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Technical Specification

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Universal Mobile Telecommunications System (UMTS);
LTE;
Architecture enhancements to facilitate communications
with packet data networks and applications
(3GPP TS 23.682 version 11.5.0 Release 11)**



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1 Scope

The present document specifies architecture enhancements to facilitate communications with packet data networks and applications (e.g. Machine Type Communication (MTC) applications on the (external) network/MTC servers) as per the use cases and service requirements defined in TS 22.368 [2], TS 22.101 [3], and related 3GPP requirements specifications. Both roaming and non-roaming scenarios are covered.

In this release, this document specifies the network elements, interfaces and procedures for:

- Device triggering by applications/servers (e.g. MTC applications on the (external) network/MTC servers) and also security mechanisms for device triggering and security for external interfaces.
- PS-Only support with and without MSISDN.
- ...

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 22.368: "Service Requirements for Machine-Type Communications (MTC)".
- [3] 3GPP TS 22.101: "Service Aspects; Service Principles".
- [4] 3GPP TS 23.003: "Numbering, addressing and identification".
- [5] 3GPP TS 23.002: "Network architecture".
- [6] 3GPP TS 23.060: "General Packet Radio Service (GPRS); Service description; Stage 2".
- [7] 3GPP TS 23.401: "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access".
- [8] 3GPP TS 29.061: "Interworking between the Public Land Mobile Network (PLMN) supporting Packet Based services and Packet Data Networks (PDN)".
- [9] 3GPP TS 29.303: "Domain Name System Procedures; Stage 3".
- [10] 3GPP TS 23.228: "IP Multimedia Subsystem (IMS); Stage 2".
- [11] 3GPP TS 23.272: "Circuit Switched (CS) fallback in Evolved Packet System (EPS); Stage 2".
- [12] 3GPP TS 23.040: "Technical realization of the Short Message Service (SMS)".
- [13] 3GPP TS 23.204: "Support of Short Message Service (SMS) over generic 3GPP Internet Protocol (IP) access; Stage 2".
- [14] 3GPP TR 23.039: "Interface Protocols for the Connection of Short Message Service Centers (SMSCs) to Short Message Entities (SMEs)".
- [15] IETF RFC 3588: "Diameter Base Protocol".

- [16] IETF RFC 4960: "Stream Control Transmission Protocol".
- [17] [WAP-168-ServiceLoad-20010731-a](#): "Service Loading".
- [18] [OMA-TS-Push_MO-V1_0-20110809-A](#): "OMA Push Management Object".
- [19] [OMA-TS-Push_Message-V2_2-20110809-A](#): "Push Message".
- [20] [OMA-AD-Push-V2_2-20110809-A](#): "Push Architecture".
- [21] 3GPP TS 23.221: "Architectural requirements".
- [22] Void.
- [23] 3GPP TS 23.142: "Value-added Services for SMS (VAS4SMS); Interface and signalling flow".
- [24] 3GPP TS 29.368: "Tsp interface protocol between the MTC Interworking Function (MTC-IWF) and Service Capability Server (SCS)".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] apply.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

AS	Application Server
CDR	Charging Data Record
CDF	Charging Data Function
CGF	Charging Gateway Function
MTC	Machine Type Communications
MTC-IWF	Machine Type Communications-InterWorking Function
P-GW	PDN Gateway
SCS	Services Capability Server
SLF	Subscriber Location Function
SME	Short Message Entities
SMS-SC	Short Message Service-Service Centre
SRI	Send Routing Information

4 Architecture Model and Concepts

4.1 General Concept

The end-to-end communications, between the MTC Application in the UE and the MTC Application in the external network, uses services provided by the 3GPP system, and optionally services provided by a Services Capability Server (SCS).

The MTC Application in the external network is typically hosted by an Application Server (AS) and may make use of an SCS for additional value added services. The 3GPP system provides transport, subscriber management and other communication services including various architectural enhancements motivated by, but not restricted to, MTC (e.g. control plane device triggering).

Different models are foreseen for machine type of traffic in what relates to the communication between the AS and the 3GPP system (refer to Annex A) and based on the provider of the SCS. The different architectural models that are supported by the Architectural Reference Model in clause 4.2 include the following:

- Direct Model - The AS connects directly to the operator network in order to perform direct user plane communications with the UE without the use of any external SCS. The Application in the external network may make use of services offered by the 3GPP system;
- Indirect Model - The AS connects indirectly to the operator network through the services of a SCS in order to utilize additional value added services for MTC (e.g. control plane device triggering). The SCS is either:
 - MTC Service Provider controlled: The SCS is an entity that may include value added services for MTC, performing user plane and/or control plane communication with the UE. Tsp is regarded as an inter-domain interface for control plane communication; or
 - 3GPP network operator controlled: The SCS is a mobile operator entity that may include value added services for MTC and performs user plane and/or control plane communication with the UE, making Tsp a control plane interface internal to the PLMN;
- Hybrid Model: The AS uses the direct model and indirect models simultaneously in order to connect directly to the operator's network to perform direct user plane communications with the UE while also using a SCS. From the 3GPP network perspective, the direct user plane communication from the AS and any value added control plane related communications from the SCS are independent and have no correlation to each other even though they may be servicing the same MTC Application hosted by the AS.

When using the hybrid model, the MTC Service provider controlled SCS, and the 3GPP operator controlled SCS may offer different capabilities to the MTC Applications.

Since the different models are not mutually exclusive, but just complementary, it is possible for a 3GPP operator to combine them for different applications. This may include a combination of both MTC Service Provider and 3GPP network operator controlled SCSs communicating with the same PLMN.

4.2 Architectural Reference Model

Figure 4.2-1 shows the architecture for a UE used for MTC connecting to the 3GPP network (UTRAN, E-UTRAN, GERAN, etc.) via the Um/Uu/LTE-Uu interfaces. The architecture covers the various architectural models described in clause 4.1.

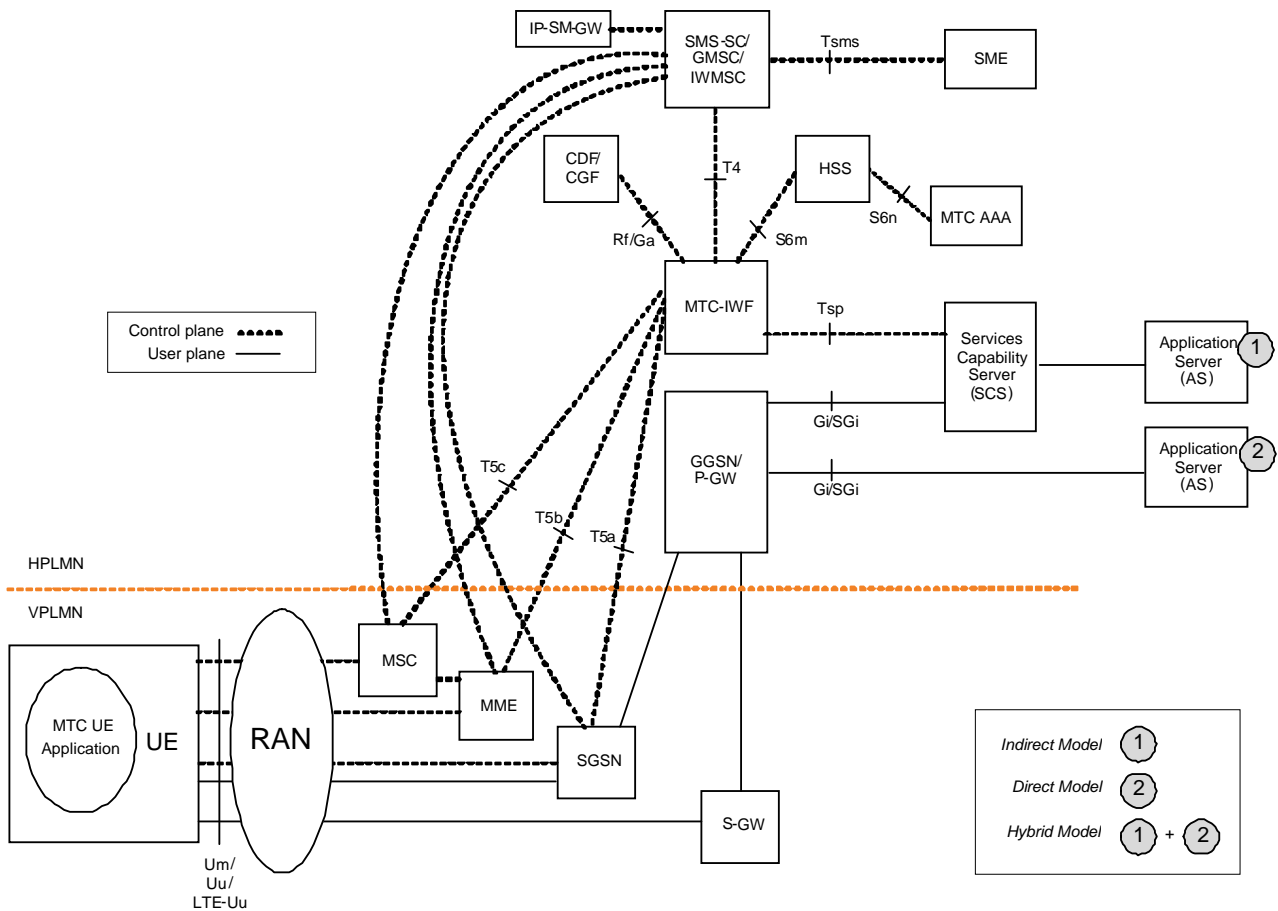


Figure 4.2-1: 3GPP Architecture for Machine-Type Communication

NOTE 1: Refer to TS 23.002 [5], TS 23.060 [6], TS 23.401 [7], TS 23.272 [11] and TS 23.040 [12] for the details of 3GPP network-internal reference points not specifically shown or labelled in figure 4.2-1 or described in this specification.

