



**Mavenir Converged Telephony Application Server (CTAS)**

Functional Description Release 10.1

Version 4c

Commercial in Confidence

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## Revision History

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| Version | Date | Reason for Change |
| 0.1 | 13 Aug 2012 | Initial version for release |
| 0.2 | 8 Nov 2012 | Updated version after review comments |
| 0.3 | 21 Dec 2012 | Updated version after second set of review comments received on Nov 30. |
| 0.4 | 15 March  2013 | Updated the document with Lawful Interception description and PVNI dependency. |
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| 2c | Nov 2014 | Updated for SRVCC alerting/pre-alerting feature |
| 2d | Jan 2015 | Updated SDLs for terminating calls |
| 2e | Feb 2015 | Updated with the following:   * DND check * Video calling support * Intra IMPU Call Transfer * Session Discovery * Location Info for WiFi * Misc Updates |
| 2f | Mar 2015 | Updated SDL for CS Retry (section 7.6.3) |
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| Release 10.1 | | |
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|  |  | * Section 6.1.1.10 - update to extract IMSI from IMPI not in standard format. * Section 6.1.1.14 - updated as the CTAS does not use re- invite without sdp (e.g. HOLD use case) and does send INVITE without SDP (e.g. call transfer). * Section 6.1.6 - updated with support for ANSI-41 LOCREQ * Section 7.2.7 - removed, moved to "CTAS Common Basic Procedures" * Section 7.2.8 - removed, moved to "CTAS Common Basic Procedures" * Section 7.4.1 – additional clarifications for OIR/OIP * Section 7.4.9 - Addition of CCBS call flow with external node to trigger CCBS. * Section 7.6 - removed all subsections, those are available in SCC AS Use case document * Section 7.8 - removed all subsections, those are available in SCC AS Use case document |
| 4b | Dec 2016 | Updated with the following:  - Correction to OIR service [Section 7.4.1] |
| 4c | Jan 2018 | Reformat to comply with current documentation standards. |

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# Scope

## Abstract

The present document specifies the characteristics of the system called Converged Multimedia Telephony (MMTEL) Application Server (AS) provided by Mavenir Systems, which will be referred to as CTAS throughout this document. The CTAS is an IMS and GSMA IR.92 compliant Application Server which provides the following high level functions:

* MMTEL supplementary services
* XCAP server for supplementary service configuration operations made via the Ut interface
* Integrated IM-SSF
* Integrated SCC AS
* Integrated Ring Back Tones (RBT) service
* Charging Trigger Function (CTF) for offline charging via Rf interface
* Charging Trigger Function (CTF) for online charging via Ro Interface
* USSI AS

Note that the integrated IM-SSF function is not covered in this document. For details on this component, please refer to the IM-SSF IN-IW Use Cases.

## Target Audience

Teams working with the CTAS and VoLTE/VoWiFi deployment.

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30. Call Transfer (PULL) Use cases
31. Session Discovery Use cases
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# Definitions and Acronyms

## Definitions

|  |  |
| --- | --- |
| **Term** | **Description** |
| O-CTAS | Originating CTAS, i.e. the CTAS serving the IMS originator (A-party) |
| T-CTAS | Terminating CTAS, i.e. the CTAS serving the IMS terminator (B-party) |
| O-MGCF | Outgoing MGCF, i.e. the entity that terminates incoming BICC or ISUP calls from the CS side and originates outgoing calls towards the IMS using SIP (as defined in 3GPP TS 29.163). |
| I-MGCF | Incoming MGCF, i.e. the entity that terminates incoming SIP calls from the IMS side and originates outgoing calls towards the CS side using the BICC or ISUP protocols (as defined in 3GPP TS 29.163) |

## Acronyms

|  |  |
| --- | --- |
| **Acronym** | **Description** |
| 3pcc | 3rd party call control |
| ACM | ISUP Address Complete Message |
| AM | Accounting Management |
| AP | Authentication Proxy |
| ATU-STI | Access Transfer Update – Session Transfer Identifier |
| CB | Communication Barring |
| CCF | Charging Control Function |
| CCPS | Client Configuration and Provisioning Server |
| CD | Communication Deflection |
| CDF | Charging Data Function |
| CDIV | Communication Diversion |
| CFB | Communication Busy |
| CFNL | Communication Forwarding on Not Logged-In |
| CFNR | Communication Forwarding No Reply |
| CFNRc | Communication Forwarding on Subscriber Not Reachable |
| CFU | Communication Forwarding Unconditional |
| CM | Configuration Management |
| CONF | Conference |
| CPG | ISUP Call Progress |
| CS | Circuit Switched |
| CSV | Comma Separated Value |
| CW | Communication Waiting |

|  |  |
| --- | --- |
| **Acronym** | **Description** |
| ECT | Explicit Communication Transfer |
| EPC | Evolved Packet Core |
| FCAPS | Fault, Configuration, Accounting, Performance, Security |
| FE | Front End |
| FM | Fault Management |
| FTN | Forward ToNumber |
| GLS | Geo Location Server |
| gsmSCF | GSM Service Control Function |
| gsmSSF | GSM Service Switching Function |
| gsmSRF | GSM Specialized Resource Function |
| HEP | Header Enrichment Proxy |
| HOLD | Communication Hold |
| HLR | Home Location Register |
| HSS | Home Subscriber Server |
| ICB | Incoming Communications Barring |
| ICS | IMS Service Centralization and Continuity |
| IMS | IP Multimedia Subsystem |
| IM-SSF | IP Multimedia – Service Switching Function |
| IN | Intelligent Networks |
| IRI | Intercept Related Information |
| ISC | IMS Service Control |
| LI | Lawful Intercept |
| LIMS | Lawful Intercept Management System |
| MGCF | Media Gateway Control Function |
| MIB | Management Information Base |
| MRFC | Media Resource Function Controller |
| MRFP | Media Resource Function Processor |
| MSIM | Multi-SIM |
| NSR | Non-Subscriber Related |
| OCB | Outgoing Communications Barring |
| OCF | Online Charging Function |
| OIP | Originating Identification Presentation |
| OIR | Originating Identification Restriction |
| OSS | Operations Support System |
| PGW | Provisioning Gateway |
| PM | Performance Management |
| RBT | Ring Back Tone |

|  |  |
| --- | --- |
| **Acronym** | **Description** |
| SCC | Service Centralization and Continuity |
| SBC | Session Border Controller |
| SDM | Subscriber Data Manager |
| SDP | Session Description Protocol |
| SGD | Sun Global Desktop |
| SIM | Subscriber Identification Module |
| CTAS | Telephony Application Server |
| TIP | Terminating Identification Presentation |
| TIR | Terminating Identification Restriction |
| UA | User Agent |
| UAC | User Agent Client |
| UAS | User Agent Server |
| UDR | Unified Data Repository |
| USSD | Unstructured Supplementary Service Data |
| USSI | Unstructured Supplementary Service Data over IMS |
| X2TP | X2 Transfer Protocol |

# System Overview

In the IMS architecture, the Converged MMTEL Telephony Application Server (CTAS) provides multimedia telephony service and supplementary services as defined in 3GPP specifications and according to operator’s specific requirements.

In addition, the CTAS supports two key integrated functions:

* An integrated Service Centralization and Continuity (SCC) function provides 3GPP compliant SCC AS functionality. This includes support for session anchoring, terminating access domain selection (T-ADS) and PS to CS SR-VCC access transfer.
* An integrated gsmSSF/IM-SSF function provides a 3GPP compliant O-BCSM/T-BCSM and IN interworking, offering IN services to IMS subscribers using the operator’s existing SCPs. This also includes an integrated gsmSRF function.
* An integrated gsmSCF function providing similar service as that of the IN SCP. The current service is limited to enable redirection of CS calls (originated or terminated) into the IMS domain for the purpose of ICS.

Note: The integrated IM-SSF function is not covered in this document. For details on this component, please refer to the [[37].](#_bookmark26)

The complete list of supplementary services supported at CTAS is:

* Originating Identity Presentation (OIP) and Restriction (OIR)
* Terminating Identity Presentation (TIP) and Restriction (TIR)
* Communication Diversion (CDIV)
* Conference (CONF)
* Communication Hold (HOLD)
* Communication Barring (CB)
* Operator Determined Barring (ODB)
* Communication Waiting (CW)
* Completion of Communications to Busy Subscriber (CCBS)
* Ring Back Tone (RBT)

Additional services supported at CTAS are:

* Originating USSD services
* IN services (CAP2, CAP3, CAP4) via the integrated gsmSSF/IM-SSF with an internal gsmSRF
* IN Services (INAP CS-1, CS-2) via the integrated gsmSSF/IM-SSF with an internal gsmSRF
* CS Redirection service via the integrated gsmSCF using CAP2, CAP3, INAP CS-1, CS-2 and ANSI-41 ver E based WIN.
* Multi UA Registration
* Multi-SIM services
* Multi UA forking
* Intra IMPU Call Transfer (Pull and Push)
* User interrogation and configuration of supplementary services
* Announcement and tones

CTAS also has an inbuilt Service Brokering (SB) functionality which manages service interactions among services and functions hosted within the CTAS. This SB function manages invocations and interactions of one or more services based on predefined service detection and resolution information.

CTAS also provides a flexible and configurable translations framework. This is described in detail in the CTAS Translations Functional Description [[36].](#_bookmark25)

These services are described in greater detail later in this document, or in other referenced documentation.

# Design Considerations

## Assumptions and Dependencies

The following are the assumptions and dependencies related to the delivered functionality:

* The S-CSCF should anchor the subscriber to a particular CTAS instance for the lifetime of the IMS registration.
* The S-CSCF must include an Authorization header containing the IMPI of the served user in the embedded REGISTER request message of the 3rd party REGISTER generated for the network initiated de-registration scenario.
* The S-CSCF must include the embedded UE REGISTER request and 200 OK response in the 3rd party REGISTER request generated as a result of Initial, Refresh, network-initiated de-registration and user initiated de-registration. In the former case, the REGISTER and 200 OK are built by the S-CSCF as no message from the UE is involved.
* The S-CSCF must support a “reg” event subscription from the CTAS with an Expires header containing a zero or non-zero value. In addition to the full registration state information for all registered contacts, the S-CSCF will include the following relevant information for every Contact address included:
  + sip.instance representing either the IMEI-URN provided by the UE or the UUID generated by the S-CSCF
  + Other Contact header field parameter including the feature tags like icsi.mmtel, etc.
  + IMPI
  + ATCF mgmt. URI
  + PANI (UE provided and/or network provided)
  + PVNI

The last three requires non-standard implementation at the S-CSCF.

* The S-CSCF must add a P-Served-User header as defined in RFC 5502 to any non-REGISTER request before sending the request to the CTAS.
* The initial INVITE request received may or may not contain a valid P-Access-Network-Info corresponding to the registered contact. The lack of P-Access-Network-Info will introduce a limitation at CTAS for profile recovery as the CGI is mandatory for any IN transactions.
* Upon network initiated de-registration, the S-CSCF should comply with the sub-clause defined in 24.229, section 5.4.1.4.1, and ensure only those dialogs initiated by or terminated towards the user’s IMS contact address should be cleared. Failure to comply would cause clearing of the active dialog of the forwarding user, or the clearing of calls which were terminated in the CS domain.
* UAs are expected to support P-Early-Media (PEM) header as defined in RFC 5009.
  + When early media is to be authorized in the backward direction, the UAS is expected to insert a P-Early-Media header with a value of “sendonly” in a 183 provisional response containing the SDP answer.
  + An absence of a PEM header or a PEM header with a value of “inactive” in the18x provisional response indicates that early media is not authorized and this should trigger the originating UA to play local ringback when the 180 Ringing is received.
* UAs are expected to comply with SDP offer/answer handling as defined in RFC 6337.
* The UAs are expected to support the UPDATE method and indicate the same by including it in the Allow header of originating INVITE request or 18x / 200 OK response in case of terminating user. If Allow header is not included, it is assumed that UPDATE method is supported. In general, the same assumption is made for all other methods.
* The O-MGCF node is expected to support the History-Info header and interwork redirection information received to History-Info header in the INVITE request.
* The MGCF will support including the Reason header in the 183 Session in Progress response when a Cause indicator is received in CPG or ACM.
* In the presence of multiple early dialogs with SDP offer/answer exchanged in one or more of the early dialogs, the P-CSCF/A-BGF may perform media gate control procedures (or latching) using the remote SDP information. But must selectively open the gate corresponding to an authorized early media flow based on the P-Early-Media header.
  + P-Early-Media with a value of “sendonly” must be considered as early media authorized.
  + P-Early-Media with a value of “inactive” must be considered as early media not authorized.
  + P-Early-Media header being omitted must be considered as early media not authorized.
  + When the P-Early-Media header is not included, the value for PEM which is currently in effect is not updated/changed, i.e. the previously received value for the early-dialog is (still) in effect.
  + The P-Early-Media header indicating early media authorization may also be included in UPDATE request.
  + The media gating will be based on the last received P-Early-Media header value on any existing or new early dialogs and if the header is omitted in the last message received on any existing or new early dialogs or included with a value of “inactive”, the previously received value for the respective early dialog will be in effect.
* The EPC or IMS HSS FE must support the Notif-Eff feature as described in 3GPP TS 29.328 to allow the CTAS to retrieve multiple data items within a single Sh UDR/SNR query.
  + Lack of support would require multiple Sh UDR/SNR queries to be performed when the CTAS requires data associated with multiple Sh data references.
* P-CSCF serving the subscribers (own or roamers) will include P-Visited-Network-Id header in the UE REGISTER request with a value indicating “HPLMN” or “VPLMN” identity in this format: epc.ims.mnc<MNC>.mcc<MCC>.3gppnetwork.org (according to GSMA IR.65) or simply a domain name identifying the attached HPLMN/VPLMN.
* IMS HSS must support receiving SNR with “Send-Data-Indication” AVP.

## General Constraints

CTAS’s compliance to the relevant 3GPP standards is defined in the detailed Mavenir VoLTE Standards Compliance document [[1].](#_bookmark4)

# Architecture

## Overall Functional Architecture

The following diagram depicts the CTAS interfaces required to achieve the functionality defined within this document.

UDR

CDMA HLR FE

GSM

HLR FE

EPC

HSS FE

MAP ANSI-41 (USSD/SRI/

IMS HSS FE

(LOCREQ) SRI-LCS/ Sh Sh

ATI/PSL)

CCPS

LDAP/ SOAP

SOAP

SDM

SIP

GLS

SOAP

IN

SCP

CAP/ INAP

IN SSF

CAP/ INAP/ ANSI41

CDF

Rf

OCF

Ro

DNS X1

AMDF

iDNS

ENUM

ENUM FE

TCAP

CNAM

DB

X2

**CTAS**

SOAP iHLR

DF2

Sh

DND DB

Ut Mr’

(SIP/MSML)

ISC Ma

AP

MRF

S-CSCF

I-CSCF

NOTE:

* The diagram above depicts a Unified User Data Repository architecture, but this is not mandatory. The UDR in the above picture could also be replaced with an IMS HSS.

The following table summarizes the CTAS interface in this release. These are described in subsequent sections.

|  |  |
| --- | --- |
| **Peer Node/System** | **Application Protocol** |
| S-CSCF | SIP |
| I-CSCF | SIP |
| AP | XCAP |
| EPC HSS FE | Diameter |
| IMS HSS FE | Diameter |
| HLR | MAP, ANSI-41 |
| UDR | LDAP SOAP |

|  |  |
| --- | --- |
| **Peer Node/System** | **Application Protocol** |
| SCP | CAP INAP |
| CDF | Diameter |
| MRF | SIP / MSML |
| AMDF | SOAP |
| DF2 | XML |
| iDNS | DNS |
| ENUM FE | ENUM/DNS |
| OCF | Diameter |
| SDM | SIP |
| GLS | SOAP |
| iHLR | SOAP |
| CNAM DB | TCAP |
| SSF | CAP INAP ANSI41 |
| DND DB | Diameter |
| CCPS | SOAP |

### Interface: CTAS to S-CSCF

CTAS supports the 3GPP-defined ISC interface to the S-CSCF. The protocol used on this interface is SIP. Both UDP and TCP transport are supported. This interface supports IPv4 and IPv6.

Depending on the features invoked by the user, the CTAS may act in one of the following roles on this interface:

* + - * Routing B2BUA using 3rd party call control
      * Initiating B2BUA using 3rd party call control
      * Originating UA

The CTAS never acts as a SIP proxy.

The following sections describe this interface and the interactions with the S-CSCF in greater detail.

#### Determination of served user type

A single CTAS instance may support serving the originating user or the terminating user. Upon receipt of an initial INVITE request, the CTAS must determine the type of user so that it can then determine the services to provide. There are three main types of users supported by the CTAS, and the CTAS relies on the presence or absence of parameters within the top most Route header to make this determination. The S-CSCF must copy these Route header parameters transparently from the SIP URI of CTAS configured in the initial Filter Criteria (iFC) of the user profile. It is there for a configuration exercise to determine the type of user.

The types of users and how they are determined is as follows:

* + - * 1. Originating user

The CTAS serving the originating user determines the served user’s identity via the SIP headers below, in the order specified:

P-Served-User

P-Asserted-Identity

From

* + - * 1. Terminating VoLTE user

The CTAS serving the terminating VoLTE user determines the served user’s identity in the order specified below:

P-Served-User

* + - * 1. Terminating non-VoLTE user

The CTAS serving the terminating VoLTE user determines the served user’s identity in the order specified below:

Request-URI

The CTAS acts as a B2BUA and 3rd party call controller for providing the MMTel services and other features. Depending on the services and features invoked, the CTAS may perform in any mode of operation defined below:

* Routing B2BUA – CTAS receives a request for a dialog from a UAC (via the S-CSCF), terminates the dialog (i.e. acts as a UAS) and generates a new request for a dialog (i.e. acts as a UAC), which is based on the received request.
* Initiating B2BUA – CTAS initiates request(s) for a dialog (i.e. acts as a UAC) on behalf of hosted subscriber(s), which may be logically connected together at the AS.
* Originating UA – CTAS generates an originating request for a dialog (i.e. acts as a UAC) and sends it to the S-CSCF.

The following section defines the interaction between the CTAS and the S-CSCF based on the mode of operation.

#### Originating Trigger (Routing B2BUA)

When an Initial INVITE request is received at the CTAS, it determines the session case based on the service token present in the topmost Route header. If the topmost Route header contains the service token identifying session case of originating, the request is considered to be origination request. CTAS processes the request received, applies any originating services and acts as a routing B2BUA to route the request to the S-CSCF based on the SIP URI in the Route header that is copied into the outgoing message from the incoming request.

CTAS can identify the originating trigger based on the following:

* Session case included in the P-Served-User header field parameter of “sesscase=orig”;
* If P-Served-User is not available or sesscase is not included,“orig” as URI parameter in the top most Route header containing AS address information

#### Terminating Trigger (Routing B2BUA)

When an Initial INVITE Request is received at the CTAS, if the service token identifying an originating session case is not present in the topmost Route header, the request is considered to be a termination request. The CTAS processes the request received, applies any terminating services and acts as a routing B2BUA to route the request to the S-CSCF based on the SIP URI in Route header that is copied into the outgoing message from the incoming request.

CTAS can identify the originating trigger based on the following:

* Session case included in the P-Served-User header field parameter of “sesscase=term”;
* If P-Served-User is not available or sesscase is not included, No “orig” indicator received in the top most Route header containing AS address information

#### Terminating Unregistered Trigger (Routing B2BUA)

When an Initial INVITE request is received for termination, if the served user is not registered, the CTAS will treat it as a Terminating unregistered request. The CTAS processes the request received, applies any terminating unregistered services and acts as a routing B2BUA to route the request to the S-CSCF based on the SIP URI in Route header that is copied into the outgoing message from the incoming request.

CTAS identifies the terminating unregistered trigger by checking the registration-state-param in the P- Served-User header. If the regstate param is set to a value of “unreg”, the request is considered to be an unregistered termination request.

If P-Served-User header is not supported by the S-CSCF, the CTAS will identify unregistered termination based on the presence of “unreg” token in the topmost Route header of the incoming INVITE for termination.

#### Requests initiated by the CTAS (Initiating B2BUA)

When the served terminating user has Multi-SIM feature subscription, the CTAS acting as an Initiating B2BUA initiates new call requests on behalf of the served user to one or more Multi-SIM members which are part of the same Multi-SIM subscription group. The requests routed as part of this feature will be routed to the S-CSCF based on the SIP URI in the Route header that is copied into the outgoing message from the incoming request.

Refer to the Multi-SIM Use Case document [[31]](#_bookmark20) for more details.

#### Requests originated by the CTAS (Originating UA)

When the call terminated to the served user is applied CDIV service, the CTAS serving the terminating user will act as an Originating UA and will initiate an originating request on behalf of the served user. The CTAS will insert a Route header field pointing to the S-CSCF where the public user identity on whose behalf the request is generated is registered and append the “orig” parameter to the URI in the topmost Route header field. The P-Served-User header is included with the identity of the served user.

Refer to the CDIV Use Case document [[35]](#_bookmark24) for more details.

#### SIP Methods

The following table summarizes the SIP method support on the ISC interface.

|  |  |  |
| --- | --- | --- |
| **Method** | **Sent** | **Received** |
| REGISTER |  | X |
| INVITE | X | X |
| ACK | X | X |
| BYE | X | X |
| CANCEL | X | X |
| UPDATE | X | X |
| PRACK | X | X |
| SUBSCRIBE | X | X |
| NOTIFY | X | X |
| MESSAGE | X | X |

|  |  |  |
| --- | --- | --- |
| **Method** | **Sent** | **Received** |
| REFER | X | X |
| OPTIONS |  | X |
| INFO | X | X |

#### SIP Headers

The SIP headers defined below are those which are relevant for the CTAS service logic. If any header not listed here is received, the CTAS will transparently relay the header.

|  |  |  |
| --- | --- | --- |
| **Header** | **Sent on ISC** | **Received on ISC** |
| Accept | X | X |
| Accept-Contact | X | X |
| Allow | X | X |
| Call-ID | X | X |
| Contact | X | X |
| Content-Disposition | X | X |
| Content-Length | X | X |
| Content-Type | X | X |
| Cseq | X | X |
| Event | X | X |
| Expires | X | X |
| From | X | X |
| History-Info | X | X |
| Info-Package | X | X |
| Max-Forwards | X | X |
| Min-expires | X | X |
| Min-SE | X | X |
| P-Asserted-Identity | X | X |
| P-Served-User | X  (originating) | X |
| P-Access-Network-Info | X  (routing) | X |
| P-Charging-Vector | X  (routing, initiating, originating) | X |
| P-Visited-Network-ID | X  (routing) | X |
| P-Early-Media | X  (routing, initiating, originating) | X |
| Privacy | X | X |

|  |  |  |
| --- | --- | --- |
| **Header** | **Sent on ISC** | **Received on ISC** |
| Rack | X | X |
| Reason | X | X |
| Record-Route | X | X |
| Recv-Info | X | X |
| Request-Disposition | X | X |
| Require | X | X |
| Route | X | X |
| Rseq | X | X |
| Session-Expires | X | X |
| Subscription-State | X | X |
| Supported | X | X |
| To | X | X |
| Via | X | X |

As a default B2BUA function, the CTAS will transparently pass supported and unsupported signalling elements (e.g. SIP headers, SIP messages bodies), except signalling elements that are modified or deleted as part of the hosted service logic. As part of B2BUA function, the Contact URI will be rewritten, but the URI parameter which includes the feature tags received in the incoming request will be copied over to the outgoing request.

#### SIP Event Packages

The following SIP event packages are supported.

|  |  |  |
| --- | --- | --- |
| **Event Package** | **Sent** | **Received** |
| reg |  | X |
| conference | X | X |
| call-completion | X | X |
| dialog |  | X |

Receipt of a SUBSCRIBE request for any other event package will result in CTAS sending a 489 Bad Event response.

#### 3rd Party Registration

The CTAS supports 3rd party registration of subscribers by the S-CSCF. CTAS relies on the 3rd party REGISTER request containing an embedded UE REGISTER and 200 OK response for the retrieval of necessary registration data. This in turn requires that the iFCs be configured appropriate to trigger the inclusion of this information, i.e. via the <IncludeRegisterRequest> and <IncludeRegisterResponse> tags.

As part of this procedure, the CTAS will retrieve the subscriber’s user profile from the UDR/HSS and cache it locally. It will also retrieve the non-subscriber data associated with the subscriber’s user profile and cache it locally.

