{imsi}}` - □□□ IMSI
- `{{msisdns}}` - □□□□□□
- `{{mcc}}` - □□□□
- `{{mnc}}` - □□□□□

□□ IMS □□

```
curl -k -X POST https://hss.example.com:8443/api/ims/profile \
  -H "Content-Type: application/json" \
  -d '{
    "ims_profile": {
      "name": "Standard VoLTE",
      "ifc_template": "<InitialFilterCriteria>...
</InitialFilterCriteria>"
    }
  }'
```

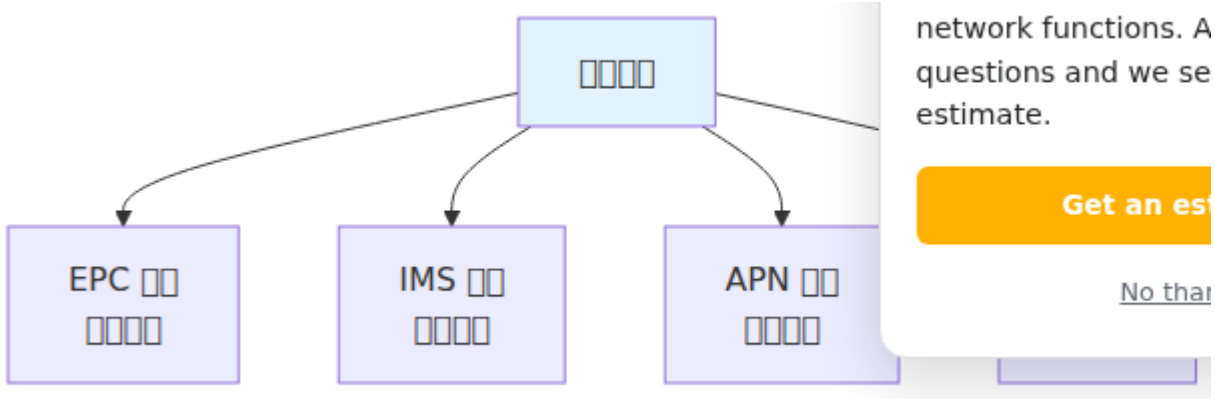
IFC □□□□

```
<ServiceProfile>
  <PublicIdentity>
    <Identity>sip:
{{imsi}}@ims.mnc{{mnc}}.mcc{{mcc}}.3gppnetwork.org</Identity>
  </PublicIdentity>
  <InitialFilterCriteria>
    <Priority>0</Priority>
    <TriggerPoint>
      <ConditionTypeCNF>0</ConditionTypeCNF>
      <SPT>
        <ConditionNegated>0</ConditionNegated>
        <Group>0</Group>
        <Method>INVITE</Method>
      </SPT>
    </TriggerPoint>
    <ApplicationServer>
      <ServerName>sip:as.ims.example.com</ServerName>
      <DefaultHandling>0</DefaultHandling>
    </ApplicationServer>
  </InitialFilterCriteria>
</ServiceProfile>
```

APN □□

APN□□□□□□□□□□□□□□□□□□□□□□□□□□□□

APN □□



APN □□□

□□ APN □□□ IP □□□□□

□□ APN:

- `internet` - □□□□□□□□
- `ims` - IMS/VoLTE □□
- `mms` - □□□□□
- `vzwadmin` - □□□□□

IP □□□□:

- `"ipv4"`: □ IPv4
- `"ipv6"`: □ IPv6
- `"ipv4v6"`: IPv4v6□□□□
- `"ipv4_or_ipv6"`: IPv4 □ IPv6□□□□□□

APN QoS □□

□□□□□□□□□

QCI□□□□□□□□□□□□□□□:

QCI	□□	□□	□□□
1	GBR	□□□□	□□
2	GBR	□□□□	□
4	GBR	□□□	□
5	□ GBR	IMS □□	□
9	□ GBR	□□□□□□□	□□

□□□□□□□□□□□□□:

APN QoS □□□□□□□□ IP-CAN □□□□□□□□□□□□□□ Gx CCA-I □□□□□ `Online`/`Offline` AVP □□□

□□	□□	□□	□□
`online_charging_enabled`	boolean	`null`	□□□□□□□□□□ `Online` AVP □`true` = □□□`false` = □□□□□□ `null` □□PCRF □□ PGW □ CCR-I □□□□□□
`offline_charging_enabled`	boolean	`null`	□□□□□□□□□□ `Offline` AVP □`true` = □□□`false` = □□□□□□ `null` □□PCRF □□ PGW □ CCR-I □□□□□□

□□□□□□□□ AVP □□□□□□□□ PCRF: □□□□□/□□□□□□

□□□□□ APN □□

```
# 1. □□ APN □□□
APN_ID=$(curl -k -X POST
https://hss.example.com:8443/api/apn/identifier \
  -H "Content-Type: application/json" \
  -d '{"apn": "internet", "ip_version": "ipv4v6"}' \
  | jq -r '.response.id')

# 2. □□ APN QoS □□
QOS_ID=$(curl -k -X POST
https://hss.example.com:8443/api/apn/qos_profile \
  -H "Content-Type: application/json" \
  -d '{
    "name": "Best Effort",
    "allocation_retention_priority": 8,
    "apn_ambr_dl_kbps": 50000,
    "apn_ambr_ul_kbps": 25000,
    "pre_emption_capability": false,
    "pre_emption_vulnerability": true,
    "qci": 9
  }' | jq -r '.response.id')

# 3. □□ APN □□
curl -k -X POST https://hss.example.com:8443/api/apn/profile \
  -H "Content-Type: application/json" \
  -d "{
    \"apn_identifier_id\": \"$APN_ID\",
    \"apn_qos_profile_id\": \"$QOS_ID\",
    \"name\": \"Internet APN\"
  }"
```

□ APN □□□ EPC □□

APN □□ `join_epc_profile_to_apn_profile` □□ EPC □□□□□

□□□□□□□□□□□□ APN □□ ID □□□ EPC □□ ID□□□ APN □□□□□□□□□ EPC □□□

□□□□

□□□ □□□□□□□ □□□□□□□□

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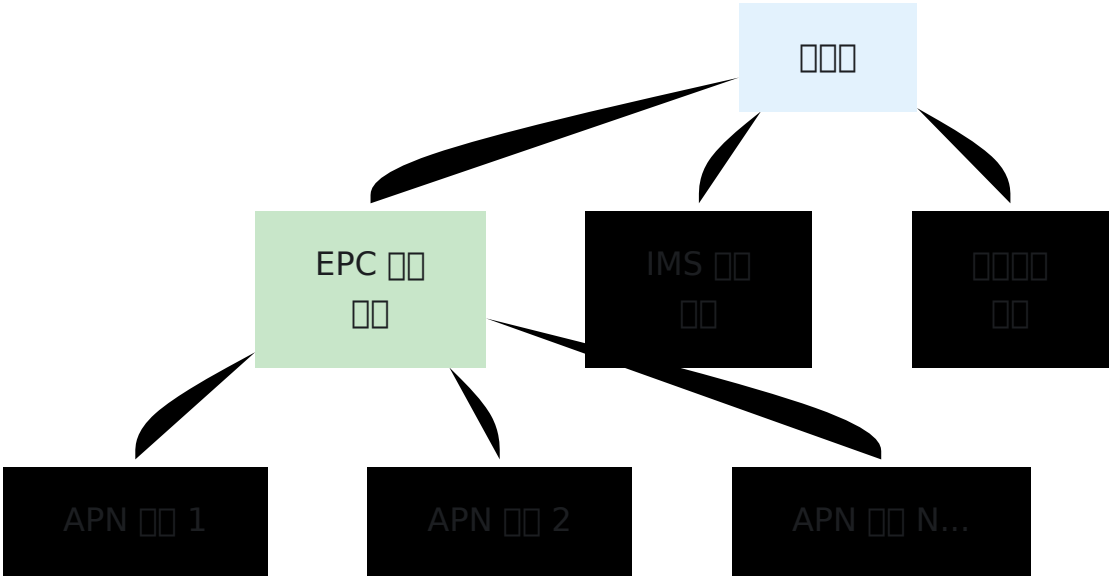

□□□
EPC □□
□□
IMS □□
□□
□□□□
□□
APN □□ 1
APN □□ 2
APN □□ N...

□□□□□□□□□

```
# □□□□□□□□□□ EPC □ IMS □□
curl -k -X POST https://hss.example.com:8443/api/subscriber \
  -H "Content-Type: application/json" \
  -d '{
    "subscriber": {
      "imsi": "001001123456789",
      "key_set_id": "6ba7b810-9dad-41d1-80b4-00c04fd430c8",
      "epc_profile_id": "e58ed763-928c-4155-bee9-fdbaaadc15f3",
      "ims_profile_id": "7c9e6679-7425-40de-944b-e07fc1f90ae7",
      "roaming_profile_id": "9c858901-8a57-4791-81fe-4c455b099bc9"
    }
  }'

# □□□□□□□□
curl -k -X PUT
https://hss.example.com:8443/api/subscriber/d290f1ee-6c54-4b01-
90e6-d701748f0851 \
  -H "Content-Type: application/json" \
  -d '{
    "subscriber": {
      "epc_profile_id": "f47ac10b-58cc-4372-a567-0e02b2c3d479"
    }
  }'
```

□□□□□□□□

□□□□

1. □□□□□□□ - □□□□□□□□□□□□□□□□□□□□□□□
2. □□□□□ - □□□□□□□□□□□□□□□□
3. □□□□□ - □□□□□□□
4. □□□□□□ - □□□□□□□□□□□□□□□□□□□□

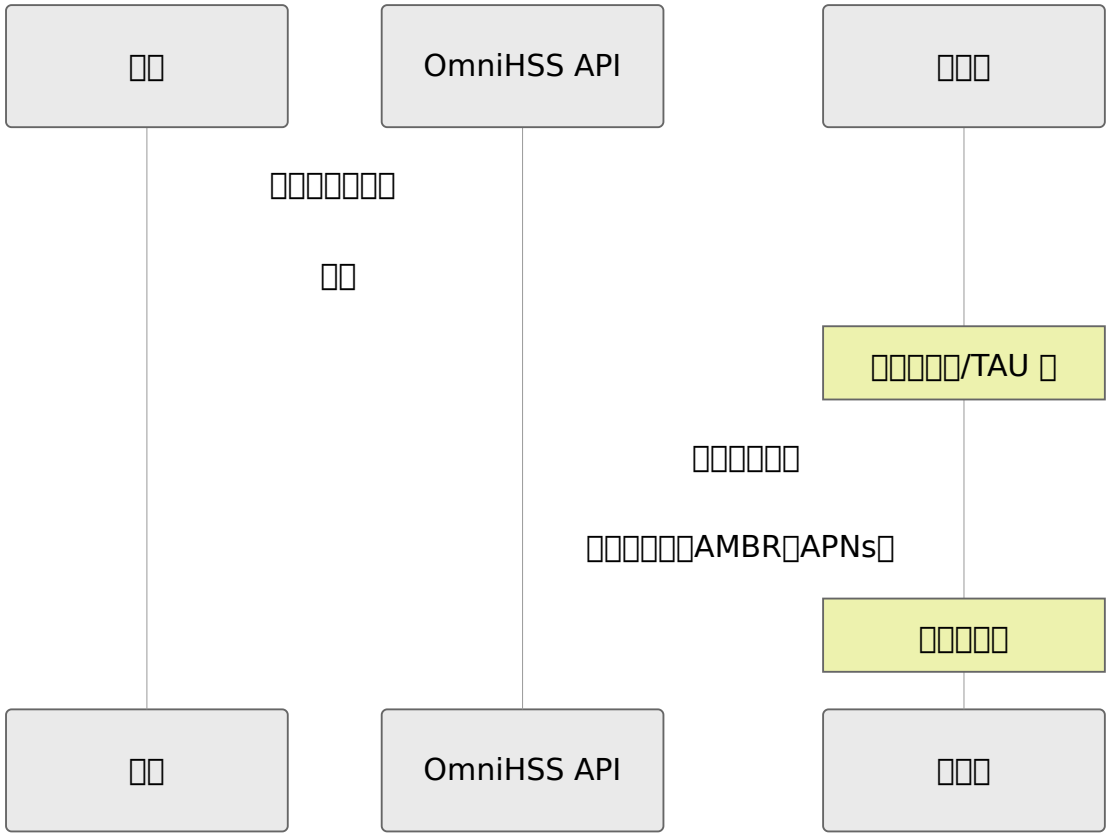
□□□□□□

```
[□□□□□]-[□□]-[□□]

□□:
- "Basic-10Mbps-Internet"
- "Premium-100Mbps-VoLTE"
- "Enterprise-1Gbps-MultiAPN"
```

□□□□

□□□□□□□□□□□□□



□□: □□□□□□□□□□□□

- □□□□□□□□TAU□
- □□
- IMS □□□□□□ IMS □□□□□□

□□□□□□□□

□□□□□□□□□□□□:

1. □□□□□□ EPC □□ AMBR □
2. □□ APN QoS □□ AMBR □
3. □□ MME/P-GW □□□□□□□ QoS
4. □□□□□□□

IMS □□□□:

1. □□□□□□ IMS □□
2. □□ IFC □□ XML □□□□
3. □□ S-CSCF □□□□□□ IFC □□□□
4. □□ S-CSCF □□□□

APN □□□:

1. □□ APN □□□□□□□□ EPC □□
2. □□ APN □□□□□□□□□□□□□□
3. □□ UE □ PDN □□□□

← □□□□□□□ | □□□: □□□□ →

OmniHSS □□□□

← □□□□□□

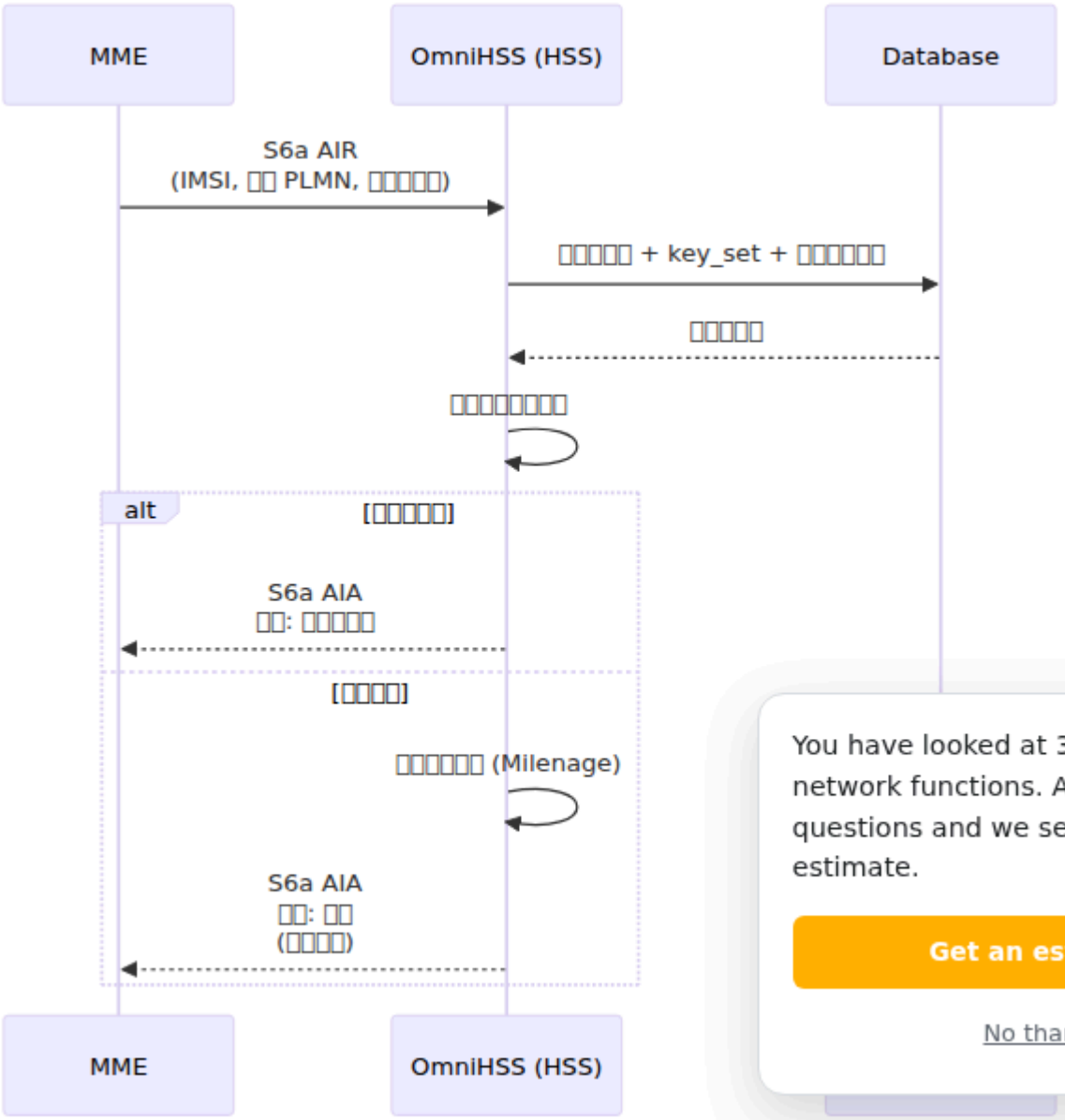
□□

□□□□□□□□ OmniHSS □□□ Diameter □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□

S6a □□ (LTE/EPC)

□□□□□□ (AIR/AIA)

MME □□□□□□□□□□□

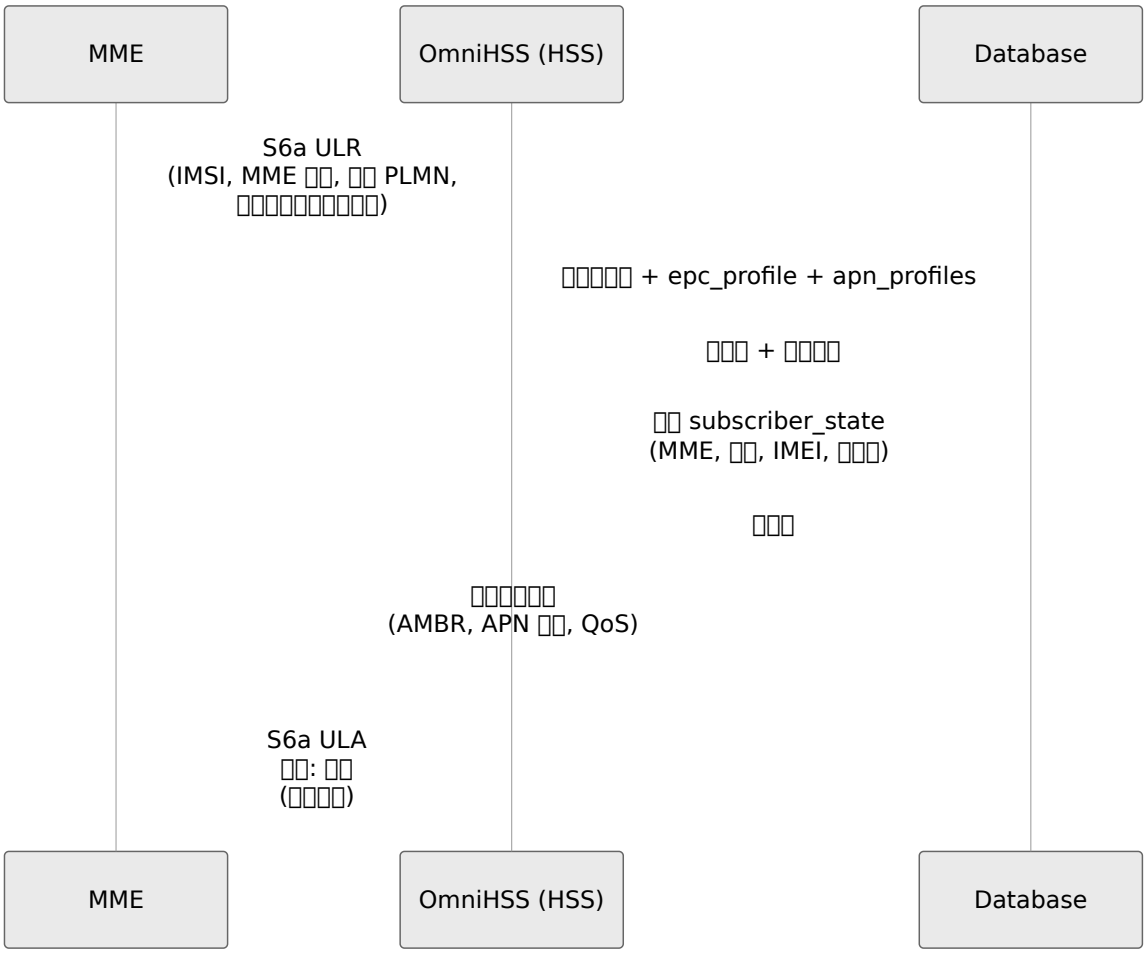


□□ AVP:

- □□: □□□ (IMSI), □□-PLMN-Id, □□□□□□□
- □□: □□□□ (RAND, AUTN, XRES, KASME)

□□□□□□□ (ULR/ULA)

MME □□ HSS □□□□□□□□□□□□□□□

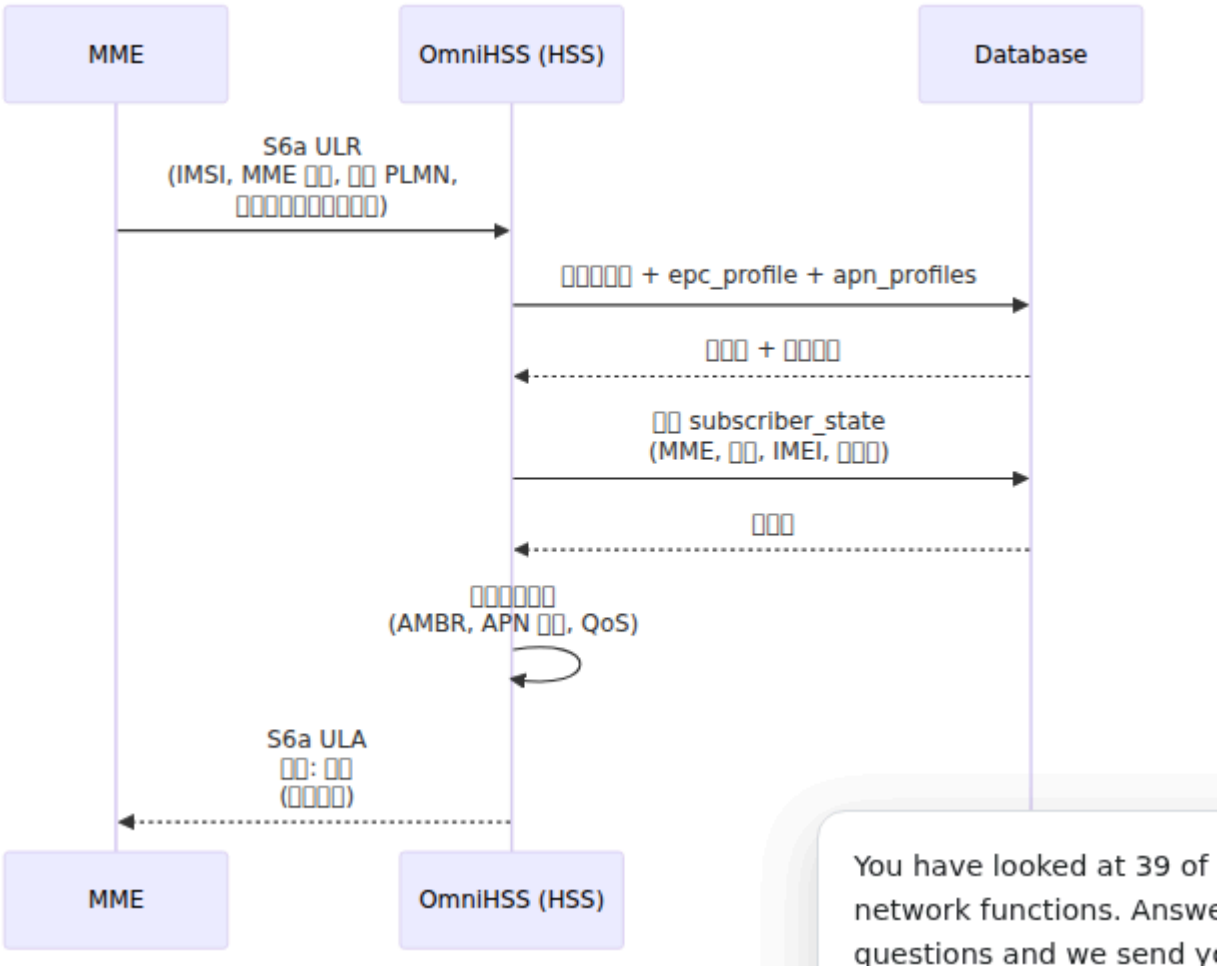


□□ **AVP:**

- □□: □□□ (IMSI), RAT □□, ULR □□, □□-PLMN-Id, UE-SRVCC □□, □□□□ (IMEI, □□□□; □□)
- □□: □□□□ (AMBR, APN □□, □□□□□□)

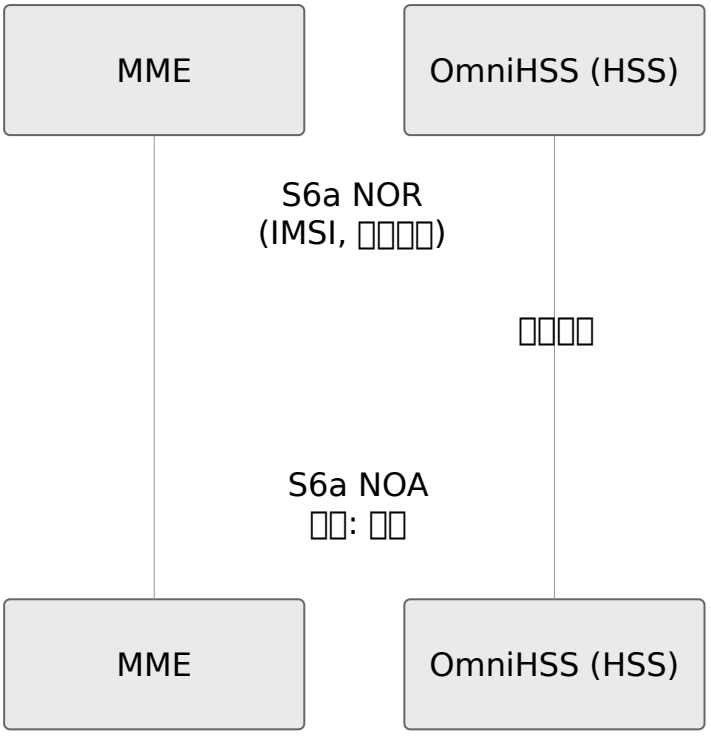
□□ UE □□ (PUR/PUA)

MME □□ HSS □□□□□□□□□□□□□□



□□□□ (NOR/NOA)

MME □□ HSS □□□□□

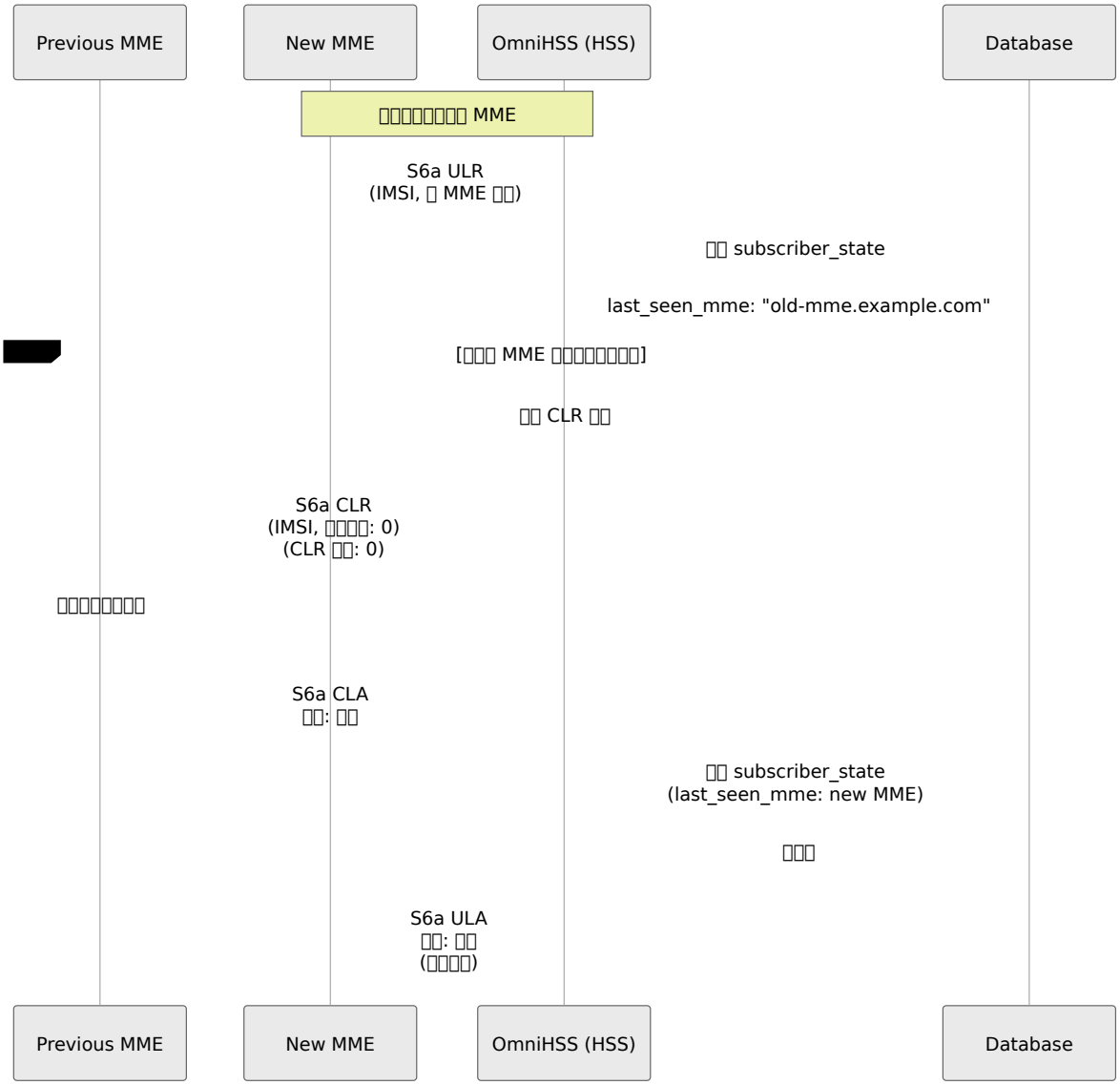


□□□□□□□ (CLR/CLA)

HSS □□□□□□□□□□□ MME □□□□□□□□□OmniHSS □□□□□□□□□ CLR □□□

□□ CLR (MME □□)

□□□□□□□□ MME □□□□□□□□□□□□OmniHSS □□□□□□□□ MME □□ CLR□□□□□□□□□□□□

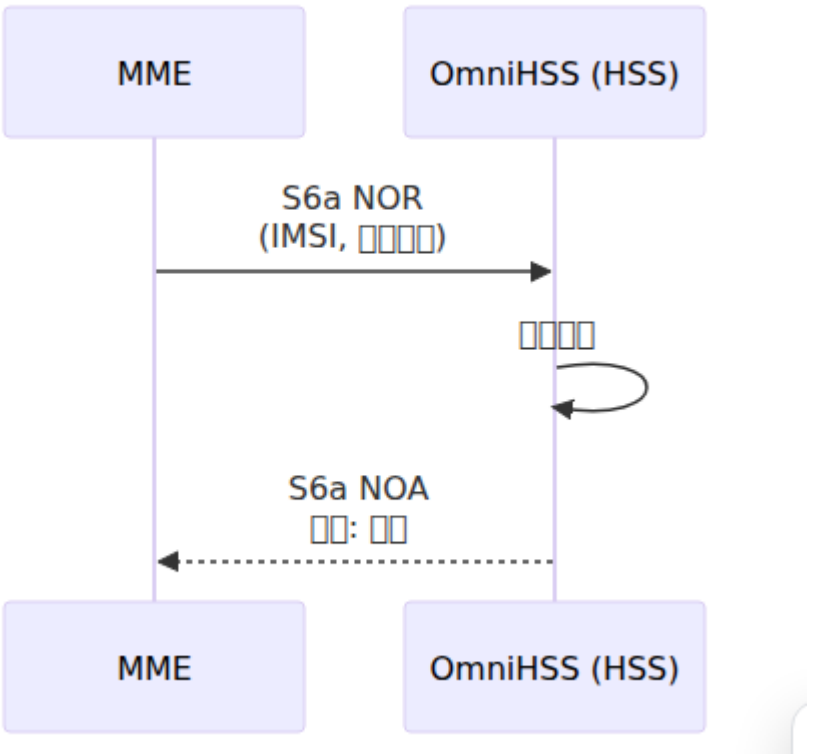


□□ AVP (□□ CLR):

- □□□: □□□□ IMSI
- ��□□□: □□□ MME □□□
- □□□: □□□ MME □
- □□□□: 0 (MME □□□□)
- CLR □□: 0
- □□□□: □□□□□□□□□

□□□ CLR (API □□)

□□□□□□□□□□ API □□ CLR□□□□□□□□□□



□□ AVP (□□□ CLR):

- □□□: □□□□ IMSI
- □□□□: ��□□□□ MME □□□
- □□□: □□□□□ MME □
- □□□□: `:subscription_withdrawal` (□ 3GPP TS 29.272 □□□□□)
- CLR □□:
  - s6a_indicator: 1 (□□□□ S6a □□)
  - reattach_required: 1 (UE □□□□□□□□□□□)

□□□□

OmniHSS □□□□□□□□□□□ 3GPP TS 29.272□

□□	□	□□	□□
MME □□□□	0	□□ MME □□	□□ MME □□□□ ULR
SGSN □□□□	1	SGSN □□	3G/2G □□□□
□□□□	2	□□□□	□□ API □□□□
□□□□ IWF	3	□□□□□□□	□□□□□□□□
□□□□□□□	4	□□□	□□□□□□□

CLR □□

CLR □□ AVP □□□□□□□□□□□□□□□□□□

□□	□	□□
S6a/S6d □□□	0	1 = □□ S6a □□
□□□□□□□	1	1 = UE □□□□□□□□□

□□ CLR □□□□:

```
clr_flags: %{
  s6a_indicator: 1,        # □□ S6a □□
  reattach_required: 1     # □□□□□□□
}
```

□ IMSI □□

OmniHSS □□□□□□□□ (IMSI) □ MME □□□□□□□□□ MSISDN□□□□□□□□ IMSI □□□□ CLR □□□□ □□□

□□ 1: □□ MSISDN□□□ IMSI

```
□□□ A:
  - IMSI: 999000123456789
  - MSISDNs: ["+1234567890", "+9876543210"]
  - last_seen_mme: "mme01.operator.com"
```

□□□□□□□□□□ MME □□

- □□□□ **CLR** □ "mme01.operator.com"□IMSI □ 999000123456789
- □□ MSISDN □□□□□□□□□□□□□□□ SIM□
- □□□ AVP □□ IMSI□□□□ MSISDNs