NOTE 2: The SCS is controlled by the operator of the HPLMN or by a MTC Service Provider.

NOTE 3: In the non-roaming case, all 3GPP network entities providing functionality for MTC are in the same PLMN. In the roaming case, 3GPP architecture for MTC supports both the home routed (illustrated in Figure 4.2-1) and the local-breakout roaming (not illustrated) scenarios. For the home routed scenario, the MTC Server/Application User Plane communication is routed through the HPLMN. In the local breakout scenario, the User Plane communication is routed directly through the serving PLMN/VPLMN over deployed GGSN/P-GW.

The SCS is an entity which connects to the 3GPP network to communicate with UEs used for MTC and the MTC-IWF in the HPLMN. The SCS offers capabilities for use by one or multiple MTC Applications. A UE can host one or multiple MTC Applications. The corresponding MTC Applications in the external network are hosted on one or multiple ASs.

Tsms is the interface that encompasses all the various proprietary SMS-SC to SME interface standards (see TR 23.039 [14]) and is outside the scope of 3GPP specifications. Tsms can be used to send a trigger to a UE encapsulated in a MT-SMS as an over-the-top application by any network entity (e.g. SCS) acting as a SME. Tsp is a 3GPP standardized interface to facilitate value-added services motivated by MTC (e.g. control plane device triggering) and provided by a SCS.

The API between the MTC Capabilities and mobile operator network services provided by the SCS and the MTC Application(s) hosted by the AS(s) are outside the scope of 3GPP specifications and thus, not depicted in the current architecture. It is solely used as abstracts to show an example of an end-to-end view for MTC and simplify mapping to MTC specifications of other standardization organizations. In the indirect model, MTC Capabilities and the MTC Application(s) in the external network can be collocated.

For the roaming scenario, the MTC-IWF shall have the connection with HSS and SMS-SC within the home network only and with serving SGSN/MME/MSC in the visited network.

4.3 Reference points

4.3.1 General

The following 3GPP reference points support the Indirect and Hybrid models of MTC.

NOTE: As further development of the MTC architecture takes place as well as when additional MTC common functionality and features are addressed, further reference points may be added.

4.3.2 List of Reference Points

The description of the MTC related reference points:

Tsms:	Reference point used by an entity outside the 3GPP network to communicate with UEs used for MTC via SMS.
Tsp:	Reference point used by a SCS to communicate with the MTC-IWF related control plane signalling.
T4:	Reference point used by MTC-IWF to route device trigger to the SMS-SC in the HPLMN.
T5a:	Reference point used between MTC-IWF and serving SGSN.
T5b:	Reference point used between MTC-IWF and serving MME.
T5c:	Reference point used between MTC-IWF and serving MSC.
S6m:	Reference point used by MTC-IWF to interrogate HSS/HLR
S6n:	Reference point used by MTC-AAA to interrogate HSS/HLR

NOTE 1: Protocol assumption: User plane communication with SCS, for Indirect model, and AS, for Direct and Hybrid models, is achieved using protocols over Gi and SGi reference points. Control plane protocols over those reference points such as RADIUS/Diameter as specified in TS 29.061 [8] can also be supported towards the SCS.

NOTE 2: In this release of the specification, T5a/b/c reference points are not specified.

4.3.3 Reference Point Requirements

4.3.3.1 Tsp Reference Point Requirements

The Tsp reference point shall fulfil the following requirements:

- connects a MTC-IWF to one or more SCSs;
- supports the following device trigger functionality:
 - reception of a device trigger request from SCS that includes an Application Port ID used by the UE to route the trigger internally to the appropriate triggering function;

NOTE 1: The Application Port ID can have different value for different applications.

- report to the SCS the acceptance or non-acceptance of the device trigger request;
- report to the SCS the success or failure of a device trigger delivery; and
- provides congestion/load control information to SCS as part of the response to device trigger requests.

In addition, Domain Name System procedures similar to what is specified in TS 29.303 [9] may be used by the SCS for lookup and selection of which specific MTC-IWF to be used.

NOTE 2: Security requirements can be found in clause 4.8.

4.3.3.2 T4 Reference Point Requirements

The T4 reference point shall fulfil the following requirements:

- connects the MTC-IWF, taking the role of the SME, to SMS-SC inside HPLMN domain;
- supports the following device trigger functionality:
 - transfer of device trigger, addressed by either an MSISDN or the IMSI, from MTC-IWF to SMS-SC inside HPLMN domain;
 - transfer to the SMS-SC the serving SGSN/MME/MSC identity(ies) along with device trigger when addressed by IMSI; and
 - report to MTC-IWF the submission outcome of a device trigger and the success or failure of delivering the device trigger to the UE.

4.3.3.3 T5a/T5b/T5c Reference Point Requirements

The T5a, T5b and T5c reference points shall fulfil the following requirements:

- T5a connects the MTC-IWF to the serving SGSN;
- T5b connects the MTC-IWF to the serving MME;
- T5c connects the MTC-IWF to the serving MSC;
- supports the following device trigger functionality:
 - transfer of device trigger request to the SGSN/MME/MSC;
 - report to MTC-IWF the success or failure of delivering a device trigger to the UE; and
 - providing SGSN/MME congestion/load information to the MTC-IWF.

NOTE: In this Release of the specification, T5a/b/c reference points are not specified.

4.3.3.4 S6m Reference Point Requirements

The S6m reference point shall fulfil the following requirements:

- connect the MTC-IWF to HSS/HLR containing subscription and UE related information; and
- support interrogation of HSS/HLR to:
 - map E.164 MSISDN or external identifier to IMSI;
 - retrieve serving node information for the UE (i.e. serving SGSN/MME/MSC/IP-SM-GW identities); and
 - determine if a SCS is allowed to send a device trigger to a particular UE.

NOTE: It is up to stage3 to define interworking between diameter-based s6m and map-based interface to the legacy HLR.

4.3.3.5 S6n Reference Point Requirements

The S6n reference point shall fulfil the following requirements:

- support communication between MTC-AAA and HSS/HLR containing subscription and UE related information; and
- support interrogation of HSS/HLR to:
 - map between IMSI and External Identifier(s).

4.4 Network Elements

4.4.1 General

The following 3GPP network elements provide functionality to support the Indirect and Hybrid models of MTC.

NOTE: As further development of the MTC architecture takes place as well as when additional MTC common functionality and features are addressed, further network elements may be defined.

4.4.2 MTC-IWF

To support the Indirect and Hybrid models of MTC, one or more instances of an MTC InterWorking Function (MTC-IWF) reside in the HPLMN. A MTC-IWF may be a standalone entity or a functional entity of another network element. The MTC-IWF hides the internal PLMN topology and relays or translates signaling protocols used over Tsp to invoke specific functionality in the PLMN.