The table below summarizes the information relevant to the served user extracted from the embedded UE REGISTER request and 200 OK response:

|  |  |  |
| --- | --- | --- |
|  | **UE REGISTER** | **UE 200 OK** |
| CGI/eCGI | One or Two P-Access-Network-Info. “np” (network-provided) P-Access- Network-Info header if available, is given higher priority. If “np” PANI is not available top most PANI is used. |  |
| VLR  Address/VPLMN Id | P-Visited-Network-Id |  |
| Instance-Id | “sip.instance” media feature tag included in the Contact header field |  |
| IMEI/IMEISV | “sip.instance” media feature tag included in the Contact header field in IMEI URN format as defined in RFC 7254 |  |
| IMSI | IMPI included in the Authorization header in "<IMSI>@ims.mnc<MNC>.mcc<MC C>.3gppnetwork.org" format.  If the host portion of the IMPI is not in the format defined above, and if configuration control is enabled, the user part is assumed to be IMSI. |  |
| Implicitly Registered Identities |  | P-Associated-URI |
| Rel 10 SRVCC  Information | Feature-Caps header or Path header containing ATCF-URI, STN-SR and ATU-Mgmt-URI. Additionally  Feature-Caps header can contain g.3gpp.mid-call, g.3gpp.srvcc- alerting and 3gpp.ps2cs-srvcc-orig- pre-alerting feature-capability indicator. |  |
| UE IP | Contact header URI parameter. The parameter name carrying the UE IP is configurable. |  |
|  |  | Contact header field is analyzed to check for mismatch in the contact binding between the S-CSCF and the TAS. If mismatch is found, profile recovery is triggered. |

#### Addressing

The CTAS supports user identities received in the following formats:

* SIP URI containing the user’s MSISDN in the user part, with or without the “user=phone” parameter
* TEL URI containing the user’s MSISDN

IMS subscribers at operator network can be configured with both of these identities included in a single implicit registration set.

CTAS also supports both Distinct PSIs and Wildcarded PSIs in either SIP URI or TEL URI format.

CTAS does not support the “phone-context” or “user=dialstring” parameter. If received, it will be ignored.

#### Parallel Early Dialogs

CTAS supports establishing multiple early dialogs towards an originating UA which indicates support for forking by either not sending the fork directive or by sending a fork directive with a value of “fork”. CTAS supports maintaining a maximum of 8 parallel early dialogs with early media authorized in only one of them, in alignment with GSMA IR.92.

#### Preconditions

CTAS supports the resource reservation framework defined in RFC 3312, otherwise known as preconditions.

#### Offer/Answer Model

CTAS supports the offer/answer model as defined in RFC 3264. CTAS uses the UPDATE method to send subsequent SDP offers within an early dialog and uses the INVITE method to send subsequent SDP offers within a confirmed dialog. If there is a change in the SDP version ID and if the SDP answer received in 200 OK response to the UPDATE/re-INVITE request has changed, the CTAS generates an UPDATE/re-INVITE request to the remote party.

#### “cpc” URI parameter

The originating CTAS will support a function that adds the Calling Party’s Category (cpc) parameter in the P-Asserted-Identity header field. Enabling and disabling this function will be configurable by the operator.

If the function is enabled, the originating CTAS will add the Calling Party’s Category (cpc) parameter in the P-Asserted-Identity header field that is represented in the tel-URI scheme as specified in 3GPP TS 24.229, section 7.2A.12.

*Note 1: The P-Asserted-Identity header field generated by the P-CSCF in sip-URI scheme does not include the user=phone parameter and is therefore not a sip-URI representation of a telephone number. The P-Asserted-Identity header field in the tel-URI scheme is generated by the originating S-CSCF according to 3GPP TS 24.607, section 4.3.2, Note 2.*

If the function is enabled, the originating TAS shall generate the Calling Party’s Category (cpc) as follows:

* If the received initial INVITE includes the authorized Resource-Priority header field the originating CTAS will generate the Calling Party’s Category (cpc) with a value that can be configured by the operator. The default configured cpc-value will be “priority”.

Note 2: The cpc-value “priority” is not specified in 3GPP TS 24.229.

* If the received initial INVITE does not include the authorized Resource-Priority header field the originating CTAS will generate the Calling Party’s Category (cpc) with a value that can be configured by the operator. The default configured cpc-value will be “mobile-hplmn”.

### Interface: CTAS to I-CSCF

CTAS supports the 3GPP-defined Ma interface to the I-CSCF. The protocol used on this interface is SIP. Both UDP and TCP transport are supported. This interface supports IPv4 and IPv6.

The Ma interface is used by the I-CSCF to direct SIP requests which are addressed to a Public Service Identity (PSI) directly to the Application Server which hosts that PSI. Use cases for PSIs and the Ma interface in this release include:

* + - * Subscriptions to the “conference” event package for MMTEL conferences

These SUBSCRIBE requests are addressed to Conference URIs allocated by CTAS at the time of conference creation. These Conference URIs are treated as wildcarded PSIs in the IMS

network, with each PSI resolving to the address of the CTAS that is hosting that particular conference. Refer to the Conferencing Use Case document [[30]](#_bookmark19) for further details.

* + - * Subscriptions to the “call-completion” event package for CCBS feature

These SUBSCRIBE requests are addressed to the terminating network (CTAS or MGCF) hosting the recipient of the original call which has triggered CC-Possible indication in the 486 Busy response.

* + - * Access transfer session requests

These INVITE requests are addressed to the ATU-STI allocated by the SCC function of the CTAS. These ATU-STIs are treated as distinct PSIs in the IMS network, with each PSI resolving to the address of the CTAS that is anchoring the call that is undergoing the SR-VCC access transfer.

* + - * CCBS Re-call Termination requests

These INVITE requests are addressed to destination B for which call completion was requested by the originating user, after destination B becomes free and a CC call has been setup with the originating user.

* + - * STN based Call Transfer requests

These INVITE requests are addressed to the STN which is a pre-defined service identifier for the service being invoked.

### Interface: CTAS to AP

CTAS supports the 3GPP-defined Ut interface to the HEP, as defined in 3GPP 24.623. The protocol used on this interface is XCAP, as defined in RFC 4825. This interface supports IPv4 and IPv6. This interface also supports HTTP over Transport Layer Security (HTTPS)

The Ut interface signaling is originated by the UE but traverses the HEP for authentication purposes. The Ut interface is used by the UE to interrogate and modify supplementary service configuration, which is carried within the “simservs” XML document within the XCAP requests and responses. CTAS supports Ut requests which operate on the entire XML document, and also supports node selector functionality which allows Ut requests to operate on specific elements or attributes within the XML document.

Refer to the Ut Interface Use Case document [[32]](#_bookmark21) for further details.

### Interface: CTAS to EPC HSS FE

CTAS supports the 3GPP-defined Sh interface to the EPC HSS FE as defined in 3GPP 29.328 and

29.329. The base protocol used on this interface is Diameter as defined in RFC 3588. Both TCP and SCTP transport are supported for this interface. This interface supports IPv4 and IPv6.

This interface is used by CTAS to retrieve information from the UDR/HSS for call routing logic, including special logic required for the Multi-SIM feature. The following Sh data reference values are supported in the Sh UDR commands in this release:

* UserState (data reference 15)

This query, along with a Requested-Domain AVP set to “CS-Domain”, is used to retrieve the subscriber’s state in the CS network.

* LocationInformation (data reference 14)

This query, along with a Requested-Domain AVP set to “CS-Domain”, is used to retrieve the subscriber’s VLR number in the CS network. When CS breakout or retry is performed, this information is used to determine the roaming status of the subscriber.

* TADSInformation (data reference 26)

This query is used to determine whether IMS voice over PS is supported on the current access network.

* STN-SR (data reference 27)

This query is used to determine whether the Session Transfer Number for SRVCC (STN-SR) is configured for a subscriber in the HSS.

* UE-SRVCC-Capability (data reference 28)

This query is used to determine whether the UE is SRVCC capable or not.

* CSRN (data reference 30)

This query is used to retrieve the CS domain Routing Number for a subscriber while performing CS breakout or CS retry.

The following Sh data reference values are supported in the Sh PUR commands in this release:

* STN-SR (data reference 27)

This update is used to update STN-SR for a subscriber in the HSS.

All Sh UDR commands are sent with the subscriber’s Master MSISDN in the User-Identity AVP and an IMSI in the User-Name AVP, which allows each query to be device-specific.

CTAS supports and uses the Notif-Eff feature defined for the Sh interface, which allows a single Sh UDR command to identify multiple data reference values, which in turn allows all requested data to be returned in a single Sh UDA command.

Refer to the CTAS Multi-SIM Use Case document [[31]](#_bookmark20) and CTAS Sh Interface specification [[50]](#_bookmark37) for more details.

### Interface: CTAS to IMS HSS FE

CTAS supports the 3GPP-defined Sh interface to the IMS HSS FE as defined in 3GPP 29.328 and

29.329. The base protocol used on this interface is Diameter as defined in RFC 3588. Both TCP and SCTP transport are supported for this interface. This interface supports IPv4 and IPv6.

This interface is used by CTAS to retrieve information from the UDR/HSS for call routing logic for re- direction of a call from CS to IMS and for retrieving service data. The following Sh data reference values are supported in the Sh UDR commands in this release:

* IMSUserState (data reference 11)

This query is used to retrieve the subscriber’s registration state in the IMS network while processing a CAP IDP for re-direction of a call from CS domain to IMS.

* Repository Data (data reference 0)

This data reference is for retrieving service data attached to the user stored in the HSS.

Refer to the CTAS Sh Interface specification [[50]](#_bookmark37) for more details.

### Interface: CTAS to HLR

CTAS supports a 3GPP-compliant MAP interface supporting version 1, 2 & 3 to the HLR as defined in 3GPP 29.002. CTAS also supports ANSI-41 interface to the CDMA HLR. M3UA/SCTP transport is supported on this interface. This interface supports IPv4 only.

This MAP interface is used for supporting mobile-originated USSD strings received via IMS. CTAS also supports the ability to pass a USSD string received from the HLR back to the IMS UE. Refer to the USSD Use Case [[29]](#_bookmark18) document for more details.

MAP interface is used for retrieving MSRN from HLR using MAP SRI query, for routing the call to CS domain in case of CS breakout or CS retry.

MAP Interface is also used for providing Location Based Services by supporting MAP SRI-LCS, MAP ATI and MAP PSL.

ANSI-41 interface to CDMA HLR is used for generating LOCREQ request.

### Interface: CTAS to UDR

#### LDAP Interface

CTAS supports an LDAP interface to the UDR for the following purposes:

* + - * + To retrieve the “MMTel” service profile of the subscriber. This profile identifies all supplementary services configured against the subscriber.
        + To retrieve or refresh the configuration data related to O-CSI and T-CSI elements which is also called the non-subscriber related (NSR) data associated with the “MMTel” service profile of the subscriber.
        + To retrieve or refresh the configuration data related Operator Configurable Control Data configured in a LDAP DS which may or may not be the same DS where subscriber data is stored. This is also referred to as non-subscriber related (NSR) data.
        + To update the “MMTel” service profile of the subscriber, based upon supplementary configuration commands received by the IMS UE via the Ut interface.

This interface supports IPv4 only.

#### SOAP Interface

CTAS supports a SOAP interface via HTTP or HTTPS to the UDR for receiving notifications of changes to the “MMTel” service profile of the subscriber and the non-subscriber related data (CSI Data and OCCD). These SOAP triggers are generated by provisioning changes made at the UDR. The SOAP trigger is sent to all CTAS nodes in the network and acted upon only by the CTAS node which is active serving the subscriber.

This interface supports IPv4 only.

#### SPML Interface

CTAS supports a SPML interface on SOAP via HTTP to the UDR for service configuration of the changes done by the user over Ut interface. Here is a complete list of SPML requests that are supported by the CTAS:

* + - * + searchRequest – This request is used to retrieve the identifier corresponding to the IMSI alias which must be used in the modifyRequest to perform modification.
        + modifyRequest – This request is used to modify the service data. CTAS supports following different versions over the SPML interface:

1. SUBSCRIBER\_v10

SPML Interface targetNamespace = urn:siemens:names:prov:gw:SPML:2:0 Subscriber Data targetNamespace = urn:siemens:names:prov:gw:SUBSCRIBER:1:0 Request Version String = SUBSCRIBER\_v10

HLR Data component name = hlrData

1. SUBSCRIBER\_v20

SPML Interface targetNamespace = urn:siemens:names:prov:gw:SPML:2:0 Subscriber Data targetNamespace = urn:siemens:names:prov:gw:SUBSCRIBER:2:0 Request Version String = SUBSCRIBER\_v20

HLR Data component name = HLR

1. xx\_SUBSCRIBER\_v10, where xx is operator specific.

SPML Interface targetNamespace = urn:siemens:names:prov:gw:SPML:2:0 Subscriber Data targetNamespace = urn:siemens:names:prov:gw:<custom> Request Version String = <custom>

The following are the list of supplementary services which can be modified over the SPML interface:

* + - * + CLIP/OIP
        + CLIR/OIR
        + COLP/TIP
        + COLR/TIR
        + CFU (unconditional)
        + CFB (busy)
        + CFNRc (not reachable)
        + CFNRy (no reply)
        + CW (Call Waiting)
        + BAOC (Barring of All Outgoing Calls)
        + BOIC (Barring of all Outgoing International Calls)
        + BOICExHC (Barring of all Outgoing International Calls except to the Home Country)
        + BAIC (Barring All Incoming Calls)
        + ALLCCF (All Conditional Call Forwarding) This interface supports IPv4 only.

#### Sh Interface

CTAS supports the 3GPP-defined Sh interface to the IMS HSS FE as defined in 3GPP 29.328 and

29.329. The base protocol used on this interface is Diameter as defined in RFC 3588. Both TCP and SCTP transport are supported for this interface. This interface supports IPv4 and IPv6.

This interface is used to retrieve and update the services data stored as transparent or non-transparent data.

Following are the list of XML document and the corresponding Services element supported over this interface:

* MMTEL-Services
  + Originating Identification Presentation (OIP)
  + Originating Identification Restriction (OIR)
  + Terminating Identification Presentation (TIP)
  + Terminating Identification Restriction (TIR)
  + Communication DIVersion (CDIV)
  + Communication Waiting (CW)
  + Communication HOLD (HOLD)
  + Communication Barring (CB)
  + Completion of Communications to Busy Subscriber (CCBS)
  + CONFerence (CONF)
* IMS-ODB-Information
  + Incoming Barring
  + Outgoing Barring
  + Outgoing Premium Call Barring
  + Operator Specific Barring
* IMS-CAMEL-Services
  + O-IM-CSI
  + VT-IM-CSI
* Custom Extension - MMTEL-Custom-Services
  + IMSI
  + Calling Name Presentation (CNAP)
  + Call Forwarding Default for Busy (CFDforCFB)
  + Call Forwarding Default for Not Reachable (CFDforCFNRc)
  + Call Forwarding Default for No Reply (CFDforCFNR)
  + Supplementary Service Code List (SSLIST, which include National Supplementary Services List)
  + TIF CSI
* Custom Extension - IMS-Services (for IMS services which does not have a corresponding HLR equivalent)
  + Video

Refer to the CTAS Sh Interface specification [[50]](#_bookmark37) for more details.

### Interface: CTAS to IN SCP

CTAS supports a CAP interface to the SCPs for providing IN services to IMS subscribers. CTAS supports CAP versions 2, 3 and 4 and INAP version CS1 and CS2 on this interface. M3UA/SCTP transport is supported on this interface. This interface supports IPv4 only.

Refer to the CTAS IN Interworking Use Case document [[37],](#_bookmark26) and the Mavenir VoLTE Standards Compliance document [[1]](#_bookmark4) for more details.

### Interface: CTAS to CDF

CTAS supports the 3GPP-defined Rf interface to the CDF as defined in 3GPP 32.299. The base protocol used on this interface is Diameter as defined in RFC 3588. Both TCP and SCTP transport are supported for this interface. This interface supports IPv4 and IPv6.

This interface is used to report offline charging events to the CDF for CDR generation. Specifically:

* + - * Session-based charging is used to report on successfully answered call legs
      * Event-based charging is used to report on:
        + Unsuccessful call setup attempts
        + Subscriber controlled input, e.g. service configuration changes made via the Ut interface or via user dialed feature codes

Refer to the Rf Interface Specification document [[38]](#_bookmark27) for more details.

### Interface: CTAS to MRF

CTAS supports a Mr’ interface with the MRF. The Mr’ interface directly connects the CTAS and MRF, this signaling does not traverse the S-CSCF. The Mr’ interface is realized using the SIP and MSML (RFC 5707) protocols.

This interface is used by CTAS for all functions which require access to media, such as:

* + - * Playing tones or announcements
      * Establishing conferences for the 3GPP MMTel CONF/3PTY service
      * DTMF prompt & collect functions as required for IN services

Refer to the MRF Interface Specification document [[39]](#_bookmark28) and MRF Use Case document [[40]](#_bookmark29) for more details.

### Interface: CTAS to AMDF

CTAS supports an X1 interface to the AMDF component of the LIMS for administration purposes. The X1 interface is used to manage the provisioned LI targets on the CTAS.

The protocol used on X1 is SOAP over HTTPS. This interface supports IPv4 only. Refer to the LI Interfaces Mavenir Application Server document [[41]](#_bookmark30) for more details.

### Interface: CTAS to DF2

CTAS supports an X2 interface to the DF2 component of the LIMS to send Interception Related Information (IRI), e.g. signaling events. CTAS uses the X2 interface to report the following IRI to the DF2:

* + - * Conferencing events
      * Subscriber Controlled Input (SCI) events, e.g. Ut requests or via user dialed feature codes to change supplementary service data

The protocol stack used on the X2 interface is:

|  |
| --- |
| XML |
| X2TP |
| TCP |
| TLS |
| IP |

X2TP is the X2 Transfer Protocol, a simple proprietary protocol used to relay X2 information. This interface supports IPv4 only.

Refer to the CTAS LI Interfaces Description document [[41]](#_bookmark30) for more details.

### Interface: CTAS to iDNS

CTAS supports a DNS interface to the customer iDNS for address resolution purposes. CTAS supports NAPTR, SRV, A and (for some interfaces) AAA records.

For SIP interfaces, the CTAS supports RFC 3263.

### Interface: CTAS to ENUM

CTAS supports an ENUM interface to ENUM Front End Service implemented as a Number Portability system. In addition it also support ENUM interface to query for SPID and LRN.

Refer to the ENUM Interface specification document [[51]](#_bookmark38) for more details.

### Interface: CTAS to OCF

The CTAS supports the 3GPP-defined Ro interface to the OCF (Online Charging Functionality within Online Charging Server (OCS)) as defined defined in 3GPP TS 32.299 [[10],](#_bookmark6) 3GPP TS 32.260 [[45],](#_bookmark33) with MMTel extensions defined in 3GPP TS 32.275 [[46]](#_bookmark34) and Mavenir extension as defined in CTAS Ro interface specification [[43].](#_bookmark31)

The base protocol used on this interface is DIAMETER as defined in IETF RFC 3588 [[7]](#_bookmark5) and IETF RFC 4006 [[44].](#_bookmark32) Both TCP and SCTP transport are supported for this interface. This interface supports IPv4 and IPv6.

Refer to the Ro Interface Specification document [[43]](#_bookmark31) for more details on the scenarios supported and a list of supported AVPs.

### Interface: CTAS to GLS

CTAS supports a SOAP (client) Interface to Geo Location Server to retrieve the Location Information corresponding to the Public UE IP. The UE IP is received as the child element of the <ims-3gpp> XML element included in the Third-Party REGISTER. The S-CSCF inserts this UE IP after taking it from the via header of the UE REGISTER.

This interface is invoked when the user is registered on WiFi Access.

### Interface: CTAS to iHLR

CTAS supports a SOAP (server) Interface to the iHLR node, which is used to query for locally cached subscriber information. This interface is mainly used for debugging purpose and currently supports returning IMPU, Registration status, Latitude/Longitude, CTAS GT Address, CGI, etc.

### Interface: CTAS to SDM

CTAS supports a SIP Interface to the SDM node, which is used to maintain the IMS Registration state for the user. When Initial Registration request is received at the CTAS for MMTEL Voice, the CTAS generates a 4th Party REGISTER to the SDM, which will create an entry and store the CTAS GT address corresponding to the CTAS FQDN received in the REGISER request. This information is looked up from the CS domain for CS origination call routing to determine, if the terminating user is IMS Registered or not. If the user is found to be IMS Registered (i.e. entry exists in the SDM), the call is routed to the IMS domain.

The CTAS GT address stored is used to route MAP SRI-LCS request to the CTAS node anchoring the subscriber. Saving of the CTAS GT address is operator specific.

The SDM entry is removed, when the user does a De-REGISTER or the profile is removed the CTAS.

### Interface: CTAS to CNAM DB

CTAS supports a TCAP interface to the CNAM Db to query for the Calling Name of the originating user to be delivered to the Called Party if the called party has subscribed to the CNAM feature.

### Interface: CTAS to IN SSF

CTAS comprises of an integrated SCP (iSCP) which supports CAP v2, v3, INAP CS-1 and CS-2, and ANSI-41 Ver E protocols. The main purpose of the iSCP is for redirection of calls terminated in CS domain to IMS over ICS Mg interface.

M3UA/SCTP transport is supported on this interface. This interface supports IPv4 only.

### Interface: CTAS to DND DB

CTAS supports a Sh interface to the DND Db to query for Called Party subscriber’s DND subscription.

### Interface: CTAS to CCPS

CTAS supports a SOAP (client) Interface to the CCPS node to set appropriate T-CSI Service information in the subscriber profile in the UDR. This interface is invoked when the user is registered using LTE access and the type of T-CSI identified in the subscriber profile is not LTE.

### Interface: Summary

The table below summarizes the Transport support for each of the interfaces:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Interface** | **Protocol** | **UDP/IPv4** | **UDPIPv6** | **TCPIPv4** | **TCPIPv6** | **SCTP/IPv4** | **SCTPIPv6** |
| ISC, Ma, Mr’ | SIP | Y | Y | Y | Y | N | N |
| SPML | HTTP/HTTPS  (client) | N | N | Y | Y | N | N |
| XCAP, SOAP  Trigger,  X1 | HTTP/HTTPS  (server) | N | N | Y | Y | N | N |
| Rf, Ro, Sh | Diameter | N | N | Y | Y | Y | Y |
| Rf, Ro, Sh | Diameter/TLS | N | N | Y | Y | N | N |
| MAP, INAP, CAP, TCAP | MAP/SIGTRAN | NA | NA | NA | NA | Y | N |
| UDR | LDAP | Y | N | Y | N | N | N |
| X2 | X2TP/TLS [NOTE 1] | N | N | Y | N | N | N |
| DNS, ENUM | DNS | Y | Y | Y | Y | N | N |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Interface** | **Protocol** | **UDP/IPv4** | **UDPIPv6** | **TCPIPv4** | **TCPIPv6** | **SCTP/IPv4** | **SCTPIPv6** |
| OSS | (S)FTP | N | N | Y | Y | N | N |
| OSS | SNMP | Y | N | N | N | N | N |
| NOTE:  1. X2TP is the X2 Transfer Protocol | | | | | | | |

The table below summarizes the Traffic Distribution mode for each of the interfaces:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Interface | Peer Node | Protocol | Traffic Routing Methods | | |
| Primary/Secondary (one or more  Primaries and Secondary’s) | Round Robin based Load balancing | DNS based Load Balancing |
| ISC [NOTE 1] | S-CSCF | SIP | N | N | Y |
| Ma [NOTE 1] | I-CSCF | SIP | N | N | Y |
| Mr' | MRF | SIP/MSML | Y | Y | N |
| IN | SCP | CAP/INAP | Multi Homing | Y | N |
| MAP C | HLR | MAP | Multi Homing | Y | N |
| Ud | UDR | LDAP | N | Y | N |
| SPML | UDR/PGW | SOAP | N | Y | Y |
| Rf | CDR | Diameter | Y | Y | N |
| Ro | OCS | Diameter | Y | Y | N |
| Sh | IMS HSS, EPC HSS | Diameter | Y | Y | N |
| X2 | DF2 | X2TP/TLS |  |  |  |
| DNS | DNS Server | DNS | Y | Y | N |
| DNS/ENUM | ENUM Server | DNS | Y | Y | N |
| NOTE:  1. Failover is not supported. On failure to route the request to the CSCF, the request is reattempted to the same node as per the SIP Timer configuration and on failure of all reattempts, the request is rejected. | | | | | |

## Overall OSS Architecture

The following diagram depicts the CTAS and Centralized Management System (CMS) interfaces required to achieve the FCAPS functionality defined within this document, specifically for Accounting Management (AM), Fault Management (FM), Performance Management (PM) and Configuration Management (CM).