□□ 2: □□□□□□□□ IMSI□□□□ MSISDN

OmniHSS □□ □□ **MSISDN** □□□□□ MSISDN □□□□□□□□□□□□□□□□□□□□□/□□□□□

```
□□□ A:
  - IMSI: 999000111111111
  - MSISDN: "+1234567890"
  - last_seen_mme: "mme01.operator.com"

□□□ B□□□□□:
  - IMSI: 999000222222222
  - MSISDN: "+1234567890"  # □□ MSISDN□□□ SIM/IMSI
  - last_seen_mme: "mme02.operator.com"
```

□□□□ B □□□□

- □□□ **CLR**□□□ IMSI = □□□□□□
- □□□ A □□□ mme01 □□
- □□□ B □ mme02 □□
- □□□□□□□□□□□□□□□□□□□□□□

□□ 3: □□□ CLR □□□ MSISDN □□□

□□□

- □□□□ **CLR** □□□□□ last_seen_mme
- □□ **MSISDN** □□ IMSI □□□□□□□□□□□

- IMSI □□□ MME □□□□□

□□□□□□

1. **IMSI □□□:** CLR □□□□□ □ **IMSI**□□□□□ MSISDN□`subscriber_state` □□□□□ (IMSI) □□ `last_seen_mme`□
2. □□□□**:** □□□□□□□□□□□□□ MME □□□□□ CLR □□□□□□□□□□□□□□□
3. □□□□□□□ **MME**□□□□□ **CLR:** □□ `last_seen_mme` □ `nil`□□□□□□□□□□□□ ULR □□□ □□ CLR□
4. □□□□□□**:** □□ CLR□□ ULR □□□□□□□□ `Subscription-Data` AVP□□□□□ MME □□□□□ □□□
5. □□**:** CLR □□□□□□□□□□□□□□ MME □ ULA □□□□□□ MME □ CLA□
6. **CLA □□:** OmniHSS □□ CLA □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□ HSS □□□

SWx □□ (□ 3GPP □□ / WiFi □□)

SWx □□□□□ ePDG□□□□□□□□□□□□□□ HSS□□□□□ 3GPP □□□□□□□□□□□□□□□□□□□□ WiFi □ □□

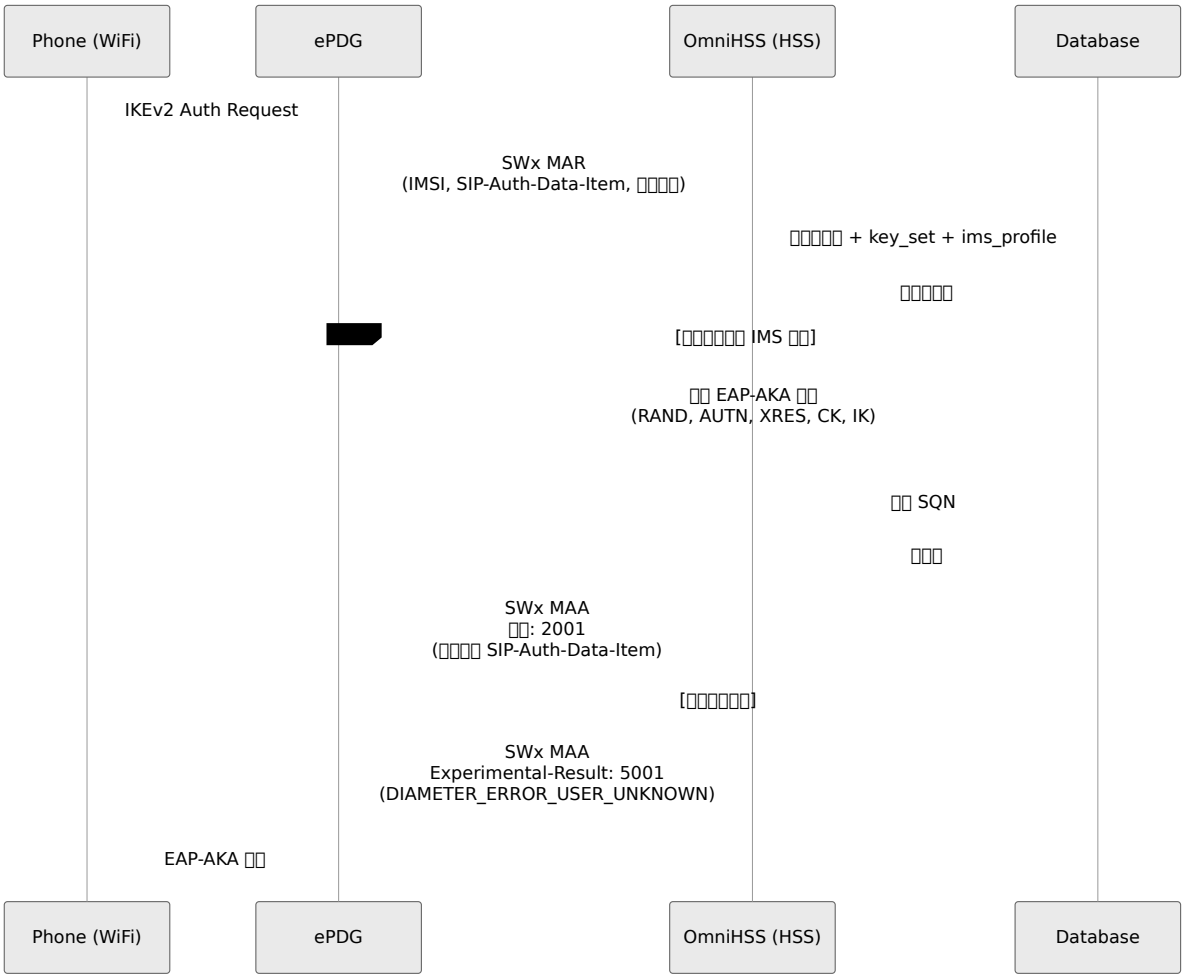
□□□□□□□ (MAR/MAA)

ePDG □□ WiFi □□□□□ EAP-AKA □□□□□TWAG□□□ WLAN□□□□□□□□□ EAP-AKA' □□□

□□□□ `SIP-Authentication-Scheme` □□□□□□□□3GPP TS 29.273 □ 8.1.2.1 □□□

□□	**ANID**	□□□□□
`EAP-AKA`	□□	AMF □□□ 0□`Confidentiality-Key` □ `Integrity-Key` □□ CK □ IK□
`EAP-AKA'`	□□	AMF □□□ 1□`Confidentiality-Key` □ `Integrity-Key` □□ CK' □ IK'□□ CK□IK□SQN xor AK □ ANID □ 3GPP TS 33.402 □□ A.2 □□□CK □ IK □□□□ HSS□

□□ `EAP-AKA'` □□□ `ANID` □□□□□ `Result-Code` 5005□DIAMETER_MISSING_AVP□□□□ □□□□□□□□□□ 5004□DIAMETER_INVALID_AVP_VALUE□□□□□□WLAN □□□□□ ANID □ `WLAN`□3GPP TS 24.302 □ 8.1.1.2 □□□



□□ AVP:

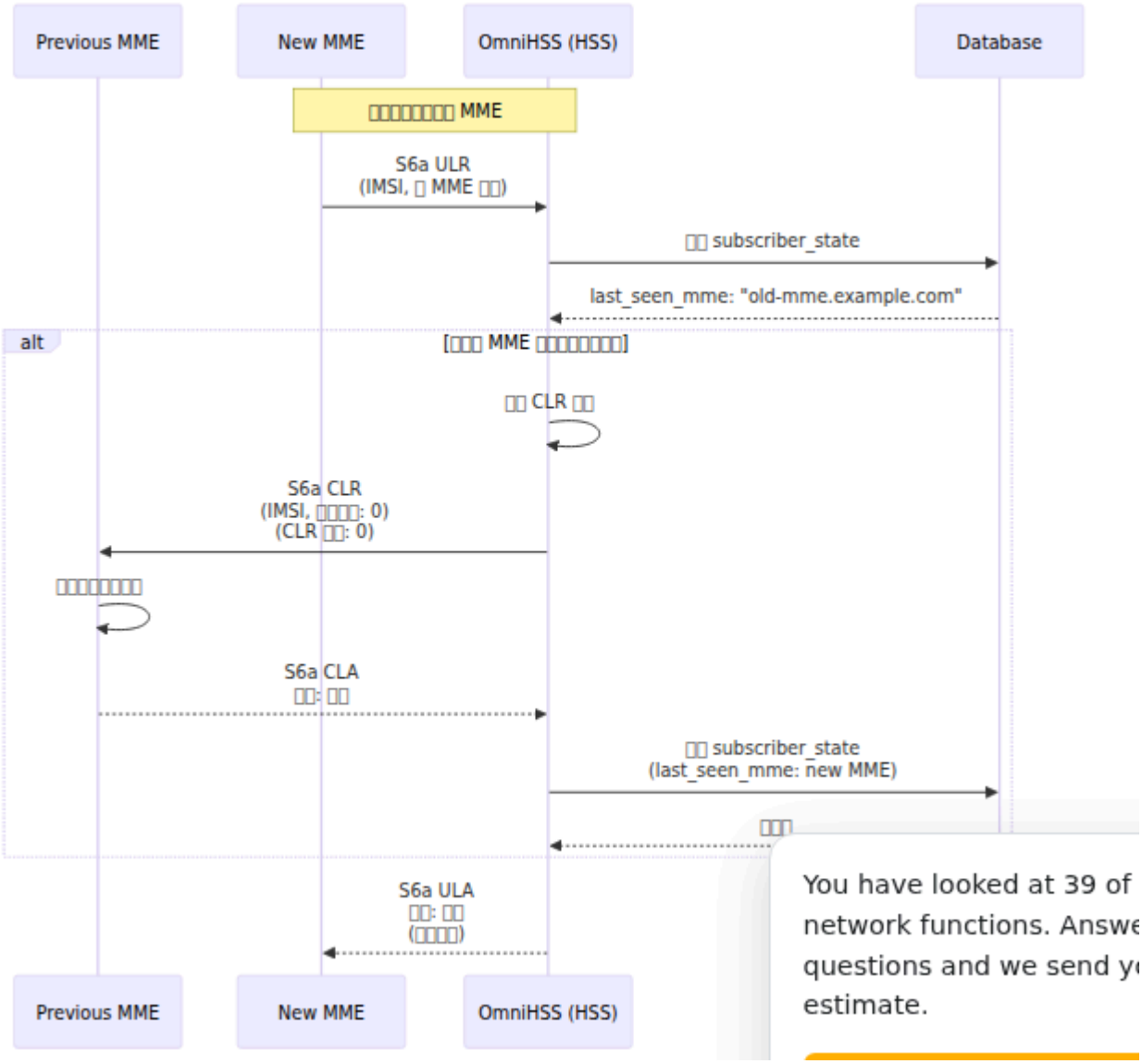
- □□: □□□ (IMSI □ IMSI@realm), SIP-Auth-Data-Item (□□□□), SIP-Number-Auth-Items

- □□: SIP-Auth-Data-Item (SIP-Authenticate, SIP-Authorization, Confidentiality-Key, Integrity-Key)

SQN □□□□: □ UE □□□□□ SQN □□□□□□□□□□□□□ePDG □ SIP-Authorization AVP □□□□□ □□□□□OmniHSS □□□□□□ AUTS□□□□ 3GPP TS 33.102 □□ IND □□□□□□□□□□ SQN□

□□□□□□□ (SAR/SAA)

ePDG □□□□□□□□□□ WiFi □□□□□



□□□□□□□:

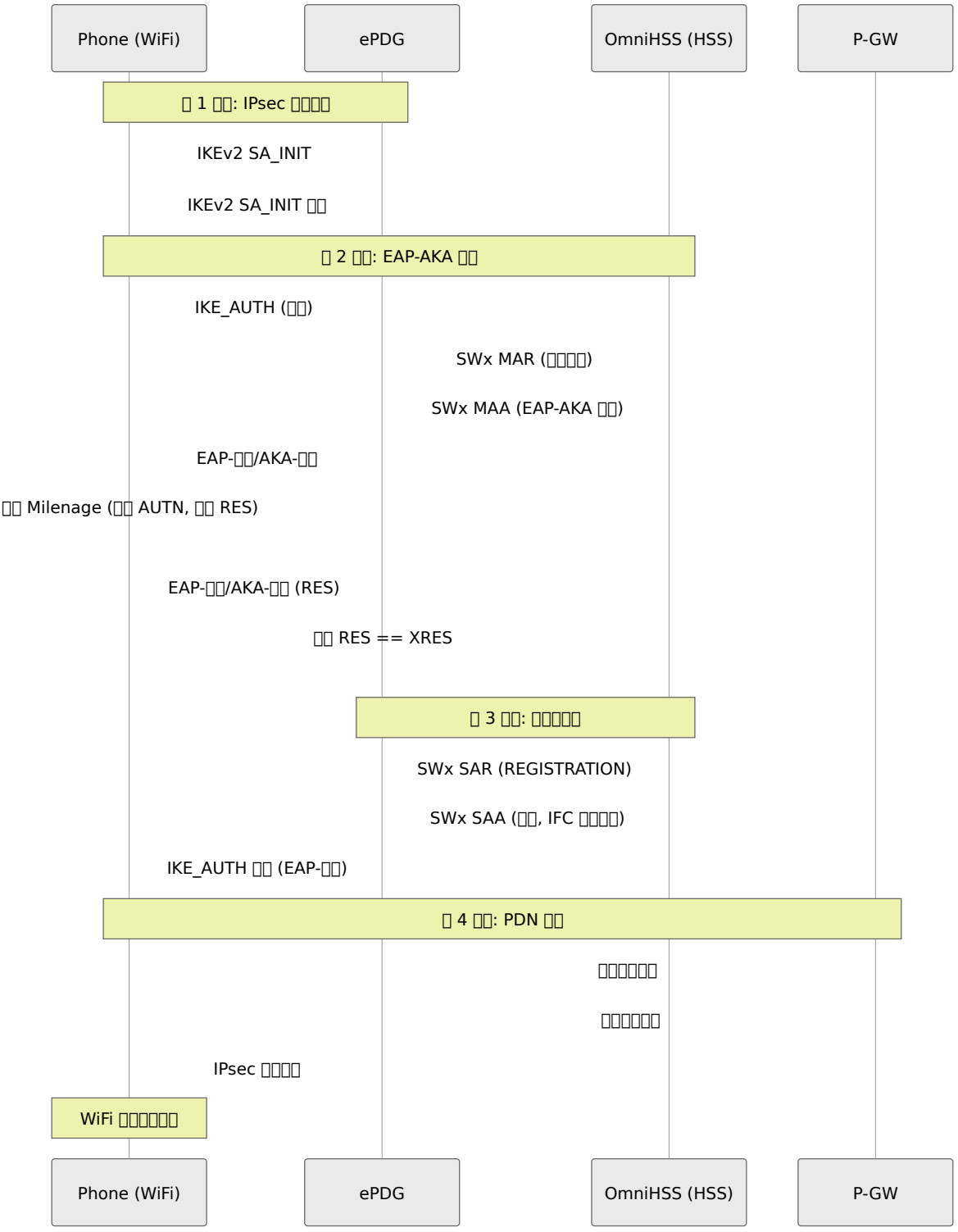
□□	□	□□
NO_ASSIGNMENT	0	□□□□□□□□□□
REGISTRATION	1	□□ WiFi □□□□
RE_REGISTRATION	2	□□□□
UNREGISTERED_USER	3	□□□□□□□□
TIMEOUT_DEREGISTRATION	4	□□□□
USER_DEREGISTRATION	5	□□□□□□□
AUTHENTICATION_FAILURE	7	□□□□□□□□□
ADMINISTRATIVE_DEREGISTRATION	8	□□□□□□□□

□□ **AVP:**

- □□: □□□ (IMSI), Server-Assignment-Type, Server-Name (ePDG □□), Service-Selection (APN)
- □□: □□□□ (IFC □□□□ XML), □ 3GPP □□□□

WiFi □□□□□□

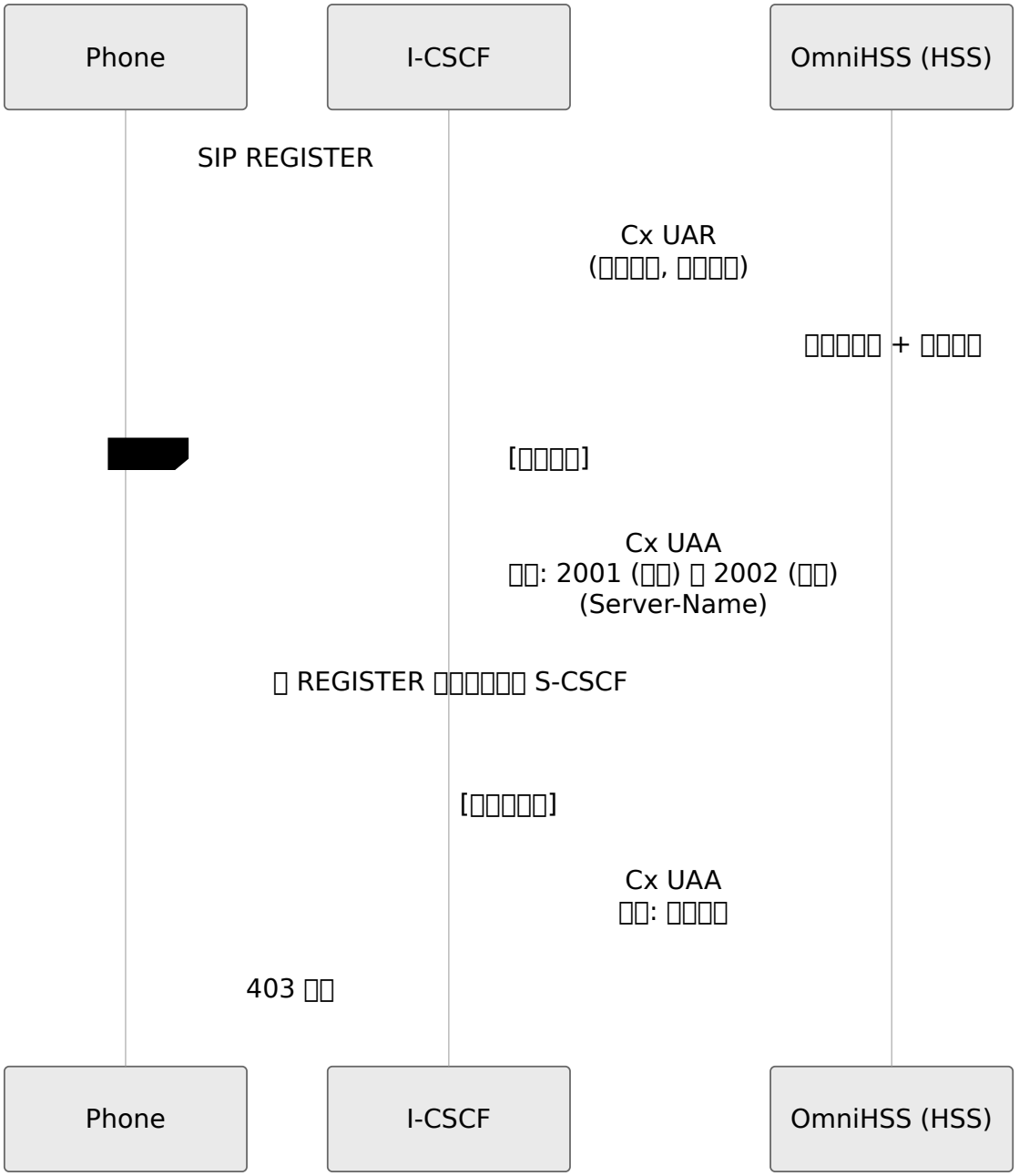
□□□□□□ WiFi □□□□□


Phone (WiFi)
ePDG
OmniHSS (HSS)
P-GW
□ 1 □□: IPsec □□□□
IKEv2 SA_INIT
IKEv2 SA_INIT □□
□ 2 □□: EAP-AKA □□
IKE_AUTH (□□)
SWx MAR (□□□□)
SWx MAA (EAP-AKA □□)
EAP-□□/AKA-□□
□□ Milenage (□□ AUTN, □□ RES)
EAP-□□/AKA-□□ (RES)
□□ RES == XRES
□ 3 □□: □□□□□
SWx SAR (REGISTRATION)
SWx SAA (□□, IFC □□□□)
IKE_AUTH □□ (EAP-□□)
□ 4 □□: PDN □□
□□□□□□□
□□□□□□□
IPsec □□□□
WiFi □□□□□□□
Phone (WiFi)
ePDG
OmniHSS (HSS)
P-GW

Cx □□ (IMS)

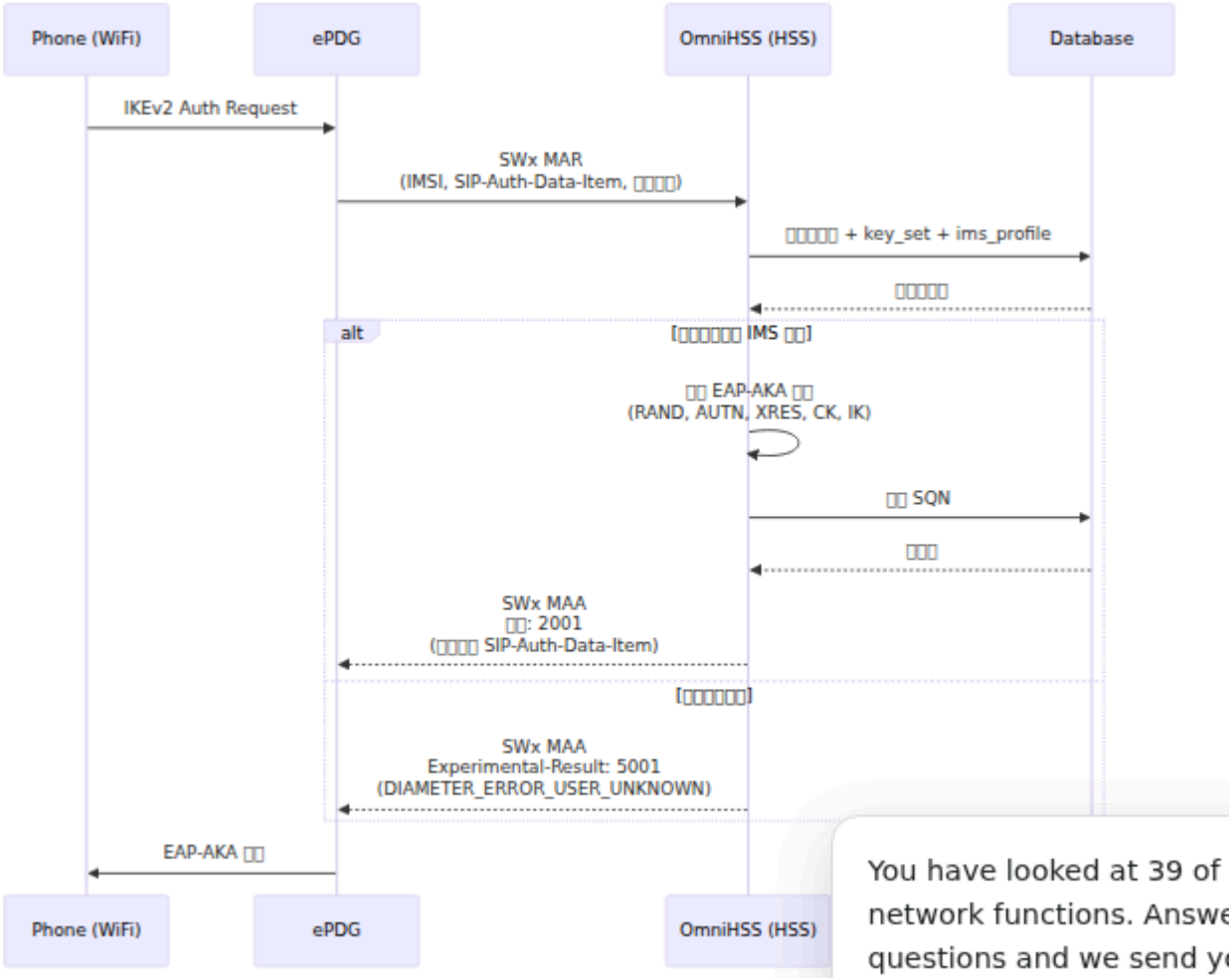
□□□□□□□ (UAR/UAA)

I-CSCF □□□□□□□□□□□□□□□□□□□ S-CSCF□HSS □□□□ S-CSCF □□□□□□ `Server-Name`□□□□ □□□□□□□□□□□□□□□□ S-CSCF □□□□ □□□



□□□□□□□ (SAR/SAA)

S-CSCF □□/□□□□□□□ IMS □□□□□



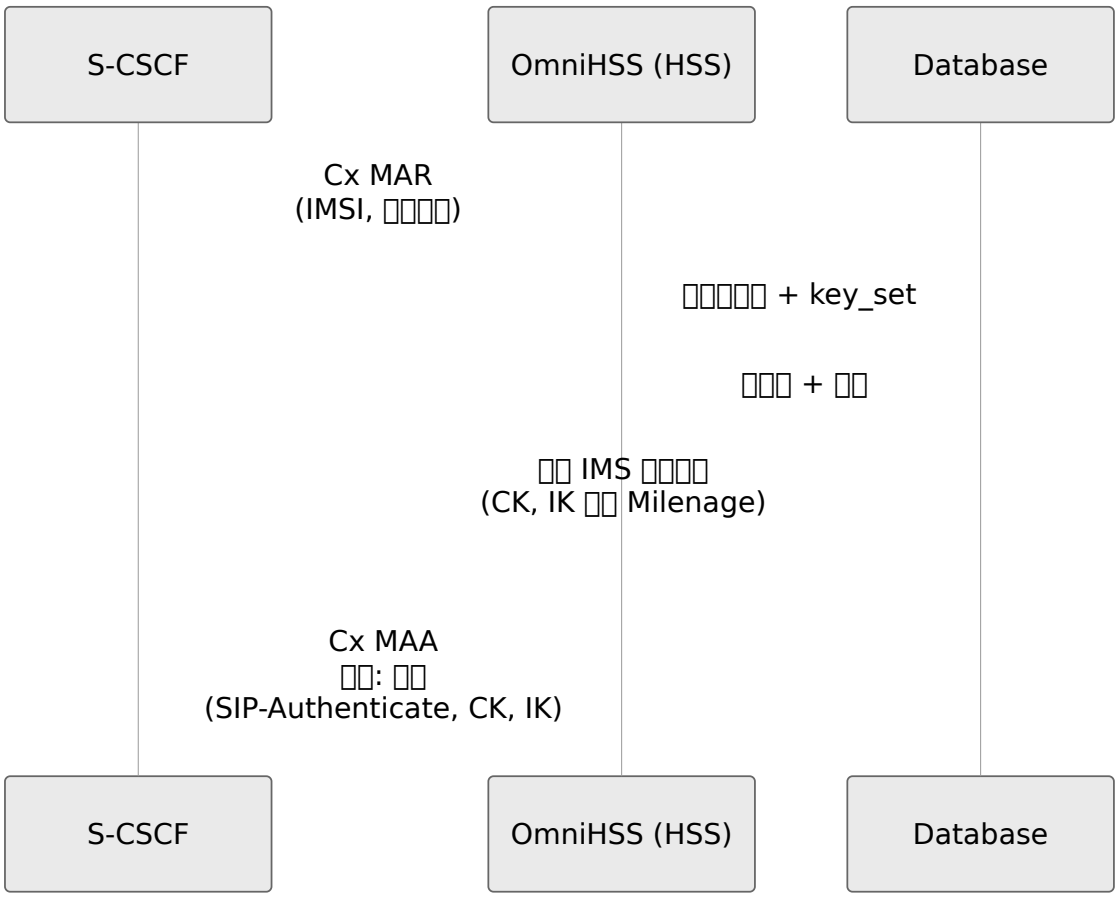
IFC □□□□:

- `{{imsi}}` → □□ IMSI
- `{{msisdns}}` → □□□□□□
- `{{mcc}}, {{mnc}}` → □□ PLMN □□

□□ SAR □□□□□□□□□□□□□□□□□□□□□□□□□□ `AUTHENTICATION_FAILURE` □ `AUTHENTICATION_TIMEOUT`□□□□ S-CSCF □□□□□

□□□□□□□ (MAR/MAA)

S-CSCF □□ IMS □□□□□□□□



S-CSCF □□□□

HSS □□□□□□□□□□□□□ IMS □□□□□□□□□□□□□□□□□□□□□□□□□□□□ 3GPP TS 29.228 §3.1□

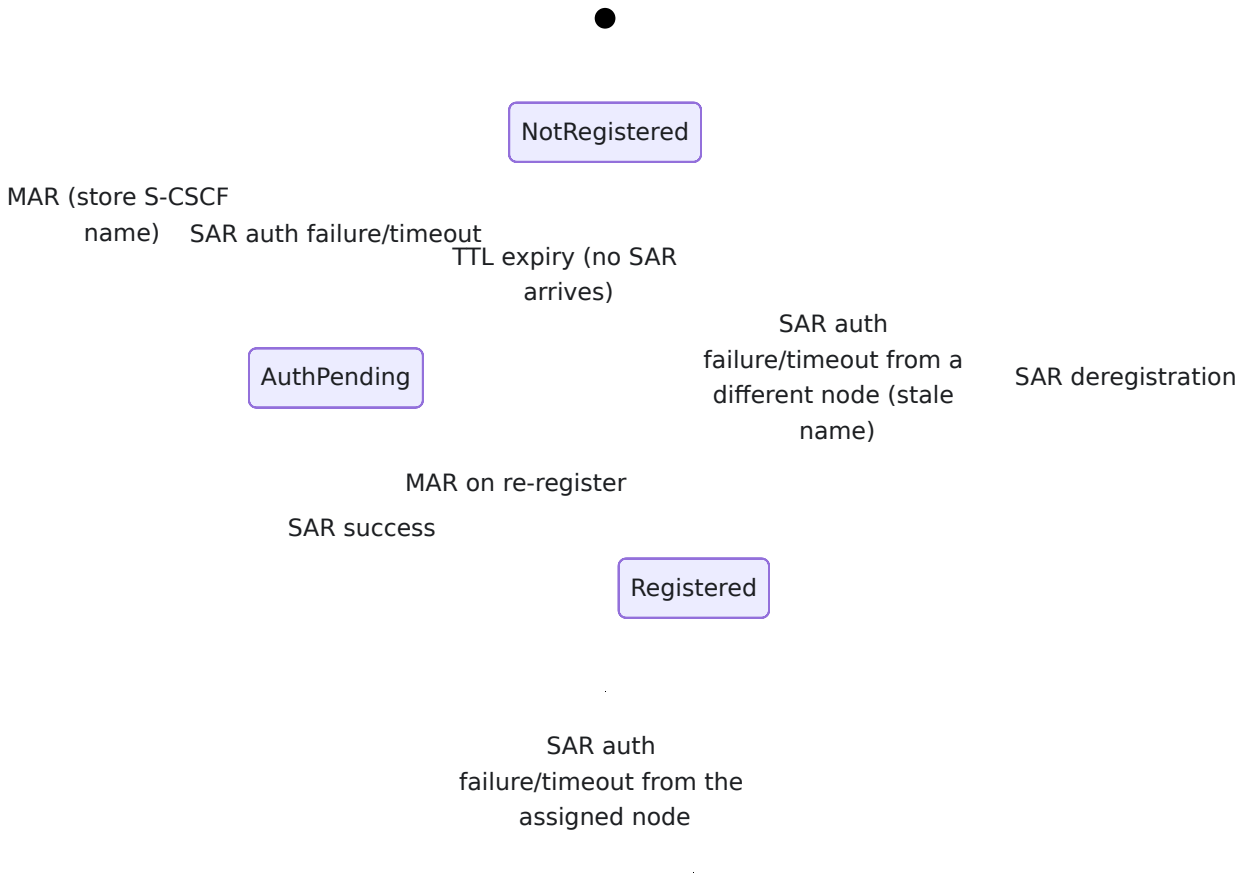
□□□□	□□□	□□□	□□
`assigned_scscf`	SAR □ □□□□□□	SAR □□□□□□□□/□□□□□□□□□□□□ □□□□/□□□□□□□□□□	□□□□□□ S-CSCF □□□□
`auth_pending_scscf`	MAR	SAR□□□□□□□□□/□□□□UAR □ □□□ TTL □□	□ S-CSCF □□ □□□ IMS-AKA □□□
`auth_pending_since`	MAR	□ `auth_pending_scscf` □□	□□□□□□□□□ HSS □□□□□□ □□□□□□□

MAR □□ S-CSCF □□□□□□□□□□□□□□□□ TS 29.228 §6.3□SAR □□□□□□□□□□ TS 29.228 §6.1.2□

UAA S-CSCF □□□□□ □□□□ UAR□HSS □□□□ S-CSCF □□□□□□□□□□□□□□□□□

1. □□□□□□□□□□□□□□□ S-CSCF□□□□□□□□□ `DIAMETER_SUBSEQUENT_REGISTRATION` (2002)□□ `auth_pending_scscf` □□□□ `auth_pending_since` □ `auth_pending_ttl_seconds` □□□□□□□□□□
2. `assigned_scscf` □□□□□□□□ S-CSCF □□□□□□□□□□ `DIAMETER_SUBSEQUENT_REGISTRATION` (2002)□
3. □□□□□□□□□□□□□□□ S-CSCF□□ S-CSCF □□□□□□□□□□ `DIAMETER_FIRST_REGISTRATION` (2001)□

