

Implement T-ADS Functionality Support in StarOS as MME

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Introduction

This document describes how the Mobility Management Entity handles Terminating Access Domain Selection functionality and its implementation in MME.

Prerequisites

Requirements

Cisco recommends that you have knowledge of the StarOS-Mobility Management Entity (MME) admin guide.

3GPP Technical Specifications - 29.272, 23.292

Components Used

This document is not restricted to specific software and hardware versions.

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

Overview

T-ADS Functionality

Terminating Access Domain Selection (T-ADS) is a functionality in the IP Multimedia Subsystem (IMS) network that determines where a call is terminated for a Voice over Long-Term Evolution (VoLTE) user

and ensures that the IMS routes the call to the User Equipment (UE) when it is in 2nd Generation/3rd Generation (2G/3G) coverage. If LTE coverage is lost, the UE can still be able to use Circuit-Switched (CS) voice services, even if Single Radio Voice Call Continuity (SR-VCC) is not available. To route Mobile-Originating (MO) and Mobile-Terminating (MT) calls appropriately, the IMS must know whether the UE is in LTE or Universal Terrestrial Radio Access Network (UTRAN) or GSM EDGE Radio Access Network (GERAN) CS coverage. T-ADS is the function that provides this support.

This call flow describes how the Home Subscriber Server (HSS), MME and IMS network interact to determine the best access network for terminating a voice call.

1. IMS Network Receives an Incoming Call

- A terminating voice call arrives at the Serving Call Session Control Function (S-CSCF) in the IMS core.
- The S-CSCF queries the HSS to determine the best way to route the call based on the UE's current access network.

2. S-CSCF → HSS: Send User-Data-Request (UDR).

- The S-CSCF sends a UDR to HSS to fetch the latest subscriber information.
- The request asks for:
 - IMS-VoPS (IMS Voice over PS Sessions support)
 - Last known Radio Access Technology (RAT) type
 - UE's last seen location Tracking Area Identity (TAI) or Routing Area Identity (RAI) information.

3. HSS → MME: Insert-Subscriber-Data-Request (ISDR)

- To get real-time UE location and network support details, HSS sends ISDR to MME.
- ISDR contains:
 - T-ADS Data Request Flag (T-ADS Data Request:1)
 - Request for RAT-Type
 - Request for Last-UE-Activity-Time

4. MME → HSS: Insert-Subscriber-Data-Answer (ISDA)

- MME retrieves:
 - Current UE registration details
 - Latest RAT-Type (LTE, 3G, 5G)
 - Last-UE-Activity-Time
- MME responds to HSS with an ISDA message, providing the requested information.

5. HSS Determines the Best Terminating Access

- HSS evaluates:
 - If UE is active in LTE, and VoLTE is supported → IMS call via LTE.
 - If UE is in GERAN/UTRAN (2G/3G), and Circuit Switched FallBack (CSFB) is available → Redirect call via CSFB.
 - If UE is in New Radio (NR) = 5G Non-StandAlone/StandAlone (NSA/SA), determine Evolved Packet System (EPS) fallback or Voice over New Radio (VoNR) options.

6. HSS → S-CSCF: Send User-Data-Answer (UDA)

- HSS responds with a User-Data-Answer (UDA), which includes:
 - IMS-Voice-Over-PS-Sessions-Supported AVP