Note: CMS is an optional Management node in the Network. All interfaces from CTAS to CMS will be from CTAS to OSS when CMS is not part of the Network architecture.

(S)FTP

CAP

R

SNMP (S)FTP

HTTP(S)/XML

**TAS**

EMS

CM

PM

FM

AM

Ro

f

OSS

OCF

CCF

SCP

**CMS**

The following table summarizes the CTAS FCAPS interfaces towards CMS and OSS in this release.

|  |  |  |
| --- | --- | --- |
| **Peer Node/System** | **Application Protocol** | **Locality** |
| CMS | HTTP(S)/XML | National |
| OSS | (S)FTP SNMP | National |

### Interface: CTAS to CMS

#### 6.2.1.1 Configuration Management (CM) Interface

For common CTAS tables configured on CMS, CMS supports an HTTP(S)/XML interface with CTAS for the transfer of this configuration data to each CTAS system. CMS owns the master copy of these tables and ensures that each CTAS system remains synchronized.

For CTAS tables which are specific to each CTAS system, CMS runs a SGD Server which provides a jump station for access to each CTAS system. This allows external clients to access the CTAS EMS via CMS.

### Interface: CTAS to OSS

#### Performance Management (PM) Interface

CTAS supports an (S)FTP interface with OSS which is used to retrieve Performance Management (PM) data.

CTAS collects statistical data in the form of performance counters and writes this data into CSV files at period intervals, configurable between 5 and 15 minutes. OSS then retrieves these CSV files from each CTAS system via (S)FTP at periodic intervals.

#### Fault Management (FM) Interface

CTAS supports an SNMP interface to OSS for reporting events and alarms. CTAS supports SNMP versions 1, 2c and 3. This MIB used on this interface will be provided separately.

# Functional Description

While the main functional use cases are described at a high level in the subsequent sections, further details can be found in the separate CTAS Use Case documents which exist. These include the following:

* MMTEL User Profile Use Cases– This document describes CTAS uses cases related to managing the user profile which is stored in the UDR.
* USSI Use Cases [[29]](#_bookmark18) – This document describes CTAS use cases related to mobile initiated USSI requests.
* Multi-SIM Use Cases [[31]](#_bookmark20) – This document describes CTAS handling of Multi-SIM subscribers for various services and functions.
* Ut Interface Use Cases [[32]](#_bookmark21) – This document describes CTAS use cases as they relate to the 3GPP defined Ut interface.
* Announcements / Tones Use Cases [[33]](#_bookmark22) – This document describes CTAS support for tones and announcements.
* RBT Use Cases [[34]](#_bookmark23) – This document describes CTAS support for the Ring Back Tone (RBT) service.
* CDIV Use Cases[[35]](#_bookmark24) – This document describes CTAS support for the Communication Diversion (i.e. call forwarding) supplementary service.
* Availability and Recovery Use Cases – This document describes use cases related to CTAS hardware and software failures and recovery.

The details and call flows in these Use Case documents are not repeated in this document.

Furthermore, details of the CTAS’s internal IM-SSF function are not covered in this document but can instead be found in the IM-SSF System Specification document **Error! Reference source not found.**.

## Registration and User Profile

The CTAS supports 3rd party initial, refresh and de-registration of subscribers by the S-CSCF.

Some of the high level procedures involved in the initial registration at CTAS are defined below, for more details refer to the User Profile Use Case document**Error! Reference source not found.**.

* Creating registration data using the information received in the UE REGISTER request and response embedded in the 3rd party REGISTER request. The contact binding is done on the basis of the Contact URI and the Instance-Id identified by the “+sip.instance” media feature tag included in the Contact header field parameter. All relevant information received is stored as part of the Contact binding.
* Creating the user profile by retrieving the subscriber and non-subscriber related data from the UDR/HSS and caching it locally. Note that the non-subscriber related data is cached separately, separate from the subscriber data.

Some of the high level procedures involved in the refresh registration at CTAS are defined below, for more details refer to the User Profile Use Case document.

* Update the contact bindings with the information received in the 3rd party REGISTER request. The refresh 3rd party REGISTER may be triggered due to an initial UE REGISTER for another device which is part of the same implicit registration set, hence the CTAS may have to create a new contact binding for the IMPU.
* Reset the reg-timer

Some of the high level procedures involved in the de-registration at CTAS are defined below, for more details refer to the User Profile Use Case document.

* Remove the contact binding for the device deregistering, the device identified by the IMPI.
* If this is the last device being deregistered, the user profile is marked as deregistered, and will be removed when the inactivity timer expires.

As part of the user profile management, the CTAS will support SOAP triggers as a subscriber data change notification from the UDR. This change notification is triggered due to any changes done from the backend by Operations on the subscriber data.

### Relationship of Private and Public Identifies with Contact Binding

Here is the high level figure showing the relation between the Public User Identity, Private User Identity and the Contact binding:

**Implicit Registration Set**

**User Profile**

deviceIdN

deviceId1

Non-Subscriber Data (not applicable

for data retrieved from the HSS)

Device (IMSI) Specific Services Data

Services Data

sip:<alpanumeric-

usernameN>@<domain>

tel:+<MSISDNn>

sip:+<MSISDNn>@<domain>

Reg Data

Contact Binding (s)

IMPIn

Reg Data

Contact Binding (s)

IMPI1

* PANI
* PANI (np)
* PVNI
* VPLMN-ID
* CGI
* IMEI/IMEISV
* ATCF Info

Contact: <URI-Yn>;+sip.instance- id=”<UUID-Yn>”;contact-param \*(contact- param)

Contact: <URI-Y1>;+sip.instance-

id=”<IMEI-Y1>|<UUID-Y1>”;contact-param

\*(contact-param)

IMPIn

**Contact Binding**

* PANI
* PANI (np)
* PVNI
* VPLMN-ID
* CGI
* IMEI/IMEISV
* ATCF Info

Contact: <URI-Xn>;+sip.instance- id=”<UUID-Xn>”;contact-param \*(contact- param)

* PANI
* PANI (np)
* PVNI
* VPLMN-ID
* CGI
* IMEI/IMEISV
* ATCF Info

Contact: <URI-X1>;+sip.instance-

id=”<IMEI-X1>|<UUID-X1>”;contact-param

\*(contact-param)

IMPI1

**Contact Binding**

* PANI
* PANI (np)
* PVNI
* VPLMN-ID
* CGI
* IMEI/IMEISV
* ATCF Info

**Registration Data**

Public User identities may be shared across multiple Private User Identities within the same IMS subscription. Hence, a particular Public User Identity may be simultaneously registered from multiple UEs that use different Private User Identities and different contact addresses.

The User profile comprises of the Services data which is downloaded from the HSS during the Initial Registration procedure. Only one user profile is associated with the Implicit Registration Set (IRS). This services data may also include device specific data, where the device is identified by the IMSI. The contact binding will be maintained on per device basis, where the device is identified by the instance-id received in the contact header of the REGISTER request.

A single device or single SIM subscriber can register multiple UA instances and each such UA instance can register using the same or different IMPI. The Instance-Id is expected to be unique across all the contact binding for a particular IMPU and this instance-id will be used to identify a particular contact binding. For example, when an origination received from a particular instance, the instance id received in the Contact header field will be used to identify the originating device instance. If Instance-Id is not received in the Contact header field (as it is not mandatory for the client to include instance-id in the Contact header field), there is need for another mechanism to identify the originating instance. Proxy- Authorization header containing IMPI is one such header which may be included by the S-CSCF which will be used to identify the instance when instance-id is not included. The use of Proxy-Authorization header imposes a limitation on identifying the contact binding. If there are more than one contact binding registered against a particular IMPI, it is not possible to identify the contact binding with just the IMPI, and therefore where there is a possibility of registering multiple instances using the same IMPI, the instance-id MUST be included in the Contact header of the INVITE request.

### Registration Flow

The high level Registration flow using LDAP Interface to the HSS/UDR is shown below:



UDR

IMS HSS FE



IMS HSS

**Cx UAR**

(IMPU, IMPI)

**Cx UAA**

(S-CSCF Name)

**Cx SAR**

(IMPU, IMPI, S-

CSCF Name)

**REGISTER**



(IMPU, IMPI,

auth resp)

I-CSCF

UE-A



200 OK

**Cache Subscriber Profile:**



FE

**Cx SAA**

**LDAP Search REQ LDAP Search RSP**

(impu/msisdn)

(IMPU, User Profile)

**REGISTER**

(IMPU, embedded UE REGISTER/200 OK)

200 OK

S-CSCF

**CTAS**

**TAS SCC IM-SSF**

UDR

UDR

* Registration Data
* Services Data
* Non-Subscriber Data
  + T-CSI
  + O-CSI
* Other Operator Specific Data

The high level Registration flow using Sh Interface to the HSS/UDR is shown below:

UDR

UDR

UDR

**Cx UAR**

IMS HSS FE

**Cx UAA**

**Cx SAR**

IMS HSS FE

**Cx SAA**

**Sh UDR/SNR**

(IMPU,

Data-Reference=RepositoryData (0)

MMTEL-Services

HSS

**Sh UDA/SNA**

(Repository-Data

MMTEL-Services

(IMPU, IMPI)

**REGISTER**

(IMPU, IMPI,

auth resp)

I-CSCF

UE-A

(S-CSCF Name)

(IMPU, IMPI,

S-CSCF Name)

(IMPU, User Profile)

**REGISTER**

(IMPU, embedded UE REGISTER/200 OK)

200 OK

S-CSCF

IMS-ODB-Information IMS-CAMEL-Services Custom-Extension-Data

)

**CTAS**

IMS-ODB-Information IMS-CAMEL-Services Custom-Extension-Data

)

200 OK

**TAS**

**SCC**

**IM-SSF**

**Cache Subscriber Profile:**

* Registration Data
* Services Data
* T-CSI
* O-CSI
* Other Operator Specific Data

## Call Establishment and Termination

The Call Establishment at CTAS is broken up into multiple phases, which are common across origination and termination:

* Profile Retrieval and Validation
* Trigger Processing
* Services
* Translations
* Call Routing

### Basic Call Processing

#### Call Origination at MMTEL

The figure below shows the sequence followed while processing the MMTEL call origination request. Based on the iFC configuration, the S-CSCF routes the call origination request to the CTAS. SCC AS being the integrated node is going to be the first application to be invoked. The SCC AS in the origination path will anchor the call leg and internally route the request to the MMTEL application.

The call processing procedures at the MMTEL involves applying one or more translation and screening profiles are various stages of the call processing. Every one of these profiles will have specific rules configured and the action configured in the matching rule will determine the next course of action to be taken. Refer to the Translation Functional Description document for the function of each of the pre- defined translation and screening profiles.

The Application Config (APPCFG) rules will determine the integrated sub-application to be invoked, which will be MMTEL by default. It will also set various SKIP flags which will control the invocation of Supplementary and other services.

Before allowing call processing to continue for call origination, the MMTEL performs profile retrieval and validation. Prior to Profile Retrieval, the Pre-Translator (PRTCT) profile is applied to normalize the calling and the called party number. The normalized calling and called party number will be used in all subsequent call processing procedures.

The Service Screening (SVCSCR) rules will screen the call origination request for defining service specific conditions and restriction. This profile sets the ACCESSCLASS based on the P-Access-Network- Info header received, which will be used for pegging access specific KPIs.

The Translation (TRN) rules may be used for number modification or for identifying specific dialed patter to identify specific service request such as Conference Creation, USSD Request, User Config (SIP based) Request, etc. When USSD or User Config service request is identified, a specific Feature (FEAT) profile is invoked to further analyze the dial string. If the dial string matches a configured USSD string, the call control is passed on to the integrated USSD AS for USSD request processing. Refer to Section [7.5.3](#_bookmark152) for more details. If the dial string matches a configured Feature code, the User config request is processing and UDR is updated. Refer to User Profile UC [[55]](#_bookmark42) or [[54]](#_bookmark41) for more details.

Prior to applying Call Barring (CB) or Operator Determined Barring (ODB) as defined in Section [7.4.6](#_bookmark136) and Section [7.4.7,](#_bookmark137) the MMTEL will invoke Roam Analyzer (ROAMANZ) rules to determine the roaming status of the user. The roaming status is determined using the VLR address allocated for the served originating user. The VLR Address is identified based on the P-Visited-Network-Id header received in the Initial INVITE or the previous registration.

If the origination request is not barred, the Call Analyzer (CALLANZ) rules are applied to determine the type of call being originated. The type of call could be International, Premium rate, etc, which is used for applying specific types of barring at the later stage of the call. This analysis is done prior to any ENUM or IN trigger invocation which may possibly modify the called party number. It could also be possible to apply this call analysis much later in the call processing.

The ENUM trigger for MNP check is configured to be invoked at one or more stages of the call. Whether the ENUM is invoked at the configured stage is determined by the SKIP\_ENUM flag set by the preceding translation & screening profile. Default value of SKIP\_ENUM flag is False, translation rules can explicitly disable ENUM trigger by setting this flag to True. For example, ENUM need not be triggered for International calls, which can be ensured by setting SKIP\_ENUM=TRUE when CALLTYPE = INTL. Refer to Section [7.2.4.](#_bookmark114)

The MMTEL supports Integrated IM-SSF, which will be support invoking IN Trigger based on active O- CSI and/or one or more N-CSI triggers. Refer to IM-SSF IN-IW Use Cases [[37]](#_bookmark26) for more details. The Integrated IM-SSF may also be skipped using the SKIP\_INAP and SKIP\_CAP flags.

The Dialed Number Translation (DNTRN) table is tabular based number manipulation framework mainly used for converting short codes to long codes, which could also be used for other number manipulation. This number manipulation can be configured based on one or more input criteria. ENUM trigger configured to be invoked following DNTRN, which may be used to trigger ENUM for the modified called party number.

Ro based Charging trigger is configured to be invoked just before call routing. This can be skipped for special numbers by setting SKIP\_Ro flags in preceding translations. For example, if Ro based online charging need not be invoked for certain short codes, it is possible to set SKIP\_Ro flag for matching short codes.

Prior to routing the call, the final screening (SCR) profile is applied which is used to apply Operator Determined Barring Type 1-4 and also to re-write the Request-URI based on the routing number returned in ENUM response or from the SCP. Based on the routing number returned the called party number in the Request-URI may need to be reformatted to include “rn” and “npdi”. Following the SCR profile, the MMTEL will apply CB/ODB and if the call is not barred, the call is routed to the S-CSCF.

From SCC

INVITE

PRTCT

APPCFG

(orig)

Profile Retrieval and Validation



USSD

SVCSCR

**SVCAUSE**

FEAT

TRN

**=FEAT**

**SVCCAUSE = USSD**

ROAMANZ

Check of Operator Controlled Barring of All Outgoing Calls Check of Operator Determined Barring of outgoing calls when roaming outside the home PLMN country

Check of Supplementary Service Barring of All Outgoing Calls

CALLANZ

**SKIP\_ENUM = TRUE**

**SKIP\_ENUM**

**= FALSE**

ENUM

**SKIP\_ENUM = TRUE**

IDP

INTRN

Check\_

O-CSI

**SVCCAUSE != SUPSCP**

**Active**

**Not Active**

**SVCCAUSE = SUPSCP**

IDP RESP

INTRN

**IM-SSF**

{CUE,CON, ETC, CTR}

IDP

Check\_ N-CSI

INTRN

**SVCCAUSE != SUPSCP**

**Active**

**Not**

**Active**

**SVCCAUSE = SUPSCP**

IDP RESP

INTRN

{CUE,CON,, ETC, CTR}

**SKIP\_DNTRN = TRUE**

**SKIP\_DNTRN = FALSE**

DNTRN

**SKIP\_ENUM**

**= TRUE**

**SKIP\_ENUM**



|  |  |  |
| --- | --- | --- |
|  | Process  Failure |  |

**= FALSE**

**Barred**

ENUM

Ro based Online Charging

Check of Operator Controlled Outgoing Barring Check of Supplementary Service Outgoing Barring

* BOIC: barr ing of (all) outgoing international calls
* BOICexHC: barr ing of (all) outgoing international calls except those directed to the home PLMN

SCR

Request-URI fo rmatting in sip:+<MSI SDN>;np di;rn=+<rn>@do main;user=phone OR sip:+<routing number><MSI SDN>@ domain;user=phone

* Operator Determined Barring of Outgoing Premium Rate Calls
* Originating Operator Specific Barring (applicable only if subscriber is registered in HPLMN)



INVITE

#### Call Termination at MMTEL

The figure below shows the sequence followed while processing the MMTEL call termination request. Based on the iFC configuration, the S-CSCF routes the call termination request to the CTAS. By default MMTEL will be the first application to process the call termination request. Following which the request is routed to the integrated SCC AS.

Similar to the call origination request, multiple translations and screening profiles are applied at various staged of the call termination processing, which will control services invoked as part of the termination processing.

If the call termination request is to an unregistered user, the MMTEL will retrieve the user profile from the UDR and if enabled will retrieve the latest CS Location Information from the HSS. The VLR number retrieved from the HSS will be used as the input to Roam Analyzer (ROAMANZ) to determine Roaming Status. This procedure of retrieving the user profile and CS Location Information is done as part of Profile Retrieval.

After applying all the term services, if the call is not barred, the call termination request is routed to the SCC AS.



INVITE

(term)

Check Operator Detemined Barring of Incoming Calls

Check Supplemetary Service Barring of All Incoming Calls

IDP

IDP RESP

{CUE,CON,

CWA,ETC}

Ro based Online Charging

**Barred**

**Not**

**Barred**

to SCC

Terminating Operator Specific Barring

Check Operator Determined Barring of Incoming Calls when Roaming outside the home PLMN country

Check Supplementary Service Barring of Incoming Calls when Roaming outside the home PLMN country

INVITE

Process Failure

SCR

CALLANZ

**Not Active**

**Active**

Check\_

T-CSI

ROAMANZ

INTRN

**SVCCAUSE = SUPSCP**

**SVCCAUSE !=**

**SUPSCP**

INTRN

TRN

SVCSCR

PRTCT

APPCFG

**IM-SSF**

SDL for termination to Unregistered Subscriber is shown below:

**Termination to Unregistered Subscriber**



S-CSCF

MMTel / IM-SSF

SCC

HSS

INVITE

For unregistered subscriber profile

recovery will be performed.

CS Location

Query?

SH

NONE

Sh UDR (Data-Reference=LocationInformation,

Requested-Domain = CS-Domain)

Sh UDA (User-Data(LocationInformation,VLRNumber))

CS Location

Query result?

Diameter error = USER\_UNKNOWN (5001),

IDENTITIES\_DONT\_MATCH (5002),

OPERATION\_NOT\_ALLOWED (5101),

USER\_DATA\_CANNOT\_BE\_READ (5102),

Any other diameter error or

Timeout

Terminating service execution,

e.g. CFU, barring, etc.

INVITE (domain=CS,

VLRNumber)

CS Breakout

NO

Is CFNL

Active?

NO

DisableCFNL

?

YES

YES

Failure in getting CSRN/MSRN

or failure in CS domain

SIP Error Response

Apply CFNL

SIP error response w/o LocInfoChanged for Unregistered subscriber

NO

Is CFNRc

Active?

YES

YES

SIP error mapping found in table internalCCtoBusyNotReachable with “non-reachable” condition?

NO

Diameter error =

USER\_DATA\_NOT\_AVAILABLE (4100),

300x, 500x (except 5001 and 5002), 501x

OR

Diameter Success

(w/o User Data or w/o VLRNumber)

Diameter Success

(VLRNumber)

Session Terminated. Call rejected by sending configurable SIP error response.

Apply CFNRc

Session Terminated. Call rejected by sending configurable SIP error response.

#### Call Termination at SCC

The figure below defines the different points in call terminations where the Translation profiles are executed at the integrated SCC AS.

The processes defined in the below procedure flow are:

* + - * + Process T-ADS & Domain Selection; Refer to Section **Error! Reference source not found.**
        + Process CSRTE; Refer to CTAS Translations & Screening Functional Description document [[36].](#_bookmark25)

from MMTEL

INVITE

(term)

T-ADS &

Domain

Selection

Domain



**IMS**

**Termination**

PS INVITE

Successful

Termination?

**No**

**CS Breakout**



MAP SRI or Sh-

Pull for CSRN

MAP SRI Ack or Sh-Pull Resp [MSRN|CSRN]

User

Roaming?

**Yes**

ROAMANZ

**Yes, CS Retry**

Error Code mapped to

CS Retry?

**Failure (Error/ Timeout), CF Data**

**Yes No**



**Return Configurable Error**

**Response to MMTEL**



**Return Error Response to MMTEL**

In case of Local CSRN, 4 steps from here are skipped and CSRTE is applied on Local CSRN.

|  |  |  |
| --- | --- | --- |
|  | Session Anchored |  |

**Return control back to**

**MMTEL for invoking Charging, applying Barring Services.**

**No**



**No**

t

CS INVITE

Successful

Termination?

CSRTE

Request-URI formatting in sip:+<CS breakout

prefix><MSI SDN>;np di;rn=<CSRN>@do main;user=phone OR

sip:+<CSRN>@do main;user=phone OR tel:+<CS breakout

prefix><MSI SDN>;np di;rn=<CSRN> OR tel:+<CSRN> - When MS ISDN is presen in the user part, the “CS breakout prefix” is needed to ensure the term iFC is

stopped, which happens when the SCSCF detects a difference in the incoming Request-URI compared to what is sent in the outgoing direct ion

**Return Error Response to**

**MMTEL**

**Yes**



|  |  |  |
| --- | --- | --- |
|  | Session  Anchored |  |

### Profile Retrieval and Validation

When the CTAS receives an origination or termination request, the served user’s user profile is retrieved from the local cache. If the served user’s user profile is not available in the local cache, the profile is recovered from the UDR before proceeding with the call processing.

Following a successful retrieval of the served user’s user profile, the CTAS performs some basic validation to ensure that the subscriber originating the call is in good standing based on the profile information received. As part of this validation procedure, the following checks are applied:

* + - * MMTel security level check – If the served user accessing MMTel service has not been authenticated using AKA authentication scheme, the call origination is not allowed; The MMTel security level check is controlled using system wide configuration and can be disabled.
      * Device check – If the terminal identity (IMSI) of the originating device is not considered to be registered i.e. not part of the contact binding stored in the user profile, the call origination is not allowed.

When the profile retrieval and validation is complete, the call processing continues. If the profile validation for call origination or termination fails, the call origination or termination request is disallowed.

If the profile retrieval of the served originating or terminating user’s user profile fails for some reason or the UDR is not available (test lab only), the CTAS supports a provision to using a locally configured default subscriber profile. The default subscriber profile is a configurable user profile containing attributes for services similar to that which is available for configuration in the UDR.

For more details on profile retrieval, refer to the CTAS MMTel User Profile use case document [[54]](#_bookmark41) or [[55].](#_bookmark42)

### Trigger Processing

The gsmSSF or IM-SSF module of the CTAS supports subscriber-based IN triggers to accommodate subscriber services provided by the SCP platforms in the network. These triggers are checked after successfully completing the profile retrieval and validation. In many instances, the service results in new destination address being returned from the SCP that are intended to route the call to a specific terminating point. The SCP may also perform translation or correct the destination address for number portability. The information provided by the SCP is eventually mapped to appropriate headers and used for routing of the INVITE request.

In addition to subscriber-based triggers, the CTAS also supports office-based triggers. The office-based triggers are configurable by the operator in the CTAS to fire when a specified digit pattern is detected.

Based on the provisioning, the CTAS examines the dialed digit string to determine whether an office- based trigger match occurs. If a match occurs, the IN trigger is fired and the call processing continues based on the instruction received from the SCP. The SCP may possibly return new address digits. This new set of destination address is checked for office-based trigger matching and may cause a trigger to be invoked. In this way, there can potentially be a number of passes through the office-based trigger cycle for a single call.

The SCP invoked due to subscriber-based IN trigger or office-based IN trigger may invoke user interaction with the calling party by sending instructions to play announcement or prompt and collect. These instructions are processed by the gsmSRF module of the CTAS and will invoke the MRF to provide the necessary user interaction.

The final destination address received from the last SCP invoked is used for routing the INVITE request. Refer to the IN Interworking Use Case document [[37]](#_bookmark26) for more details.