□□ 2 □□□□□□□□□□□ URI □□□□□□□□□□□□□□□□□



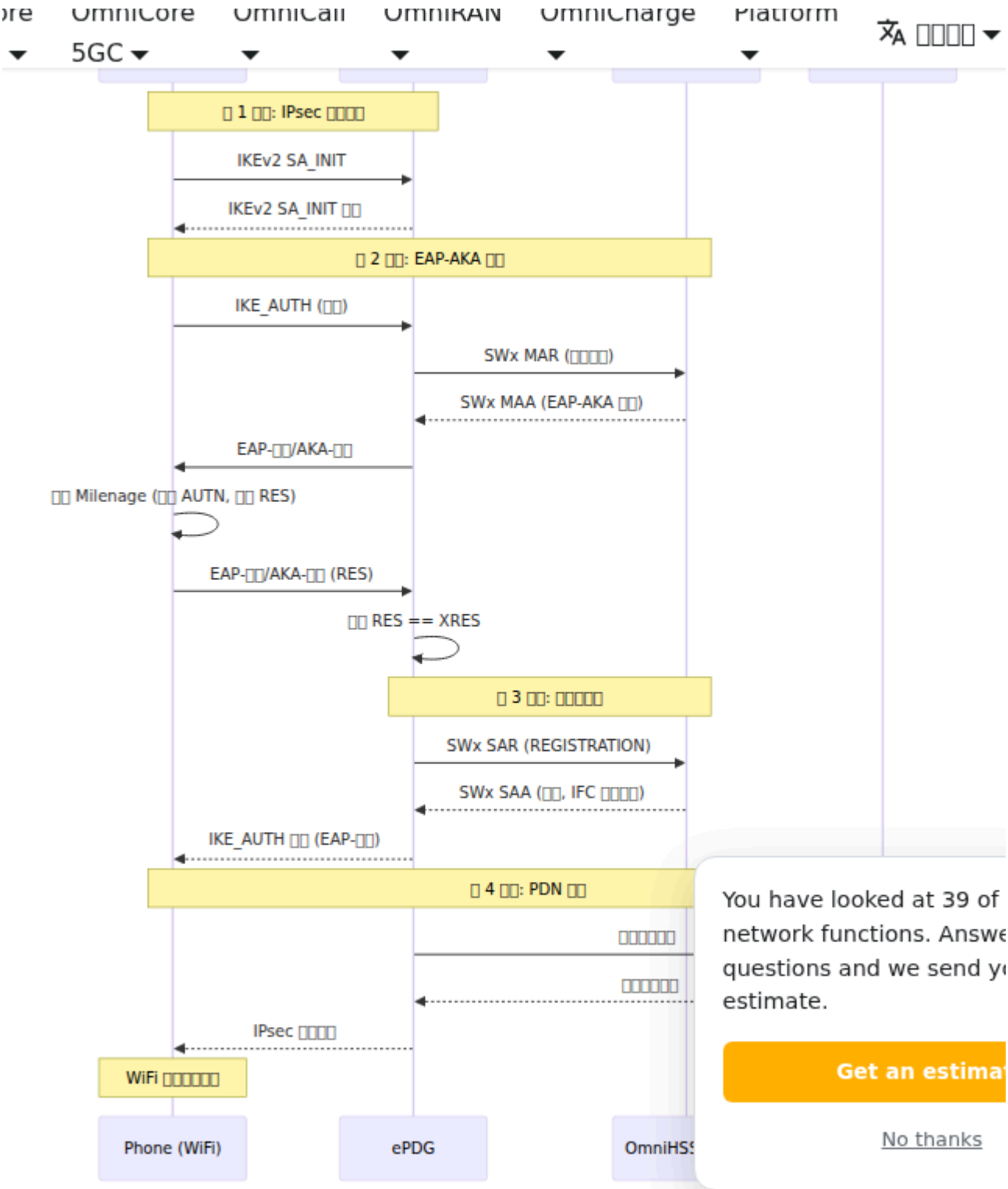
Cx □□□□□

□□	□□	□□	□□
2001	DIAMETER_FIRST_REGISTRATION	□□□□□ S-CSCF□□□□□□□□□□□□	TS 29.229
2002	DIAMETER_SUBSEQUENT_REGISTRATION	□□□□ S-CSCF□ HSS □□□□□□□□	TS 29.229

□□□□□□□□□□□□ (SAR)□

□	□□	**HSS □□**
0	NO_ASSIGNMENT	□□ S-CSCF □□□□□□□
1	REGISTRATION	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
2	RE_REGISTRATION	□□□□□□□□□□□□□□□□
4	TIMEOUT_DEREGISTRATION	□□ S-CSCF □□□□□□□
5	USER_DEREGISTRATION	□□ S-CSCF □□□□□□□
6	TIMEOUT_DEREGISTRATION_STORE_SERVER_NAME	□□□□□□□□ S-CSCF □□□□□□□□
7	USER_DEREGISTRATION_STORE_SERVER_NAME	□□□□□□□□ S-CSCF □□□□□□□□
8	ADMINISTRATIVE_DEREGISTRATION	□□ S-CSCF □□□□□□□
9	AUTHENTICATION_FAILURE	□□□□□□□□□□□□□□□□□□□□

□□ 6 □ 7 □□□□□□□□ S-CSCF □□□□□ TS 29.228 §6.1.2□□□□□□□

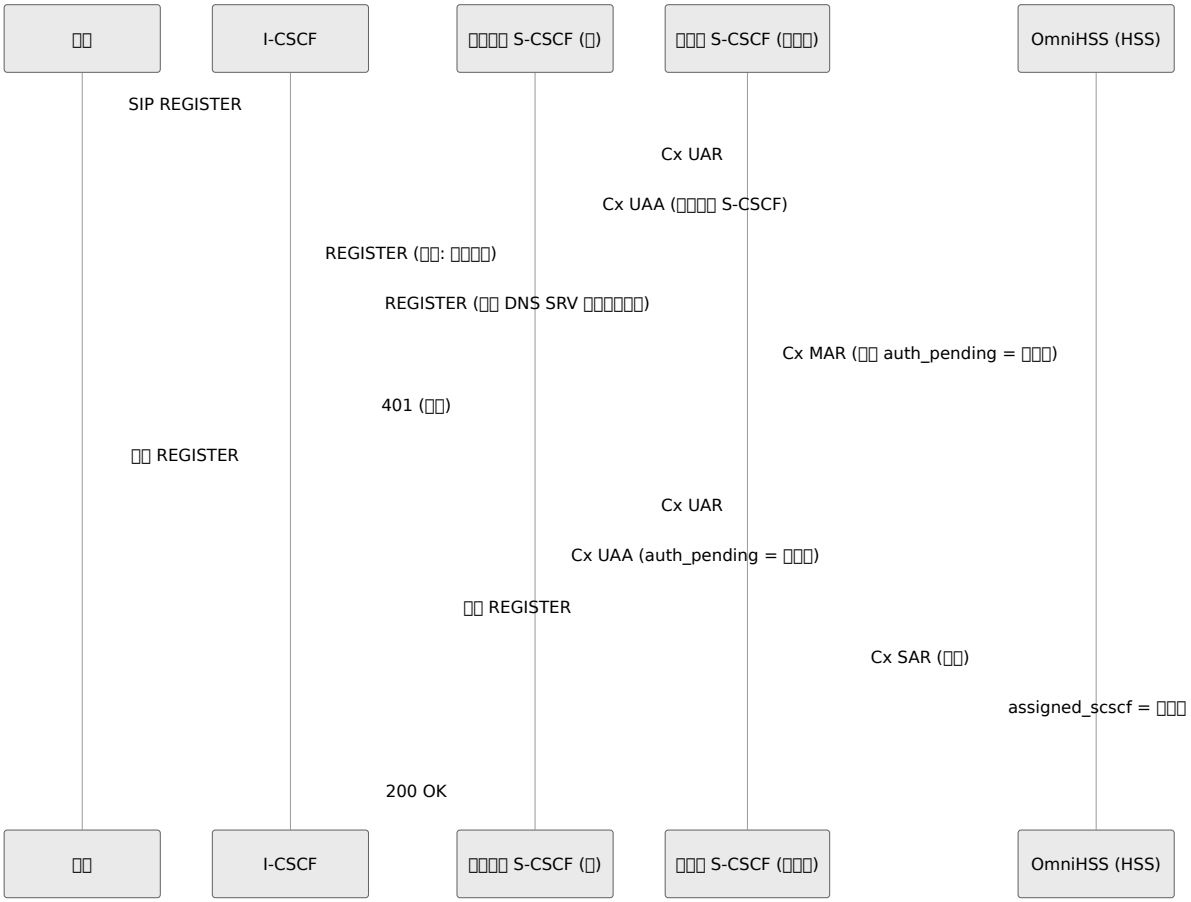


S-CSCF □□□□

□□□□□□□ S-CSCF □□□□□I-CSCF □□ REGISTER □□□□□□ S-CSCF □□□□□□□□ S-CSCF □□□□□□ □□□□□□□□ I-CSCF □□□□□□□ HSS `auth_pending_scscf` □□□□□□□□

□□□□□□□□□

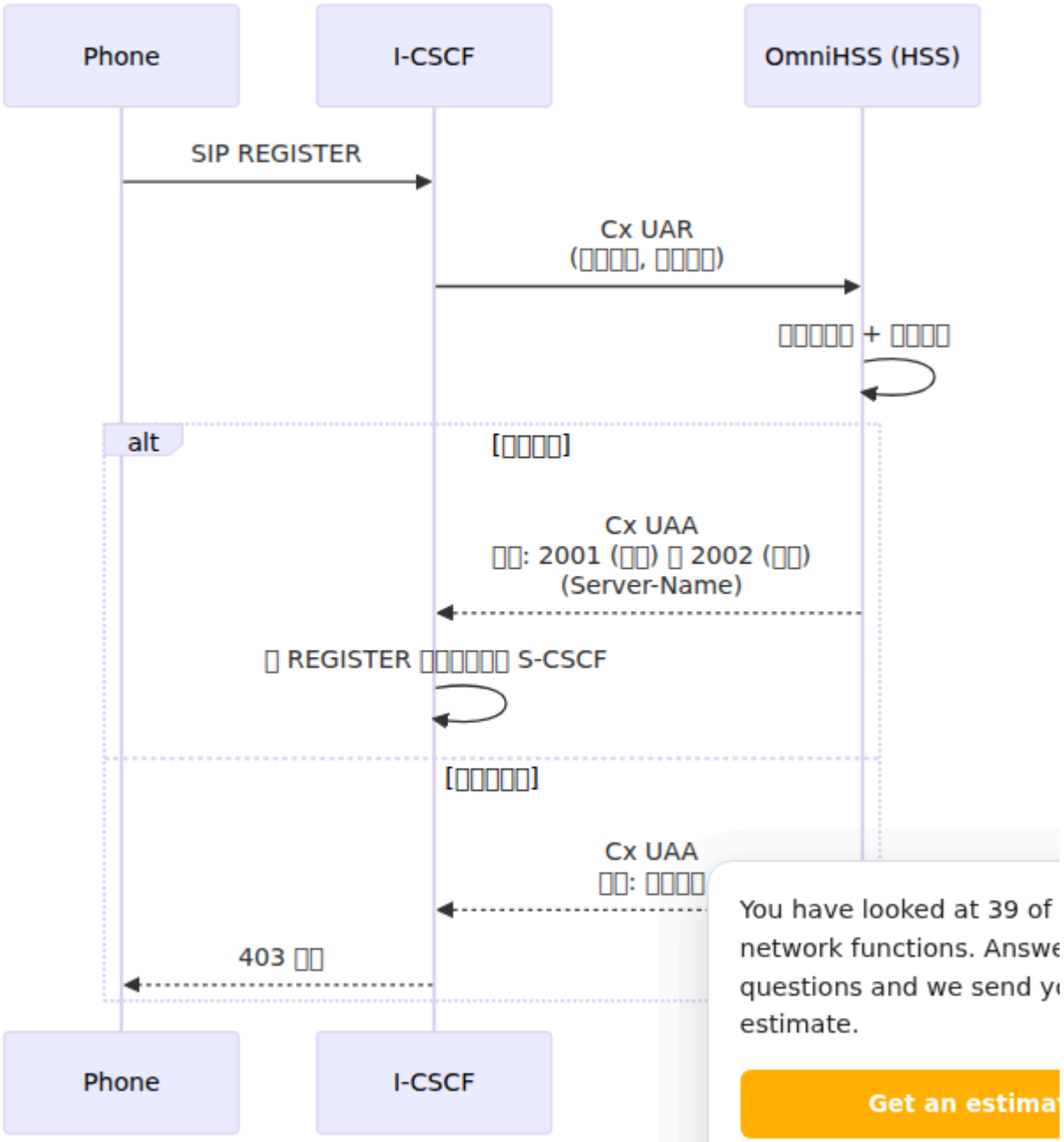
□□□□	□□□□	□□
□□□□□ S-CSCF □□□HSS □□□□ □□□□□□□□	DNS □□ NXDOMAIN□I-CSCF □□□□□□□□□□□	I-CSCF □□□□□□ URI□DNS SRV □□□□□□ □ S-CSCF□
□□□□□ S-CSCF □S-CSCF □□□□ □□	TCP □□□□□□□□□□□□□	I-CSCF □□□□□□□□□□□□ URI□ `use_dst_blocklist` □ `use_dns_failover` □ DNS □□□□□□



□□ REGISTER □□□□□□□□□□□□□□□ S-CSCF□UAA □□ `auth_pending_scscf` □□□□□□□□□□ □□□□□□□□□□ MAR □□HSS □□□□ UAR □□□□□□□□□□□□□□□

□□□□□□□ (LIR/LIA)

I-CSCF □□□□ S-CSCF □□□□□□□□□



Sh □□ (IMS □□□□)

□□□ **Sh RepositoryData (□□□□)** □□□□□□□□□□□□/□□□□□□ **MMTEL □□/IMS-ODB □□** □□□ **REST □□ API**□

□□□□□□□ (UDR/UDA)

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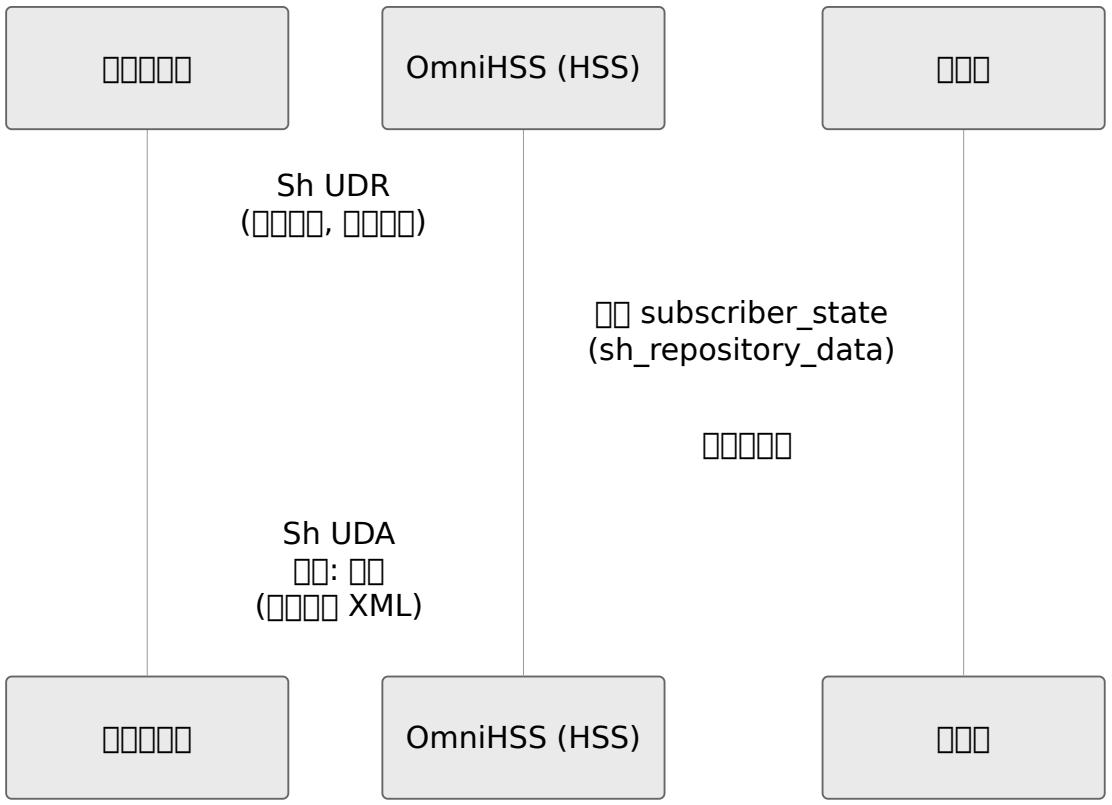

□□□□□□□ (PUR/PUA)

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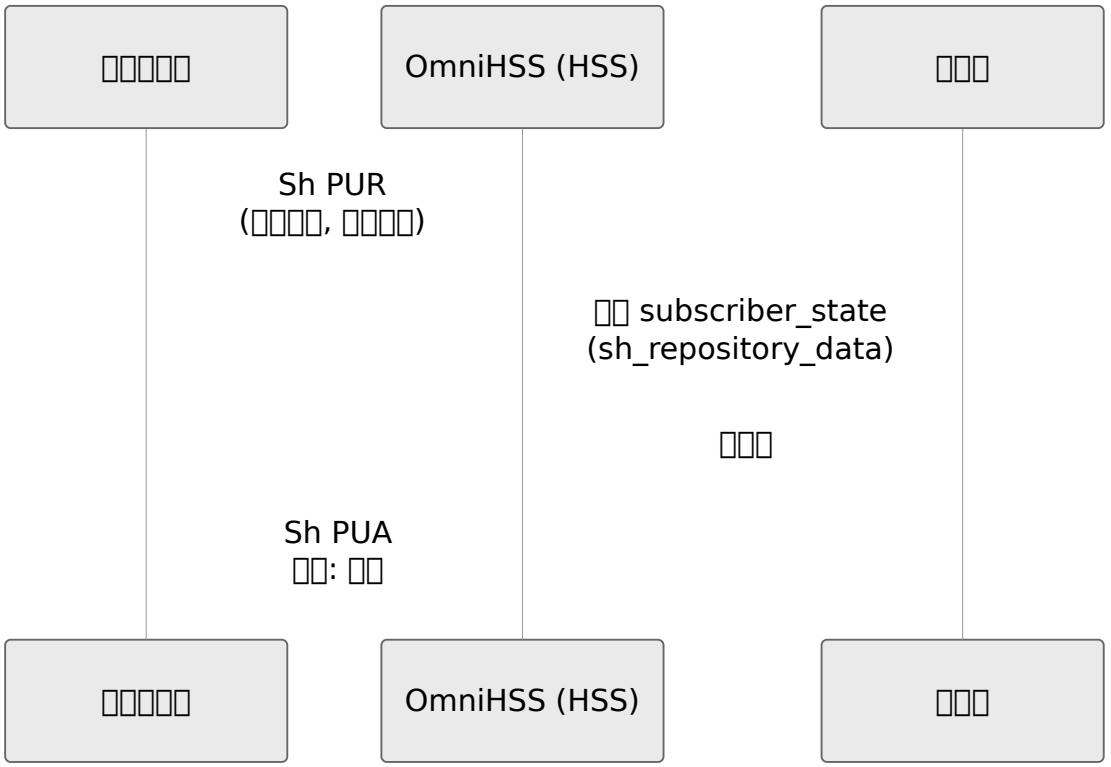
□□□□□□
OmniHSS (HSS)
□□□
Sh PUR
(□□□□□, □□□□□)
□□ subscriber_state
(sh_repository_data)
□□□
Sh PUA
□□: □□
□□□□□□
OmniHSS (HSS)
□□□

□□□□□□□ (SNR/SNA)

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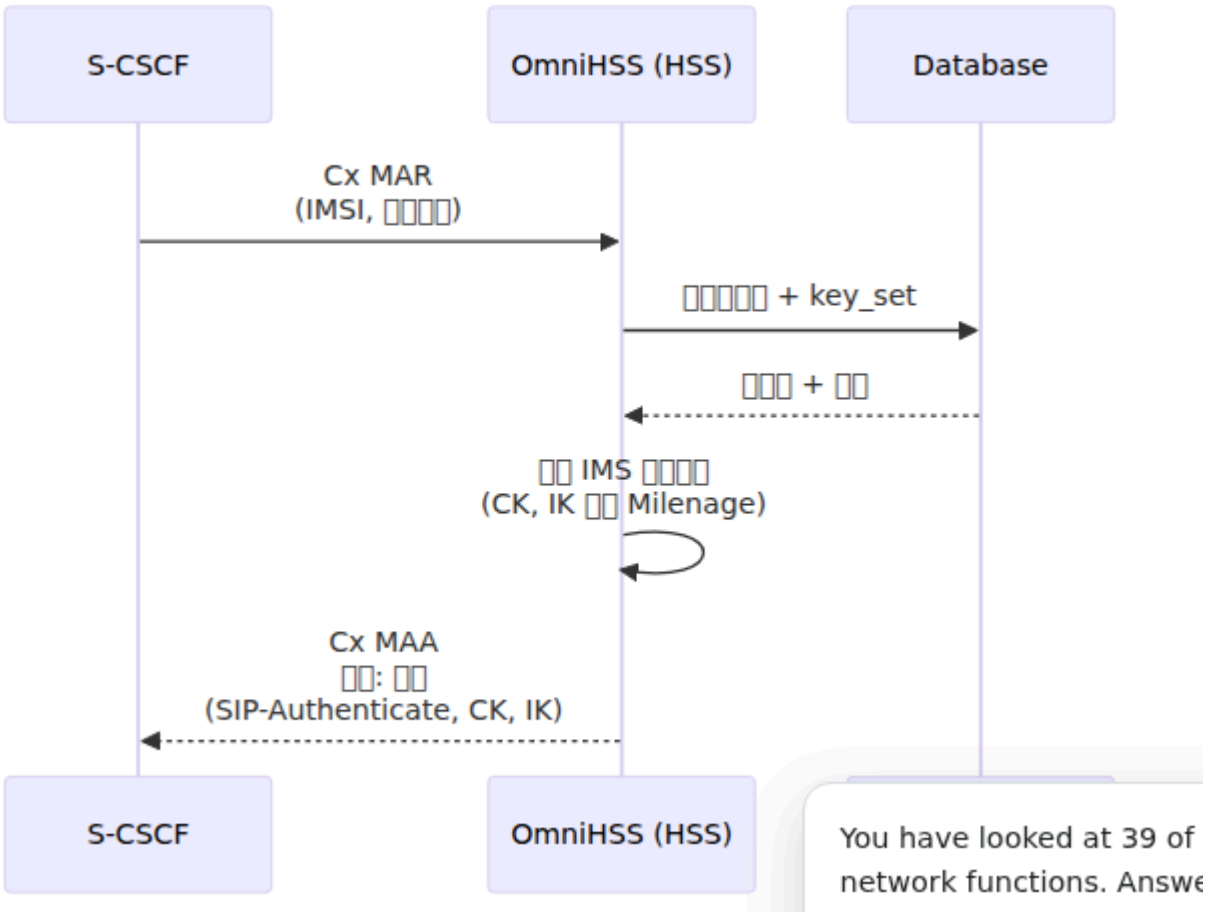


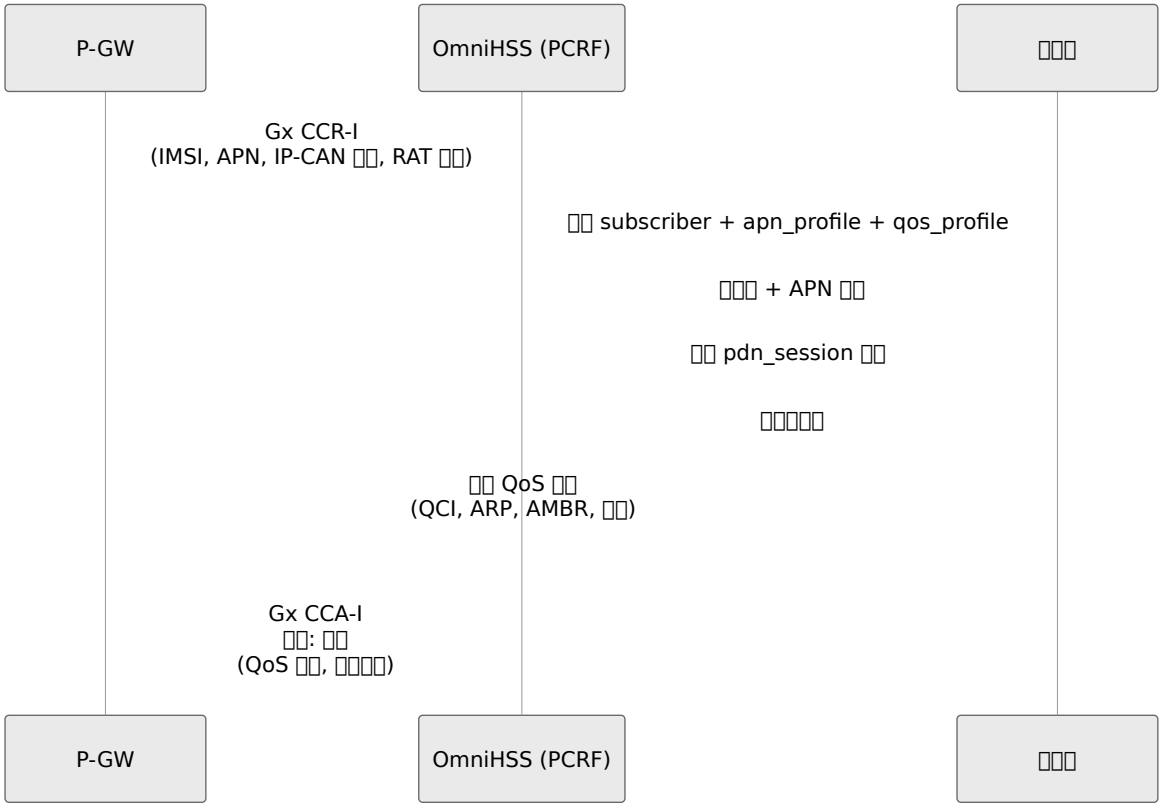
Gx □□ (□□□□)

OmniHSS □□ Gx □□□□ PCRF□□□□□□□□□□□□□□

□□□ **PCRF** □□ □□□□□□□□□□□□□□□ **QoS** □□□

□□□□□□ - □□ (CCR-I/CCA-I)

P-GW □ PDN □□□□□□□□□□□□

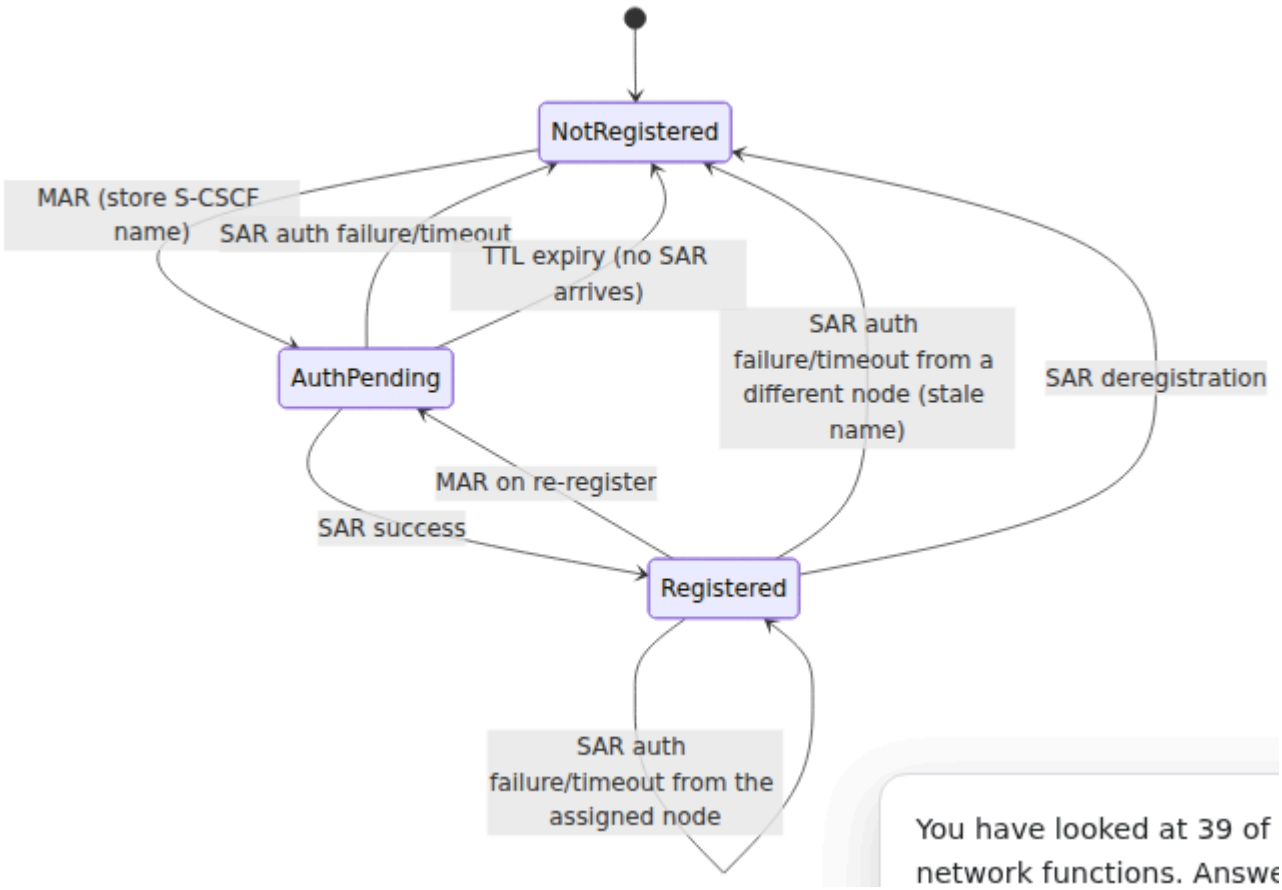


□□ **AVP**□

- □□: Subscription-Id (IMSI), Called-Station-Id (APN), RAT-Type, IP-CAN-Type
- □□: QoS-Information (QCI, ARP, AMBR), Charging-Rule-Install

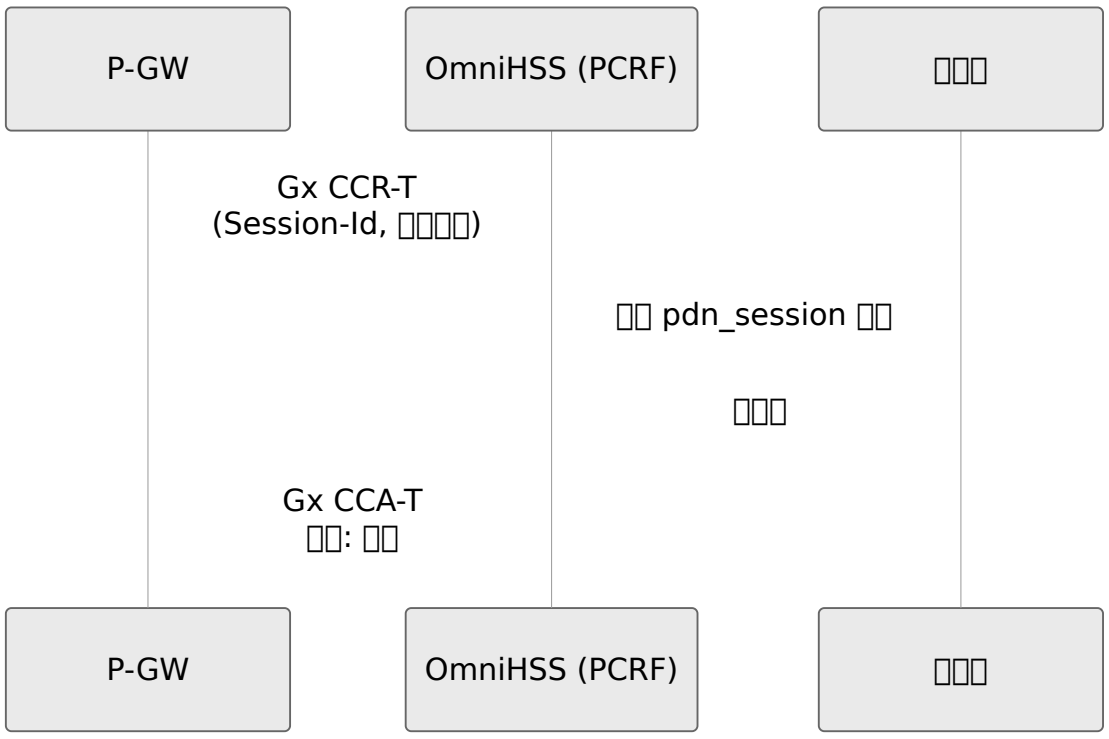
□□□□□□□ - □□ (CCR-U/CCA-U)

P-GW □□□□□□□□



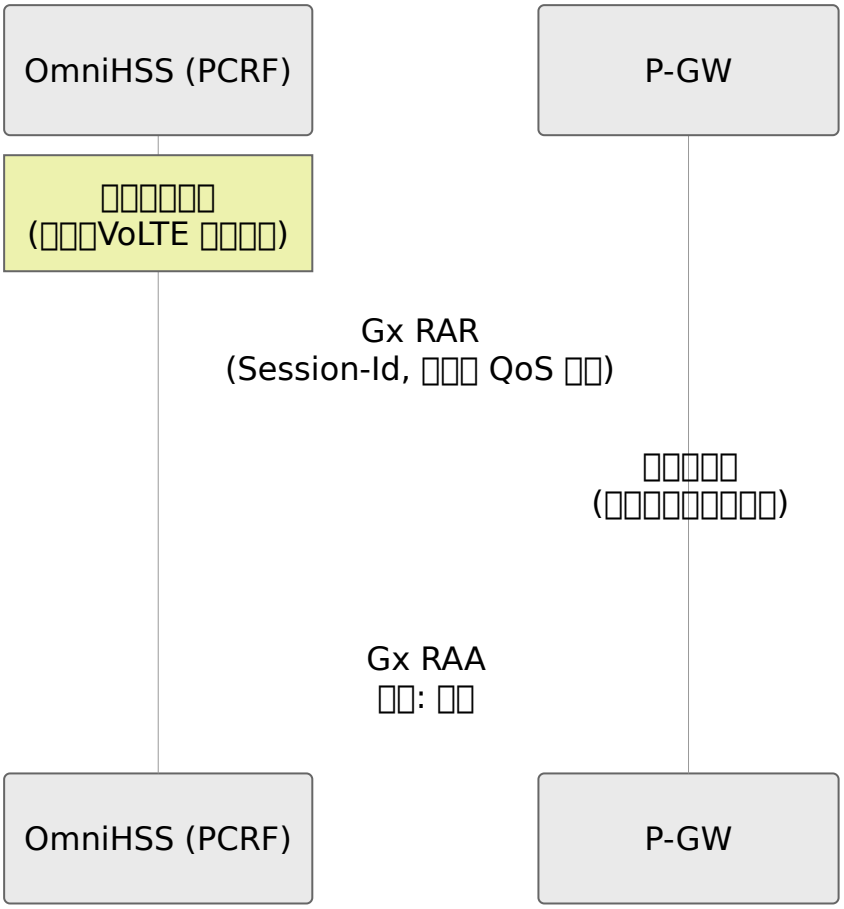
□□□□□□□ - □□ (CCR-T/CCA-T)

P-GW □□ PDN □□□□□



□□□□□□□ (RAR/RAA)