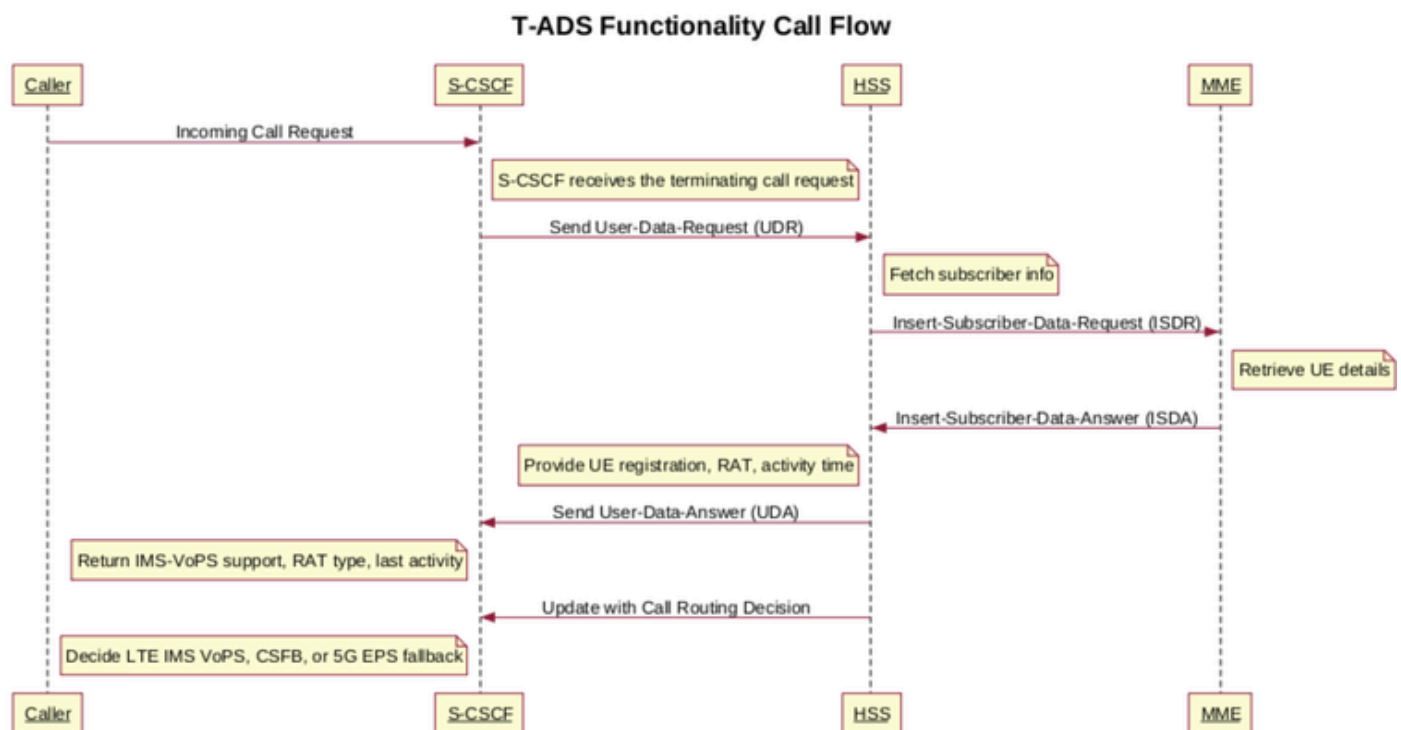
- Homogeneous-Support-of-IMS-Voice-Over-PS-Sessions AVP
- Last known RAT Type (LTE, GERAN, UTRAN, NR)
- Last-UE-Activity-Time (if available)

7. HSS → S-CSCF: Update with Call Routing Decision

- HSS informs S-CSCF about the selected access network:
 - If LTE IMS VoPS is supported, continue call setup over LTE.
 - If LTE IMS VoPS is NOT supported, initiate CSFB to 2G/3G for circuit-switched fallback.
 - If 5G NSA, decide whether to use EPS fallback or VoNR.

8. IMS Call Setup Over the Selected Access

- If VoLTE is supported → Call proceeds over LTE IMS.
- If CSFB is required → Call is redirected to 2G/3G via SGs interface.
- If EPS fallback is triggered → Call is handed over to LTE from 5G.



T-ADS Functionality Call Flow

MME's Role in T-ADS Functionality

MME plays a crucial role in the Terminating Access Domain Selection (T-ADS) process by providing real-time network and subscriber-related information to the HSS and IMS Core. Its primary functions in T-ADS include:

1. Providing UE's Last Known Access Information

- When HSS requests the last known Radio Access Technology (RAT) Type and Last-UE-Activity-Time, the MME retrieves and sends this data.
- This helps the HSS and IMS core determine whether the UE is on an LTE/5G network (for VoPS) or a legacy network (for CS fallback).

2. Handling Insert-Subscriber-Data Requests (ISDR) from HSS

- Upon receiving an ISDR message from the HSS, the MME extracts:
 - Current RAT Type (LTE, NR, GERAN, UTRAN).
 - Timestamp of the last radio contact with the UE.
 - IMS Voice over PS Sessions Support status in the UE's registered tracking area.
- The MME then sends an Insert-Subscriber-Data Answer (ISDA) message back to the HSS, containing the requested details.

3. Supporting VoLTE or Circuit-Switched Fallback (CSFB) Decisions

- If the IMS Voice over PS Sessions is supported, the IMS Core can continue the call over LTE VoLTE.
- If the UE is not on an IMS VoPS-supported network, the MME can facilitate CSFB to 2G/3G networks via SGs interface.