### MNP Check

Mobile Number Portability (NP) check is performed as part of the origination session to determine the destination network of the recipient. The MNP procedure is to be applied for each session that is initiated by the served originating user. There could be exceptions configured at the TAS for certain special numbers, short codes or for international dialing.

The NP related information is stored in NPDB within the operator’s network. The MNP procedures are realized using any of the below supported mechanisms::

* CAP v2 based MNP Query
* INAP CS-2 based MNP Query
* ENUM based MNP Query

The CAP based MNP Query is triggered based on the O-CSI subscription of the served user, while the INAP based MNP Query is done based on office based trigger for dialed number. The IN SCP might return a NIP (Number Portability Information) which identifies different routing to be used for a particular session. The NIP is used to build the outgoing Request-URI which might include “npdi” and “rn” parameter.

The ENUM based MNP Query can be configured to be performed at various stages of the origination sessions based on service logic. For example, for certain numbers the MNP check must be performed before the IN Triggering, such that the IN SCP is aware of the portability status of the called party number. For certain special numbers, the MNP check must be performed after the number has been modified. Therefore the MNP trigger is checked at various Point In Calls, and if armed and if the Skip ENUM flag has not been set by the preceding translation rule, the ENUM is triggered for the called party address.

As part of the MNP check, the CTAS will trigger an ENUM query and will update the original Request-URI with the URI returned in the ENUM Response. All subsequent call processing will use the possibly modified called party address returned by the ENUM server. The ENUM response returned might include “rn” and “npdi”, or may just return a NIP indicator, which may or may not be translated by the CTAS into a specific Request-URI format.

### DND Check

The Do Not Disturb (DND) service enables a user to avoid receiving unwanted telemarketing calls by registration of their telephone number in the National Do Not Call register.

The access provider will maintain a local DND DB which will be synced with the National Do Not Call register periodically. The CTAS will interface to the DND DB using the Sh (Diameter) Interface. For every call from the calling party pattern that matches a telemarketer, the CTAS will generate a DND query to the local DND DB over the Sh interface using the normalized Called Party MSISDN. The CTAS rejects the call if an entry for the particular subscriber is present in the database, otherwise the call is continued to the subscriber.

### Video Calling

The Video Calling support at the CTAS enables users to make conversational video calls with full-duplex voice and video streams. The Video calling service support is based on the limited capabilities defined in the GSMA IR.94 PRD. Users can make one to one video call, switch to video at any point in call and drop video at any point in call while continuing with voice.

Below is the high level summary of the Video Calling support at the CTAS:

* + - * Compliance to IR.94 v5.0 (conversational video), relevant sections which are supported at the CTAS are:
        + Section 2.2.1 SIP Registration procedures
        + Section 2.2.2 Call Establishment and Termination [NOTE : the SDP negotiation remains transparent to the TAS]
        + Section 2.3 Early Media
        + Section 2.3 Supplementary Services

All IR.92 defined SS are supported for video as well.

Section 2.3.2 Hold

Section 2.3.3 Ad-Hoc Multi Party Conference

* + - * + SRVCC for Video session is not supported, only the audio component is transferred and video component is rejected.
      * SS data specific for Video
        + No support for video specific SS received over LDAP Interface. In such case, all audio SS will be applied for Video session too.
        + Supports video specific SS received over Sh interface, which is based on standard defined MMTEL-Services XML in 29.364. This enables configuration of Video specific CDIV and Video specific CB.
      * Other services are:
        + Supports playing video announcement for video session, also supports network provided Video Local Ring Tone
        + Supports Ro interface based online charging for Video sessions. No impact of Offline CDR/Rf charging, as it already captures SDP.
        + SIP based user config for Video CFx Activation/Deactivation (this is mainly for fixed terminals)
      * Other miscellaneous items related to Video are:
        + Video specific KPIs
        + Capability to perform session (audio or video) based flexible number translation
        + Capability to suppress or enable SS and other features based on Session Type (Audio or Video)

### Services

At various stages of call establishment and during the call, the originating or terminating supplementary services configured in the served user’s profile is applied. The services are described in detail in subsequent sections of this document.

### Translations & Screening

Translations are applied at multiple phases of the call and every time serving a different purpose. Some of the translations are applied during basic call processing and some special translations rules are applied for services or special routing.

Refer to the CTAS Translations & Screening Functional Description document [[36]](#_bookmark25) for more details.

### Call Routing

Since the CTAS node is not responsible for determining the destination route, all it does is to update the Request-URI with the final destination address. The final destination address may have been possibly modified by the SCP or the ENUM Server or it could be the original destination address. Depending on the services and features applied, the CTAS will use any of the ISC mode of operation i.e. routing B2BUA, initiating B2BUA or Originating UA to route the call.

### Basic Call Scenarios

7.2.10.1 **VoLTE to VoLTE**

ENUM-FE

**ENUM RSP** [SIP|TEL

URI with

IN SCP

**ENUM Query**

RN]

**IDP [TDP2**

**CUE/**

**CON**

**CTAS**

**(orig)**

SCC

**INVITE**

(UE-2)

[UE-2]

**and/or TDP3]**

CLDPN = UE-2

MMTEL

IM-SSF

**INVITE**

(UE-2)

Orig

iFC

IN SCP

**INVITE**

(UE-2)

UDR

UE-1

S-CSCF

**INVITE**

**INVITE**

sip:+CC NDC SN @<domain>

;user=phone or

tel:+CC NDC SN

**Cx LIR**

Public-Identity = UE-2

BGCF

(UE-2)

**IDP [TDP12]**

EPC HSS FE

Called Party Number = UE-2

**Sh UDA**

User-Data = <T-ADS info>

**Sh UDR**

Data-Reference = T-ADS

MSISDN = UE-2

**CUE/**

**CON**

IM-SSF

IMS HSS FE

UDR

**INVITE**

(UE-2)

**CTAS**

**(term)**

MMTEL SCC

**Cx LIA**

S-CSCF Address

**INVITE**

(UE-2)

Term

iFC

**INVITE**

**INVITE**

(UE-2)

**INVITE**

(UE-2)

S-CSCF

I-CSCF

Registered contact address P-Called-Party-ID =

sip: + CC NDC SN @ own.com

UE-2

#### CS to VoLTE

* + - * 1. **Dynamic Diversion**

IMS HSS

UDR

**Sh UDR (IMPU)**



Data-Reference = IMS User State

User is IMS registered:

* Either found in local cache; or
* Indicated from HSS

iSCP returns CONNECT with [IMRN] to GMSC or CONTINUE

**CTAS(any)**

iSCP

HLR

**Sh UDA**

User-Data = <IMS User State>

**Sh UDR**

Data-Reference = T-ADS

MSISDN = UE-2

**CON/ CUE**

**IDP [TDP12]**

EPC HSS FE

IN SCP

(UE-2)

IM-SSF MMTEL

**INVITE**

UDR

(RURI=UE2, PAI=UE1,

SDP-MGW)

SCC

**Sh UDA**

User-Data = <T-ADS info>

**CTAS**

Sh UDR

Data-Reference = CSR

**(term)**N

IMS HSS FE

**CC: Setup**

(UE2)

UE1

**IAM**

(UE2)

GMSC/MGCF

VMSC

**SRI**

(UE2)

**SRI Rsp**

(T-CSI)

**IDP** (CdPN= UE2)

**Cx LIR**

Public-Identity = UE-2

**CON**

(DRA=IMRN)

**INVITE**

(RURI=UE2, PAI=UE1)

I-CSCF

**Cx LIA**

S-CSCF Address

**INVITE** (RURI=UE2, PAI=UE1, SDP-MGW)

**INVITE** (RURI=UE2, PAI=UE1, SDP-MGW)

Term iFC

**INVITE**

(UE-2)

**INVITE**

Registered contact address

S-CSCF

UE-2

P-Called-Party-ID =

sip: + CC NDC SN @ own.com

routes the session to IMS

rn= parameter in RURI and

prefix or includes the IMRN

GMSC either strips the IMRN

#### Static Diversion

HLR

SCP

**CC: Setup**

(UE2)

UE1

**IAM**

**SRI**

(UE2)

Sh UDR

Data-Reference = CSR

**SRI Rsp**

(T-CSI)

**IDP** (CdPN= UE2)

**Cx LIR**

Public-Identity = UE-2

**IDP**

(UE-2)

**MAP Ack**

MSRN

**CTAS**

**(term)**N

IM-SSF

MMTEL

**INVITE**

(RURI=UE2, PAI=UE1, SDP-MGW)

**LDAP/Sh**

SCC

**Cx LIA**

S-CSCF Address

**INVITE** (RURI=UE2, PAI=UE1, SDP-MGW)

**INVITE**

(CSRN, SDP-MGW)

iFC

**INVITE**

BGCF

S-CSCF

I-CSCF

IMS HSS FE

U D R

UDR

**MAP SRI**

(UE-2

T-CSI Suppress)

**CUE**

HLR

IN SCP

**CON**

(DRA=IMRN)

**INVITE** (RURI=UE2, PAI=UE1)

routes the session to IMS

rn= parameter in RURI and

prefix or includes the IMRN

GMSC either strips the IMRN

(UE2)

GMSC/MGCF

VMSC

(RURI=UE2, PAI=UE1, SDP-MGW)

**IAM CC: SETUP**

MSC/VLR

MGCF

UE2

#### VoLTE to VoLTE (CS breakout)

IN SCP

**IDP [TDP2 and/or TDP3]**

Called Party BCD Number = UE-2

**CUE/**

**CON**

**CTAS**

**(orig)**

SCC

**INVITE**

(UE-2)

IM-SSF MMTEL

UDR

**INVITE**

(UE-2)

Orig iFC

**INVITE**

(UE-2)

**Sh UDR**

**Sh UDA**

EPC HSS FE

User-Data =

**CUE/**

**CON MAP SRI**

(UE-2

T-CSI Suppress)

HLR

IN SCP

Data-Reference = Location

**INVITE**

sip:+CC NDC SN @<domain>

;user=phone or

tel:+CC NDC SN

**Cx LIR**

Public-Identity = UE-2

BGCF

S-CSCF

UE-1

**INVITE**

<VLR number>

(UE-2)

Information CS-Domain MSISDN = UE-2

**MAP Ack**

<CS Loc Info>

**IDP [TDP12]**

CLPDN = UE-2

MSRN

UDR

IM-SSF

**CTAS**

**(term)**

MMTEL SCC

IMS HSS FE

**Cx LIA**

Default S-CSCF Address

**INVITE**

(UE-2)

Term

Unregistered **INVITE**

**INVITE**

I-CSCF

(UE-2)

iFC

(CSRN, SDP-MGW)

**IAM CC: SETUP**

BGCF

S-CSCF

MSC/VLR

MGCF

UE2

NOTE: The diagram above assumes CTAS is configured for MAP SRI to be used for CSRN generation. This could also be modified to support Local CSRN generation or Sh query for CSRN.

#### VoLTE to VoLTE (CS Retry)

**IDP [TDP2 and/or TDP3]**

Called Party BCD Number = UE-2

**CUE/**

**CON**

**CTAS**

**(orig)**

**INVITE**

(UE-2)

IM-SSF

SCC MMTEL

**INVITE**

(UE-2)

**INVITE**

(UE-2)

Orig

iFC

IN SCP

**INVITE**

sip:+CC NDC SN @<domain>

;user=phone or

tel:+CC NDC SN

**INVITE**

(UE-2)

EPC HSS FE

HLR

**IDP [TDP12]**

Called Party Number = UE-2

**CUE/**

**CON**

**Sh UDR**

Data-Reference = T-ADS

MSISDN = UE-2

**Sh UDA**

User-Data =

<T-ADS info>

**MAP SRI** (UE-2 T-CSI

Suppress)

**MAP SRI Ack**

<MSRN>

IM-SSF

**CTAS**

**(term)**

**INVITE**

(UE-2)

IMS HSS FE

MMTEL

SCC

**Cx LIR Cx LIA**

Public-Identity = UE-2 S-CSCF Address

**INVITE**

(UE-2)

**INVITE**

(UE-2)

Term

iFC

**INVITE**

(CSRN, SDP-MGW)

**INVITE**

(UE-2)

**INVITE**

Registered contact address

P-Called-Party-ID =

sip: + CC NDC SN @ own.com

**IAM**

**CC: SETUP**

**408 Request Timeout or**

Other 4xx/5xx/6xx

P-CSCF/ SBC

MSC/VLR

MGCF

BGCF

S-CSCF

I-CSCF

UDR

BGCF

S-CSCF

UE-1

UDR

IN SCP

UE2

NOTE: The diagram above assumes CTAS is configured for MAP SRI to be used for CSRN generation. This could also be modified to support Local CSRN generation or Sh query for CSRN.

## Service Brokering (SB)

The CTAS supports multiple integrated applications and functions, which are invoked in a predefined order for the purpose of establishing an MMTEL session. These integrated applications and functions can also be treated as independent applications and can be invoked independently or can be invoked in combination of one or more applications. The Service Broker facilitates the invocation of one or more integrated CTAS applications.

Service Broker

SCC **….**

MMTEL

**….**

CTF

(Ro/Rf)

USSD

IM-SSF

**CTAS**

ISC Ma

S-CSCF

I-CSCF

The SB functionality can be used to have external applications invoke a specific integrated application of the CTAS. Some of the use cases for using the SB are:

* The CTAS can be included in the signaling path of non-MMTEL voice session for the purpose of providing IN-IW function of the integrated IM-SSF.
* The CTAS can be included in the signaling path of Videoshare session for the purpose of providing Online Charging (Ro) function of the integrated CTF.
* The CTAS can be included in the signaling path of non-MMTEL voice session for the purpose of providing Session Continuity function of the integrated SCC AS,
* Etc.

### Integrated Applications

The two main integrated applications supported at the CTAS are:

* + - * MMTEL – This is the default application providing MMTEL Supplementary Services.
      * SCC AS – This is the Session Centralization and Continuity Application Server providing Session anchoring, Session continuity in the form of PS to CS SRVCC and CS breakout/Retry functions.

The MMTEL sub-applications which can be invoked using the SB interaction logic are:

* + - * IM-SSF – Integrated gsmSSF & gsmSRF providing IN Interworking
      * CTF for online charging via Ro Interface
      * USSD – MO USSD Service

The SCC sub-functions which can be invoked using the SB interaction logic are:

* + - * CS breakout

### Supplementary Service Suppression

When the request is routed to the CTAS for the purpose of invoking IN Interworking function of the integrated IM-SSF or for invoking any other MMTEL sub-application, there will be a need to suppress the Supplementary Services supported by the MMTEL. This is achieved using the Translation and Service screening framework which allows defining rules to suppress Supplementary Services based on one or more input criteria (s).

The list of Supplementary Services which can be controlled using this mechanism are:

* + - * OIP (Originating Identity Presentation)
      * OIR (Originating Identity Restriction)
      * TIP (Terminating Identity Presentation)
      * TIR (Terminating Identity Restriction)
      * CFU (Communication Forwarding Unconditional)
      * CFB (Communication Forwarding on Busy user)
      * CFNR (Communication Forwarding on no Reply)
      * CFNRc (Communication Forwarding on Subscriber Not Reachable)
      * CFD (Communication Forwarding Default)
      * HOLD (Communication Hold)
      * BAOC (Barring of all outgoing calls)
      * BOIC (Barring of all outgoing international calls)
      * BOICEXHC (Barring of all outgoing international calls except those directed to the home plmn country)
      * BAIC (Barring of all incoming calls)
      * BICROAM (Barring of all incoming calls when roaming outside the home plmn country)
      * ODBBAOC (Operator Determined Barring of all outgoing calls)
      * ODBBOIC (Operator Determined Barring of all outgoing international calls)
      * ODBBOICEXHC (Operator Determined Barring of all outgoing international calls except those directed to the home plmn country)
      * ODBBAIC (Operator Determined Barring of all incoming calls)
      * CW (Communication Waiting)
      * CCBS (Completion of Communications to Busy Subscriber)
      * RBT (Ring Back Tone)
      * CONF (Conference Service)
      * ALLSS – All Supplementary Services listed above.

The rule for this suppression of services can be defined in one or more translation profiles. When a service suppression criteria defined in a particular translation profile matches, that service will remain suppressed for the remaining of that call leg. This suppression is specific for a particular call leg and will not be carried forward to any connected call leg.

When a particular supplementary service is identified to be suppressed, the CTAS will process the INVITE request without invoking that particular service i.e. similar to when that particular service is not implemented at the CTAS.

### SKIP Service

In addition to suppression of Supplementary Services, it is possible to skip other integrated CTAS services. This is done by defining SKIP flags for these services. These SKIP flags are set by various translation profiles invoked at different Point In Calls.

Below is the list of SKIP Flags supported at the CTAS:

|  |  |
| --- | --- |
| **SKIP Flag** | **Description** |
| SKIP\_ENUM | This flag is used to SKIP invocation of ENUM Query. |
| SKIP\_UDR | This flag is used to SKIP retrieving Service Data from the UDR. |
| SKIP\_RF | This flag is used to SKIP Rf based Offline Charging |
| SKIP\_CDR | This flag is used to SKIP CDR based Offline Charging. |
| SKIP\_RO | This flag is used to SKIP Ro based Online Charging |

|  |  |
| --- | --- |
| **SKIP Flag** | **Description** |
| SKIP\_TADS | This flag is used to SKIP TADS query at the SCC |
| SKIP\_INAP | This flag is used to suppress invocation of INAP trigger. |
| SKIP\_CAP | This flag is used to suppress invocation of CAP trigger. |
| SKIP\_ANNC | This flag is used to suppress applying announcement. |

### Interaction Logic

The Service Broker manages the execution of the integrated application based on service interaction logic. The interaction logic is based on set of rules configured using SIP METHOD, SIP HEADER NAME, SIP HEADER VALUE, Source Application and order in which the configured rules must be executed. The matching entry will define the Next Application to be invoked, which determines the route to be taken for a particular request. The SB manages the execution of the services or applications based on these rules.

SB function is controlled by the configuration defined in the **APPSELECTOR** table with following columns, combination of all the 4 columns being unique:

* + - * **PRIORITY** – Identifies the order in which the entry matching must be performed, with 0 being the highest priority.
      * **METHOD** – Identifies the SIP method of the Initial Request.
      * **HDRNAME** – Identifies the SIP header of the Initial Request to be used for evaluating the matching condition.
      * **HDRVALUE** – Identifies the SIP header value to be used for evaluating the matching condition. The matching of the header value will be based REGEXP.
      * **CURRENTAPP** – Identifies the source node which is initiating this request. When the source is the SIP ISC Interface, the CURRENTAPP will be set to “SIP”.
      * **NEXTAPP** – Identifies the destination node where the request needs to be forwarded.

The following use case demonstrates how iFCs in the S-CSCF and interaction logic in the Service Broker work together to manage IMS Service interactions and integrations.

IN SCP

**IDP [TDP2**

**and/or TDP3]**

CLDPN = UE-2

**CTAS**

**(orig)**

IM-SSF

**CUE/**

**CON**

SB

**Non-MMTEL AS**

**INVITE**

(UE-2)

Orig

iFC

**INVITE**

(UE-2)

S-CSCF

IN SCP

**INVITE**

UE-1

sip:+CC NDC SN @<domain>

;user=phone or

tel:+CC NDC SN

**INVITE**

(UE-2)

BGCF

**IDP [TDP12]**

CLDPN = UE-2

**CUE/**

**CON**

IM-SSF

**CTAS**

**(term)**

IMS HSS FE SB

UDR

**Non-MMTEL AS**

**Cx LIR**

Public-Identity = UE-2

**Cx LIA**

S-CSCF Address

**INVITE**

(UE-2)

Term iFC

**INVITE**

(UE-2)

**INVITE**

I-CSCF

(UE-2)

**INVITE**

Registered contact address

S-CSCF

UE-2

P-Called-Party-ID =

sip: + CC NDC SN @ own.com

The use case is to invoke integrated IM-SSF for non-MMTEL voice origination session. The iFC of the user invoking the non-MMTEL voice origination session will have the following iFC configured:

<InitialFilterCriteria>

<Priority>11</Priority>

<TriggerPoint>

<ConditionTypeCNF>1</ConditionTypeCNF>

<SPT>

</SPT>

<SPT>

</SPT>

<SPT>

</SPT>

<Group>0</Group>

<Method>INVITE</Method>

<Group>2</Group>

<SessionCase>0</SessionCase>

<Group>2</Group>

<SessionCase>3</SessionCase>

</TriggerPoint>

<ApplicationServer>

<ServerName>sip:URI\_OF\_CTAS;lr;orig;imssf;transport=tcp</ServerName>

<DefaultHandling>0</DefaultHandling>

</ApplicationServer>

<ProfilePartIndicator>0</ProfilePartIndicator>

</InitialFilterCriteria>

The SB will have the following rule configured:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **PRIORITY** | **METHOD** | **HDRNAME** | **HDRVALUE** | **CURRENTAPP** | **NEXTAPP** |
| 0 | INVITE | ROUTE | imssf | SIP | MMTEL |

When this Initial INVITE request is routed to the CTAS with the Route header containing the CTAS FQDN and “imssf” service token included, the above rule will match and the request will be routed to the MMTEL Application.

At the MMTEL Application, the Service Screening (SVCSCR) Profile will be configured with following rule:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **RuleSet Name** | **Priority** | **Operand** | **Rule** | | **Action** | | |
| **Group** | **(SPT Element = Value)** | **Action Element** | **Sub-Action** | **Value** |
| 0 | SVCTOKEN = imssf | APPTYPE |  | IMSSF |
| IMSSF | 0 | AND |
| SUPSVCLIST |  | ALLSS |
| SKIP\_UDR |  | TRUE |
| CAUSE |  | EXIT |

As per this rule the Initial INVITE request will be processed similar to an MMTEL session, but after suppression of all Supplementary Services and user profile retrieval.

After completion of call processing logic at the MMTEL Application, the request will be routed back to the SB to determine the next application, if any.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **PRIORITY** | **METHOD** | **HDRNAME** | **HDRVALUE** | **CURRENTAPP** | **NEXTAPP** |
| 1 | INVITE | ROUTE | imssf | MMTEL | SIP |

Since the current application is MMTEL, the above defined rule will match, where the next application is defined to be the SIP ISC Interface, which will cause the request to be routed back to the S-CSCF over the ISC interface.

## Supplementary Services

### Originating Identity Presentation (OIP) & Restriction (OIR)

The Originating Identification Presentation (OIP) service provides the terminating user with the possibility of receiving identity information in order to identify the originating user.

The supported OIP service procedures are:

* + - * Activated at provisioning or by user
      * Deactivated at withdrawal or by user
      * Registration is not applicable
      * Erasure is not applicable
      * Interrogation is applicable

The OIP subscription option supported is:

|  |  |
| --- | --- |
| **Subscription option values** | **Values** |
| originating-identity-presentation | Active/Inactive |

There is also a network provided override category which allows the operator to override the OIP setting of the subscriber.

The Originating Identification Restriction (OIR) service enables the originating user to prevent presentation of its identity information to the terminating user.

The supported OIR service procedures are:

* + - * Activated at provisioning or by user
      * Deactivated at withdrawal or by user
      * Registration is not applicable
      * Erasure is not applicable
      * Interrogation is applicable

The OIR subscription options supported are:

|  |  |
| --- | --- |
| **Subscription option values** | **Values** |
| Mode | - temporary mode (specified by the user per the initial outgoing request) |
| - permanent |
| Temporary mode default | * presentation restricted * presentation not restricted |

The CTAS will support the following network wide configuration:

|  |  |
| --- | --- |
| **Network option** | **Values** |
| No screening  Note: Even though this is a network wide option, it may be overridden by the user profile settings. | Active/Inactive |

The CTAS will support following configuration table for setting Privacy header when OIR service is subscribed:

#### Privacy Header for OIR

|  |  |  |
| --- | --- | --- |
| **Field Name** | **Field Description** | **Allowed Values** |
| Subscription Mode | Identifies the subscription mode  – permanent or temporary. | * PERMANENT * TEMP\_RESTRICTED * TEMP\_NOTRESTRICTED |
| Restriction | Identifies whether to restrict the asserted identity or to restrict all  the private information appearing in headers | * ASSERTED\_ID * ALL\_PRIVATE\_INFO * NA (Not applicable) |
| Privacy Header | dentifies operation defined priv- value for Privacy Header. This field can have multiple comma separated values. | * user * id * header |

CTAS supports OIP and OIR service as defined in 3GPP TS 24.607 [[16]](#_bookmark7) which includes:

* + - * If user has not subscribed to OIP, terminating AS removes P-Asserted-Identity and Privacy header fields, replaces From header with “anonymous” identity.
      * OIP override option is supported for terminating user. CTAS removes Privacy header set to “id” when OIP override option is enabled for the terminating user.
      * Originating identity screening. If OIR is not active for the originating user, the CTAS performs screening of identity included in the From header by matching it with the set of registered public identities. If no match is found, CTAS replaces the value of the From header with network provided identity from the P-Asserted-Identity header.
      * Originating display name screening. If OIR is not active for the originating user, the CTAS performs screening of display name included in the From header by matching it with display name provisioned for the used identity. If a match is not found or no display name is provisioned for the user identity, CTAS removes display name from the request.
      * White list for no screening option on a per user basis. CTAS does not screen the originating user's identity information in the From header intended to be transparently transported by the network, based on subscription option. There is currently no subscriber specific “no screening” subscription option defined in the UDR, hence this option by default becomes network wide and applicable for all subscribers.
      * Prevention of premium number ping. CTAS changes the originating user’s identity information in the From header of requests originating from Premium Rate numbers to “Anonymous” identity. This can be controlled in such a way that the modifying originating user’s identity can be done only for a specific premium number or a group of premium numbers.
      * OIR service is supported in permanent and temporary subscription modes. In case of temporary mode both default options – presentation restricted and presentation not restricted are supported.
      * OIR service supports restriction of asserted identity and restriction of all private information appearing in the headers as subscribed by the user. This is applied by default whenever the OIR service is set to permanent mode or temporary mode-presentation restricted.



