

SRVCC for 1xRTT

The MME supports single radio voice call continuity (SRVCC) for CDMA2000 1x (single-carrier) radio transmission technology (1x-RTT) networks.

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Feature Description

Overview

SRVCC functionality is required within VoLTE systems to enable the packet domain calls received in LTE to be handed over to a legacy circuit-switched (CS) voice system, such as CDMA2000 1xRTT. SRVCC for 1xRTT, also referred to as enhanced SRVCC, enables the MME to move a VoLTE UE between an LTE and a 1xRTT network with smooth, seamless handovers. The MME acts as a relay agent to ensure CDMA2000 messages received from the UE are delivered to the interworking solution function (for 3GPP2, 1xCS IWS) associated with the mobile switching center (1x RTT MSC) (or vice-versa) through the S1-AP and S102 interfaces.

By using the MME's SRVCC for 1xRTT capabilities, the operator performs handovers while maintaining existing quality of service (QoS) and ensuring call continuity that meets the critical requirements for emergency calls.

This feature is license-controlled and the commands to configure and manage the feature interfaces require a feature license key. Speak with your Cisco Representative for information about this license. For information about the commands and their use, refer to the *Configuring SRVCC for 1xRTT* section later in this chapter.

Supported Features

The MME provides the following features in support of SRVCC for 1xRTT functionality:

MSC Pool Areas: Multiple MSCs would be handled by pooling all the MSCs mapping to a particular cell for load distribution. MSC pool areas can be configured for load balancing and intelligent selection of MSC servers based on IMSI hash values. Up to 10 MSC servers can be defined per S102 service.

MSC Non-Pool Areas: MSC selection, based on local MSC configuration.

MSC Selection: If an MSC pool area has been configured, the selection logic for the pool area is based on the CDMA2000 sector cell ID (includes the MSC ID and the Cell ID) in the CDMA2000 1xRTT network

Both the MSC ID and the cell ID are used to locate the pool / non-pool area. The MME attempts to select an MSC using the following selection order:

1. The MME attempts to match the MSC ID and the Cell ID:
   - If the match is found in the non-pool area configuration, then the configured MSC is selected.
   - If the match is found in the pool area configuration,
     - then IMSI hashing is used to select the MSC.
     - if no hash corresponds, then the MSC selected is the one configured for the 'non-configured-values'.
2. If no MSC is found, a failure message is returned.



Important When the UE attaches with IMEI, the MSC configured for the non-pool area is always selected because IMSI hashing cannot be performed for that UE.

Relationships to Other Features

SRVCC for 1xRTT is related to the CSFB for 1xRTT feature. Each requires a separate license to take advantage of the separate functionality and use the configuration commands.

If licenses for both features are installed in the system and both features are configured, then the MME can use the S102 interface for both CSFB for 1xRTT and SRVCC for 1xRTT.

1xRTT SRVCC and 1xRTT CSFB calls will be decided based on the presence or absence of the CDMA2000 1xRTT SRVCC Info IEs in an Uplink S1 CDMA2000 Tunneling message. This IE should not present for a 1xRTT CSFB call. If only one feature is licensed and configured and if the above condition is not appropriately satisfied for any received call, then that call will be dropped.

The CSFB for 1xRTT feature is described elsewhere in this administration guide.