OmniHSS (PCRF) □ P-GW □□□□□□□□



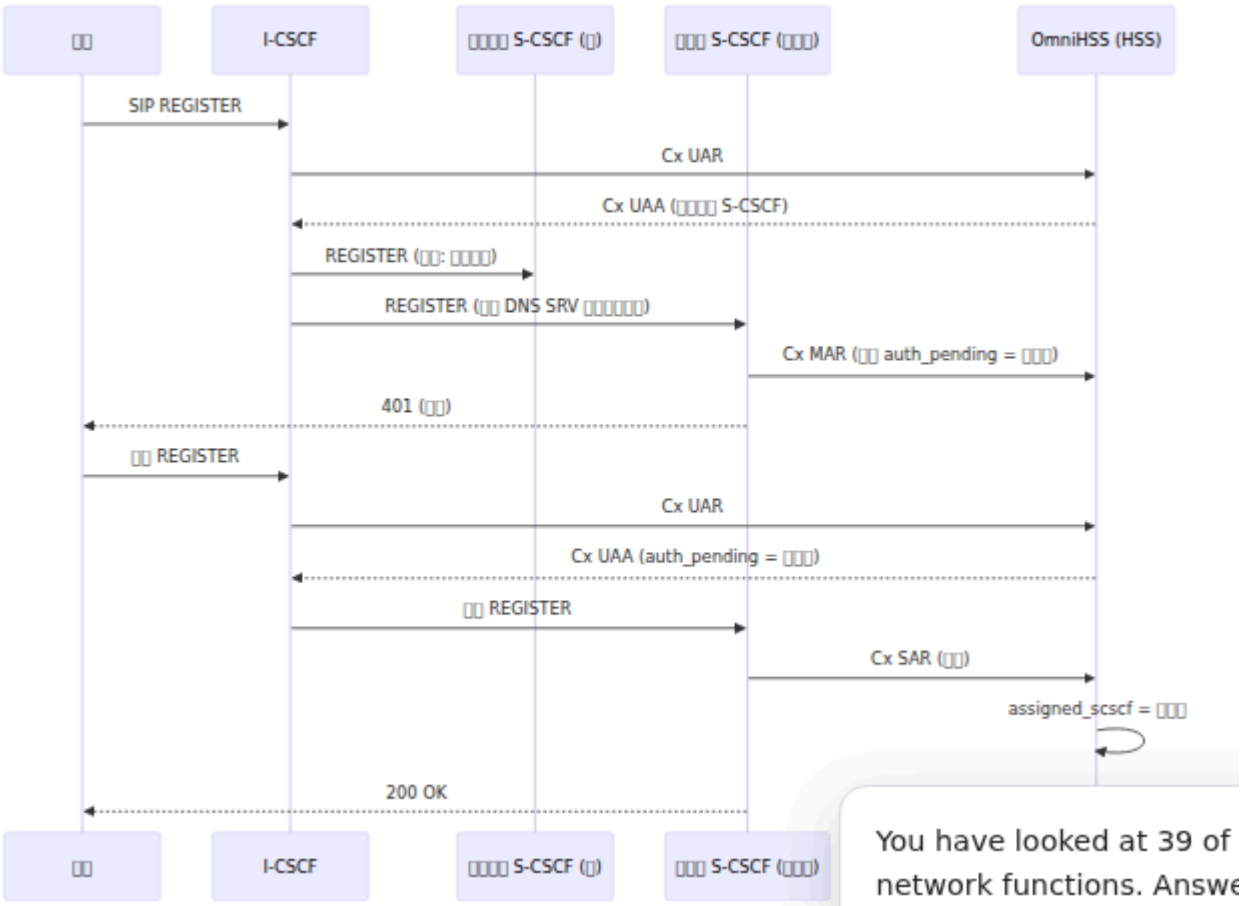
Rx □□ (IMS □□□□)

OmniHSS □□ Rx □□□□ PCRF □□□□□ IMS □□□□□

□□□ **PCRF □□** □□□□□□□ **VoLTE** □□□□□□□□□□□

AA □□ (AAR/AAA)

P-CSCF □□ IMS □□□□□□□□

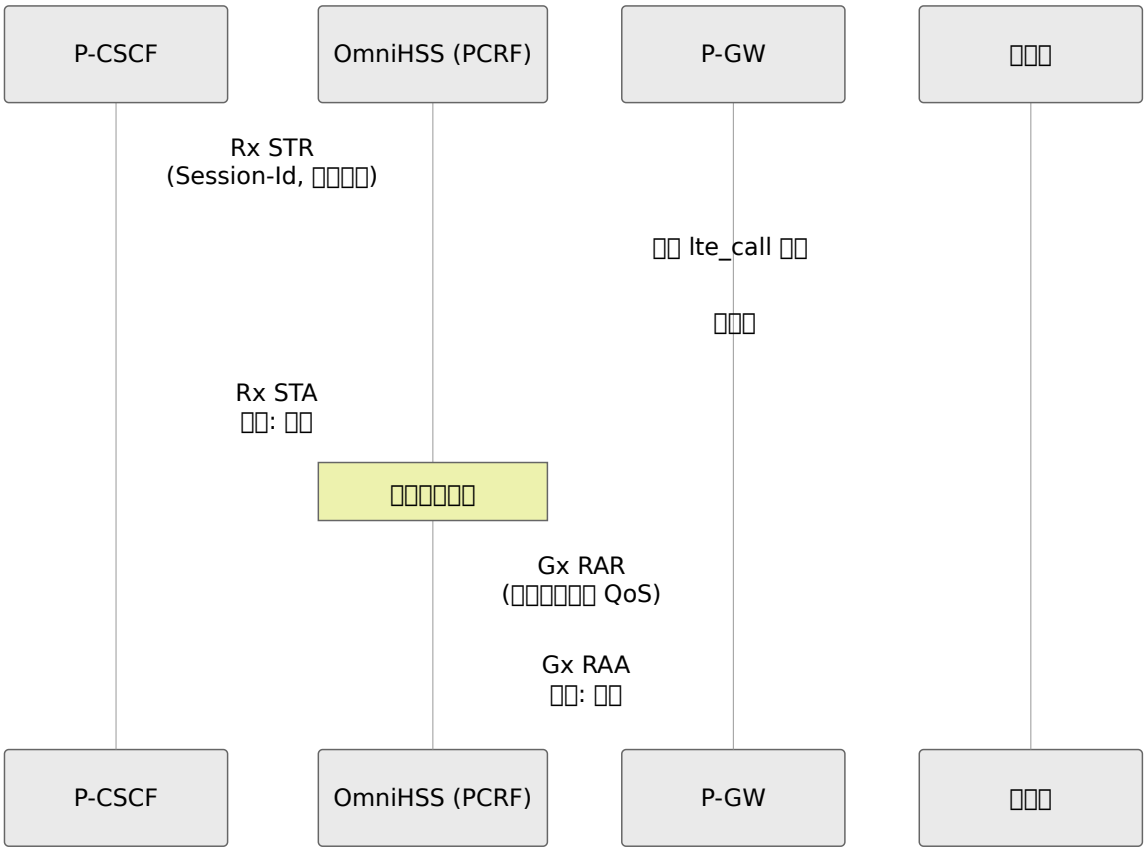


□□□□□

- □□ SDP □□□□□□□□□□□
- □□□□□□□ (□□/□□)
- □□□□□□□ SDF □□□
- □□ Gx RAR □□□□□□□

□□□□□□□ (STR/STA)

P-CSCF □□ IMS □□□□□

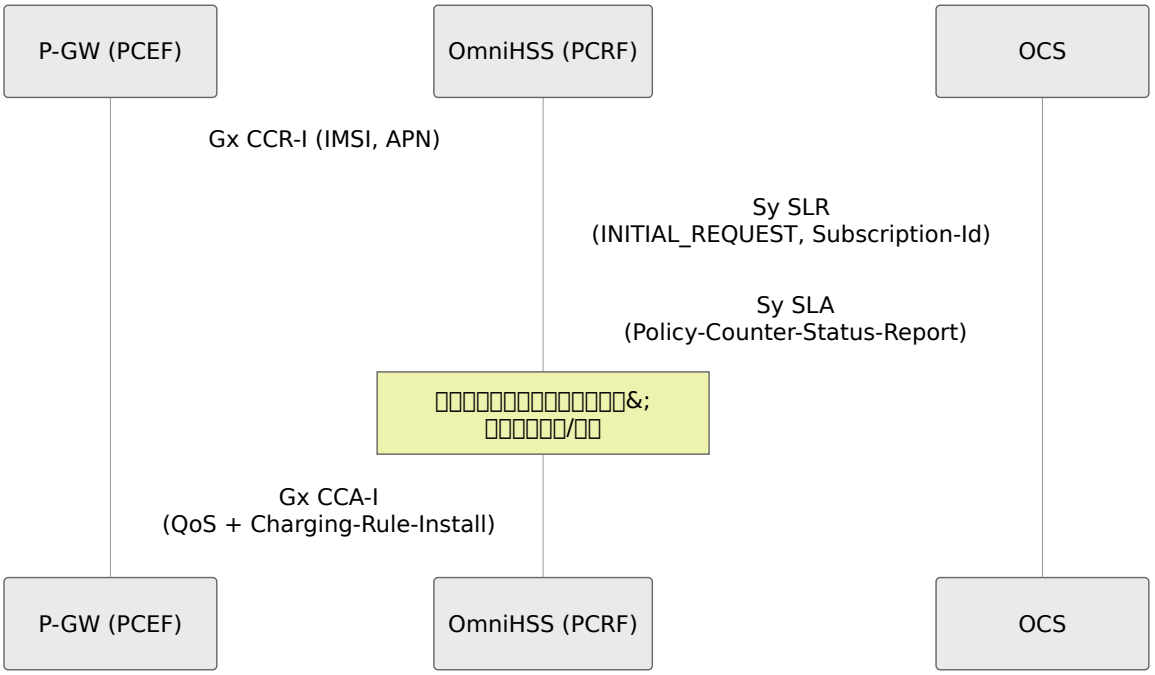


Sy □□ (□□□□□□)

OmniHSS □□ PCRF□□□ Sy □□□□□ OCS□□□□□□□□□□□□□□□□□□□□□□□□ Gx □□□□□□□□□□□ Sy □□□□□□ ID `16777302`□3GPP TS 29.219□□HSS □ Sy □□□□OCS □□□□□□□□ Sy □□ □ □□□□□□□□□□□□□□□□AVP□□□□□

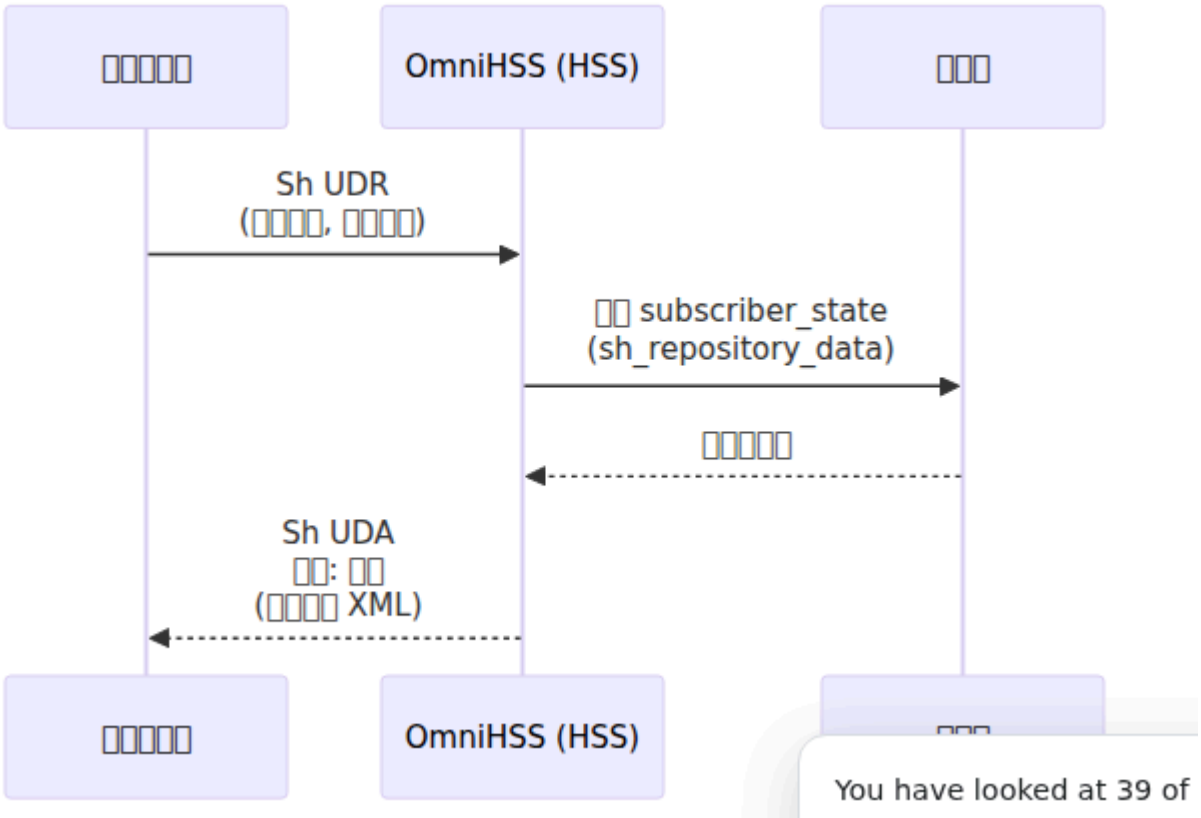
□□□□□□ (SLR/SLA)

PCRF □□□□□□□□ Sy □□□□□ OCS □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□ Gx CCA □□



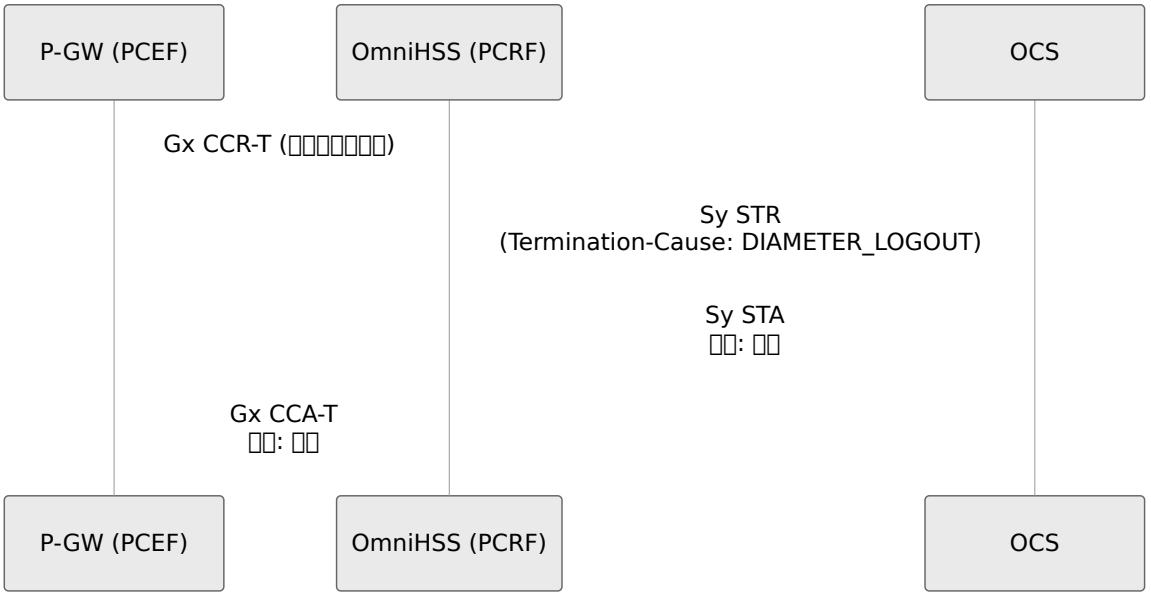
□□□□□□□ (SNR/SNA)

□□□□□□□□□□□□□□□□□□□□□□□□□□□□□OCS □□ PCRF□PCRF □□□□□□□□□ PGW□□□ Gx RAR□



□□□□ (STR/STA)

□□□□□□□□□□□□□□□□□□□□PCRF □□ Sy □□□



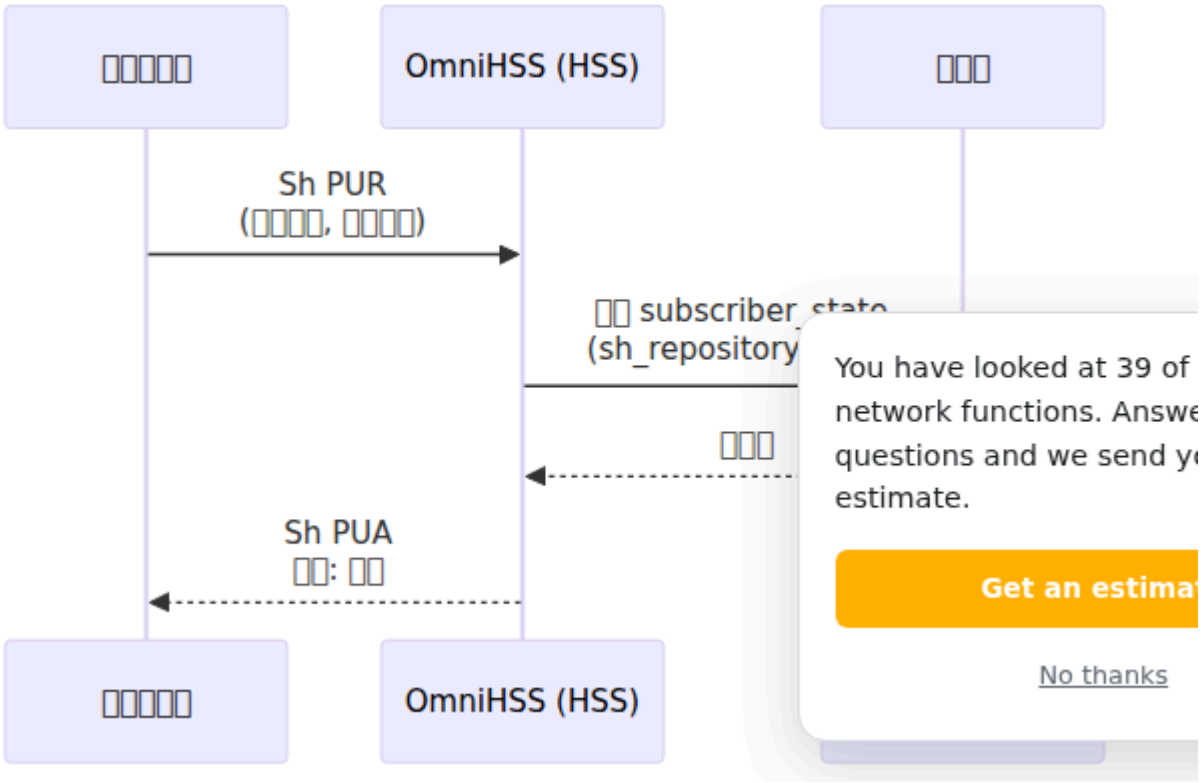
S13 □□ (EIR)

OmniHSS □□ S13 □□□□ EIR□□□□□□□□□□□□

□□□ **EIR** □□ □□□□□□□□□□□□□□**IMEI** □□□□□□□□□ □□□□□□

ME □□□□□□ (ECR/ECA)

□□ EIR □□□□□ MME□□□□□□□□



□□□□□□□

- □□□ **(0)** - □□□□
- □□□ **(1)** - □□□□□
- □□□ **(2)** - □□□□□□□□□

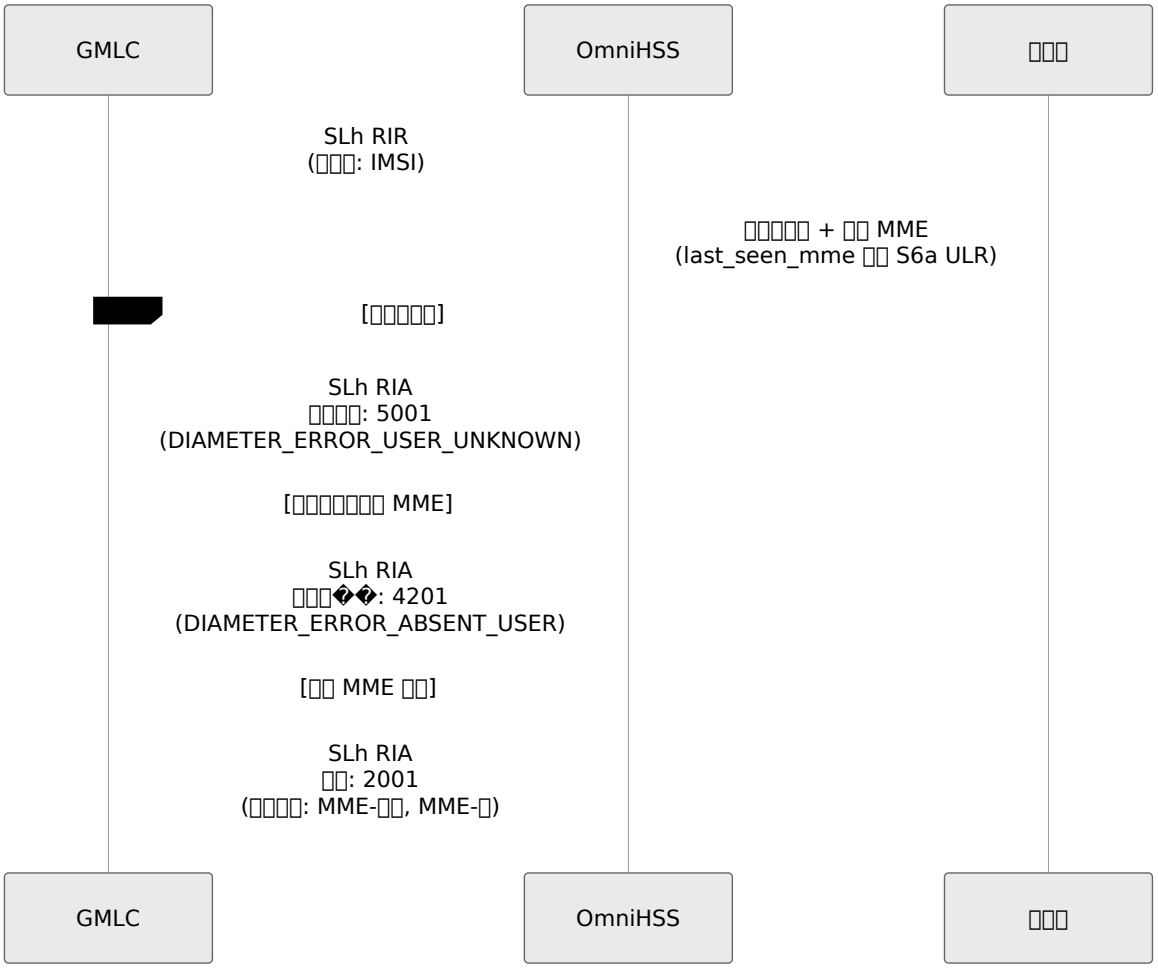
□□□□□□ IMSI □□□□□□□□□□□□□□□□□ `unknown_equipment_behaviour` □ `:reject_unknown_equipment`□□ ECA □□□□□□□□□ 5422 (DIAMETER_ERROR_EQUIPMENT_UNKNOWN)□□□□□□□□□

SLh □□ (LCS / □□□□)

OmniHSS □□ SLh `LCS-Routing-Info-Request` (RIR)□□□ GMLC □□□□□ SLg □□□□□□ □□□□□□□□□□□□□□ MME□□□ MME □□ S6a □□□□□□□□□□□□□SLh □□□□□□ ID `16777291` □3GPP TS 29.173□□

LCS □□□□□□ (RIR/RIA)

GMLC □□□□□□□□□□



□□□

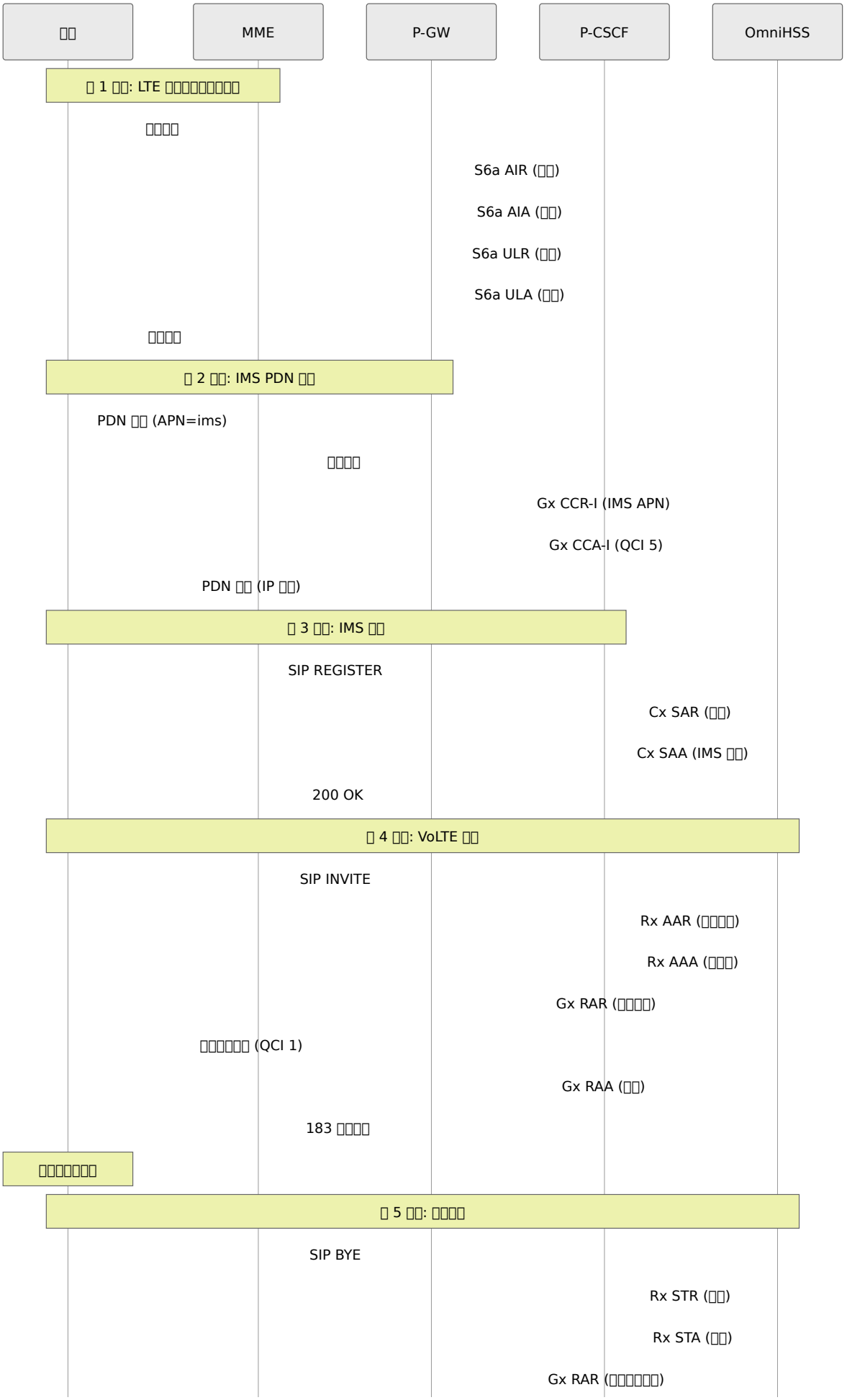
- IMSI □□ `□□□`□MSISDN □□□□□□□□
- □□□ `□□□□` □□ S6a AIR/ULR □□□□□□□□□□ `MME-□□`/`MME-□` □`subscriber_state.last_seen_mme` / `last_seen_realm`□ - □□□□□□□□□
- GMLC □□□□□□ RIA □□□ SLg Provide-Location-Request □□□□ MME□

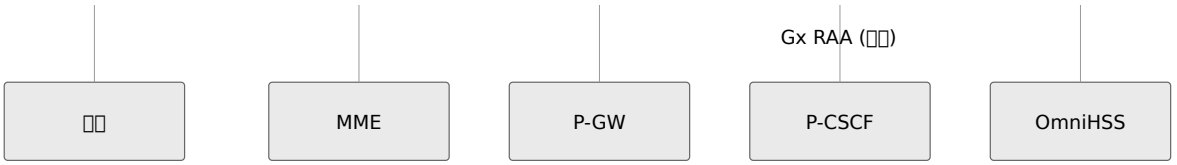
□□□□□

- **2001** - □□□□□ `□□□□`□
- **5001** - `DIAMETER_ERROR_USER_UNKNOWN`□IMSI/MSISDN □□□□
- **4201** - `DIAMETER_ERROR_ABSENT_USER`□□□□□□□□□□□□□□□ MME□□□□□□□□□□□□ □□□

□□□□□□□□VoLTE □□

□□□ VoLTE □□□□□□□□□□□□□□


UE
MME
P-GW
P-CSCF
OmniHSS
第 1 阶段: LTE 附着和默认承载
附着请求
S6a AIR (请求)
S6a AIA (响应)
S6a ULR (请求)
S6a ULA (响应)
附着接受
第 2 阶段: IMS PDN 连接
PDN 连接 (APN=ims)
创建会话
Gx CCR-I (IMS APN)
Gx CCA-I (QCI 5)
PDN 连接 (IP 分配)
第 3 阶段: IMS 注册
SIP REGISTER
Cx SAR (请求)
Cx SAA (IMS 用户)
200 OK
第 4 阶段: VoLTE 呼叫
SIP INVITE
Rx AAR (媒体请求)
Rx AAA (已接受)
Gx RAR (专用承载)
专用承载激活 (QCI 1)
Gx RAA (确认)
183 会话进度
被叫振铃并接听
第 5 阶段: 呼叫释放
SIP BYE
Rx STR (请求)
Rx STA (确认)
Gx RAR (释放专用承载)

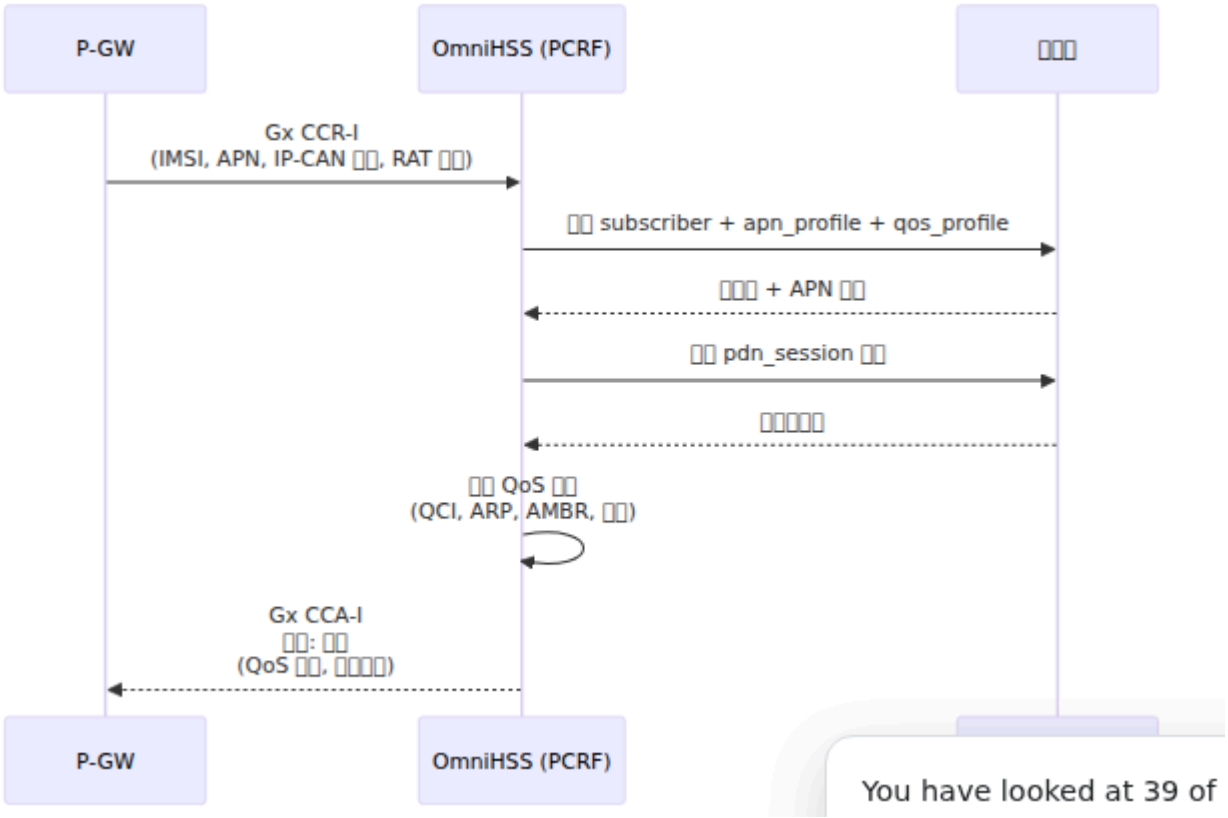


Zh □□□□□□□□□□

Zh □□□□□□□□□□□□□□BSF□□□□ HSS□□□□□□□□□□GBA□□□□□□□□□□□□□□□□□□

□□□□□□□□MAR/MAA□

BSF □□ GBA □□□□□□□□□□



□□ AVP:

- □□: □□□ (IMPI), Public-Identity, SIP-Auth-Data-Item (□□□□), □□□
- □□: SIP-Auth-Data-Item (SIP-Authenticate, SIP-Authorization, Confidentiality-Key, Integrity-Key), GBA-UserSecSettings

GBA □□:

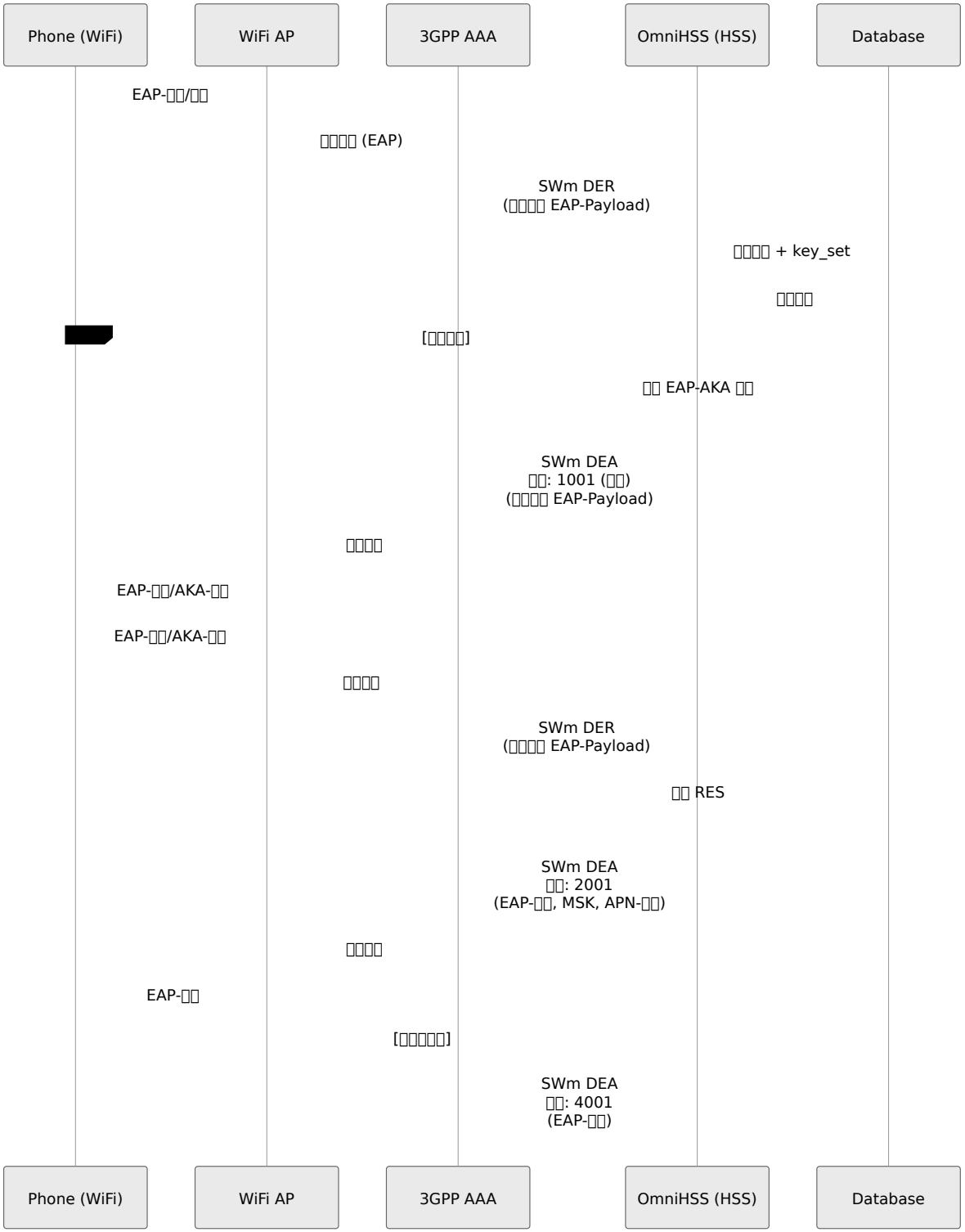
□□□□	□□
MBMS	□□□□□□□□□□□□□
HTTPS	□□ GBA □□□□□
NAF	□□□□□□□□□□
Presence	□□□□□□□□□