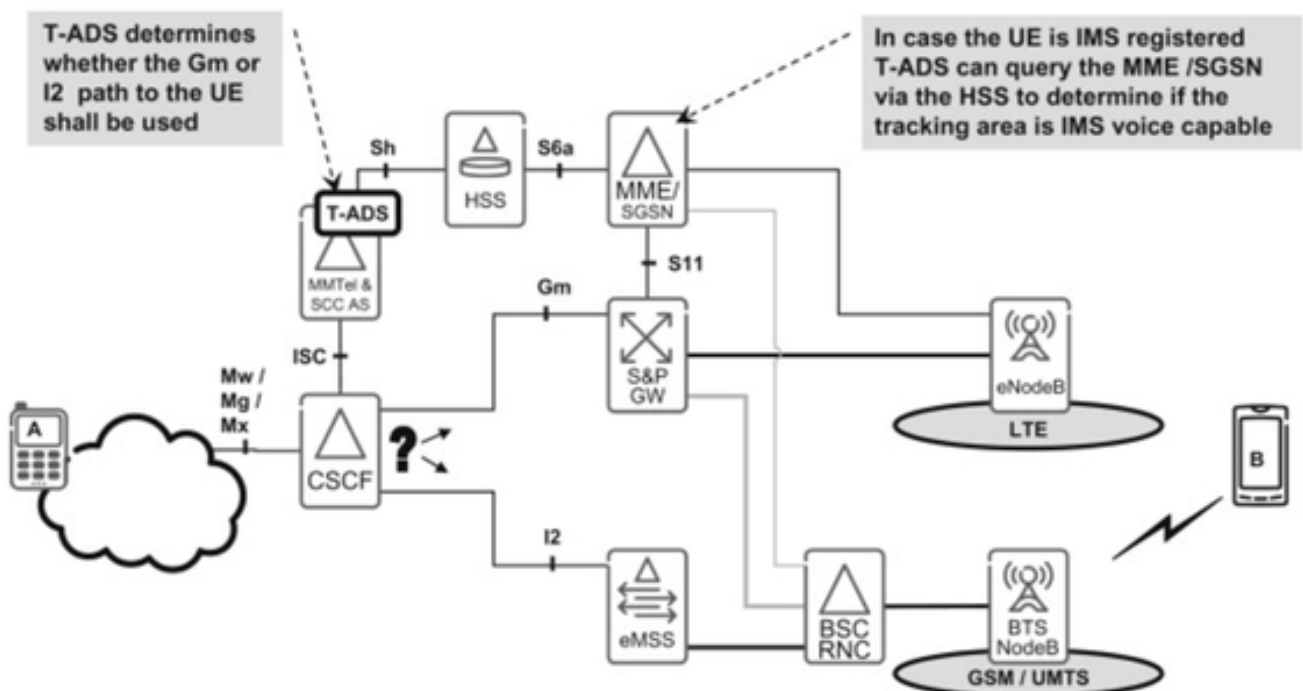
4. Assisting IMS Core in Call Routing Decisions

- The IMS Core and SCC AS rely on the MME's response to determine whether:
 - The call can proceed over VoLTE.
 - EPS Fallback to LTE from 5G is needed.

CSFB to a 2G/3G network is required for call delivery.

Configure

Network Diagram



Network Diagram of EPS and IMS System

Configurations

Certain configurations need to be done in MME to facilitate T-ADS support:

associate

Associates various MME -specific lists and databases with this call control profile

Mode

Exec > Global Configuration > Call Control Profile Configuration

configure > call-control-profile profile_name

Entering the command sequence results in the prompt:

```
[local]host_name(config-call-control-profile-profile_name)#
```

Syntax

```
associate hss-peer-service service_name s6a-interface
```

network-feature-support-ie

Configures support for the IMS Voice over Packet-Switched indication and Homogeneous Support of IMS Vo

Product

MME

Privilege

Administrator

Mode

Exec > Global Configuration > Call Control Profile Configuration

configure > call-control-profile profile_name

Entering the command sequence results in the prompt:

```
[local]host_name(config-call-control-profile-profile_name)#
```

Syntax

```
network-feature-support-ie ims-voice-over-ps supported
```

diameter update-dictionary-avps

Specifies which release of 3GPP TS 29.272 is to be used for the HSS peer service.

Mode

Exec > Global Configuration > Context Configuration > HSS Peer Service Configuration

configure > context context_name > hss-peer-service service_name

Entering the command sequence results in the prompt:

```
[context_name]host_name(config-hss-peer-service)#
```

Syntax

diameter update-dictionary-avps 3gpp-r11

Verify

Using the mentioned configurations, the call flow was tested in our internal TAC lab and could see the proper parameters from StarOS MME.

Here is the successful pcap collected using mentioned reference configurations.