The functionality of the MTC-IWF includes the following:

- termination of the Tsp, S6m and Rf/Ga reference points;
- termination of one or more reference points among T4, T5a, T5b and T5c;
- ability to authorize the SCS before communication establishment with the 3GPP network;
- ability to authorize control plane requests from an SCS;
- the following device trigger functionalities:
 - reception of a device trigger request from SCS that includes an Application Port ID used by the UE to route the trigger internally to the appropriate triggering function;
 - report to the SCS the acceptance or non-acceptance of the device trigger request;
 - report to the SCS the success or failure of a device trigger delivery;
 - may apply MTC-IWF and/or SGSN/MME induced congestion/load control as part of the response to trigger requests; and
 - uses a standardised identifier to allow the UE and the network to distinguish an MT message carrying device triggering information from any other type of messages.
- an HSS resolution mechanism for use when multiple and separately addressable HSSs have been deployed by the network operator (see e.g. the SLF / Diameter Proxy agent specified in clause 5.8 TS 23.228 [10]);
- interrogation of the appropriate HSS, when needed for device triggering, to:
 - map E.164 MSISDN or External Identifier to IMSI;
 - retrieve serving node information for the UE (e.g. serving SGSN/MME/MSC/IP-SM-GW identifier); and
 - determine if a SCS is allowed to send a device trigger to a particular UE.
- selection of the most efficient and effective device trigger delivery mechanism and shielding of this detail from SCS based on;
 - current UE serving node information from HSS/HLR (e.g. serving MME/SGSN/MSC/IP-SM-GW identifier);
 - the device trigger delivery mechanisms supported by the UE;
 - the possible device trigger delivery services supported by the HPLMN and, when roaming, VPLMN;
 - operator defined device trigger delivery policies, if any; and/or
 - optionally, any information received from the SCS.

- protocol translation, if necessary, and forwarding towards the relevant network entity (i.e. serving SGSN/MME/MSC or SMS-SC inside HPLMN domain) of a device trigger request to match the selected trigger delivery mechanism;
- generation of device trigger CDRs with External Identifier and SCS Identifier and forwarding to CDF/CGF over instance of Rf/Ga; and

NOTE 1: CDR generation with or without a device trigger indication by other network entities is not precluded by CDR generation by the MTC-IWF.

- ability for secure communications between the 3GPP network and the SCS.

The architecture shall allow the use of multiple MTC-IWFs within a HPLMN

NOTE 2: This is useful in particular to maintain service upon single MTC-IWF failure.

4.4.3 HSS/HLR

An HSS/HLR supporting device triggering shall support the following functionalities:

- termination of the S6m reference point where MTC-IWFs connect to the HLR/HSS;
- stores and provides to MTC-IWF (and optionally to MTC AAA) the mapping/lookup of E.164 MSISDN or external identifier(s) to IMSI and subscription information used by MTC-IWF for device triggering;
- mapping of E.164 MSISDN or external identifiers to IMSI;
- optionally, mapping from External Identifiers to MSISDN is also provided for legacy SMS infrastructure not supporting MSISDN-less SMS;
- HSS stored "Routing information" including serving node information if available for the UE (e.g. serving SGSN/MME/MSC identifier and registered IP-SM-GW identifier); and
- determine if a SCS is allowed to send a device trigger to a particular UE;
- termination of the S6n reference point;
- provides to MTC-AAA the mapping between IMSI and External Identifier(s).

4.4.4 GGSN/P-GW

A GGSN or P-GW supporting the Indirect or Hybrid model of MTC may support the following functionality

- Based on APN configuration and unavailability of MSISDN and External Identifier(s) in the GGSN/PGW, the GGSN/PGW either queries a MTC AAA server for retrieval of External Identifier(s) based on IMSI or routes RADIUS/Diameter requests for AAA servers in external PDNs (as specified in TS 29.061 [8]) via a MTC AAA proxy.

4.4.5 SGSN/MME/MSC

SGSN and MME specific functionality to support the Indirect and Hybrid models of MTC includes the following:

- SGSN terminates the T5a reference point;
- MME terminates the T5b reference point;
- MSC terminates the T5c reference point;
- receives device trigger from MTC-IWF;
- encapsulates device trigger information in NAS message sent to the UE used for MTC;
- receives device trigger acknowledgement from the triggering UE;
- reports device trigger delivery success/failure status to MTC-IWF; and

- may provide SGSN/MME congestion/load information to MTC-IWF.

NOTE: In this Release of the specification, T5a/b/c reference points are not specified.

4.4.6 SMS-SC

SMS-SC specific functionality to support the Indirect and Hybrid models of MTC includes the following:

- terminates the T4 reference point where MTC-IWFs connect to the SMS-SC; and
- supports PS-only MT-SMS that can be delivered with IMSI in lieu of E.164 MSISDN; and
- provides the routing information it received from MTC-IWF to SMS-GMSC if needed.

4.4.7 MTC AAA

To support translation of the IMSI to External Identifier(s) at the network egress, an AAA function (MTC AAA) is used in the HPLMN. The MTC AAA may be deployed to return the External Identifier(s) based on IMSI. Alternatively the MTC AAA may be deployed as a RADIUS/Diameter proxy between the GGSN/PGW and the AAA server in the external PDN.

When deployed as an AAA Server, the MTC AAA shall support the following functionalities:

- termination of the S6n reference point where the MTC-AAA communicates with the HLR/HSS;
- return the external identifier(s) corresponding to an IMSI; and
- may query the HSS with IMSI to retrieve the External Identifier(s) and may cache IMSI/External Identifier mapping to avoid multiple HSS queries.

When deployed as an AAA Proxy, the MTC AAA shall support the following functionalities:

- termination of the S6n reference point where the MTC-AAA communicates with the HLR/HSS;
- replace IMSI with an External Identifier for messages to an external AAA server;
- replace External Identifier with IMSI for messages from an external AAA server;
- identifying the destination external AAA server using standard RADIUS/Diameter procedures; and
- optionally, query the HSS with IMSI to retrieve the external identifier(s) and cache IMSI/External Identifier mapping to avoid multiple HSS queries.

4.5 High Level Function

4.5.1 Device Triggering Function

Device Triggering is the means by which a SCS sends information to the UE via the 3GPP network to trigger the UE to perform application specific actions that include initiating communication with the SCS for the indirect model or an AS in the network for the hybrid model. Device Triggering is required when an IP address for the UE is not available or reachable by the SCS/AS.

Device trigger message contains information that allows the network to route the message to the appropriate UE and the UE to route the message to the appropriate application. The information destined to the application, along with the information to route it, is referred to as the Trigger payload. The UE needs to be able to distinguish an MT message carrying device triggering information from any other type of messages.

- NOTE: The Trigger payload, for example, upon the reception by the UE possibly provides information to the application that may trigger application related actions. The application in the UE may perform indicated actions, such as for example to initiate immediate or later communication to the SCS/AS, based on the information contained in the Trigger payload.

Device Triggering is subscription based. The subscription provides the information whether a UE is allowed to be triggered by a specific SCS. When device triggers are delivered via MT-SMS the serving nodes MME, SGSN and MSC provide the service towards a specific UE based on the UE's subscription for MT-SMS and other subscription parameters affecting MT-SMS service provision.

Charging data are collected for the device triggering. The MTC-IWF generates CDRs for the service requester. When device triggers are delivered via MT-SMS then network entities, like MME, SGSN, MSC or SMS-SC generate CDRs for SMS services provided for the mobile subscriber.

4.5.2 PS-only Service Provision

PS-only service provision is providing a UE with all subscribed services via PS domain. PS-only service provision implies a subscription that allows only for services exclusively provided by the PS domain, i.e. packet bearer services and SMS services. The support of SMS services via PS domain NAS is a network deployment option and may depend also on roaming agreements. Therefore, a subscription intended for PS-only service provision may allow also for SMS services via CS domain to provide a UE with SMS services in situations when serving node or network don't support SMS via PS domain NAS. The functionality that enables PS-only service provision is described in TS 23.060 [6] and TS 23.272 [11].

The functionality that enables PS-only service provision for SMS delivery in IMS is described in TS 23.204 [13].

4.6 Identifiers

4.6.1 General

Identifiers relevant for the 3GPP network are specified in TS 23.003 [4].

4.6.2 External Identifier

A subscription used for MTC has one IMSI and may have one or several External Identifier(s) that are stored in the HSS.

NOTE 1: If several External Identifiers are mapped to one IMSI, some functions might not work in this release of the specification.

External Identifier shall be globally unique. It shall have the following components:

- a. Domain Identifier: identifies a domain that is under the control of a Mobile Network Operator (MNO). The Domain Identifier is used to identify where services provided by the operator network can be accessed (e.g. MTC-IWF provided services). An operator may use different domain identifiers to provide access to different services.
- b. Local Identifier: Identifier used to derive or obtain the IMSI. The Local Identifier shall be unique within the applicable domain. It is managed by the Mobile Network Operator.

NOTE 2: Use of External Identifiers is not restricted to MTC only.

NOTE 3: Use of IMSI outside the 3GPP operator domain is dependent on the operator policy.

4.7 Addressing

For UEs used for Machine-Type Communications (MTC) IP Addressing principles and solutions for different scenarios are described in clause 5 of TS 23.221 [21].