CTAS manipulates Privacy header as defined in the table below –

|  |  |  |  |
| --- | --- | --- | --- |
| **Subscription** | **Privacy Header** | **Originating CTAS** | **Terminating CTAS** |
| Not subscribed | \* | Removes Privacy Header | - |
| Permanent | \* | * Adds Privacy header with priv- values as configured in “Privacy Header for OIR” for subscription option as PREMANENT and application restriction * A priv-value of “none” is removed, if present. * Adds priv-value “header” if presentation restriction option is “all-private-information” (if not already included) * Adds priv-value “id” if presentation restriction option is “restrict the asserted identity” (if not already included)Applies full privacy service. * If anonymization of From header is required then it is done only if “anonymizeFromHeader” is TRUE. If anonymization is needed as per privacy rules but “anonymizeFromHeader” flag is FALSE then CTAS adds priv-value “user” in Privacy header (if not included) in outgoing INVITE. | If priv-value of “header” is included in the Privacy header, Terminating CTAS adds priv-value of “id” if not already present. |
| Temporary, Presentation restricted | none | Privacy is not applied |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Temporary, Presentation restricted | * Privacy: Any combination of {id, header, user} * or no Privacy header present | * Adds Privacy header with priv-values as configured in “Privacy Header for OIR” for subscription option as TEMP\_RESTRICTED and application restriction * Adds priv-value “header” if presentation restriction option is “all-private- information” (if not already included) * Adds priv-value “id” if presentation restriction option is “restrict the asserted identity” (if not already included)Applies full privacy service. * If anonymization of From header is required then it is done only if “anonymizeFromHeader” is TRUE. If anonymization is needed as per privacy rules but “anonymizeFromHeader” flag is FALSE then CTAS adds priv-value “user” in Privacy header (if not included) in outgoing INVITE. | If priv-value of “header” is included in the Privacy header, Terminating CTAS adds priv-value of “id” if not already present. |
| Temporary, Presentation not restricted | none  or no Privacy header present | Privacy is not applied |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Temporary, Presentation not restricted | Privacy: Any combination of {id, header, user} | * Adds Privacy header with priv- values as configured in “Privacy Header for OIR” for subscription option as TEMP\_NOTRESTRICTED and application restriction * Adds priv-value “header” if presentation restriction option is “all-private-information” (if not already included) * Adds priv-value “id” if presentation restriction option is “restrict the asserted identity” (if not already included) * If priv-value of “header” is included in the Privacy header, Originating CTAS adds priv- value of “id” if not already present. * Applies requested privacy service. * If anonymization of From header is required then it is done only if “anonymizeFromHeader” is TRUE. If anonymization is needed as per privacy rules but “anonymizeFromHeader” flag is FALSE then CTAS adds priv-value “user” in Privacy header (if not included) in outgoing INVITE. | If priv-value of “header” is included in the Privacy header, Terminating CTAS adds priv-value of “id” if not already present. |

CTAS applies privacy services as defined in the table below for the various Privacy header values.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Target headers** | **where (R=Request, r=response)** | **“user”** | **“header”** | **“id”** | **“history”** |
| Call-ID | R | anonymize (Note 4) | - | - | - |
| Call-Info | Rr | delete | don't add | - | - |
| Contact | R | - | anonymize (Note 4) | - | - |
| From | R | anonymize (Note 6) | - | - | - |
| History-Info | Rr | - | anonymize (Note 5) | - | anonymize (Note 5) |
| In-Reply-To | R | delete | - | - | - |
| Organization | Rr | delete | don't add | - | - |
| P-Asserted-Identity | Rr | - | -  (Note 1) | - | - |
| Record-Route | Rr | - | anonymize | - | - |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Target headers** | **where (R=Request, r=response)** | **“user”** | **“header”** | **“id”** | **“history”** |
| Referred-By | R | anonymize (Note 2) | - | - | - |
| Reply-To | Rr | delete | - | - | - |
| Server | r | delete | don't add | - | - |
| Subject | R | delete | - | - | - |
| User-Agent | R | delete | - | - | - |
| Via | R | - | anonymize | - | - |
| Warning | r | (Note 3) | - | - | - |

Note 1: RFC 5379 recommends removing this header, but it will be kept as it could be required by downstream nodes. The only scenario in which it is removed in at the terminating CTAS in compliance with 24.607 section 4.5.2.9 if OIP service of the terminating user is not activated and at originating CTAS in compliance with 24.608 section 4.5.2.4 if an originating user does not subscribe to the TIP service.

Note 2: If "user" privacy is requested in an incoming REFER request, CTAS will anonymize the Referred-By header in outgoing re-INVITE requests. CTAS never sends REFER requests.

Note 3: RFC 5379 recommends anonymizing this header, but it will be left unchanged as it could be required by downstream nodes for debug purposes.

Note 4: CTAS, as a B2BUA, changes these headers by default. Hence no special actions are performed beyond standard B2BUA functionality.

Note 5: RFC 5379 says to anonymize History-Info headers. CTAS deletes the headers to achieve this.

Note 6: According to 3GPP TS 24.607 the AS serving the terminating UE shall remove or anonymize the contents of the From header if incoming the request includes the Privacy header field set to "user". In this release the TAS serving the originating UE provides configuration option for “From” header anonymization or to skip it and add “user” privacy.

The service interactions of the OIP/OIR services with other supplementary services are described in the table below.

|  |  |  |
| --- | --- | --- |
| **Service** | **OIP Interaction** | **OIR Interaction** |
| OIP | NA | OIR service takes precedence over the OIP service, unless Restriction override is active for the terminating user. |
| OIR | OIR service takes precedence over the OIP service, unless Restriction override is active for the terminating user. | NA |
| TIP | No impact. | No impact. |
| TIR | No impact. | No impact. |
| CDIV | The diverted-to user receives the identity information of the original originating user. | The originating user's identity information is not presented to the diverted-to user, unless restriction override is active for the diverted-to user. |

|  |  |  |
| --- | --- | --- |
| **Service** | **OIP Interaction** | **OIR Interaction** |
| CB/ODB | The BAIC service takes precedence over the OIP service. | No impact. |
| CW | No impact. | No impact. |
| HOLD | No impact. | No impact. |
| CONF | No impact. | If a participant has joined the conference as an originating party and has OIR active, then the identity information of that participant is not included in the conference event notifications to other participants. |
| CCBS | No impact. | CTAS enforces the privacy settings of the originating call on the CC call.  CTAS enforces the privacy settings of the originating call for SUBSCRIBE and NOTIFY requests when CC is invoked. |

### Terminating Identity Presentation (TIP) & Restriction (TIR)

The Terminating Identification Presentation (TIP) service provides the originating party with the possibility of receiving identity information in order to identify the terminating party.

The supported TIP service procedures are:

* + - * Activated at provisioning or by user
      * Deactivated at withdrawal or by user
      * Registration is not applicable
      * Erasure is not applicable
      * Interrogation is applicable

The TIP subscription option supported is:

|  |  |
| --- | --- |
| **Subscription option values** | **Values** |
| terminating-identity-presentation | Active/Inactive |

There is also a network provided override category which allows the operator to override the TIP setting of the subscriber.

The Terminating Identification Restriction (TIR) is a service offered to the connected party which enables the connected party to prevent presentation of the terminating identity information to originating party.

The supported TIR service procedures are:

* + - * Activated at provisioning or by user
      * Deactivated at withdrawal or by user
      * Registration is not applicable
      * Erasure is not applicable
      * Interrogation is applicable The subscription option supported is:

|  |  |
| --- | --- |
| **Subscription option values** | **Values** |
| Mode | - temporary mode (specified by the user per request) |
| Temporary mode default | * presentation restricted * presentation not restricted |

The CTAS will support the following network wide configuration for Line-Id:

|  |  |
| --- | --- |
| **Network option** | **Values** |
| No screening  Note: Even though this is a network wide option, it may be overridden by the user profile settings. | Active/Inactive |

CTAS supports TIP and TIR service as defined in 3GPP TS 24.608 [[17]](#_bookmark8) which includes:

* + - * TIR service is supported in permanent and temporary subscription modes. In case of temporary mode both default options – presentation restricted and presentation not restricted are supported.
      * TIR override option is supported for originating user. CTAS removes the Privacy header set to “id” when TIR override option is enabled for the originating user
      * Called user identity screening. If TIR is not active for the terminating user, the CTAS performs screening of identity included in the From header of UPDATE request by matching it with the set of registered public identities. If no match is found, CTAS replaces the value of the From header in UPDATE request with network provided identity from the P-Asserted-Identity header.
      * Called user display name screening. If TIR is not active for the terminating user, the CTAS performs screening of display name included in From header of UPDATE request by matching it with display name provisioned for the used identity. If a match is not found or no display name is provisioned for the user identity, CTAS removes display name from the UPDATE request.
      * White list for no screening option on a per user basis. CTAS does not screen the originating user's identity information in the From header of UPDATE request intended to be transparently transported by the network, based on subscription option. There is currently no subscriber specific “no screening” subscription option defined in the UDR, hence this option by default becomes network wide and applicable for all subscribers.

The service interactions of the TIP/TIR services with other supplementary services are described in the table below.

|  |  |  |
| --- | --- | --- |
| **Service** | **TIP Interaction** | **TIR Interaction** |
| OIP | No impact. | No impact. |
| OIR | No impact. | No impact. |
| TIP | NA | TIR service takes precedence over the TIP service, unless Restriction override is active for the terminating user. |
| TIR | TIR service takes precedence over the TIP service, unless Restriction override is active for the terminating user. |  |

|  |  |  |
| --- | --- | --- |
| **Service** | **TIP Interaction** | **TIR Interaction** |
| CDIV | The diverted-to user’s identity information is presented to originating user only if TIP subscription is active. In addition, diverted-to user’s identity information is controlled based on terminating user’s subscription.  If originating user has Restriction override active, diverted-to user’s identity information is presented when the communication is answered. | The diverted-to user's identity information is not presented to the originating user, if TIR is active in permanent mode.  The diverted-to user's identity information is presented to the originating user during a positive response to the call, if TIR is active in temporary mode.  If originating user has Restriction override active, diverted-to user’s identity information is presented when the communication is answered. |
| CB/ODB | No impact. | No impact. |
| CW | No impact. | No impact. |
| HOLD | No impact. | No impact. |
| CONF | Participants in a conference do not receive the TIP service information of participants being added to the conference. | If a participant has joined the conference as a terminating party and has TIR active, then the identity information of that participant is not included in the conference event notifications to other participants. |
| CCBS | No impact. | CTAS enforces the privacy settings of the CC recall answer on the CC call and if necessary on the subsequent communication, if the CC recall is invoked via 3pcc procedures. |

### Communication Diversion (CDIV)

The Communications Diversion (CDIV) service enables diverting user, to divert the communications addressed to diverting user to another destination.

CTAS supports CDIV as defined in TS 24.604 [[18]](#_bookmark9) which includes:

* + - * Communication Forwarding Unconditional (CFU)
      * Communication Forwarding on Busy user (CFB)
      * Communication Forwarding on no Reply (CFNR)
      * Communication Forwarding on Subscriber Not Reachable (CFNRc)
      * Communication Deflection (CD)
      * Communication Forwarding on Not Logged-in (CFNL)

In addition, the CTAS supports following additional functionality related to CDIV:

* + - * Call Forwarding Default - CDIV by default means that the forwarding’s CFB, CFNR and CFNRc are always active. If the respective forwarding was not activated by the user by registering a forwarded-to number, a default forwarded-to number is automatically registered instead.
      * Configurable SIP and Q.850 codes for not-reachable and busy conditions
      * CS breakout (if user available in CS domain) before invoking CFNL
      * CS retry before invoking CFNRc for configurable SIP response codes
      * Notification to the originating user that his communication has been diverted
      * Checking of diversion limits with possible exception when the forwarding number is a Voicemail number
      * Checking of parallel diversion limits
      * CF Suppression based on the type of CDIV i.e. User Controlled Call Forwarding (UCCF) variant or Operator Controlled Call Forwarding (OCCF) variant and roaming status.

The figure below shows a high level flow for CDIV, for more details refer to the CDIV Use Case Description document [[35].](#_bookmark24)

SCC

IN SCP

CDIV condition detected by T-CTAS:

- CFU configured

If CFU Notify Calling Party subscription is enabled originating user is

notified about call being diverted <181 Call Being Forwarded>

**IDP**

Calling Party = UE-2

Called Party BCD Number = UE-3

**CUE**

**CTAS**

**(orig)**

**CTAS CTAS**

**(term) (orig)**

**INVITE**

(UE-3)

IM-SSF

IM-SSF

IMS HSS FE MMTEL SCC SCC MMTEL

SCC

MMTEL

**INVITE**

(UE-2)

**Cx LIR**

Public-Identity = UE-2

**INVITE**

Orig (UE-2)

iFC

**INVITE**

**INVITE**

**Cx LIA** (sip|tel:UE-3; cause 302

S-CSCF Address **INVITE** Route: orig@scscf

(UE-2) PSU: UE-2

HI: <UE-2>; index 1 Term HI: <UE-3;cause=302>;

**INVITE**

(UE-3)

Orig

iFC

**INVITE**

(UE-3)

(UE-2)

I-CSCF

**INVITE**

(UE-2)

iFC

index 1.1)

S-CSCF

**INVITE**

sip:+CC NDC SN

@<domain>

;user=phone

**IDP**

CLDPN = UE-3

**Sh UDA**

User-Data = <T-ADS info>

IM-SSF

**INVITE**

(UE-3)

**CTAS**

**(term)**

MMTEL

SCC

**Cx LIR Cx LIA**

Public-Identity = UE-3 S-CSCF Address

**INVITE**

(UE-3)

**INVITE**

(UE-2)

**INVITE**

(UE-3)

Term **INVITE**

iFC Registered contact address

P-Called-Party-ID =

sip: + CC NDC SN @ own.com

S-CSCF

I-CSCF

S-CSCF

UE-1

IMS HSS FE

**Sh UDR**

Data-Reference = T-ADS

MSISDN = UE-3

**CUE**

EPC HSS FE

IN SCP

UDR

UDR

IN SCP

UE-3

UDR

### Conference (CONF)

The CONFerence (CONF) service enables a user to participate in and control a simultaneous communication involving a number of users.

CTAS supports the CONF service as defined in 24.605 [[19]](#_bookmark10) which include:

* + - * Three-way session creation using conference factory URI
      * User inviting another user to a conference
      * 3rd party call control (3pcc) procedures for special handling of REFER request as defined in 24.628 [[21]](#_bookmark11) to avoid sending REFER to remote party and instead use re-INVITE to add user to conference.
      * Conference event package with support for the following elements and attributes:
        + Conference-info: entity
        + Maximum-user-count
        + Users
        + User: entity
        + Endpoint: entity
        + Status (supported values: connected, disconnected, on-hold)
      * Leaving a conference
        + Controller leaving a conference
        + Controller removing a conference participant from a conference using a REFER request sent within the existing dialog for a conference session containing.

Conference URI in the RURI and

A Refer-To header including a valid IMPU for the user to be removed and the “method” parameter set to “BYE”

* + - * Configurable conference termination policy, with option to terminate conference when either the conference controller leaves or when the last non-controlling participant leaves.
      * Media type supported is audio
      * Maximum participants supported are configurable with default being 6.
      * Blocking of calls made to premium numbers.

Refer to the Conference Use Case Description document [[30]](#_bookmark19) for details.

### Communication Hold (HOLD)

The Communication Hold supplementary service enables a user to suspend the reception of media stream(s) of an established IP multimedia session, and resume the media stream(s) at a later time.

The supported HOLD service procedures are:

* + - * Activated at provisioning
      * Deactivated at withdrawal
      * Registration is not applicable
      * Erasure is not applicable
      * Interrogation is not applicable

CTAS supports HOLD service as defined in 24.610 [[22]](#_bookmark12) which include:

* + - * Service configuration i.e. the user is allowed to place the call on hold only if hold service is enabled in the user profile.
      * Playing tones/announcements towards held user, with the following exception:
        + If a participant of a conference invokes a HOLD service, the CTAS will not provide announcement/tone to the held user.
      * Limit parallel calls on hold, with configurable allowed limit, by limiting the number of maximum active communications for the served user.

The service interactions of the CH service with other supplementary services are described in the table below.

|  |  |
| --- | --- |
| **Service** | **HOLD Interaction** |
| OIP | No impact. |
| OIR | No impact. |
| TIP | No impact. |
| TIR | No impact. |
| CDIV | No impact. |
| CB/ODB | No impact. |
| CW | No impact. |
| HOLD | NA |
| CONF | If a participant of a conference invokes the HOLD service, CTAS will not initiate announcement/tone procedures towards the held user. |
| CCBS | No impact. |

### Communication Barring (CB)

The Communication Barring (CB) service offers the following services:

* + - * The Incoming Communication Barring (ICB) is a service that rejects incoming communications that fulfill certain provisioned or configured conditions on behalf of the terminating user.
      * The Outgoing Communication Barring (OCB) is a service that rejects outgoing communications that fulfill certain provisioned or configured conditions on behalf of the originating user.

The supported ICB service procedures are:

* + - * Activated at provisioning or by user
      * Deactivated at withdrawal or by user
      * Registration is not applicable
      * Erasure is not applicable
      * Interrogation is applicable

The ICB types supported are described in the table below:

|  |  |
| --- | --- |
| **Barring Class** | **Treatment** |
| BAIC | Barring All Incoming Calls |
| BICRoam | Barring of all Incoming Calls when roaming outside the home plmn country. |

The supported OCB service procedures are:

* + - * Activated at provisioning or by user
      * Deactivated at withdrawal or by user
      * Registration is not applicable
      * Erasure is not applicable
      * Interrogation is applicable

The OCB Types supported are described in the table below:

|  |  |
| --- | --- |
| **Barring Class** | **Treatment** |
| BAOC | Barring of All Outgoing Calls |
| BOIC | Barring of all outgoing international calls |
| BOICExHC | Barring of all outgoing international calls except those directed to the home PLMN country |

CTAS supports CB as defined in 24.611 [[23]](#_bookmark13) which include,

* + - * Service Provisioning - The CB service is provided only if enabled in the user profile. By default, when CB service is disabled in the user profile, CB service is not provided to the user.
      * Barring of all outgoing calls (BAOC)
      * Barring of all outgoing international calls (BOIC). Translation rules will need to be configured to analyze the dialed digit pattern to identity international dialing. The CALLTYPE set by the translation will be used to apply barring of all outgoing international calls.
      * Barring of all outgoing international calls except those directed to the home PLMN country (BOICexHC). If the user is roaming, outgoing international calls except those directed to home PLMN country are rejected. Translation rules will need to be configured to identify roaming status of the originator. The VLR address of the served originating user is used to identify international calls i.e. when the VLR address does not begin with the CC matching that of the called party digits, the call is considered as international call. Called party number starting with CC of the home country is considered call to home country.
      * Barring of all incoming calls (BAIC).
      * Barring of all incoming calls when roaming outside the home PLMN country (BICRoam). If the user is roaming, as identified by his VLR address, all incoming calls are rejected.
      * CTAS provides the capability to play an announcement for the barred call.
      * ICB service takes precedence over Communication Diversion for the served user.
      * OCB service takes precedence over outgoing communication towards the targeted-to user.

The service interactions of the CB service with other supplementary services are described in the table below.

|  |  |  |
| --- | --- | --- |
| **Service** | **ICB Interaction** | **OCB Interaction** |
| OIP | No impact. | No impact. |
| OIR | No impact. | No impact. |
| TIP | No impact. | No impact. |
| TIR | No impact. | No impact. |

|  |  |  |
| --- | --- | --- |
| **Service** | **ICB Interaction** | **OCB Interaction** |
| CDIV | ICB service takes precedence over the Communication Diversion service for the served user.  ICB service is also applied for the diverted-to user.  ODB services takes precedence over CDIV service. | The OCB service takes precedence on the outgoing communication towards the targeted-to user.  OCB service is also applied for the diverting user.  ODB takes precedence over CDIV service. |
| CB/ODB | ICB service takes precedence over ODB services. | OCB service takes precedence over ODB services. |
| CW | No impact. | No impact. |
| HOLD | No impact. | No impact. |
| CONF | No impact. | OCB service takes precedence over Conference. If OCB service is active, the conference creation request is rejected. If the OCB service is activated after conference has been established, any outgoing calls in progress within that conference will not be barred. |
| CCBS | No impact. | No impact. |

### Operator Determined Barring (ODB)

The Operator Determined Barring is similar to CB service except that the ODB service is controlled by the operator. The Subscriber profile will contain Operator Determined Barring (ODB) options which are configured against the subscriber at the UDR.

The ODB types supported are described in the table below.

|  |  |
| --- | --- |
| **Barring Class** | **Treatment** |
| **ODB-General Data** | |
| odbBAOC | Takes the following values:   * 0 None * 1 Outgoing Calls * 2 Outgoing International calls * 3 Outgoing International Calls exHC * 4 Outgoing Calls while Roaming |
| odbBAIC | Takes the following values:   * 0 None * 1 Incoming calls * 2 Incoming calls while roaming |

|  |  |
| --- | --- |
| **Barring Class** | **Treatment** |
| odbBAPREM | Takes the following values:   * 0 None * 1 Outgoing Premium Rate calls (Information) * 2 Outgoing Premium Rate calls (Entertainment) * 3 All Outgoing Premium Rate calls |
| **ODB-PLMN Data** | |
| Operator Determined Barring Type 1 | Rules based on the leading digits with the length up to the complete number. |
| Operator Determined Barring Type 2 | Rules based on the leading digits with the length up to the complete number. |
| Operator Determined Barring Type 3 | Rules based on the leading digits with the length up to the complete number. |
| Operator Determined Barring Type 4 | Rules based on the leading digits with the length up to the complete number. |

CTAS supports ODB as defined in 22.041 [[24]](#_bookmark14) which include,

* + - * Barring of all outgoing calls (odbBaoc)
      * Barring of all outgoing international calls (odbBaoc). Translation rules will need to be configured to analyze the dialed digit pattern to identity international dialing. The CALLTYPE set by the translation will be used to apply barring of all outgoing international calls.
      * Barring of all outgoing international calls except those directed to the home PLMN country (odbBaoc). If the user is roaming, outgoing international calls except those directed to home PLMN country are rejected. Translation rules will need to configured to identify roaming status of the originator. The VLR address of the served originating user is used to identify international calls i.e. when the VLR address does not begin with the CC matching that of the called party digits, the call is considered as international call. Called party number starting with CC of the home country is considered call to home country.
      * Barring of outgoing calls while roaming. Translation rules will be configured to identify the roaming status of originating user.
      * Barring of all incoming calls (odbBaic).
      * Barring of all incoming calls when roaming outside the home PLMN country (odbBaic). If the user is roaming, as identified by his VLR address, all incoming calls are rejected.
      * Barring of outgoing Premium Rate Calls (Information) (odbBaprem). Translation rules needs to be configured to identify digit pattern for premium rate calls.
      * Barring of outgoing Premium Rate Calls (Entertainment) (odbBaprem). Translation rules needs to be configured to identify digit pattern for premium rate calls.
      * Operator Specific Barring Type 1 – Type 4 (odbHplmn). Based on the leading digits configured in translation rules, calls are rejected.
      * CTAS provides the capability to play an announcement for the barred call.
      * Operator Determined Barring of Subscriber Controlled Input (applicable for SIP based user configuration only). CTAS rejects Subscriber Controlled Input if the subscription option is not configured in the Subscriber profile.