How It Works

Functional Overview

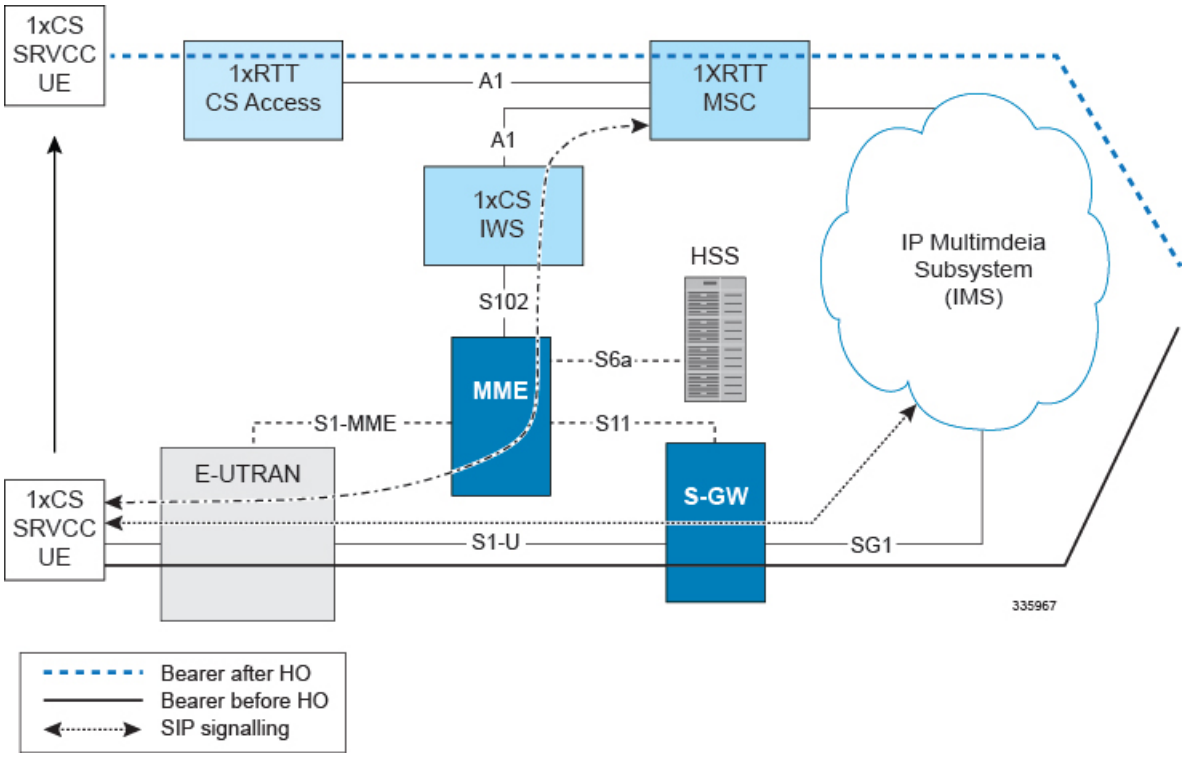
The call originating from the UE, and anchored as part of the voice-call continuity,.is part of a bidirectional process. The MME communicates with the 1xCS IWS (a circuit-switched fallback interworking solution function for 3GPP2 1xCS) to enable a single radio UE (an eSRVCC-enabled UE) to communicate in parallel with both the source system and the target system.

- On the originating source side, the 1xCS signaling messages are tunneled from the UE across the E-UTRAN to the MME.
- Moving from the originating side to the target side, the messages tunnel from the MME through the S102 interface via the A21 protocol to reach the 1xCS IWS at the target side.

- At the target side, from the 1xCS IWS, the messages tunnel through the A1 interface to the 1xRTT MSC. From the MSC, signaling moves towards the VLR/HLR for registration and authorization, if needed, or towards call setup procedures.

Architecture

Figure 1: MME's Architecture for SRVCC for 1xRCC



Flows

SRVCC for 1xRTT complies with the following call flows procedures as defined by 3GPP TS 23.216, Release 10:

- **E-UTRAN Attach Procedure:**
  - An SRVCC UE includes the SRVCC capability indication as part of the 'UE Network Capability' in the EPS Attach Request.
  - The MME includes an 'SRVCC Operation Possible' indication in the S1-AP Initial Context Setup Request.
  - The request is followed by eSRVCC HO, with eNB sending an Uplink CDMA2000 message with 1xSRVCC Info IE on S1-AP.
  - The MME copies the contents transparently and sends an A21 Air Interface message towards 1xIWS.
  - MEID is sent as IMSI towards the MSC.
- **PS Handover (S1-based):**

- The target MME includes an 'SRVCC Operation Possible' indication in the S1-AP Handover Request message. This indicates that both the UE and the target MME are SRVCC-capable.
- If the S1-HO is successful, then the Request message is followed by an Uplink CDMA2000 message with 1xSRVCC Information from the target eNB.
- If an MME change is required, the a Forward Relocation Request is sent towards the target MME with the UE Network capability, inside the MM Context message, indicating 1xSRVCC support.

- **PS Handover (X2-based):** The source eNodeB includes an 'SRVCC Operation Possible' indication in the X2-AP Handover Request message to the target eNodeB.