4.8 Security Aspects

4.8.1 Security Requirements

4.8.1.1 Requirements on Tsp Reference Point

The Tsp reference point shall fulfil the following requirements:

- integrity protection, replay protection, confidentiality protection and privacy protection for communication between the MTC-IWF and SCS shall be supported:
 - mutual authentication between two directly communicating entities in the security domains, in which MTC-IWF and SCS respectively reside, shall be supported;
 - the use of mutual authentication shall follow the provisions in TS 29.368 [24];
 - integrity protection and replay protection shall be used;
 - confidentiality protection should be used;
 - privacy shall be provided (e.g. IMSI shall not be sent outside the 3GPP operator domain).

4.8.1.2 Requirements on MTC-IWF

The functionality of the MTC-IWF includes the following:

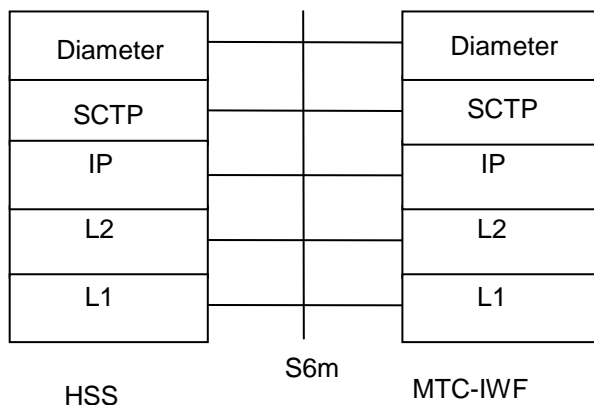
- support ability to satisfy security requirements on Tsp reference point in clause 4.8.1.1.

5 Functional Description and Information Flow

5.1 Control and user plane

5.1.1 Control Plane

5.1.1.1 HSS – MTC-IWF



Legend:

- **Diameter:** This protocol supports transferring of subscription and UE related information for identifier mapping and serving node information retrieval between MTC-IWF and HSS (S6m). Diameter is defined in RFC 3588 [15].
- **Stream Control Transmission Protocol (SCTP):** This protocol transfers signalling messages. SCTP is defined in RFC 4960 [16].

Figure 5.1.1.1-1: Control Plane for S6m interface

NOTE: It is up to stage3 to define interworking between diameter-based s6m and map-based interface to the legacy HLR.

5.2 Device triggering procedures

5.2.1 Device triggering procedure over Tsp

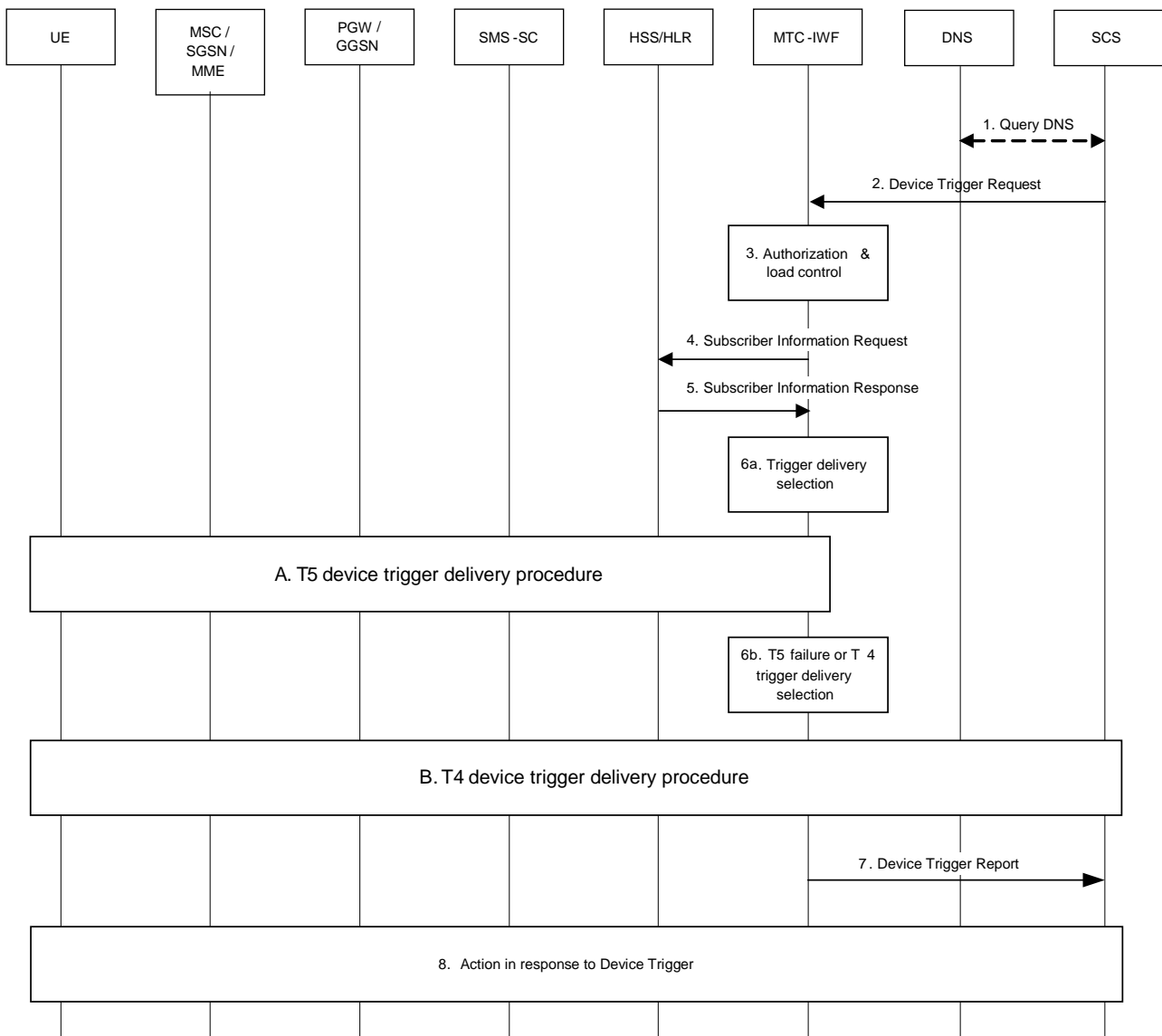


Figure 5.2.1-1: Device triggering procedure over Tsp

1. The SCS determines the need to trigger the device. If the SCS has no contact details for an MTC-IWF, it may determine the IP address(es)/port(s) of the MTC-IWF by performing a DNS query using the External Identifier or using a locally configured MTC-IWF identifier.
2. The SCS sends the Device Trigger Request (External Identifier or MSISDN, SCS Identifier, trigger reference number, validity period, priority, Application Port ID and trigger payload) message to the MTC-IWF. The SCS includes a trigger payload that contains the information destined for the MTC application, along with the information to route it to the MTC application. The Application Port ID is set to address a triggering function within the UE.

NOTE 1: The assignment of SCS identifier is out of scope of 3GPP. The SCS identifier should meet the 3GPP / operator requirement. As an example it may be possible to use MSISDN as SCS identifier.

3. The MTC-IWF checks that the SCS is authorised to send trigger requests and that the SCS has not exceeded its quota or rate of trigger submission over Tsp. If this check fails the MTC-IWF sends a Device Trigger Confirm message with a cause value indicating the reason for the failure condition and the flow stops at this step. Otherwise, the flow continues with step 4.

4. The MTC-IWF sends a Subscriber Information Request (External Identifier or MSISDN and SCS Identifier) message to the HSS/HLR to determine if SCS is authorized to trigger the UE, to resolve the External Identifier or MSISDN to IMSI and retrieve the related HSS stored "Routing information" including the identities of the UE's serving CN node(s).

NOTE 2: The MTC-IWF may cache authorization and routing information for the UE. However, this may increase the probability of trigger delivery attempt failures when the cached serving node information is stale.

NOTE 3: Optionally, mapping from External Identifiers to MSISDN is also provided for legacy SMS infrastructure not supporting MSISDN-less SMS.

5. The HSS/HLR sends the Subscriber Information Response (IMSI and/or MSISDN and related "Routing information" including the serving node(s) identities, cause) message. HSS/HLR policy (possibly dependent on the VPLMN ID) may influence which serving node identities are returned. If the cause value indicates the SCS is not allowed to send a trigger message to this UE, or there is no valid subscription information, or "Absent subscriber" is received from HSS and the validity period of this trigger message is set to zero, the MTC-IWF sends a Device Trigger Confirm message with a cause value indicating the reason for the failure condition and the flow stops at this step. Otherwise this flow continues with step 6a.
- 6a. The MTC-IWF selects trigger delivery procedure based on the information received from HSS/HLR and local policy. If T5 delivery procedure is selected, MTC-IWF attempts T5 trigger delivery procedure.