CTAS supports following additional functionality related to ODB:

* + - * ODB service provisioning is specific to device hence the ODB service is applied based on the device which is originating the request or the device to which the request is terminated to.
      * Activation of ODB will cause termination of calls of a user that has been established prior to the application of the ODB service and which are still ongoing.
      * ODB service takes precedence over CDIV for the served user.
      * ICB/OCB services take precedence over ODB for the served user.
      * ODB service takes precedence over outgoing communication towards the targeted-to user.

The service interactions of the ODB service with other supplementary services are described in the table in section [7.4.6.](#_bookmark136)

### Communication Waiting (CW)

The Communication Waiting (CW) service enables a UE to be informed that no resources are available for an incoming communication. The user then has the choice of accepting, rejecting or ignoring the incoming communication (as per basic communication procedures).

The supported CW service procedures are:

* + - * Activated at provisioning or by user
      * Deactivated at withdrawal or by user
      * Registration is Not Applicable
      * Erasure is Not Applicable
      * Interrogation is Applicable The subscription option supported is:

|  |  |
| --- | --- |
| **Subscription options** | **Value** |
| *Served user* subscribes to “calling user receives notification that his call is waiting" | No  Yes (default) |

CTAS supports terminal-based CW service as defined in 24.615 [[25]](#_bookmark15) which include:

* + - * When the served terminating user has one or more active calls in progress, if the served user has CW service active, the CTAS will not apply NDUB and will always route the call termination request to the UE.
      * When the served terminating user is in the middle of call establishment i.e. call has not transitioned to active/connected state, the CTAS will apply NDUB and invoke CFB if active.
      * CTAS will provide CW indication in the form of announcement/tone,
        + when 180 Ringing is received from the remote end with Alert-Info header field set to "<urn:alert:service:call-waiting>" or
        + when 180 (Ringing) is received from the served terminating user who has one or more active call dialog(s)
      * CTAS will support the configurable timer “Call Waiting Timer” to supervise the time CW is applied.
      * When user accepts a waiting call, if the number of active communications exceeds the limit, CTAS will release the previous active call.

CTAS supports network-based CW service as defined in 24.615 [[25]](#_bookmark15) which include:

* + - * The maximum number of total communications permitted has been reached. The total communications permitted is controlled by a configurable parameter.

CTAS supports a configurable option to disable NDUB, thus ensuring all calls are presented to the served terminating user irrespective of the NDUB condition match.

The service interactions of the CW service with other supplementary services are described in the table below.

|  |  |
| --- | --- |
| **Service** | **HOLD Interaction** |
| OIP | No impact. |
| OIR | No impact. |
| TIP | No impact. |
| TIR | No impact. |
| CDIV | CFU takes precedence over CW service.  CFU activation while a communication is waiting is not applied for the waiting communication.  If CW invoked results in UDUB, CTAS invokes CFB if subscribed.  CFNR is invoked if noReplyTimer expires after invoking CW.  CFNRc is invoked if notReachableTimer expires after invoking CW. |
| CB/ODB | No impact. |
| CW | NA |
| HOLD | No impact. |
| CONF | No impact. |
| CCBS | CTAS does not invoke the CW service on a CC recall.  If the communication waiting indication cannot be given at the destination B, user A will receive busy indication and can invoke the CCBS service to destination B. |

### Completion of Communications to Busy Subscriber (CCBS)

The CCBS services enables a user, encountering a destination that is busy, to have the communication completed at a later point in time without the user having to manually initiate a new communication attempt when the destination B becomes not busy.

The supported CCBS service procedures are:

* + - * Activated at provisioning
      * Deactivated at withdrawal
      * Registration is not applicable
      * Erasure is not applicable
      * Interrogation is not applicable

CTAS supports CCBS service as defined in 24.642 [[26],](#_bookmark16) which include:

* + - * CCBS is a subscription based service and hence will be invoked only if the corresponding flag is enabled in the user profile.
      * CCBS activation is supported in both user confirmation mode and automatic activation mode.
      * Communication completion procedures using both REFER method and 3rd party call control procedures.
      * Configurable option to not invoke CCBS service retention procedure, if CCBS is already active on an identical communication.
      * Identical communication is identified as calls with the same
        + From header field
        + To header field
        + Request-URI field
        + SDP offer
        + Privacy header field
        + P-Asserted-Identity header field
      * Configurable option for the operator to control if user A is informed about CC possibility at user B.
      * Configurable option to control network provider option “CC request retention”, separately for each network.
      * Configurable queue length for the operator to control the number of outstanding communication completion requests per user.
      * Configurable user level parameter for the operator to control the number of outstanding communication completion requests against one destination
      * Configurable network level parameter for the operator to control the number of outstanding communication completion requests against one destination, when per user queue configuration is deactivated.
      * Communication completion requests are processed in a first-in first-out fashion.
      * Communication completion support for a UE that has Multi-SIM Account.

The service interactions of the CCBS service with other supplementary services are described in the table below.

|  |  |
| --- | --- |
| **Service** | **CCBS Interaction** |
| OIP | No impact. |
| OIR | CTAS enforces the privacy settings of the originating call on the CC call.  CTAS enforces the privacy settings of the originating call for SUBSCRIBE and NOTIFY requests when CC is invoked. |
| TIP | No impact. |
| TIR | CTAS enforces the privacy settings of the CC recall answer on the CC call and if necessary on the subsequent communication, if the CC recall is invoked via 3pcc procedures. |

|  |  |
| --- | --- |
| **Service** | **CCBS Interaction** |
| CDIV-CFU | **For CFU activated by B before A requests CC on B:**   1. If Disable CCBS If CFU parameter is False, user B has activated CFU, and the forwarded communication results in a call-completion condition at user C, the originating TAS will inform user A that CC is possible at user C.   Note: If user A activates CC and subsequently activates CFU, the originating TAS will give the CC recall to user A at his original location.   1. If Disable CCBS If CFU parameter is True, user B has activated CFU, and the forwarded communication results in a call-completion condition at user C, the originating TAS will not inform user A that CC is possible.   **For CFU activated by B after A requests CC on B:**   1. If Suspend CCBS If CFU Activated parameter is set to False, and if user B activates CFU after user A has activated CC on user B, then the terminating TAS will cancel the CC request and will send a notification "CC cancelled" to the user A. 2. If Suspend CCBS If CFU Activated parameter is set to True, the terminating TAS will suspend (stop monitoring user B to become not busy or CC busy) the CC request until user B deactivates CFU. If the service duration timer CC-T3 expires before user B deactivates CFU, the originating TAS will cancel the CC request. If the service duration timer CC-T7 expires before user B deactivates CFU, the terminating TAS will cancel the CC request. 3. If Suspend CCBS If CFU Activated parameter is set to True, the terminating TAS will resume (start monitoring user B to become not busy or CC busy) each suspended CC request due to user B activating CFU, when user B deactivates CFU. |
| CDIV-CFB | **For CFB activated by B before A requests CC:**   1. If Invoke CCBS on CLDPTY if CFB parameter is set to False, and if user B has activated CFB before user A requests CC and is busy, and if the forwarded communication results in a call-completion condition at user C, the terminating TAS of B will forward the Call-Info header received from the terminating TAS of C to the originating TAS of A.   Note: The originating TAS of A will inform user A that CC is possible at user C, if CCBSstatus (natCCBS) parameter in user profile is set to true and the CCBS Enable parameter is ENABLED.   1. If Invoke CCBS on CLDPTY if CFB parameter is set to True, and if user B has activated CFB before user A requests CC and is busy, the terminating TAS of B will include a Call-Info header to indicate that CC is possible at B and sends it to the originating TAS of A.   Note: The originating TAS of A will inform user A that CC is possible at user B, if CCBSstatus (natCCBS) parameter in user profile is set to true and the CCBS Enable parameter is ENABLED.  **For CFB activated by B after A requests CC on B:**   1. If Activate CCBS If CFB Activated parameter is set to True, user B will be considered as being busy and the terminating TAS will apply the procedures of CCBS on the CC call from user A. 2. If Activate CCBS If CFB Activated parameter is set to False, the terminating TAS will forward the communication (i.e. the CC call from user A) as a normal communication to user C.   Note: Supplementary services are not applied to this forwarded CC recall at T-TAS of user C. |

|  |  |
| --- | --- |
| **Service** | **CCBS Interaction** |
| CDIV-CFNR | **For CFNR activated by B before A requests CC:**   1. If Disable CCBS If CFNR parameter is False, if user B has activated CFNR and is not answering, and the forwarded communication results in a call-completion condition at user C, originating TAS will inform user A that CC is possible at user C. 2. If Disable CCBS If CFNR parameter is True, if user B has activated CFNR and is not answering, and the forwarded communication results in a call-completion condition at user C, the originating TAS will not inform user A that CC is possible.   **For CFNR activated by B after A requests CC on B:**   1. If Suspend CCBS If CFNR Activated parameter is set to False, and if user B activates CFNR after user A has activated CC on user B, for a CC call from user A which encounters a no answer condition at user B, terminating TAS will cancel the CC request and will send a notification "CC cancelled" to the user A. 2. If Suspend CCBS If CFNR Activated parameter is set to True, the terminating TAS will suspend (stop monitoring user B to become not busy or CC busy) the CC request until user B deactivates CFNR. If the service duration timer CC-T3 expires before user B deactivates CFU, the originating TAS will cancel the CC request. If the service duration timer CC-T7 expires before user B deactivates CFU, the terminating TAS will cancel the CC request. 3. If Suspend CCBS If CFNR Activated parameter is set to True, the terminating TAS will resume (start monitoring user B to become not busy or CC busy) each suspended CC request due to user B activating CFNR, when user B deactivates CFNR. |
| CDIV-CFNRc | **For CFNRc activated by B before A requests CC:**   1. If Disable CCBS If CFNRc parameter is False, if user B has activated CFNRc and is not answering, and the forwarded communication results in a call-completion condition at user C, originating TAS will inform user A that CC is possible at user C. 2. If Disable CCBS If CFNRc parameter is True, if user B has activated CFNRc and is not answering, and the forwarded communication results in a call-completion condition at user C, the originating TAS will not inform user A that CC is possible.   **For CFNRc activated by B after A requests CC on B:**   1. If Suspend CCBS If CFNRc Activated parameter is set to False, and if user B activates CFNRc after user A has activated CC on user B, for a CC call from user A which encounters a not reachable condition at user B, terminating TAS will cancel the CC request and will send a notification "CC cancelled" to the user A. 2. If Suspend CCBS If CFNRc Activated parameter is set to True, the terminating TAS will suspend (stop monitoring user B to become not busy or CC busy) the CC request until user B deactivates CFNRc. If the service duration timer CC-T3 expires before user B deactivates CFU, the originating TAS will cancel the CC request. If the service duration timer CC-T7 expires before user B deactivates CFU, the terminating TAS will cancel the CC request. 3. If Suspend CCBS If CFNRc Activated parameter is set to True, the terminating TAS will resume (start monitoring user B to become not busy or CC busy) each suspended CC request due to user B activating CFNRc, when user B deactivates CFNRc. |

|  |  |
| --- | --- |
| **Service** | **CCBS Interaction** |
| CDIV-CD | **For the originating user A:**  If a communication to the called user B is deflected to user C by the CD service and results in a call-completion condition at user C, TAS shall inform user A that CC is possible at user C. TAS shall not deflect a CC recall.  **For the called user B:**  TAS shall not deflect a CC call. |
| CB/ODB | **For the originating user A:**  If user A has OCB/ODB activated after activating CC on user B, a CC recall from user A will be rejected by originating TAS and CC request will be cancelled.  **For the terminating user B:**  If user B has ICB/ODB activated after user A has activated CC on user B, a CC recall from user A will be rejected by terminating TAS and CC request will be cancelled. |
| CW | CTAS does not invoke the CW service on a CC recall.  If the communication waiting indication cannot be given at the destination B, user A will receive busy indication and can invoke the CCBS service to destination B. |
| HOLD | No impact. |
| CONF | No impact. |
| CCBS | A user can be both a "user A" and a "user B" simultaneously, i.e. that user can have activated the CC service and have CC requests outstanding whilst at the same time that user can be the destination of CC requests from other users.  CTAS handles CC requests activated by user (the user's queue A) with priority over CC requests activated by other users on the user (the user’s queue B). |

The interworking considerations of the CCBS service with CS network are described in the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Terminating user** | | | | |
| **Originating user** |  | **CS subscriber** | **VoLTE subscriber IMS connected** | **VoLTE subscriber CS connected** |
| **CS subscriber** | OK | N/A - CCBS possible indication offered by terminating MMTEL but  removed by MGCF | N/A - CCBS possible indication offered by terminating MMTEL  but removed by MGCF |
| **VoLTE subscriber IMS connected** | N/A - CCBS possible indication offered by  terminating MSC but removed by MGCF | OK | Partly - CCBS possible is offered if B is busy with terminating call, therefore the MMTEL knows that user B is  busy. |
| **VoLTE subscriber CS connected** | OK | N/A - CCBS possible indication offered by terminating MMTEL but removed by MGCF | N/A - CCBS possible indication offered by terminating MMTEL but removed by MGCF |

#### CCBS Invocation

The following flow shows the scenario where CTAS-B finds user B is busy and sends CCBS possible indication to CTAS-A. CTAS-A informs user A that CCBS is possible and gets confirmation to invoke CCBS. CTAS-A subscribes for CCBS notification from CTAS-B.

UE-A

INVITE (from:A, to: B, SDP1)

S-CSCF

(AB)

CTAS

(A)

CTAS

(B)

MRFC/

MRFP

UE-B

486 Busy Call-Info: <sip:CTAS- b.mav.com>;purpose=call-completion;m=BS

CTAS-B will include CCBS possible indication only if there is an another ongoing call and no 180 Ringing is received prior to receiving 486.

486 Busy

Start CC-T1 Timer

CTAS-A initiates CCBS activation procedure by connecting A party to the IVR for prompt and collect instructions.

It’s assumed that MGCF would not be interworking Release with Cause #17 to CCBS Possible indication.

PRACK

183 [SDP2], PEM=sendrecv

INVITE sip:msml@domain SDP1

200 OK [tag=<conn: id:msisdnA>SDP2

ACK

INFO

<dialogStart name=**ccbs-prompt**

audio uri="file://provisioned ccbs-prompt">

<dtmf><pattern digits=”min=1;max=1"/><dtmfexit><send event=”app.dtmfDone” namelist=”dtmf.digits dtmf.end”/

></dtmfexit></dtmf></dialogStart>

RTP (CCBS Activation Prompt, Press 1 for Activation)

200 OK

INFO

Subscriber has requested for Activation of CCBS

SUBSCRIBE [sip:CTAS-

b.mav.com]

Call-Info: <ue-a>;purpose=call-

completion;m=BS

Event: call-completion

<id=conn:id:msisdnA/dialog:ccbs-prompt>

<name>dtmf.end</name><value>dtmf.match</value> 200 OK

Stop CC-T1 Timer

Start CC-T2 Timer

202 Accepted

NOTIFY

Event: call-completion [cc-state: queued, cc-

service-retention]

200 OK

CTAS-B adds a CC Request to the outstanding CC request queue. CTAS- B will begin state supervision for UE-B

Start CC-T7 Timer

Stop CC-T2 Timer Start CC-T3 Timer

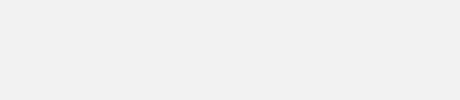
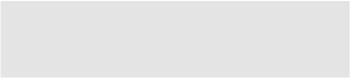
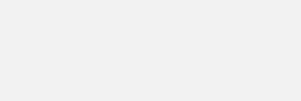
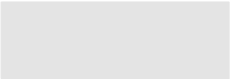
INFO

<dialogStart name=**ccbs-activated-prompt** audio uri="file://provisioned ccbs-prompt">

RTP (CCBS Successful Activation Announcement)

200 OK

INFO



ACK

486 Busy Content-Type: message/ external-body; access-type = “URL”; expiration: "Mon, 26 Nov 2012 09:00:00 GMT";

URL=””;

<id=conn:id:msisdnA/dialog:**ccbs-prompt**>

<name>play.end</name><value>play.complete</value> 200 OK

BYE/200 OK

#### CCBS Invocation controlled by external Call Control node

The following flow shows the scenario where CTAS-B finds user B is busy and if following conditions are met, forwards the INVITE to cfdFTNOforCFB (using the procedures described in CDIV Use Case Description document [[35]](#_bookmark24)), which is routed to an external call control node. The CTAS will suppress sending 181 to the caller in this case.

* + - * + CFB is not active for the terminating user, but, cfdforCFBActive set to “active” AND cfdFTNOforCFB has an FTN and
        + There is an ongoing call and NDUB condition occurs or no 180 Ringing is received prior to receiving 486 or 603 and
        + Number of diversions for the terminating call identified by the received History-Info header does not equal to, or exceed ‘Max Allowed Diversions for CFD Busy’ and ‘Max Allowed Diversions’.

If the external call control node returns 486 busy, CTAS-B sends CCBS possible indication to CTAS-A. CTAS-A informs user A that CCBS is possible and gets confirmation to invoke CCBS. CTAS-A subscribes for CCBS notification from CTAS-B.

UE-A

INVITE (from:A, to: B, SDP1)

* 1. SCF

(AB)

TAS

(A)

TAS

(B)

Ext. CC

Node

MRFC/

MRFP

UE-B

486 Busy

TAS-B will forward the INVITE to external call control node if following conditions are met (TAS will suppress sending 181 to caller in this case) -

1. CFB is not active for the terminating user, but, cfdforCFBActive set to “active” AND cfdFTNOforCFB has an FTN and
2. There is an ongoing call and NDUB condition occurs or no 180 Ringing is received prior to receiving 486 or 603 and
3. Number of diversions for the terminating call identified by the received History-Info header does not equal to, or exceed ‘Max Allowed Diversions

for CFD Busy’ and ‘Max Allowed Diversions’.

486 Busy

Call-Info: <sip:tas-b.mav.com>;purpose=call-

completion;m=BS

INVITE (from:A, to: B,

SDP1)

486 Busy

TAS-B will include CCBS possible indication if 486 Busy response is received from external Call Control node.

Start CC-T1 Timer

TAS-A initiates CCBS activation procedure by connecting A party to the IVR for prompt and collect instructions.

It’s assumed that MGCF would not be interworking Release with

Cause #17 to CCBS Possible indication.

PRACK

183 [SDP2], PEM=sendrecv

INVITE sip:msml@domain SDP1

200 OK [tag=<conn: id:msisdnA>SDP2

ACK

INFO

<dialogStart name=**ccbs-prompt**

audio uri="file://provisioned ccbs-prompt">

<dtmf><pattern digits=”min=1;max=1"/><dtmfexit><send

event=”app.dtmfDone” namelist=”dtmf.digits dtmf.end”/

></dtmfexit></dtmf></dialogStart>

RTP (CCBS Activation Prompt, Press 1 for Activation)

200 OK

INFO

Subscriber has requested for Activation of CCBS

SUBSCRIBE [sip:tas-

b.mav.com]

Call-Info: <ue-a>;purpose=call-

completion;m=BS Event: call-completion

<id=conn:id:msisdnA/dialog:ccbs-prompt>

<name>dtmf.end</name><value>dtmf.match</value>

200 OK

Stop CC-T1 Timer

Start CC-T2 Timer

202 Accepted

NOTIFY

Event: call-completion [cc-state: queued, cc-

service-retention]

200 OK

TAS-B adds a CC Request to the outstanding CC request queue. TAS-B will begin state supervision for UE-B

Start CC-T7 Timer

Stop CC-T2 Timer

Start CC-T3 Timer

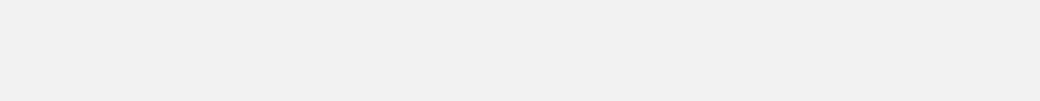
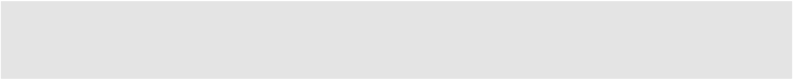
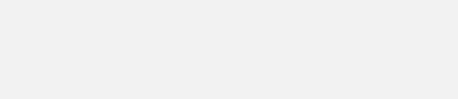
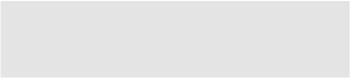
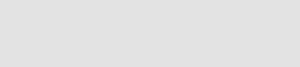
INFO

<dialogStart name=**ccbs-activated-prompt**

audio uri="file://provisioned ccbs-prompt">

RTP (CCBS Successful Activation Announcement)

200 OK INFO



ACK

486 Busy Content-Type: message/ external-body; access-type = “URL”; expiration: "Mon, 26 Nov 2012 09:00:00 GMT";

URL=””;

<id=conn:id:msisdnA/dialog:**ccbs-prompt**>

<name>play.end</name><value>play.complete</value> 200 OK

BYE/200 OK

#### CCBS Revoke

The following flow shows the scenario where CTAS-A revokes CCBS request following CC Service Duration timer expiry.



NOTIFY [sip:CT

Subscription-state: terminated;r

200 OK

Stop CC-T7 Timer Stop CC-T9 Timer

AS-a.mav.com] eason=timeout

from the e.

CTAS-B removes the CC Request outstanding CC request queu

200 OK

mer expires for a g CC request

CC-T3 Ti

pendin

SUBSCRIBE [sip:CTAS-

b.mav.com] Call-Info: <ue-a>;purpose=call-

completion;m=BS Event: call-completion

Expires: 0

Expires

. CC-T3 Timer

Alternate Scenario

MRFP

UE-B

MRFC/

CTAS

(B)

CTAS

(A)

S-CSCF

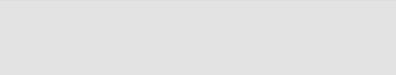
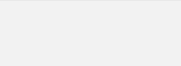
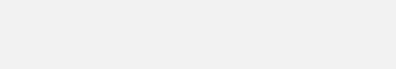
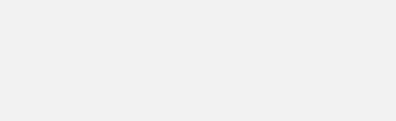
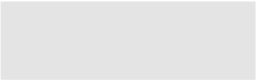
(AB)

UE-A

#### CCBS Recall using REFER method

The following flow shows the scenario where CTAS-B finds that user B is not busy and notifies CTAS-A. CTAS-A then performs CCBS recall using the REFER method.

Call Setup continues, A-B call Active



NOTIFY [sip:CTAS-a.mav.com] Subscription-state: active;expires=<nn> Event: call-completion [cc-state: ready]

200 OK

NOTIFY (100 Trying)

200 OK

INVITE ue-b [SDP1]

-

-

NOTIFY [sip:CTAS-a.mav.com]

Subscription-state:

terminated;reason=noresource

UE-B

o be

stination

If there are further CC requests t

processed, it continues to monitor de

B to be not busy.

T3 Timer

Stop CC-

200 OK

m the

CTAS B deletes the CC request fro

destination B queue.

T7 Timer

T9 Timer

Stop CC

Stop CC

INVITE ue-b [SDP1]

Call-Info:<ue-a>;purpose=call-

completion;m=BS

T4 Timer

Stop CC-

T4 Timer

Start CC-

AS is aware of UE-A’s support for

, it will use REFER, else it will use

3PCC procedure.

If the CT

REFER

REFER [From: B, To: A, Refer-

To: ue-b]

200 OK

Start CC-T9 Timer

CC-T8 Timer Expires

T8 Timer

Start CC-

nd is not nding quest. If is not Recall.