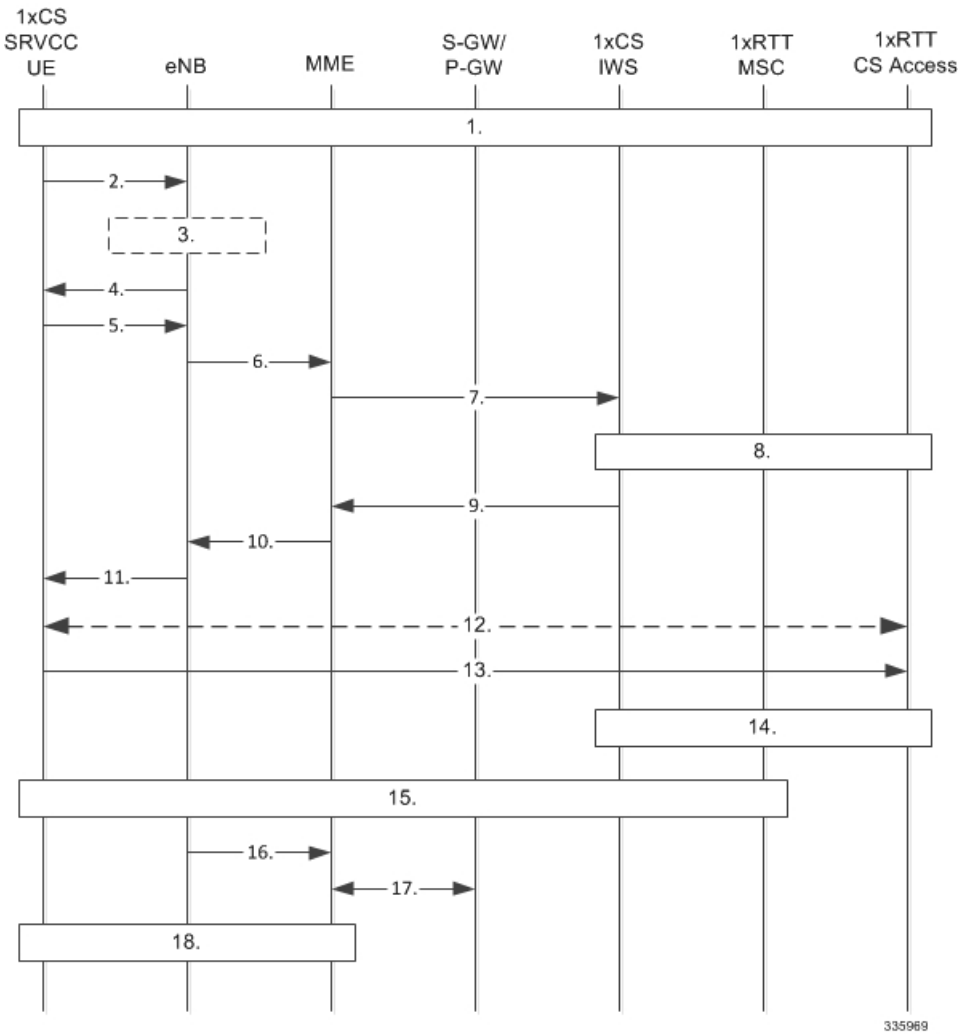


Important The MME is not participate in carrying the SRVCC information in the X2-based PS Handover. This is a direct eNB-to-eNB transfer.

- **Service Request Procedure:** The MME includes an 'SRVCC Operation Possible' indication in the S1-AP Initial Context Setup Request during the Service Request Procedure.
- **E-UTRAN Emergency Attach Procedure:**
  - The SRVCC UE includes the SRVCC capability indication as part of the 'UE Network Capability' in the Emergency Attach Request with IMEI/IMSI as the identity.
  - The MME includes an 'SRVCC Operation Possible' indication in the S1-AP Initial Context Setup Request.
  - The request is followed by eSRVCC HO, with the NB sending an Uplink CDMA2000 message with the 1xSRVCC Info IE on S1-AP.
  - The MME copies the contents transparently and sends an A21 Air Interface message towards the 1xIWS.
  - MEID is sent as IMEI/IMSI towards the MSC.