NOTE 2: The T5 delivery is not supported in this version of the specification.
- 6b. If T5 delivery is unsuccessful or not supported by the serving nodes(s) or by the UE or if T4 delivery is selected during step 6a, the MTC-IWF attempts T4 trigger delivery procedure according to clause 5.2.2. Otherwise, this flow continues with step 7.
7. The MTC-IWF sends the Device Trigger Report (External Identifier or MSISDN and trigger reference number) message to the SCS with a cause value indicating the trigger delivery outcome (e.g. succeeded, unknown or failed and the reason for the failure). The MTC-IWF generates the necessary CDR information including the External Identifier or MSISDN and SCS Identifier.
8. In response to the received device trigger, the UE takes specific actions that take into consideration the content of the trigger payload. This response typically involves initiation of immediate or later communication with the SCS or an AS.

5.2.2 Trigger Delivery using T4

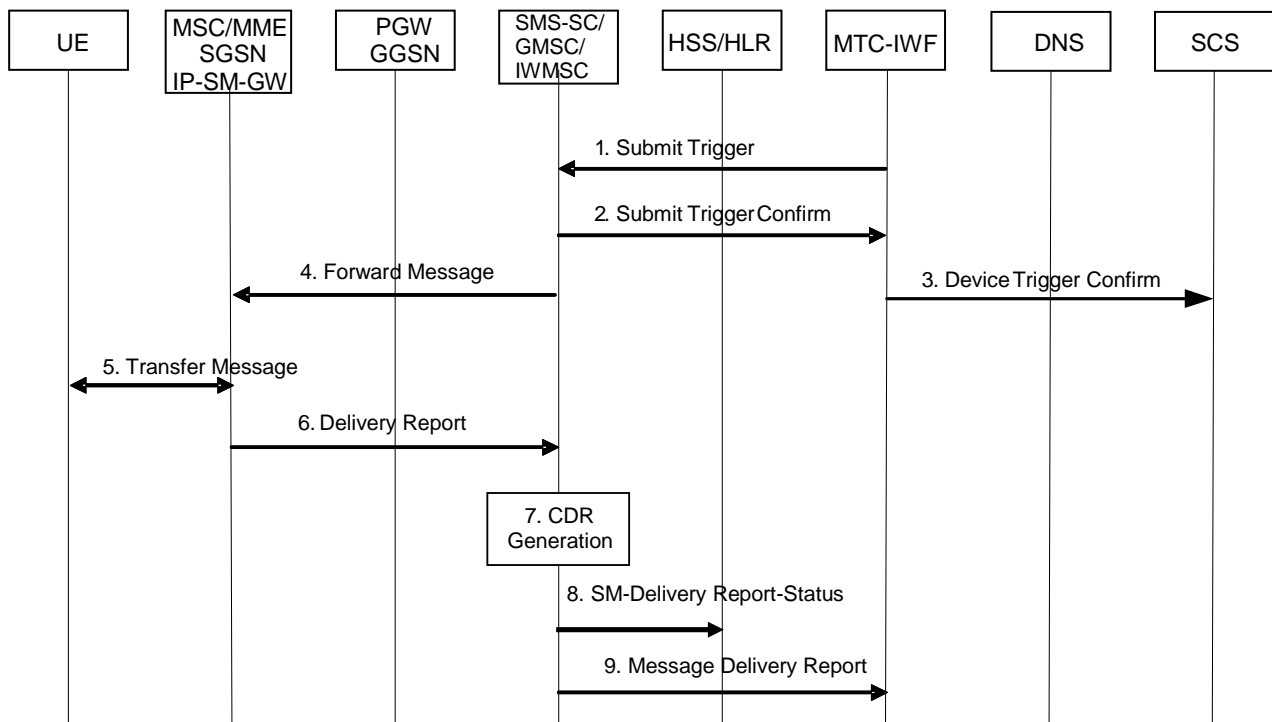


Figure 5.2.2-1: T4 Trigger Delivery Flow

1. The MTC-IWF selects a suitable SMS-SC based on configured information. The MTC-IWF sends a Submit Trigger (External Identifier or MSISDN, IMSI, SCS Identifier, trigger reference number, validity period, priority, serving node ID(s) if available from HSS, SMS Application port ID, trigger payload, Trigger Indication) message to the SMS-SC. The SMS-SC should avoid an initial HSS/HLR interrogation (SRI for SM) when it has already received necessary parameters in the Submit Trigger message from the MTC-IWF. The MTC-IWF forwards the Application Port ID received from SCS as the SMS Application port ID which is used to address the triggering function within the UE. The Trigger Indication is a standardised identifier to allow the UE and the network to distinguish an MT message carrying device triggering information from any other type of messages. The SMS-SC does any necessary segmentation for larger messages.

If the MTC-IWF indicates that "Absent subscriber" was received from HSS, the SMS-SC should not submit the message, but store it directly and send Routing Information for SM to request the HSS to add the SMS-SC address to the Message Waiting List.

2. The SMS-SC sends a Submit Trigger Confirm message to the MTC-IWF to confirm that the submission of the SMS has been accepted by the SMS-SC.
3. The MTC-IWF sends a Device Trigger Confirm message to the SCS to confirm that the Device Trigger Request has been accepted for delivery to the UE.
- 4, 5, 6. The short message is delivered to the UE (see MT-SMS procedures specified in TS 23.040 [12]). This may involve delivery attempts in MSC or MME, SGSN or over IMS via IP-SM-GW (see MT-SMS without MSISDN procedures specified in TS 23.204 [13]).

The SMS-delivered trigger payload is processed and handled by the triggering function in the UE. Any information contained within the trigger payload is forwarded to the related or addressed UE-application.

7. The SMS-SC generates the necessary CDR information and includes the SCS Identifier. The SMS Application port ID which is included in the SM User Data Header and the Trigger Indication are included in the CDRs in order to enable differentiated charging. The SMS-SC stores the trigger payload, without routing information. If the message delivery fails and is attempted to be delivered again, HSS interrogation will be performed.
8. If the message delivery fails and the validity period of this trigger message is not set to zero, the SMS-SC shall send a SM Message Delivery Status Report to request the HSS to add the SMS-SC address to the Message

Waiting list. When the message delivery is later re-attempted, a new HSS interrogation will be performed by the SMS-GMSC using IMSI or MSISDN. HSS interrogations using IMSI shall not be forwarded or relayed to SMS-Router or IP-SM-GWs. HSS may include up to three serving node identities (MSC or MME, SGSN, IP-SM-GW) in the response to SMS-GMSC.

9. If the message delivery fails and depending on the failure cause either directly or when validity period of the trigger message expires, or when the message delivery succeeds, the SMS-SC shall send a Message Delivery Report (cause code, trigger reference number, SCS Identifier) to the MTC-IWF.

5.3 Information Storage

This clause describes the context information that is stored in the different nodes for MTC device trigger procedure.

5.3.1 Trigger Information in SMS-SC (Triggering with T4)

This table includes information that needs to be stored in SMS-SC for triggering with T4.

Table 5.3.1-1: SMS-SC trigger information

Field	Description
External Identifier/MSISDN	It is used to identify the corresponding External Identifiers in the delivery report. This can be also the MSISDN if used.
IMSI	It is used to indicate the UE used for MTC that is required to be triggered.
Trigger reference number	This is to co-relate the trigger request with trigger response.
SCS ID	It is used to allow the SMS SC to send the trigger response back to the appropriate SCS.
Trigger payload	The SMSC will store the Trigger payload until it receives the delivery confirmation.
Routing Information for SMS	The identities of the serving node(s).
Priority	It is used to indicate the priority of trigger request.
Validity period	To indicate the time period for which the trigger request is valid.
SMS Application Port ID	It is used to route the short message to the triggering function in the UE.

NOTE 1: The Trigger Payload is stored as user data in SMS-SC.

NOTE 2: Priority, Validity period and SMS Application Port ID are included in the Trigger payload.

5.4 Security Procedures

5.4.1 Tsp Interface Security

The security procedures for the Tsp interface are specified in TS 29.368 [24].

5.4.2 Network based solution for filtering SMS-delivered device trigger messages

The operator can enforce filtering the trigger messages on the SMS router if SMS router has been deployed.

The following solutions may be implemented to filter SMS-delivered device trigger messages. This solution relies on the fact that there is a standardised indicator in the SM that can be used to distinguish a trigger SM from other types of SM, i.e. TP Protocol Id as specified in TS 23.040 [12]. The solutions further assumes that legitimate trigger SMs are delivered via either a SMS-SC in the HPLMN that can verify the identity of the SME sending a legitimate trigger SM over Tsms, or via an MTC-IWF in the HPLMN that can verify the identity of the SCS sending a legitimate trigger SM over Tsp.