SWm □□□□□□□□□ 3GPP □□□

SWm □□□□□ 3GPP AAA □□□□□□ HSS□□□□□□□□ 3GPP □□□□□□□□□□ ePDG □ WiFi□□□ EAP-AKA □□□

Diameter-EAP-□□□DER/DEA□

WiFi □□□ EAP □□□□□

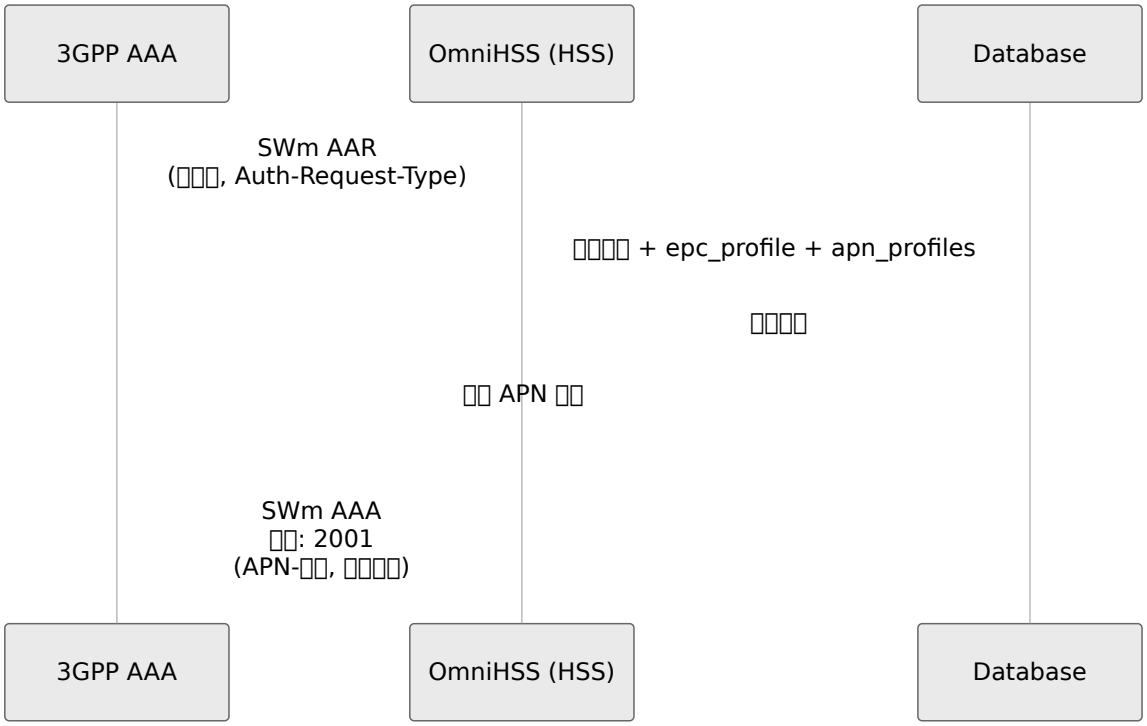


□□ AVP:

- □□: □□ ID, Auth-Application-Id, EAP-Payload, Auth-Request-Type, □□□□□□□□
- □□: EAP-Payload, EAP-□□□□□ (MSK), APN-□□, □□□□

AA-□□□AAR/AAA□

□□ EAP □□□□□□□□

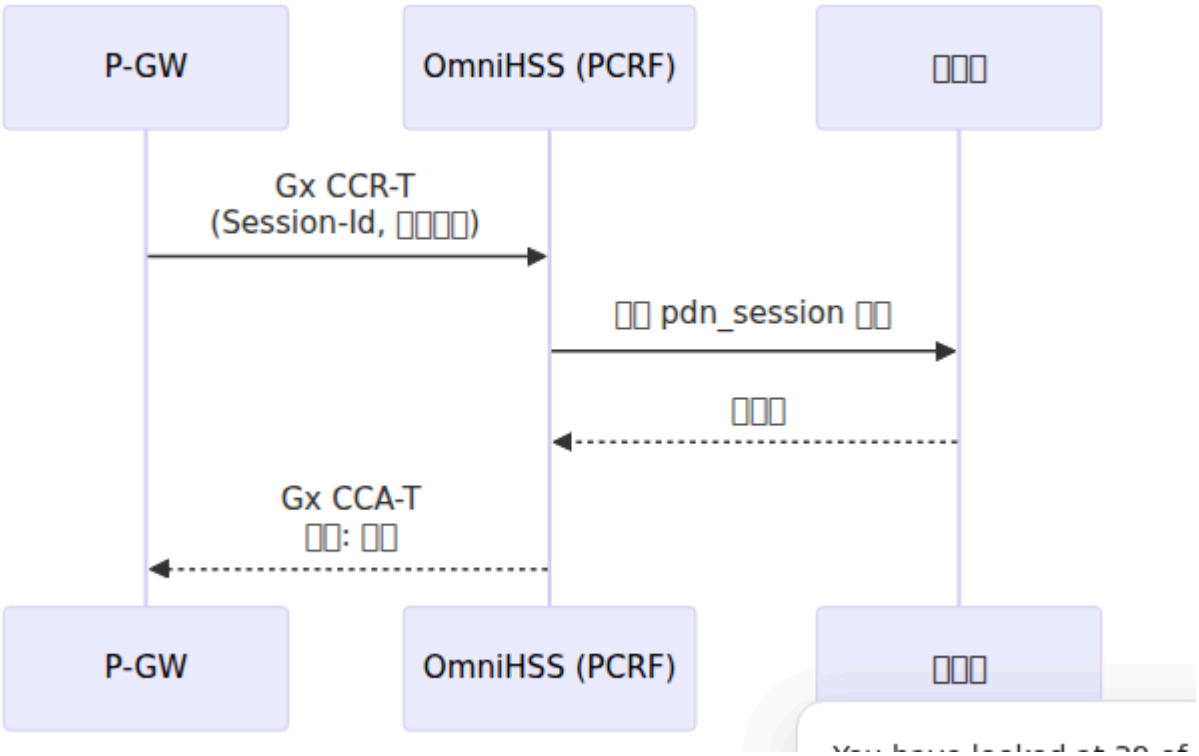


□□ **AVP:**

- □□: □□ ID, Auth-Application-Id, □□□, Auth-Request-Type, AAR-□□
- □□: APN-□□, 3GPP-□□□□, □□□□

□□□□□□□□STR/STA□

WiFi □□□□□□□□



□□□□:

□□	□	□□
DIAMETER_LOGOUT	1	□□□□
DIAMETER_SERVICE_NOT_PROVIDED	2	□□□□□
DIAMETER_BAD_ANSWER	3	□□□□
DIAMETER_ADMINISTRATIVE	4	□□□□□
DIAMETER_LINK_BROKEN	5	□□□□
DIAMETER_AUTH_EXPIRED	6	□□□□
DIAMETER_USER_MOVED	7	□□□□□□□□□
DIAMETER_SESSION_TIMEOUT	8	□□□□

□□□□□□□□

□□□□□S6a AIR□

□□:

1. □□□□□□□□□Ki, OPC, AMF□
2. SQN □□□□□□□□□□□
3. □□□□□□□□□□

□□□□□□□S6a ULR□

□□:

1. EPC □□□□□□□□□□□ APN
2. □□□□□□□□
3. MME □□□□□□

IMS □□□□□Cx SAR□

□□:

1. IMS □□□□□□□□□□
2. IFC □□□□ XML
3. S-CSCF □□□□□
4. □□□□□□□□□□□□□□ MSISDN

PDN □□□□□Gx CCR-I□

□□:

1. APN □ EPC □□□□□ APN □□□□□
2. APN QoS □□□□□□□
3. PDN □□□□□□□□□□□□□□

← □□□□□□

OmniHSS □□□□

← □□□□□□

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OmniHSS □□□□□□

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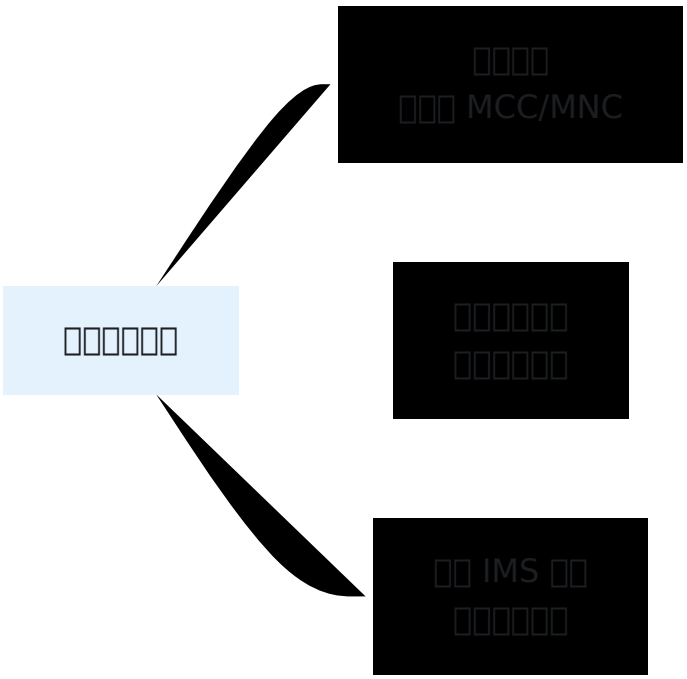

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□□□□□□□□□□□□MCC/MNC □□□□□□□□□□

□□:

- `name` - □□□□□□
- `mcc` - □□□□□□□□3 □□□□
- `mnc` - □□□□□□□□2-3 □□□□
- `data_action` - "allow" □ "deny"
- `ims_action` - "allow" □ "deny"

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□□□□□□□□□□□□□□□□

□□:

- `name` - □□□□□□
- `data_action_if_no_rules_match` - "allow" □ "deny"
- `ims_action_if_no_rules_match` - "allow" □ "deny"

□□□□

□□□□□□

```
# □□□□□□□□□□□□□□□□
curl -k -X POST https://hss.example.com:8443/api/roaming/profile \
  -H "Content-Type: application/json" \
  -d '{
    "roaming_profile": {
      "name": "□□□□",
      "data_action_if_no_rules_match": "allow",
      "ims_action_if_no_rules_match": "allow",
      "roaming_rules": []
    }
  }'
```

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```
# □□□□□□□□□□□□□□□□
curl -k -X POST https://hss.example.com:8443/api/roaming/profile \
  -H "Content-Type: application/json" \
  -d '{
    "roaming_profile": {
      "name": "□□□□□",
      "data_action_if_no_rules_match": "deny",
      "ims_action_if_no_rules_match": "deny",
      "roaming_rules": []
    }
  }'
```

□□□□□□□□□□□

```
# □□ AT&T □□
RULE1=$(curl -k -X POST
https://hss.example.com:8443/api/roaming/rule \
  -H "Content-Type: application/json" \
  -d '{
    "roaming_rule": {
      "name": "□□ AT&T",
      "mcc": "310",
      "mnc": "410",
      "data_action": "allow",
      "ims_action": "allow"
    }
  }' | jq -r '.response.id')

# □□ Verizon □□
RULE2=$(curl -k -X POST
https://hss.example.com:8443/api/roaming/rule \
  -H "Content-Type: application/json" \
  -d '{
    "roaming_rule": {
      "name": "□□ Verizon",
      "mcc": "311",
      "mnc": "480",
      "data_action": "allow",
      "ims_action": "allow"
    }
  }' | jq -r '.response.id')

# □□□□□□□□□□□□□□□□□□□□
curl -k -X POST https://hss.example.com:8443/api/roaming/profile \
  -H "Content-Type: application/json" \
  -d "{
    \"roaming_profile\": {
      \"name\": \"□□□□□□□□\",
      \"data_action_if_no_rules_match\": \"deny\",
      \"ims_action_if_no_rules_match\": \"deny\",
      \"roaming_rules\": [$RULE1, $RULE2]
    }
  }"
```

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```
# □□□□□□□□□□ IMS □□□
curl -k -X POST https://hss.example.com:8443/api/roaming/rule \
  -H "Content-Type: application/json" \
  -d '{
    "roaming_rule": {
      "name": "□□□□ - T-Mobile",
      "mcc": "310",
      "mnc": "260",
      "data_action": "allow",
      "ims_action": "deny"
    }
  }'
```

□□□□□□□□□□□

```
# □□□□□□□□□□□□
RULE=$(curl -k -X POST
https://hss.example.com:8443/api/roaming/rule \
  -H "Content-Type: application/json" \
  -d '{
    "roaming_rule": {
      "name": "□□□□□□□",
      "mcc": "206",
      "mnc": "01",
      "data_action": "deny",
      "ims_action": "deny"
    }
  }' | jq -r '.response.id')

# □□□□□□□□□□□□
curl -k -X POST https://hss.example.com:8443/api/roaming/profile \
  -H "Content-Type: application/json" \
  -d "{
    \"roaming_profile\": {
      \"name\": \"□□□□□□□\",
      \"data_action_if_no_rules_match\": \"allow\",
      \"ims_action_if_no_rules_match\": \"allow\",
      \"roaming_rules\": [$RULE]
    }
  }"
```

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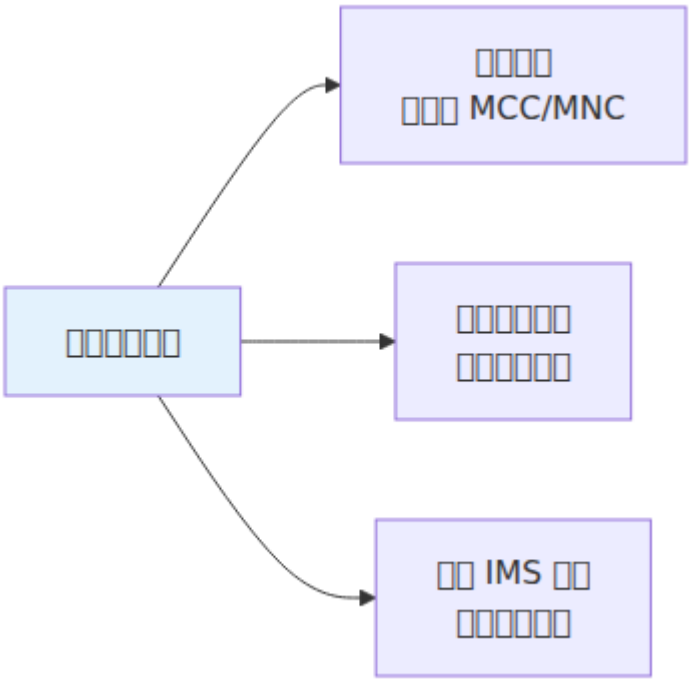

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- □□□□□□□□□□□ MCC □□□310, 311, 312, 313, 314, 315, 316□

□□ 2□□□□□□□□□

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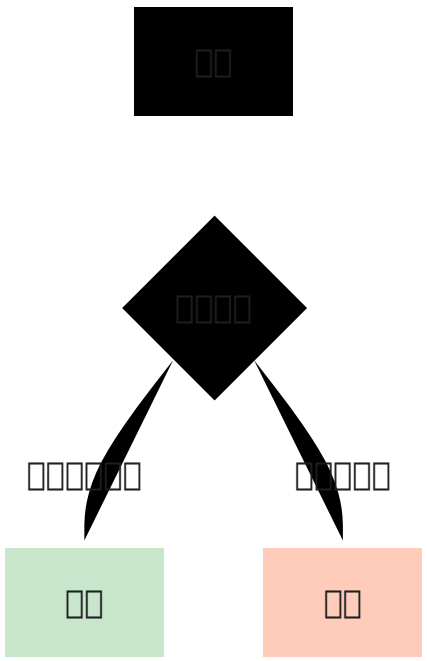

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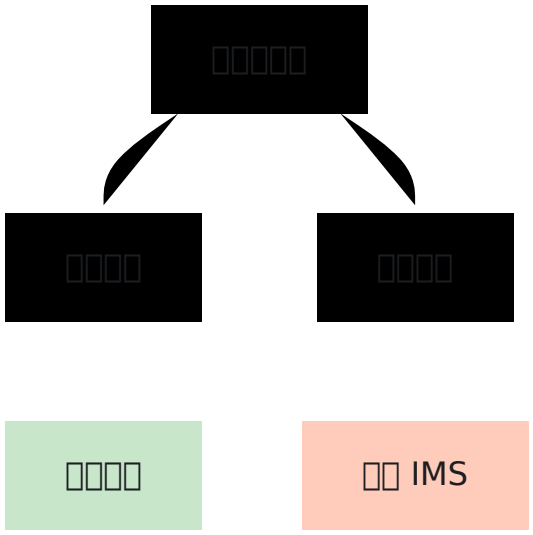
- □□□□□□□□□□□□□□□□□□□□ MCC/MNC□

□□ 3□□□□□□□□□□□

□□□□□□□□□□□□□□□□□□□□ WiFi □□□□□□□□



□□:

- □□□`data_action: "allow"`□`ims_action: "deny"`

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□□□ □□□□□□□□□ MME/□□□□□□□□OmniHSS □□□□□□□□□□□□□□

MCC/MNC □□

□□□□□□□□MCC□

MCC	□□	□□
310-316	□□	AT&T, Verizon, T-Mobile □
302	□□□	Rogers, Bell, Telus
234-235	□□	Vodafone, O2, EE
262	□□	Deutsche Telekom, Vodafone
208	□□	Orange, SFR, Bouygues
222	□□□	TIM, Vodafone, Wind
214	□□□	Movistar, Vodafone

□□□□□□□□MCC 310-316□

MCC	MNC	□□□
310	410	AT&T
311	480	Verizon
310	260	T-Mobile
310	120	Sprint
313	380	□□□□□□□□

□□□□□ □□□ ITU-T E.212 □ MCC/MNC □□□

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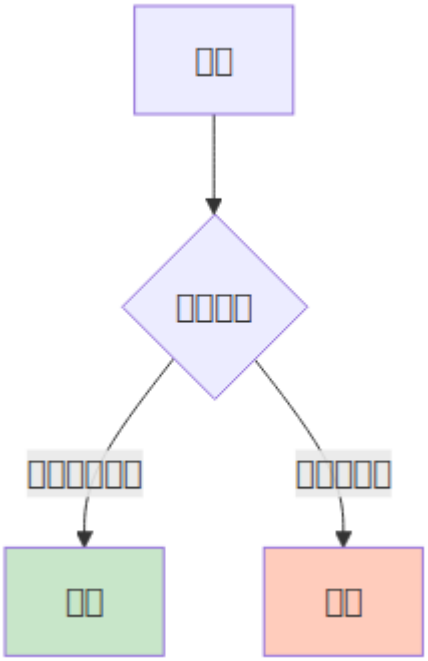

Cx □□□IMS□

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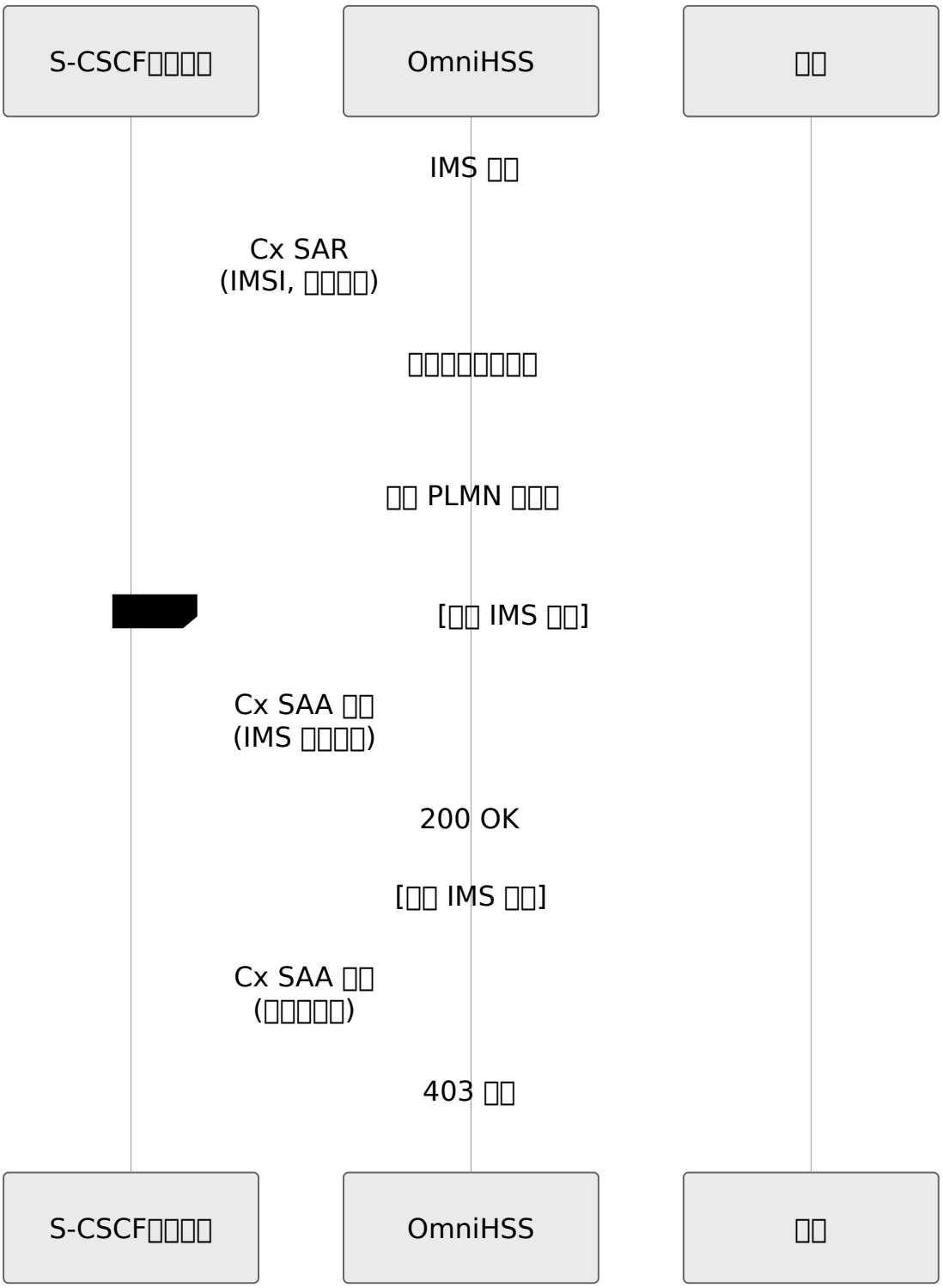
S-CSCF□□□□
OmniHSS
□□
IMS □□
Cx SAR
(IMSI, □□□□)
□□□□□□□□□
□□ PLMN □□□
[□□ IMS □□]
Cx SAA □□
(IMS □□□□)
200 OK
[□□ IMS □□]
Cx SAA □□
(□□□□□)
403 □□
S-CSCF□□□□
OmniHSS
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- □□□□□□□□□□□□□□□□ MCC/MNC □□□□□□□
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- □□□□□□□□ data_action □

□□□□□□□□□□□ IMS

□□□□ **IMS** □□:

- □□□□□□□□□□□
- □□ data_action □ ims_action □
- □□□□□□□□ IMS □□□□□□

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```
[info] □□□□: IMSI 001001123456789, □□ PLMN 310-410
[info] □□□□□□□: "□□ AT&T"
[info] □□□□: □□, IMS □□: □□
```

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4. □□□□□ - □□□□□□□□□□□□□□□

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1. □□□□□□□□ - "Allow-ATT-Data-Only" □□□ "Rule1"
2. □□ **MCC/MNC** - □□□□□□□□□□□□□□□
3. □□□□□□□ - □□□□□□□□ IMS
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Sh RepositoryData (□□□□)

OmniHSS □□□□□□□□ □□□□□□□□□□□□□□□ (AS) □ Sh □□ □□□□□□□□□□□□□□□ **MMTEL-Services**□□□□□□/□□□□□□□□□□□□OIP/OIR□□□□□□ **IMS-ODB-Information**□□□□□□□□□□□□□□□□ AS □□□□□ HSS □□□□□□□□□□□□□

“□□”□ 3GPP TS 29.328 □□□□□□□□□HSS □ □□□□□□ □□□□□□□ □□□□□□□□□□□□ AS □□□□□□□ XML□OmniHSS □ □□□□ □□□□□□□□□ `ServiceData` □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□AS □□□□□□□ etags □□□□□□□□ XCAP/MMTel□□□□□□□□□□

□□□□□□□□□□□□ REST Provisioning API □□□□/CRM □□□□□□□□□□□

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- Sh □□□□
- SequenceNumber □□□□
- REST Provisioning API
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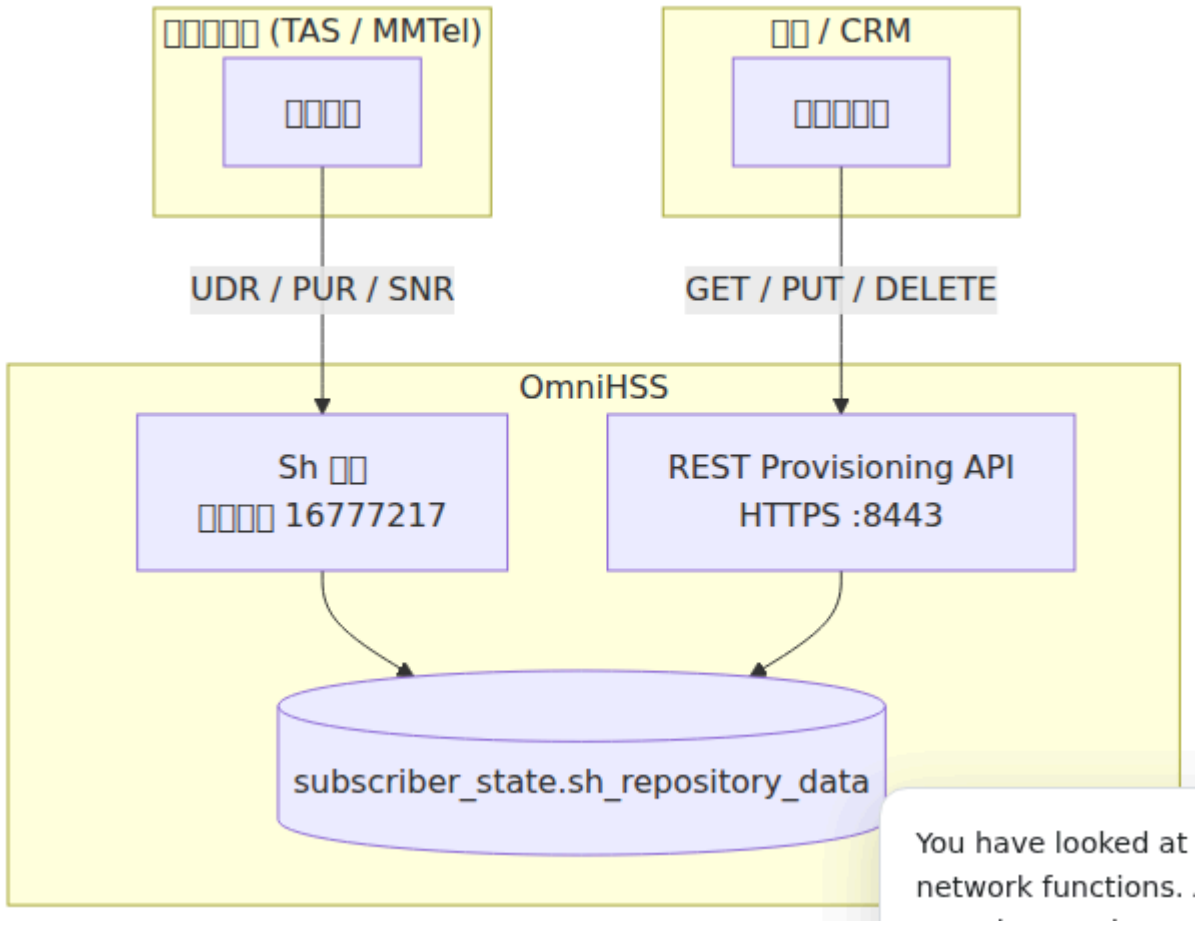
□□	□□□	□□
Service-Indication	HSS □□	□□□□□□□ `MMTEL-Services`□`IMS-ODB-Information`□□
SequenceNumber	HSS □□	□□□□□□□□□□□□□□□□□ SequenceNumber □□□□
ServiceData	AS □□□□□□□□	XML □□□□□□□□□□□□□□□□

HSS □□□ Service-Indication □ SequenceNumber□`ServiceData` □□□□□□□□□□□□



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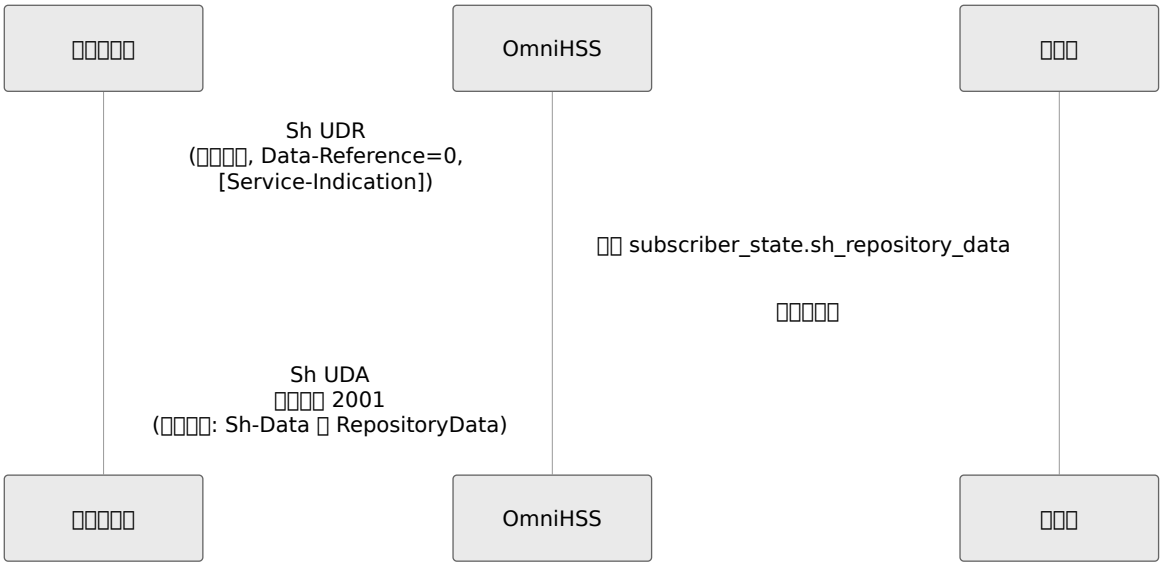
□□□□□□□□□□□□□□□□□ `subscriber_state.sh_repository_data` □□□□□□□ Service-Indication □□□ JSON □□□□□□□□□□□□□□□□□□□□