No.	Time	Protocol	Info
1	2024-04-08 09:07:52.717000	SIAP/NAS...	InitialUEMessage, Attach request, PDN connectivity request
2	2024-04-08 09:07:52.791000	DIAMETER	cmd=3GPP-Authentication-Information Request(318) flags=RP-- appl=3GPP S6a/S6d(16777251) h2h=adb07543 e2e=a0ec2c
3	2024-04-08 09:07:52.797000	DIAMETER	cmd=3GPP-Authentication-Information Answer(318) flags=-P-- appl=3GPP S6a/S6d(16777251) h2h=adb07543 e2e=a0ec2c
4	2024-04-08 09:07:52.798000	SIAP/NAS...	DownlinkNASTransport, Authentication request
5	2024-04-08 09:07:52.837000	SIAP/NAS...	UplinkNASTransport, Authentication response
6	2024-04-08 09:07:52.838000	SIAP/NAS...	DownlinkNASTransport, Security mode command
7	2024-04-08 09:07:52.870000	SIAP/NAS...	UplinkNASTransport, Security mode complete
8	2024-04-08 09:07:52.872000	DIAMETER	cmd=3GPP-Update-Location Request(316) flags=RP-- appl=3GPP S6a/S6d(16777251) h2h=adb07544 e2e=a0ec2d
9	2024-04-08 09:07:52.876000	DIAMETER	cmd=3GPP-Update-Location Answer(316) flags=-P-- appl=3GPP S6a/S6d(16777251) h2h=adb07544 e2e=a0ec2d
10	2024-04-08 09:07:52.882000	GTPv2	Create Session Request
11	2024-04-08 09:07:52.883000	GTPv2	Create Session Request

```
AVP Vendor Id: 3GPP (10415)
<Feature-List: 2080375815>
  Feature-List Flags: 0x7c000407
    0... .. = Additional MSISDN: Not supported
    .1.. .. = UE Time Zone Retrieval: Supported
    ..1. .. = Partial Purge from a Combined MME/SGSN: Supported
    ...1. .. = State/Location Information Retrieval: Supported
    ....1.. .. = Terminating Access Domain Selection Data Retrieval: Supported
```

MME PCAP Highlighting ULA Diameter Message

No.	Time	Protocol	Info
18	2024-04-08 09:07:52.891000	SIAP/NAS...	InitialContextSetupRequest, Attach accept, Activate default EPS bearer context request
19	2024-04-08 09:07:52.944000	SIAP/NAS...	UplinkNASTransport, Attach complete, Activate default EPS bearer context accept
20	2024-04-08 09:07:53.083000	DIAMETER	cmd=3GPP-Insert-Subscriber-Data Request(319) flags=RP-- appl=3GPP S6a/S6d(16777251) h2h=1b1d9e0c e2e=89059e0c
21	2024-04-08 09:07:53.083000	DIAMETER	cmd=3GPP-Insert-Subscriber-Data Answer(319) flags=-P-- appl=3GPP S6a/S6d(16777251) h2h=1b1d9e0c e2e=89059e0c
22	2024-04-08 09:07:53.183000	SIAP	InitialContextSetupResponse

```
> Frame 20: 770 bytes on wire (6160 bits), 770 bytes captured (6160 bits)
> Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)
> Internet Protocol Version 4, Src: 192.168.1.100, Dst: 10.1.30.1
> Stream Control Transmission Protocol, Src Port: 3868 (3868), Dst Port: 0 (0)
< Diameter Protocol
  Version: 0x01
  Length: 708
  > Flags: 0xc0, Request, Proxyable
  Command Code: 3GPP-Insert-Subscriber-Data (319)
  ApplicationId: 3GPP S6a/S6d (16777251)
  Hop-by-Hop Identifier: 0x1b1d9e0c
  End-to-End Identifier: 0x89059e0c
  > AVP: Session-Id(263) l=58 f=-M- val=calipers-session-id;2016325686;1916625135;03370708
  > AVP: Origin-Host(264) l=24 f=-M- val=hss1.caliper.com
  > AVP: Origin-Realm(296) l=19 f=-M- val=caliper.com
  > AVP: Destination-Host(293) l=15 f=-M- val=sim-s6a
  > AVP: Destination-Realm(283) l=17 f=-M- val=cisco.com
  > AVP: User-Name(1) l=23 f=-M- val=123456001000000
  > AVP: Vendor-Specific-Application-Id(260) l=32 f=-M-
  > AVP: Supported-Features(628) l=56 f=VM- vnd=TGPP
  > AVP: Auth-Session-State(277) l=12 f=-M- val=NO_STATE_MAINTAINED (1)
  < AVP: IDR-Flags(1490) l=16 f=VM- vnd=TGPP val=2
    AVP Code: 1490 IDR-Flags
    > AVP Flags: 0xc0, Vendor-Specific: Set, Mandatory: Set
    AVP Length: 16
    AVP Vendor Id: 3GPP (10415)
    < IDR-Flags: 2>
    < IDR Flags: 0x00000002
      0000 0000 0000 0000 0000 000. .... = Spare: 0x000000
      .... .. = P-CSCF Restoration Request: Not set
      .... .. = RAT-Type Requested: Not set
      .... .. = Remove SMS Registration: Not set
      .... .. = Local Time Zone Request: Not set
      .... .. = Current Location Request: Not set
      .... .. = EPS Location Information Request: Not set
      .... .. = EPS User State Request: Not set
      .... ..1. = T-ADS Data Request: Set
      .... ..0 = UE Reachability Request: Not set
```