The HPLMN shall implement Home Network Routing according to TS 23.040 [12] for Mobile Terminated SMs destined for all HPLMN subscribers that need protection against unauthorised SMS-delivered device trigger messages (e.g. all subscriptions that may be used in MEs that support SMS-delivered device triggering). Home Network Routing shall have the effect of forcing the delivery of the SM to an SMS Router in the HPLMN rather than to the serving MSC/VLR, SGSN or MME of the destination UE. If an SM received by the SMS Router does not originate from the

SMS-SC in the HPLMN that handles SMS-delivered device trigger messages, then the SMS Router shall forward the SM to infrastructure that shall filter and block all SMs that contain a trigger indication.

If an SM received by the SMS-SC in the HPLMN that handles SMS-delivered device trigger messages does not originate from the T4 interface, then the SMS-SC shall forward the SM to filtering infrastructure. If an SM received by the filtering infrastructure contains a trigger indication, and does not originate from a trusted SME that is authorised to send trigger SMs, then the SM shall be blocked. If an SM received by the filtering infrastructure contains a trigger indication, and does originate from a trusted SME that is authorised to send trigger SMs, then the filtering infrastructure shall only allow trigger requests to be sent to particular UEs that the trusted SME is authorised to send to. It is outside the scope of this specification how the filtering infrastructure shall determine if a trusted SME is allowed to send a device trigger to a particular UE.

If a trigger request received by the MTC-IWF originates from the Tsp interface, then the MTC-IWF shall filter and block the trigger unless it originates from a trusted SCS that is authorised to send trigger requests. The procedure is described in clause 5.2.1 of the present specification.

NOTE 1: Depending on operator policy, a trusted source may be authorized to send trigger messages to any UE.

In order to protect against source spoofing, the interfaces used to transport trigger messages shall be suitably secured. In particular, the Tsms, Tsp and T4 interfaces shall be secured. Tsp interface security is specified in clause 4.3.3.1. The security mechanisms for the Tsms interface are outside the scope of this specification.

Filtering of SMS can be performed according to the architecture specified in TS 23.142 [23]. When the filtering entity receives an SM, it can identify if the SM is a trigger SM based on the trigger indication contained in the SM (i.e. TP Protocol Id as specified in TS 23.040 [12]).

NOTE 2: In the above solution filtering is distributed between filtering infrastructure associated with the SMS Router, filtering infrastructure associated with the SMS-SC, and the filtering functions within the MTC-IWF. This reflects the fact that the filtering needs to be invoked by an entity which can verify the source of the SM on a locally connected interface. Whilst the SMS Router is in the path of all SMs towards MTC devices, it does not have the capability to verify the original source of messages on the Tsp or Tsms interfaces, and therefore a solution where only the SMS Router invokes filtering is not sufficient.

NOTE 3: The solution in this clause aims to protect against unauthorised entities sending potentially high volumes of trigger messages to large numbers of MTC devices to cause a Distributed Denial of Service (DDoS) attack against the core network. However, the solution only provides protection against SMS application level threats; it does not protect against attacks where network internal nodes or network signalling links are compromised or abused by an attacker (e.g. spoofing of MAP_Forward_Short_Message operations containing trigger indications towards target UEs on an SS7 connection). If such attacks need to be mitigated, or if Home Network Routing is not supported by the HPLMN, then the solution specified in this clause is not sufficient and some form of end-to-end cryptographic protection of trigger messages is needed between the MTC Application in the network and the MTC Application in the UE. Such solutions may be provided at an application level outside the scope of 3GPP specifications. A solution to cryptographically protect trigger messages may be introduced in a future 3GPP Release.

Annex A (Informative): MTC Deployment Scenarios

In the indirect and hybrid models, the deployment of a SCS may be inside or outside the operator domain as illustrated in figures A-1 and A-2. When the SCS is part of the operator domain (figure A-1 C and figure A-2), the SCS is considered a mobile operator internal network function, is operator controlled, and may provide operator value-added services. In this case, security and privacy protection for communication between the MTC-IWF and SCS is optional. When the SCS is deployed outside the operator domain (figure A-1 B and A-2), the SCS is MTC Service Provider controlled. In this case, security and privacy protection for communication between the MTC-IWF and SCS is needed. In the direct model (figure A-1 A), there may not be an external or internal SCS in the communication path.

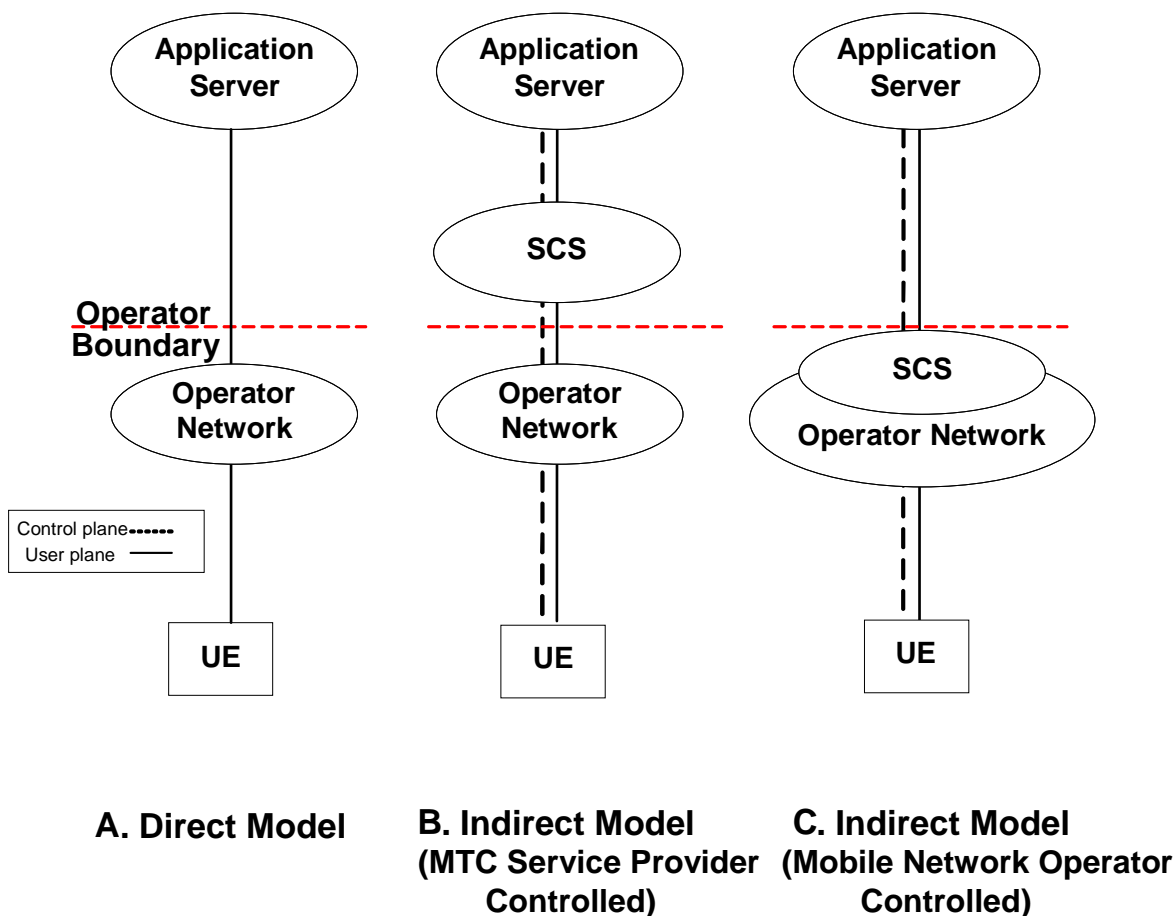


Figure A-1: Deployment scenarios for direct and indirect model

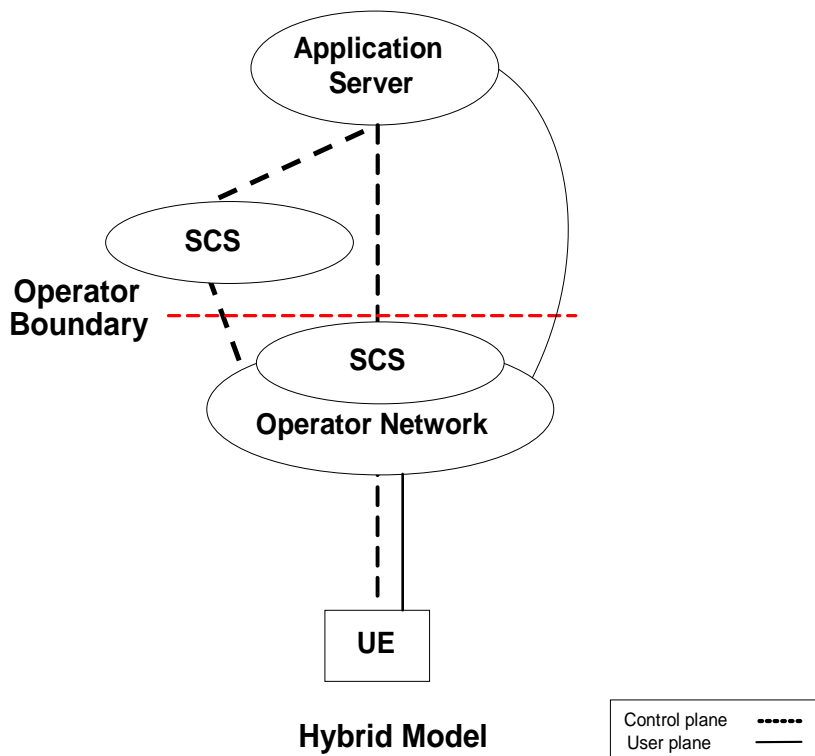


Figure A-2: Deployment scenarios for hybrid model

An operator may deploy the hybrid model with a combination of no internal and external SCS (as in the Direct Model) and internal and/or external SCS (as in the Indirect Model). As shown in Figure A-2, a UE may be in communications with multiple SCSs in an HPLMN which can be made up of a combination of operator controlled and MTC service provider controlled SCSs. In that scenario, the MTC Service provider controlled SCS, and the 3GPP operator controlled SCS may offer different capabilities to the MTC Applications.