```
{
  "MMTEL-Services":      { "sequence_number": "0", "service_data":
"<MMTelServices …>…</MMTelServices>" },
  "IMS-ODB-Information": { "sequence_number": "1", "service_data":
"<OdbForImsOrientedServices xmlns=\"odb.mmtel.omnitou.ch\"/>" }
}
```

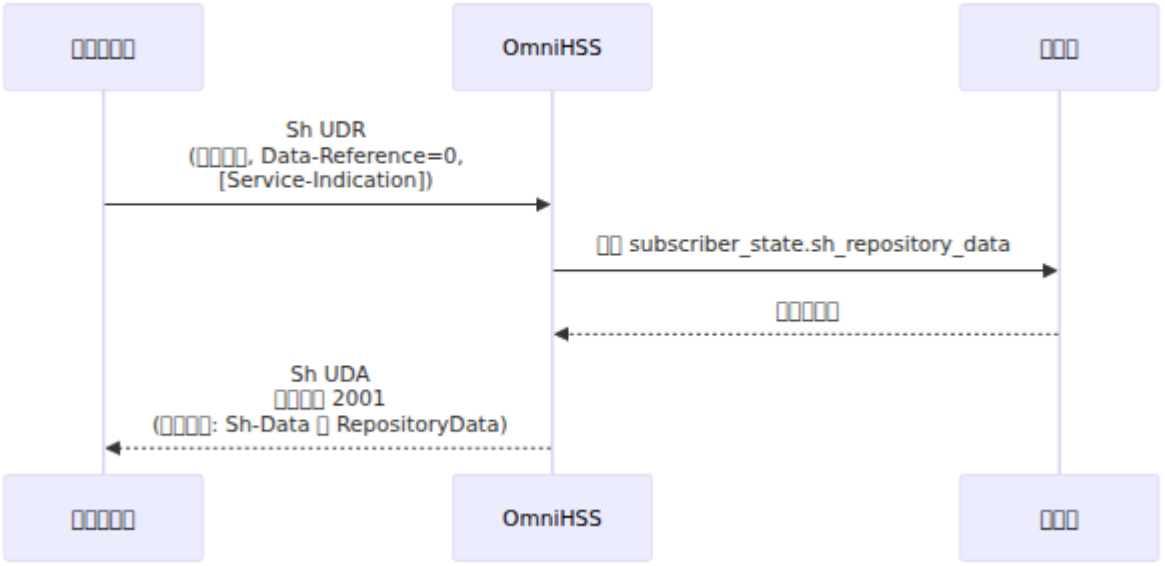
□□	□□
`sequence_number`	□□□□□□□□□□□□□ HSS □□□□□□□ `UDA` □□□□□□□□□□□□□
`service_data`	□□□□ XML □□□□ AS □□□□□□□□□□□□□



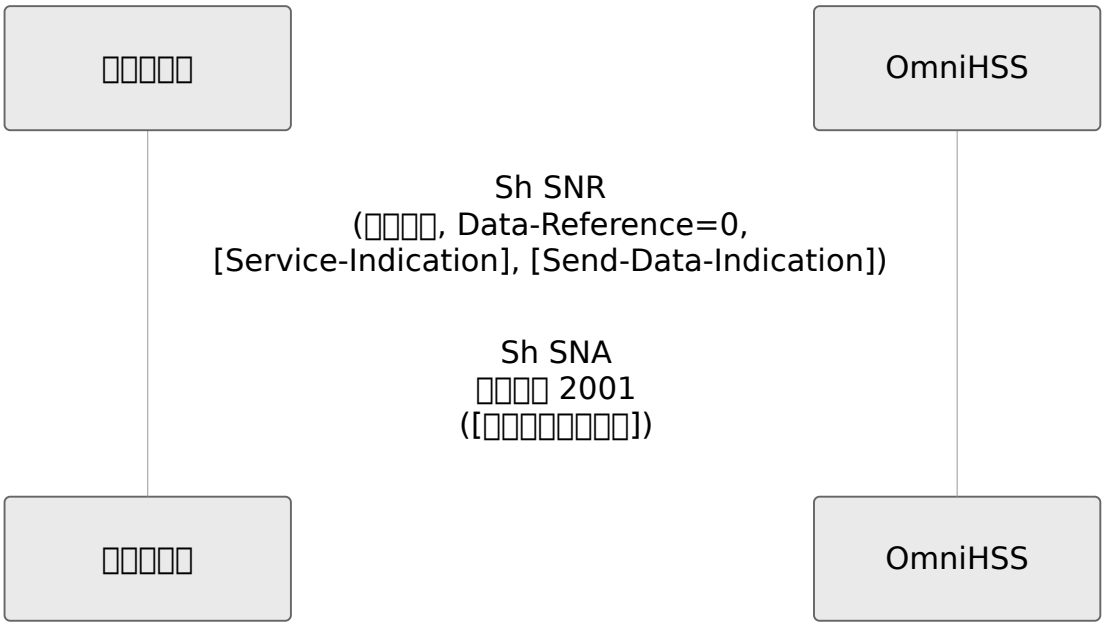
□□□□ IMS □□□□□□□ **Experimental-Result 5001 (DIAMETER_ERROR_USER_UNKNOWN)**□

□□□□□□□ (PUR/PUA)□□□

AS □□□□□□□□□□□`ServiceData` □□□□□□□□□□□□□ SequenceNumber □□□□□□□□□□□□□□□□□□□□

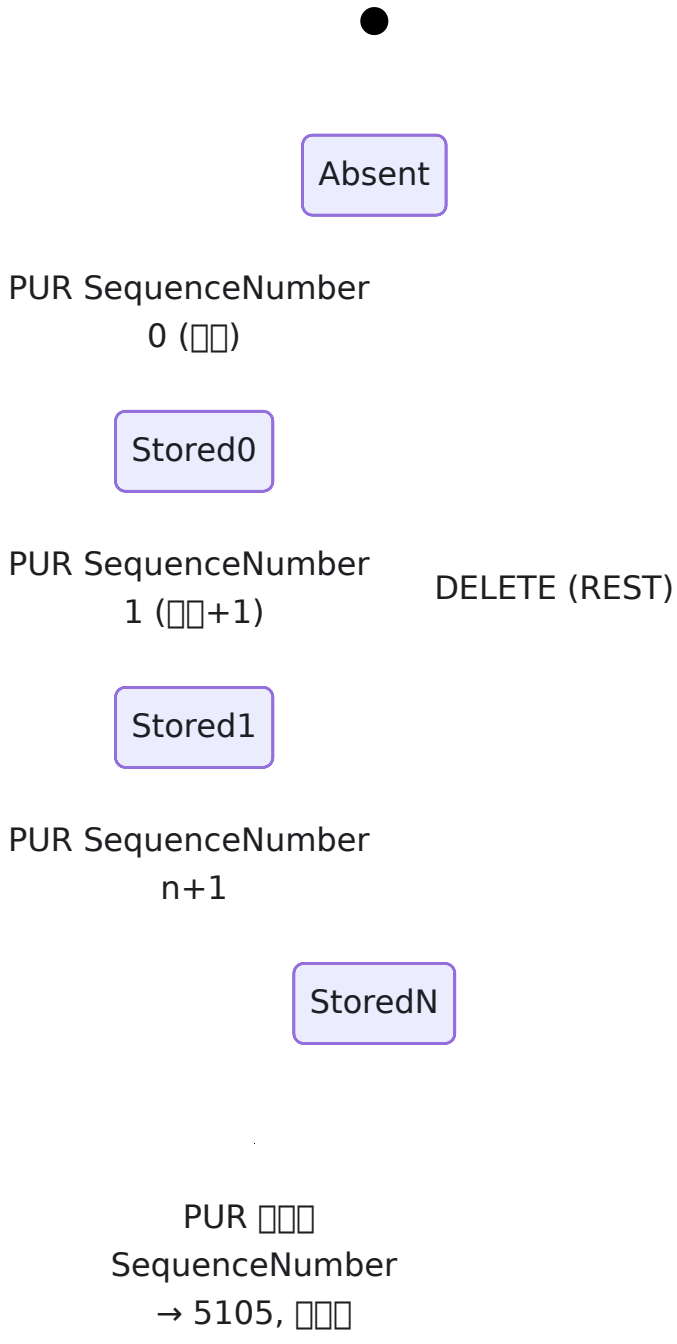


□ PUR □□□□□□□□□□□□□□□□□□□□



SequenceNumber □□□

SequenceNumber □□□□□□□□□□□



□□□ □□□□□□□□ SequenceNumber `0`□□□ SequenceNumber `5` □ PUR □□□□□□ `5105`□ □□□□□□□□□□ SequenceNumber `1` □ PUR □□□□□□□□□□□□ `1`□

REST Provisioning API

□□□□□□□□□□□□□/CRM □□□□□□□□□□□□□ IMSI □□□□□□□□□□□ `service_indication` □□ □□□□□□□□□□□□□□□/□□□□□□□□□□□□□□□ `service_data` □□□□□□□□□ Sh □□□

□□□□□□□□ API □□□

```
{ "status": "success", "response": { } }
```

□ Sh □□□□□REST API □□□□□□□□□□□□□ SequenceNumber □□□□□□□□□□□□□□□□

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□□□ `GET /api/subscriber/repository_data/:imsi`

```
curl -k
https://hss.example.com:8443/api/subscriber/repository_data/001001123
```

```
{
  "status": "success",
  "response": {
    "MMTEL-Services":      { "sequence_number": "0",
"service_data": "<MMTelServices …/>" },
    "IMS-ODB-Information": { "sequence_number": "1",
"service_data": "<OdbForImsOrientedServices
xmlns=\"odb.mmtel.omnitou.ch\"/>" }
  }
}
```

□□□□□□

□□ Service-Indication □□□□□□□

□□□ `GET /api/subscriber/repository_data/:imsi?service_indication=:service_indication`

```
curl -k
"https://hss.example.com:8443/api/subscriber/repository_data/00100112
service_indication=MMTEL-Services"
```

```
{
  "status": "success",
  "response": { "sequence_number": "0", "service_data": "
<MMTelServices …/>" }
}
```

□□□□□□□

□□□□□□□□□□□□□□□□□□

□□□ `PUT /api/subscriber/repository_data/:imsi`

```
curl -k -X PUT
https://hss.example.com:8443/api/subscriber/repository_data/001001123
\
  -H "Content-Type: application/json" \
  -d '{
        "service_indication": "MMTEL-Services",
        "service_data": "<MMTelServices version=\"1\"/>",
        "sequence_number": "0"
      }'
```

□□	□□	□□	□□	□□
`service_indication`	□□□	□	-	□□□/□□□□□□□□□□ `MMTEL-Services` □□
`service_data`	□□□	□	-	□□□□ XML □□□□□□□□□□□□□□□□□□□□□□□□ Service-Indication □ SequenceNumber□□
`sequence_number`	□□□	□	`0`	□□□□□□□□□□

□□□□□□□□□□

```
{
  "status": "success",
  "response": { "sequence_number": "0", "service_data": "
<MMTelServices version=\"1\"/>" }
}
```

□□□

□□ Service-Indication □□□□□□□

□□□ `DELETE /api/subscriber/repository_data/:imsi`

```
curl -k -X DELETE
https://hss.example.com:8443/api/subscriber/repository_data/001001123
\
  -H "Content-Type: application/json" \
  -d '{ "service_indication": "MMTEL-Services" }'
```

□□	□□	□□	□□	□□
`service_indication`	□□□	□	-	□□□□□□□

□□□□□□□□□□□□

□□□

Data-Reference □ (RepositoryData)

□	□□	□□	□□
0	RepositoryData	□ Service-Indication □□□□□□□□□ □	3GPP TS 29.328 §7.6

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□□	□□	□□
2001	DIAMETER_SUCCESS	UDR/PUR/SN □□
5001	DIAMETER_ERROR_USER_UNKNOWN	□□□□□□□□□ I
5105	DIAMETER_ERROR_TRANSPARENT_DATA_OUT_OF_SYNC	□□□ SequenceNu □□□□□□□□

□□ ID

ID	□□	□□	□□
16777217	Sh	AS ↔ HSS □□□□	3GPP TS 29.329

□□ Service-Indications

Service-Indication	□□□□
`MMTEL-Services`	MMTel □□□□□□□□□□□□□□□□/□□/□□□OIP/OIR□□□□□ simservs XML
`IMS-ODB-Information`	□□ IMS □□□□□□□□□□□□□□□□

> Service-Indication □□□□□□□□□□□□□ XML □□□□□HSS □□□□□□□□□

□□□□

□□□□□□□□□□□□ 5105

□□□ PUR □□□□ Experimental-Result `5105`□□□□□□□

□□□□□

- AS □□□□□ SequenceNumber□□□□□□□□ HSS □□□□□□□□□□□□□□□□□□□□
- □□□ AS □□□□□□□□ SequenceNumber□

□□□□□

1. □□ UDR □□□□□□□□□□□□□□ SequenceNumber□
2. □□□□ PUR□SequenceNumber = □□ + 1□
3. □□□□□□□□□□ REST API □□□□ API □□□□□□□□

□□□ ServiceData □□□□□□

□□□ AS □□□□□□□□ HSS □□□

□□□□□

- □□□□□□□□OmniHSS □□□□□□□□ `ServiceData`□□□□□□□□□□ AS □□□ XML □□□□□□□□□ □□□□□□□□□□□□□□□□□□□□□□□□□□□□

□□□□□

1. □ `UDA`/REST □□
2. □□ AS □□□□□□□□□□□□□ XML □□□□

□□ REST □□□□□

□□□ `GET …/repository_data/:imsi?service_indication=…` □□□□□

□□□□□

- □□□□□□□□ Service-Indication □□□□

- IMSI □□□□□□□□□□

□□□□□

1. □□ `GET /api/subscriber/repository_data/:imsi` □□□□□□□□□□□□□□□□□□
2. □□ □□ IMSI □□□□ □□ IMSI□

SRVCC - □□□□□□□□□□□□

← □□□□□□

□□

SRVCC□□□□□□□□□□□□□□□□□□□□□□□□□□LTE□□□□□□□□□□□VoLTE□□□□□2G/3G□□□□□CS□□□□ MME□□**Sv**□□□TS 29.280□□□□□□□□□□□Sv PS□CS□□□MME□□□HSS□□□□□□

AVP	□□	□□
`STN-SR`	1433	SRVCC□□□□□□□□MSC-Server□□□E.164□□□□□TAS/S-CSCF□ □□□□SIP REFER□□□□VoLTE□□□□□CS□□□
`C-MSISDN`	1452	□□MSISDN□TAS□□□□□□□□□STN-SR□□□□□□□□□□□□□□□□□□□□ □□□□□□□

OmniHSS□S6a □□□□□□□□ULA□`Subscription-Data` AVP□□□`STN-SR`□MME□ULA□□□ □□□□Sv PS□CS□□□□□□

□□□□□

□□	□□
TS 23.216	SRVCC PS□CS□□
TS 29.272	S6a□□□STN-SR §7.3.89□Subscription-Data §7.3.2□
TS 23.003	STN-SR□□□□□§13.4□

□□□□

OmniHSS□□□

□□

□□	□□	□□	□□	□□
`stn_sr_prefix`	□□□	□	□□□	□□□□□□STN-SR□□□□□□□□□□□□□MSISDN□□□□□□E.164 STN-SR□□□□□□□□□□OmniHSS□□□□□ULA□□□□□□`STN-SR` AVP□

STN-SR□□□□

□□□STN-SR□□□□□

```
STN-SR = stn_sr_prefix + □□□ MSISDN
```

□□□□**TBCD**□□□□□□□□□□□□□□□□□TS 24.008 §10.5.4.7□□□□□□□□□`STN-SR` AVP□□□1433□□□□10415□□□

□□□

□□	□
□□□□□	`9`
□□□ MSISDN	`61412345678`
□□□ STN-SR	`961412345678`

MSC-Server□□`961412345678`□□□□□TAS□TAS□□MSISDN□□□□□□□IMS□□□□□□SIP REFER□□□□□CS□□□

□□□□

□□SRVCC

```
# config/runtime.exs

config :hss, :srvcc,
  # MSC-Server□□□□□□□□PSTN/CS□□TAS□
  # STN-SR = stn_sr_prefix + □□□ MSISDN□
  stn_sr_prefix: "9"
```

□□□□□ □□ULA□□□`Subscription-Data`□□□`STN-SR`□□□□□□□□□□□□MSISDN□□□TBCD□□□MME□□□□□□□□□□□□SRVCC□□Sv PS□CS□□□□□□□□

□□**SRVCC**□□□□

□`srvcc`□□□□`stn_sr_prefix`□□□□□OmniHSS□□□`STN-SR` AVP□ULA□□□□□□□□□□□□□□□□□□SRVCC□□□□□□□□□□

□MME□□□

MME□OmniMME□□ULA `Subscription-Data`□□□`STN-SR`□□□□□□□□□□□□□□□□□□□□SRVCC□□□□□□□□MSC-Server□Sv **PS□CS**□□□□□□`STN-SR`□□□MME□□□□□□□□□□□□□□Omnitouch/omnimme#426□



□□□□

ULA□□□□STN-SR

□□□ MME□□□□Sv PS□CS□□□SRVCC□□□□□

□□□□□

- `config/runtime.exs`□□□□`stn_sr_prefix`□

- HSS□□□□□□□□□□□□□□□□□□

□□□□□

1. □□`config/runtime.exs`□□□□□`srvcc`□□□□`stn_sr_prefix`□□□
2. □□□□OmniHSS□□□□□□□□□□
3. □MME□□□□ULR□□□□□□□TAU□□□□ULA `Subscription-Data`□□□□`STN-SR`□

STN-SR□□□□

□□□ MSC-Server□□□□□□□□□□□□□□□□□

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- □□□HSS□□□□□MSISDN□□□□□E.164□□□□□□□□`+`□□

□□□□□

1. □□API□□□□□□MSISDN□`GET /api/subscriber/imsi/:imsi`□□
2. □□□□□STN-SR□□`stn_sr_prefix`□□□□MSISDN□□□
3. □□MSC-Server□□□□□□□□□□□□

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Sy □□□□□□□□□□

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Sy □□□ HSS□□□ **PCRF**□□□□□□□□□□□□□□□□ **OCS**□□□□□□□□□□□ □□□□□□□□□□□□ PCRF □□ OCS □□□□□□□□ □□□□□ □□□□□□□□□□□□□□□□□

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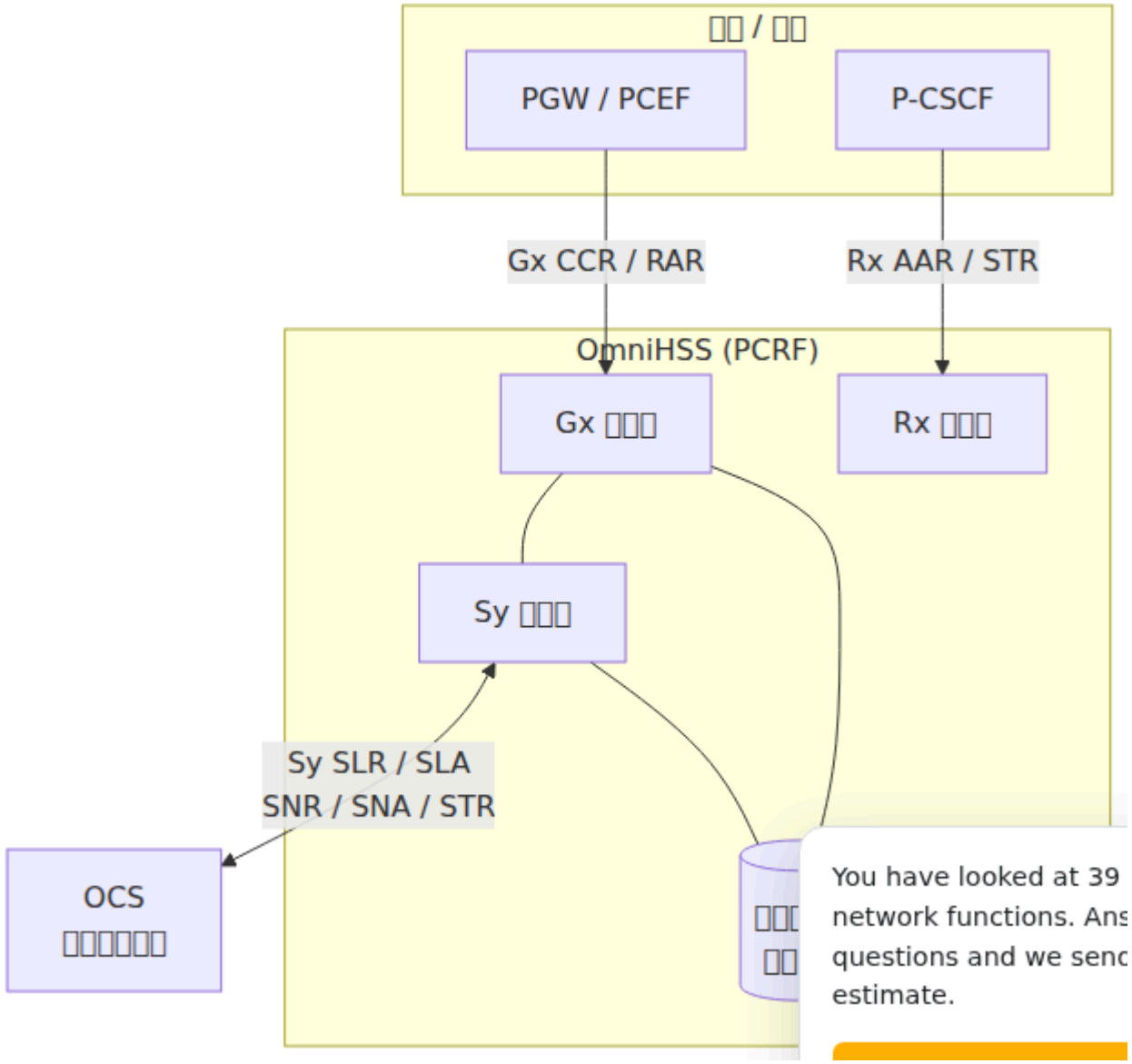
□□ / □□
PGW / PCEF
P-CSCF
Gx CCR / RAR
Rx AAR / STR
OmniHSS (PCRF)
Gx □□□
Rx □□□
Sy □□□
Sy SLR / SLA
SNR / SNA / STR
OCS
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You have looked at 39
network functions. Ans
questions and we senc
estimate.

HSS □ **Sy** □□□□□□□□

OmniHSS □□□□□□□□□□□□□□□□□ □□□□□□

Sy AVP	□□	□□□	□□
`Policy-Counter-Identifier` (2901)	□□ - □□ □□□	HSS □□□□□ □ □□□□□	□□□□□□□□ *□□* □□□□
`Policy-Counter-Status` (2902)	□□ - □□ □□□□	□□□□	□□□□□□□□ *□□□*□□□□ □□□□□□□□□

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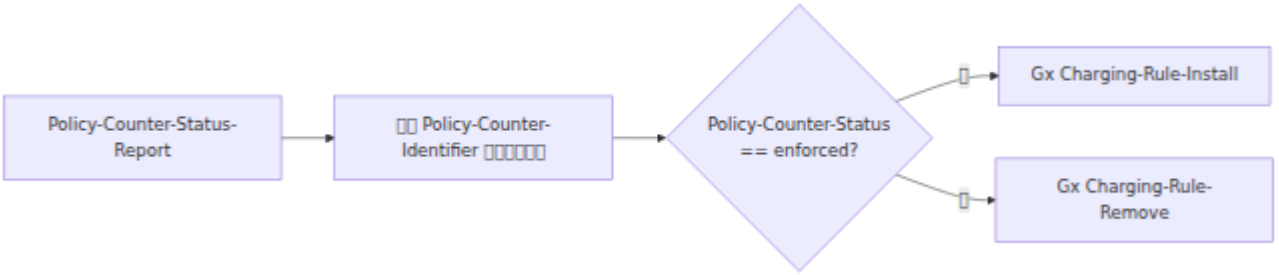
- □□□□ `enforced` □□□□□□□□□□□ Gx □□□ `Charging-Rule-Install`□□
- □□□□□□□□□□□□□`Charging-Rule-Remove`□□

> **Sy** □□□□□□□□□□□ Sy □□□□□□□□QoS □□ AVP - □□□□□□□ Gx □□□□□□OCS □□□ PCRF □□□□□□□□□□□ *□□* □□□□□□□□□□□□□□□□□□ *□□* □□□□□□□□□□□□□□□□□□□□□□ HSS □□□□□□□□□□ □□ `Policy-Counter-Identifier` □□□□□□□□□□□□□□□□ OCS □□□□□□□□□□□□□ `enforced` □□□□□□□□□□□□□□



Sy □□□□□□

Sy □□□ □□□□□□□□□□□□□□□□□PCRF □□□□□□□□ Sy □□□□□□□□□ `Session-Id` □□□□□□□□□□□□□□□□□□□□



- □□ **(SLR, INITIAL_REQUEST)**□ □□□□ Gx CCR-I □□□□□□□□□□□□□□□□□□□□PCRF □□ Sy □□□□□□□□□□□□□□□□OCS □ SLA □□□□□□□□□□□□□□□
- □□ **(SLR, INTERMEDIATE_REQUEST)**□ □□ PCRF □□□□□□□□□□□□□□□□□□□□ Sy □ □□□□□□□□□□
- □□ **(SNR / SNA)**□ □□□□□□□□□□□□OCS □□□□□□□□□□□□PCRF □ SNA □□□□ Gx □□□□ □□
- □□ **(STR / STA)**□ □□□□□□□□□□□□□□□□□□PCRF □□□□□□□□□ Sy □□□

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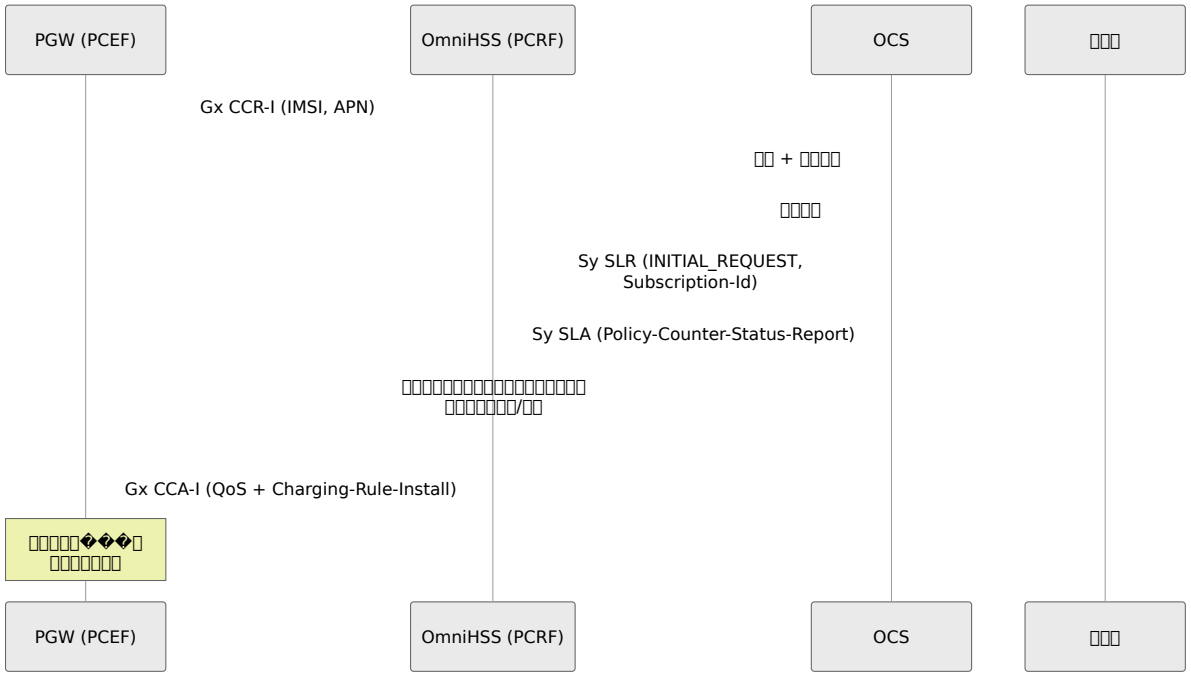
PGW (PCEF)
OmniHSS (PCRF)
OCS
□□□
Gx CCR-I (IMSI, APN)
□□ + □□□□
□□□□
Sy SLR (INITIAL_REQUEST, Subscription-Id)
Sy SLA (Policy-Counter-Status-Report)
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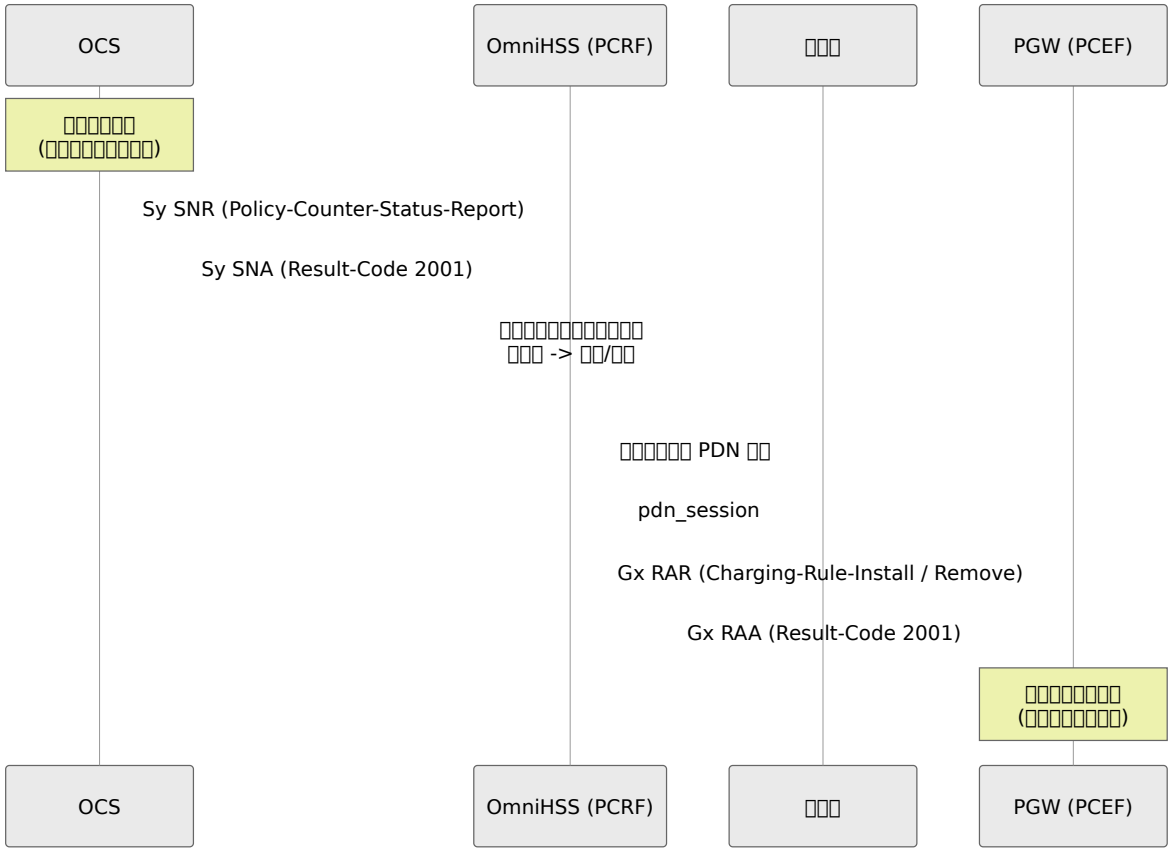
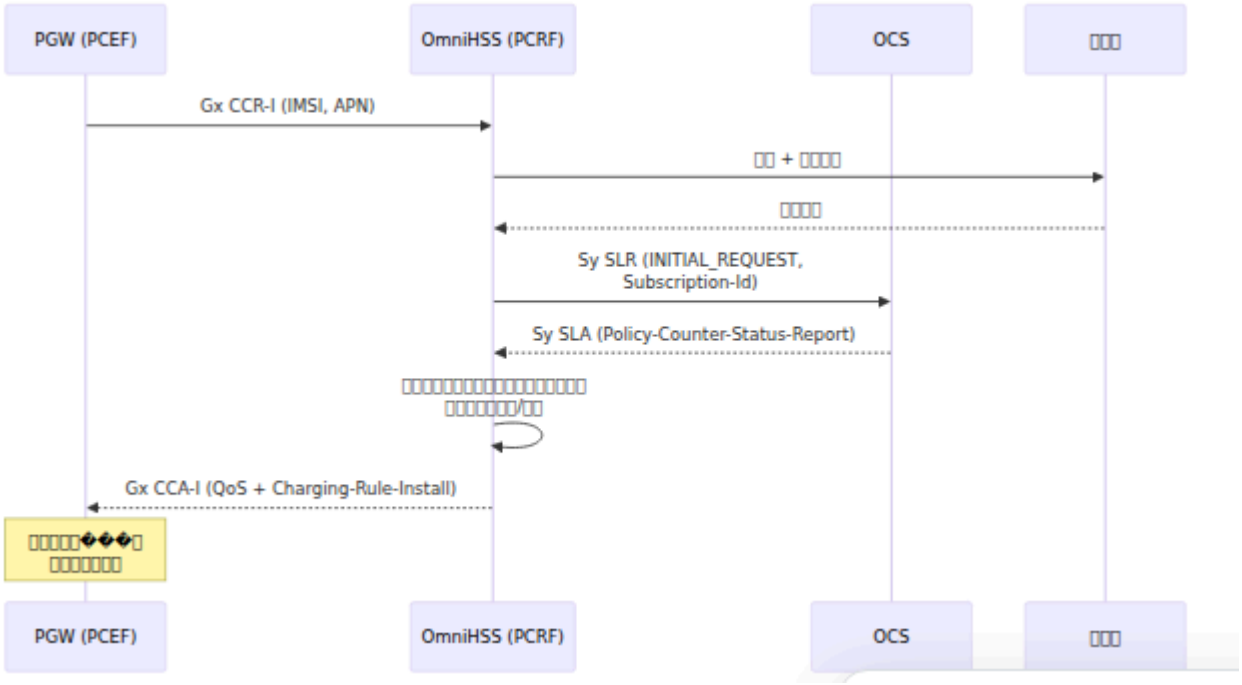
□□ 2□□□□□□□□□OCS -> PCRF -> Gx RAR□



□□□□ PCRF □□□ Gx □□□□ □□ - □□ VoLTE □□□□□□□□□□ - □□□□□□□□□□□□□□□ PGW□□□□□□□□ □□ CCR□

□□ 3□Sy □□□□



□□

Sy □□

Sy □□□ HSS □□□□□□□□□□ Gx □ Rx □□□`config/runtime.exs`□□

```
%{
  application_name: :sy,
  application_dictionary: :diameter_gen_3gpp_sy,
  vendor_specific_application_ids: [
    %{vendor_id: 10415, auth_application_id: 16_777_302,
acct_application_id: nil}
  ]
}
```

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`application_name`	Atom	□	-	□□□□□□□□□□□□ `:sy` Sy □□□
`application_dictionary`	Atom	□	-	□□□□□□□□□□□ `:diameter_gen_3` □3GPP TS 29.219□
`vendor_specific_application_ids`	List	□	-	□□□□□□□□ Sy □□□□
`vendor_id`	Integer	□	-	□□□ ID□3GPP □□ `1`
`auth_application_id`	Integer	□	-	□□□□ ID□Sy □□ `16_777_302`□
`acct_application_id`	Integer | nil	□	`nil`	□□□□ ID□Sy □□□□□ ��□ `nil`□

Sy □□

Sy □□□ `:hss, :sy` □□□□□ `config/runtime.exs` □□

```
config :hss,
  sy: %{
    enabled: false
  }
```

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`enabled`	Boolean	□	`false`	□□□□□□ `true` □□PCRF □ Gx CCR-I □□□□□ □□□□□ Sy □□□□□ `false` □□Sy □□□□□□

□□□□□□□□□□ `Policy-Counter-Status` □□□□□□□ **`enforced`**□□□□□□□□□□□□□□□□□□□□ OCS □□□□□□□□□□□□□□□□

OCS □□

HSS □ □□ OCS □□□□□□□□□□ SLR □ STR □□ HSS □ □□ `Destination-Realm`□□□□ `Destination-Host`□□□□□□□□□ Sy □□ ID□16777302□□□□□□□□□□□□□□□□□ Sy □□□□□□□□□□□□ - □□□ **DRA**□□□□□□□□□□ OCS□□□□□□ DRA □□ OCS □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□ OCS □□□□□□□□

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- □ **OCS** □□□□□□□□□□□ `Policy-Counter-Identifier` □□□ HSS □□□□ □□□□ □□□ `name`□□□□□□□□□□□□□□□□□□□□□□ `enforced`□
- □ **HSS** □□□□□□□□□□□□□□□□□□□

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Sy □□□ HSS □□□□□□□□□ Prometheus □□□□ □□□□□□□

□□: `hss_sy_messages_total` □□: □□□ □□: □□□ Sy □□□□□□□□□□□□□□□□□ □□:

- `command` - `slr`□`sla`□`snr`□`sna`□`str`□□ `sta`
- `direction` - `incoming`□□ OCS □□□□ `outgoing`□□□□ OCS□
- `result` - `sent`□`received`□`success`□□ `error`

□□: `hss_sy_policy_updates_total` □□: □□□ □□: □ Sy □□□□□□□□□□ Gx □□□□□□□□□□ □□□□□□□□ □□:

- `action` - `install` □ `remove`

- `result` - `success` □ `error`□Gx RAR □ PGW □□□□

□□□□:

```
# □ OCS □ Sy □□□
rate(hss_sy_messages_total{command="snr", direction="incoming"}
[5m])