MME PCAP Highlighting ISDR Diameter Message

No.	Time	Protocol	Info
18	2024-04-08 09:07:52.891000	S1AP/NAS...	InitialContextSetupRequest, Attach accept, Activate default EPS bearer context request
19	2024-04-08 09:07:52.944000	S1AP/NAS...	UplinkNASTransport, Attach complete, Activate default EPS bearer context accept
20	2024-04-08 09:07:53.083000	DIAMETER	cmd=3GPP-Insert-Subscriber-Data Request(319) flags=RP-- appl=3GPP S6a/S6d(16777251) h2h=1b1d9e0c e2e=89059e0c
21	2024-04-08 09:07:53.083000	DIAMETER	cmd=3GPP-Insert-Subscriber-Data Answer(319) flags=-P-- appl=3GPP S6a/S6d(16777251) h2h=1b1d9e0c e2e=89059e0c
22	2024-04-08 09:07:53.183000	S1AP	InitialContextSetupResponse
▶ Frame 21: 362 bytes on wire (2896 bits), 362 bytes captured (2896 bits) ▶ Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00) ▶ Internet Protocol Version 4, Src: 10.1.30.1, Dst: 192.168.1.100 ▶ Stream Control Transmission Protocol, Src Port: 59126 (59126), Dst Port: 3868 (3868) ▼ Diameter Protocol			
Version: 0x01 Length: 300 ▶ Flags: 0x40, Proxyable Command Code: 3GPP-Insert-Subscriber-Data (319) ApplicationId: 3GPP S6a/S6d (16777251) Hop-by-Hop Identifier: 0x1b1d9e0c End-to-End Identifier: 0x89059e0c ▶ AVP: Session-Id(263) l=58 f=-M- val=calipers-session-id;2016325686;1916625135;03370708 ▶ AVP: Supported-Features(628) l=56 f=V-- vnd=TGPP ▶ AVP: Supported-Features(628) l=56 f=V-- vnd=TGPP ▶ AVP: Result-Code(268) l=12 f=-M- val=DIAMETER_SUCCESS (2001) ▶ AVP: Auth-Session-State(277) l=12 f=-M- val=NO_STATE_MAINTAINED (1) ▶ AVP: Origin-Host(264) l=15 f=-M- val=sim-s6a ▶ AVP: Origin-Realm(296) l=17 f=-M- val=cisco.com ▼ AVP: IMS-Voice-Over-PS-Sessions-Supported(1492) l=16 f=V-- vnd=TGPP val=SUPPORTED (1) AVP Code: 1492 IMS-Voice-Over-PS-Sessions-Supported ▶ AVP Flags: 0x80, Vendor-Specific: Set AVP Length: 16 AVP Vendor Id: 3GPP (10415) IMS-Voice-Over-PS-Sessions-Supported: SUPPORTED (1) ▼ AVP: Last-UE-Activity-Time(1494) l=16 f=V-- vnd=TGPP val=Apr 8, 2024 07:37:52.000000000 UTC AVP Code: 1494 Last-UE-Activity-Time ▶ AVP Flags: 0x80, Vendor-Specific: Set AVP Length: 16 AVP Vendor Id: 3GPP (10415) Last-UE-Activity-Time: Apr 8, 2024 07:37:52.000000000 UTC ▼ AVP: RAT-Type(1032) l=16 f=V-- vnd=TGPP val=EUTRAN (1004) AVP Code: 1032 RAT-Type ▶ AVP Flags: 0x80, Vendor-Specific: Set AVP Length: 16 AVP Vendor Id: 3GPP (10415) RAT-Type: EUTRAN (1004)			

MME PCAP Highlighting ISDA Diameter Message