Though not illustrated, it is also possible that the deployment of an AS may be inside the operator domain and under operator control.

Annex B (Informative): Trigger Delivery using T5

NOTE: T5 triggering is work in progress and not part of this Release.

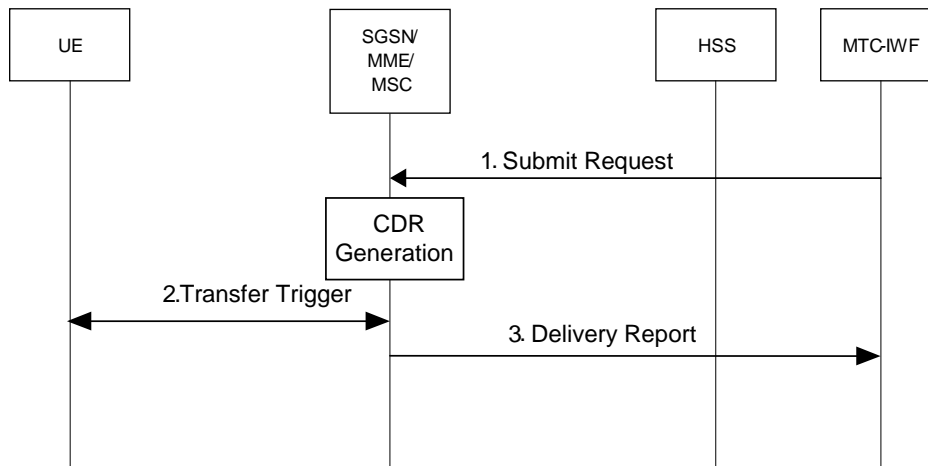


Figure B-1: T5 Trigger Delivery Flow

1. The MTC-IWF uses the UE capabilities, serving CN node(s) capabilities retrieved from the HSS to select a suitable serving CN node capable of T5 triggering. The MTC-IWF sends a Submit Request (IMSI, message priority, MTC-IWF ID, reference number, single delivery attempt flag (optional), validity time (optional), Request type (trigger application), application PDU) to the serving CN node. If there is more than one serving CN node, the MTC-IWF should send the message to the serving CN node where the UE is currently camping with highest probability e.g. based on information received from HSS or cached information from earlier trigger attempts.
2. The serving CN node indicates the Request type (trigger application), application PDU, MTC-IWF ID, Reference number within the NAS message and delivers it to the UE. Serving CN node generates the necessary CDR information for charging. UE provides the trigger content and trigger type to the corresponding application.

Editor's Note: It is FFS whether and how a generic container or SMS can be used to transport the trigger content.

NOTE: If the UE is in idle mode, the serving CN node may page the UE prior to sending a NAS message for delivering the trigger.

The UE responds with the delivery status (cause), MTC-IWF ID, Reference number, Response type (trigger application), and optionally, application PDU.

3. The serving CN node sends a Delivery Report (IMSI, cause, reference number, delivered by CN node, Response type (trigger application), and if received, application PDU) message to the MTC-IWF. Cause indicates whether the Trigger-Message was successfully delivered to the UE or if failed, the reason for the failure.

Annex C (Informative): Triggering with OMA Push

C.1 General

The 3GPP Device Trigger function enables a transport of application defined triggers to be delivered from a Service Capability Server (SCS) towards the UE. One defined application trigger framework is OMA Push Architecture [20]. OMA Push defined messages can be carried as payload in the Device Trigger message.

C.2 Triggering flow using Service Loading

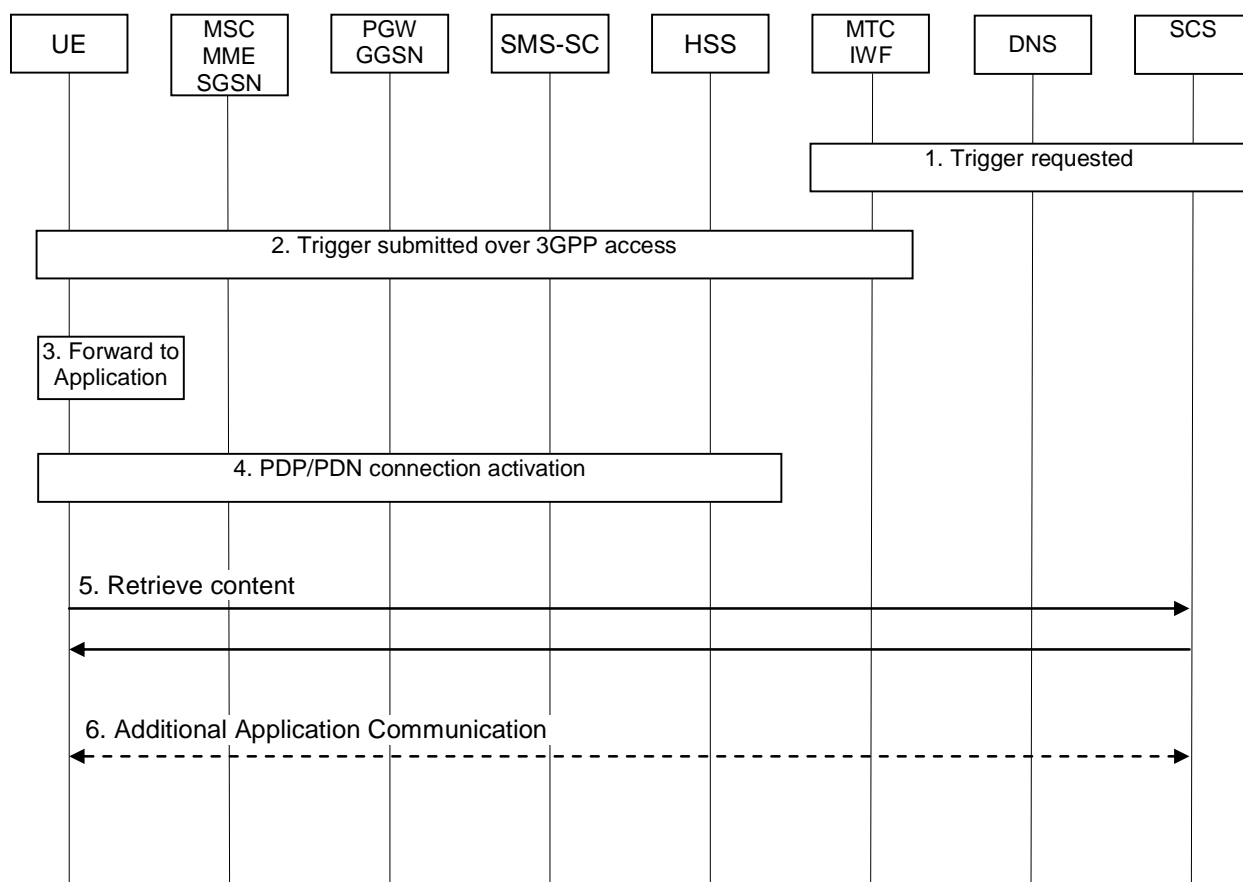


Figure C.2-1: Triggering flow using OMA Push

1. The SCS generates content (e.g. an MTC application specific command) and a URI towards the content (or receives a URI towards content from another source) and then the SCS (performing OMA Push Proxy Gateway functionality) generates a Push Message [19] with the PDU set according to Service Loading [17], and sends a trigger request over Tsp according to clause 5.2.1.
2. The MTC-IWF receives the trigger request and sends it according to clause 5.2.1.
3. The UE SMS dispatcher receives the SMS and routes it to the OMA Push Client which has registered for the triggering routing identifier (e.g. SMS Application port). The OMA Push Client, optionally validates the source (using white-list defined in OMA Push Management Object [18]) and then forwards the trigger using the Application-Id (e.g. to the M2M Service Capability Layer).
4. The UE activates a PDP/PDN connection.