UE-B has released the previous call a busy now. CTAS-B checks the CC Pe Request queue for an outstanding re there is an outstanding request which suspended, it will be selected for CC

MRFP

MRFC/

CTAS

(B)

CTAS

(A)

S-CSCF

(AB)

UE-A



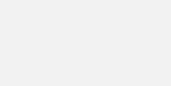
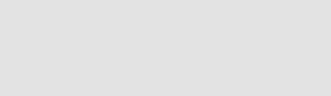
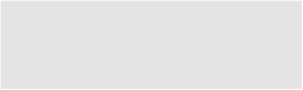
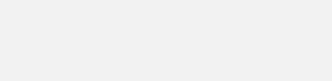
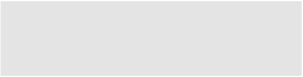
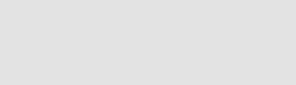
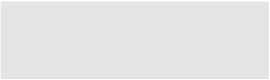
#### CCBS using 3rd party call control

The following flow shows the scenario where CTAS-B finds that user B is not busy and notifies CTAS-A. CTAS-A then performs CCBS recall using the 3rd party call control.

Term iFC is skipped due to the presence of “skipiFC=term” and the request is routed directly to UE-A

RTP (CCBS Announcement)

In order to ensure the recall establishes the same type of call which was attempted earlier, the original SDP Offer stored in the CC Retention queue should be used. But, to avoid interworking issues, we are using SDP3 which is negotiated with MRF while establishing the call towards B party.



I/S-CSCF (AB)

CTAS CTAS

(A)

(B)

MRFC/ MRFP

UE-B

Start CC-T8 Timer

UE-B has released the previous call and is not busy now. CTAS-B checks the CC Pending Request queue for an outstanding request. If there is an outstanding request which is not suspended, it will be selected for CC Recall.

NOTIFY [sip:CTAS-a.mav.com] Subscription-state: active;expires=<nn> Event=call-completion [cc-state: ready]

Start CC-T9 Timer

200 OK

If the CTAS is aware that the UE-A does not support REFER method, it uses 3PCC procedure. Using 3PCC procedure, CTAS establishes call to A, connects it to media server to play announcement, following which it establishes call to B.

INVITE sip:msml@domain [<original SDP1 Offer from A party stored in retention queue is used, without pre- conditions>]

200 OK [tag=<conn: id:msisdnA> [SDP1 answer]

ACK

CTAS sends a INVITE to UE-A with the X-mav- service header set to skipiFC=term

INVITE UE-A [SDP2 offer =

SDP1 answer]

From: B

Route: scscf-addr Call-Info:<ue-a>;purpose=call-

completion;m=BS

X-mav-service:skipiFC=term

Start CC-T4 Timer

200 OK [SDP2 answer]

CTAS applies Orig Services (IN, CB) for user A.

Stop CC-T4 Timer

re-INVITE [SDP3 offer = SDP2 answer]

200 OK [SDP3 answer]/ACK

ACK

CTAS sends ACK to SCSCF.

INFO

<dialogStart name=ccbs-announcement

audio uri="file://provisioned/messageIDortoneID"/>

200 OK

183 [SDP4 answer]

PRACK/200 OK

180 Ringing

INFO

<dialogStart name=local-ringtone

audio uri="file://provisioned/messageIDortoneID"/>

200 OK

200 OK (INVITE)

ACK (200 OK)

CTAS sends reINVITE to UE-A to redirect it to UE-B’s media.

BYE

200 OK

A-B call Active

Stop CC-T7 Timer

Stop CC-T9 Timer

CTAS B deletes the CC request from the

destination B queue.

NOTIFY [sip:CTAS-a.mav.com]

Subscription-state:

terminated;reason=noresource

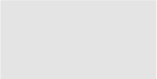
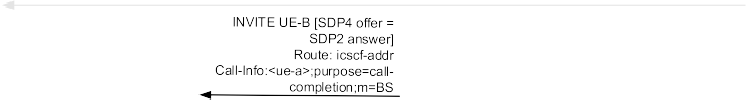
200 OK

Stop CC-T3 Timer

If there are further CC requests to be processed, it continues to monitor destination B to be not busy.

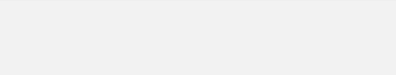
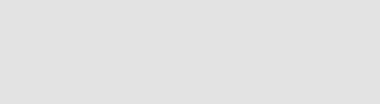
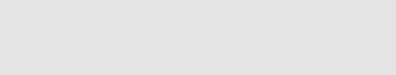
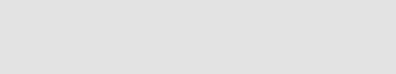
CC-T8 Timer Expires

UE-A



#### CCBS Suspend and Resume

The following flow shows the scenario where CCBS is suspended by the CTAS-A serving user A, when CCBS Recall fails. CTAS-A resumes CCBS request when user A becomes available.



NOTIFY [sip:CTA

Event: call-completion [cc

revokes CC request the call flow is

r to other CC Revoke call flows.

NOTIFY [sip:CTAS-a.mav.com]

Event: call-completion [cc-state: ready]

If the UE-B is available and there is no entry in the CC queue which is currently being processed, CTAS-B will service the destination B queue.

200 OK

n the

CTAS-B resumes the CC Request i

outstanding CC request queue.

200 OK

A sent suspension requests to

CTAS it resumes each suspended

request.

If CTAS

different

PUBLISH [sip:CTAS-

b.mav.com]

To: <ue-b>

Call-Info: <ue-a>;purpose=call-

completion;m=BS

Contact: sip:CTASa.mav.com

Expires: <rem time>

[status\_basic==open]

ilable.

A becomes ava

Supervision. User

If CTAS A

simila

o be

stination

If there are further CC requests t

processed, it continues to monitor de

B to be not busy.

200 OK

Stop CC-T9 Timer

in the

CTAS-B suspends the CC Request

outstanding CC request queue.

S-a.mav.com]

-state: queued]

200 OK

PUBLISH [sip:CTAS-

b.mav.com] Call-Info: <ue-a>;purpose=call-

completion;m=BS

Contact: sip:CTASa.mav.com

Expires: <rem time>

[status\_basic=closed]

n.

fails. Suspensio

CCBS Recall

MRFP

UE-B

MRFC/

CTAS

(B)

CTAS

(A)

S-CSCF

(AB)

UE-A

### Ring Back Tone (RBT)

The personalized Ring Back Tone (RBT) service allows the user to replace the standard ring back tone with a personalized tone of the user’s choice.

The RBT service which the CTAS supports is described as follows:

* + - * RBT is a subscription based service hence will be invoked only if the corresponding flag is enabled in the user profile.
      * RBT is not applied in case of early forwarding.
      * When late forwarding gets invoked, then depending on configuration:
        + RBT of diverting party is stopped; or
        + RBT of diverting party is continued until the call is answered by the diverted-to party or the call fails or the diverted-to network plays some early media (e.g. announcement).
      * RBT is not applied for the diverted call at the CTAS serving the diverted-to party.
      * For the served user with RBT and MSIM service active, one RBT is played irrespective of number of ringing MSIM devices.
      * RBT player is external to CTAS and the CTAS will establish additional call leg towards the RBT player.

Refer to the RBT Use Case Description document [[34]](#_bookmark23) for details.

### CNAP

This feature allows the name of the calling party to be delivered to the called party if the called party has subscribed to the CNAP feature. CNAP is a terminating user feature allowing the CTAS connected to a switching system to receive a calling party's name during the first silent interval.

When a terminating call request is received and display-name is not received in the P-Asserted-Identity of the From header and if the served user has CNAP subscription active, TCAP Name Query is generated to retrieve the calling name of the originating user.

If display-name is received in the P-Asserted-Identity or the From header, based on configuration it is possible to generate TCAP Name query and override the display-name received.

When TCAP Name query is successful and if the presentation is not restricted, the name returned in the response is used to set the display-name of the P-Asserted-Identity and the From header.

### Explicit Communication Transfer (ECT)

The explicit communication transfer (ECT) service provides a party involved in a communication to transfer that communication to a third party.

The CTAS supports the 3PCC procedures for ECT service as defined in 3GPP TS 24.629 [[58].](#_bookmark44) The following types of call transfer are supported:

* + - * *Blind Transfer* - The transferor has no ongoing consultation communication with the transfer target. The transferor wants to perform the transfer without any further action on the transfer operation.
      * *Assured Transfer* – The transferor has no ongoing consultation communication with the transfer target. The transferor wants to have a feedback on the transfer operation progress with the possibility to retrieve the communication with the transferee.
      * *Consultative Transfer* - The transferor has a consultation communication with the transfer target. Some of the main characteristics of the ECT service supported by the CTAS are:
      * The CTAS supports subscription based ECT service.
      * The CTAS uses procedures specified in 3GPP TS 24.628 [[21]](#_bookmark11) for special REFER request handling using 3PCC procedures.
      * The transferor CTAS remains in the signaling path even after the communication is transferred as specified in 3GPP TS 24.629 [[58].](#_bookmark44)
      * The CTAS applies classical charging model i.e. charging continues for the transferred call, fresh charging is applied for the transfer leg on both originating (transferor) and terminating (transfer target) legs as applicable as specified in Appendix C of 3GPP TS 24.629 [[58].](#_bookmark44)
      * The CTAS does not un-hold the transferred call. It is expected that the transfer target will un-hold the call using appropriate SDP directionality.

## Other Services

### Multi-SIM

Multi-SIM (or MSIM) is a service to support several mobile devices belonging to a single user under one visible public MSISDN, which is called the Master-MSISDN. The user can have up to 5 SIM cards with one primary (or Master) and one to four reserve (or Slave) SIMs. The MSIM service makes use of normal SIM cards with their own IMSIs and MSISDNs.

Some of the main characteristics of MSIM service supported at CTAS are:

* + - * For mobile originating calls, each device is used independently. The calling line id visible to the B party is always that of the Master-MSISDN.
      * MSIM subscriber is disallowed from having more than one call (active or held) at the same time in more than one device, when in IMS domain.
      * For mobile terminating calls, the call handling will be as described below:
        + If all devices are idle, parallel outgoing session requests are made to each device, with the first accepting device being connected and the others legs being disconnected.
        + If any of the MSIM member devices is busy, the busy device is chosen for termination, which may result in CW or CFB, based on the service settings of the Master-MSISDN.
      * The originating and terminating supplementary services are normally (independent from MSIM) handled on IMPU level, Operator Determined Barrings are configured and executed per IMSI/IMPI (to allow barring of single devices/SIM cards in the case of loss)

Refer to the MSIM Use Case description document [[31]](#_bookmark20) for details.

### Multi UA Forking

Multi Instance is a service similar to MSIM service except that it is a single SIM service, with the user registering one or more UA instances using the same IMPU.This feature allows IMS subscribers to receive call requests on different UA instances registered as a contact against the same public user identity, increasing the reachability. In order to allow this feature to be triggered, a subscriber must be previously registered with more than one UA instance defined using the same public user identity.

The scope of this document is limited to parallel forking when more than one UA instances registered from a primary and/or secondary device. The scope also includes use case where all the UA instances are registered from primary device. Under such condition, the CTAS attempts sequential forking to all the registered UA instances from primary device.

Some of the main characteristics of Single SIM Multi UA Forking service supported at CTAS are:

* + - * For mobile originating calls, each registered UA instance can be used independently, the CTAS tracks the served user instance state using the Instance-ID.
      * The served user is allowed to have only one ongoing session (active or held) at any point of time when in IMS domain.
      * For mobile terminating calls, the following gives the overview of the call handling for parallel forking:
        + The CTAS identifies the User state and generates the target list with the list of IMS/CS idle UA instances.
        + If there is any busy instance, the request is terminated to the busy instance depending on the subscription to Call Waiting Service.
        + If there are multiple UA Instance registered on the Primary Device, the call requests is forked sequentially to the one or more UA instances. The order among UUID-based and IMEI-based UA instances is configurable, with UUID-based instance defaulted as the preferred. The CS attached instance if available, will be attempted after attempting any PS/IMS registered UA instances.
        + In conjunction with the sequential forking to the Multiple UA instances registered on the Primary Device, the call request is parallel forked to Multiple UA Instances registered on Secondary devices.

### Unstructured Supplementary Services Data (USSD)

CTAS has an integrated USSI Application Server function which provides support for mobile initiated USSD operations to IMS registered UEs. The integrated USSI AS at the CTAS supports following variants of the USSD solution:

* + - * 3GPP TS 24.290 based USSD

This is a standard based solution for which provides the support for UE initiated MMI-mode USSD operations, which enables the transparent transport of MMI strings entered by the user to the IM core network and enables the transparent transport of text strings from the IM core network which are displayed by the UE for user information. Using this solution, the USSD messages can be transported in SIP INFO requests and SIP BYE requests, using a application/vnd.3gpp.ussd+xml MIME body.

* + - * SMS Class 0 based USSD

This is a non-standard solution where the CTAS provides support for USSD within IMS via the IP Short Message procedures defined in 3GPP TS 24.341. Specifically, the CTAS will convey a USSD response to the IMS registered UE via an encapsulated SMS Class 0 RPDU using the application/vnd.3gpp.sms MIME type. Class 0 SMs are immediately display and acknowledged, but not stored on the UE.

This solution is a workaround for devices which are not compliant to the 3GPP TS 24.290 based USSD solution. There is no need for any special adaptation needed at the client to support this solution.

* + - * Proprietary application/ussd content based USSD

This is a proprietary solution, which transports USSD messages using proprietary MIME type within the SIP MESSAGE. This requires adaptation at the device to be able to display the USSD message content.

When an Initial INVITE Request is received with the Request-URI containing USSD dial string, if the Recv-Info header field containing the g.3gpp.ussd info-package name is included, the 3GPP 24.290 based USSD solution to chosen by the CTAS.

If the Recv-Info header field is not received or not received with g.3gpp.ussd info-package, the CTAS choses between the two non-standard USSD solutions based on the configuration defined.

Refer to the USSI Use Case description document [[29]](#_bookmark18) for details.

### Intra IMPU Call Transfer

This feature allows a UA Instance attached (or registered) to the IMS or CS network to be able to pull or grab an established session (active or held) from another UA Instance belonging to the same Single SIM Multi UA subscriber.

Refer to the Pull based Call Transfer use cases [[56]](#_bookmark43) for more details.

### Session Discovery

This feature allows a UA Instance attached (or registered) to the IMS network to discover sessions of other UA instances registered for the same user. This feature is a pre-requisite for Pull based Call Transfer using Replaces header containing the dialog identifier.

Refer to Session Discovery use cases [[57]](#_bookmark45) for more details.

## Service Centralization and Continuity (SCC)

The Service Centralization and Continuity Application Server (SCC AS) is a logical IMS application server that primarily provides call signaling anchoring capability. SCC AS acts as a SIP back-to-back user agent (B2BUA).

3GPP has defined the single radio call continuity procedures enabling UE moving from one access technology to another while in a call. The UE is assumed to be able to use one RAT at a time and hence it is named Single Radio Voice Call Continuity (SRVCC).

All voice sessions originated by the UE within IMS are anchored in the IMS domain at SCC AS. SCC AS is an evolution of VCC AS, which was originally defined as part of IMS Centralized Services (ICS) solution (3GPP TS 23.292). Using methods defined by 3GPP in ICS solution, the user sessions (whether using CS access or PS access) are anchored in IMS/SCC AS and thus service consistency is ensured.

The 3GPP R10 defined reference architecture for SRVCC is shown below.

**Mw / Mx**

**Gm**

**CS Access**

**P-CSCF**

**UE**

**Mw/I 2\*\***

**ISC**

**Mw/Mx**

**ATCF \***

**I /S-CSCF**

**SCC AS**

**ATGW \***

**Iq/Ix**

**MSC Server**

\*: Location of functionality depends on deployment and collocation scenario

\*\*: Reference point dependent on MSC Server capa.bility

The Mavenir SCC AS provides the following functions:

1. **IMS Centralized Services:** The SCC AS acts as an SCP for Mobile Originations in CS domain and re-directs origination/termination to IMS to enable centralization of MMTEL services.
2. **Terminating Access Domain Selection (T-ADS):** The SCC AS is responsible for selecting the domain (PS or CS) for a terminating session setup request that is anchored and then actual session termination in the selected domain.
3. **CS Retry:** The SCC AS is responsible for performing CS Retry for a terminating session setup request that is anchored when the PS session termination request fails.
4. **Access Transfer:** The SCC AS is responsible for keeping a special number required for Access Transfer up-to-date in HSS and also for handling Access Transfer requests received and updating the remote leg when required.

Refer to the SCC AS Use Case document [[53]](#_bookmark40) for more details.

### IMS Centralized Services (ICS)

ICS aims at providing consistent services no matter what access network is used (CS or PS). With ICS, all services are provided by the IMS application servers and controlled by the IMS service control architecture. Hence CS users can benefit from the new IMS services while still using CS domain for the media bearer. ICS treats IMS sessions with CS bearer like any other full IMS session. With ICS all user sessions are controlled by the IMS core network. The ICS architecture is based on the usage of an enhanced MSC server acting as a SIP User Agent on behalf of the CS UE and making signaling adaptation between the CS and the IMS. The SCC AS is responsible for anchoring the user sessions and executing the transfer between PS and CS domains.

3GPP has specified in 3GPP TS 23.237 [[47]](#_bookmark35) and 3GPP TS 23.292 [[48]](#_bookmark36) the principles for centralization and continuity of services in the IMS in order to provide consistent services to the user regardless of the attached access type. In order to support this principle, all originated and terminated sessions via the CS or PS domains need to be anchored in the Service Centralization and Continuity Application Server (SCC AS) in the IMS. The SCC AS must be inserted in the session path using the originating and terminating initial Filter

Criteria (iFC). The SCC AS is configured as the first AS in the originating iFC and as the last AS in the terminating iFC chain.

#### Session Anchoring

As specified in 3GPP TS 23.237 [[47]](#_bookmark35) and 3GPP TS 23.292 [[48],](#_bookmark36) all sessions originated and terminated when using the PS or CS access are anchored in the IMS network at the SCC AS.

The SCC AS anchors all sessions originated in PS domain along with the associated terminating sessions in PS or CS domain. When the session is originated in the CS domain, the anchoring of this origination session in the IMS network requires the MSC to route the originated session to the IMS network. Similarly when the session originated in CS domain has to be terminated to the user with IMS subscription, the MSC is required to route the terminated session to the IMS network. When the MSC server is enhanced for ICS, the call routing is achieved using the procedures defined in 3GPP TS 23.292 [[48]](#_bookmark36) over the I2 interface.



Ut/XCAP

HSS

MMTEL &

Sh SCC-AS (SCP)

ISC

SIP

BTS

NodeB

GSM / UMTS

Abis / lub

BSC

RNC

I2

A / luCS

MSC-S

MGW

CSCF

Mb/RTP

Serving Network

Home Network

MSC-S works as IMS UA

towards IMS

In the deployments not using the MSC server enhanced for ICS, the routing of call originated sessions from the MSC for origination/termination session anchoring is achieved via the MGCF. This interface is called the ICS-Mg, which denotes the usage of ICS using home routing via MGCF, where the MSC server is not enhanced for ICS.

The current release does not support interworking with MSC server enhanced for ICS. The description below assumes deployment without MSC server enhanced for ICS.

ICS-Mg interface is used for anchoring the originating and terminating sessions. In the current release, the SCC AS supports ICS-Mg usage for anchoring the terminating sessions only. Following diagram shows the high level architecture of ICS-Mg usage for anchoring the terminating sessions using Static Routing, i.e., not based on the registration status of the terminating user in IMS.



Ut/XCAP

MME/

SGSN

MMTEL &

HSS Sh SCC-AS (SCP)

ISC

SIP

BTS

NodeB

GSM / UMTS

Abis / lub

BSC

RNC

ISUP

Mg/SIP

A / luCS MSC

GMSC

CS voice

MGCF

MGW

CSCF

Mb/RTP

Serving Network

Home Network

Following diagram shows the high level architecture of ICS-Mg usage for anchoring the terminating sessions using Dynamic Routing, i.e., based on the registration status of the terminating user in IMS. The

SCC AS supports an SCP function for processing CAP v2/v3 or INAP CS1/CS2 based IDP triggered by the GMSC to dynamically redirect terminating sessions to IMS.



Ut/XCAP

MME/

SGSN

HSS

MMTEL &

Sh SCC-AS (SCP)

CAP/INAP

ISC

ISUP

SIP

BTS

NodeB

GSM / UMTS

Abis / lub

A / luCS

CS voice

MGCF

MGW

Mg/SIP

CSCF

Mb/RTP

Serving Network

Home Network

MSC

BSC RNC

#### Supplementary Services

Supplementary Services configured in the UDR may be configured with a split view or a shared view. In the split view, the Services data configuration is split between the domains i.e. the HLR-view will contain services which must be invoked when only in CS domain, while the MMTEL-view will contain services to be invoked in IMS domain. For example, the CDIV services which are terminating services are expected to be invoked when the user is in IMS domain, hence these services will not be configured in the HLR- view of the user profile.

In the shared view, the same set of services is available irrespective of the domain of the user.

#### Split View

Supplementary services in the CS and IMS domain are applied as follows:

Originations

Made over CS access

Originating services provided by MSC

Made over PS/IMS access

Originating services provided by CTAS

Terminations

All mobile terminating call attempts made to a user with an IMS voice subscription are routed to IMS/CTAS.

T-ADS procedure invoked by CTAS determines IMS voice over PS is supported

Services provided by CTAS

Call termination attempt first made via IMS, with a retry via CS being performed for a configurable set of error scenarios

T-ADS procedure invoked by CTAS determines IMS voice over PS support is unknown

Services provided by CTAS

CS breakout is performed

The table below summarizes the location for supplementary service invocation. The column “B on IMS” implies that the subscriber is on a RAT for which IMS voice is supported.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Service** | **A on CS** | **A on IMS** | **Note (A side)** | **B on CS** | **B on IMS** | **Note (B side)** |
| OIP | n/a | n/a |  | CTAS & MSC | CTAS |  |
| OIR | MSC | CTAS |  | n/a | n/a | Restricted CgPty withdrawn in P-CSCF (IMS) or MSC (CS) |
| TIP | MSC | CTAS |  | n/a | n/a |  |
| TIR | n/a | n/a | Restricted ConnectedPty withdrawn in P-CSCF (IMS) or VMSC (CS | CTAS & MSC | CTAS |  |
| CDIV | n/a | n/a |  | CTAS | CTAS | No CFx data provided to MSC, i.e. no need to suppress late CFx at the MSC |
| CB | MSC | CTAS |  | CTAS | CTAS | IMS verifies “barring of incoming calls when roaming” even in case of B party is CS attached |
| HOLD | MSC | CTAS | A has active call (incoming or outgoing) | MSC | CTAS | B has active call (incoming or outgoing) |
| CW | N/A | N/A |  | CTAS & MSC | CTAS | B has an active call (incoming or outgoing) and receives a second one |
| CONF | MSC | CTAS | A has set-up/received two calls and invokes 3Pty conference | MSC | CTAS | B has set-up/received two calls and invokes 3Pty conference |
| CCBS | MSC | CTAS | A has received busy indication and invokes CCBS | 1. IMS busy (e.g. MTC with break out): IMS 2. CS busy: CCBS not possible | CTAS | “CCBS possible indication” received from CS (MGCF) shall be suppressed by terminating IMS AS |

Note that for IMS subscribers without an IMS voice subscription, the CTAS will trigger immediate CS breakout and will provide no terminating services.

#### Shared View

Supplementary services in the CS and IMS domain are applied as follows:

Originations – Same as that for the Split view. Current release does not support anchoring of originating sessions when the user is attached to CS domain.

Terminations

All mobile terminating call attempts made to a user with an IMS voice subscription are routed to IMS/CTAS, when Static Routing of CS Originated calls are used. When dynamic routing option is used, mobile terminating call attempts made to a IMS registered is routed to IMS/CTAS.

T-ADS procedure invoked by CTAS determines IMS voice over PS is supported

Services provided by CTAS

Call termination attempt first made via IMS, with a retry via CS being performed for a configurable set of error scenarios. When Dynamic routing option is used, it could still be possible that the user is registered in IMS, but not reachable in IMS.