Typical SRVCC Call Flow

Figure 2: SRVCC Call Flow



The following notes on the flow definition are derived from section 6 of the 3GPP spec and for details we recommend you refer to TS 23.216:

1. ongoing VoIP session over the IMS access leg established over E-UTRAN access
2. measurement reports to eNB
3. determination to handover
4. E-UTRAN signals handover to UE handover
5. UE sends UL Handover Preparation Transfer message containing 1xRTT origination message (if appropriate, includes Request-Type = 'emergency handover' and the MEID (e.g. IMEI))
6. MME notified handover preparation has started - Uplink S1 CDMA2000 Tunneling (RAT Type, Sector ID, RAND, PDU, 1x Origination and 1xSRVCC Info IE containing MEID and mobile subscription information) message to the MME.S102 Direct Transfer message (1x Air Interface Signaling (origination))
7. S102 Direct Transfer message (1x Air interface Signaling (origination))
8. 1x traffic assignment / handoff initiation

9. S102 Direct Transfer (1x Air interface Signaling (handoff direction)
10. DL CDMA2000 Tunneling message (handoff direction)
11. Mobility from EUTRA command (handoff direction)
12. 1x radio interface procedures to acquire traffic channel
13. 1x handoff completion message
14. 1x handoff completed
15. ongoing voice call over the CS access leg established over 1xRTT access
16. S1 UE Context Release Request with release cause 'Redirect towards 1xRTT'.
17. Suspend Request / Ack
18. S1 UE Context Release

Limitations

Step 19 of the SRVCC Call Flow procedure (outlined above), as defined by TS 23.216, provides a Subscriber Location Report to the GMLC. This function is currently not supported by the MME.

Standards Compliance

The MME's SRVCC for 1xRTT complies with the following standards:

- A21 Interface spec A.S0009-C
- 3GPP TS 36.413, Release 10
- 3GPP TS 24.301, Release 10
- 3GPP TS 29.274, Release 10
- 3GPP TS 23.272, Release 10
- 3GPP TS 23.216, Release 10

Configuring SRVCC for 1xRTT

If you have the appropriate license, you will be able to see and configure the commands identified below to

- setup an S102 service for the use of an S102 interface.
- associate the S102 service configuration with the MME service.
- configure MSC selection.

All three sets of configuration must be completed for this feature to function.



Important For more details on commands and keywords indicated below, we recommend that you refer to the *Command Line Interface Reference, StarOS Release 19* or higher.

Configuring the S102 Service

This configuration enables you to define the characteristics for a specific S102 interface as an S102 service instance, including:

- configuring the interface to work with SRVCC for the 1xRTT CDMA2000 messaging.

- binding or unbinding a logical IPv4 address and ports to the S102 service.
- configuring an IPv4 address and ports for the IWS/MSC in the S102 service configuration.

```
config
  context context_name
    [ no ] s102-service service_name
      [ no ] 1xRTT srvcc
      [ no ] bind ipv4-address ipv4_address port port_number
      [ no ] msc msc_name
        [ no ] ipv4-address ipv4_address port port_number
        exit
      [ no ] msc msc_name
        [ no ] ipv4-address ipv4_address port port_number
        exit
      end
```

Notes:

- *context_name* enter a string of 1 to 79 alphanumeric characters to define the name of the context in which the S102 service is configured. You can configure the S102 service in the same context in which the associated MME service is configured.
- *service_name* enter a string of 1 to 63 alphanumeric characters to define the name. We recommend that each service name be unique on this MME.
- The MME supports configuration of an undefined number of S102 services (interfaces). As there is a 1-to-1 correlation between S102 service configurations and MME services, the only limiting factor is the maximum number of MME services that can be configured per system maximum number is 8.
- **1xrtt** configures the S102 interface to provide either SRVCC or CSFB capabilities for the 1xRTT CDMA2000 network. The **1xrtt** command can be repeated so that a single S102 interface provides both CSFB and SRVCC functionality.
- **bind ipv4-address** *ipv4_address* **port** *port_number* binds the S102 interface to the specified source (MME) IPv4 interface address, and optionally to a specific port number if the port option is included. The value for the IPv4 address must be entered in standard IPv4 dotted-decimal notation and, if included, the port number must be an integer from 1 to 65535.
- **msc** *msc_name* enter 1 to 63 alphanumeric characters to define a unique name for the MSC. Executing the **msc** command causes the system to enter the S102-MSC configuration mode to define the target IPv4 address (and optionally the port ID). This associates the S102 interface to the specified MSC.
- **ipv4-address** *ipv4_address* **port** *port_number* identifies IPv4 interface address of the MSC, and optionally a specific port number if the port option is include. The value for the IPv4 address must be entered in standard IPv4 dotted-decimal notation and, if included, the port number must be an integer from 1 to 65535.
- It is possible to associate up to 10 IWS/MSCs with the S102 interface/service configuration. Repeat the **msc**, **ipv4-address**, and **exit** commands sequence as often as needed to identify all MSCs.
- **no** prefix included with a command, disables and/or erases the specified configuration from the MME's configuration.
- **default** prefix is unused at this time and is available for future development.