5. The content described as part of the URI is retrieved (retrieval of content is mandatory for content type Service Loading [17]).
6. Based on the content retrieved the addressed Application may perform additional actions (e.g. the M2M Service Capability Layer may convey the information to an M2M Application addressed as part of the "command" retrieved, within the same or in a different physical device), but this is outside scope of 3GPP standardisation.

Annex D (Informative): Device triggering using direct model over user plane

The following flow shows an example of device triggering using direct model over user plane. In this example, an application in the UE explicitly registers with a DT-AS/SCS (Device Trigger Application Server) in the home operator's network using an existing PDN connection (e.g., default PDN connection). The DT-AS uses the information from the application registration (such as IP address, port, protocol, etc.) to deliver the incoming device triggers, forwarded by another AS (e.g., third party AS) or itself, to the UE through the user plane. Once the UE receives the trigger, the UE either uses the existing PDN connection or the UE sets up a new PDN connection to the appropriate APN to contact the third-party Application Server.

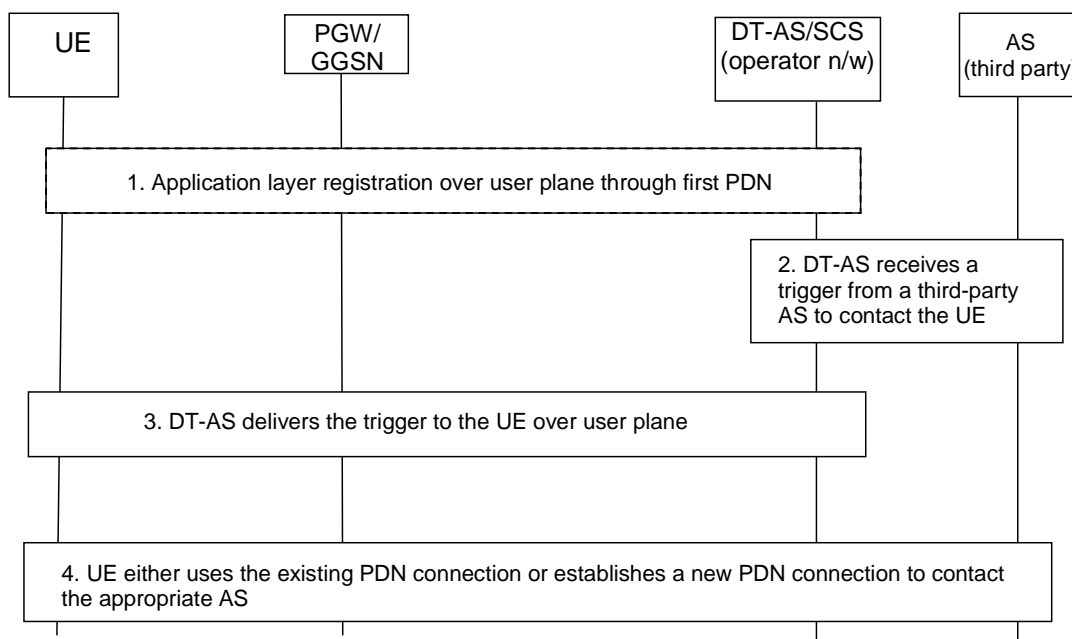


Figure D-1: Triggering flow using direct model over user plane

1. The UE/MTC application registers with the DT-AS in an operator's network using an existing PDN connection (for e.g., default PDN). The registration information, for example, could include the IPv4/IPv6 address and the port number where the application is reachable.
2. The DT-AS receives a trigger from a third-party AS to reach the UE.
3. The DT-AS delivers the trigger to the UE over the user plane.
4. The UE either uses the existing PDN connection or sets up a new PDN connection using the appropriate APN to contact the third-party AS.

Annex E: Change history

Change history								
Date	TSG #	TSG Doc.	CR	Rev	Cat	Subject/Comment	Old	New
2012-02	SP-55	SP-120095	-	-	-	MCC Update to version 1.0.0 for presentation to TSG SA for Information and Approval .	0.2.0	1.0.0
2012-03	SP-55	-	-	-	-	MCC Update to version 11.0.0 after TSG SA Approval (Release 11)	1.0.0	11.0.0
2012-06	SP-56	SP-120239	0001	2	F	Deletion of the SMS-SC from the SCS related description	11.0.0	11.1.0
2012-06	SP-56	SP-120239	0004	2	F	Removal of unnecessary information in Table 5.3.1-1	11.0.0	11.1.0
2012-06	SP-56	SP-120239	0006	2	F	Overall corrections	11.0.0	11.1.0
2012-06	SP-56	SP-120240	0007	1	F	Missing description of addressing in 23.682	11.0.0	11.1.0
2012-06	SP-56	SP-120239	0009	2	F	Clarifications on Device Triggering	11.0.0	11.1.0
2012-06	SP-56	SP-120239	0011	2	F	Clarification for the reference point between HSS/HLR and MTC-IWF	11.0.0	11.1.0
2012-06	SP-56	SP-120240	0018	2	F	Identifier and addressing usage	11.0.0	11.1.0
2012-06	SP-56	SP-120240	0021	1	F	SIMTC with IP-SM-GW adaption for SMSMI work from Server to MSISDN-less IMS UE direction	11.0.0	11.1.0
2012-06	SP-56	SP-120239	0023	2	F	Corrections of trigger flows	11.0.0	11.1.0
2012-06	SP-56	SP-120239	0025	2	F	External Identifier Usage	11.0.0	11.1.0
2012-06	SP-56	SP-120239	0027	2	F	Corrections to T4 interface requirements	11.0.0	11.1.0
2012-06	SP-56	SP-120239	0028	2	F	Changes to clause 4.4	11.0.0	11.1.0
2012-06	SP-56	SP-120240	0030	1	F	T4 triggering for PS-only IMS UE without MSISDN	11.0.0	11.1.0
2012-06	SP-56	SP-120239	0031	-	F	Giving the MTC AAA to HSS/HLR reference point a name	11.0.0	11.1.0
2012-06	SP-56	SP-120239	0032	3	F	Backward compatibility with legacy SMS networks	11.0.0	11.1.0
2012-06	SP-56	SP-120239	0036	1	F	Clarifications on Functionality of Network Elements	11.0.0	11.1.0
2012-06	SP-56	SP-120337	0039	2	F	Updates to TS 23.682 Scope	11.0.0	11.1.0
2012-06	SP-56	SP-120337	0040	2	C	External Interface Security	11.0.0	11.1.0
2012-06	SP-56	SP-120337	0041	-	B	Network based solution for filtering SMS-delivered device trigger messages	11.0.0	11.1.0
2012-09	SP-57	SP-120482	0049	1	F	Addition of MTC AAA into the architecture figure	11.1.0	11.2.0
2012-09	SP-57	SP-120482	0054	2	F	Adding missing information elements into Table 5.3.1-1	11.1.0	11.2.0
2012-09	SP-57	SP-120482	0058	2	F	Clarification of Architecture Models and Deployment scenarios	11.1.0	11.2.0
2012-09	SP-57	SP-120482	0060	1	F	Message waiting for Device Triggering Function corrections	11.1.0	11.2.0
2012-09	SP-57	SP-120601	0052	1	F	Tsp interface security requirements	11.1.0	11.2.0
2012-12	SP-58	SP-120717	0055	4	F	Device Triggering corrections	11.2.0	11.3.0
2012-12	SP-58	SP-120717	0065	1	F	Add IP-SM-GW identifier to S6m and T4 messages	11.2.0	11.3.0
2012-12	SP-58	SP-120717	0066	1	F	Message Waiting for device trigger procedure correction	11.2.0	11.3.0
2013-06	SP-60	SP-130305	0069	4	F	Triggering indication added in the CDR	11.3.0	11.4.0
2013-06	SP-60	SP-130305	0072	3	F	Making Device Trigger outcome to SCS optional	11.3.0	11.4.0
2013-06	SP-60	SP-130305	0073	1	F	Missing condition of delivery of Message Delivery Report	11.3.0	11.4.0
2013-06	SP-60	SP-130257	0074	2	F	Device triggering indication in SM	11.3.0	11.4.0
2013-09	SP-61	SP-130403	0075	1	F	HSS/HLR filtering SMS-delivered device trigger messages	11.4.0	11.5.0

History

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V11.2.0	November 2012	Publication
V11.3.0	January 2013	Publication
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V11.5.0	September 2013	Publication