T-ADS procedure invoked by CTAS determines IMS voice over PS support is unknown

Services provided by CTAS

CS breakout is performed

The table below summarizes the location for supplementary service invocation. The column “B on IMS” implies that the subscriber is on a RAT for which IMS voice is supported.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Service** | **A on CS** | **A on IMS** | **Note (A side)** | **B on CS** | **B on IMS** | **Note (B side)** |
| OIP | n/a | n/a |  | CTAS & MSC | CTAS |  |
| OIR | MSC | CTAS |  | n/a | n/a | Restricted CgPty withdrawn in P-CSCF (IMS) or MSC (CS) |
| TIP | MSC | CTAS |  | n/a | n/a |  |
| TIR | n/a | n/a | Restricted ConnectedPty withdrawn in P-CSCF (IMS) or VMSC (CS | CTAS & MSC | CTAS |  |
| CFU | n/a | n/a |  | CTAS | CTAS | When the call is originated in the CS domain, the SRI query done by the GMSC will return T-CSI along with CFU. When dynamic Routing option is used, the T-CSI will be invoked, causing the call to be routed to the IMS domain. |
| CFNL | n/a | n/a |  | CTAS | CTAS |  |
| CFB | n/a | n/a |  | MSC | CTAS or MSC (1) | (1) CS Retry |
| CFNR | n/a | n/a |  | MSC or CTAS (1)(2) | CTAS or MSC (2) | 1. CS breakout 2. Depending on the no- reply timer value, CFNR will get invoked either in MSC or CTAS.   CFNR invocation needs to be suppressed either at the CTAS or at the MSC to avoid race conditions. |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Service** | **A on CS** | **A on IMS** | **Note (A side)** | **B on CS** | **B on IMS** | **Note (B side)** |
| CFNRc | n/a | n/a |  | MSC or  CTAS (1)(2) | CTAS or MSC (2) | 1. CS breakout 2. Depending on the not- reachable timer value, CFNRc will get invoked either in VMSC or CTAS.   Not-Reachable timer configured at the CTAS must be lower than that at the CTAS.  CFNRc invocation needs to be suppressed either at the CTAS or at the MSC to avoid race conditions. |
| CB | MSC | CTAS |  | CTAS or GMSC (1) | CTAS | (1) When  Dynamic Routing is used. |
| HOLD | MSC | CTAS | A has active call (incoming or outgoing) | MSC | CTAS | B has active call (incoming or outgoing) |
| CW | N/A | N/A |  | CTAS & MSC | CTAS | B has an active call (incoming or outgoing) and receives a second one |
| CONF | MSC | CTAS | A has set-up/received two calls and invokes 3Pty conference | MSC | CTAS | B has set-up/received two calls and invokes 3Pty conference |
| CCBS | MSC | CTAS | A has received busy indication and invokes CCBS | 1. IMS busy (e.g. MTC with break out): IMS 2. CS busy: CCBS not possible | CTAS | “CCBS possible indication” received from CS (MGCF) shall be suppressed by terminating IMS AS |

## IM-SSF

CTAS also supports an integrated IM-SSF (i.e. gsmSSF) function. Refer to the IN IW Use cases [[37]](#_bookmark26) for more details.

## iSCP

CTAS supports an integrated gsmSCF function which is designed to provide similar service as that of the IN SCP. The current scope of this function is limited to facilitating the ICS functionality as described in Section **Error! Reference source not found.**.

Below described are the two services supported at the iSCP:

#### ICS Mg MO redirection (static or dynamic)

This service enables redirection of CS originated MOC calls into the IMS domain using the Mg interface i.e. between MGCF and the I-CSCF. This enables IMS Centralized Services (ICS) based service control for this session.

#### ICS Mg MT redirection (static or dynamic)

This service enables redirection of MTC CS calls into the IMS domain using the Mg interface i.e. between MGCF and the I-CSCF. This enables IMS Centralized Services (ICS) based service control for this session.

iSCP supports following interface protocol for providing the above services:

* + - * CAP v2, v3
      * INAP CS-1, CS-2
      * ANSI-41 ver E

iSCP supports the below messages over the CAP/INAP interface:

* + - * InitialDP (IDP)
      * Connect (CON)
      * Continue (CUE)

iSCP supports the below messages over ANSI-41 interface:

* + - * AnalyzedInformation (ANLYZD)

Refer to Section 3.5 of SCC AS Use Case document [[53]](#_bookmark40) for more details.

## User Configuration of SS (Supplementary Services)

CTAS supports the following two methods of User Configuration of SS:

* Ut interface using XCAP as described in 3GPP TS 24.623
* SIP based User Config as described in 3GPP TS 24.238

### Ut Interface using XCAP

The XML Configuration Access Protocol (XCAP), defined in RFC 4825, is used on the Ut interface to allow an XCAP client to read, write and modify application configuration data which is stored in XML format on an XCAP server. This is referred to as the simservs XML document.

For VoLTE, the XCAP client resides in the UE and the XCAP server resides in the CTAS. 3GPP TS 24.623 defines a supplementary services XCAP application usage which allows the UE to read, write and modify supplementary services data that is stored in the network.

CTAS supports the Ut interface as defined in 3GPP TS 24.623 [[27]](#_bookmark17) which includes:

* Interrogation of following supplementary services:
  + Originating Identification Presentation (OIP)
  + Originating Identification Restriction (OIR)
  + Terminating Identification Presentation (TIP)
  + Terminating Identification Restriction (TIR)
  + Communication Forwarding Unconditional (CFU)
  + Communication Forwarding on Busy (CFB)
  + Communication Forwarding on No Reachable (CFNRc)
  + Communication Forwarding on No Reply (CFNR)
  + Communication Forwarding on Not-Logged In (CFNL)
  + Communication Waiting (CW)
  + Incoming Communication Barring (ICB)
  + Outgoing Communication Barring (OCB)
* Manipulation of following supplementary services:
  + Originating Identification Presentation (OIP)
  + Originating Identification Restriction (OIR)
  + Terminating Identification Presentation (TIP)
  + Terminating Identification Restriction (TIR)
  + Communication Forwarding Unconditional (CFU)
  + Communication Forwarding on Busy (CFB)
  + Communication Forwarding on No Reachable (CFNRc)
  + Communication Forwarding on No Reply (CFNR)
  + Communication Forwarding on Not-Logged In (CFNL)
  + Communication Waiting (CW)
  + Incoming Communication Barring (ICB)
  + Outgoing Communication Barring (OCB)

Note that CTAS supports configurable control over the Ut operations allowed by the XCAP server function in CTAS. So for example, CTAS can be configured to support the interrogation of services such as OIP, OIR, TIP, TIR, etc.

CTAS supports operations on the entire XML document and also supports node selector functionality which allows operations to be performed on specific XML elements and attributes.

CTAS does not provide any authentication of XCAP requests received over the Ut interface, but instead requires an external and intermediate node to perform this function.

Refer to the Ut Use Case document [[32]](#_bookmark21) for further details.

CTAS supports updating the User config changes to the UDR over the following interfaces:

* + - * LDAP Interface
      * SPML Interface
      * Sh Interface

### SIP based User Config

SIP-based protocol framework serves as a means of user configuration of supplementary services in the backend user profle database. The contents of the Request-URI in a SIP INVITE request is used to convey the configuration code to the CTAS that hosts the supplementary service. Upon session initiation, the contents of the Request-URI are delivered by means of normal session setup signalling. The CTAS then acts upon the Request-URI contents to effect the desired configuration data change (e.g., register and activate Communication Forwarding unconditional).

CTAS supports manipulation of following supplementary services:

* Originating Identification Presentation (OIP)
* Originating Identification Restriction (OIR)
* Terminating Identification Presentation (TIP)
* Terminating Identification Restriction (TIR)
* Communication Forwarding Unconditional (CFU)
* Communication Forwarding on Busy (CFB)
* Communication Forwarding on No Reachable (CFNRc)
* Communication Forwarding on No Reply (CFNR)
* Communication Forwarding on Not-Logged In (CFNL)
* Communication Waiting (CW)
* Incoming Communication Barring (ICB)
* Outgoing Communication Barring (OCB)
* All Call Forwarding (ALLCF)

## Error Handling

The Error Handling framework defines a common control to handle all the errors generated at the CTAS due to an external or an internal trigger. As part of this framework, the final action when a particular error is received is determined by the action configured against the internal cause code generated. Any external error received is first mapped to an internal cause code before determining any further action.

In addition to the Internal cause code, the following are the other input criteria (s) used to determine the final action for a particular Internal cause code generated:

* Session Type – Identifies the type of session.
* Organization – Identifies the Organization associated with the served user.
* Application Type – Identifies the MMTEL sub-application set by the APPCFG translation profile prior to call request processing.
* Account Type – Identifies the account-type for a subscriber indicating a categorization of prepay or post-pay status.
* Call Event – Identifies the Call Event type associated with this call.
* Roam Type – Identifies the Roaming Status of the served user.

The action (or the behavior) set for the configured internal cause codes are:

* Play Announcement and Tone (PLAY\_ANNCTONE) – This action instructs the CTAS to reject the call after playing the configured Announcement and Tone. For example, when the outgoing calls are barred, this action when set against the outgoing calls barred specific Internal Cause Code will result in the caller hearing an announcement followed by a tone, before the call is terminated.
* Play Announcement (PLAY\_ANNC) – This action instructs the CTAS to reject the call after playing the configured Announcement. The Tones table is skipped, but it could be possible that the Tone could be part of the announcement file configured in the Announcement table itself.
* Play Tone (PLAY\_TONE) – This action instructs the CTAS to reject the call after playing the configured Tone.
* Play Prompt and Collect (PLAY\_PAC) – This action instructs the CTAS to Prompt for more information from the Caller. This action is mainly used for service specific cause code like that set for CCBS Activation prompt.
* Play Announcement and continue (PLAY\_ANNC\_CON) – This action instructs the CTAS to continue with the call routing with a (possibly modified) destination address after playing an announcement.
* Play Announcement and redirect (PLAY\_ANNC\_RDR) – This action instructs the CTAS to redirect the call after playing an announcement. The destination address to be used for redirection is configured against this particular cause code.
* Continue (CONTINUE) – This action instructs the CTAS to continue with the call routing with a (possibly modified) destination address without playing an announcement.
* Redirect (REDIRECT) - This action instructs the CTAS to redirect the call without playing an announcement. The destination address to be used for redirection is configured against this particular cause code.

The default action when there is no matching entry found in this table would be to reject the call without playing any announcement.

The Error Handling will be invoked at the CTAS under the following conditions:

* Any external SIP or Q.850 error response received;
* Any internal failure generated due to failure in services provided by the CTAS, like Ro charging, supplementary service like barring, etc.
* Any other internal failure causing a release of the call.

## Announcements and Tones

Announcements may be sent during the establishment of a communication session, when rejecting a communication request, during an established communication session or during the release of a communication session.

The announcement may be network provided or IN induced. A network provided announcement is triggered due to receiving of backward causes or any other internal error requiring clearing of the call. The CW tone/announcement, Hold tone/announcement and local ringtone is also considered network provided announcement.

CTAS supports playing announcements and/or tones during following scenarios:

* Session Reject - A service may provide an announcement when rejecting a communication request e.g. in order to explain the reason for rejecting the communication request in more detail. If an announcement is provided the service will use early media for sending the announcement in-band in an early dialog and using the P-Early-Media header field authorizing early media and insert the Reason header with the proper cause value.
* Session Establishment - A service may provide an announcement during the establishment of a communication. If an announcement is provided the service will:
  + Use early media for sending the announcement in-band in an early dialog and using the P-Early-Media header field authorizing early media or
  + Use multiple early dialogs and using P-Early-Media header field authorizing early media.

Examples of announcement played during session establishment are local ring tone, call waiting tone or any other IN induced announcement/tone.

* Established communication - A service may provide an announcement during an established communication. If an announcement is provided the service will:
  + Use the existing media stream. The media stream may have to be re-negotiated by the service to a media type suitable for the announcement.

Examples of announcement played in established communication are IN induced prepaid warning tone, announcement to held user & Ro charging session update failure.

Refer to the Announcement/Tone Use Case document [[33]](#_bookmark22) for details.

## Lawful Interception

The Lawful Interception (LI) is an action based on the law, performed by operator of making available certain information and providing that information to a law enforcement agency’s monitoring facility.

From the CTAS perspective, the LI functionality comprises of following tasks:

* Administration of LI-requests
* Transfer of the interception output to the Law Enforcement Agencies ('LEA').

In order to provide LI functionality, the CTAS interwork with Utimaco’s Lawful Interception Management (LIMS) System. The CTAS supports following interface defined by Utimaco’s LIMS systems

* The administration interface (X1) of the LIMS is used to provision the interception measures (called LI targets) on the CTAS.
  + Note:
    - Target interception can be the phone number MSISDN in (TEL\_URI) or the URI of a SIP server (SIP\_URI), IMEI/IMEISV or IMSI
    - CTAS supports up to 20,000 unique interception targets
    - CTAS supports interception of same targets by multiple LEA’s
* The Control Plane Interface (X2) is used by the CTAS to transport intercepted signaling information (both call and non-call related) to/from network element using the protocol defined by the Utimaco’s LIMS system.
* The CTAS supports SSL/TLS as encryption algorithm over X1/X2 interface. The CTAS supports interception of following events
* Interception of Subscriber Controlled Input (SCI)

The CTAS receives User Configuration of Supplementary Services (SCI) from the UE over Ut interface.

* Intercept conferencing events

The CTAS intercepts following conferencing events when the target of the interception is involved in the conference (either as a controller and/or as a party to the conference (including remote users)

* + Creation of Conference
  + Party Join
  + Party Leave
  + Conference Bearer Modification. For example:
    - When a party to a conference successfully modifies (i.e., add, remove, change) a bearer stream in the conference.
    - When a party to a conference unsuccessfully attempts to modify (i.e., add, remove, change) a bearer stream in the conference.
  + Start of Intercept on an Active Conference
  + End of Conference; (Conference Host)

The interception output is called Interception Related Information (IRI) a.k.a LITicket and it contains signaling events.

The LITicket to be transmitted to the LEAs via delivery functions (DF) of the LIMS are defined for each target during provisioning. The CTAS transmits the LITicket(s) over X2 interface to the configured DF2 address,

The CTAS re-transmits the LITicket(s) to the configured retransmission interval for up to the configured number of reattempts (This could be due to X2 link between LIMS and CTAS going down).

In case re-transmission resulted in failure, the CTAS stores the intercepted LITicket(s) in secure buffer for configured duration in persistent memory, upon expiry of the timer the buffer is permanently deleted.

Upon detection of X2 link failure, the CTAS raises alarm and the alarm is cleared only when the X2 link is up.

## Charging

CTAS provides function that implement offline and/or online charging mechanisms. In offline charging, the resource usage is reported from the network to the Billing Domain after the resource usage has occurred. In online charging, a subscriber account, located in an online charging system, is queried prior to granting permission to use the requested network resource(s).

Offline and online charging may be performed simultaneously and independently for the same chargeable event.

### Online Charging

Online charging is a process where charging information for network resource usage is collected concurrently with that resource usage in the same fashion as in offline charging. However, authorization for the network resource usage is obtained by the network prior to the actual resource usage to occur. This authorization is granted by the Online Charging System upon request from the network.

When receiving a network resource usage request, the network assembles the relevant charging information and generates a charging event towards the OCS in real-time. The OCS then returns an appropriate resource usage authorization. The resource usage authorization received in the units of time ( duration in seconds), therefore the authorization may have to be renewed from time to time as long as the user’s network resource usage persists.

In conclusion, online charging is a mechanism where charging information can affect, in real-time, the service rendered and therefore a direct interaction of the charging mechanism with the control of network resource usage is required.

CTAS supports the below defined mechanisms for Online charging, which may be performed independent of each other.

#### IN

The IN based charging is triggered based on the O-CSI or T-CSI subscription received as part of the service data retrieved from the UDR/HSS.

Refer to the IN Interworking use case document [[37]](#_bookmark26) for more details.

#### Ro

The CTAS supports Session Charging with Unit Reservation (SCUR) as defined in 3GPP TS 32.260; this includes procedures for requesting service units and returning used units during sessions. The “unit” measurement supported by CTAS is time (in units of seconds), CTAS performs quota management of the received units upon session answer i.e. By default upon receiving ACK for 200 OK for initial INVITE.

The CTAS supports online charging using Ro for the following session type

* + - * + Mobile originated voice and video call
        + Mobile originated videoshare call
        + Mobile Terminated voice and video call or selectively Mobile Terminated calls when roaming,
        + Upgrade and downgrade of voice and video call respectively.

Further, CTAS supports online charging via Ro for the following supplementary services for voice call:

* + - * + Communication Diversion (CDIV), i.e. call forwarding
        + Conferencing (CONF)

Refer to the Ro interface specification document [[43]](#_bookmark31) for more details.

### Offline Charging

Offline charging is a process where charging information for network resource usage is collected concurrently with that resource usage. The charging information is then passed through a chain of logical charging functions that are further explained in clause 4.3.1. At the end of this process, CDR files are generated by the network, which are then transferred to the network operator's Billing Domain for the purpose of subscriber billing and/or inter-operator accounting (or additional functions, e.g. statistics, at the operator’s discretion). The BD typically comprises post-processing systems such as the operator's billing system or billing mediation device.

In conclusion, offline charging is a mechanism where charging information does not affect, in real-time, the service rendered.

CTAS supports the below defined mechanisms for Offline charging, which are mutually exclusive.

#### Rf

Offline charging using Rf interface consists of the CTAS reporting accounting information to the CDF upon receiving various SIP requests and/or SIP responses. This reporting is achieved by sending Diameter Accounting-Request (ACR) command to the CDF. There are four ACR types: Start, Interim, Stop and Event.

The CTAS supports Session Charging and Event based offline charging using Rf interface as defined in 3GPP TS 32.260 and as explained below:

The CTAS supports two basic charging scenarios:

* + - * + **Session-based charging** – This type of charging is used for reporting successfully answered voice and video sessions:
        + **Event-based charging** – This type of charging is used for reporting non-session related events, such as IMS registrations, failed call setup attempts or SCI operations

The CTAS supports offline charging using Rf interface for the following session type

Third Party Registration

Mobile originated voice call

Mobile terminated voice call

Further, CTAS supports offline charging using Rf interface for all supplementary services as listed in this document section [7.4.](#_bookmark130)

Refer to the Rf interface specification document [[38]](#_bookmark27) for more details.

#### CDR

The CTAS supports generation of following types of CDR

* + - * + MMTel CDR
        + SCI CDR

Of this, the CTAS supports generation of MMTel CDR for complete session or partial MMTel CDR i.e. a MMTel CDR that provides information on part of a user session.

Partial CDRs if generated by the CTAS are always “Fully Qualified Partial CDR” i.e. it contains a complete set of the fields specified for the CDR. This includes all the mandatory and conditional fields for that session with values available at the time of partial CDR record generation.

The CTAS supports CDR generation for the following session type

* + - * + Third Party Registration
        + Mobile originated voice and video call
        + Mobile terminated voice and video call

Further, CTAS supports CDR generation for all supplementary services as listed in this document section [7.4](#_bookmark130)

Refer to the CDR interface specification document [[52]](#_bookmark39) for more details.

## Operational

### Backup and Restore

The Backup and Restore software module runs on the AM blade and manages the automatic (i.e. scheduled) backup process and the coordination of the backup procedures between the active and standby blades. The Backup and Restore module also supports on-demand backup requests.

The following data is backed up:

|  |  |
| --- | --- |
| **Blade** | **Backup Files** |
| AM blades | 1. mOne system software, i.e. software images for each blade 2. Linux configuration files 3. 3rd party software |
| SE Blades | All necessary files required to restore the SE configuration, e.g. VLAN configuration files |
| Database | All system configuration related to application, ems, etc. |

System configuration is provided for the following:

* + - * Scheduled backup times
      * Directory path for backups
      * Backup timeout timers
      * Length of time to keep each backup file

3rd party agents can be installed on the AM blade to periodically copy the backup files to external storage. A Backup and Restore Method of Procedure (MOP) will be provided with the product documentation.

### User Authorization

The CTAS system administrator enforces policy management and assigns user access privileges and roles to personnel using the EMS GUI or Centralized Management Server (CMS). There are four types of roles defined:

|  |  |
| --- | --- |
| **User Roles** | **Description** |
| Super Administrator | A Super Administrator is allowed to do the following:   * Add, delete and modify privileges for all parameters * Add, delete and modify access permissions for all users * Perform system backup * Initiate software upgrades and downgrades |

|  |  |
| --- | --- |
| **User Roles** | **Description** |
| Administrator | An Administrator is allowed to do the following:   * Add, delete and modify privileges for all parameters * View permissions |
| User / Operator | A User / Operator is allowed do to the following:   * View the privileges for all parameters * Add, delete and modify a subset of all parameters |
| Guest | A Guest is allowed to do the following:   * View the privileges for all parameters * A guest cannot add, delete or modify any parameters within the system. |

Each user is defined with the following:

* + - * User ID
      * Password
      * Name
      * Email address
      * User role (as shown above)
      * Account lock status (locked or unlocked)
      * User type (temporary, regular)

For each user type an access level can be defined. Access Management enables the assignment of different access levels to different type of users for configuring different elements. Hence each user group privilege is configurable on GUI. The access privilege is provided to different system elements like Quick view, Fault Alarm, Fault Event, Fault Definition, Configuration, etc.

A Method of Procedure (MOP) for all user management procedures will be provided with the product documentation.

### Alarming

The CTAS system supports two integration models for Fault Management: mView can be used in the operator NOC to monitor mOne faults, or alternatively the CTAS system can report alarms to an external 3rd party OSS for integrated Fault Management. SNMP is the interface used to pass traps related information from the mOne system to the external entities. The mOne system has the capability to send SNMP traps to more than one system, thus providing customer the ability to monitor the system across various NOC centres. Event and Alarm reporting is managed via a defined SNMPv2/v3 MIB structure that contains relevant information regarding the alarm or event. Events and alarms are collected by the Event Manager from the various applications, and then sent via SNMP to an external SNMP agent or directly to mView. The Fault Management process ensures an appropriate alarm or event for failures associated with the hardware components, communication links, and processing errors.

The Alarms and Event function in the CTAS Element Management System (EMS) provides the operator with a consolidated view of the alarm sand events generated across all blades within the system. The mOne system complies with ITU-T X.733 and X.734.

The following table summarizes the system alarm types.

|  |  |
| --- | --- |
| **Alarm Type** | **Description** |
| Communication Alarm | A communication alarm is associated with the procedures and/or processes that convey information from one point ot another. |
| Processing Error Alarm | A processing error alarm indicates software or processing fault. |
| Equipment Alarm | An equipment alarm indicates an equipment / hardware fault. |
| Environmental Alarm | An environmental alarm indicates a condition relating to an enclosure where the equipment resides. |

The following table describes the system alarm severity levels supported.

|  |  |
| --- | --- |
| **Severity Level** | **Description** |
| Cleared | Indicates a clearing of one or more previously reported alarms. This clears all alarms for a managed object that has the same alarm type, including the probable cause and the specific problems (if given). |
| Critical | Indicates a service affecting condition has occurred where immediate corrective action is required. This severity levels occurs when a managed object goes out of service and its capability must be restored. |
| Major | Indicates a service affecting condition has occurred where urgent corrective action is required. This severity level applies when there is a degradation in the capability of the managed object and it’s capability must be restored. |
| Minor | Indicates a non-service affecting fault condition has occurred where corrective action should be taken in order to prevent a more serious fault. This severity level applies when the detected alarm condition is not currently degrading the capacity or performance of the managed object. |
| Warning | Indicates the detection of a potential service affecting fault. This severity level applies when further action should be taken to diagnose the reported condition. |
| Indeterminate | Indicates the detection of a fault, where no severity could be associated with. |

The EMS GUI can be used for viewing and troubleshooting the events, as well as configuring the system for forwarding the fault events to the Operators network management system using SNMPv3.

### Logging

Log management system is used to log event and/or activity that occur within the system. Log Management provides capabilities for log browsing, strategy setting, and backup. Several types of logs are supported by the mOne system, including Event, System and Admin logs. Alarm and/or event information is stored in an Event Log for a definable number of days. System logs record the start and stop of the mView system, processes or tasks, and any abnormalities of high, intermediate and low levels. Admin logs record all the administrative operations performed by the operator crafts person through the mView system. By viewing and analysing the logs, the system operator and maintenance personnel can review the operating status of the system and locate network faults. Administration Log records all the CTAS GUI user operations. It supports admin log query function. It records information’s such as, User name, IP address, Login time. It also raise an alarm, if a user fails to login after 3 consecutive attempts. It locks the user for at least 24 hours. An administration log file is created for each user. A log file is closed and a new one is opened after 7 days or when the file size is over 2M, whichever occurs first.

In addition the CTAS provides a Call Trace feature which can be used to troubleshoot data packets and failures that occur during call establishment. The Call Trace can capture the following information:

* + - * External Signalling messages involved in call setup, the protocols supported are:
        + SIP
        + CAP
        + MAP
        + Diameter
        + LDAP
        + SOAP