Verify the S102 Service Configuration

Use the **show s102-service name** *s102_service_name* command to verify the S102 configuration that you have entered following the steps outlined above. The output will appear *similar* to the following:

```
[local]MMEhost# show s102-service name s102-mme1
Service name      : s102-mme1
Context           : test
Status            : NOT STARTED
1xRTT type        : SRVCC
Bind              : Done
IP Address        : nnn.nnn.nnn.1
Port              : 54321
```

Associating the S102 Service

Use the following to add an association between a previously configured MME service and an S102 service.

```
config
   context context_name
      mme-service mme_service_name
         associate s102-service s102_service_name [ context context_name ]
         end
```

Notes:

- **context** *context_name* : enter a string of 1 to 79 alphanumeric characters to identify the name of the context in which the S102 service is configured. We recommend that you identify the context if it is not the same one in which the associated MME service is configured.

Verifying the S102 Association

Use the **show mme-service name** *mme_service_name* command to verify the S102 association that you have entered following the steps outlined above. The output will appear *similar* to the following:

```
[local]MME show mme-service name mme1
Service name                        : mme1
Context                             : test
Status                              : NOT STARTED
Bind                                : Not Done
. . .
. . .
IPNE Service                        : Not defined
S102 Context                        : test
S102 Service                        : s102-A
Max bearers per MS                  : 11
. . .
. . .
```

Configuring MSC Selection

The following process configures up to 10 MSC pool/non-pool areas per S102 service in support of MSC selection. Both the MSC-Id and the Cell-Id are used to locate the pool or non-pool area for the MSC selection process.

Prerequisite: Each of the MSCs must have been defined and associated with an S102 service (see *Configuring the S102 Service* noted above) before the MSC can be included in the non-pool-area or pool-area configuration.

Defining a Non-Pool Area

```
config
     context context_name
     [ no ] s102-service service_name
```



Important The **plmn** option that is visible in the code is not supported at this time and is included for future development.

```
        non-pool-area non_pool_area_name msc msc_name msc-id msc_id cell-id cell_id
+
        no non-pool-area non_pool_area_name cell-id cell_id +
```

Notes:

- *non_pool_area_name* enter a string of 1 to 63 alphanumeric characters to uniquely identify the non-pool-area definition used for MSC selection.
- **msc** *msc_name* enter a string of 1 to 63 alphanumeric characters to identify one of the MSCs previously configured in the S102 service configuration.
- **msc-id** *msc_id* cell-id *cell_id* +
  - *msc_id* enter an integer from 1 through 16777215 to identify the unique numeric ID for the MSC.
  - *cell_id* + enter an integer from 1 through 65535 to identify a CDMA2000 sector cell ID that you are assigning to this non-pool area configuration. Enter up to 24 cell IDs, separated by a single blank space, in the same command.
- **plmnid { any | mcc** *mcc_id* **mnc** *mnc_id* **}** is not operationally supported at this time. The code is included for future development.
- **no** prefix included with the command, erases or disables the specified configuration from the MME's configuration.

Defining a Pool Area

```
config
   context context_name
      s102-service service_name
         [ no ] pool-area pool_area_name
            [ no ] cell-id cell-id cell-id
            [ no ] hash-value { hash_value | non-configured-values | range
lower_hash_value to higher_hash_value } { msc msc_name }
            [ no ] msc-id msc-id
            [ no ] plmnid { any | mcc mcc_id mnc mnc_id }
            end
```

Notes:

- **pool-area** *pool_area_name* enter a string of 1 through 63 alphanumeric characters to create a unique name of an MSC pool area configuration. After the command is entered, the system enters the S102-Pool-Area configuration mode.
- **cell-id** *cell-id* **[** *cell-id* **+]** enter an integer from 1 through 65535 to identify a CDMA2000 reference cell ID that you are assigning to this pool area configuration. Enter up to 24 cell IDs, separated by a single blank space, in the same command.
- **hash-value**

  - *hash_value* enter an integer from 0 through 999 to identify a specific MSC.
  - **non-configured-values msc** *msc_name* assigns all non-configured hash values to use the named MSC.
  - **range** *lower_hash_value* **to** *higher_hash_value* **msc** *msc_name* specifies the range of hash values for an MSC:
    - *lower_hash_value* enter an integer from 0 through 999 to identify the start value for a range of hash. The *lower_hash_value* must be lower than *higher_hash_value*.
    - *higher_hash_value* enter an integer from 0 through 999 to identify the end value for a range of hash. The *higher_hash_value* must be higher than *lower_hash_value*.