# □□□□□□□□□□□/□□□□□□□□
rate(hss_sy_policy_updates_total{action="install",
result="success"}[5m])

# Sy Gx RAR □□□□
sum(rate(hss_sy_policy_updates_total{result="error"}[5m]))
  / sum(rate(hss_sy_policy_updates_total[5m]))
```

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□□□□□□	SLR	8388635	PCRF -> OCS	□□□□□□□□□□□□□□□
□□□□□□	SLA	8388635	OCS -> PCRF	□□□□□□□□□
□□□□□□□□	SNR	8388636	OCS -> PCRF	□□□□□□□□□
□□□□□□□□	SNA	8388636	PCRF -> OCS	□□□□
□□□□□□	STR	275	PCRF -> OCS	□□ Sy □□□□□□□□
□□□□□□	STA	275	OCS -> PCRF	□□□□□□

□□□□□□□□□ ID `16777302`□□□□□□ STR/STA (RFC 6733 □□□□)□

□□ AVPs

AVP	□□	□□	□□
`Policy-Counter-Identifier`	2901	UTF8String	□□□□□□□□□□□□□□□ OmniHSS □□□□□□□□□□
`Policy-Counter-Status`	2902	UTF8String	��□□□□□□□□□□□□□□□□□□□□□□□□□□□
`Policy-Counter-Status-Report`	2903	Grouped	□□□□□□□□□□ + □□ (+ □□□□□□□□)□
`SL-Request-Type`	2904	Enumerated	□□□□□□□ `INITIAL_REQUEST (0)`□□□□ `INTERMEDIATE_REQUEST (1)`□
`Pending-Policy-Counter-Information`	2905	Grouped	□□□□□□□□□□□□□□□
`Pending-Policy-Counter-Change-Time`	2906	Time	□□□□□□□□□□□□□
`SN-Request-Type`	2907	Unsigned32	SNR □□□□□□□□ 0 = □□□□□□□ 1 = □□□OCS □□□□□ Sy □□□□
`Subscription-Id`	443	Grouped	□□□□□IMSI □/□ MSISDN□□ SLR □□

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2001	DIAMETER_SUCCESS	□□□□□□□
5030	DIAMETER_USER_UNKNOWN	OCS □□□□□□□Sy □□□□□
5570	DIAMETER_ERROR_UNKNOWN_POLICY_COUNTERS	□□□□□□□□□□□□□□ OCS □□□
4241	DIAMETER_ERROR_NO_AVAILABLE_POLICY_COUNTERS	OCS □□□□□□□□□□□□□

□□ 5570 □ 4241 □ Sy □□□□□□□□□□□□□TS 29.219 §5.5□□5030 □□ RFC 4006 □□□□

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- PCRF - Gx □ Rx □□□□□Sy □□□□
- □□□□ - □□ HSS □□□□□□□
- □□ - □□ HSS □□

OmniHSS □□□□□□

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- Diameter □□□
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- EPC □□□
- IMS □□□
- VoLTE □□□
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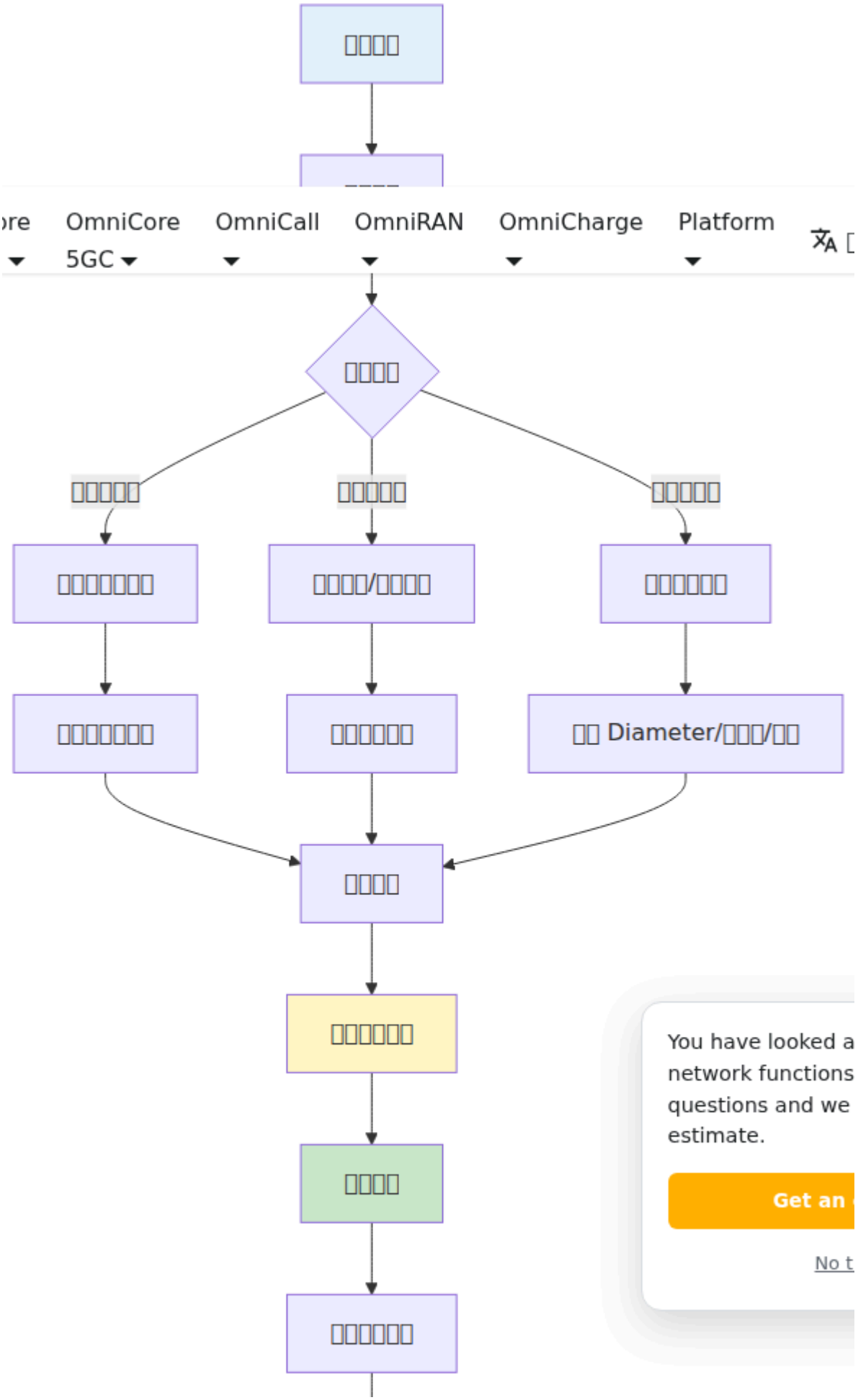
- API □□
- □□□□□□



You have looked a
network functions
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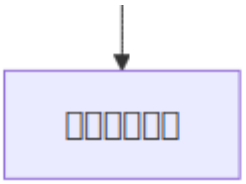

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1. □□□□□□□□ key_set_id□

   ```
   curl -k https://hss.example.com:8443/api/subscriber/imsi/[IMSI]
   ```

2. □□□□□□□□□□□□□□□□□□□

   ```
   curl -k https://hss.example.com:8443/api/key_set/[KEY_SET_ID]
   ```

3. □ Ki □ OPC □□ SIM □□□□□□□

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- □□□□□ □□□ □□□□□
- □□□□□□□SIM □□□□□□

□□ **2**□**SQN** □□□

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- □□□“SQN □□□□”
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1. □□□□□□□□□□□□□ SQN □
2. □□□□□□□□ SQN □□□□□
3. □□□□□□□□□□ SQN □

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- □□□□□□ AUTS □□SQN □□□□□□□
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□□□ □□ SQN □□□□□□□□□□□□□□□□□□□□□□

□□ **3**□□□□□□□

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1. □□□□□□□□□□

   ```
   curl -k https://hss.example.com:8443/api/subscriber/imsi/[IMSI]
   ```

2. □□ `enabled` □□□ `true`

□□□□□

- □□□□□□

```
curl -k -X PUT https://hss.example.com:8443/api/subscriber/[ID]
\
  -H "Content-Type: application/json" \
  -d '{"subscriber": {"enabled": true}}'
```

□□ **4**□□□ **EPC** □□□□

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- □□□“□□□ EPC □□□□”

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1. □□□□□□□ `epc_profile_id` □□
2. □□ EPC □□□□□□□□□□

```
curl -k
https://hss.example.com:8443/api/epc/profile/[PROFILE_ID]
```

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- □□□□ EPC □□□□ □□□□□□□

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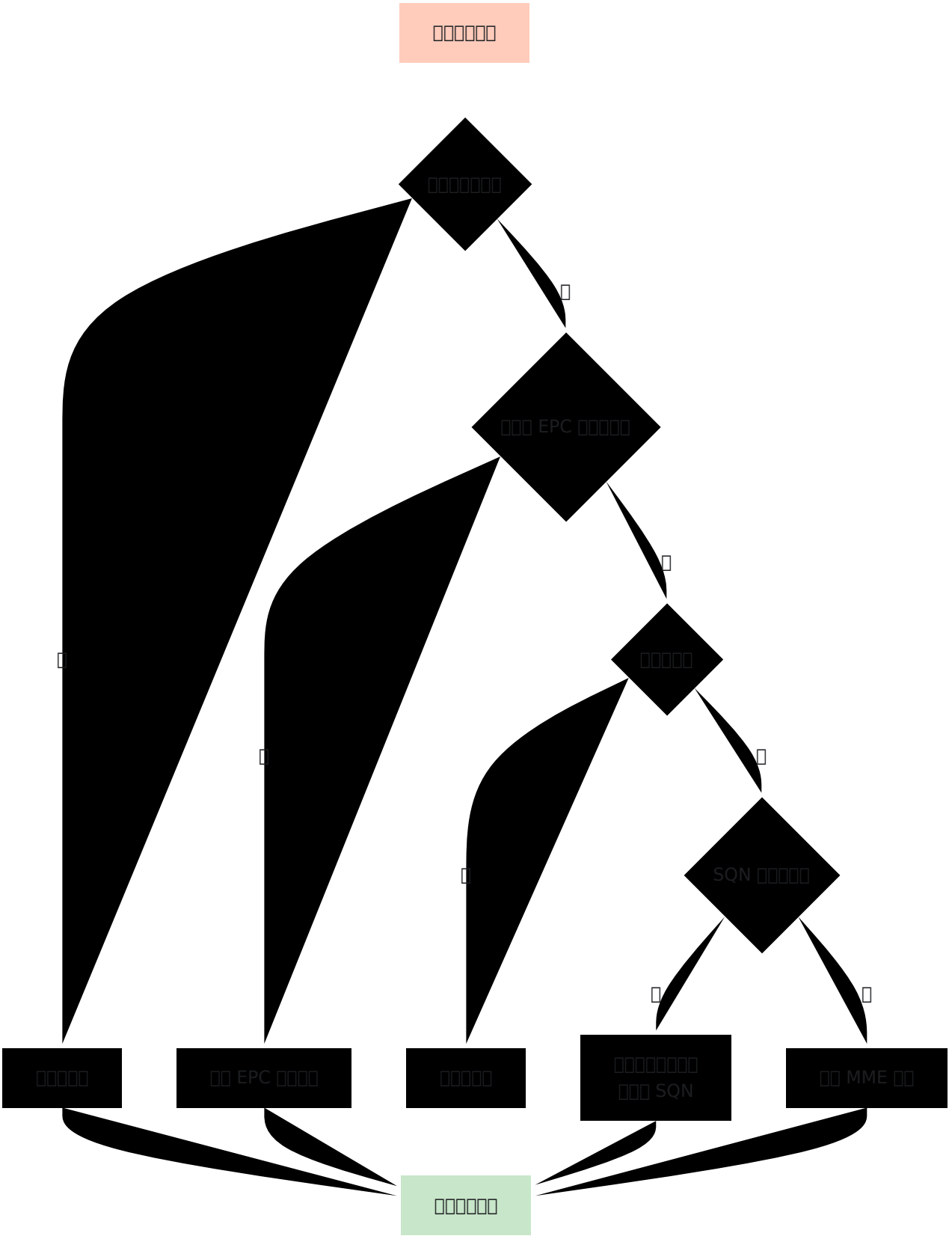
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□□□□ SQN
□□ MME □□
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Diameter □□□□

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- □ □□□□ □□□ Diameter □□□□□□□
- "□□□□□□□□" □□
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□□ **1**□□□□□□□

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- □□□□□□
- Ping □□□□

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1. □□ OmniHSS □□□□□□□□□□

```
ping [PEER_IP]
```

2. □□ Diameter □□□□□□□

```
telnet [PEER_IP] 3868
```

3. □□□□□□□□□ Diameter □□□□ 3868□

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□□ 2□Diameter □□□□□

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- □□□□□□□
- CER/CEA □□□□
- □□□□□□□□

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1. □□ runtime.exs Diameter □□□
    - □□□□□ origin_host □□□□□□□□
    - □□ origin_realm □□
    - □□□□□ IP □□□□□□
2. □□□□□□ CER/CEA □□
3. □□□□□□□□□□□□ OmniHSS □ origin_host

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- □□□□□ Diameter □□ □□ runtime.exs
- □□□□□□□ OmniHSS
- □□□□□□□□□□□□□□□

□□ 3□□□□□□TLS Diameter□

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- □ TLS □□□□□□□□
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- "□□□□" □ "□□□□" □□

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1. □□ `priv/cert/` □□□□□□□□□
2. □□□□□□□

```
openssl x509 -in priv/cert/diameter.crt -noout -dates
```

3. □□□□□□□□□□

4. □□□□□□□□□□□□□□□ TLS

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- □□□□□□□□□□ OmniHSS

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1. □□ □□□□ Diameter □□ □□□□□□□□□
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3. □□□□□□ CER/CEA □□

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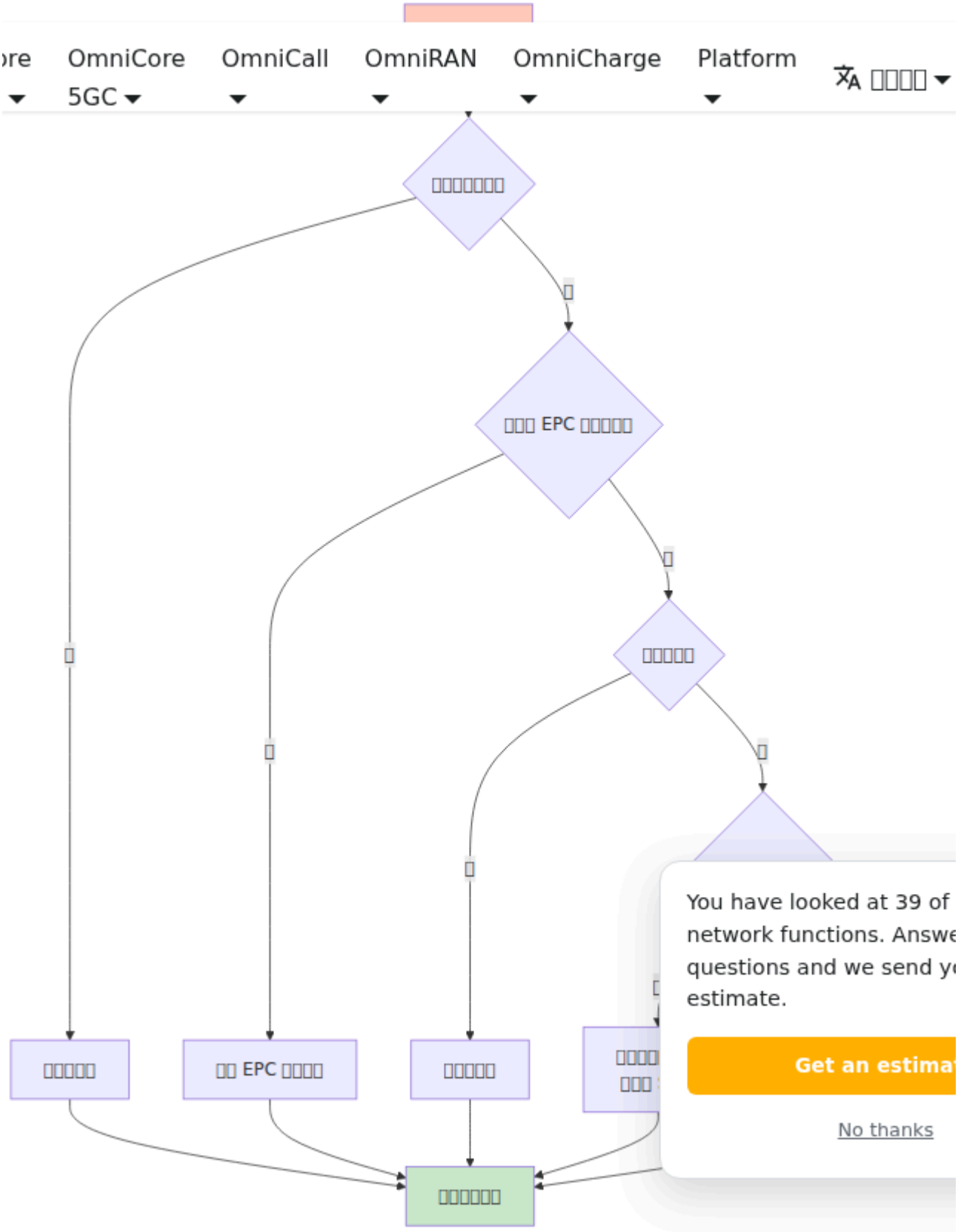
  - MME □□□□ S6a□16777251□
  - S-CSCF □□□□ Cx□16777216□
  - P-GW □□□□ Gx□16777238□

Diameter □□□□□□□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OmniRAN
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network functions. Answe
questions and we send y
estimate.
Get an estima
No thanks

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1. □□□□□□□□□

   ```
   # □□□□□□
   psql -h [DB_HOST] -U [DB_USER] -d [DB_NAME]
   ```

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□□ **2**□□□□□□□□□

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- "□□□□□□□" □□
- OmniHSS □□□□□□□□□

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1. □□ runtime.exs □□□□□□□
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- □□□□□□□ OmniHSS

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- □□□ CPU □

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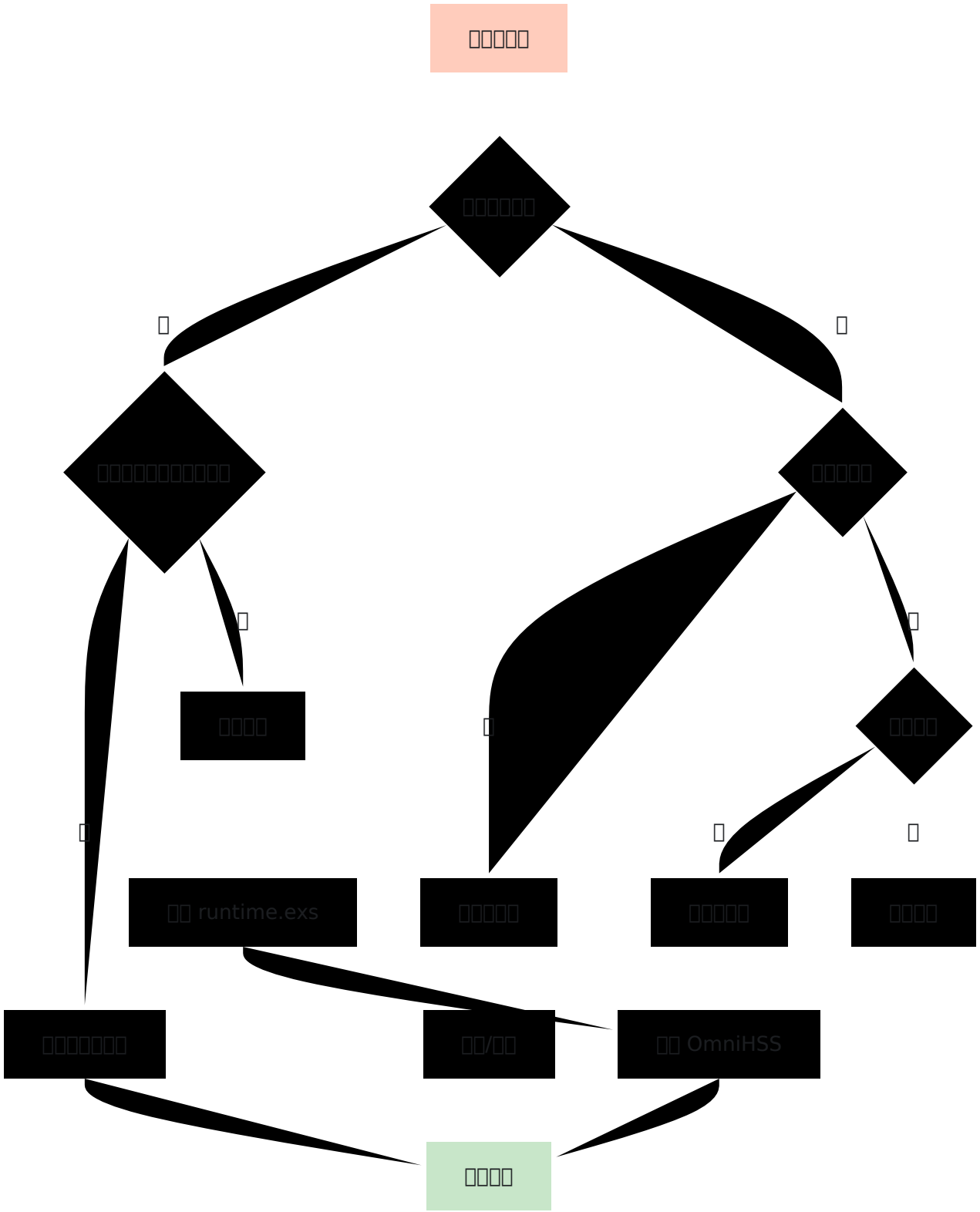
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EPC □□□□

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- MME □□□□
- □□□ PDN □□

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1. □□□□□□□ roaming_profile_id
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3. □□□□□□□□ MCC/MNC
4. □□□□□□□□□□□□□□□

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□□ **2**□□□ **APN** □□

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- MME □□ "□□ APN" □□

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3. □□ APN □□□□

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- □ APN □□□□ □□□□□□□□ EPC □□□□
- □□ APN □□□□□□□□□□
- □□ APN QoS □□□□□□□□□

□□ 3□MME □□□

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- □ MME □□□□
- Diameter □□□□□

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1. □□ □□□□ Diameter □□
2. □□ MME □□□□□□ "□□□"
3. □□ MME □□□□ S6a □□□□

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- □□ Diameter □□□□
- □□ MME □□
- □□ MME □□□

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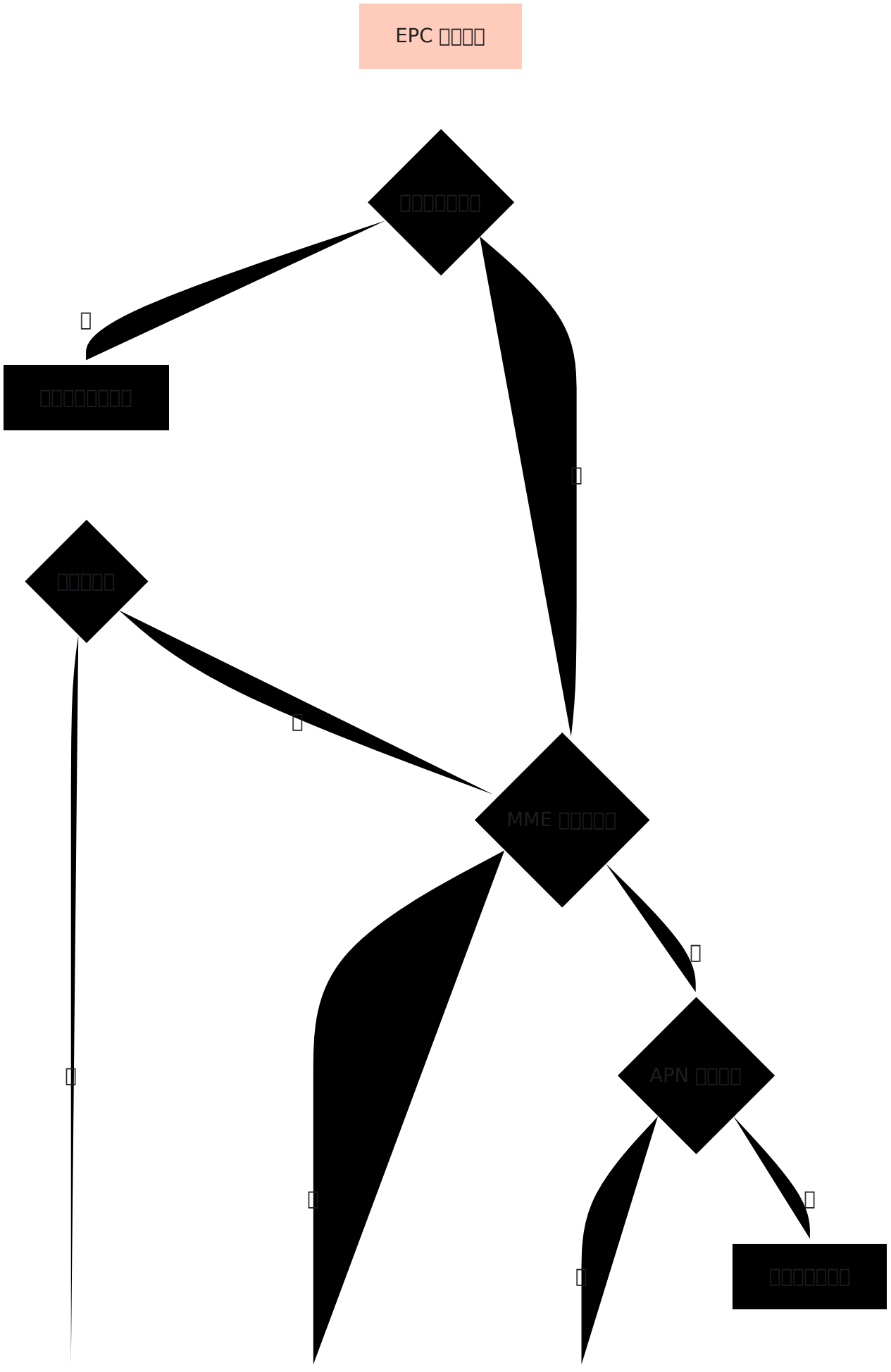
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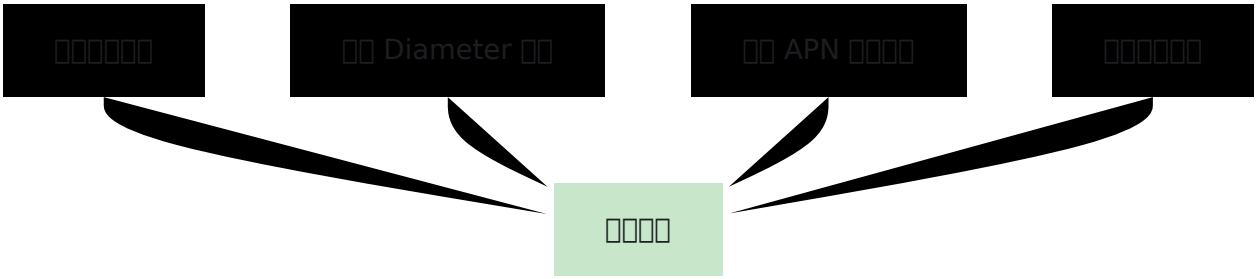

IMS □□□□

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□□ 1□□□□ **IMS** □□□

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- □□□□□□□□□ IMS
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1. □□□□□□□□ `ims_enabled` □□
2. □□□□□□□□□□ `ims_profile_id`

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- □□ IMS □□□□□□□
- □□ IMS □□□□

□□ 2□**S-CSCF** □□□

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- □□ IMS □□□□
- □□ IMS □□□ Diameter □□

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1. □□ □□□□ Diameter □□
2. □□ S-CSCF □□□□□□
3. □□ S-CSCF □□□□ Cx □□□□

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- □□□ S-CSCF □ Diameter □□□□
- □□ S-CSCF □□

□□ 3□□□□□□□ IFC □□

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- □□□□□□ IFC □□□□□

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1. □□□□□□ IMS □□□□
2. □□ IFC □□□□□□
3. □□ IFC XML □□

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- □□□□□ IFC □□□□ IMS □□□□
- □□ IFC □□□□□□ □□□□□□

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1. □□□□□□□□ IMS □□
2. □□□□□□□□□□□□□□ `ims_action`

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- □□ □□□□ □□□ IMS
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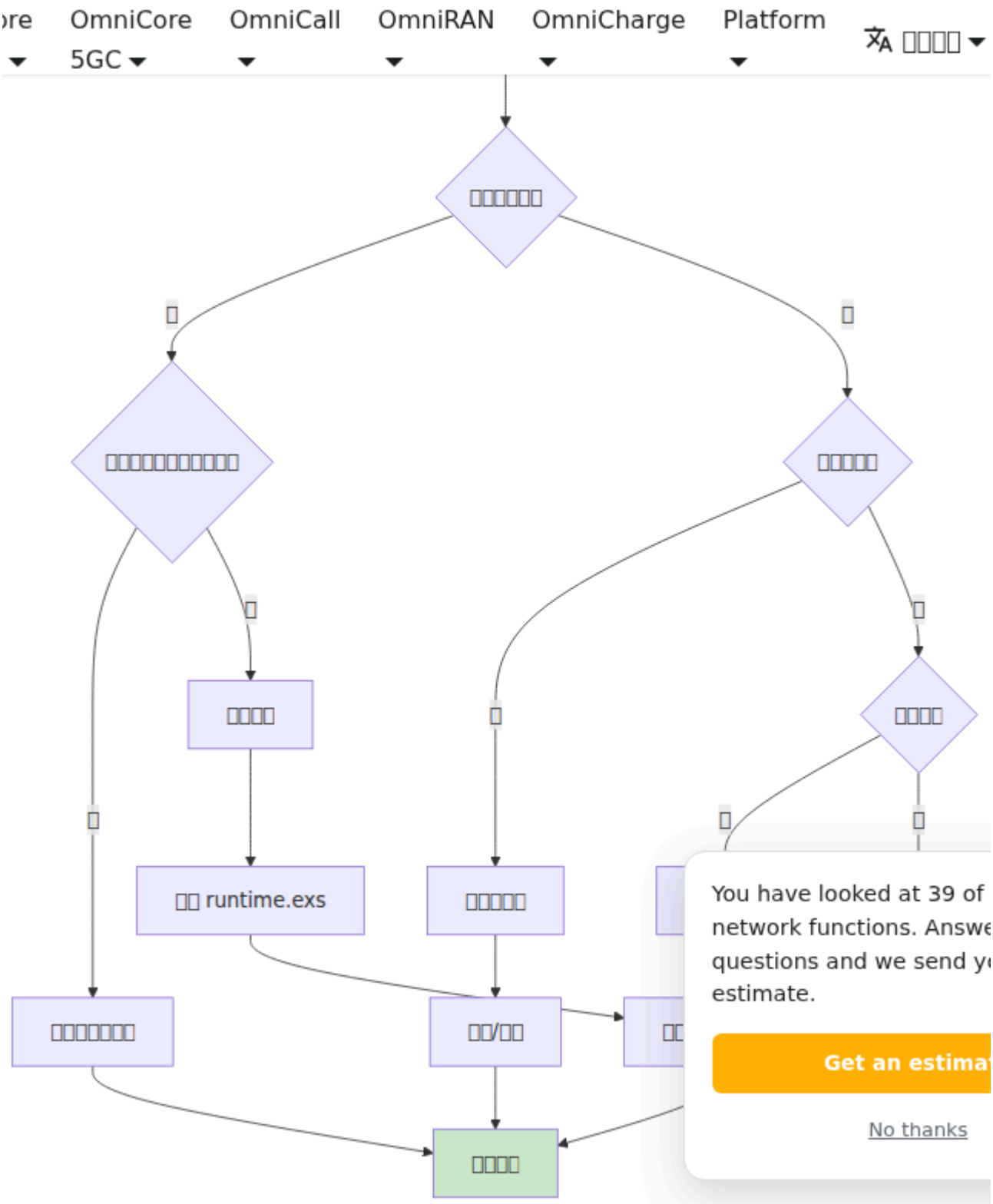
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questions and we send y
estimate.
Get an estima
No thanks

VoLTE □□□□

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□□ 1□P-CSCF □□□

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1. □□ □□□□ Diameter □□
2. □□ P-CSCF □□□□□□
3. □□ P-CSCF □□□□ Rx □□□□□OmniHSS PCRF □□□

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- □□□ P-CSCF □ Diameter □□□□
- □□ P-CSCF □□□□ OmniHSS □ Rx

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- AAR/AAA □□□□
- Rx □□□□

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1. □□□□□□□ Rx Diameter □□
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3. □□ AAA□AA-□□□□□□

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- □□ P-CSCF □□□□□ AAR □□□□□□□
- □□ OmniHSS Rx □□□□□□□
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2. □□ QCI □□□□□□□□□□□□□□□ QCI 1□
3. □□ P-GW □□□□□ Gx□PCRF □□□

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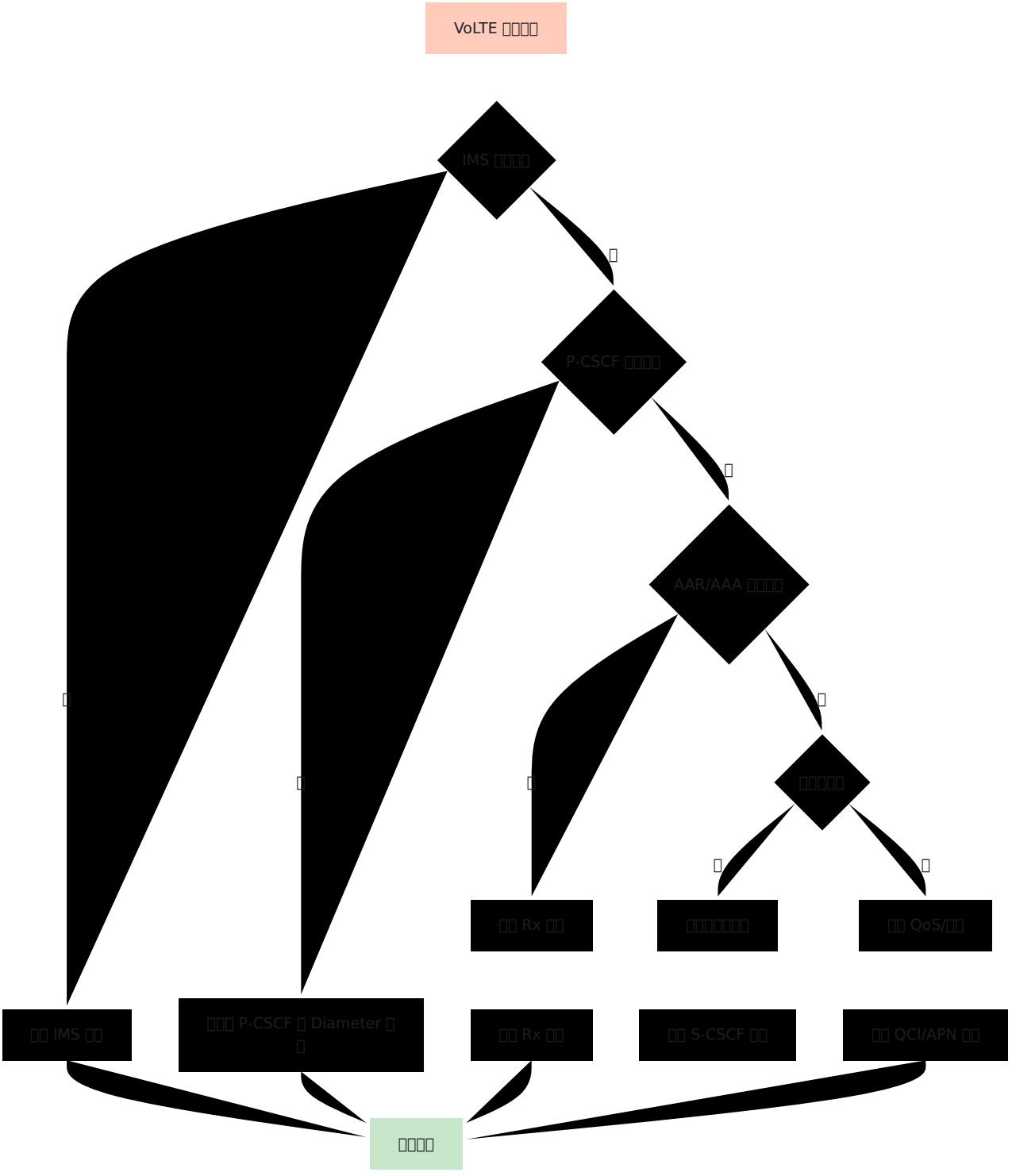
VoLTE □□□□□□□□□□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1. □□□□□□ `roaming_profile_id`
2. □□□□□□□□ null

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```
curl -k -X POST https://hss.example.com:8443/api/roaming/rule \
  -H "Content-Type: application/json" \
  -d '{
    "roaming_rule": {
      "name": "Allow Visited Network",
      "mcc": "310",
      "mnc": "410",
      "data_action": "allow",
      "ims_action": "allow"
    }
  }'
```