- *msc_id* enter an integer from 1 through 16777215 to identify the unique numeric ID for the MSC.
- **plmnid { any | mcc** *mcc_id* **mnc** *mnc_id* **}** is not operationally supported at this time. The code is included for future development.
- **no** prefix included with the command, erases the specified configuration from the MME's configuration.

Verifying Pool and Non-Pool Area Configuration

Use the **show configuration** command to view the S102 pool area and S102 non-pool area configuration. It should appear similar to the following:

```
[local]MME# show configuration
 ...
     s102-service s102test
       bind ipv4-address 209.165.200.225 port 54321
       1xrtt srvcc
       msc msc1
         ipv4-address nn2.nn2.nn2.2 port 33333
       exit
       msc msc10
         ipv4-address nn1.nn2.nn1.2 port 23272
       exit
       pool-area poolone
         cell-id 2 4 5
         hash-value 34 msc msc10
       exit
       non-pool-area np1 msc msc1 msc-id 1233 cell-id 223
       non-pool-area np3 msc msc1 msc-id 14441 cell-id 6 7 8
```

Monitoring and Troubleshooting the SRVCC for 1xRTT

Monitoring Protocol

When using the monitor protocol command, enable option 86 to see all A21 messages.

Show Command(s) and/or Outputs

show s102-service statistics name *s102_service_name*

The command noted above generates statistical output indicating the status and activity of the interface. The output generated will appear similar to the following:

```
S102-AP Statistics:
  S102-AP Data:                                 Tx    ReTx    Rx
    A21-1x Air Interface Signaling message      0      0      0
     A21-Ack message                            0      0      0
Unknown MSG                                     0      0      0
Error Statistics:
  Encoding Errors:                                 0
  Mismatch in Correlations:                        0
  Decoding Errors:                                 0
    Missing Mandatory IEs:                         0
    Syntax Errors:                                 0
  Misc Errors:                                     0
```

Bulk Statistics

Bulk statistics are described in the *Statistics and Counters Reference*.

MME Schema

The MME tracks the number of SRVCC 1xRTT calls and 4G-to-1xRTT handovers using the following variables:

- s1ap-transdata-dlinktunnel
- s1ap-recdata-ulinktunnel
- s1-ho-4gto1xrtt-cs-srvcc-attempted
- s1-ho-4gto1xrtt-cs-srvcc-success
- s1-ho-4gto1xrtt-cs-srvcc-failures

S102 Schema

The MME will use the S102 interface to tunnel the 1xRTT messages between the MME and IWS/MSC. The S102 schema has been created to track performance over this interface and includes all of the following stat variables (which are described in detail in the *Statistics and Counters Reference*) :

- vpnname
- vpnid
- servname
- servid
- s102ap-tx-a21-air-signal-msg
- s102ap-tx-a21-ack-msg
- s102ap-tx-a21-evt-ntfy-msg
- s102ap-tx-unknown-msg
- s102ap-retx-a21-air-signal-msg
- s102ap-retx-a21-ack-msg
- s102ap-retx-a21-evt-ntfy-msg
- s102ap-retx-unknown-msg
- s102ap-rx-a21-air-signal-msg
- s102ap-rx-a21-ack-msg
- s102ap-rx-a21-evt-ntfy-msg
- s102ap-rx-unknown-msg
- s102ap-encode-errors
- s102ap-missing-mandatory-ies

- s102ap-corelation-mismatch
- s102ap-decode-errors
- s102ap-syntax-errors
- s102ap-misc-errors

Traps

Traps are defined to indicate when an S102 service starts or stops. The trap information includes the context identification in which the S102 service is configured the unique identification of the S102 service. The following are examples of how the traps would appear :

```
Internal trap notification <XXXX> (S102ServiceStop) context S102 service s102-service
Internal trap notification <YYYY> (S102ServiceStart) context S102 service s102-service
```