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2. □□ `data_action` □ `ims_action` □
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  - □□ `ims_action: "allow"`
- □□□□□□□□ `ims_action_if_no_rules_match` □ `"allow"`

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EIR □□

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1. □□ EIR □□ (`GET /api/eir/rule`)□□□□ `id` □□□□□□□□ `precedence` □□□□□□□□□
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- □□□“key_set_id □□□”
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   - key_set_id → □□□
   - epc_profile_id → EPC □□□□
   - ims_profile_id → IMS □□□□

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   - URL: `https://[hostname]:7443/overview`
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2. **Diameter** □□

   - URL: `https://[hostname]:7443/diameter`
   - □□□□□□□□□□□□□□□

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   - URL: `https://[hostname]:7443/application`
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API □□□

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```
curl -k https://hss.example.com:8443/api/status
```

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```
# □ IMSI
curl -k
https://hss.example.com:8443/api/subscriber/imsi/001001123456789

# □ MSISDN
curl -k
https://hss.example.com:8443/api/subscriber/msisdn/14155551234

# □ ID
curl -k https://hss.example.com:8443/api/subscriber/d290f1ee-6c54-
4b01-90e6-d701748f0851
```

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```
curl -k https://hss.example.com:8443/api/subscriber
```

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```
# EPC □□□□
curl -k https://hss.example.com:8443/api/epc/profile/e58ed763-
928c-4155-bee9-fdbaaadc15f3

# IMS □□□□
curl -k https://hss.example.com:8443/api/ims/profile/7c9e6679-
7425-40de-944b-e07fc1f90ae7

# □□□□□□
curl -k https://hss.example.com:8443/api/roaming/profile/9c858901-
8a57-4791-81fe-4c455b099bc9
```

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□□ Diameter □□□□□□

```
telnet [PEER_IP] 3868
```

□□ TLS □□□

```
openssl s_client -connect [hostname]:8443 -showcerts
```

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```
psql -h [DB_HOST] -U [DB_USER] -d [DB_NAME] -c "SELECT COUNT(*)
FROM subscriber;"
```

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```
grep "001001123456789" /var/log/omnihss/omnihss.log
```

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```
grep "authentication.*fail" /var/log/omnihss/omnihss.log
```

□□ Diameter □□□□□□

```
grep "Diameter peer" /var/log/omnihss/omnihss.log
```

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```
grep -i "database.*error" /var/log/omnihss/omnihss.log
```

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Diameter □□

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"Diameter □□□□□□□"	□□□□	□□□□□□
"CER/CEA □□□□"	□□□□□	□□ Diameter □□
"□□□□□□"	□□□□□□□□□□	□□□□□□□
"TLS □□□□"	□□□□	□□□□

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"□□□□□"	□□□□□	□□□□□
"□□□□□□"	□□□□	□□□□
"□□□□□□"	□□□	□□□□□
"□□□□□□□□"	□□□□	□□□□

API □□

□□□□	□□	□□□□
"key_set_id □□□"	□□□□	□□□□□□□□
"IMSI □□□□"	□□ IMSI	□□□□□ IMSI □□□□□□
"□□□□"	□□□□	□□□□□□□□□

← □□□□□□ | □□□□API □□ →

OmniHSS Webhook □□

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- □□
- Webhook □□□□□
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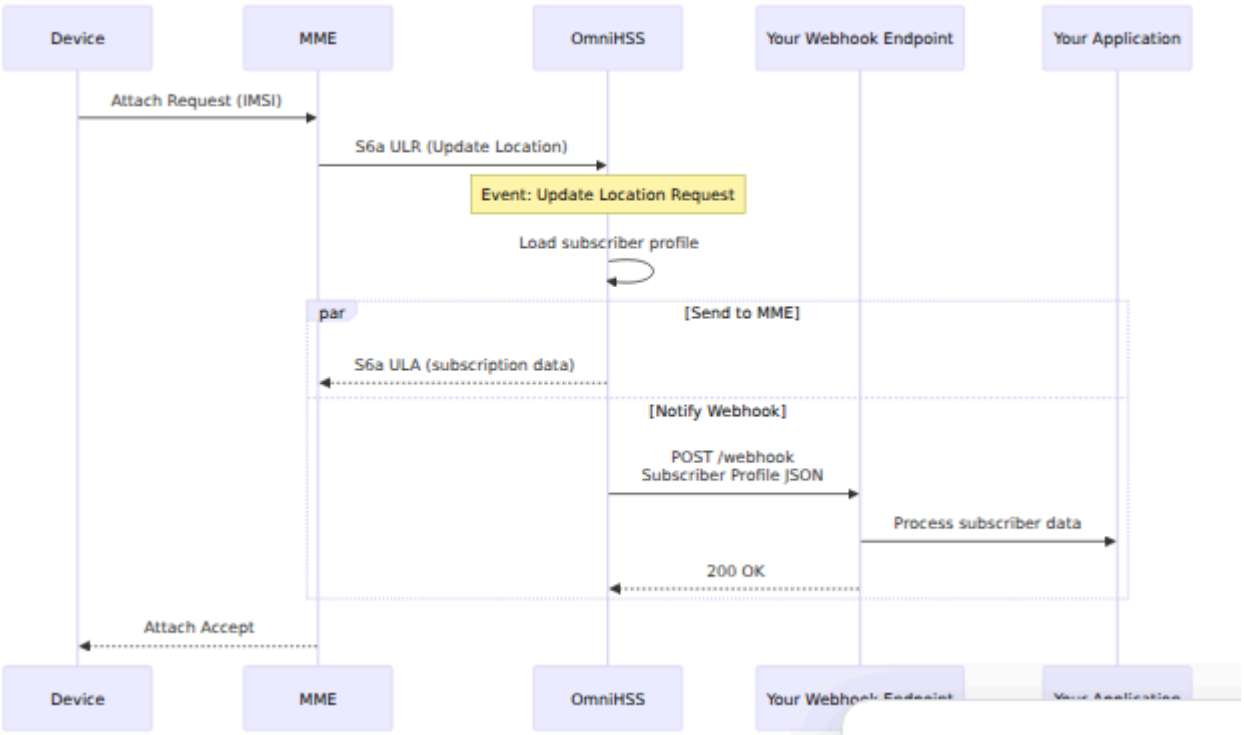
OmniHSS □□ **webhooks** □□□□□□



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- □□□□□□□□ - □□ webhook □□□□□□□□□□□□□□ `GET /api/subscriber` □□□
- □□□□□□□□ - □□□□□□□□□□□□□□□□□
- □□□□ - □□□□□□ API □□□□□□□□□□
- □□□□□ - □ OmniHSS □□□□□□□□□□□□□□□□□□□□

Webhook □□□□

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1. □□□□ - □□□□□□□□□□□□□□□□□□□IMS □□□□
2. **HSS** □□□□ - OmniHSS □□□□ Diameter □□/□□
3. **Webhook** □□□ - □□□□□□□□□□ webhook□HSS □□□□□□□□ HTTP POST
4. □□□□□□□ - Webhook □□□□□□□□□□□□□□□□ JSON
5. □□□□□□□□ - □□□□□□□ HTTP 200-299 □□□□□

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- □□□□□□□□ - Webhooks □□□□□□□□□□□□□□□□
- □□ - Webhook □□□ 5 □□□□
- □□□ - □□□□□□□□□□□□□□□□□□□□□□ webhook
- □□□□□ - □□□□□□□□□□□□□□□□

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Webhook □□

OmniHSS □□□□□□□□□ webhooks□

EPC/LTE □□

□□	□□	□□
`update_location_request`	S6a ULR	□□□□□□□□□□□□□□□
`authentication_information_request`	S6a AIR	□□□□□□□□□□□□□□□
`purge_request`	S6a PUR	MME □□□□□□□□□□□□□□□□□□
`cancel_location_answer`	S6a CLA	MME □□□□□□□

IMS □□

□□	□□	□□
`ims_registration`	Cx SAR	□□□□□ IMS/VoLTE □□
`ims_deregistration`	Cx SAR (de-reg)	□□□□□ IMS
`ims_profile_request`	Sh UDR	□□□□□□□□□□ IMS ××□□□

□□□□ (PCRF)

□□	□□	□□
`policy_request`	Gx CCR	P-GW □□□□□□□□□□□□
`media_authorization`	Rx AAR	P-CSCF □□ IMS □□□□□□□

□ IMSI □□

□□	□□	□□
`imsi_switch`	ULR for different IMSI on same SIM	□□□□ IMSI SIM □□□□□□□ IMSI

Webhook □□

□□□□

□□□□□□□OmniHSS □□□□□ webhook URL □□ HTTP POST □□□

```
POST /your-webhook-endpoint HTTP/1.1
Host: your-server.com
Content-Type: application/json
X-OmniHSS-Event: update_location_request
X-OmniHSS-Event-ID: 550e8400-e29b-41d4-a716-446655440000
X-OmniHSS-Timestamp: 2025-01-15T14:30:00Z

{
  "event": "update_location_request",
  "event_id": "550e8400-e29b-41d4-a716-446655440000",
  "timestamp": "2025-01-15T14:30:00Z",
  "subscriber": {
    "id": "d290f1ee-6c54-4b01-90e6-d701748f0851",
    "imsi": "001001123456789",
    "enabled": true,
    "ims_enabled": true,
    "msisdns": [
      {"id": "16fd2706-8baf-433b-82eb-8c7fada847da", "msisdn":
"14155551001"},
      {"id": "27ae3807-9cbf-4a4c-93fc-9d8afdb958eb", "msisdn":
"14155551002"}
    ],
    "sim": {
      "id": "3f2504e0-4f89-41d3-9a0c-0305e82c3301",
      "iccid": "8991101200003204510",
      "is_esim": false
    },
    "key_set": {
      "id": "6ba7b810-9dad-41d1-80b4-00c04fd430c8",
      "amf": "8000"
    },
    "epc_profile": {
      "id": "e58ed763-928c-4155-bee9-fdbaaadc15f3",
      "name": "Premium 100Mbps",
      "ue_ambr_dl_kbps": 100000,
      "ue_ambr_ul_kbps": 50000
    },
    "ims_profile": {
      "id": "7c9e6679-7425-40de-944b-e07fc1f90ae7",
      "name": "Standard VoLTE"
    },
    "roaming_profile": {
      "id": "9c858901-8a57-4791-81fe-4c455b099bc9",
```

```
      "name": "International Roaming Allowed"
    },
    "subscriber_state": {
      "mme_host": "mme-01.example.com",
      "mme_realm": "epc.mnc001.mcc001.3gppnetwork.org",
      "visited_plmn": "001001",
      "last_update": "2025-01-15T14:30:00Z"
    },
    "custom_attributes": {
      "account_type": "premium",
      "billing_plan": "unlimited"
    }
  },
  "event_context": {
    "visited_plmn": "310410",
    "mme_host": "mme-roaming.example.com",
    "location_update_type": "initial_attach"
  }
}
```

□□□□

□□	□□	□□
`event`	string	□□□□□□□□ `update_location_request` □
`event_id`	string	□ webhook □□□□□ UUID
`timestamp`	string	□□□□□□ ISO 8601 □□□
`subscriber`	object	□□□□□□□□□□□□□ `GET /api/subscriber/:id` □□□
`event_context`	object	□□□□□□□□□□□□□

□□□□□□□

`event_context` □□□□□□□□□□□□□

□□ **`update_location_request`:**

```
{
  "visited_plmn": "310410",
  "mme_host": "mme-roaming.example.com",
  "mme_realm": "epc.mnc410.mcc310.3gppnetwork.org",
  "location_update_type": "initial_attach"
}
```

□□ **`imsi_switch`**:

```
{
  "previous_imsi": "001001111111111",
  "new_imsi": "310410222222222",
  "sim_id": "3f2504e0-4f89-41d3-9a0c-0305e82c3301",
  "previous_mme_host": "mme-home.example.com",
  "new_mme_host": "mme-roaming.example.com"
}
```

□□ **`ims_registration`**:

```
{
  "scscf_host": "scscf-01.ims.example.com",
  "public_identities": [
    "sip:001001123456789@ims.mnc001.mcc001.3gppnetwork.org",
    "sip:+14155551001@ims.example.com",
    "tel:+14155551001"
  ]
}
```

HTTP □

□	□□	□□
`Content-Type`	□□□ `application/json`	`application/json`
`X-OmniHSS-Event`	□□□□	`update_location_request`
`X-OmniHSS-Event-ID`	□□□□□□□	UUID
`X-OmniHSS-Timestamp`	□□□□□	ISO 8601 □□
`User-Agent`	OmniHSS □□	`OmniHSS/1.0`

□□

□□ Webhooks

Webhooks □□ OmniHSS API □□□

□□□□ **Webhook**

```
curl -k -X POST https://hss.example.com:8443/api/webhook \
  -H "Content-Type: application/json" \
  -d '{
    "webhook": {
      "url": "https://your-server.com/omnihss-webhook",
      "events": [
        "update_location_request",
        "ims_registration",
        "imsi_switch"
      ],
      "enabled": true,
      "description": "□□□□□□ webhook"
    }
  }'
```

□□:

```
{
  "data": {
    "id": "4e5d6c7b-8a9f-4b0c-8d1e-2f3a4b5c6d7e",
    "url": "https://your-server.com/omnihss-webhook",
    "events": [
      "update_location_request",
      "ims_registration",
      "imsi_switch"
    ],
    "enabled": true,
    "description": "□□□□□□ webhook",
    "created_at": "2025-01-15T14:00:00Z"
  }
}
```

□□ Webhooks

```
curl -k https://hss.example.com:8443/api/webhook
```

□□ Webhook

```
curl -k -X PUT https://hss.example.com:8443/api/webhook/4e5d6c7b-
8a9f-4b0c-8d1e-2f3a4b5c6d7e \
  -H "Content-Type: application/json" \
  -d '{
    "webhook": {
      "enabled": false
    }
  }'
```

□□ Webhook

```
curl -k -X DELETE
https://hss.example.com:8443/api/webhook/4e5d6c7b-8a9f-4b0c-8d1e-
2f3a4b5c6d7e
```

Webhook □□□□

□□ webhook □□□□□

1. □□ **POST** □□□□□ `Content-Type: application/json`
2. □□□□ - □ 5 □□□□ HTTP 200-299
3. □□□□ - □□□□□□□□□□
4. □□ **HTTPS** - □□□□□□□ TLS/SSL □□□□□□
5. □□□□ - □□□□□□ OmniHSS□□□□□□□□□

□□ Webhook □□□□ (Node.js/Express):

```
const express = require('express');
const app = express();

app.post('/omnihss-webhook', express.json(), (req, res) => {
  const { event, subscriber, event_context } = req.body;

  console.log(`□□□□: ${event}`);
  console.log(`□□□ IMSI: ${subscriber.imsi}`);

  // □□□□□□□□
  // ... □□□□□□□□□□ ...

  // □□□□□□□□□□
  res.status(200).json({ received: true });

  // □□□□□□□□□□
  processWebhook(req.body).catch(console.error);
});

async function processWebhook(payload) {
  // ???□□□□□□□
  // □□□□□□□□□□□□□□□□
}

app.listen(3000);
```

□□

1. □□□□□□□□□

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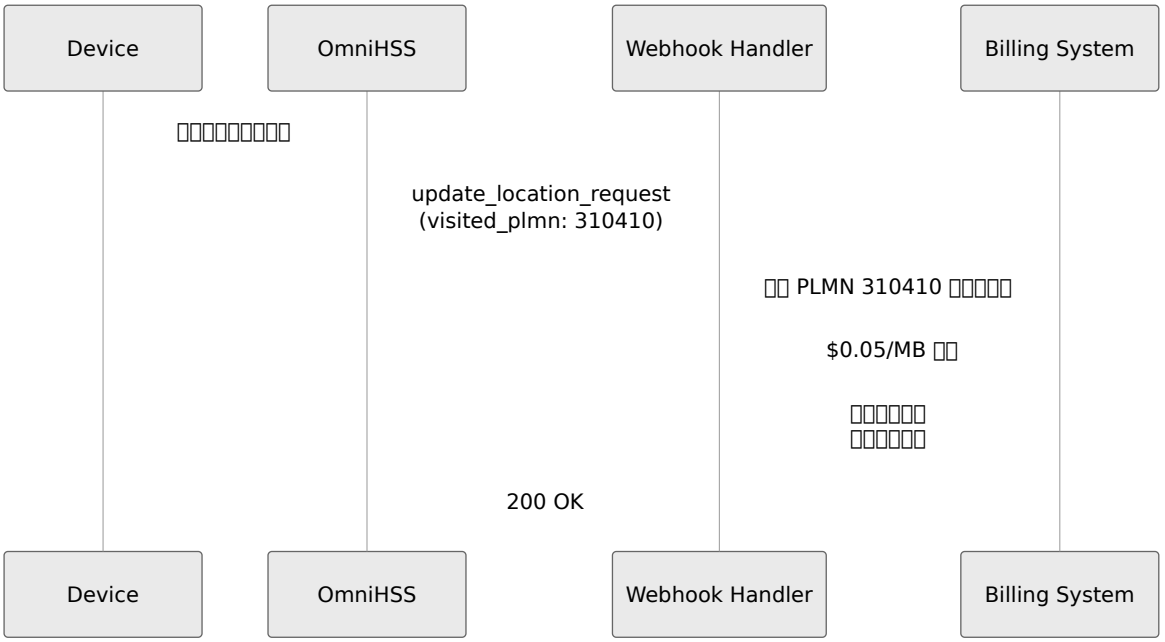

Device
OmniHSS
Webhook Handler
Billing System
□□□□□□□□□□
update_location_request
(visited_plmn: 310410)
□□ PLMN 310410 □□□□□
$0.05/MB □□
□□□□□□□
□□□□□□□
200 OK
Device
OmniHSS
Webhook Handler
Billing System

□□:

- □□□□□□□□□□□□□□
- □□□□□□□□□□□□
- □□□□□□□□□/□□□□
- □□□□□□□□□□□□□

2. □□□□□

□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□

□□: □□□□□□□□□□□

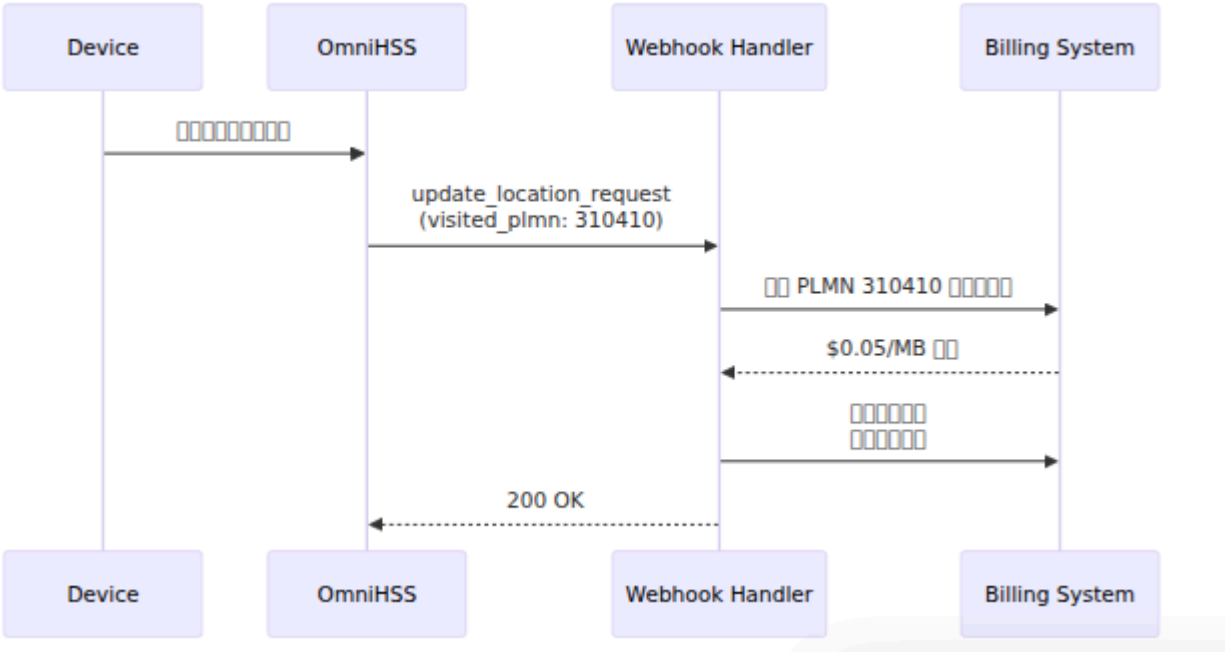
```
// Webhook □□□□□□□□□□□□□□□□
app.post('/omnihss-webhook', async (req, res) => {
  const { event, subscriber, event_context } = req.body;

  if (event === 'update_location_request') {
    await analytics.track({
      event: 'subscriber_location_update',
      imsi: subscriber.imsi,
      visited_plmn: event_context.visited_plmn,
      timestamp: req.body.timestamp,
      profile: subscriber.epc_profile.name
    });
  }

  res.status(200).send();
});
```

□□□□□:

- □□ MME □□□□□□
- □□□□□□□□□
- □□□□□□
- IMS □□□□□

3. □□□□□□□

□□□□□□□□□□□□□□□□□□□



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1. □□□□□□□
   - □□□□□ A □□□
   - 30 □□□□□□ B □□□□□□□□□□□□□
   - □□: □□□□□□□□□□□□□□□□□
2. **IMSI** □□□□
   - □□ SIM □□□□□□ IMSI □□
   - □□□ SIM □□□□□□□□□□ IMSI □□
   - □□: □□ SIM □□□□□ IMSI□□□□□□□□
3. □□□□□□□□
   - □□□□□□□□□□□□□□□□□□□□□□□□□□□□
   - □□: □□□□□□□□□□□□□□□□□

□□□□:

```
@app.route('/omnihss-webhook', methods=['POST'])
def webhook_handler():
    data = request.json
    subscriber = data['subscriber']
    event_context = data.get('event_context', {})

    if data['event'] == 'update_location_request':
        visited_plmn = event_context.get('visited_plmn')

        # □□□□□□□□□
        if visited_plmn in BLOCKED_PLMNS:
            disable_subscriber(subscriber['imsi'])
            alert_security_team(subscriber, '□□□□□□□□ PLMN')

        # □□□□□□□□□
        if is_impossible_travel(subscriber['imsi'], visited_plmn):
            flag_for_review(subscriber['imsi'])
            alert_fraud_team(subscriber, '□□□□□□□□□□')

    return jsonify({'status': 'ok'}), 200
```

4. □□□□□

□□□□□□□□□□□□□□□□□□□□□□

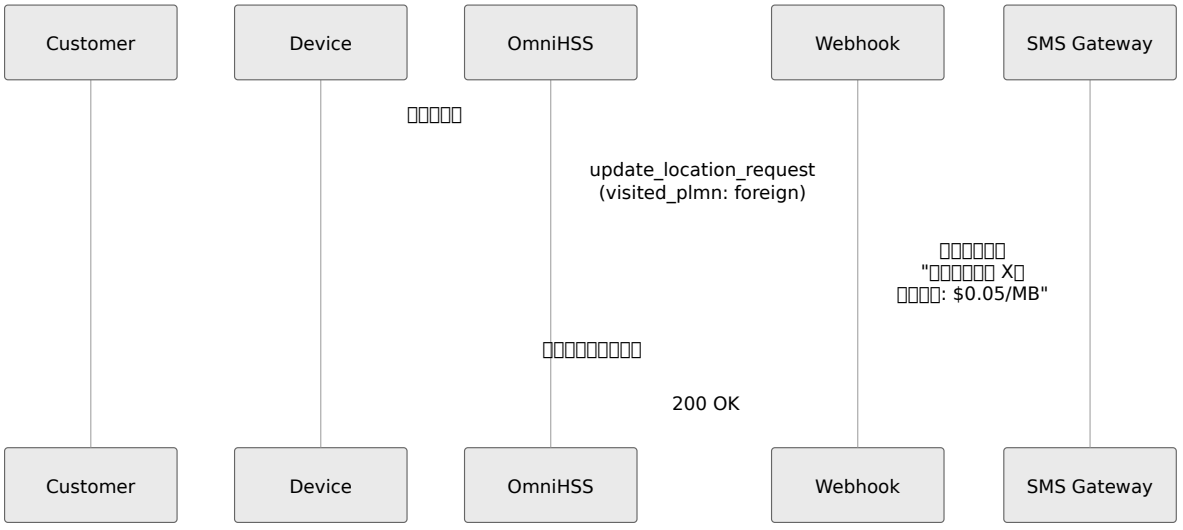
□□: □□□□□□□□ VoLTE □□□□□ IMS

```
app.post('/omnihss-webhook', async (req, res) => {
  const { event, subscriber } = req.body;

  if (event === 'ims_registration' && !subscriber.ims_enabled) {
    // □□ IMS □□ - □□□□ IMS
    await omnihss.updateSubscriber(subscriber.id, {
      ims_enabled: true,
      custom_attributes: {
        ...subscriber.custom_attributes,
        volte_activated_at: new Date().toISOString()
      }
    });

    // □□ CRM
    await crm.updateCustomer(subscriber.imsi, {
      features: ['volte']
    });
  }

  res.status(200).send();
});
```

5. □□□□

□□□□□□□□□□□□□□□□□□

□□: □□□□□□□□□□□□□



□□□□:

- "□□□□□ [□□]□□□□□□□□□"
- "□□□□□ 80% □□□□□□"
- "□□□□□□□□□ VoLTE □□"
- "□□□□□□□□□□□□□"

6. □ IMSI SIM □□

□□□□□□□□□ IMSI SIM □□□□□□□□□□□ IMSI □□□□□□□

```
app.post('/omnihss-webhook', async (req, res) => {
  const { event, subscriber, event_context } = req.body;

  if (event === 'imsi_switch') {
    const { previous_imsi, new_imsi, sim_id } = event_context;

    // □□ IMSI ��□□□□□□
    await db.logImsiSwitch({
      sim_id,
      from_imsi: previous_imsi,
      to_imsi: new_imsi,
      timestamp: req.body.timestamp
    });

    // □□□□□□
    await billing.endSession(previous_imsi);
    await billing.startSession(new_imsi);

    // □□□□□□□□□□□□□□□□□□□□□□
    const switchCount = await db.getSwitchCount(sim_id, '24h');
    if (switchCount > 10) {
      await alertFraudTeam(`□□ IMSI □□: SIM ${sim_id}`);
    }
  }

  res.status(200).send();
});
```

7. □□□□□□□

□ OmniHSS □□□□□□□□□□□□□□

□□□□:

- **CRM** □□ - □□□□□□□□□□□□□□□□□
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Webhook □□/□□

□□□□ webhooks □□ OmniHSS□□□□□□□□□□

```
# □□□□□□□ webhook
curl -k -X POST https://hss.example.com:8443/api/webhook \
  -H "Content-Type: application/json" \
  -d '{
    "webhook": {
      "url": "https://your-server.com/omnihss-webhook",
      "events": ["update_location_request"],
      "secret": "your-secret-key-here"
    }
  }'
```

OmniHSS □□□□□ `X-OmniHSS-Signature` □□

```
X-OmniHSS-Signature:
sha256=5d7a8f9b2c1e3a4d6f7e8b9c0a1b2c3d4e5f6a7b8c9d0e1f2a3b4c5d6e7f8a
```

□□□□:

```
const crypto = require('crypto');

function verifyWebhook(req) {
  const signature = req.headers['x-omnihss-signature'];
  const secret = process.env.WEBHOOK_SECRET;
  const payload = JSON.stringify(req.body);

  const expectedSignature = 'sha256=' +
    crypto.createHmac('sha256', secret)
      .update(payload)
      .digest('hex');

  return crypto.timingSafeEqual(
    Buffer.from(signature),
    Buffer.from(expectedSignature)
  );
}

app.post('/omnihss-webhook', (req, res) => {
  if (!verifyWebhook(req)) {
    return res.status(401).json({ error: '□□□□□' });
  }

  // □□ webhook...
  res.status(200).send();
});
```

□□□□

1. □□ **HTTPS** - □□□ webhook □□□□ TLS
2. □□□□ - □□ webhook □□□□□□□
3. □□□□ - □ webhook □□□□□□□□□
4. **IP** □□□ - □□ webhook □□ OmniHSS IP □□
5. □□□□ - □□ webhook □□□□□□□
6. □□□□ - □□□□□□□□□□ webhook □□
7. □□□□ - □□□□□□□□ webhook □□□□□□□□□□□□□□

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Webhook □□□□ □□□□□□□□□□

- IMSI□□□□□□□□
- MSISDN□□□□□□□
- □□□□□□□□□ PLMN□MME□
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- **GDPR** - □□ webhook □□□□□□□□ GDPR
- □□□□ - □□□□□□□□□□□□
- □□□□ - □□ webhook □□□□
- □□ - □ webhook □□□□ TLS
- □□□□ - □□□□ webhook □□□□□□□□

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Webhook □□□

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- □□□□□ webhook □□□
- Webhook □□□□□□□□□□

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1. □□ **webhook** □□□□:

   ```
   curl -k https://hss.example.com:8443/api/webhook
   # □□ "enabled": true
   ```

2. □□ **webhook** □□□□:

- □□□□□□□□□□ webhook □ `events` □□□
- □□: □□□□□ `ims_registration` □□□□□□□□□□□□□□□□□

3. □□ **HSS** □□□

- □□ webhook □□□□
- □□□□□□□□□
- □□□□ DNS □□□□

4. □□□□□□□□□□

```
curl -X POST https://your-server.com/omnihss-webhook \
  -H "Content-Type: application/json" \
  -d '{"test": true}'
```

Webhook □□

□□□

- HSS □□□□ webhook □□□□
- Webhook □□□□□□□□ HSS □□□□□

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1. □□□□□

- □ 5 □□□□ HTTP 200
- □□□□□□□□□□

2. □□□□□□□

```
// □□ - □□□□□□□
app.post('/webhook', (req, res) => {
  processData(req.body); // □□ 10 □
  res.status(200).send();
});

// □ - □□□□□□□□
app.post('/webhook', (req, res) => {
  res.status(200).send(); // □□□□
  processData(req.body); // □□□□
});
```

□□□ Webhooks

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- □□□□□□□□□
- □□□□□ `event_id` □□

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- □□□□□□□ OmniHSS □□□□□□□□□□□□□□□□□□
- □□□□□□□□□□ webhook

□□□□□

□□□ `event_id` □□□□□□

```
const processedEvents = new Set();

app.post('/omnihss-webhook', (req, res) => {
  const eventId = req.body.event_id;

  if (processedEvents.has(eventId)) {
    // □□□□□□□
    return res.status(200).json({ status: 'duplicate' });
  }

  processedEvents.add(eventId);

  // □□ webhook...
  processWebhook(req.body);

  res.status(200).json({ status: 'processed' });
});
```

Webhook □□□□

□□□

- □□□□ HTTP 4xx □ 5xx
- HSS □□ webhook □□□□

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1. **401 Unauthorized** - □□□□□□
   - □□ webhook □□□□□□□□□
   - □□□□□□□□
2. **400 Bad Request** - □□□□
   - □□ webhook □□□□
   - □□□□ Content-Type □
3. **500 Internal Server Error** - □□□□
   - □□□□□□□□

- □□□□□□□□□□□□□

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```
app.post('/omnihss-webhook', async (req, res) => {
  try {
    // □□□□
    if (!verifyWebhook(req)) {
      return res.status(401).json({ error: 'Invalid signature' });
    }

    // □□□□
    if (!req.body.event || !req.body.subscriber) {
      return res.status(400).json({ error: 'Invalid payload' });
    }

    // □□ webhook
    await processWebhook(req.body);

    res.status(200).json({ status: 'ok' });

  } catch (error) {
    console.error('Webhook processing error:', error);
    // □□ 200 □□□□□□□□□□□□□□□□□
    res.status(200).json({ status: 'error', message: error.message
});
  }
});
```

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- □□ webhook □□□□□□□□□□
- □□□□□□ null □□□

□□□□□□

1. □□□□□□□□□□ - □□□□□□□□□□□□□□IMS□□□□□

2. □□□□□□□ - □□□□□□ webhook □□□□□□□□□□

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```
const { subscriber } = req.body;

// □□□□□□□□
const imsProfile = subscriber.ims_profile || { name: 'No IMS' };
const roamingProfile = subscriber.roaming_profile || { name: 'No
Roaming' };

// □□□□□□ MSISDN
const msisdns = subscriber.msisdns || [];
```

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Webhook □□

□□ webhook □□□□□□□□

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- Webhook □□□□□□□□□□□□
- Webhook □□□□□□□□□□□□□□□□□□□
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- □□□□□□□□
- □□□□□□

□□□□□□□□□**Prometheus/Grafana**□□

```
# Webhook □□□
rate(omnihss_webhook_success_total[5m]) /
rate(omnihss_webhook_attempts_total[5m])

# Webhook □□
histogram_quantile(0.95, omnihss_webhook_duration_seconds)
```

Webhook □□

□□□□□ webhook □□□□□□□□□□□□

□□□□□

```
{
  "timestamp": "2025-01-15T14:30:00Z",
  "level": "info",
  "component": "webhook",
  "event_id": "550e8400-e29b-41d4-a716-446655440000",
  "webhook_id": "4e5d6c7b-8a9f-4b0c-8d1e-2f3a4b5c6d7e",
  "event_type": "update_location_request",
  "subscriber_imsi": "001001123456789",
  "endpoint": "https://your-server.com/omnihss-webhook",
  "http_status": 200,
  "duration_ms": 145,
  "error": null
}
```

← □□□□□□ | □□□□API □□ →